

Improvement of the Statutory Framework for Construction and Demolition Waste Management exemplified in Germany and Australia

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Abstract Construction and demolition (C&D) waste occupies the largest share of overall waste generation in many countries. However, waste management practices and outcomes may differ between countries. For instance, in Australia, C&D waste recovery is continuously improving during the last years but the amount of C&D waste increases every year, as there has been little improvement in waste avoidance and minimization. In contrast, in Germany, waste generation remains constant over many years despite the continuous economic growth. The waste recycling rate in Germany is one of the highest in the world. However, most waste recycled is from demolition work rather than from waste generated during new construction. In addition, specific laws need to be developed to further reduce landfill of non-recycled waste. Despite of the differences, C&D waste generation and recovery in both countries depend on the effectiveness of the statutory framework, which regulates their waste management practices. This is an issue in other parts of the world as well. Therefore countries can learn from each other to improve their current statutory framework for C&D waste management. By taking Germany and Australia as an example, possible measures to improve current practices of C&D waste management through better statutory tools are identified in this paper. After providing an overview of the statutory framework of both countries and their status in waste generation and recovery, a SWOT analysis is conducted to identify strengths, weaknesses, opportunities and threats of the statutory tools. Recommendations to improve the current statutory frameworks, in order to achieve less waste generation and more waste recovery in the construction industry are provided for the German and Australian government and they can also be transferred to other countries.

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Introduction

Construction and demolition (C&D) waste is a worldwide issue due to the rapid growth of towns and cities, and a significant number of illegal dumps [10]. It occupies the largest share of overall waste generation in many countries with their economic growth. The need and importance of C&D waste management and minimization is being recognized around the world. However, the practices and outcomes related to this are different between countries. For example, in Australia, most of the C&D waste (58 %) was recycled [5]. Despite the progress in waste recycling, there has been little improvement in waste avoidance, as the amount of waste continues growing every year [4, 5]. Compared to Australia, the total volume of C&D waste in Germany has remained constant over many years given the steadily growing economy [6]. The waste recovery rate in Germany is one of the highest in the world [3, 6] However, most waste recycled in Germany is from demolition work without much recovery from new construction waste. In addition, specific laws have yet to be developed to further reduce landfill of non-recycled waste.

The practices of waste management and minimization and situations of waste generation and recovery in Australia and Germany are regulated by their statutory framework of the government [13]. This is a common situation in other countries as well. There is the opportunity for different countries to learn from each other about experience and practice of the implementation of statutory tools for waste management.

The research presented in this paper intends to seek solutions to promote waste management and minimization practices through improved statutory framework. Take Germany and Australia as an example, it first provides an overview of the statutory frameworks in Germany and Australia and describes the status of waste generation and recovery in both countries. Then a SWOT analysis is performed to identify strengths, weaknesses, opportunities and threats of the statutory tools, before recommendations are proposed for both German and Australian governments to improve current statutory tools in order to result in more effective waste management and better outcomes of waste avoidance, minimization and recovery.

Statistics and Statutory Framework for C&D Waste Management in Germany

C&D Waste Generation and Recovery in Germany

C&D waste in Germany mainly consists of excavated earth, construction and demolition debris, road construction waste, gypsum-based construction material and construction waste. Table 1 shows the composition of C&D waste and the status of recycling in 2004. It can be noted that most of the waste recycling took place in demolition waste and road scarification and only little in waste generated by new constructions and through excavation.

Table 1 C&D Waste Composition and Recycling in Germany, 2004 [12]

Waste type	Total C&D waste production		Amount of waste recycled
	Million tons	%	Million tons
Demolition waste	50.5	25.2%	31.1
Road scarification	19.7	9.8%	18.4
Construction waste	1.9	0.9%	0.1
Cement	0.3	0.2%	–
Total (without excavation)	72.4	36.1%	49.6
Waste from excavation	128.3	63.9%	9.1
Total	200.7	100%	58.7

Table 2 C&D Waste Balance 2008 in Germany [7]

		C&D waste [million tons]	Hazardous waste [million tons]	Non-hazardous waste [million tons]
Total		200.52	8.49	192.03
Disposal		24.02	3.71	20.31
Of which	Landfill	22.58	2.67	19.91
	Incineration	0.15	0.05	0.1
	Treatment for disposal	1.29	0.99	0.3
Recovery		176.49	4.78	171.72
Of which	Energy recovery	0.82	0.2	0.62
	Treatment for recovery	175.67	4.58	171.09
Recovery rate %		88	56	89

Regarding the general situation of C&D waste treatment in Germany in 2008 as shown in Table 2, most of the recovered waste was dealt with by “treatment for recovery”, which largely avoided high energy consumption in energy recovery. For disposal, most of the waste went to landfill, followed by the “treatment for disposal”. Only a small part of the waste was incinerated.

Statutory Tools

In Germany, the statutory tools for waste management are reviewed and the key information of them is presented in Table 3.

Statistics and Statutory Framework for C&D Waste Management in Australia

C&D Waste Generation and Recovery in Australia

In Australia, the largest components of the C&D waste stream and the most commonly recycled materials in Australia are concrete, bricks, asphalt, soil, timber and

Table 3 Statutory Tools for C&D Waste Management in Germany

	Statutory tool	Key information
Legislation and policies	EU Waste Strategy and Waste Framework Directive	Waste prevention Waste handling and hazardous waste management
	Act for Promoting Closed Substance Cycle Waste Management and Ensuring Environmentally Compatible Waste Disposal	Closed loop recycling Responsibilities of waste producers
	The Law for the Prevention and Disposal of Waste	Transition from disposal to waste management Improvement of waste composition to permit reuse and recycling
	Commercial Wastes Ordinance	Safe and high quality waste recovery Residual waste container for waste disposal
Strategy and guidelines	Strategy for the future of disposal of waste from human settlements	Municipal waste recovery Minimization of landfill
	The Certification of the German Sustainable Building Council	Sustainable building and construction Waste minimization
	Guideline for Sustainable Construction	Sustainable construction throughout the building life cycle Minimization of the use of energy and resources Use of renewable and recoverable materials
Technical instructions	Technical Instruction for Municipal Waste	Treatment and disposal of waste streams Recycling of unavoidable waste Reduction of toxic waste Environmental-friendly waste treatment
	DIN Standards	Regulation of construction and deconstruction work Construction work standards General and contracting construction issues Handling of deconstruction materials
Voluntary commitment	European Waste Catalogue and Hazardous Waste List	A hierarchical list of waste descriptions A consistent waste classification system
	Consortium of recycling management in construction	Until 2011 there had been a consortium of construction industry stakeholders to reduce landfilled construction waste within 10 years by 50 %. But at the moment there is no voluntary commitment of construction industry stakeholders

Table 4 C&D Waste
Landfilled in NSW Australia,
2006–07 [8]

Waste Materials	Landfill by weight
Paper and cardboard	2 %
Plastic	2 %
Ferrous metals	3 %
Garden organics	4 %
Timber	13 %
Soil and rubble	25 %
Concrete, asphalt, brick and sand	31 %
Other	20 %
Total	100 %

Table 5. Recycling Rates for
C&D Waste by Jurisdiction,
2006–07 [5]

Jurisdiction	Recycling Rate
NSW	67 %
VIC	72 %
QLD	30 %
WA	17 %
SA	79 %
ACT	91 %
TAS	Unknown
NT	Unknown

ferrous metals, because they are usually demolished in large quantities and have an existing market for reuse and recycling (e.g. concrete, bricks and asphalt), or they have a relatively high commercial value (e.g. metals) [5]. There is no consolidated data available at the national level about the specific compositions of C&D waste, which is land filled or recovered in Australia, because there are different waste categories used in each jurisdiction. Take New South Wales for example, the largest C&D waste components by weight land filled from 2006 to 2007 were concrete, asphalt, bricks and sand (31 %), soil and rubble (25 %), and timber (13 %), as shown in Table 4.

Although the recovery of C&D waste in Australia has improved significantly in recent years, it varies in different jurisdictions because of the different waste management laws and enforcement. Data in some jurisdictions is even unavailable. The waste recycling rates from 2006 to 2007 achieved by each jurisdiction are shown in Table 5.

Statutory Tools

Information related to the Australian statutory tools for C&D waste management is summarized in Table 6.

Table 6 Statutory Tools for C&D Waste Management in Australia

	Statutory tool	Key information
Legislation and policies	National Waste Policy: Less Waste, More Resources	Resource recovery and waste management Reduction of waste disposal
	National Environment Protection Measures	National objectives to protect the environment Several mandatory national regulations
	The Product Stewardship Bill 2011 (Product Stewardship Act 2011)	A national framework to manage the environmental, health and safety impacts of products Regulated and voluntary activities
Strategy and guidelines	National Strategy for Ecologically Sustainable Development	An integrated approach for waste prevention and minimization Improvement of resource usage and reduction of the impact of waste disposal Avoidance and handling of hazardous waste
	Carbon Pollution Reduction Scheme (CPRS)	Main driver to reduce greenhouse gas emissions Reduction of greenhouse gas emissions through reduction of waste landfill and increased waste recycling
Technical instructions	Green Star Certified Ratings	Reduction of the environmental impact of buildings Achievement of waste recycling, occupant health and productivity, and cost savings Innovation in sustainable building practices
Voluntary commitment	Australian Packaging Covenant	Reduction of the environmental impacts of consumer packaging Avoidance, minimization, reuse and recycling of packaging waste
	Sustainable Packaging Guidelines	Optimization of consumer packaging for efficient resource usage and environmental impact reduction Design, manufacture and end-of-life management of sustainable packaging

SWOT Analysis

SWOT analysis is applied in this research to compare the statutory tools of waste management in Germany and Australia. SWOT is an acronym for strengths, weaknesses, opportunities and threats [11]. SWOT analysis was popularized by [1] It is used to develop four types of strategies, namely SO (strengths-opportunities) strategies, WO (weaknesses-opportunities) strategies, ST (strengths-threats) strategies, and WT (weaknesses-threats) strategies [2, 9].

Through SWOT analysis, the strengths, weaknesses, opportunities and threats of the statutory tools of both Germany and Australia are identified, as shown in Table 7. Strategies indicated by SO, WO, ST, WT are also established and explained in the table.

Table 7 SWOT Analysis of the Statutory Framework for C&D Waste Management in Germany

Germany		Strengths (S)	Weaknesses (W)
Opportunities (O)	Increase recycling of (new) construction waste and excavation waste	Waste prevention and minimization is top of the preference. Most statutory tools include C&D waste section or target on C&D waste. Sustainable construction in the national scope to strengthen understanding and standardise actions in achieving waste minimization. Standard waste classification according to EU waste catalogue. Technical instructions for real practice of waste management	Lack of specific regulatory support for waste minimization from suppliers' packaging on construction site. No voluntary commitments
		<i>SO</i> Specific regulations and support on increasing construction waste recycling on new construction sites and of excavation waste	<i>WO</i> Regulations on minimising packaging. Commitment of the stakeholders of the construction industry with set, high quality targets for waste recycling and reuse
Threats (T)	Most of the disposed waste goes to landfill	<i>ST</i> Policies to reduce landfill New technologies of waste disposal to minimise the impact on the environment	<i>WT</i> Encourage packaging reuse and new technologies on packaging New technologies of waste degradation Commitment of the stakeholders to prevent landfill and increase recycling of excavation waste

Recommendations

Based on the findings from the SWOT analysis, recommendations are provided for both countries to improve their government regulations to encourage better waste management practices in the construction industry.

Recommendations for Germany

Recommendations drawn from the SWOT analysis for the improvement of German statutory tools for C&D waste management are listed in Table 9.

Table 8 SWOT Analysis of the Statutory Framework for C&D Waste Management in Australia

Australia		S	W
		Waste prevention and minimization is top of the preference.	Most statutory tools address general waste management rather than C&D waste specifically.
		Focus on collaborations of stakeholders in achieving waste management targets.	No standard classification of waste categories at national level.
		Waste minimization and management is nested in broader concepts of resource efficiency, carbon pollution reduction and ecological sustainable development.	Lack of technical instructions for C&D waste management in real practice
O	Establish market of recycled materials	Specific regulations and guidelines for products and materials packaging from manufacturing industry to assist waste minimization on construction site	
		<i>SO</i> Guidelines for the establishment of recycled materials market Financial support from the government to encourage the use of recycled materials and components	<i>WO</i> Technical instructions for construction waste handling, management, transportation, reuse, recycling and sale Develop standards for different recycled materials
T	No consolidated data at the national level Different development of construction industry and waste recycling in different jurisdictions	<i>ST</i> Collaboration of different jurisdictions in waste minimization and recycling Develop national waste database to encourage comparison with other countries for improvement	<i>WT</i> Develop standard and uniform waste classification system at national level Establish and improve the current statutory tools to address problems related to C&D waste

Recommendations for Australia

Recommendations drawn from the SWOT analysis for the improvement of Australian statutory tools for C&D waste management are listed in Table 10.

Conclusions

C&D waste minimization is an important contributor to the goal of achieving sustainability of the construction industry. In order to regulate C&D waste management practices, governments around the world have established statutory tools to

Table 9 Recommendations for the improvement of statutory tools for C&D waste management in Germany

Statutory tool	Specific issue	Issue description
Financial support for	Newly-construction waste recycling	The government needs to provide financial support to the client and waste management companies to increase waste recovery from newly construction processes
	The development of innovations on waste reduction	The government needs to provide financial support to the construction industry, construction material manufactures and research associations for technological innovations on waste reduction, for instance innovation in material packaging and waste recovery, and alternative options for waste disposal
Legislations for	Reducing waste landfill and reduction of down-cycling	The German government needs to establish relevant legislations for the reduction of waste landfill and material down-cycling, for instance by checking construction waste on site and respective payments
	Waste minimization by manufacturers	It is necessary for the German government to establish material design standard and product stewardship, and develop regulations and policies for manufacturers to recover packaging
Voluntary commitment for	The high quality construction waste recycling and reuse and prevention of landfill	In the past the consortium “Kreislaufwirtschaftsträger Bau (KWTB)” of construction industry stakeholders existed, which made a voluntary commitment with the government to reduce landfilled construction waste (excluding excavation waste) within 10 years by 50 %. A similar voluntary commitment of the industry stakeholders including excavation waste and preventing landfill should be established again

reduce waste generation and encourage waste recovery. The effectiveness of these statutory frameworks has resulted in different waste management status in different countries. Therefore countries can learn from each other about good experience in developing waste management regulations and practices in waste minimization and recovery.

This paper discusses the comparison of different statutory frameworks for C&D waste management by taking Germany and Australia as an example. It firstly outlines the current statutory tools for C&D waste management in both countries and presents their situations of C&D waste generation and recovery. A SWOT analysis is conducted to identify their strengths, weaknesses, opportunities and threats with relevant strategies for improvement. Finally the recommendations are provided for Germany and Australia to improve their statutory frameworks and promote their industry practices of waste minimization and recovery. The recommendations for Germany include financial support for newly-construction waste recycling, legislations

Table 10 Recommendations for the improvement of statutory tools for C&D waste management in Australia

Statutory tool	Specific issue	Issue description
Financial support for	Waste recovery	Government needs to set up financial incentive programs to encourage waste recovery, and to maintain and develop the recycled material market to drive more waste recovery in the industry
Legislations for	C&D waste specific issues	Legislations for C&D waste need to be established for waste minimization throughout the project life cycle by the coordination and collaboration among all the project stakeholders
Technical instructions for	Overall C&D waste management	Technical instructions and guidance on C&D waste handling and hazardous waste management need to be established and reviewed and revised regularly
National system for	Waste classification	Standard and uniform waste classification system needs to be developed at the national level, in order to facilitate data exchange, comparison and benchmarking
	Waste data tracking	A national waste data tracking system should also be established to collect and store a comprehensive range of data on waste generation, disposal to landfill and resource recovery
National guidelines for	Sustainable construction	National guidelines to promote nationally waste minimization and recovery throughout the whole building life cycle

for reducing waste landfill, legislations for waste minimization by manufacturers, and incentive measures for technological innovation of packaging minimization and recovery. For Australia, recommendations are provided including waste legislations specific to C&D waste, technical instructions for C&D waste management, national waste classification system, national waste data tracking system, guidelines for sustainable construction, and financial incentives for waste recovery.

The result of this research will provide a valuable reference for both German and Australian government to improve their current statutory frameworks for C&D waste management. It is also applicable to other countries to review and update their regulatory tools for C&D waste management.

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