World Health Organization
Europe

EUROPEAN ENVIRONMENT AND HEALTH PROCESS

# ASBESTOS

## ECONOMIC ASSESSMENT OF BANS AND DECLINING PRODUCTION AND CONSUMPTION

**Lucy P. Allen, Jorge Baez, Mary Elizabeth C. Stern and Frank George**


# ASBESTOS

## ECONOMIC ASSESSMENT OF BANS AND DECLINING PRODUCTION AND CONSUMPTION

**Lucy P. Allen, Jorge Baez, Mary Elizabeth C. Stern and Frank George**

# ABSTRACT

The global asbestos industry is shrinking as countries have increasingly banned and moved away from reliance on asbestos. This publication assesses the economic impact of declines in asbestos production and consumption and banning of asbestos use. According to country-level data, no negative economic impact is observed. Since the importance of asbestos to the economies of current producer/consumer countries is similar to that of other countries that have already banned its use, this analysis suggests that countries currently consuming/producing asbestos would not experience an observable effect on gross domestic product from a ban on or a decline in asbestos consumption/production. In addition, the continued use of asbestos carries substantial costs related to health, remediation and litigation.

**KEYWORDS**

ASBESTOS – ECONOMICS

ASBESTOS – ADVERSE EFFECTS

ASBESTOS – TOXICITY

ENVIRONMENTAL EXPOSURE – PREVENTION AND CONTROL

ISBN 978 92 890 5248 1

Address requests about publications of the WHO Regional Office for Europe to:

Publications
WHO Regional Office for Europe
UN City, Marmorvej 51
DK-2100 Copenhagen Ø, Denmark

Alternatively, complete an online request form for documentation, health information, or for permission to quote or translate, on the Regional Office website (http://www.euro.who.int/pubrequest).



Cover photo: Depositphotos/Francescoscatena.

# CONTENTS

# ACKNOWLEDGEMENTS

This publication was written by staff of the firm NERA Economic Consulting (Lucy P. Allen, Jorge Baez, Mary Elizabeth C. Stern) and the WHO Regional Office for Europe (Frank George, Technical Officer, Environmental Health and Economics). The authors would like to thank Andrew Nguyen, Agastya Shastri and Weiyi Yu (NERA economic Consulting, New York, United States of America) for their research, and Denise Martin and Stephanie Plancich (NERA Economic Consulting) for their comments and suggestions. The authors would also like to thank Ken Takahashi (Department of Environmental Epidemiology, University of Occupational and Environmental Health, Kitakyushu, Japan) and Vojtěch Máca (Researcher, Environmental Economics and Sociology, Charles University Environment Centre, Prague, Czech Republic) for their comments and suggestions. The authors gratefully acknowledge the managerial and technical support provided by staff from the Regional Office's WHO European Centre for Environment and Health, in Bonn, Germany: Elizabet Paunovic, Head; Marco Martuzzi, Programme Manager; and Aliya Kosbayeva, Technical Officer for Occupational Health.

Public information and industry and statistical data referenced herein are from sources deemed to be reliable; however, the authors make no representation as to the accuracy or completeness of such information and have accepted the information without further verification.

The findings contained in this report may contain predictions based on current data and historical trends. Any such predictions are subject to inherent risks and uncertainties. In particular, actual results could be affected by future events that cannot be predicted or controlled, including, without limitation, changes in business strategies, the development of future products and services, changes in market and industry conditions, the outcome of contingencies, changes in management or changes in law or regulations.

# EXECUTIVE SUMMARY

Asbestos has been used for centuries because it is inexpensive and long lasting. Historically, it has had more than 3000 different applications, primarily in construction materials and a wide range of friction products (Virta, 2006a). Because asbestos has been linked with the development of deadly diseases, such as asbestosis, mesothelioma and other types of cancer, many countries have reduced their production and consumption and instituted bans.

WHO and the International Labour Organization (ILO) therefore recommend that the most effective way to eliminate asbestos-related diseases is to ban the use of all forms of asbestos. Even though many countries have already introduced total bans on both the production and consumption of asbestos, the countries that still use it argue that a total ban would harm their economic growth and development. This publication examines the global historical trends in asbestos production, consumption and bans and assesses the economic impact of declines in production and consumption. It assesses data at the

country level, and at a more local level for a subset of countries. The publication also identifies and quantifies potential economic costs associated with continued production and consumption. In general, the literature on the economic benefits and costs of asbestos bans is sparse. Further research is needed, especially on the availability of asbestos-substitute products, which are safer for heath, and litigation and remediation costs, including removal and waste-management expenses.

## Findings

1. Aggregate annual asbestos production and consumption have been declining since 1980, when they peaked at almost 4.8 million tonnes. Annual production and consumption had been more than halved as of 2013. At present, four countries – Brazil, China, Kazakhstan and the Russian Federation – produce over 99% of the world's asbestos, and 25 countries consume at least 1000 tonnes of asbestos per year; seven of the latter are in the WHO European Region.

2. An examination of asbestos consumption over time by country shows a similar pattern in relation to economic development across most countries, albeit occurring at different times: steady growth to a peak, followed by steady decline. Le et al. (2010) observed a similar pattern, quantifying a relationship between countries' income level and asbestos use. In general, the period of decline has been shorter for countries whose consumption peaked more recently. This trend may imply that countries are moving away from asbestos faster than before, perhaps because:

    - information about its negative health effects has been more widely disseminated;
    - the costs associated with these effects increasingly outweigh the benefits of continued use; and/or
    - asbestos substitutes may be more readily available and cheaper.

3. Bans on asbestos use have continued to increase, often following substantive drops in consumption and production. In 1972, Denmark was the first country to partially ban asbestos. By 2000, 35 countries had instituted bans, and 67 had instituted either partial or complete bans as of 2013. The data reviewed do not make clear whether consumption and production are declining because countries anticipate bans or bans become more feasible and politically easier to implement once declines have occurred. The number of countries that have instituted bans has steadily increased, and no ban has been reversed. This trend indicates that these countries have overcome any resistance to moving away from asbestos, and that any potential negative economic effects are manageable.

4. Country-level data reveal no observable negative effects on gross domestic product (GDP) following an asbestos ban or a decline in consumption or production. The power of this test may be limited, however, because asbestos consumption and production do not typically comprise a substantial portion of country-level GDP. Nevertheless, since the importance of asbestos to the economies of current producer and consumer countries resembles that of other countries that have banned asbestos, this analysis suggests that producer and consumer countries also would not experience an observable effect on GDP at the country-level from a ban or a decline in consumption and production.

5. The effect of bans and reductions in asbestos were analysed at a more local level for Brazil and Canada, as relevant regional data were available. No persistent negative effect was observed on either GDP or employment at the regional level. Where a drop in employment at the local level was observed, employment returned to pre-ban levels within two years.

6. The substantial costs associated with the continued use of asbestos potentially outweigh any other economic benefit. The annual global health care costs associated with the health effects of asbestos are estimated to be US$ 2.4–3.9 billion, excluding the additional costs of pain, suffering and welfare losses. Other costs include remediation and removal costs, particularly for countries moving away from asbestos, as well as compensation costs, which may include significant litigation costs for some countries. Even countries that have not yet elected to move away from the production and use of asbestos may also incur remediation and removal costs. The extent to which compensation for asbestos-related diseases occurs through litigation is likely to depend on the litigation environment within each country. Data on these costs are not readily available for countries currently using asbestos. Based on a comparison of worldwide asbestos consumption from the early 1900s to the present, however, the total asbestos consumption of current consumers has surpassed the amount of asbestos consumed by the United States of America, a country for which data on historical costs are available. Current consumers have already used over twice as much asbestos as the United States in its many decades of past use. Studies have estimated the costs of the United States' past use of asbestos as billions of dollars annually. In particular, the annual medical costs from mesothelioma in the United States have been estimated at US$ 1.9 billion, and annual remediation costs have been estimated at approximately US$ 3.0 billion: almost US$ 5.0 billion combined. Asbestos litigation costs in the United States, which are a proxy for compensation-related costs, have been estimated at another US$ 2.3 billion per year. If the experience of past asbestos consumers such as the United States is representative, then continued consumption and production of asbestos is likely to lead to substantial medical and remediation costs, including removal and waste-management costs, as well as potential litigation and compensation costs. Indirect economic costs, such as loss of labour-force participation and reduced tax revenues, present additional costs not reflected in these cost estimations.

Overall, the analysis described in this publication suggests that a continued decline in the use of asbestos should be expected, as global demand decreases and the number of countries instituting bans continues to increase.

Moreover, since asbestos has a similar importance to the economies of current producer and consumer countries and of other countries that have already instituted bans, this analysis suggests that the former group would not experience an observable effect on GDP from a ban or a decline in consumption and production.

In addition, the continued use of asbestos carries substantial costs, including health, remediation, and litigation and compensation costs. While the health costs for countries that continue to produce and consume asbestos will be substantial, data from past producers and consumers indicate that the costs for remediation, litigation and compensation may be even higher.

# 1 Literature review

The literature on the economic effects of asbestos bans is sparse. A few studies have estimated the potential economic impact of proposed asbestos bans, while little has been written on the actual economic impact after a ban has been imposed.

A 2010 study (da Silva & Etulain, 2010) examined the economic impact of a proposed asbestos ban in Brazil. The analysis concluded that the only negative economic effect of the proposed ban would be in the asbestos extraction space: mining and primary processing. It also found that public policies in the affected region, including the development of the tourism industry, could mitigate the potential negative effects.

Another study, commissioned by the National Economic Development and Labour Council in South Africa (2002), found that declining local and international demand had led to the end of asbestos mining in the country in 2001, before a proposed ban was to be implemented. The South African Government established the Council in 1994 as a partnership between the Government and labour, business and community organizations. The authors found that the country's building and construction industry was in the final stages of phasing out asbestos products at the time of their study. They also noted that, although South African manufacturers of fibre cement products had almost completely converted to non-asbestos products, they continued to experience competition from neighbouring countries still manufacturing asbestos-containing products.

Instead of studying the economic costs of banning asbestos, much of the asbestos-related literature has examined the flip side of the ban question: what are the effects of asbestos use? While prepared with a different question in mind, a review of this literature is also informative in seeking to understand the impact of a ban. The health effects of asbestos use have been studied extensively, in terms of both the development of diseases and the costs of treating them.

Several papers have examined the health effects of asbestos use at the country level. Lin et al. (2007) studied the link between asbestos consumption and development of related diseases across countries and found a positive relationship between disease incidence in the early 2000s and asbestos use during the 1960s. Thus, the greater the asbestos use per capita in the 1960s, the greater the incidence of related diseases in the early 2000s, due to the long latency period associated with the development of these diseases after exposure. Addressing both asbestos use and bans, Nishikawa et al. (2008) studied the impact of changes in the former on mesothelioma mortality, looking at the data on the country level and grouping countries by whether and when they had instituted bans. The authors found that countries with bans reduced asbestos use more quickly than others and that a change in asbestos use in 1970–1985 was a significant predictor of change in the annual rates of mesothelioma mortality in 1996–2005. Both Lin et al. (2007) and Nishikawa et al. (2008) applied a lag in their studies to account for the long latency period between exposure to asbestos and the development of asbestos-related diseases.

More recently, Järvholm & Burdorf (2015) studied the impact of the asbestos ban on the relative incidence of mesothelioma across different age groups in Sweden, finding it (when measured at the same age) lower for groups entering the workforce after the ban than for those entering before it was instituted.

In addition to examining the development of asbestos-related diseases, studies have found that treating them has significant costs. Watterson (2012) estimated that medical and pension costs for mesothelioma in one year, for 15 European countries, were approximately US$ 2.0 billion. The author estimated the costs in euros; they were converted to US dollars based on the average annual exchange rate in 2012, using the yearly average exchange rates for converting foreign currencies into US dollars published by the Internal Revenue Service in the United States. A study published in a journal of health-care policy estimated the annual medical costs for mesothelioma in the United States at US$ 1.9 billion (Leigh, 2011).

2

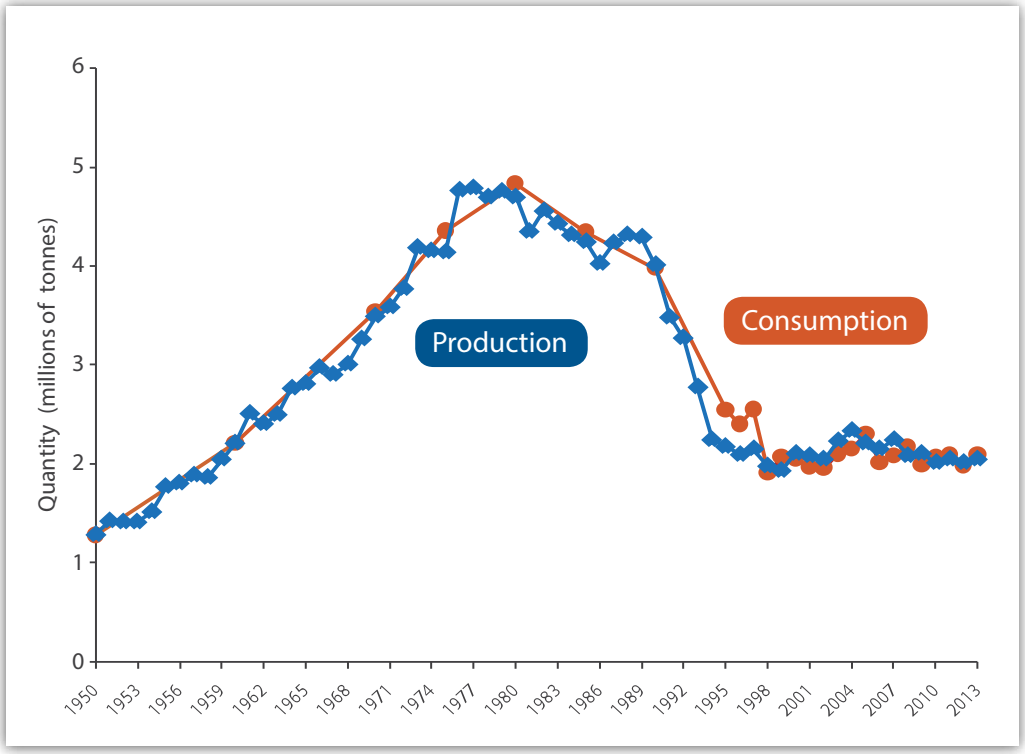
# Overall trends in asbestos production, consumption and bans

## Trends in world production and consumption

Annual asbestos production and consumption worldwide have declined since their peak in 1980. As shown in Fig. 1, the annual aggregate consumption and production of asbestos fell from approximately 4.8 million tonnes in 1980 to approximately 2.0 million tonnes by 2000, where they have remained for the past decade.

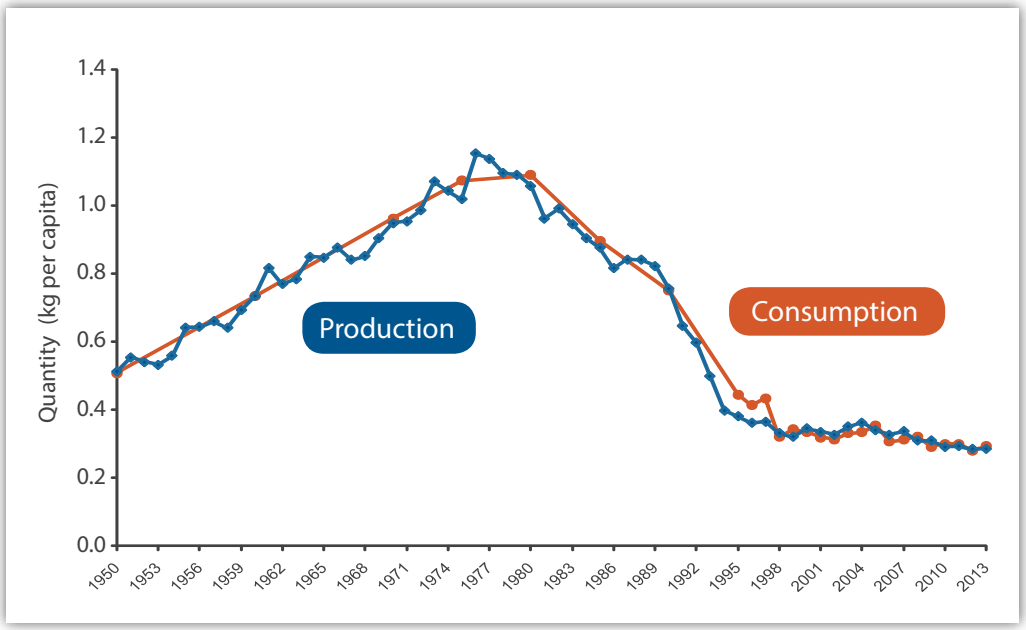
While annual production and consumption appear to have remained steady over the past decade, the global population has continued to expand. When measured on a per-capita basis across all countries, regardless of their current production and consumption status, worldwide production and consumption of asbestos have declined throughout the 2000s, albeit more slowly than in prior decades (Fig. 2).

**Fig. 1. World asbestos production and consumption, 1950–2013**




*Source:* data from the US Geological Survey.

**Fig. 2. World asbestos production and consumption, 1950–2013, per capita**




*Source:* data on production and consumption from the US Geological Survey and data on population from the United Nations.

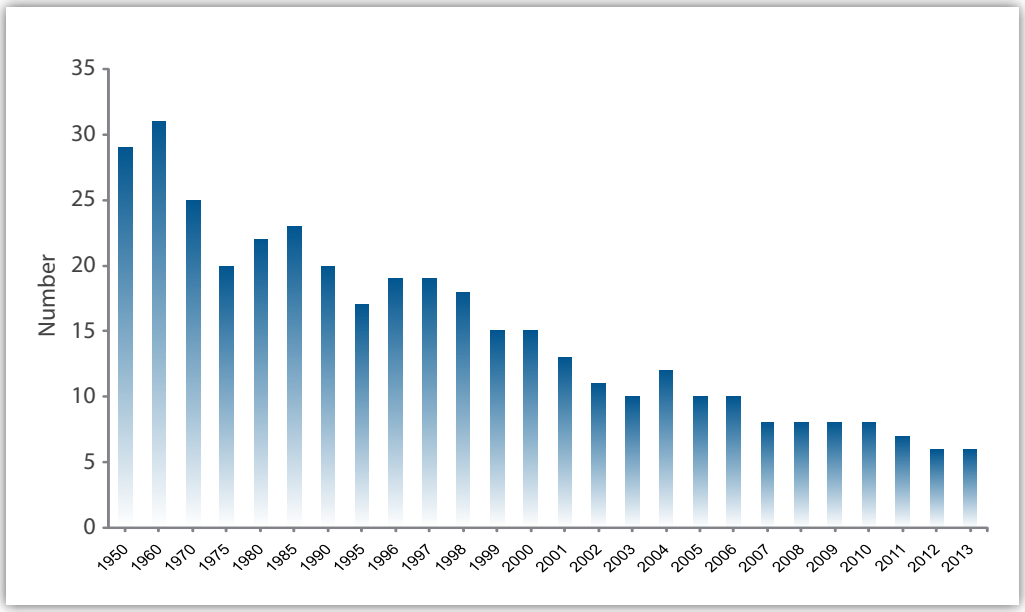
Both the number of countries producing asbestos and the number consuming it have fallen. The latter first rose from 51 in 1950 to almost 90 at the peak in 1980, before starting to decline. The number of producing countries fell over the same period, from 30 to 20. As of 2013, only six countries were still producing asbestos and only 25 were still consuming it, with only 10 accounting for the majority of consumption. After 2007, data on annual asbestos consumption were available only for countries that consumed more than 1000 tonnes per year. To be consistent, the data cited in this report for all years exclude countries that consumed 1000 or fewer tonnes. Annex 1 lists the countries currently producing and consuming asbestos and the amounts for each.

Fig. 3 and 4 show a clear declining pattern in the number of countries producing and consuming asbestos since the 1980s. These are adjusted for country definitions that have changed over time. For example, during the 1990s, data on asbestos production and consumption became available for countries that were formerly part of Czechoslovakia, the USSR and Yugoslavia.[1] To account for these changes and ensure a consistent comparison across time, the number of countries was counted assuming the current composition of countries existed across all periods; for example, Czechoslovakia was treated as two countries, Czech Republic and Slovakia.

Recently, world production of asbestos has been concentrated among four countries – Brazil, China, Kazakhstan and the Russian Federation, which together represented

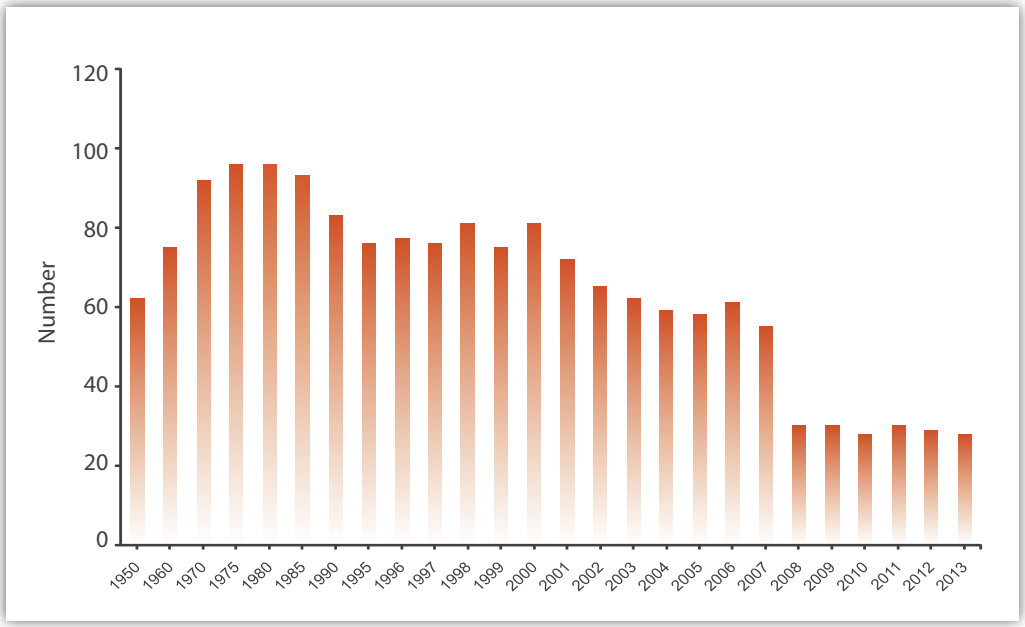
[1] Data through 2003 come from Virta (2006b) and data after 2003 were obtained from the website of the US Geological Survey (2016). The Survey reported production and consumption data every 10 years through 1970, every five years between 1970 and 1995, and then every year starting in 1995. Aggregated data are reported for Czechoslovakia, the USSR and Yugoslavia through 1990. Starting in 1995, data are given separately for Belarus, Estonia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, the Republic of Moldova and the Russian Federation; for Bosnia and Herzegovina, Croatia, Serbia, Slovenia and the former Yugoslav Republic of Macedonia; and for Czech Republic and Slovakia. Data on Germany between 1949 and 1985 are divided between the eastern and western parts of the country.

**Fig. 3. Number of countries producing asbestos, 1950–2013**




*Source:* data from the US Geological Survey.

**Fig. 4. Number of countries consuming asbestos, 1950–2013**

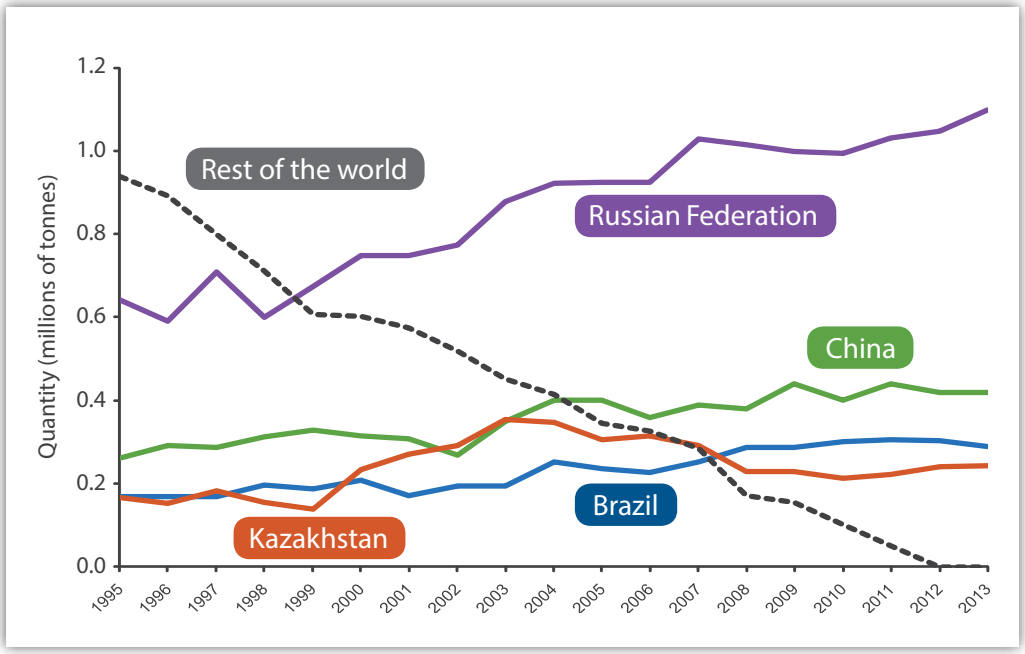



*Note.* The figure excludes countries consuming ≤ 1000 tonnes in a particular year.
*Source:* data from the US Geological Survey.

over 99% of world asbestos production in 2013, according to data from the US Geological Survey. Two other countries, India and Argentina, together produced fewer than 500 tonnes in 2013. In contrast, the four main producers each produced over 200 000 tonnes in 2013. Fig. 5 shows asbestos production by country since 1995.

Consumption is also concentrated among relatively few countries. Three countries – China, India and the Russian Federation –

**Fig. 5. Major asbestos producers, 1995–2013**

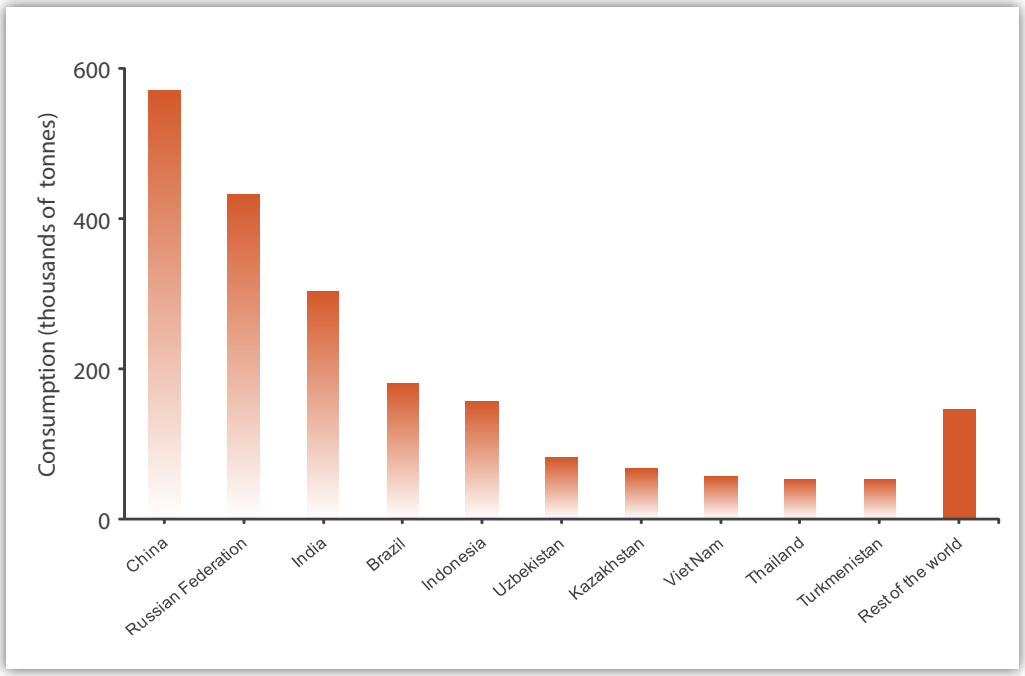



*Source:* data from the US Geological Survey.

account for over 60% of world consumption, and seven others – Brazil, Indonesia, Kazakhstan, Thailand, Turkmenistan, Uzbekistan and Viet Nam – account for an additional 30%. The remaining 10% is spread across 18 countries. Fig. 6 shows asbestos consumption by country in 2013.

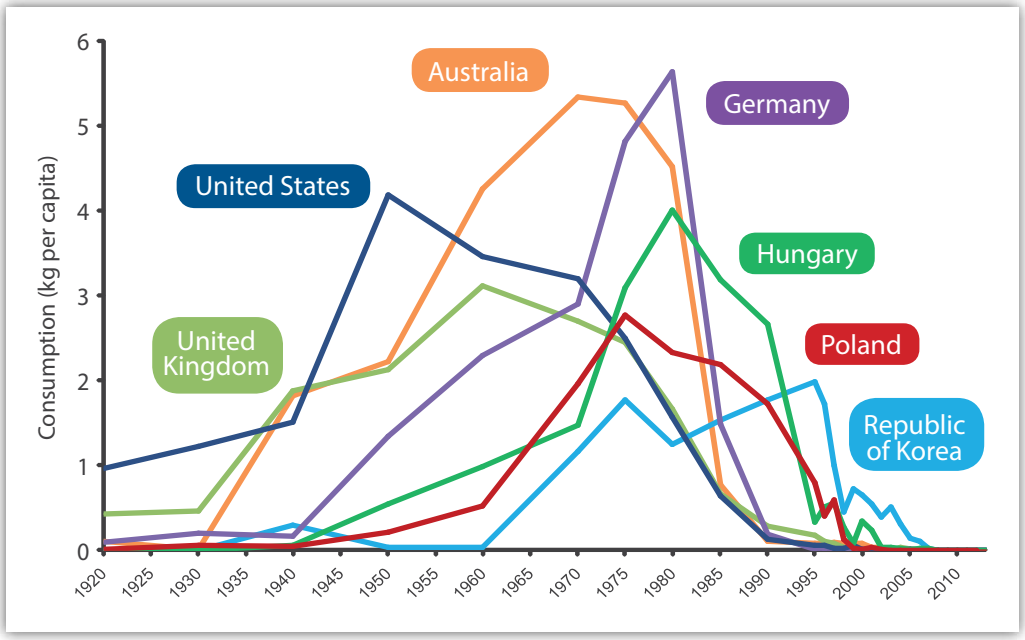
An examination of consumption patterns over time shows a similar pattern across countries that no longer consume asbestos: a steady growth to a peak and then a steady decline (Fig. 7). This pattern has occurred at different times for different countries. For example, peaks occurred in the 1960s

**Fig. 6. Top 10 asbestos consumers, 2013**




*Source:* data from the US Geological Survey.

**Fig. 7. Asbestos consumption per capita in individual countries, 1920–2013**



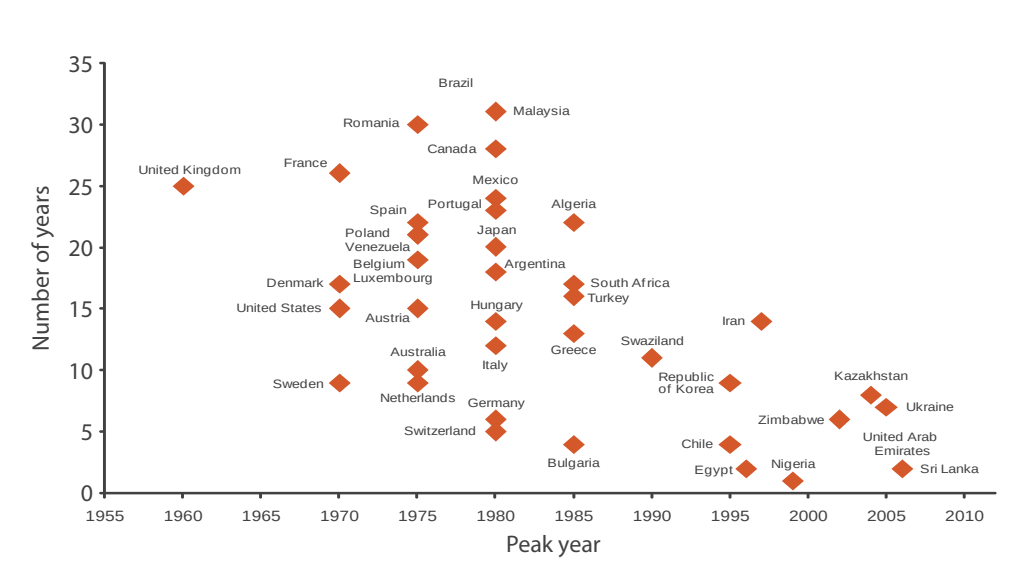

*Source:* data from the US Geological Survey.

in the United Kingdom, in the 1980s in Germany and Hungary, and in the mid-1990s in the Republic of Korea.

Countries appear to be making the transition away from asbestos more quickly. Fig. 8 shows the number of years taken by various countries to move away from using asbestos: specifically, the number of years between peak consumption and the year in which consumption had declined to 25% of the peak. For example, the United Kingdom took 25 years to move away from using asbestos from its peak consumption in 1960; Hungary took 14 years from the peak in 1980, while Chile took only four from the peak in 1995. As shown in Fig. 8, the transition away from asbestos took, on average, fewer years in countries that reached the peak of their asbestos consumption more recently.

Fig. 8 shows the differences in peak years of consumption and the number of years until consumption declined to 25% of that level for countries that had already experienced this decline. It does not include countries whose consumption had neither peaked nor declined below 25% of the peak-year consumption, or those that consumed ≤ 250 000 tons in total between 1920 and 2013. The analysis does not include Belarus, Brazil, China, India, Kyrgyzstan, the Russian Federation, Sri Lanka, Thailand, Uzbekistan or Viet Nam. To assess whether the observed trend holds even when accounting for the experience of the current consumers, an analysis was run using a Cox proportional hazards model, which controls for the potential bias introduced by countries that have not yet moved away from using asbestos. This analysis of the different transition times indicates that, even accounting for the current consumers, there is a statistically significant trend towards shorter times for the transition away from asbestos.

**Fig. 8. Asbestos consumption: years from peak to 75% decline**




*Source:* data from the US Geological Survey.

## Trends in the number of countries with bans

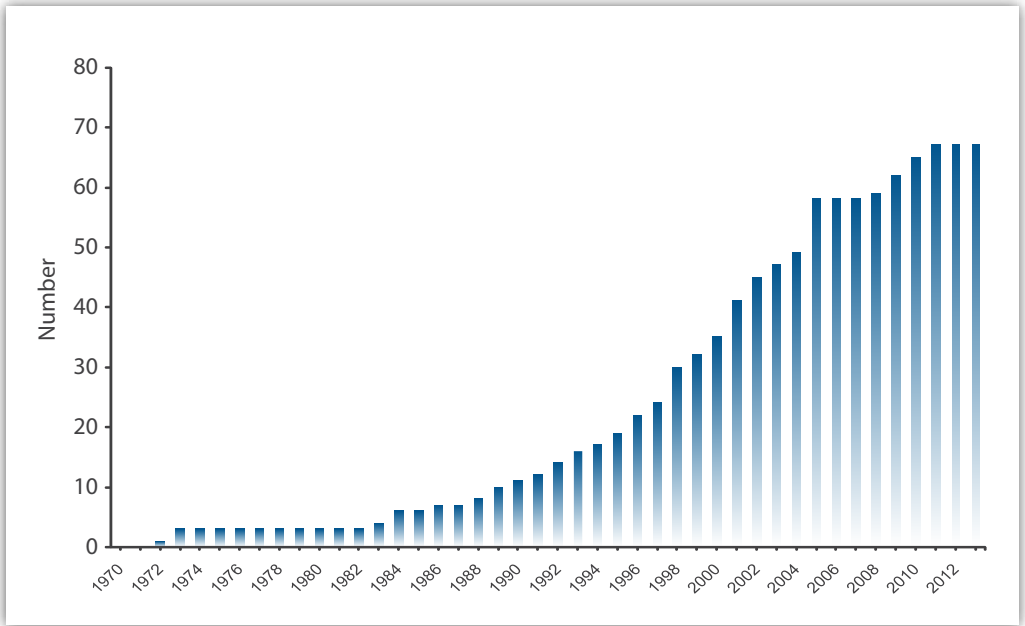
The drop in the number of countries producing and consuming asbestos has corresponded with an increase in the number of bans on asbestos use. Data on bans were obtained from the International Ban Asbestos Secretariat (http://www.ibasecretariat.org). Denmark was first, instituting a partial ban on the use of asbestos for insulation 1972. The United States followed suit in 1973, prohibiting the use of spray-applied asbestos-containing material for fireproofing, and passing a series of partial bans between 1973 and 1978. Although asbestos consumption has almost completely ended in the country, the United States has not instituted a complete ban on asbestos. The US Environmental Protection Agency (2016) provides more information about asbestos bans in the United States. Other countries gradually instituted their own bans. In 1986, Sweden was the first to ban asbestos completely, and was followed by other European countries. The European Union completely banned asbestos use by all its 25 Member States by 2005 (Commission of the European Communities, 1999). As of 2013, 67 countries had instituted either partial or complete bans on asbestos. Fig. 9 shows the number of countries that have instituted asbestos bans over time, including the year of the first ban for countries that instituted multiple bans across multiple years. Annex 2 lists bans by country and year.

As shown in the figure, the number of countries with asbestos bans is clearly growing, from three in 1980, to 35 in 2000 and then 67 as of 2013. A particularly large increase occurred in 2005, when the European Union's ban on asbestos consumption for all Member States (Commission of the European Communities, 1999) came into force. By 2014, 37 of the 53 Member States in the WHO European Region adopted policies banning the use of all forms of asbestos (WHO Regional Office for Europe, 2015). Further, asbestos consumption has fallen even in some countries that have not instituted bans. For example, Mexico consumed almost 40 000 tonnes in 1999,

but annual consumption had dropped to less than 10 000 tonnes, or 0.06 kg per capita, by 2013.

In general, countries instituted bans after consumption or production had declined for a number of years. Nishikawa et al. (2008) observe a similar pattern. It is not clear whether consumption and/or production declines because countries are anticipating bans or because bans become more feasible when consumption and/or production has declined.

**Fig. 9. Number of countries with partial or complete asbestos bans, 1970–2013**




*Source:* data on bans from the International Ban Asbestos Secretariat.

# 3

# Economic effect of bans and declines in consumption and production

## Potential costs of shifting away from asbestos

There is sufficient evidence in human beings for the carcinogenicity of all forms of asbestos (chrysotile, crocidolite, amosite, tremolite, actinolite and anthophyllite). Asbestos causes mesothelioma and cancer of the lung, larynx and ovary, and positive associations have been observed between exposure to all forms of asbestos and cancer of the pharynx, stomach and colorectum (International Agency for Research on Cancer, 2012). Owing to this evidence and based on WHO/ILO recommendations, many countries have already reduced their production and consumption or instituted bans.

While the number of countries banning asbestos is clearly increasing, shifting away from asbestos and introducing safer substitutes can have costs. Relevant costs – especially for asbestos-producing countries – may include a negative impact on jobs and income, particularly in mining and the manufacture, transport, distribution and sale of asbestos products.

Historically, asbestos has been used in a number of different products, including friction products, gaskets, construction materials, textiles and paper products (Virta, 2006b). As of 2003, asbestos cement products accounted for over 85% of global asbestos consumption (Virta, 2006b). Thus, another potential issue related to banning asbestos consumption may be whether adequate substitutes exist and whether they are safe and affordable.

Several studies examined possible substitutes for asbestos. In 1982, the US Environmental Protection Agency issued a report on the then-current uses for asbestos and available substitutes (Krusell & Cogley, 1982), concluding that "[w]ith the exception of a few specific applications, each asbestos product category has commercially available alternatives". In 1999, before the United Kingdom banned chrysotile asbestos, Harrison et al. (1999) found that substitutes existed for chrysotile asbestos, including *p*-aramid, polyvinyl alcohol (PVA) and cellulose fibres. The study did not consider substitute materials already in use for thermal and sound insulation, such as glass and other man-made mineral fibres. The researchers concluded that chrysotile asbestos was more hazardous than these other materials, particularly in causing lung cancer and asbestosis, and that "the continued use of chrysotile in asbestos-cement products is not justifiable in the face of available and technically adequate substitutes" (Harrison et al., 1999). In reaching their conclusion, the authors noted that they considered only the health effects and did not conduct a cost–benefit analysis. Annex 3 gives a detailed list of substitutes.

While substitutes exist, the literature indicates that using them instead of asbestos may increase costs. For example, Tri, Toan & Cong (2004) calculated that substituting PVA-cement roofing tile for asbestos-cement roofing tile in Viet Nam

would increase the cost of the product by 30%.

A study in South Africa (National Economic Development and Labour Council, 2002) estimated that products using non-asbestos materials would cost 10–50% more than those using asbestos. The World Bank (2009) found that substituting PVA or polypropylene cellulose for asbestos cement added 10–15% to the cost of roof panels, but the increase in the overall cost of construction due to these substitute materials is "to some degree offset by the obviation of special hygiene measures in installation/maintenance/renovation, the lack of continuing hazard to building workers and occupants, and reduced costs of waste removal and disposal". The German Federal Institute for Occupational Safety and Health (2014) found that the economic consequences initially feared from Germany's ban on asbestos "did not materialize" and "on the contrary, Germany's pioneering role with respect to producers of asbestos substitute products resulted in a competitive advantage on the international market". Virta (2006a) reported that asbestos substitutes had fully replaced asbestos in the United States, western Europe and parts of eastern Europe, and that "many asbestos substitutes have been in use for a sufficient period of time that they should no longer be labeled as substitutes, but can now be considered an essential component of the product".

Despite potential costs, the trend has increasingly been to shift away from using and producing asbestos towards safer substitutes. As shown in Fig. 8, countries have shortened the time they take to move away from using asbestos. The transition time may continue to shrink as more and more countries ban asbestos consumption and shift towards using substitutes.

In addition, as discussed in the next two sections, economic data for countries that have banned asbestos or stopped producing and consuming it show no observable negative effects afterwards.

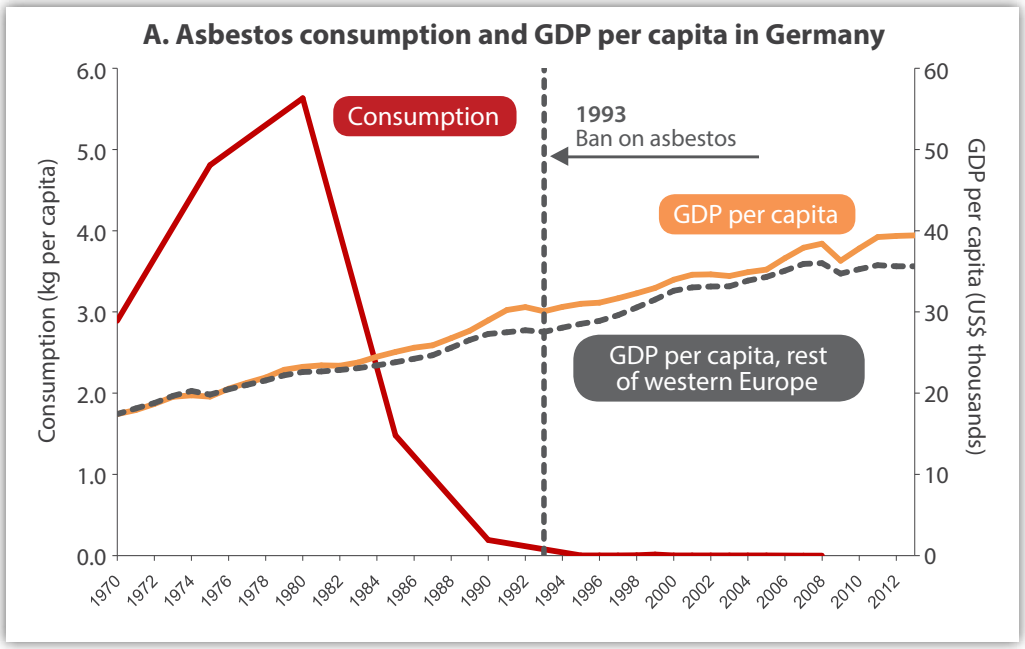
## Economic impact in countries

Country-level economic data show no observable short- or long-term negative effect on individual countries after asbestos bans or declines in consumption or production. In particular, the analysis assessed GDP per capita and asbestos consumption and production data before and after individual countries reduced their production or consumption and instituted bans. Here is a discussion of two European countries with histories of large asbestos consumption, Germany and the United Kingdom, and two countries with histories of large asbestos production, Canada and Italy.

For the consumer countries, historical asbestos consumption was compared with GDP per capita to assess how the latter changed after the former declined and the countries instituted bans. Changes in GDP per capita in each country were also compared to such changes in western Europe as a whole, to account for factors affecting the region more broadly. For both Germany and the United Kingdom, no negative national-level economic effect was observed from either the ban on use or the decline in consumption (Fig. 10 and 11). In 1980, asbestos cement accounted for 43% of asbestos consumption in western Europe (Virta, 2006b). Since the decline and ban could have the largest impact on the construction industry, sector-level GDP for this industry was also examined: it, too, showed no observable negative effect.

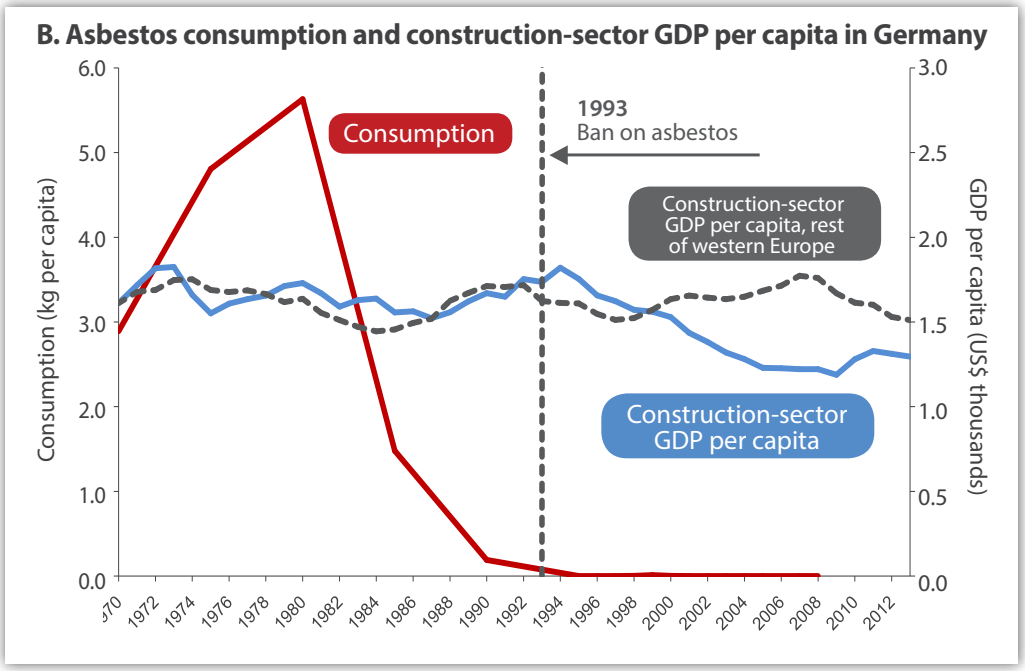
For the producer countries, Canada and Italy, historical asbestos production was compared with GDP per capita to assess how the latter changed after the former declined, and after Italy banned asbestos production. The assessment for Italy included overall GDP per capita, as well as GDP per capita in the mining sector. Changes in GDP in Italy were compared to those in western Europe to account for broader macroeconomic factors.

**Fig. 10. Germany: asbestos consumption and GDP and construction-sector GDP per capita, 1970–2013**




*Notes*. GDP data are in constant 2005 prices. GDP per capita for the rest of western Europe excludes Germany's GDP and population, and is pegged to the value of Germany's GDP per capita in 1970. Germany's asbestos consumption between 1950 and 1985 is the sum of consumption by the German Democratic Republic and the Federal Republic of Germany.

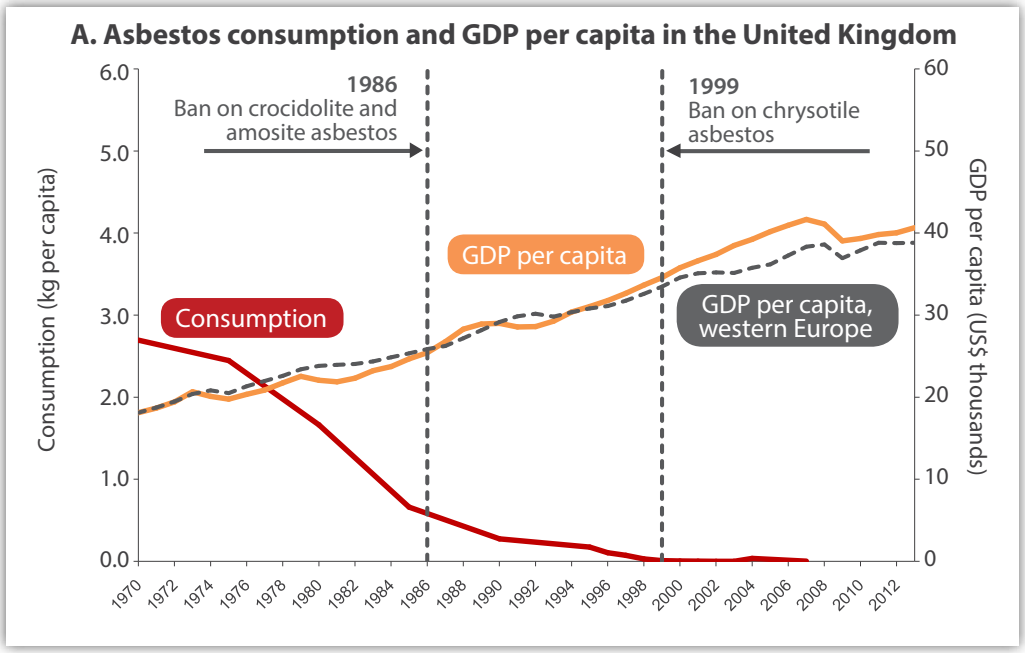
*Sources:* consumption data from the US Geological Survey and GDP and population data from the United Nations.




*Notes*. GDP data are in constant 2005 prices. Construction-sector GDP per capita for the rest of western Europe excludes Germany's GDP and population, and is pegged to the value of Germany's construction-sector GDP per capita in 1970. Germany's asbestos consumption between 1950 and 1985 is the sum of consumption by the German Democratic Republic and the Federal Republic of Germany.

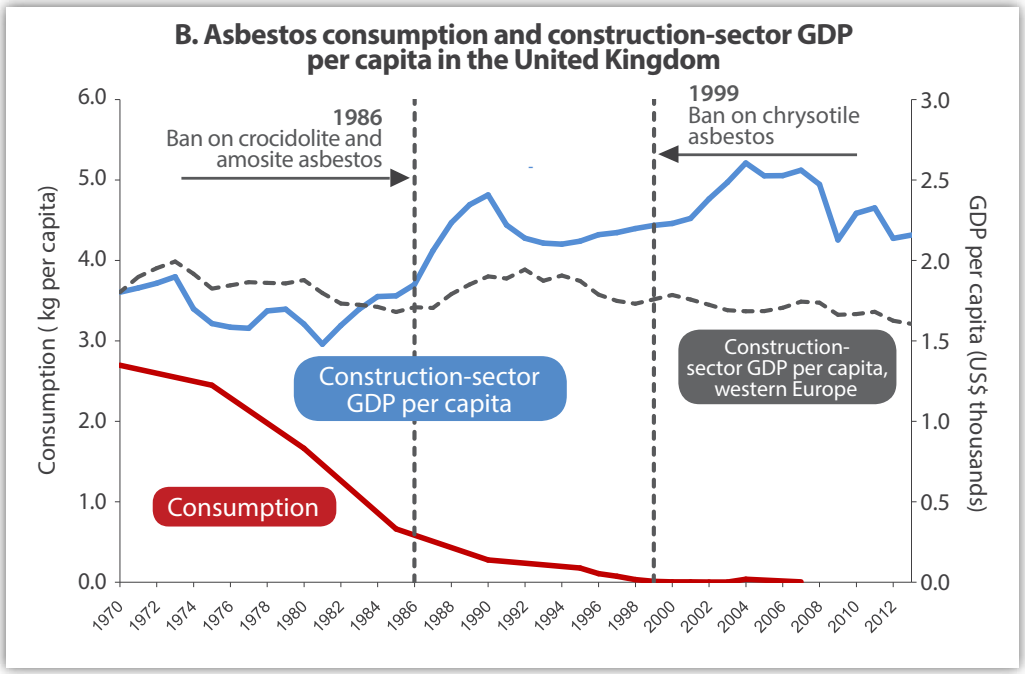
*Sources:* consumption data from the US Geological Survey and GDP and population data from the United Nations.

**Fig. 11. United Kingdom: asbestos consumption and GDP and construction-sector GDP per capita, 1970–2013**




*Notes*. GDP data are in constant 2005 prices. Construction-sector GDP per capita for western Europe is pegged to the value of the United Kingdom's construction-sector GDP per capita in 1970.

*Sources*: consumption data from the US Geological Survey and GDP and population data from the United Nations.




*Notes*. GDP data are in constant 2005 prices. Construction-sector GDP per capita for the rest of western Europe excludes Germany's GDP and population, and is pegged to the value of Germany's construction-sector GDP per capita in 1970. Germany's asbestos consumption between 1950 and 1985 is the sum of consumption by the German Democratic Republic and the Federal Republic of Germany.

*Sources*: consumption data from the US Geological Survey and GDP and population data from the United Nations.

For Canada, regional GDP was compared to that of the rest of the country, since most of Canada's asbestos production was concentrated in one province, Quebec. No negative impact on GDP was observed from the ban or the production decline in the countries. The small decline in Italian GDP after the 1992 ban mirrored a general decline in GDP in western Europe (Fig. 12 and 13).

Along with analyses of individual countries, an econometric analysis was made using all 67 countries with bans, to assess whether declines in asbestos consumption and/or production or subsequent asbestos bans were associated with any impact on economic activity. This analysis included 36 countries in the WHO European Region: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, Monaco, the Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. Owing to data constraints, the analysis was limited to the country level. Numerous models and specifications were considered.

A difference-in-differences approach was used to test the impact of asbestos bans on GDP growth. This is a common technique used to measure the effects of policy changes (Talosaga & Mink, 2014).

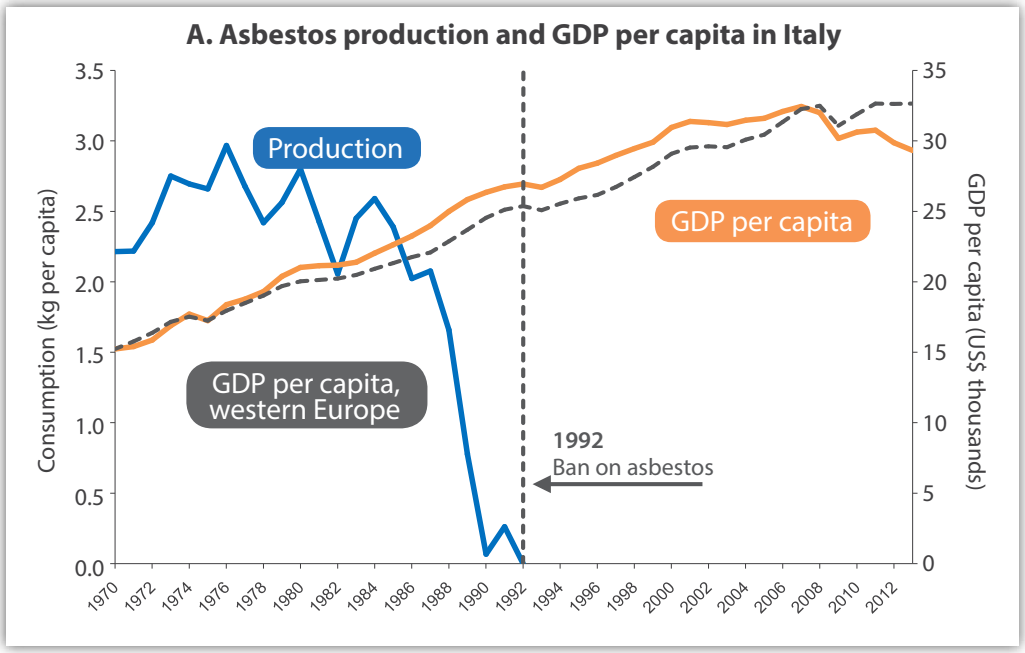
A number of different models and specifications were considered to test for an impact on GDP growth for countries that implemented bans versus those that did not. The models included variables to account for country-specific effects, as well as time-specific effects, in GDP growth. For example, one tested whether on average GDP growth is affected 0–5 years after a ban. The formal specification of this model is as follows:

$$\Delta GDP_{(i,t)} = \alpha_i + \gamma_t + \beta_1 \cdot ban_{i,t-n} + \beta_2 \cdot consumption_{(i,t)} + \varepsilon_{(i,t)}$$

where:

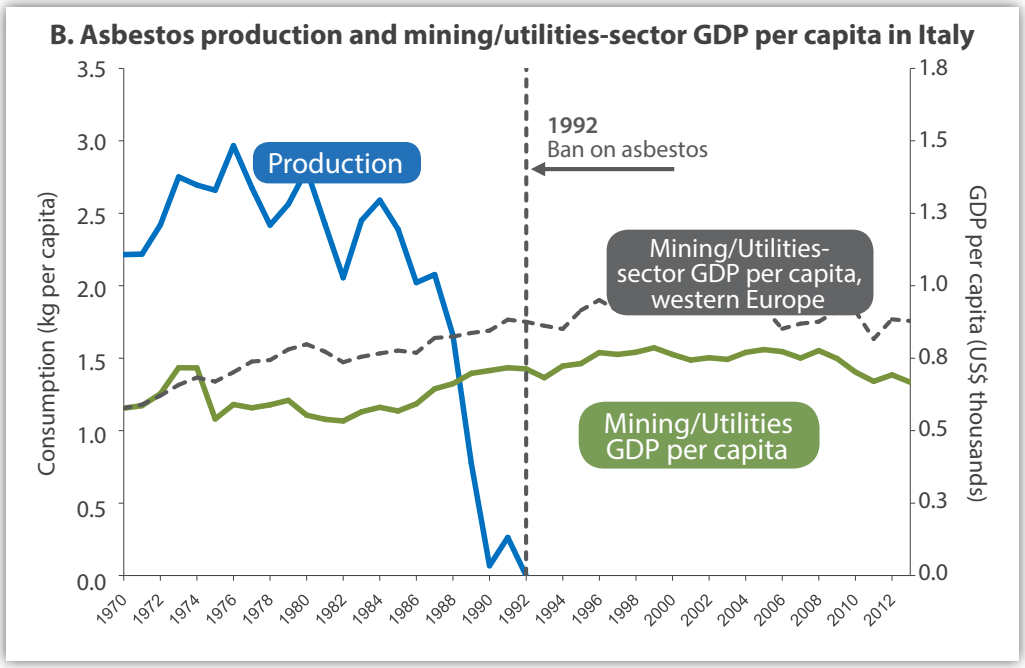
| | | |
|---|---|---|
| $\Delta GDP_{(i,t)}$ | = | GDP growth |
| $\alpha_i$ | = | estimated country effect |
| $\gamma_t$ | = | estimated time effect |
| $ban_{i,t-n}$ | = | a dummy variable equal to one on the year of the asbestos ban and zero otherwise (the model accounted for a potential delay in the effect of the asbestos ban by including a lag n of 0–5 years) |
| $\beta_1$ | = | estimated effect of the asbestos ban |
| $consumption_{i,t}$ | = | level of asbestos consumption |
| $\beta_2$ | = | estimated effect of asbestos consumption |
| $\varepsilon_{i,t}$ | = | residual term |

**Fig. 12. Italy: asbestos production and GDP and mining/utilities-sector GDP per capita, 1970–2013**




*Notes*. GDP data are in constant 2005 prices. GDP per capita for western Europe is pegged to the value of Italy's GDP per capita in 1970.

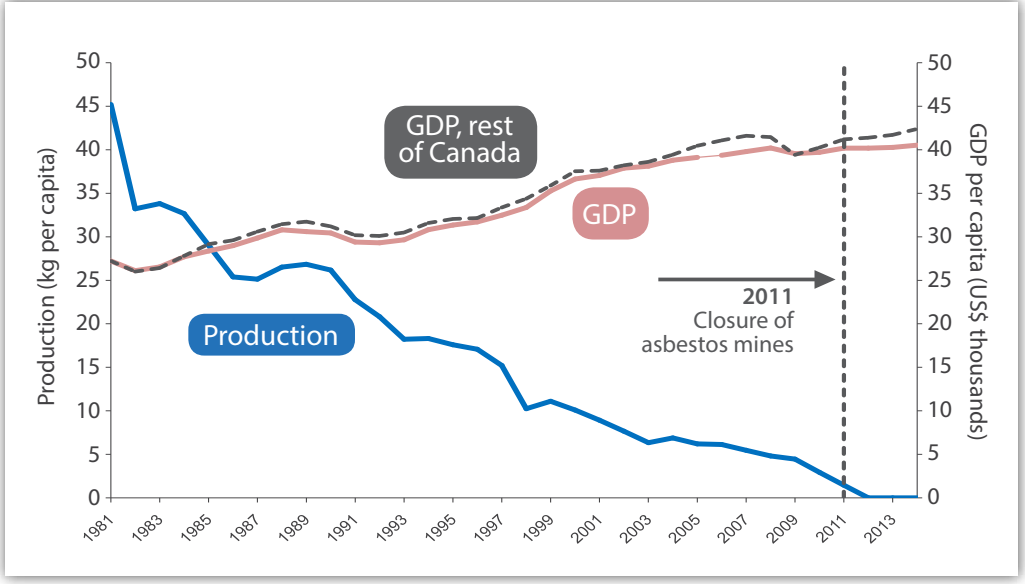
*Sources*: production data from the US Geological Survey and GDP and population data from the United Nations.




*Notes*. GDP data are in constant 2005 prices. GDP per capita in the mining and utilities sector for western Europe is pegged to the value of Italy's GDP per capita in the mining and utilities sector in 1970.

*Sources*: production data from the US Geological Survey and GDP and population data from the United Nations.

**Fig. 13. Quebec, Canada: asbestos production and GDP per capita, 1981–2014**




*Notes*. GDP data are in constant 2007 prices. GDP per capita for the rest of Canada excludes Quebec's GDP and population and is pegged to the value of Quebec's GDP per capita in 1981.

*Sources*: production data from the US Geological Survey and GDP and population data from Statistics Canada.

The results of this model indicated there was no statistically significant relationship between asbestos bans and GDP growth. An alternative model focused only on bans on asbestos production, and whether they and/or changes in the level of production had an effect on GDP growth. These results also showed no statistically significant relationship between asbestos production bans and GDP growth using this alternative specification.

A separate specification tested for longer-term effects of asbestos bans on GDP growth. For this model the dummy variable for the ban was equal to one for the year of the ban and all subsequent years. The results again showed no statistically significant effect of a ban.

The power of this country-level analysis to detect effects is limited, in part because asbestos production and/or consumption were typically not a substantial factor in country-level GDP. For example, the mining and utilities sector, of which asbestos was one aspect, represented only 3% of GDP in Italy in the years prior to the ban. In fact, country-level statistics may well hide even large effects on specialized economies or communities. Nevertheless, this analysis may be informative about the potential country-wide effects of future bans for current producer or consumer countries, because the available data indicate that asbestos does not make up a larger part of their economies than of those of countries that have already instituted bans.

Table 1 shows the relative amounts of asbestos consumed, after adjusting for differences in GDP, in countries that currently consume asbestos, along with a sample of countries that instituted bans. Given data limitations on the price of asbestos, a scalar – specifically, tonnes of asbestos to constant dollars of GDP – is used as the comparator. As shown, asbestos consumption relative to the GDP of current consumers is below that of some of the prior consumers. For example, China consumed 570 000 tonnes of asbestos with a GDP of $9.5 trillion in 2013, or a scalar of 0.06. In comparison, the United States consumed 668 129 tonnes of asbestos with a GDP of $6.5 trillion at its peak consumption in 1970, or a scalar of 0.10, higher than that of China.

**Table 1. Asbestos consumption and GDP in current consumer countries (2013) and former consumers (peak year)**

| Countries | Year | Quantity consumed (tonnes) | GDP (US$ millions) | Asbestos/ GDP scalar |
|---|---|---|---|---|
| Current consumers | | | | |
| China | 2013 | 570 000 | 9 490 603 | 0.06 |
| Russian Federation | 2013 | 432 000 | 2 079 025 | 0.21 |
| India | 2013 | 303 000 | 1 861 802 | 0.16 |
| Brazil | 2013 | 181 000 | 2 465 774 | 0.07 |
| Former consumers | | | | |
| United States | 1970 | 668 129 | 6 459 657 | 0.10 |
| Japan | 1980 | 398 877 | 3 073 076 | 0.13 |
| United Kingdom | 1960 | 163 019 | 569 234 | 0.29 |
| France | 1970 | 152 357 | 894 296 | 0.17 |

*Note*. For current consumers, 2013 was the most recent year for which consumption data were available. For former consumers, the year of peak consumption and the consumption and GDP figures for that year are shown. GDP values were adjusted to 2013 US dollars using consumer-price-index data from the US Bureau of Labor Statistics.

*Sources*: data on consumption from the US Geological Survey and data on GDP from the World Bank.

Table 2 shows similar information for producer countries. 2014 was the most recent year for which asbestos-production data were available. As shown, asbestos has less relative importance to current producers, measured as the scalar of asbestos production to GDP, than it did to some former producers, such as Canada and South Africa.

**Table 2. Asbestos production and GDP in current producer countries (2014) and former producers (peak year)**

| Countries | Year | Quantity consumed (tonnes) | GDP (US$ millions) | Asbestos/ GDP scalar |
|---|---|---|---|---|
| Current producers | | | | |
| Russian Federation | 2014 | 1 000 000 | 1 860 598 | 0.59 |
| China | 2014 | 400 000 | 10 354 832 | 0.04 |
| Brazil | 2014 | 284 000 | 2 416 636 | 0.12 |
| Kazakhstan | 2014 | 240 000 | 217 872 | 0.10 |
| Former producers | | | | |
| Canada | 1970 | 1 507 497 | 535 476 | 2.82 |
| South Africa | 1975 | 354 710 | 162 582 | 2.18 |
| Australia | 1980 | 92 418 | 429 959 | 0.21 |
| Greece | 1996 | 80 213 | 220 081 | 0.36 |

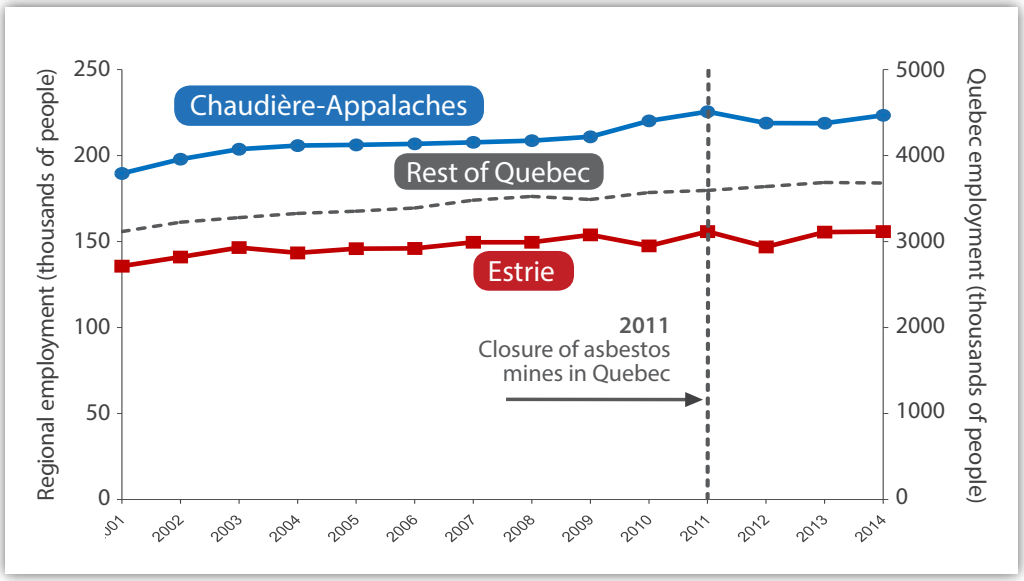
*Note*. For current producers, 2014 was the most recent year for which consumption data were available. For former producers, the year of peak production and the production and GDP figures for that year are shown. GDP values were adjusted to 2014 US dollars using consumer-price-index data from the US Bureau of Labor Statistics.

*Sources*: data on production from the US Geological Survey and data on GDP from the World Bank.

# Economic impact in selected regions

To assess the effect of asbestos bans and declines in asbestos reliance at a regional or local level, two areas were examined for which regional data were available on asbestos production and/or consumption and regional or local GDP or employment: the province of Quebec, Canada, and five states in Brazil. Canada's asbestos production, primarily concentrated in Quebec, peaked at 1.5 million tonnes in 1970, but had declined to 300 000 tonnes, most of which were exported, by 2000 (Virta, 2006b). Production continued to decline in the 2000s (US Geological Survey, 2016), and the last two asbestos mines halted production in 2011 (Anonymous, 2011). In 2012, the provincial government announced plans to invest the funds in "economic diversification of the asbestos mining region" (Ruff, 2012). Annex 4 gives a short description of the Canadian Initiative for the Economic Diversification of Communities Reliant on Chrysotile. As noted above, a negative impact on GDP in the province of Quebec was not observed following closure of the mines. In addition, the employment data available from Statistics Canada for the two regions in Quebec in which the mines were located, Estrie and Chaudière-Appalaches, show declines in employment in both following the closure of the mines. In particular, total employment in Estrie declined from about 156 000 people to about 147 000 (a decline in the employment rate from 59.5% to 55.6%), and that in Chaudière-Appalaches declined from about 226 000 people to about 219 000 (a decline in the employment rate from 65.6% to 63.4%). The employment rate is the number of people employed per 100 members of the population. Within one to two years, however, the employment levels in both regions had returned to pre-closure levels: in 2014, employment returned to about 156 000 people in Estrie and to about 223 000 in Chaudière-Appalaches (Fig. 14). The drivers behind the increased employment in these regions post-closure were not studied, so whether population changes or migration, or government intervention may have played a role in each region's recovery is not known.

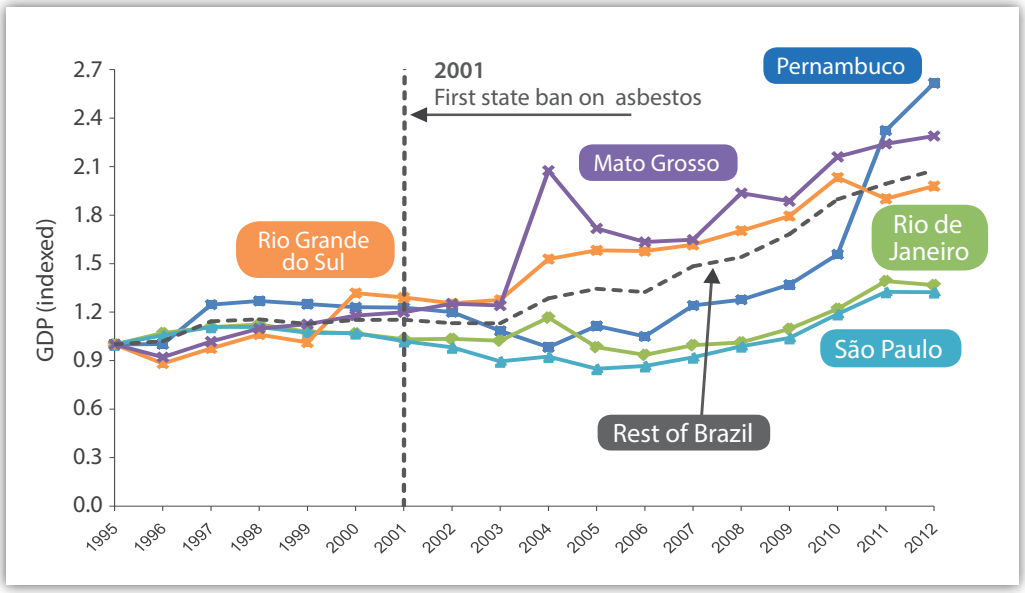
**Fig. 14. Employment in Chaudière-Appalaches and Estrie, Quebec, Canada, 2001–2014**




*Source*: data from Statistics Canada.

Although Brazil has not instituted a country-wide ban, a number of Brazilian states have banned asbestos; the states of São Paulo, Rio Grande do Sul, Rio de Janeiro, Pernambuco, and Mato Grosso did so in or after 2001, according to the International Ban Asbestos Secretariat. While São Paulo clearly banned asbestos in 2001, the precise years for the other four states are unknown. A sixth state, Minas Gerais, banned asbestos at the end of 2013. Fig. 15 shows that the trends in the construction industry for the states that have banned asbestos showed no observable change after the bans were implemented and were generally in line with those for the rest of Brazil. After the bans, the construction industry continued to grow faster in two states, Mato Grosso and Rio Grande do Sul, than in the rest of Brazil, but more slowly in two others, Rio de Janeiro and São Paulo. Growth in the state of Pernambuco, which had been faster than the rest of Brazil before the bans, temporarily slowed down afterwards, but recovered by 2011. A comparison of overall GDP also shows that the trends in GDP of the Brazilian states that banned asbestos continued after implementation and were generally in line with those the rest of Brazil.

**Fig. 15. Changes in the growth of the construction-sector GDP of Brazilian states that banned asbestos, 1995–2012**




*Notes*. GDP data are in constant 2005 prices. Construction-sector GDP for the rest of Brazil excludes that of states that banned asbestos. Figures for the construction-sector GDP of the different states and of the rest of Brazil are indexed to 1 starting in 1995.

*Sources*: data from the United Nations and the Brazilian Institute of Geography and Statistics.

# 4

# Economic costs of continued production and consumption

As discussed above, negative effects on economic activity were not observed following bans of asbestos and declines in consumption and production; this finding may reflect the small size of the asbestos industry relative to national economic activity, and the possible mitigating effect of developing substitute industry. Moreover, numerous costs are associated with the continued use and production of asbestos. Beyond the direct (cost of medical care and premature death) and indirect (loss of labour-force participation and tax revenues) health-care costs, countries that have been heavy users of asbestos have also incurred other societal costs, such as compensation/litigation costs and removal costs (including waste management and disposal), as well as welfare loss, including pain and suffering for which some injured individuals, families and communities have not been compensated. Countries that still consume asbestos may also incur costs associated with environmental concerns, such as a loss of tourism. For example, China, despite being a heavy consumer of asbestos, banned its use in the construction of sport facilities for the 2008 Summer Olympics in Beijing, out of concern about a possible boycott by some athletes or tourists (Frank & Joshi, 2014). In addition, the Russian Federation appears also to have banned the use of asbestos in the construction of facilities for the 2014 Winter Olympics and Paralympic Games in Sochi (Kazan-Allen 2013).

## Health effects and costs of use

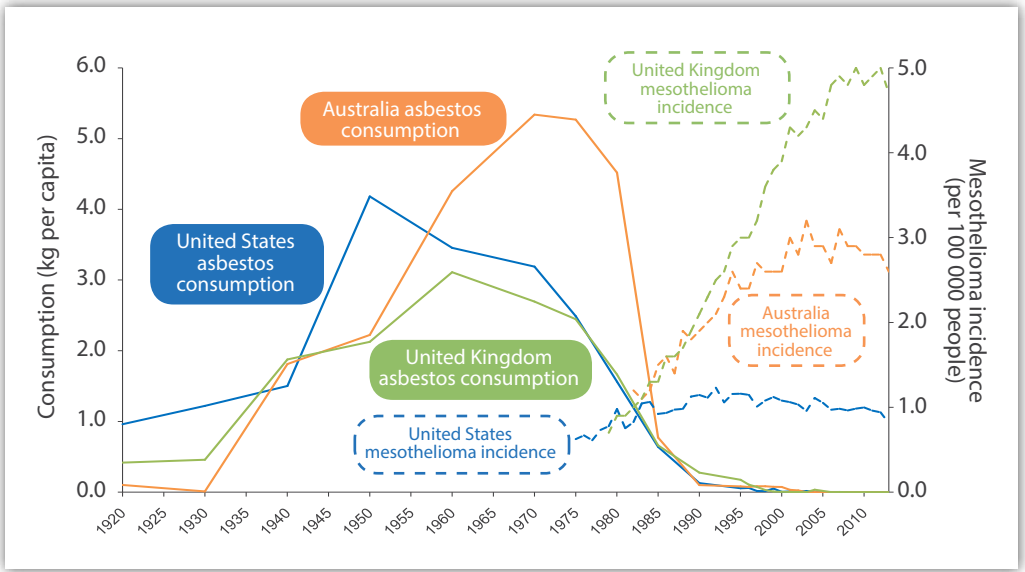
One of the largest historical costs of asbestos use has been the associated adverse health effects. WHO has estimated that more than 100 000 people annually die from asbestos-related diseases, and the global direct health costs related to increased mortality and morbidity from asbestos-related cancer have been estimated to range from US$ 2.4 billion to over US$ 3.9 billion per year (Leigh, 2011; Watterson, 2012). These estimates do not include costs associated with non-cancerous asbestos-related diseases such as asbestosis, or any adjustment for years of life or years of healthy life lost due to asbestos-related diseases (Driscoll, 2012ab). The annual medical costs for mesothelioma in the United States have been estimated at US$ 1.9 billion (Leigh, 2011).

Asbestos-related diseases, particularly mesothelioma, have long latency periods: up to 40 years (Robinson, Musk & Lake, 2005). As shown in Fig. 16, several countries that were heavy consumers of asbestos – Australia, the United Kingdom and the United States – did not experience high levels of mesothelioma until decades after consumption peaked. As discussed above, Lin et al. (2007) applied a 30–40-year lag in their study of asbestos exposure and mesothelioma deaths, finding that asbestos use in the 1960s "was a highly significant positive predictor" of mesothelioma deaths in the early 2000s.

In many of the countries included in this study (Lin et al., 2007) asbestos consumption

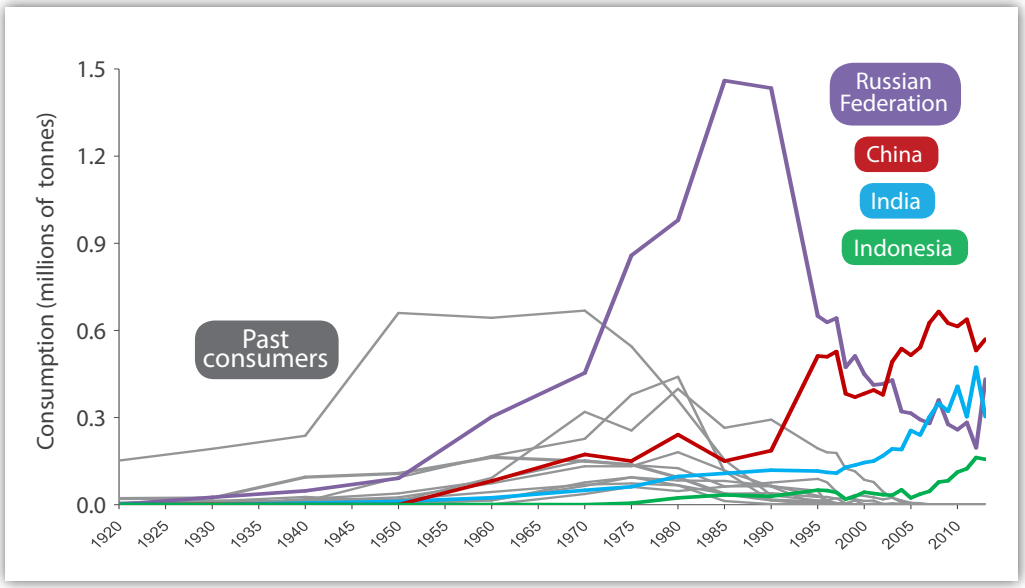
had peaked several decades previously. In contrast, as shown in Fig. 17, the largest current consumers – including China, India, Indonesia and the Russian Federation – increased consumption more recently, and it may not yet have peaked in some. These countries consume hundreds of thousands of tonnes of asbestos per year, according to data from the US Geological Survey through 2013. Only one of the top current consumers, Brazil, had data on mesothelioma mortality and was included in the study of Lin et al. (2007). Consequently, based on the relationship between national asbestos use and mesothelioma deaths documented by Lin et al. (2007), current asbestos consumers can expect to experience significant increases in mesothelioma death rates in the future.

**Fig. 16. Asbestos consumption and mesothelioma incidence in Australia, the United States and the United Kingdom, 1920–2013**




*Sources*: consumption data from the US Geological Survey and age-adjusted mesothelioma-incidence data from the Surveillance, Epidemiology, and End Results (SEER) database of the National Cancer Institute of the United States, Cancer Research UK and the Australian Mesothelioma Registry.

**Fig. 17. Asbestos consumption of current leading consumer countries, 1920–2013**




*Notes*. Negative asbestos-consumption values were excluded. Consumption for the Russian Federation before 1990 was estimated using the country's share of total consumption by all newly independent states of the former USSR in 2000.

*Source*: data from the US Geological Survey.

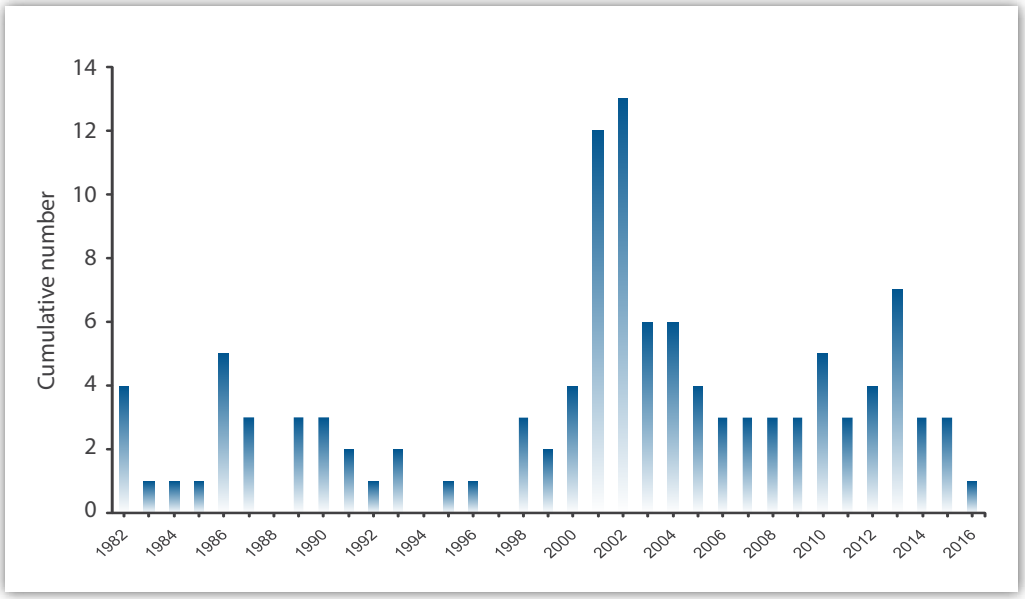
# Related compensation/litigation costs

In addition to adverse health effects, asbestos consumption and production have led to significant compensation costs; in the United States, these arise primarily through litigation expenditure. For example, a 2005 study conducted by the RAND Corporation, a non-profit-making global think tank, estimated that spending on asbestos-related litigation in the United States had totalled over US$ 70 billion as of 2002 (Carroll et al., 2005). Estimating these costs from the inception of asbestos litigation in the 1960s through the end of 2002, the authors estimated that claimants had received US$ 30 billion in compensation, with an additional US$ 40 billion going to cover litigation costs paid by plaintiffs and defendants. In addition, from 2002 through 2014, insurers in the United States paid approximately US$ 30 billion in compensation and defence costs related to asbestos litigation: an average of US$ 2.3 billion per year (Insurance Information Institute, 2016). By comparison, Leigh (2011) estimated that medical costs in the United States related to mesothelioma deaths in 2007 totalled US$ 1.9 billion. This estimate is for direct medical costs only and does not include loss of productivity. The high cost of asbestos litigation drove over 100 companies in the United States to file for bankruptcy because of their liabilities (Fig. 18) (Crowell & Moring, 2016).

Many of these companies funded trusts, using insurance assets or other company assets available at the time of the bankruptcy, to compensate current or future claims of asbestos-related diseases against the company. As of 2008, RAND estimated the value of assets under active and proposed trusts at over US$ 32 billion (Dixon, McGovern & Coombe, 2010).

In 2002, Stiglitz, Orszag & Orszag (2002) estimated the impact of asbestos-related bankruptcies on the United States economy; at the time, an estimated 61 companies had declared bankruptcy as a result

**Fig. 18. Annual number of asbestos-related bankruptcies in the United States, 1982–2016**




*Source*: data from Crowell & Moring (2016).

of asbestos liabilities. The bankruptcies were considered asbestos related if the cost of compensating future claimants was a driving force. The authors found that the bankruptcies had led to losses of jobs (52 000–60 000) and displaced workers' wages (US$ 25 000–50 000 per worker) and pension income (25% reduction on average from their retirement accounts). In addition, the authors estimated that, based on the literature on bankruptcy costs, the 61 asbestos-related bankruptcies were likely to have had direct legal, accounting or other transaction costs of US$ 325–650 million.

Asbestos-litigation costs are not limited to the United States. Other countries, even those with asbestos-related compensation funds, have also reported either asbestos-related litigation or the potential for it.

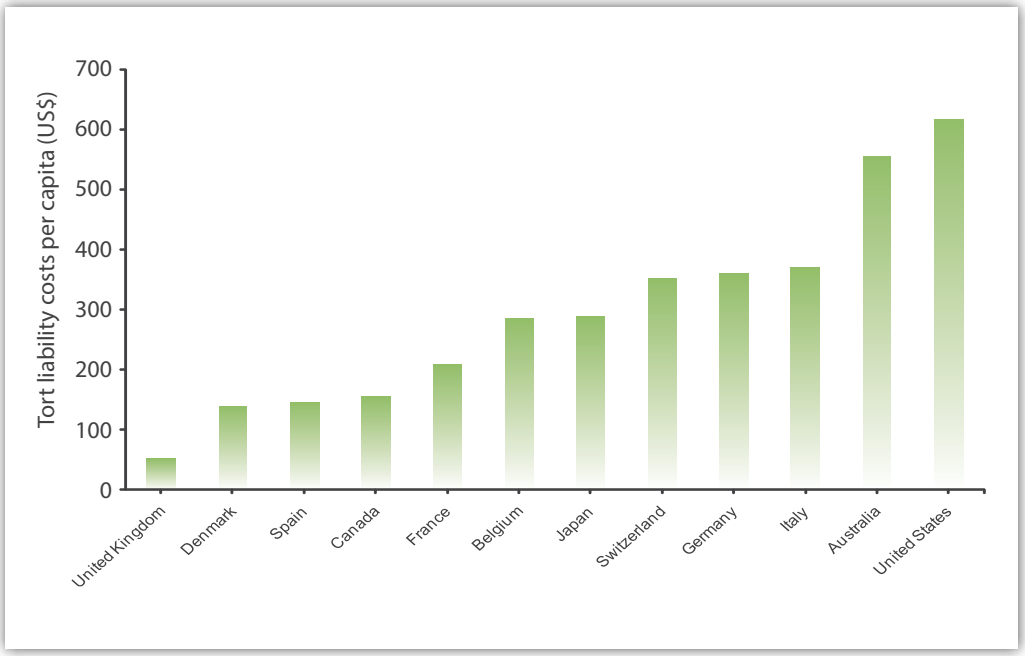
For example, the Government of France created a compensation fund in December 2000 for claims of asbestos-related disease (FIVA – Fonds d'Indemnisation des Victimes de l'Amiante). FIVA pays claimants but also has the right to pursue subrogation claims in court. Since its creation, FIVA has paid over €2.4 billion to over 50 000 claimants. It paid out €359 million in 2009 alone. Nevertheless, over 13% of claimants filed their claims directly with French courts, rather than going through FIVA (Bouckaert, 2011).

In Germany, asbestos claimants are compensated by the state occupational health system (DGUV–Deutsche Gesetzliche Unfallversicherung). According to a 2013 study by the Government, an estimated 1500 people die from asbestos-related diseases each year in Germany. Over the period 1994–2010, DGUV granted 50% of applications related to asbestosis, 20–40% of those related to lung or throat cancer, and 80% of those related to mesothelioma, making aggregate compensation payments of €1.3 billion (Lach, Polly & Boeck, 2013). Historically, there has been little evidence that claimants who are denied coverage turn to private litigation against employers, manufacturers, distributors or importers. Lach, Polly & Boeck (2013) hypothesized that asbestos claimants do not pursue individual claims because almost everyone in Germany has access to statutory health insurance, but the possibility for future claims exists, given the number of people whose claims are denied under DGUV.

In the United Kingdom, asbestos claimants can obtain compensation by suing their employers, under employee-liability insurance, or by filing a claim with the Department of Work and Pensions (Anonymous, 2009). A third approach is to file claims under the Pneumoconiosis etc. (Workers' Compensation) Act 1979, covering dust-related injuries when former employers were bankrupt, but, according to *The Actuary* (Anonymous, 2009), awards under this approach are much lower than those under the other two. In 2009, the insurance profession's United Kingdom Asbestos Working Party estimated that future costs to the insurance industry of asbestos claims in the country were expected to total £10 billion for the period 2009–2050, with an estimated range around of £5 billion to over £20 billion (Ball et al., 2010). These cost estimates were double those of a study conducted in 2004. The authors note that £8 billion of the estimated £10 billion in costs over the period 2009–2050 relates to the period 2009–2040. Estimates are undiscounted.

Whether other countries, particularly current asbestos consumers, will experience litigation costs similar to those in the United States may depend on their legal and liability environments. Historically, litigation costs have comprised a greater share of GDP in the United States than in other countries. For example, Allen & Martin (2006) estimated litigation costs per capita in 2003 for several countries, and found that these costs in European countries were approximately 50% of those in the United States (Fig. 19). Even if today's asbestos consumers face average litigation costs that are a fraction of those in the United States, they may still face large litigation-related costs in the future, given the magnitude of their asbestos consumption.

**Fig. 19. Liability costs per capita in 2003**




*Source*: data from Allen & Martin (2006).

## Remediation and removal costs

Countries with high asbestos consumption in the 1960s and 1970s have been involved in the remediation and safe removal of previously installed asbestos, which includes the proper disposal of waste, for decades. State governments in the United States provide guidelines for remediation and safe removal that include the proper disposal of such waste. For example, guidance from the Minnesota Department of Health (2016) on hiring an asbestos contractor identifies the costs associated with removal of asbestos to include labour, air monitoring and waste removal. Similarly, the Connecticut Department of Public Health (2006) details how removal must include the proper disposal of asbestos waste. Levin & Mudarri (2005) estimated that activities for asbestos and lead abatement in the United States cost US$ 4 billion annually as of 2003. Updating the 2005 study, Mudarri (2014) estimated that the cost of asbestos and lead abatement in the United States had decreased to an annual average of US$ 3 billion as of 2011. Based on these estimates, asbestos and lead abatement in the United States have cost more than US$ 50 billion since 2000: the total was estimated by interpolating costs between the two estimates and holding costs constant on either side of them.

Governments of European countries, such as Germany (BG BAU, 2014), also provide guidelines for the safe removal and proper disposal of asbestos. The aggregate annual costs of asbestos remediation in the United Kingdom are not readily available, but the market is at least £75 million annually, according to data for two firms engaged in asbestos remediation. Edison Investment Research reported estimated remediation revenues for Silverdell in 2013 of £60.5 million for asbestos removal and industrial services, of which industrial services comprised 5 million – 6 million (Anonymous, 2012); Endole, a company providing market research on other firms, estimates that Rhodar Limited, a private company engaged in asbestos removal and remediation (see http://www.rhodar.co.uk) had revenues of £50 million in 2015 (Anonymous, 2016).

In sum, large economic costs are associated with using, producing and removing asbestos. As discussed above and shown in Table 3, in the United States alone, annual health costs related to treating mesothelioma have been estimated at US$ 1.9 billion, and annual remediation costs at US$ 3.0 billion: a combined total of almost US$ 5.0 billion. In addition, health costs are associated with other asbestos-related diseases, such as asbestosis, and lung and other types of cancer. Asbestos-litigation costs in the United States have been estimated at another US$ 2.3 billion per year. The litigation-related payments may include the reimbursement of medical costs associated with mesothelioma, but the overlap, if any, is likely to be small. A review of a sample of mesothelioma verdicts, in which economic and other components were identified, showed that medical costs represented only 4% of awards. While data on these costs are not readily available for countries currently using asbestos, these countries' aggregate consumption has reached approximately 80 million tonnes, more than twice the 29 million tonnes consumed by the United States in its long decades of asbestos use. Given the level of asbestos consumption of current users, the potential costs could be substantial.

**Table 3. Asbestos consumption and estimated annual related costs in the United States and consumption by current consumers**

| Country | Asbestos consumption, 1920–2013 (tonnes) | Asbestos-related annual costs (US$ billions) | | |
|---|---|---|---|---|
| | | Health care | Abatement | Litigation |
| **United States** | 28 727 657 | 1.9 | 3.0 | 2.3 |
| **Current consumers (total)** | 79 739 738 | | | |
| Russian Federation | 40 651 944 | | | |
| China | 16 580 261 | | ? | |
| Ukraine | 7 748 291 | | | |
| India | 7 381 662 | | | |
| Kazakhstan | 7 377 581 | | | |

*Notes.* Asbestos consumption is interpolated for years in which data are missing. Asbestos consumption for Kazakhstan, the Russian Federation and Ukraine before 1990 is estimated using each country's share of total consumption by the newly independent states in 2000.

*Sources:* consumption data from the US Geological Survey; estimated annual health care costs from Leigh (2011); estimated litigation costs from the Insurance Information Institute (2016); and estimated asbestos-abatement costs from Mudarri (2014).

# 5 Conclusion

Global asbestos production and consumption show some clear trends: many countries have produced and consumed declining amounts, and an increasing number have instituted bans, although at different times. Analysing country-level economic data for past producers and consumers may be informative about the impact of potential future bans and production and consumption declines for current producers and consumers. Country-level data show no observable negative economic impact following declines in asbestos production and consumption and the institution of bans. The lack of an effect at the national level, however, may merely reflect the small share that asbestos represents in national economic activity.

In addition, where relevant data are available, no persistent effect was observed at the regional level following declines in asbestos consumption or production. Data at the local level are limited, however, making it difficult to observe and control for all factors that may influence a ban's effect on a particular community. More study may be needed to identify and quantify costs that may be observable only at this level.

Overall, the trends show that the global asbestos industry is shrinking, and countries have successfully moved away from reliance on asbestos. Further, its continued use carries substantial costs, including those related to health, remediation and litigation. Countries that continue to produce and consume asbestos will sustain substantial health costs, and, based on data from past producers and consumers, perhaps even greater and remediation and litigation costs.

# References


Allen LP, Martin DN (2006). Forecasting product liability by understanding the driving forces. In: The international comparative legal guide to: product liability 2006. London: Global Legal Group:37–43.

Anonymous (2009). Asbestos liability in the United Kingdom. The Actuary, 7 February. (http://www.theactuary.com/archive/old-articles/part-6/asbestos-liability-in-the-uk, accessed 16 November 2016).

Anonymous (2011). Asbestos mining stops for first time in 130 years. CBC News, 24 November 2011 (http://www.cbc.ca/news/business/asbestos-mining-stops-for-first-time-in-130-years-1.1103672, accessed 16 November 2016).

Anonymous (2012b). Silverdell, strategic outlook. London: Edison Investment Research (http://www.edisoninvestmentresearch.com/?ACT=18&ID=8614).

Anonymous (2016). Rhodar Limited. Endole Ltd, last updated 23 August 2016. (https://www.endole.co.uk/company/01269463/rhodar-limited).

Ball M, Beard D, Brooks R, Couchman N, Gravelsons B, Kefford C et al. (2010). United Kingdom Asbestos Working Party update 2009. London: Institute and Faculty of Actuaries (https://www.actuaries.org.uk/practice-areas/general-insurance/research-working-parties/uk-asbestos, accessed 16 November 2016).

BG BAU (2014). Technische Regeln für Gefahrstoffe TRGS 519 Asbest Abbruch-, Sanierungs- oder Instandhaltungsarbeiten [Asbestos: demolition, refurbishment or maintenance measures]. Berlin: Berufsgenossenschaft der Bauwirtschaft (http://www.bgbau-medien.de/tr/trgs519/inhalt.htm).

Bouckaert C (2011). Resurgence in asbestos litigation risk in France. Lexology [website]. London: Globe Business Media Group (http://www.lexology.com/library/detail.aspx?g=61671856-e9ef-485a-b2f5-e6d485c8969d, accessed 16 November 2016).

Carroll SJ, Hensler D, Gross J, Sloss EM, Schonlau M, Abrahamse A et al. (2005). Asbestos litigation. Santa Monica, CA: RAND Corporation.

Commission of the European Communities (1999). Commission Directive 1999/77/EC of 26 July 1999 adapting to technical progress for the sixth time Annex I to Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (asbestos). Official Journal of the European Communities, L207:18–20. (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1999:207:0018:0020:EN:PDF)

Connecticut Department of Public Health (2006). Standards for asbestos abatement. In: Connecticut Department of Public Health [website]. Hartford: State of Connecticut (http://www.ct.gov/dph/lib/dph/public_health_code/sections/19a-332a-1_to_19a-332a-16_asbestos_abatement.pdf, accessed 16 November 2016).

Crowell & Moring (2016). Chart 1: company name and year of bankruptcy filing (chronologically). Crowell & Moring [website]. Washington, DC: Crowell & Moring LLP (https://www.crowell.com/files/List-of-Asbestos-Bankruptcy-Cases-Chronological-Order.pdf, accessed 16 November 2016).

da Silva ALG, Etulain CR (2010). The economic impact of the banning of the use of asbestos in Brazil. Jornal da Unicamp. 24(483).

Dixon L, McGovern G, Coombe A (2010). Asbestos bankruptcy trusts: an overview of trust structure and activity with detailed reports on the largest trusts. Santa Monica, CA; RAND Corporation.

Driscoll T (2012a). Annex 3. Report on DALYs lost from asbestos exposure in European countries. In: The human and financial burden of asbestos in the WHO European Region. Copenhagen: WHO Regional Office for Europe:41–5 (http://www.euro.who.int/en/health-topics/environment-and-health/occupational-health/publications/2013/the-human-and-financial-burden-of-asbestos-in-the-who-european-region, accessed 16 November 2016).

Driscoll T (2012b). Annex 4. Step-by-step guidance on calculating DALYs lost from asbestos exposure in a country for a national asbestos profile. In: The human and financial burden of asbestos in the WHO European Region. Copenhagen: WHO Regional Office for Europe:46–52 (http://www.euro.who.int/en/health-topics/environment-and-health/occupational-health/publications/2013/the-human-and-financial-burden-of-asbestos-in-the-who-european-region, accessed 16 November 2016).

Federal Institute for Occupational Safety and Health (2014). National asbestos profile for Germany. Dortmund: Federal Institute for Occupational Safety and Health (http://www.baua.de/en/Publications/Expert-Papers/Gd80.html;jsessionid=C42B4CADB5D86E01EAAE17CF8057D840.1_cid343, accessed 16 November 2016).

Frank AL, Joshi TK (2014). The global spread of asbestos. Ann Glob Health. 80:257–62.

Harrison PTC, Levy LS, Patrick G, Pigott GH, Smith LL (1999). Comparative hazards of chrysotile asbestos and its substitutes: a European perspective. Environ Health Perspect. 107(8): 607–11.

Insurance Information Institute (2016). Archived tables. Estimated Asbestos Losses, 2005–2014. Estimated Asbestos Losses, 2004–2013. Estimated Asbestos Losses, 2002–2011. In: Insurance Information Institute [website]. New York, NY: Insurance Information Institute (http://www.iii.org/table-archive/21043, accessed 18 April 2016).

International Agency for Research on Cancer (2012). Arsenic, metals, fibres and dusts. Lyon: International Agency for Research on Cancer (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 100C; http://monographs.iarc.fr/ENG/Monographs/vol100C).

National Programmes for Elimination of Asbestos Related Diseases: Review and Assessment, Bonn: World Health Organization, 7–8 June 2011.

Järvholm B, Burdorf A (2015). Emerging evidence that the ban on asbestos use is reducing the occurrence of pleural mesothelioma in Sweden. Scand J Public Health. 43:875–81.

Kazan-Allen L (2013). Russia's Olympic asbestos policy. London: International Ban Asbestos Secretariat (http://www.ibasecretariat.org/lka-russias-olympic-asbestos-policy.php).

Krusell N, Cogley D (1982). Asbestos substitute performance analysis. Washington, DC: US Environmental Protection Agency (https://www.google.dk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwj0yNGI_6_QAhXBEywKHWnCBGoQFggfMAA&url=http%3A%2F%2Fnepis.epa.gov%2FExe%2FZyPURL.cgi%3FDockey%3D9100IJFN.TXT&usg=AFQjCNEmsEPc90LwZ3shDDn2WOjfY3CjNg, accessed 16 November 2016).

Lach S, Polly S, Boeck N (2013). Statement of the federal German government on asbestos-related diseases in Germany. Lexology [website]. London: Globe Business Media Group (http://www.lexology.com/library/detail.aspx?g=e6036ebc-b333-49ac-ae9e-f272ddf97ca9, accessed 16 November 2016).

Le GV, Takahashi K, Karjalainen A, Delgermaa V, Hoshuyama T, Miyamura Y et al. (2010). National use of asbestos in relation to economic development. Environ Health Perspect. 118(1):116–9.

Leigh JP (2011). Economic burden of occupational injury and illness in the United States. Milbank Q. 89(4):728–72.

Levin H, Mudarri D (2005). National expenditures for IAQ: problem prevention or mitigation. In: Levin H, editor. BuildingEcology.com [website]. Santa Cruz: Building Ecology (http://www.buildingecology.com/articles/national-expenditures-for-iaq-problem-prevention-or-mitigation, accessed 16 November 2016).

Lin R-T, Takahashi K, Karjalainen A, Hoshuyama T, Wilson D, Kameda T et al. (2007). Ecological association between asbestos-related diseases and historical asbestos consumption: an international analysis. Lancet, 369:844–9.

Minnesota Department of Health (2016). Hiring an asbestos contractor. In: Minnesota Department of Health [website]. St Paul: Minnesota Department of Health (http://www.health.state.mn.us/divs/eh/asbestos/homeowner/howhire.html, accessed 16 November 2016).

Mudarri DH (2014). National expenditures, jobs, and economic growth associated with indoor air quality in the United States. J Environ Health. 76(9):26–31.

National Economic Development and Labour Council (2002). The socio-economic impact of phasing out asbestos in South Africa. Johannesburg: National Economic Development and Labour Council.

Nishikawa K, Takahashi K, Karjalainen A, Wen C-P, Furuya S, Hoshuyama T et al. (2008). Recent mortality from pleural mesothelioma, historical patterns of asbestos use, and adoption of bans: a global assessment. Environ Health Perspect, 116(12):1675–80.

Robinson BWS, Musk W, Lake RA (2005). Malignant mesothelioma. Lancet. 366:397–408.

Ruff K (2012). Quebec and Canadian governments end their historic support of the asbestos industry. Int J Occup Environ Health. 18(4):263–7.

Stiglitz JE, Orszag JM, Orszag PR (2002). The impact of asbestos liabilities on workers in bankrupt firms. Washington, DC: Sebago Associates.

Talosaga T, Vink M (2014). The effect of public pension eligibility age on household saving: evidence from a New Zealand natural experiment. Wellington: New Zealand Treasury

(Treasury Working Paper Series, No 14/21; http://www.treasury.govt.nz/publications/research-policy/wp/2014/14-21).

Tri DD, Toan NN, Cong NT (2004). Possibility of using substitute materials for asbestos and non-asbestos fibro cement roofing tiles to reduce environmental pollution and increase workers' health protection in Vietnam. Global Asbestos Congress 2004. Tokyo: Waseda University; 19–21 November 2004 (http://worldasbestosreport.org/conferences/gac/gac2004/PL1-07.php).

US Environmental Protection Agency (2016). U.S. federal bans on asbestos. In: United States Environmental Protection Agency [website]. Washington, DC: United States Government (https://www.epa.gov/asbestos/us-federal-bans-asbestos, accessed 16 November 2016).

US Geological Survey (2016). Asbestos statistics and information. In: US Geological Survey [website]. Reston, VA: US Geological Survey (http://minerals.usgs.gov/minerals/pubs/commodity/asbestos, accessed 22 March 2016).

Virta RL (2006a). Asbestos substitutes. In: Kogel JE, Trivedi NC, Barker JM, Krukowski ST, editors. Industrial minerals & rocks: commodities, markets, and uses. Englewood, CO: Society for Mining, Metallurgy, and Exploration:3–5.

Virta RL (2006b). Worldwide asbestos supply and consumption trends from 1900 through 2003. Reston, VA: US Geological Survey.

Watterson A (2012). Annex 5. Economic costs of ARDs. In: The human and financial burden of asbestos in the WHO European Region. Copenhagen: WHO Regional Office for Europe:53–67 (http://www.euro.who.int/en/health-topics/environment-and-health/occupational-health/publications/2013/the-human-and-financial-burden-of-asbestos-in-the-who-european-region, accessed 16 November 2016).

WHO (2016). Asbestos: elimination of asbestos-related diseases. Geneva: World Health Organization (Fact sheet; http://www.who.int/mediacentre/factsheets/fs343/en, accessed 16 November 2016).

WHO Regional Office for Europe (2012). National programmes for elimination of asbestos-related diseases: review and assessment. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/__data/assets/pdf_file/0005/176261/National-Programmes-For-Elimination-Of-Asbestos-related-Diseases-Review-And-Assessment.pdf).

WHO Regional Office for Europe (2015). Towards the elimination of asbestos-related diseases in the WHO European Region. Assessment of current policies in Member States, 2014. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/publications/abstracts/towards-the-elimination-of-asbestos-related-diseases-in-the-who-european-region.-assessment-of-current-policies-in-member-states,-2014, accessed 16 November 2016).

World Bank Group (2009). Good practice note: asbestos: occupational and community health issues. Washington, DC: World Bank Group (http://siteresources.worldbank.org/EXTPOPS/Resources/AsbestosGuidanceNoteFinal.pdf, accessed 16 November 2016).

# Annex 1
# Countries currently consuming and producing asbestos

**Table 1. Countries consuming asbestos in 2013**

| Country | Consumption (tonnes) |
|---|---|
| 1. China | 570 000 |
| 2. Russian Federation | 432 000 |
| 3. India | 303 000 |
| 4. Brazil | 181 000 |
| 5. Indonesia | 156 000 |
| 6. Uzbekistan | 81 400 |
| 7. Kazakhstan | 66 800 |
| 8. Viet Nam | 57 800 |
| 9. Thailand | 53 100 |
| 10. Turkmenistan | 53 000 |
| 11. Ukraine | 35 000 |
| 12. Sri Lanka | 23 000 |
| 13. Colombia | 16 000 |
| 14. Belarus | 11 100 |
| 15. Bangladesh | 8 030 |
| 16. Kyrgyzstan | 7 200 |
| 17. Mexico | 7 140 |
| 18. Malaysia | 6 510 |
| 19. Pakistan | 6 320 |
| 20. Zimbabwe | 5 440 |
| 21. Cuba | 4 770 |
| 22. Bolivia | 4 420 |
| 23. Ecuador | 4 160 |
| 24. Philippines | 2 650 |
| 25. Ghana | 2 040 |

*Note.* Excludes countries that consumed ≤ 1000 tonnes.
*Source:* data from the US Geological Survey.

**Table 2. Countries producing asbestos in 2013**

| Country | Production (tonnes) |
|---|---|
| 1. Russian Federation | 1 100 000 |
| 2. China | 420 000 |
| 3. Brazil | 290 825 |
| 4. Kazakhstan | 243 000 |
| 5. India | 267 |
| 6. Argentina | 100 |

*Source:data from the US Geological Survey.*

# Annex 2
## Asbestos bans by country and year

**Table 1. Asbestos bans: country, year and content**

| Country | Year | Details |
|---|---|---|
| 1. Algeria | 2009 | Use of all types of asbestos and products containing asbestos is banned. |
| 2. Argentina | 2000 | Use of amphibole asbestos is banned. |
| | 2001 | Production, import, marketing and use of chrysotile asbestos are banned. |
| 3. Australia | 2003 | Import, use and sale of products containing chrysotile asbestos are banned. |
| 4. Austria | 1990 | Use of chrysotile asbestos is banned. |
| 5. Bahrain | 1996 | Import, manufacture, and circulation of asbestos and products containing asbestos are banned. |
| 6. Belgium | 1998 | Use of chrysotile asbestos is banned. |
| 7. Brazil | 2001 | Brazilian states pass asbestos bans. |
| | 2013 | Another state (Minas Gerais) bans asbestos. |
| 8. Brunei | 1994 | Use of all types of asbestos is banned. |
| 9. Bulgaria | 2005 | Import, production and use of all types of asbestos and products containing asbestos are banned. |
| 10. Burkina Faso | 1998 | Manufacture, processing, import, marketing and use of building materials containing asbestos are banned. |
| 11. Chile | 2001 | Use of all types of asbestos is banned. |
| 12. China | 2003 | Use of asbestos in friction materials for the automobile industry is banned. |
| | 2005 | Import and export of amphibole asbestos are banned. |
| | 2008 | Use of asbestos in building the infrastructure for the Beijing Olympics and 2010 Asian Games is banned. |
| 13. Croatia | 1993 | Use of crocidolite and amosite asbestos is banned. |
| 14. Cyprus | 2005 | Use of chrysotile asbestos is banned. |
| 15. Czech Republic | 1998 | Import of all types of asbestos is banned. |
| | 2005 | Use of chrysotile asbestos is banned. |
| 16. Denmark | 1972 | Use of asbestos for insulation is banned. |
| | 1980 | Use of all types of asbestos is banned. |

| Country | Year | Details |
|---|---|---|
| 17. Djibouti | 1999 | Manufacture, processing, sale, and import of all types of asbestos are banned. |
| 18. Egypt | 2005 | Import and manufacture of all types of asbestos are banned. |
| 19. Estonia | 2000 | Marketing and use of all types of asbestos are banned. |
| | 2005 | Use of chrysotile asbestos is banned. |
| 20. Finland | 1992 | Use of chrysotile asbestos is banned. |
| 21. France | 1996 | Use of chrysotile asbestos is banned. |
| 22. Germany | 1993 | Use of chrysotile asbestos is banned. |
| 23. Greece | 2005 | Use of chrysotile asbestos is banned. |
| 24. Honduras | 2004 | Use of all types of asbestos is banned. |
| 25. Hungary | 1988 | Use of amphibole asbestos is banned. |
| 26. Iceland | 1983 | Use of all types of asbestos is banned. |
| 27. Ireland | 2000 | Use of chrysotile asbestos is banned. |
| 28. Israel | 1984 | Use of all types of asbestos is banned. |
| 29. Italy | 1992 | Use of all types of asbestos is banned. |
| 30. Japan | 1995 | Use of crocidolite and amosite asbestos is banned. |
| | 2004 | Use of chrysotile asbestos in building and friction materials is banned. |
| | 2012 | Manufacture, import, transfer, provision and use of all types of asbestos are banned. |
| 31. Jordan | 2005 | Use of all types of asbestos is banned. |
| 32. Kuwait | 1995 | Use of all types of asbestos is banned. |
| 33. Latvia | 2001 | Use of all types of asbestos is banned. |
| 34. Lebanon | 1998 | Use of crocidolite, amosite, anthophyllite, actinolite and tremolite asbestos is banned. |
| 35. Lithuania | 1998 | Use of all types of asbestos is restricted. |
| | 2005 | Use of chrysotile asbestos is banned. |
| 36. Luxembourg | 2002 | Use of chrysotile asbestos is banned. |
| 37. Malta | 2005 | Use of chrysotile asbestos is banned. |
| 38. Mauritius | 2004 | Import, manufacture, use and possession of all types of asbestos are banned. |
| 39. Monaco | 1997 | Use of asbestos in building materials is banned. |
| 40. Morocco | 2001 | Use of amphibole asbestos and products containing amphibole asbestos is banned. |
| 41. Mozambique | 2010 | Use, import, export and trade of all types of asbestos and products containing asbestos are banned. |
| 42. Netherlands | 1991 | Use of chrysotile asbestos is banned. |
| 43. New Zealand | 2002 | Import of all types of raw asbestos is banned. |

| Country | Year | Details |
|---|---|---|
| 44. Norway | 1984 | Use of all types of asbestos is banned. |
| 45. Oman | 2001 | Use of amosite and crocidolite is banned. |
| | 2008 | Use of chrysotile is banned. |
| 46. Philippines | 2000 | Use of all types of asbestos is banned. |
| 47. Poland | 1997 | Use of all types of asbestos is banned. |
| 48. Portugal | 2005 | Use of chrysotile asbestos is banned. |
| 49. Qatar | 2010 | Import of all types of asbestos is banned. |
| 50. Republic of Korea | 2009 | Use of all types of asbestos is banned. |
| 51. Romania | 2005 | Use of chrysotile asbestos is banned. |
| 52. Russian Federation | 1999 | Use of amphibole asbestos is banned. |
| 53. Saudi Arabia | 1998 | Use of all types of asbestos is banned. |
| 54. Serbia | 2011 | Use of all types of asbestos is banned. |
| 55. Seychelles | 2009 | Import of all types of asbestos is banned. |
| 56. Singapore | 1989 | Use of all types of raw asbestos is banned. |
| 57. Slovakia | 2005 | Use of chrysotile asbestos is banned. |
| 58. Slovenia | 1996 | Production of asbestos cement products is banned. |
| 59. South Africa | 2008 | Use, manufacture, import and export of asbestos and materials containing asbestos are banned. |
| 60. Spain | 2002 | Use of chrysotile asbestos is banned. |
| 61. Sweden | 1973 | Use of spray-applied asbestos material is banned. |
| | 1976 | Some uses of asbestos are banned. |
| | 1982 | Use of all types of asbestos is banned. |
| 62. Switzerland | 1989 | Use of crocidolite, amosite and chrysotile asbestos is banned. |
| 63. Thailand | 2011 | Import of all types of asbestos and sale of products containing asbestos are banned. |
| 64. Turkey | 2010 | Use of all types of asbestos is banned. |
| 65. United Kingdom | 1986 | Import, supply and use of crocidolite and amosite asbestos are banned. |
| | 1999 | Use of chrysotile asbestos is banned. |
| 66. United States | 1973 | Use of spray-applied asbestos material in fireproofing and insulation is banned. |
| | 1975 | Installation of friable asbestos insulation is banned. |
| | 1977 | Use of asbestos in artificial fireplace embers and wall patching compounds is banned. |
| | 1978 | Use of spray-applied asbestos material is banned. |
| 67. Uruguay | 2002 | Import and manufacture of all types of asbestos are banned. |

*Source:* data from the International Ban Asbestos Secretariat (http://www.ibasecretariat.org).

# Annex 3
# Asbestos-containing products and potential substitutes

**Table 1. Asbestos-containing products and potential substitutes**

| Products | Potential substitutes | |
|---|---|---|
| Asbestos-cement products | | |
| | Aluminium siding | Cellulose fibres |
| | Ductile iron | Fibreglass and corrugated fibreglass |
| | Fibrillated polypropylene (PP) | Mica |
| | Polyvinyl Alcohol (PVA) fibre | Polyacrylonitrile (PAN) fibre |
| | Polyvinyl chloride (PVC) | Pre-stressed and reinforced concrete |
| | Vinyl siding | |
| | Wollastonite | Wood |
| Coatings and composites | | |
| | Aramid fibre | Carbon fibre |
| | Cellulose fibre | Clay |
| | Cotton | Limestone |
| | Mica | Polyethylene (PE) fibre |
| | Polypropylene fibre | Particulate mineral fillers |
| | Rubber membrane roofing | Talc |
| | Wollastonite | |
| Gaskets | | |
| | Aramid fibre | Carbon fibre |
| | Cellulose fibre | Ceramic fibre |
| | Cork | Fibreglass |
| | Graphite | Mica |
| | Metal gaskets | Mineral wool |
| | Polytetrafluoroethylene (PTFE) | Rubber sheeting |
| Heat-resistant textiles | | |
| | Aramid fibre | Carbon fibre |
| | Ceramic fibre | Fibreglass |
| | Mineral wool | Polybenzimidazole (PBI) fibre |
| Insulation | | |
| | Calcium silicate board | Cement board |
| | Ceramic fibre | Fibreglass |
| | Mica | Mineral wool |
| | Vermiculite | |

| Products | Potential substitutes | |
|---|---|---|
| Flooring | | |
| | Ceramic tile | Clay |
| | Fibreglass | Polyethylene (PE) pulp |
| | Silica | Talc |
| | Vinyl compositions | |
| Friction materials | | |
| | Aramid fibre | Cellulose fibre |
| | Ceramic fibre | Fibreglass |
| | Metal fibre (e. g. brass, bronze, copper, iron) | Palygorskite (attapulgite) |
| | | Polyacrylonitrile (PAN) fibre |
| | Potassium titanate | Semi-metallic brakes |
| | Sepiolite | Steel fibre |
| | Vermiculite | Wollastonite |
| Paper and paperboard | | |
| | Ceramic fibre | Cellulose |
| | Fibreglass | Mica |
| | PTFE | Vermiculite |
| | Wollastonite | |
| Plastics | | |
| | Aramid fibre | Carbon fibre |
| | Fibreglass | Fumed silica powder |
| | Mica | PTFE |
| | Potassium titanate | Wollastonite |
| Sealing materials | | |
| | Aramid fibre | Carbon fibre |
| | Glass fibre | Glass yarn |
| | Graphite | Mineral wool |
| | PTFE | |

*Sources:* Harrison PTC, Levy LS, Patrick G, Pigott GH, Smith LL (1999). Comparative hazards of chrysotile asbestos and its substitutes: a European perspective. Environ Health Perspect. 107(8):607–11; and Virta RL (2006). Asbestos substitutes. In: Kogel JE, Trivedi N, Barker JM, Krukowski ST. Industrial minerals & rocks: commodities, markets, and uses, seventh edition. Englewood, CO: Society for Mining Metallurgy & Exploration:1215–27.

# Annex 4
# Canadian Initiative for the Economic Diversification of Communities Reliant on Chrysotile

In June 2013, the Government of Canada launched the Canadian Initiative for the Economic Diversification of Communities Reliant on Chrysotile. In effect until March 2020, the Initiative is intended to "support the economic transition of communities economically linked to the chrysotile asbestos industry" (Canada Economic Development for Quebec Regions, 2013). The Initiative is exclusive to the regions in Quebec that relied on the asbestos industry for employment and has a budget of C$ 50 million, which can be invested in small- to medium-sized enterprises, business-support organizations, non-profit-making organizations and regional municipalities.

Projects that are eligible for funding vary greatly, but must encourage the creation of jobs in the secondary and tertiary sectors. Some examples include the establishment or creation of new businesses, the purchase of new equipment or the adoption of new technology, the development of new products and services, and the expansion or construction of new facilities.

In the three years since the launch of the Initiative, small businesses in the towns of Thetford Mines (in the Chaudière-Appalaches region) and Asbestos (in the Estrie region) have already received funding to acquire new equipment and build infrastructure (Anonymous, 2014ab). For example, in June 2015, the town of Asbestos received funding for the construction of a new road to allow for the expansion of its industrial park, as well as a grant for the renovation of the Mont-Ham Regional Park reception pavilion to better accommodate visitor traffic and help the development of the local and regional tourism industry (Canada Economic Development for Quebec Regions, 2015).

According to Canada Economic Development for Quebec Regions, the projects in the town are expected to lead to the creation of a number of new jobs and promote new investment in the region.

# References

Anonymous (2014a). BiodeLices Inc. receives support from Government of Canada. Market Wired. 20 January.

Anonymous (2014b). Quebec job shop gets government support to expand. Shop Metal-working Technology. 13 December.

Canada Economic Development for Quebec Regions (2013). Government of Canada launches the Canadian Initiative for the Economic Diversification of Communities Reliant on Chrysotile. Montreal: Canada Economic Development for Quebec Regions (http://news.gc.ca/web/article-en.do?crtr.sj1D=&crtr.mnthndVl=6&mthd=advSrch&crtr.dpt1D=19&nid=750279&crtr.lc1D=&crtr.tp1D=1&crtr.yrStrtVl=2013&crtr.kw=&crtr.dyStrtVl=13&crtr.aud1D=&crtr.mnthStrtVl=6&crtr.page=1&crtr.yrndVl=2013&crtr.dyndVl=13&_ga=1.1691697.1419071812.1479807965, access 16 November 2016).

Canada Economic Development for Quebec Regions (2015). Asbestos Industrial Park and Mont-Ham Regional Park modernizing thanks to support from the Government of Canada. Montreal: Canada Economic Development for Quebec Regions (news release; http://news.gc.ca/web/article-en.do?nid=983679&_ga=1.26270525.1419071812.1479807965, accessed 16 November 2016).

## The WHO Regional Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

## Member States

Albania
Andorra
Armenia
Austria
Azerbaijan
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Luxembourg
Malta
Monaco
Montenegro
Netherlands
Norway
Poland
Portugal
Republic of Moldova
Romania
Russian Federation
San Marino
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
Tajikistan
The former Yugoslav Republic of Macedonia
Turkey
Turkmenistan
Ukraine
United Kingdom
Uzbekistan

Original: English

**World Health Organization**
**Regional Office for Europe**
Marmorvej 51 DK-2100 Copenhagen Ø, Denmark
Tel.: +45 4533 70 00| Fax: +45 45 33 70 01
E-mail: postmaster@euro.who.int
Web site: www.euro.who.int

9 789289 052481