Implications of legal frameworks on construction and demolition waste recycling – a comparative study of the German and Australian systems

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Abstract -

This comparative study between German and Australian legislation demonstrates that legal frameworks impact on the way in which recycling systems work. Both Australia and Germany operate as Federations and the autonomy of states influences common federation wide practices and standards. In Germany's case however, it is obliged to comply with European Union guidelines which result in German federal legislation being binding for all German states and to common industry practices across all of Germany. Purely industry regulated systems are not always sufficient to cater for societal and environmental needs, and political intervention can sometimes be necessary to achieve desired outcomes. The construction and demolition (C&D) waste recycling industry is a good example. In Australia C&D waste recycling is mostly industry regulated, while the state has greater influence in Germany. A statistical analysis illustrates legislative impact on recycling outcomes. Nonetheless, any legislative efforts can also have effects contrary to the intended ones. A study of such cases is conducted and other influencing factors also considered. In conclusion, the study outlines the importance of interstate coordination and regulation; and the need for the incorporation of industry requirements and other potentially influencing factors into the legal frameworks in order to meet desired outcomes.

Keywords -

Construction and Demolition (C&D) waste; recycling; legislation; Australia; Germany

1 Introduction

The intense activity in the construction sector during the last decades worldwide has generated huge amounts of construction and demolition (C&D) waste. C&D waste includes a wide range of mostly inert materials, such as: maintenance materials, road construction and excavation materials; but can also contain hazardous waste types such as asbestos, PCBs or PAHs, which can be present in significant proportions when buildings are renovated or demolished.

It can be assumed that the differences in the amount of C&D waste between different countries derive from the: differences in building tradition; poor quality of available data; unequal levels of control and reporting of C&D waste in States; legislative systems; and differences in definitions [1].

In an attempt to correct the serious effects which the C&D waste can have on the environment, important developments have been incorporated into International and European laws, which aim to promote the culture of reuse and recycling [2]. Furthermore the recovery of waste is an opportunity for the protection of the environment. It mitigates climate change by saving energy during the material recovery, conserving natural resources by substitution and preventing illegal dumping. For example in the Sydney basin, there is a need to substitute virgin sand by other materials in the process of concrete production due to a now limited availability. The recycling and processing of C&D waste to substitute natural sand has been found to be a suitable alternative.

The following paper reports on a comparative study between the Australian and the German legislative systems and their effects on recycling rates and conservation of resources and embodied energy.

2 Objects of investigation

Australia and Germany are both well developed countries. Nonetheless, there are differences between the two in the field of waste management. Table 1 and Table 2 gives an overview of the stages of development of both countries. Since Australia and Germany have very similar human development index and gross domestic product (GDP) values [3], their stages of development are comparable. However, there is a considerable gap between the two countries' waste recycling outcomes, particularly with regard to C&D waste recycling, although comparable recycling technologies are used. For the same time period in Germany 88 percent of C&D waste was recovered and reused in further applications or recycled, whereas in Australia this was only the case for 55 percent [4]. It is noticeable that Germany, in contrast to Australia, has adequate natural resources such as construction sand available within feasible transportation limits.

Table 1 Country Data of Australia 2008-2012 [3, 4]

Attribute	Data
Population (Mill.)	22.919
Population urban (%)	89.4
Human Development Index [0-1]	0.938
GDP per capita (US $)	34,548
Carbon dioxide emissions per capita (tonnes)	18.6
C&D waste (Mill. tonnes)	19.00
C&D waste per capita (tonnes)	1.206
C&D waste recovery rate	55.26

Table 2 Country Data of Germany 2008-2012 [3, 4]

Attribute	Data
Population (Mill.)	81.991
Population urban (%)	74.1
Human Development Index [0-1]	0.920
GDP per capita (US $)	34,437
Carbon dioxide emissions per capita (tonnes)	9.6
C&D waste (Mill. tonnes)	201.47
C&D waste per capita (tonnes)	2.457
C&D waste recovery rate	88.00

The study presented in this paper investigates the impact of different legislative systems on C&D waste recycling rates. It will also consider how far international and national legislation applies to the national recycling system(s).

As a general measure, the recycling system is divided into three stages. The first stage represents the collection and salvaging operations of C&D waste. The second stage focuses on the C&D waste treatment, whereas the third stage includes products, applications and disposal. The simplified recycling system model is illustrated in figure 1.

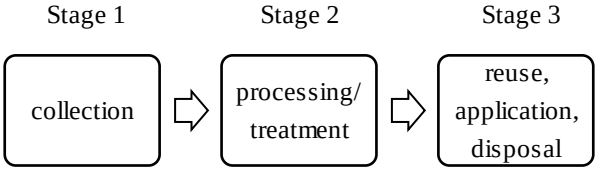

Figure 1 Simplified recycling system model

3 Australian & German legislation

3.1 Germany

Construction and demolition waste management in Germany is a mature and well integrated sub industry within the broader German construction market.

In 2011, German construction and demolition activity generated 201.47 Megatons of waste, which is composed of two thirds of excavation material, approximately one third of building and road demolition waste, and a smaller fraction of 2 percent of mixed construction site waste. Despite these large amounts of waste, only 12 percent of this material was disposed of in landfills, while the remaining 88 percent was recovered and reused in further applications or recycled [5]. In Germany, C&D waste is normally collected source-segregated as a result of selective demolition. The separation of materials at the demolition site through selective demolition or other means is often the most effective way to ensure a clean, uncontaminated product [6].

Germany's high material, energy, labour and waste disposal costs favour the economics of recovering, reusing and recycling as much C&D waste as possible. In 2011 the costs for landfill were between 100 to 170 Euro per tonne (appr. AUD 150-250), expect for excavated soil, which has a lower cost. These high landfill costs stem from strict regulative environmental specifications in Germany such as the regulation on waste dumps and long-term deposits. Hence, a multi-barrier concept preventing negative environmental impacts is required for landfill operations. Additionally, strong waste management systems have long been required by laws and regulations at all levels of government in order to minimise the impact of C&D waste in the waste stream [4].

The Federal Republic of Germany is composed of 16 states (Länder) with relatively broad powers and responsibilities over their regions. Generally, the

Federal level of government establishes laws that the Länder must implement and administer.

These federal laws and regulations are mainly based on international and European legislation. The *Basel Convention* and the *Kyoto Protocol* are the most important international agreements influencing the German legislation waste management.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, short *Basel Convention*, is an international agreement established on 22 March 1989 to initiate a transnational waste management framework. It sets rules to control transboundary movements of wastes that are hazardous to human health and the environment, and their disposal at an international level. The Convention became effective on 5 May 1992 and has 180 countries participating today (May 2013), including Australia and the European Union (EU) [4]. The goal of the Basel Convention is to minimise the movements of certain hazardous wastes, which can also be found in C&D wastes. The Conventions also strive to reduce the amount of the generated hazardous wastes, and its toxicity, by assisting developing countries directly on the source of generation. [7]

The Kyoto-Protocol was passed on 11 December 1997 and is an additional protocol for the configuration of the climate convention framework of the UNFCCC. It came into force on 16 February 2005 and sets binding goal values for the emission of greenhouse gases within the developed countries. As at 2011, 193 states worldwide, including Germany and Australia, had signed the Kyoto-Protocol. [7]

In addition, the resolution of many environmental issues in Germany, as a member of the European Union (EU), has to comply with EU standards which are implemented through national laws. This includes dealings with hazardous and non-hazardous waste within the European Waste Legislation. Along with this, the European environmental legal frameworks contain guidelines and acts for various topics, including a *Waste Shipment Act*, an *End Of Life Vehicle Directive*, a *Package Directive*, a *Sludge Directive*, and a *Waste Oil Directive*. By establishing an overall guideline for the handling of waste, the EU contributes to the development of high standards of waste management in Europe. Besides the guidelines, there are also compulsory directives, which regulate and monitor the management of waste within the EU. The most important laws and acts are described below.

The *Directive 2008/98/EC* of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, or also called *Waste Framework Directive*, establishes a legal framework for the treatment of waste within the European Community.

It contains important subsections regarding the hierarchy of waste (figure 2), the waste management, permits and registration, plans and programs for future waste treatments. It defines and determines key policies and concepts for waste and its recovery and recycling. The goal of the Directive 2008/98/EC is to preserve and protect the environment, to diminish the harmful effects waste has on the environment and human health within the EU. [8]

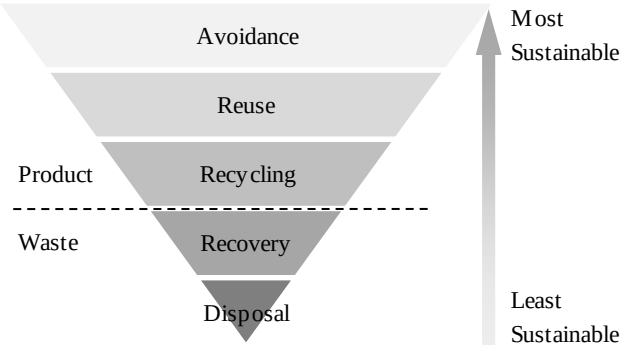

Figure 2 European waste hierarchy

The Directive 2008/98/EC came into force on 12 December 2008 and had to be implemented within the following two years.

The *Regulation (EC) No 1013/2006*, regulates and monitors the movements of waste between the member states of the EU, as well as the importation and export of waste to and from countries outside of the EU. It also directs and observes the notification procedures, giving a clear overview about the type of waste treatment (recycling or disposal), the waste movement directions (import or export), the role of the affected states (sending, receiving, or transferring state), or the type of waste (for example hazardous or non-hazardous wastes). The regulation was opened to signature on 14 June 2006 and entered into force on 12 July 2007. [8]

Another important Regulation of the European Parliament is the Regulation *(EC) No 2150/2002*, *it* establishes a legal framework for the creation of statistics on waste within the EU. The goal is to provide the EU and all its member states with continual, comparable and reliable data streams in order to regulate and supervise the transposition of the acts and directives on waste management established by the European Parliament and the Council. It provides data streams and elaborates statistics on the production, the recovery and recycling, and the disposal of waste within the EU by collecting and estimating data and by claiming statistics. [8]

Besides the more general regulations and directives mentioned above, which Germany is obligated to implement in domestic legislation by law, there are

several other EU efforts which aim to regulate specific areas in waste management. For example, the *Council Directive 1999/31/EC* requirements for landfills, specifically on surface water, groundwater, soil, air and human health, as well as the *Directive 2000/76/EC* on preventing or reducing air, water and soil pollution caused by the incineration or co-incineration of waste, or the European Commission's *Green paper* on the management of organic waste.

In order to comply with all European directives and regulations, the Recycling and Waste Management Act of Germany, the so called *Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen*, short *Kreislaufwirtschaftsgesetz (KrWG)*, was enacted. This Act promotes closed substance cycle waste management and ensures environmentally compatible waste disposal. Enacted in 2005, the Recycling and Waste Management Act of Germany bans untreated waste from being disposed. This has led to higher recycling rates, since this prohibition pressed for the development of a functional recycling system. In contrast, the economic influence of landfill fees on the C&D recovery rate appear to be only marginal. Figure 3 illustrates this using the example of Hamburg. It shows that disposal costs have only a minor influence on the high waste recovery rates. Other drivers such as limitations in landfill space or the preservation of resources had a more significant impact. Landfill levies to avoid the disposal of C&D waste have never been charged in Germany. Nevertheless, over a long period the landfill costs were high and contributed to the high C&D waste recovery rates baseline.

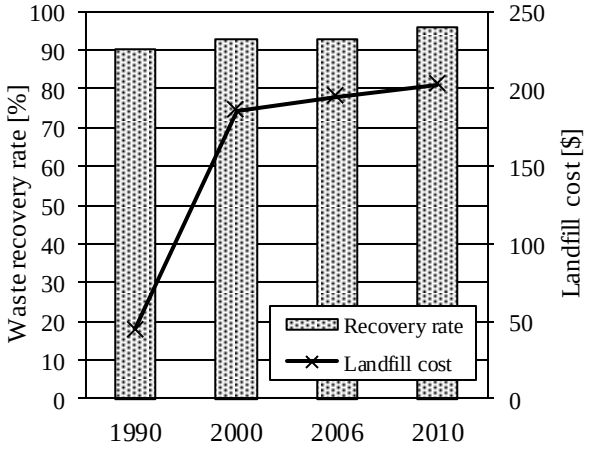

Figure 3 Development of waste recovery rate in Hamburg

The Recycling and Waste Management Act of Germany is complemented and specified by several ordinances and acts, for example:

- regulation on the European waste listing
- regulation on requirements regarding removal and usage of mature timber
- regulation on the disposal of commercial wastes and of certain building and demolition wastes
- regulation on refuse economy concepts and waste balances
- PCB/PCT Waste Ordinance
- regulation on dumps and long-term camp
- regulation on the storage of waste

The last two items concerning the dumping and storage of waste highlights the specific nature of the legislation which even deals with the distinction between dumping and backfilling. For example backfilling of excavated soil in open cut mines, is a recovery option, because the material is used to stabilise the quarry, which is seen as utilisation and not disposal. In practice however, these regulations can have negative effects. For example, a recycling facility usually has to pay for the backfilling of treated material thus enabling the open cut mines to offer their excavated virgin material and resources at lower prices than they otherwise would have been able to. This in return leaves recycled materials more expensive than virgin materials which can severely impact on German recycling facilities and the markets for their products.

In general, looking at the simplified recycling system, illustrated in figure 1, it can be assumed that the federal German governmental legislation focuses mainly on the 1st and 3rd stage. The primary responsibility for ensuring the proper treatment of C&D waste, influencing the 2nd stage of the simplified model, is mainly in the hands of local authorities, but is also partially legislated by the German government and the Länder (e.g. immission control law (BImSchG), Environmental Impact Assessment Law (UVPG)). Meanwhile, the 16 Länder are responsible for the implementation and establishment of more specific extensions to the waste management legislation. They are also responsible for the enforcement of regulations meant to achieve C&D waste goals set by higher levels of government, particularly the Federal government of Germany and the EU and to oversee the proper operation of waste treatment and disposal facilities.

At the local level, municipalities are responsible for the administration and issuing of demolition and construction permits that now occasionally include detailed deconstruction plans and detailed recycling specifications of the building's materials. While local authorities are responsible for arranging the collection, recycling and disposal infrastructure of household waste, commercial waste such as C&D waste is solely the responsibility of the waste's owners. The local authority ensures this responsibility is met according to federal and state legislation, and is responsible for initiating prosecution against offenders. Any commercial use of the processing, recycling and disposal infrastructure

operated by the municipality is paid for directly by the user.

3.2 Australia

Construction and demolition waste management in Australia is a young and moderately integrated industry within the broader Australian construction market.

In 2011, Australian construction and demolition activity generated 19 Megatons of waste [4]. Currently, no consolidated data about the specific composition and origin of C&D waste is available at the national level. Only 55 percent of C&D waste was recovered and reused in further applications or recycled and 45 percent of this material was disposed of in landfills [4].

Compared to Germany, Australia has a considerably lower material and energy recovery rate. In the greater area of Sydne, for example, C&D waste is often collected as mixed waste. Lower waste disposal costs appear to limit the economics involved in recovering, reusing and recycling C&D waste. In 2011 the costs for landfill disposal were between AUD $40 to AUD $130 per tonne [4]. The landfill design is comparable to the German multi-barrier concept.

One likely explanation for this situation is the fact, that the Australian Government does not directly legislate the management of C&D waste [9]. The management of environmental issues, including all waste streams, is largely the responsibility of Australian state and territory governments. Exceptions to this general principle are where international treaties are involved (i.e. the Basel Convention, Kyoto Protocol) or developments are deemed to be of significant environmental importance to the nation [4].

Waste management and resource recovery in Australia is dependent on the regulatory framework of a particular State or Territory. Thus, the approach commonly adopted by the Australian Government is one of multi-stakeholder engagement and the introduction of multi-party agreements. These may be supported by underpinning legislative measures in instances where all parties support the need for such fall-back legislation at a jurisdictional level [10]

Looking at the simplified recycling system, illustrated in figure 1, it can be seen that the federal Australian governmental legislation focuses mainly on the 3rd stage. Examples of this kind of legal framework are the *Australian and New Zealand Government Framework for Sustainable Procurement* and the *National Road Pavement Guidance*. Both policies regulate product design and associated specification, manufacture and application [10], but influence the 1st and 2nd stage of the recycling system only indirectly. The first two stages of C&D waste recycling are mostly industry regulated.

C&D waste recycling rates are strongly dependent on State or Territory legislation. Table 3 illustrates the resource recovery rates and future targets by jurisdiction of the 8 Australian states. It is noticeable that some states and territories (e.g. New South Wales (NSW), South Australia (SA), Australian Capital Territory (ACT)) have significantly higher recovery rates than the other states. On closer observation a link between legislation and resource recovery can be identified. A comparison of South Australia and Western Australia legislation documents this in a remarkable way.

The state of South Australia has one of the highest developed legislative systems with respect to C&D waste management in Australia [cf. 9]. For instance the *Zero Waste SA Act* of 2004 influences the C&D waste management in SA by promoting C&D recycling infrastructure and business development for recycling C&D waste materials. This results in increased C&D waste avoidance and resource recovery by C&D waste generators, and C&D waste recovery by reprocessors and landfill operators.

Table 3 Resource recovery rates (2008-09) and future targets by jurisdiction [9]

	NSW	VIC	QLD	SA
recovery rate (2008-09)	73%	53%	37%	77%
Target recovery rate	76% by 2014	80% by 2014	50% by 2014 60% by 2017 75% by 2020	90% by 2015
	ACT	**WA**	**NT**	**TAS**
recovery rate (2008-09)	81%	29%	<1%	15%
Target recovery rate	Overall 80% by 2015 (no specific C&D target)	100% by 2015 Inert waste (mainly C&D)	Overall 50% by 2020 (no specific C&D target)	No specific targets

In contrast to the situation in SA, the Government of Western Australia established a comparable act (*Waste Avoidance and Resource Recovery Act*) like SA with strict division targets and associated regulations commencing 1 July 2008 – four years later than SA. This lag in time causes significant differences in recycling rates between the two territories, because it normally takes several years, before additional recycling capacity reaches the market.

Another reason for the lower recovery rates is the enormous range of landfill levies within the eight Australian states and territories. Levies have been created as an additional charge and instrument to the normal tipping fee ($15-$30), and to enhance the recovery and

recycling efforts. Waste levies correct a market failure by making recycling cost competitive against landfill disposal [11]. These landfill levies exist in NSW, Victoria, SA and ACT. The other states either scrapped a levy regulation altogether (Queensland (QLD)), made it voluntary (Tasmania (TAS)), limited it to special regions (Western Australia (WA)) or never adopted a levy regulation in the first place (Northern Territory (NT)). Table 4 illustrates the current status of the landfill levy across Australia. The influence of an increasing levy on the C&D recovery rate is illustrated in figure 4. It shows that high disposal costs can be associated with a high landfill levy leading to high waste recovery rates [13]. A point in case is Germany, where the high landfill costs have led to one of the highest C&D waste recovery rates worldwide.

Table 4 Actually Landfill Levy Rates [13]

	NSW	VIC	QLD	SA
levy (AUS-$/tonne)	122.40 (rural & urban)	26.60 (rural, municipal), 46.60 (rural, industrial), 53.20 (metropolitan & provincial)	no levy (levy of $35.00 scrapped in 2013)	23.50 (rural & urban), 47.00 (metro-politan)
	ACT	WA	NT	TAS
levy (AUS-$/tonne)	121.90 (com. waste), 136.80 (Asbestos waste)	12.00 (only for waste from Perth)	no levy	voluntary levy by the 3 regional waste groups (approx.: 2.00)

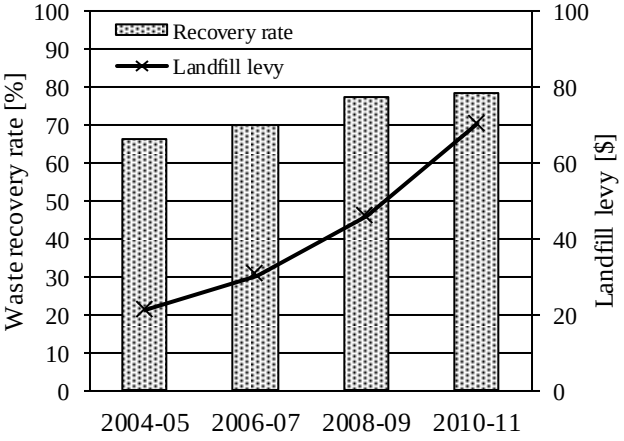

Figure 4 Development of waste recovery rate in Sydney Metropolitan Area

4 Discussion

From the various values presented in the previous sections, it can be seen that there is a direct correlation between high C&D disposal costs and legislative incentives such as the landfill levy in Australia. Figure 5 shows clearly that the recovery rates are directly proportional to the landfill levy imposed in different states, apart from Southern Australia which has well integrated legislation for C&D waste recycling.

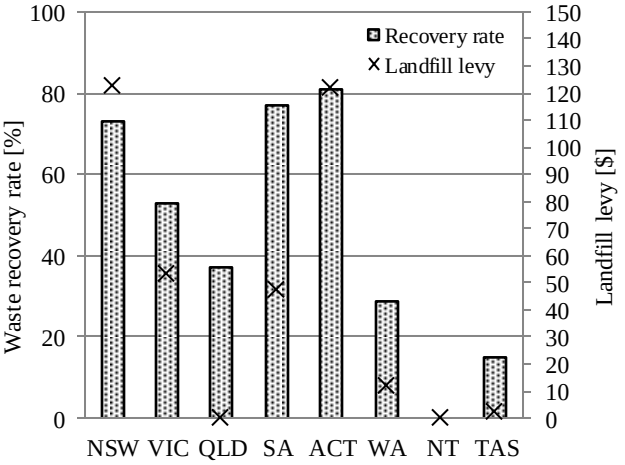

Figure 5 Waste recovery rate and Landfill levies of the 8 Australian states

It does however have to be noted that there might be a slight distortion of figures due to "exporting of waste" to other states in order to avoid high levies. For example, it is common to dispose NSW waste in Queensland landfills, which prove cheaper even when considering transportation costs. This highlights the issue of inconsistent legislation across state boundaries. The German system is more consistent due to overarching European legislation and directives; Australia would require federal guidelines to overcome issues such as "waste exporting" to other states which can be counterproductive to the goal of increasing recovery rates. In Germany on the other hand, the use of virgin material is partially increased due to backfilling operations that provide revenue to open cut mines and hence causing prices of virgin materials to be lower than recycled materials. This is also counterproductive to the goal of reusing C&D waste and makes recycling of this kind of waste less viable. These examples demonstrate the need to develop consistent and overarching legislation with the policy goal of ensuring higher recovery rates and reuse of recycled C&D waste materials and its associated products. Regular revision of legislation is required under consideration of the current situation in the C&D waste market; this will also require consistent data collection across states in Federal countries such as Australia and countries, such as Germany, in legislative unions such as

the EU. Federation can cause tension when individual states insist on their own ways of managing their C&D waste, which can prove counterproductive to other states' efforts. The impact of Germany's participation in the EU, means that it is bound to European directives and legislation, which provides a consistent system across all German states.

5 Conclusion

The study demonstrates that the demolition of buildings and civil infrastructure usually create significantly more waste material than construction activities. Traditional demolition practices in which all building materials are mixed together create a waste stream which is difficult and costly to recycle has been almost eradicated in Germany today. Local landfill fees have a strong influence on the economic viability of alternative demolition practices. In the absence of strong government regulations, as in the case of Australia, landfill fees are the primary factor influencing demolition processes.

While the recycling processes used to sort mixed materials and reduce contamination vary between countries and regions, it is clear that the separation of materials at the demolition site through selective demolition or other means is often the most effective way to ensure a clean, uncontaminated product. To enhance the selective demolition and collection of C&D waste, national laws, acts and guidelines are necessary. However, demolition materials can sometimes be mixed together depending on the use identified for them. Concrete, bricks and ceramics for instance, are often ground up together for use as fill in road building or other construction projects. Such a use allows these materials to be mixed during the demolition process, although other materials may still need to be sorted out.

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