

National Waste Reporting 2013

FACTSHEET – HAZARDOUS WASTE PROFILE 2010-11

The [Hazardous Waste \(Regulation of Exports and Imports\) Act 1989](#), defines hazardous waste as:

- Waste prescribed by the regulations, where the waste has any of the characteristics mentioned in Annex III to the Basel Convention. These characteristics include:
 - Explosive
 - Flammable Liquids/Solids
 - Poisonous
 - Toxic
 - Ecotoxic
 - Infectious Substances.
- Wastes that belong to any category contained in Annex I to the [Basel Convention](#), unless they do not possess any of the hazardous characteristics contained in Annex III. Wastes in Annex I include:
 - Clinical wastes
 - Waste oils/water, hydrocarbons/water mixtures, emulsions
 - Wastes from the production, formulation and use of resins, latex, plasticizers, glues/adhesives
 - Wastes resulting from surface treatment of metals and plastics
 - Residues arising from industrial waste disposal operations
 - Wastes which contain certain compounds such as: copper, zinc, cadmium, mercury, lead and asbestos.
- Household waste
- Residues arising from the incineration of household waste.

Hazardous wastes in Australia

The [National Waste Report 2010](#) found that in 2007¹ Australia:

- generated 1.117 million tonnes of hazardous waste (around 2.5 per cent of all waste generated).
- exported 29,240 tonnes and imported 893 tonnes of hazardous waste.
- managed most of this hazardous waste through either treatment and/or disposal to landfill.
- did not have accurate and comprehensive data on the amounts of hazardous waste treated, recovered (including waste reuse), recycled and disposed of to landfill.

The [Waste Account, Australia, Experimental Estimates](#) produced by the Australian Bureau of Statistics “shows that in 2009-10 a total of 3500 kilotonnes of hazardous waste was generated in Australia, which represented six per cent of the total waste generated. This hazardous waste comprised quarantine waste, contaminated soil, industrial waste and asbestos.”²

¹ The Basel Convention (and by extension the OECD Control System for recovery of hazardous wastes) uses a calendar year as the base period for reporting. This is in contrast to the financial year basis of Australia’s other waste data sets, such as the *Waste generation and resource recovery in Australia/Waste and Recycling in Australia* report series. It is not currently possible to produce six monthly hazardous waste data in order to align it with other national waste data, but this is being investigated as part of national hazardous waste reforms.

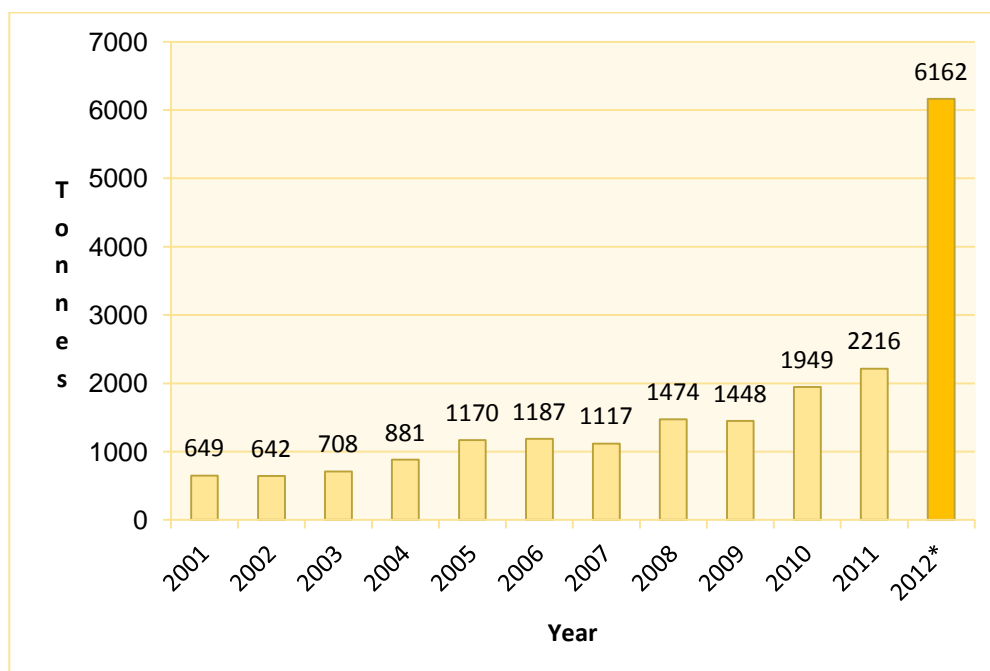
²<http://www.abs.gov.au/ausstats/abs@.nsf/Products/4602.0.55.005-2013-Main+Features-Hazardous+Waste?OpenDocument>

By 2013, investments to improve data, reporting and knowledge about hazardous wastes helped identify that hazardous waste amounts had been significantly under-estimated and under-reported, both domestically and to the Basel Convention. The 2011 calendar year data reported under the Basel Convention included 2.216 million tonnes of hazardous waste generation in Australia.

The most recent and best quality data available since the submission of the 2011 Basel report indicates that for 2010–11, Australia generated 6.162 million tonnes of hazardous waste (not counting hazardous materials in the municipal solid waste stream).³

Waste generation and resource recovery in Australia (2013) indicates that hazardous wastes represent 4.6 per cent of national (solid) waste generation. The more expansive [Hazardous Waste Data Summary](#) material suggests that hazardous wastes are likely to represent 8-12 per cent of national waste generation.

Figure 1 Australian hazardous waste generation as reported to the Basel Convention, 2011 (rounded to thousand tonnes)



*Note: The last column is coloured differently to indicate it is a break in series, drawing on a broader data set of hazardous waste arisings (*Hazardous Waste Data Summary*) than had previously been used for Basel reporting. Data points for 2001 to 2007 are taken from Figure 3.6 on page 175 of the *National Waste Report 2010*.

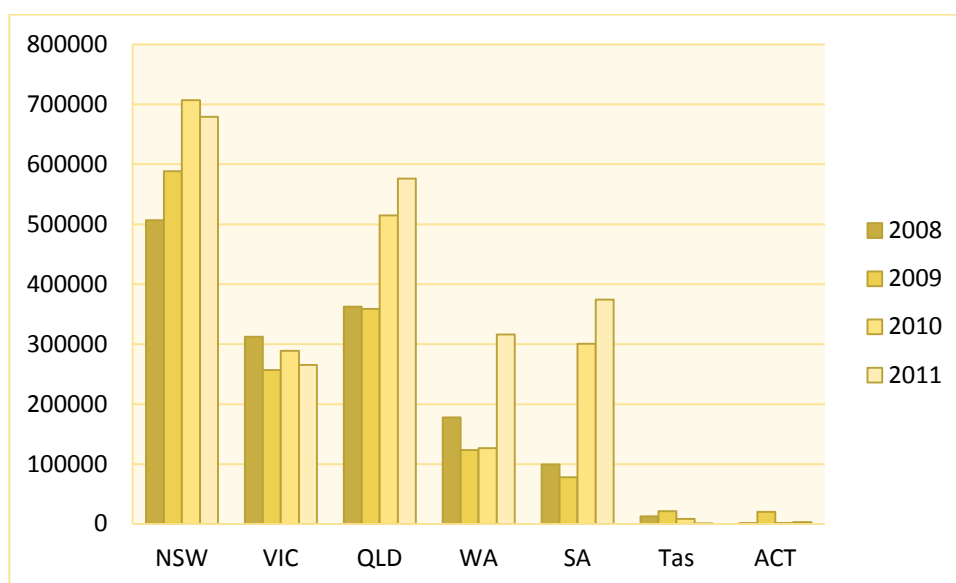
The *National Waste Report 2010* noted that, based on the figures for 2001 to 2007, the amount of hazardous waste generated appears to have doubled between 2001 and 2005 and then stabilised at about 1.1 million tonnes per annum. The data collected since 2007 indicates that hazardous waste generation has continued to experience strong growth, rather than stabilising, but it is likely that these amounts are still underestimating hazardous waste generation. For example, there are arisings and flows of hazardous waste that are not captured by current systems for tracking the movements of controlled waste.

Hazardous waste by jurisdiction

Figure 2 shows the amounts of hazardous waste (as reported to Basel) for the 2008 to 2011 calendar years. Data for the Northern Territory is not included.

³ KMH. *Hazardous Waste Data Summary*, p2.

Figure 2 Basel reported hazardous waste, 2008–2011, by jurisdiction (tonnes)



This figure illustrates recent growth in reported tonnages from South Australia, Western Australia and Queensland. NSW tonnages grew from 2008 to 2011, with a small decrease between 2010 and 2011. Victorian tonnages have declined since 2008.

The *Hazardous Waste Data Summary* provides the following breakdown by jurisdiction of hazardous wastes moved within and between states and territories.

Table 1 Revised (normalised) national hazardous waste data by jurisdiction, 2010–11

Jurisdiction	Hazardous waste generated (tonnes)		
	Intrastate	Sent interstate	Total from waste movements
Australian Capital Territory	6345	7325	13,670
New South Wales	1 641 853	0*	1 641 853
Northern Territory	35 300	5994	41 294
Queensland	1 759 040	6505	1 765 545
South Australia	596 015	5201	601 216
Tasmania	35 820	16 029	51 849
Victoria	1 330 445	43 725	1 374 170
Western Australia	664 168	8142	672 309
Total	6 068 986	92 921	6 161 907

*Data not provided

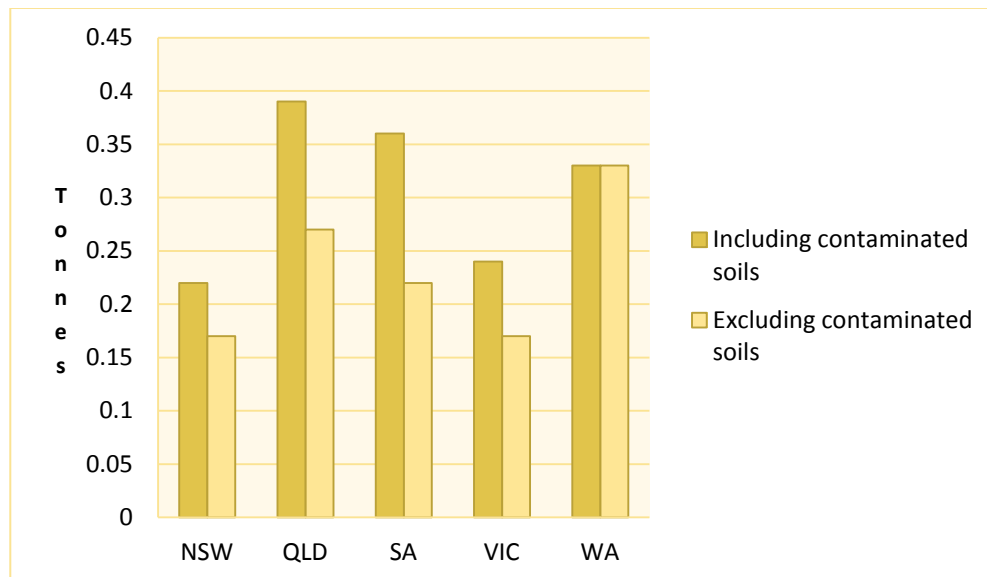
Per capita hazardous waste

Using the 2011 Census national population total of 21 507 717 people, and a reported hazardous waste generation figure of 6 161 906 tonnes, we can say that:

- Australia generated 287 kilograms of hazardous waste per person in 2010–11.
- This is an increase of 234 kilograms on the 53 kilograms of hazardous waste generation per person for the 2007 calendar year.⁴
- Australia's 2010–11 per capita hazardous waste generation is 53 per cent greater than the 188 kg per person average of the European Union (EU-27) for 2010.⁵

Per capita waste generation across Australia differs between jurisdictions. The *Hazardous Waste Data Summary* report found that WA was the jurisdiction generating the most hazardous wastes per capita when contaminated soils were excluded. Including contaminated soils made Queensland the highest generator per capita, followed by South Australia and then WA. It should be noted that asbestos data is not available from WA so this waste has not been included in these totals.

Figure 3 Per capita hazardous waste generation 2010–11, with and without contaminated soils



Hazardous waste and Australia's waste streams

Australia traditionally thinks of waste in three major streams: municipal solid waste (MSW), commercial and industrial (C&I) and construction and demolition (C&D) streams and then hazardous waste as a separate-order category outside these streams. The streams roughly correspond to sources and different markets and/or institutional and regulatory arrangements.

The MSW stream mainly comprises wastes produced by Australian households and some wastes from local government operations. Hazardous wastes are part of this waste stream, which is why household waste is considered a hazardous 'other waste' under the Basel Convention.

⁴ Based on the December 2007 ABS population estimate of 21,181,000 people and a hazardous waste generation figure for 2007 calendar year (*National Waste Report 2010* p175).

⁵ Eurostat http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Waste_statistics#Hazardous_waste_generation with specific data available from the waste statistics tables and figures excel file available for download from http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Waste_statistics#Further_Eurostat_information

The C&I waste stream comprises wastes produced by commercial and industrial facilities. This covers the bulk of industry sectors across the Australian economy, including both private and public sector activities. For example, both public and private sector health care facilities generate C&I waste, including hazardous clinical wastes. This stream contains more hazardous material as tonnage and percentage than the MSW stream, including some highly hazardous wastes from sectors involved in the manufacture and use of dangerous goods.

The third stream is C&D waste, comprising of large flows of some heavy materials (such as concrete and soil) and is mostly the product of a single industry in the economy. As well as C&D waste stream materials being heavy, they are often hazardous. This is the waste stream where much of Australia's asbestos waste and contaminated soils arise, is collected and managed. There is more hazardous waste by mass in the C&D stream than in the C&I stream, but the C&I stream has a wider range of different hazardous wastes and has some of the most hazardous e.g. toxic wastes.

Traditionally, hazardous wastes have been an anomaly in Australian waste data overall, and specifically in these three streams. Policy-making has often addressed hazardous and non-hazardous wastes separately. Targets are often set for the generic waste streams and for non-hazardous wastes, but only rarely for hazardous wastes. Data collection and reporting arrangements (often to deliver accountability against these policies and targets) tend to follow the focus on non-hazardous waste, excluding hazardous wastes from jurisdictional and national waste totals (such as total waste generated, recovered, recycled and disposed of to landfill) or totals by MSW, C&I and C&D waste streams, even where these wastes are produced by the same sites and activities that produce non-hazardous wastes.

Improvements made in overall waste data and knowledge of hazardous wastes will improve the accuracy of Australian waste reporting, by allocating hazardous waste amounts back to the waste streams in which they arise. Using the *Hazardous Waste Data Summary* and *Waste generation and resource recovery in Australia (WGRRIa)*, we have estimated a revised waste generation by stream which reflects higher hazardous waste figures.

Table 2 Illustrative estimates of waste streams including and excluding previously un-allocated hazardous wastes (2010-11)

	Waste generation data from WGRRIa*(tonnes)	Hazardous waste tonnage from <i>Hazardous Waste Data Summary</i>	WGRRIa data plus Hazardous Waste Data Summary data(tonnes)	Percentage of total waste generation excluding Hazardous Waste Data Summary data	Percentage of total waste generation including Hazardous Waste Data Summary data	Change in percentage of waste generation for waste stream by allocating revised hazardous waste
MSW	14 046 000	308 095.3	14 354 095.3	30	27	-3%
C&I	15 190 000	2 772 857.7	17 962 857.7	32	33	+1%
C&D	18 230 000	3 080 953	21 310 953	38	40	+2%
Total	47 466 000	6 161 906	53 627 906			

* Includes 2.35 Mt of hazardous waste

These estimates are provided for illustrative purposes only. They are produced by allocating the hazardous waste volumes within a total of 6 161 906 tonnes of hazardous waste to the streams MSW (5 per cent), C&I (45 per cent) and C&D (50 per cent). This assumes no prior allocation of post-treatment, previously-hazardous wastes to these three waste streams. This will mean some double-counting in these numbers (such as of hazardous wastes that are already, post-treatment, allocated as general waste to landfill), as well as hazardous waste already included within the WGGRiA data. There may also be some counter-vailing under-estimation due to values missing from the *Hazardous Waste Data Assessment*. Further work to correct for these factors would enable a more accurate estimate of total waste and waste per stream, including both hazardous and non-hazardous wastes.

Within these caveats, Table 2 indicates that improved hazardous waste data will increase Australia's national waste generation and change the relative significance of the three waste streams. Based on the notional split across streams indicated in Table 2, MSW is still important as a waste stream and offers opportunities for better recovery and recycling performance. However, the size and share of C&I and C&D as a proportion of the national waste challenge and opportunity increase once hazardous waste is included. For further discussion on Australia's waste streams, see:

- *National waste stream profile overview*
- *Municipal solid waste stream profile 2010–11 factsheet*
- *Commercial and industrial waste stream profile 2010–11 factsheet*
- *Construction and demolition waste stream profile 2010–11 factsheet*
- *Waste generation and resource recovery in Australia.*

Composition of Australia's hazardous waste

While, as discussed above, the amount of hazardous waste reported under Basel has historically been an under-reporting, these reports are useful for identifying the composition of Australia's hazardous waste.

The Basel Convention uses a series of 47 different 'Y-codes' to classify wastes by their hazardous properties or hazardous constituents. The first 45 of these codes have been the focus of Australian hazardous waste management, data and reporting. The Y46 and Y47 codes cover household wastes and residues from household waste incineration.

Of the Y1 to Y45 codes, around 95 per cent of the waste comes from just 11 Y-codes. These top Y codes, a description of each, average tonnage generated between 2008 and 2011, as well as the average share of Basel hazardous reported tonnage for each are provided in the table below.

Table 3 Major Y-codes (2008 to 2011, average tonnage & share)

Y code	Description	Avg tonnes	Avg % share
Y36 (asbestos)	Asbestos dust and fibres	352 647	19.91
Y9 (waste oil mixes)	Waste oils/water, hydrocarbons/water mixtures, emulsion	341 479	19.27
Y8 (waste mineral oils unfit for original use)	Waste mineral oils unfit for their originally intended use	275 329	15.54
Y35 (bases)	Basic solutions or bases in solid form	206 749	11.67
Y18 (residues from industrial waste disposal)	Residues arising from industrial waste disposal operations	186 210	10.51
Y34 (acids)	Acidic solutions or acids in solid form	72 185	4.07
Y31 (lead)	Lead; lead compounds	69 334	3.91
Y1 (clinical wastes)	Clinical wastes from medical care in hospitals, medical centres and clinics	58 143	3.28
Y12 (wastes from production of inks, dyes, paints etc)	Wastes from production of inks, dyes, pigments, paints, etc	51 287	2.89
Y23 (zinc)	Zinc compounds	36 973	2.09
Y24 (arsenic)	Arsenic; arsenic compounds	30 938	1.75
Other Y codes	Other	90 349	5.10

Note this does not include Annex II (Y46 & Y47) wastes

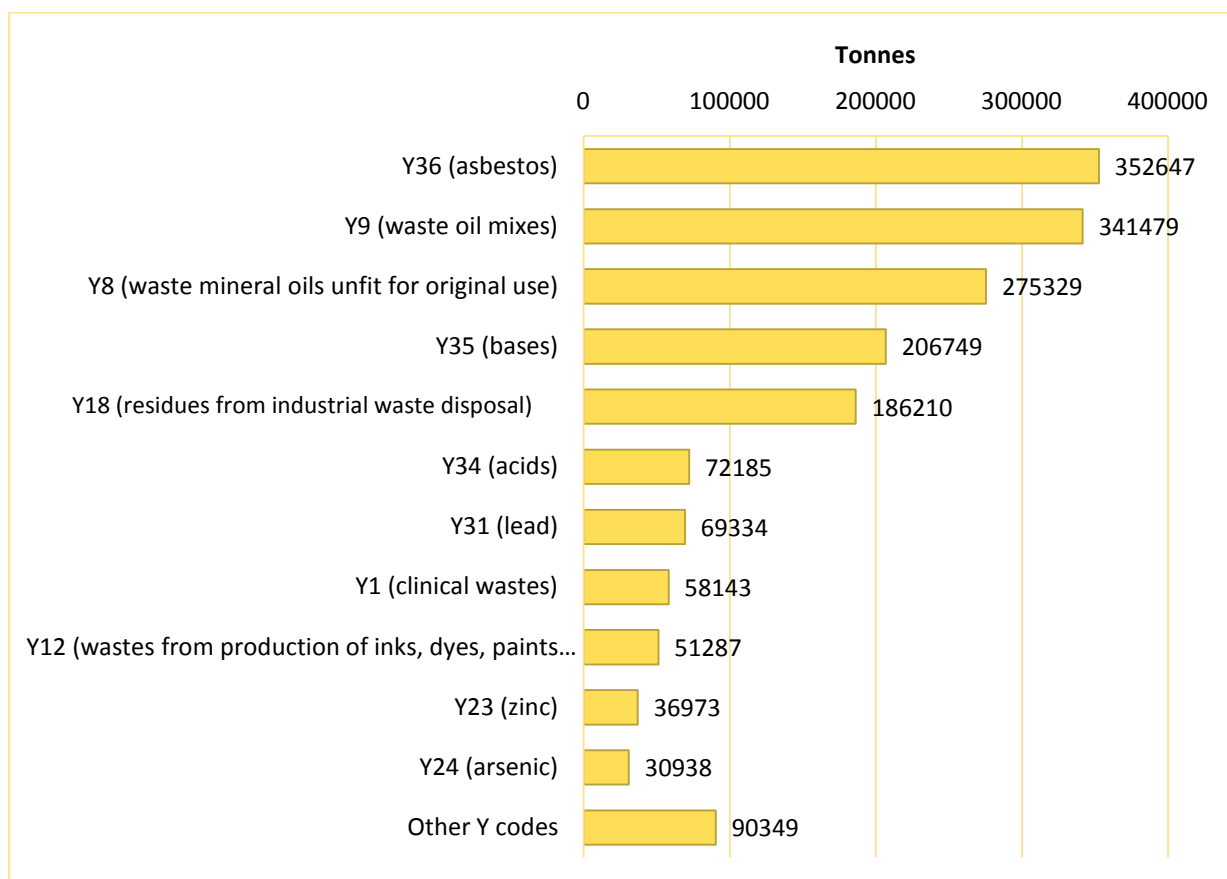
The leading component of Australia's reported Basel tonnage is asbestos dust and fibres. On average, 352 647 tonnes of asbestos waste arose each year between 2008 and 2011. This was 20 per cent of reported hazardous wastes, but is likely to be an underestimate as not all jurisdictions have systems in place to track, collect data and report on asbestos waste. Asbestos is often mixed with soils or with C&D wastes, contributing to the large mass of waste classified as asbestos waste.

The two Y codes that produce the next highest component of hazardous waste reported to the Basel Convention relate to oil and petroleum products. Waste oil mixes and waste mineral oils unfit for their original use amounted to 616 808 tonnes on average across 2008 to 2011, or 35 per cent of Basel-reported hazardous wastes. These wastes can be in solid, liquid or sludge forms and pose significant risks including of fire and contamination of drinking water. Y9 (waste oil mixes) have increased by 34 per cent in the 2008–2011 period.

Basic solutions or bases in solid form make up a little under 12 per cent of Basel waste and acids a further four per cent. Some of these wastes may be subject to applications for export and treatment overseas, such as spent sulphuric acid. Some of these wastes can be recycled and returned to use (such as with acid regeneration) but they are often sent to treatment, neutralised and their solid residues sent to landfill for final disposal.

A little over 10.5 per cent of Basel reported hazardous wastes are classified under the Y18 code for residues from industrial waste disposal. These wastes may arise when, for example, an industrial waste treatment facility produces a hazardous residue from the treatment of other wastes. This waste stream is concentrated at a relatively small number of industrial waste treatment sites and could represent a significant opportunity for improved landfill diversion of hazardous wastes.

Figure 4 Major Y-code hazardous wastes (2008 to 2011 average tonnage)



As Figure 4 indicates, the remaining five Y codes in the top 11 are: lead, clinical wastes, wastes from the manufacture of products such as inks, dyes and paints, zinc wastes and arsenic wastes. Manufacturing and mineral processing activities are significant sources of some of these wastes, while clinical wastes are mainly from the health services sector.

Liquid hazardous waste

The top 11 Y codes reported to Basel include large amounts of hazardous wastes that are in liquid form. Liquid waste was recognised during the development of the *National Waste Report 2010* and the National Waste Policy as an area lacking in good data and clear understanding.

The scope of the policy and this report covers liquid, solid and gaseous wastes, so in 2010 work commenced on the first national baseline set of liquid waste data. This was published in 2011 as the [Liquid Waste Assessment](#) and provides descriptions of, and baseline data for, the various flows of liquid waste in Australia. Crucially, both hazardous and non-hazardous liquid wastes are covered in the assessment.

A key finding of the assessment was that liquid waste flows are likely to be an important component of waste flows overall, and hazardous waste in particular. The historical focus on non-hazardous wastes and solid wastes means that liquid hazardous wastes may not be incorporated in key waste policies, programs and data sets.

While accurate data on specific flows of particular liquid hazardous wastes, by NEPM or Basel waste type, into and out of specific facilities is not yet available, the *Liquid Waste Assessment* provides a baseline for further investigation.

For further discussion of liquid waste see the [Liquid Waste Assessment](#).

Hazardous waste from Australian households

The Basel Convention considers mixed household waste to be a hazardous 'other waste' due to it containing hazardous substances. Households can generate hazardous wastes in many ways. Home renovation projects can produce asbestos wastes, as well as left over paints, oils and solvents. Equipment and appliances can contain hazardous substances (for example electronic waste) or specific hazardous components, such as some types of batteries. Waste household and garden chemicals and their containers require disposal. In-home care can produce hazardous clinical wastes. When these substances are mixed into the rest of the MSW stream, they can contaminate those other materials, reducing capacity to achieve safe handling and efficient recovery of resources.

The *Hazardous Waste Data Assessment* project attempted to estimate the component of the municipal waste stream that is actually hazardous. In 2010–11, an estimated 301 836 tonnes of hazardous waste was generated inside the MSW stream. If this was added to the amounts of hazardous waste generated out of the C&I and C&D waste streams, it would lift total Australian hazardous waste generation from 6 161 906 tonnes to 6 463 743 tonnes for the 2010–11 year.⁶

There are a range of options and approaches available for the recovery, recycling or safe disposal of household hazardous wastes. Many Australian councils offer a periodic collection of unwanted household hazardous wastes at a council site or transfer station. The national TV and Computer Recycling Scheme is now in place to collect and recycle televisions, computers and computer peripherals at end-of-life. The Product Stewardship for Oil Program collects waste oil. The national Return of Unwanted Medicines scheme allows free takeback of old, out of date, damaged or unwanted medicines at pharmacies across Australia. Some types of batteries can be returned to battery retailers or participating supermarkets for recovery and recycling. Limited drop-off or takeback schemes are in place in some parts of the country for paints and other materials.

A key issue for these arrangements is that the overall flow of hazardous household materials and substances is not well understood, especially at a national scale. The majority of hazardous wastes produced by households arise from products that are traded in national and international markets. To understand the extent of appropriate disposal of these chemicals at end of life requires an understanding of the total market which includes the purchase, use and final destination of these products.

Waste audits at kerbside and at final disposal indicate that these hazardous wastes are present in mixed wastes destined for recovery, recycling and landfill disposal, rather than being separated from non-hazardous household wastes.⁷ Improving the source separation of household hazardous wastes, which can then improve the quality and performance of recovery and recycling through reduced contamination, is an ongoing challenge.

Asbestos waste in Australia

Asbestos is one of the largest flows of hazardous waste in Australia and poses significant health risks. Since the first National Waste Report, some significant changes have taken place with regards to managing asbestos.

The Australian Parliament passed legislation in June 2013 to establish an independent statutory authority, the Asbestos Safety and Eradication Agency (the Agency). The Agency began operations on 1 July 2013 and will provide a focus on issues which go beyond work health and safety to encompass transport, environmental (including storage and disposal) and public health issues and ensure asbestos issues receive the attention and focus needed to drive change across all levels of government.

⁶ *Hazardous Waste Data Summary*, p2.

⁷ Council kerbside waste audits routinely identify between 0.2 and 1% of waste in the landfill bin as being actually hazardous.

The broad functions of the Agency include advocating, coordinating, monitoring and reporting on the implementation of the *National Strategic Plan for Asbestos Awareness and Management* (Plan) which has been developed in consultation with Commonwealth, state and territory and local governments and a range of non-governmental stakeholders. The Plan can be found on the Agency's website at: www.asbestossafety.gov.au.

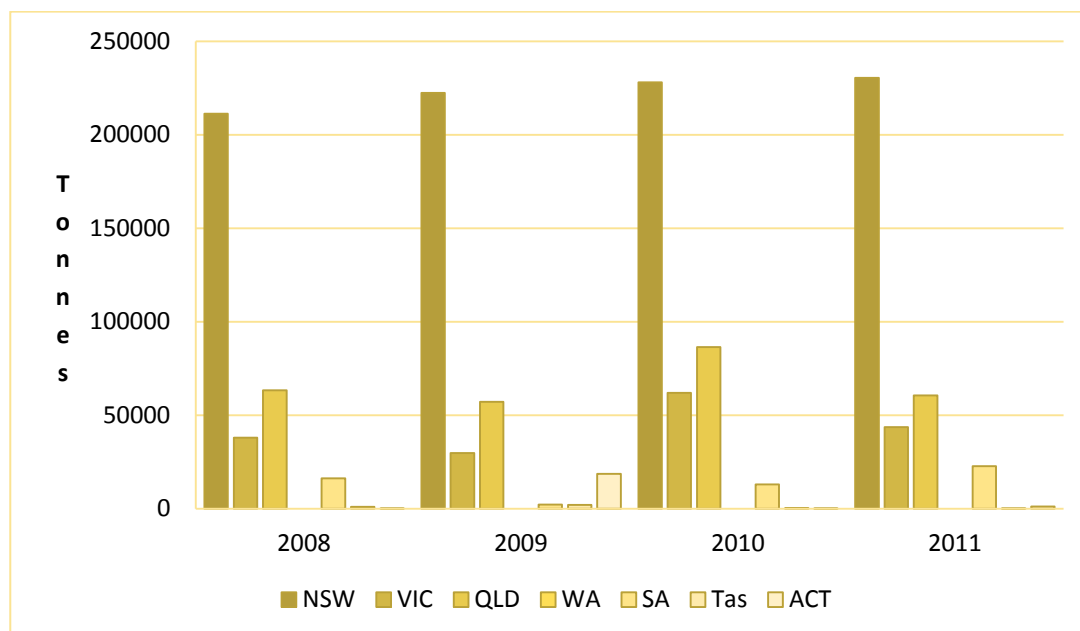
Prior to the operation of the Agency, there has been data on asbestos wastes reported under the code Y36 Asbestos (dust and fibres) to the Basel Convention. Across 2008 to 2011, reported tonnages for asbestos wastes were as follows:

Table 4 Asbestos waste generation reported to Basel, by jurisdiction (tonnes, 2008 to 2011)

	2008	2009	2010	2011
NSW	211 184	222 299	227 936	230 443
VIC	37 960	29 868	62 042	43 606
QLD	63 265	57 145	86 471	60 670
WA	0*	0*	0*	0*
SA	16 221	2174	13 009	22 779
Tas	1009	2023	332	171
ACT	24	18 661	170	1126
Total	329 663	332 171	389 960	358 795

* No WA asbestos data was available.

Figure 5 Asbestos waste reported under Basel Y-code Y36 Asbestos (dust and fibres), 2008 to 2011, by jurisdiction (tonnes)



This figure shows that there is significant variation in data on asbestos tonnages both between the jurisdictions and between years for the same jurisdiction, with the exception of NSW. NSW data on asbestos is relatively consistent, year to year.

For more information on asbestos see www.asbestossafety.gov.au.

Contaminated soils

Contaminated soils are a major component of Australia's hazardous waste flows. Soils can be contaminated with a single product or hazardous substance (such as a spill of fuel or oil) or can have multiple contaminants. For example, a site with a long history of mixed commercial and industrial use may have accumulated multiple heavy metal contaminants, fuel and oil spills, asbestos and particular chemical wastes. The costs of treatment and disposal are higher where there is a complex of contaminants and the opportunities for waste reuse are constrained.

Contaminated soils can arise in very large amounts which may have a major impact on waste tonnages at disposal. There are also significant transport costs associated with their weight. While there is some irregularity in the volumes of contaminated soils arising as wastes in particular places at particular times, there is also a predictability about these wastes. Major development on contaminated sites in the inner city or industrial areas produce contaminated soil wastes that require appropriate handling and disposal. For example, major construction projects at contaminated sites in Adelaide and Canberra in recent years produced such large amounts of contaminated soil wastes that there was a discernible effect on the overall waste and recycling data for those jurisdictions.

A common pathway for contaminated soils is direct to landfill. The level and nature of contamination will determine the class of landfill to which they may be directed. Where treatment options exist, contaminated soil may go through one or more of the following treatment processes:

- physical (e.g. grinding, screening)
- chemical (e.g. adjustments to acidity or alkalinity)
- thermal (drying and heating to degrade particular chemical contaminants)
- or biological (e.g. phytoremediation where plants are used to contain, treat or remove the contaminants).

Sometimes the treatment is able to restore the soil to a point where it is no longer considered hazardous.⁸ At other times, the degree of hazard or risk may have been reduced, enabling further recovery effort or disposal at a cheaper, less hazardous, landfill site. This treatment may include fixing or stabilising the hazardous substance so it is less at risk of being emitted to air, land or water.

The *Hazardous Waste Data Summary* estimates the amount of contaminated soil wastes generated in Australia in 2010–11. In this data set, a total of 1 718 890 tonnes of contaminated soil was generated in NSW, QLD, SA, VIC and WA, with 4.28 per cent of this being recovered and the rest disposed of to landfill. This data has contaminated soils as 28 per cent of the total hazardous waste generated across those five jurisdictions.

⁸ This issue, of treatment being both a phase in the lifecycle of hazardous wastes, and a point where waste may no longer be hazardous, causes significant challenges for waste data and reporting methods. Wastes starting out as hazardous, and assigned to that material category, can be transformed into non-hazardous materials before they meet their final recovery or disposal fate. Simply adding recovery (recycling + energy recovery + waste reuse) to landfill disposal to get a waste generation total may not be the best method for hazardous wastes. It is important that this aspect is reflected in data collection, such that contaminated soil is not assumed to solely end up in landfill.

New hazardous waste infrastructure for contaminated soils – Renex

In September 2012, work commenced on a new facility for treating hazardous wastes, particularly contaminated soils, at Dandenong South in Victoria. Being built by Renex, the new facility will be completed in 2014.

The facility has a focus on receiving and processing soils contaminated with a variety of substances and wastes (such as waste oils or polychlorinated biphenyls, PCBs, used in industrial and commercial applications including as insulators or coolants) as well as some liquid hazardous wastes. The key process is thermal treatment, heating the wastes (such as contaminated soils) in a large dryer, then a rotary kiln, before waste gases are sent for destruction in a combustion chamber. The process recovers energy for further use and will produce decontaminated outputs such as soils suitable for use as fill.

The facility began to receive soil in September 2013 and will start the treatment process between March and June of 2014.

Hazardous waste infrastructure in Australia

Generation and transport

To understand hazardous waste infrastructure it can be useful to think of the hazardous waste lifecycle. Where hazardous waste is produced in a commercial or industrial process, there will be some infrastructure involved in the original generation of the hazardous waste, e.g. a factory and a bonded storage area for used acid. Transport infrastructure and facilities for receiving, aggregating and storing the waste infrastructure will be involved when the waste is sent away for treatment, recovery, recycling or disposal.

Treatment, storage and disposal

Waste may be processed in Australia or overseas in plants which can use a wide range of technologies, from simple pH correction through to complex thermal treatments, designed to reduce the hazard and risk associated with the waste. The result can be outputs suited for recovery, recycling or safe disposal to landfill. Some of these outputs can then be blended into other products or media for further use.

Some hazardous wastes, such as asbestos, may not be able to be recovered or recycled in Australia and are destined for landfill disposal. These wastes may still need intervening infrastructure before they arrive at a place of final disposal. In the case of asbestos, for example, landfills or transfer stations which also handle non-hazardous wastes can be points of receipt and safe storage before subsequent disposal in an appropriate landfill.

Occasionally, hazardous wastes may bypass the treatment, recovery and recycling infrastructure and proceed straight to a place of final disposal.

As the above picture illustrates, hazardous waste infrastructure in Australia is both specific-purpose (only handling hazardous waste) and multi-purpose (able to handle hazardous and non-hazardous waste). The multi-purpose infrastructure is often crucial for the safe, efficient, and environmentally sound management of hazardous wastes such as waste oils, chemicals and asbestos. Given the difficulty of negotiating planning approval processes for dedicated hazardous waste infrastructure, the availability of multi-purpose waste infrastructure is crucial for the appropriate management of hazardous wastes.

A recent study⁹ reviewed the domestic availability and capacity of infrastructure for some types of hazardous waste that may potentially be exported to offshore recovery operations. The waste types considered included lead (particularly from used lead acid batteries), cathode ray tube glass, spent sulphuric acid and aluminium pot liners.

The study found that the domestic hazardous waste processing industry had¹⁰:

- limited economic scale (particularly for used lead acid batteries, cathode ray tube glass and sulphuric acid regeneration), leading to higher unit costs compared to offshore competitors.
- constrained domestic market opportunities for the processed waste (used lead acid batteries, cathode ray tube glass and spent pot linings).
- high domestic transport costs, due to controlled waste regulatory requirements (whole tube cathode ray tube glass), distances and lack of density on many routes.
- responsiveness with investment in regards to relevant trends in world commodity markets (such as with used lead acid batteries).

Geoscience Australia has developed a database and map of waste-related infrastructure, (see: www.ga.gov.au) and the spatial data is available as a map layer in the interactive mapping. However, while the dataset contains some of Australia's specific-purpose and multi-purpose hazardous waste infrastructure, it is not currently possible for data users to extract and map just the infrastructure pertinent to hazardous waste or to find out where the nearest infrastructure for handling particular types of hazardous wastes is located.

Work is expected to commence in early 2014 on the development of a baseline data set for Australia's specific-purpose and dual-purpose hazardous waste infrastructure to gain a better understanding of the overall capacity of Australian hazardous waste infrastructure.

For more information on waste infrastructure see:

- Australia's waste management and resource recovery infrastructure overview
- Australia's waste management and resource recovery infrastructure factsheet
- interactive mapping tool.

Pathways and fates for Australian hazardous wastes

Australia does not have robust, current, national data about pathways and fates met for hazardous waste arisings. There may be a variety of possible fates for hazardous wastes as illustrated by the used lead acid batteries example in Table 5.

⁹ GHD 2013, *Cost-benefit analysis of possible changes to export provisions favouring domestic hazardous waste treatment*, unpublished.

¹⁰ Ibid.

Table 5 Recovery and other outcomes for used lead acid batteries arisings

Fate of used lead acid batteries arisings	Australia (2010)		Western Australia (2012)	
	Tonnage	Per cent	Tonnage	Per cent
Reprocessed in Australia	100 750	75	8889	53
Legal export	300	..		
Landfill	11 374	8	1138	7
Stockpiled formal	6500	5	2197	13
Stockpiled informal	5820	4	936	6
Rebirth	2055	2	730	4
Illegal export	8150	6	2928	17
TOTAL	134 949	100	16 821	100

Sources: GHD 2013, Warnken ISE 2010, 2012.

As the example indicates, there are a range of pathways and fates for Australian hazardous wastes. Most of these are within Australia, as only a very small proportion of Australian hazardous waste is exported for treatment and recovery.

Data available on the recovery of hazardous wastes is mostly collected via surveys of recovery and recycling services providers. While waste reuse fates exist for hazardous wastes, these are poorly served by current data arrangements, so cannot easily be included in overall recovery data.

Legal exports are covered by Australia's Basel Convention and OECD Control System arrangements for hazardous waste import, export and transit permitting. Some data is available here, but only on the maximum amounts of waste that *could* be exported over the lifetime of the permit - usually 12 months - with little to no data available on the *actual* amounts exported.

Hazardous waste flows to landfill disposal are the best understood of hazardous waste fates in Australia. This is mostly due to the regulation of landfills and the mandatory data collection and reporting arrangements in place to support state and territory waste levies.

Informal stockpiles of hazardous waste are common, both within and without Australian cities but information on these is limited. Some common types of these informal stockpiles include waste chemicals stored in sheds on farms or dumped piles of mixed C&D waste that contain asbestos. Some of these informal stockpiles are prohibited by regulation such as illegal stores of mixed C&D waste containing asbestos and are a focus for hazardous waste compliance and enforcement efforts. Other informal hazardous waste stockpiles, such as on-farm stores of waste chemicals, are less directly regulated but may have voluntary programs available to assist in the collection and safe disposal of these wastes, for instance ChemClear.

Formal stockpiles of hazardous waste are better understood as environmental approvals and licence conditions for hazardous waste storage, treatment, recovery and disposal facilities will usually specify stockpile conditions and limits.

In most jurisdictions, regulators can ask licensed facilities to supply periodic data on the size, composition, condition, age, specific location and storage circumstances of hazardous waste stockpiles. In practice, these powers to require the provision of information about stockpiles are not used on a regular basis to produce annual, jurisdiction-wide data on hazardous waste stockpiles. Little to no data on hazardous waste stockpiles is released into the public domain for community or market users, with notable exceptions being where facilities have periodic public reporting as part of a consent condition or agreement with local communities.

Table 5 also illustrates that national-scale data on hazardous waste pathways and fates may not tell the story for all parts of Australia. Western Australia, with its different geography and markets, produces a set of pathways and fates different to national totals. In this case, reprocessing of WA batteries in Australia is 53 per cent compared to a national average of 75 per cent. Used lead acid batteries are significantly more likely to go to formal stockpiles or illegal export in Western Australia, reflecting the distance from, and cost to, reach domestic reprocessing facilities.

Imports and exports of hazardous wastes

Australia has obligations, including those under the Basel Convention, to ensure international movements of hazardous wastes are minimised and those that do occur do so safely, and in environmentally sound fashion. The *Hazardous Waste (Regulation of Exports and Imports) Act 1989* and associated regulations make up part of Australia's systems for managing international movements of hazardous wastes into, out of and through the country.

Only small amounts of Australian hazardous wastes move across international borders. In 2007, exports and imports together made up 2.7 per cent of Australian hazardous waste generation. In 2011, of the 2 215 510 tonnes of generated hazardous waste reported to Basel, 44 925.3 tonnes were imports and exports (two per cent of reported generation). Permitted exports in 2011 were up to 40 310 tonnes and permitted imports up to 4 615.3 tonnes. This is a change of an additional 11 070 tonnes exported (up 38 per cent) and 3 722.3 tonnes imported (up more than four times) on the 2007 data reported in the *National Waste Report 2010*.¹¹ Using the *Hazardous Waste Data Summary* figure of 6 161 906 tonnes, permitted exports and imports were up to 0.7 per cent of hazardous waste generation.

Examples of hazardous wastes that may be subject to import, export or transit are listed in Table 6 below.

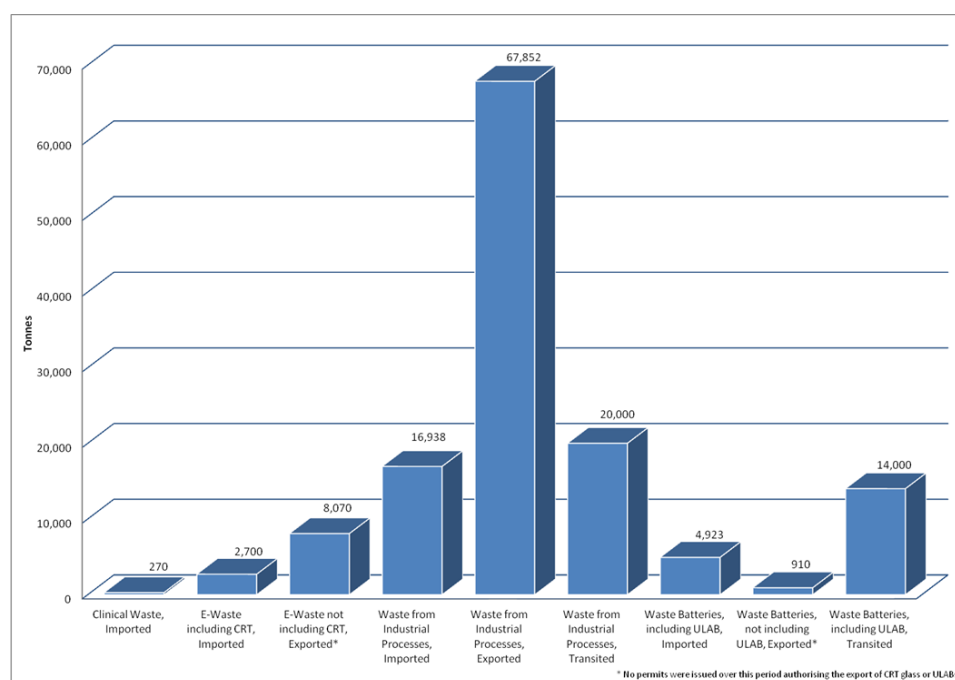
¹¹There were 29 240 tonnes exported and 893 tonnes imported in 2007 (*National Waste Report 2010*, 178). It is likely that total imports and exports of hazardous waste are even less of a proportion of total hazardous waste flows in Australia than indicated by Basel data. This is because the permitting-related numbers used by Australia in reports are for *potential* exports, transits or imports (i.e. the limit of tonnage under a permit), rather than the actual mass moved under a permit. Actual data is not available.

Table 6 Examples of hazardous wastes proposed for import, export or transit

	Import	Export	Transit
For recycling	Crushed waste lamps containing mercury Zinc ash Waste batteries Used oil	Spent 'pot linings' from aluminium smelting Spent catalyst from oil refining Waste batteries Waste glass from cathode ray tubes Electronic waste	Used lead acid batteries
For final disposal	Capacitors contaminated with PCBs Household waste from Antarctica (non-Australian territory) Clinical waste	Waste zinc ashes and residues	Waste pesticides

By weight, most hazardous wastes authorised for export, import or transit are industrial wastes, such as spent pot linings from aluminium smelting (see Figure 6).

Figure 6 Authorised movements of hazardous waste, 2009–10 to 2011–12



Most exports of hazardous waste from Australia are sent to OECD member countries, such as the Republic of Korea, which have the appropriate infrastructure and markets for recovery of resources from hazardous wastes, as well as ensuring the appropriate disposal of any hazardous residues remaining after recovery. From time to time, small amounts of hazardous wastes may be exported to non-OECD member countries such as Singapore.

Little is known about possible unauthorised movements of hazardous wastes out of Australia for which a permit may be required but not obtained. These include:

- used oil
- second-hand goods, particularly used electrical and electronic equipment
- batteries (used lead acid batteries and mixtures of battery types).

Some current exporters of these wastes may be unaware of the need to secure a permit prior to export, or may be unwilling to meet the requirements of the permitting process.

Improving our knowledge of hazardous wastes and their management

Under the National Waste Policy, there has been substantial investment in improving overall knowledge about waste, as well as hazardous wastes specifically. Some of the consequences of this improved knowledge include understanding that:

- there is more hazardous waste arising and moving within Australia than previously acknowledged and reported.
- as well as leading to more waste in total, these additional volumes mean hazardous waste is now a greater percentage of total waste.
- movements of hazardous wastes within a single jurisdiction, without crossing a state or national border, have significant gaps in coverage.
- better accounting of hazardous wastes and attribution of hazardous waste amounts to their sources in the MSW, C&I and C&D streams changes some of our current understanding of the relative significance, performance and opportunities in those waste streams.
- some wastes, including wastes with large quantities and significant hazards or risks (such as asbestos wastes and contaminated soils) are least-well-served by current tracking, data collection and reporting arrangements.

Future challenge case study – persistent organic pollutants and waste

Wastes that contain Persistent Organic Pollutants (POPs) are likely to present future challenges both in terms of (a) the quantity and volume of material that will need to be separated and treated and (b) the specialised treatment capability required to destroy or manage such wastes. There are several brominated flame retardants that are widely used in articles in Australia that have either already been listed in the Stockholm Convention [commercial pentabromodiphenyl ether, commercial octabromodiphenyl ether and hexabromocyclododecane (HBCD)] or that are proposed for listing in the Convention (e.g. decabromodiphenyl ether). The POP hexabromocyclododecane (HBCD) which was listed in the Stockholm Convention in 2013 illustrates the challenge that Australia will face from waste articles containing POPs from the perspectives of toxicity, persistence, the volume and quantity of the waste generated that contains the POPs that will need to be carefully managed and the potential for such wastes to contaminate otherwise valuable waste streams.

HBCD is added to different types of products including extruded and expanded polystyrene foam building products. The life expectancy of products containing HBCD is the same as that of buildings – between 30 and 50 years. As these products were first used in the Australian construction industry in the 1960s, most are still in use and will present in the C&D, C&I and possibly the municipal waste streams into the foreseeable future. The total quantity of HBCD imported into Australia between 2003-04 and 2009-10 (seven years) was about 460 tonnes or 66 tonnes per year. Assuming that HBCD is present in products at around 1 per cent, this equates in volume to approximately 500,000 m³ or 200 Olympic swimming pools of HBCD containing product that has been incorporated into our buildings each year and which will eventually present in waste streams.

This example, which focuses on just one POP, conveys an insight into the extent of the POPs waste problem that will need to be managed into the foreseeable future. The potential listing of further POPs contained in products used in the Australian economy will further strengthen the need for increased domestic capacity to manage hazardous waste.

Note: Differences between hazardous waste data sets

There are four key hazardous waste data sets for the National Waste Report 2013, with some further supplementary sources, including reports such as the *Liquid Waste Assessment*. The four main data sources on hazardous waste for the NWR are:

- Hazardous Waste Data Assessment
- *Waste generation and resource recovery in Australia* (2013)
- Australia's *Basel Convention reporting data* (in national aggregation and jurisdictional component data)
- Movement of Controlled Waste NEPM data from the *National Environment Protection Council Annual Report*

A key issue for the NWR is that these data sets on the generation, flows and fates of hazardous waste in Australia do not align. *Waste generation and resource recovery in Australia* reports a total of around 2.39 million tonnes of hazardous waste generation in Australia in 2010-11. The Hazardous Waste Data Summary has Australian hazardous waste generation at over 6 million tonnes. Basel data (which is by calendar year, not financial year) has 2 215 510 tonnes for 2011. Controlled Waste NEPM data for 2010-11 has 178 588 tonnes of hazardous waste.

So why do these figures differ so much? The Controlled Waste NEPM is meant to capture and report on amounts of controlled (hazardous) wastes crossing Australia's internal borders. This data does not, therefore, include all those amounts of hazardous waste that arise, move and are disposed of within a single state or territory. Some of these wastes, such as contaminated soils and asbestos, can represent large amounts. In addition, the NEPM relies on data collected by state and territory waste tracking systems. Hazardous wastes that are exempt from waste tracking systems may then not be included in the data reported under the Controlled Waste NEPM.

Basel Convention annual reporting data is compiled in a somewhat different way to Controlled Waste NEPM data. The Basel total for 2011 of 2.2 million tonnes of hazardous waste was produced by aggregating data provided to the Commonwealth by each state and territory. Basel reporting is meant to capture all hazardous waste flows, including those that stay within a single jurisdiction. Again, tracking systems provide the key inputs, but other parallel or shadow systems are also used, where these exist, and for whatever types of hazardous waste they cover. As a result, this reporting picks up some (but not all) arisings of hazardous waste.

Some of the key gaps in Australia's Basel Convention data reporting are:

- Hazardous wastes not covered by formal tracking systems or parallel systems
- Contaminated soils wastes
- Wastes treated and disposed of onsite, including some hazardous mining wastes
- 'Other wastes' (incineration residues and mixed wastes from households)
- Actions and results of actions undertaken to avoid or minimise the generation of hazardous waste.

Waste generation and resource recovery in Australia and the previous volumes in this series (formerly called *Waste and Recycling in Australia*) approach hazardous waste via a set of 'material categories' that differ from the NEPM's 75 categories in total or 15 summary categories and the 47 Y codes of Basel reporting. The categories of 'industrial waste', 'quarantine waste', 'contaminated soil' and 'asbestos' are used to come up with a hazardous waste total, but this excludes liquid hazardous wastes. Any hazardous waste that does not fit these categories, or the other requirements (such as being solid waste, not coming from the core processes of primary production, etc) is not reported in the final data set.

Waste generation and resource recovery in Australia data is reported directly to the project team by the states. This means that if there is missing data (such as for hazardous waste moving intrastate and not to landfill), no adjustment or estimation is made. Similarly, large volumes of contaminated soil that are not tracked as hazardous waste within a jurisdiction are not estimated.

What is reported in the *Hazardous Waste Data Summary* report is the current best estimate of hazardous waste generation in Australia. It takes a deliberately expansive approach, drawing on both directly-reported data and proxy data or estimations and projections to cover gaps in current data. Crucially, it covers hazardous wastes in liquid solid and sludge forms, as well as wastes that move within and between states and territories. Contaminated soils are included in the analysis and the data, as these are key types of hazardous waste in terms of scale, ubiquity and risk.