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Overcoming Head Contractor Barriers to Sustainable Waste Management Solutions in the Australian Construction Industry

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Abstract: The construction industry has one of the highest waste intensities in Australia. While there are barriers to the implementation of sustainable waste management (WM) practices, there is a lack of viable solutions for head contractors to overcome these barriers. This research investigates the role of incentives in achieving sustainable WM in the Australian commercial construction industry. A qualitative approach was adopted through interviews with experts in the field to explore the role of incentives as possible solutions to the barriers presented. The findings show that participants are willing to use more sustainable WM practices. However, the barriers are perceived to be too substantial. Many types of incentives can encourage changes in behavior, which contribute to better waste outcomes. The findings also indicate key stakeholders such as the client, government, and industry regulators may provide incentives, including enhancing relevant key performance indicators, amending existing legislations, and implementing government programs to foster a Circular Economy to improve sustainable WM practices. This study contributes to the field by raising awareness about the role of incentives for head contractors to achieve sustainable WM practices.

Keywords: construction; incentivization; resource recovery; recycling; sustainability; waste management

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1. Introduction

The value of Australian commercial building activity has risen from $38 billion in 2015 to an all-time high of $49 billion in 2019–2020 [1], while the construction industry has one of the highest waste intensities in Australia [2]. Globally, around 800 billion tons of natural resources have been captured by the construction industry [3], which is among the leading industries contributing to the largest carbon footprint [4]. The current waste management (WM) practices in the Australian commercial construction industry present issues that impact the Australian economy, society, and the environment, including the health and well-being of communities [5]. In Australia, 43% of the total waste is generated by the construction and demolition (C&D) waste stream, which accounts for 20.4 Mt annually. It is estimated that 6.7 Mt of the C&D waste stream goes to landfill every year [6]. Attempts for waste resource recovery are limited in the industry, which leads to useful waste ending up in landfill sites [7]. Population growth and migration accelerate the issues by increasing construction activities and C&D waste generation [8].

The implementation of sustainable WM solutions in the industry is significantly impeded by various barriers, such as cost, legislation, and poor quality of waste data [3], and there are no viable solutions to overcome them yet. There is a lack of viable government incentives and regulations to support the quality and use of recycled products, which could ultimately reduce waste levels in the Australian construction industry [6]. Compounding the problem is a lack of education and awareness about the nature and size of the issue that impacts the environment [3]. Promotion and wide implementation of sustainable WM practices in the Australian construction industry can foster the reduction, recycling, and reusing of waste, which is an opportunity to improve the efficiency of the industry, the environment, the economy, and society.

There is limited existing research that assists head contractors (HCs) in creating better WM outcomes in the Australian construction industry. The HC is central to all parties involved in the construction process and, therefore, waste generation, and holds the initial contract with the client, leads the project, obtains the required resources, and is responsible for performing the works according to the agreed terms and standards in the contract, in compliance with regulations such as waste disposal [9] and industry standards [10]. The HC also manages the subcontractors; each subcontractor is contractually obligated to the HC [11]. This demonstrates the significance of HCs as decision-makers in construction projects, including WM practices and the potential for reducing construction waste from commercial construction projects.

This research explores the main barriers and motivators of Australian commercial construction HCs for implementing sustainable WM practices. It explains how they can overcome the barriers through a range of measures that incentivize sustainable WM practices. This research also evaluates the individual willingness of Australian commercial construction HCs to change towards sustainable WM solutions.

2. Literature Review

Construction activities are globally one of the major generators of waste. Construction and demolition waste may include metal, masonry, concrete, lumber, plaster, glass, asphalt, plastic, carpet, and dirt [12]. The Australian C&D sector generated 27 Mt (millions of tons) of C&D waste in 2018–2019, managed within the waste and resource recovery sector. This is significant because it represents 44% of Australia's total core waste [2]. C&D waste goes to landfill sites, and attempts for resource recovery are limited [7], illustrating the need for a wide application of sustainable WM solutions in the industry. Existing research shows several benefits to sustainable WM solutions, including more recycled content and utilizing more secondary materials in construction projects, reduced waste generation, less pollution, lower consumption levels, and decreased pressure on landfill capacities and natural products [13]. Reducing, reusing, and recycling waste materials avoid illegal dumping [6], all leading to reduced burning of fossil fuels and emissions of carbon dioxide, and consequently, a more sustainable environment. Another benefit is that utilizing recycled C&D waste products can lead to a reduction in construction costs, landfill tax, and energy consumption [6]. Implementing sustainable WM practices is an opportunity to create niche markets and new job opportunities in the local markets [6]. This can incentivize several stakeholders in the industry and the government. According to the study conducted by Li and Du [14], engaging in sustainable construction activities can improve corporate social responsibility. For instance, using secondary materials in construction projects plays a positive role in the community.

The implementation of sustainable WM solutions is demonstrated to be significantly impeded by various barriers. The study by Maqsood et al. [5] found that there is limited knowledge in the industry about the possibilities of using recycled materials. This finding is supported by Shooshtarian et al. [6], who argued that a lack of competent staff and awareness about managing construction waste reduces demand in the market for recycled materials. Additional time and costs associated with separating, transporting, and reprocessing waste keep builders from implementing sustainable WM practices [6]. O'Farrell et al. [15] summarized that there is limited awareness about the financial benefits of minimizing and avoiding waste and that there are space constraints for the segregation, handling, and storage of materials. This finding is supported by Ratnasabapathy et al. [3], who stated that on-site space does not always allow for proper separation of waste, which limits the quality and demand of secondary materials. Another important barrier is the shortage of accessible (web-based) technologies, waste data systems, and market platforms for waste information [3], critical tools to manage waste and buy products of the required quality. Investment in research and development is required to provide new processes and innovative technologies that contribute to better WM practices, including reduction, reuse, and recycling [16]. The Office of the Chief Economics report [17] confirms this finding, which shows that the Australian construction industry is slow in implementing innovations and web-based technologies.

Maqsood et al. [5] also found a lack of incentives and investment for innovation in the recycling sector. Another issue is that waste strategy documents are developed by individual states and territories [8], with different strategies leading to inconsistencies. This points to an opportunity to learn from each other and improve by paralleling back the methods used in the best practices throughout the remaining states and territories.

2.1. Existing Incentives for Improving Waste Management Practices

Incentivization strategies are based on overcoming barriers and include programs, tools, and accessible systems to encourage the utilization of recycled products, application of material testing and product certification to accelerate reuse, and waste avoidance [6]. Various industries use different incentives, including charges, rewards, compensations, and recognitions. The Green Building Council of Australia (GBCA) rates the sustainability of building projects through a rating system named Green Star, which encourages the efficient use of construction materials. Green Star also focuses on C&D waste minimization through credits to encourage construction projects to design and construct in a way that fosters the best WM outcomes [18]. These credits aim to incentivize and reward WM practices that minimize the amount of C&D waste from construction activities going to landfills. Construction projects can obtain credit points for waste-related practices, including using recycled materials, waste storage that promotes recycling, and recycling C&D waste from the project. Therefore, the Green Star credit points act as an incentive for companies to develop and maintain sustainable WM practices. GBCA claims that Green Star-certified buildings recycle 96% of their generated waste. However, Green Star's waste requirements are not mandatory [19], which indicates the potential for further improvement around the encouragement of WM practices in the industry. Clients must incur significant costs to receive a Green Star certificate which may limit participation and point to a lack of incentives for the widespread adoption of such programs. Another existing incentive to reduce waste is penalizing through waste levies, which help reduce waste by incentivizing waste generators to look for alternatives to avoid waste and minimize the waste they create and send to landfill. From 2020–2021 to 2021–2022, the landfill levy has increased by 61% and is a key tool that drives waste reduction, reuse, and recycling in the C&D industry [20]. Lastly, educational programs are used to encourage material diversion, which increases awareness for better WM outcomes. For example, education around the opportunities to use more recycled products and associated government requirements for quality standards and specifications of recycled products [21].

2.2. Circular Economy

The Circular Economy (CE) principle supports the circulation of materials to ensure natural resources remain in the supply chain by maximizing the recycling and reusing of materials through innovation of the entire chain of consumption, production, recovery, and distribution. Material consumption and waste generation can be influenced from the early stages. For instance, design optimization can help increase reuse and recycling in construction projects while minimizing waste remains [22], illustrated in Figure 1. Research shows that circa 90% of C&D waste is recyclable [23], while Australia's C&D waste recovery rate is circa 60% [2]. This shows the significance of the CE concept and the potential to reduce waste remains in the industry.

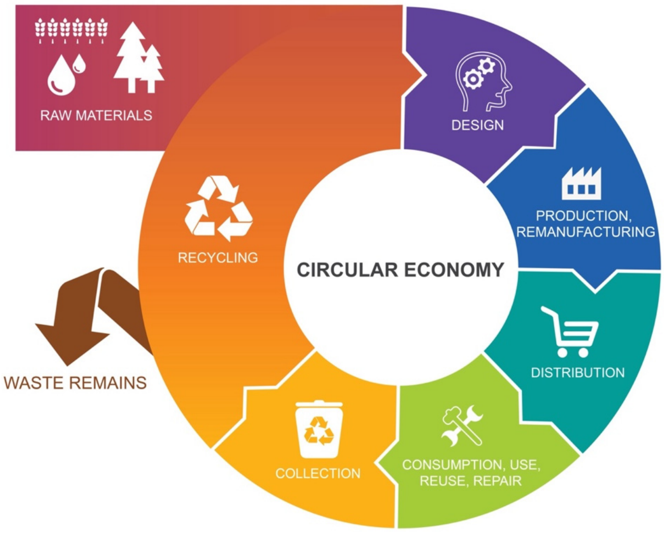

Figure 1. Circular Economy. Adapted from Victorian Cleantech Cluster [24].

CE principles are already widely implemented around the world (including in Japan, China, and Europe) as a political objective to encourage sustainable WM through government programs [25]. CE reduces material demand and greenhouse gas emissions while increasing the use of secondary materials, consequently increasing the value and reuse of construction waste and broadening their activities. According to Ferdous et al. [26], every 10,000 tons of waste recycling is estimated to create 9.2 jobs, compared to 2.8 jobs for landfill disposal, which shows the significance of encouraging a CE. Hence, the CE concept can be used to promote, incentivize, and support sustainable WM practices while advancing economic development. However, there is a varying profile of recyclability and profitability of different materials in the WM cycle. For instance, metal has a higher collection efficiency and recycling rate than plastic [2]. The quality of most metals does not degrade in the recycling cycle, making it a more profitable and desirable material for recycling.

2.3. Conceptual Model

Research into WM practices has been active across many industries, including the construction industry, over the past decades. The major factors to sustainable WM practices have been asserted in previous studies in the field, each focused on different dimensions. As such, several researchers have attempted to define generic factors for sustainable WM practices across different industries and disciplines. For example, Mair & Jago [27] discussed that these factors fall within two generic categories of barriers and drivers. On a different view, Michie et al. [28] argued that proper interactions among the influential factors, including capability, motivation, and opportunity, generate behavior to good practice in WM. In the same vein, Weck [29] discussed the process by considering barriers and facilitators to motivation and readiness, and eventually, behaviors change to support sustainable lifecycle change.

In this study, drawing upon the discussion and frameworks in previous studies, the influential antecedents to sustainable WM have been synthesized into a conceptual model, as shown in Figure 2. This conceptual model is a process-view model showing that sustainable WM can be viewed as a "process" with inputs, steps, and outputs that need to be considered for good practices in WM. This process comprises antecedents that start with *Organizational Context* (both internally and externally), followed by *Barriers* and *Motivators* for sustainable WM, and then *Incentives to overcome barriers*, which eventually lead to sustainable WM in the industry, as discussed next. Figure 2 offers a benchmark to show where the gaps lie regarding the antecedents and their interactions in sustainable WM.

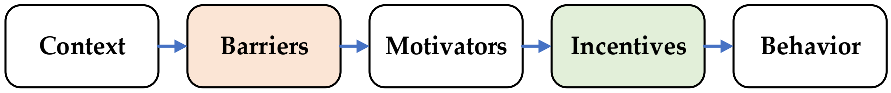

Figure 2. The conceptual model in the present study.

Context:

The first influential factor within the process is the context, which includes the organizational context (both internally and externally). The external issues include industry and government regulations, available technologies, consumer trends, economic situations, and cultural factors. The internal issues involve the business size, perspectives, values, resource capabilities, and contractual relationships. Factors influencing WM are opportunities for industry practitioners and policymakers to develop and implement suitable strategies [16].

Barriers:

The major barriers to sustainable WM practices have been asserted in previous studies focusing on technical, economic, legal, and environmental dimensions. For example, lack of knowledge, skills, technologies, and awareness around managing C&D waste sustainably [6]. Other significant barriers to consider include space constraints and additional costs for separating waste on-site, limited quality and demand for secondary materials [3], and a lack of incentives to achieve better WM outcomes [5].

Motivators:

Existing literature reveals motivators for implementing sustainable WM solutions, including financial benefits from reduced consumption, waste, and construction costs. The implementation of sustainable WM practices is shown to be an opportunity to create niche markets and new job opportunities [6]. Increasing the supply of (re)used and recycled materials can also reduce pressure on natural products and landfill capacities that impact public health and well-being. Finally, sustainable construction activities can improve company image and corporate social responsibility [14].

Incentives:

Incentivization strategies include the programs and tools to overcome the barriers towards sustainable WM practices. For example, educational programs and governmental directives can lead to increased awareness. This, in turn, can lead to an impulse for research and development, improved technologies, and changes in behavior, which contribute to better waste outcomes [16].

Behavior:

Incentives can encourage behavioral change that satisfies the WM norms [16]. Proper interactions among the influential factors, including capability, motivation, and opportunity, generate behavior to good practice in WM [28].

3. Research Methodology

A qualitative approach for this study facilitated exploring insights into individual participants, including their opinions, understandings, and attitudes [30], with semi-structured interviews used as the mean of qualitative data collection. Other research methods were considered. However, for this study, they are less effective. For instance, a case study would not be suitable due to its limited representatives (a small group or one person). This would provide little basis for generalization of the outcomes [31].

The research includes data collection through semi-structured, in-depth interviews with ten head contractors (Tier-1), 1 Supplier, 1 Building Surveyor and 1 Waste Contractor in the Australian commercial construction industry. The target population for semi-structured interviews of this research project include the decision makers around sustainable WM practices within Australian commercial construction companies. The relevant participants to be interviewed for this research include:

- Sustainable Development Managers
- Directors
- Contract Managers
- Project Managers
- Design Managers

Sustainable Development Managers are likely to be the most relevant participants for the data collection of this research project due to their responsibility to implement sustainable (WM) strategies for construction projects. However, different views from professionals with different skills and positions in the industry need to be obtained. The interviews were conducted as video calls and audio recorded due to diverse locations. Transcripts were obtained from the audio recordings to ensure all the relevant information could be retrieved and used for data analysis. Sampling was based on snowballing, which is a non-probability sampling method. The snowball sampling method starts with potential participants that meet the criteria and are invited to participate in the research project. The willing participants are then asked to suggest other potential participants (that meet the criteria) who may also be interested in participating in the research project, who may also provide new potential (and suitable) participants, and so forth. This sampling technique enables an expanding chain of participants, which is suitable when participants are harder to reach. The process of sampling usually finishes when the point of saturation has been achieved [32]. In total, 13 online interviews were conducted through video calls. After interviewing 12 participants, no new information was discovered, and the point of data saturation was reached. Therefore, after interview 13, the data collection ceased. The list of participants and their profiles, mainly in Victoria State, are illustrated in Table 1.

Table 1. Interviewees' profiles.

No.	ID	Role	Experience (Years)	Organization Type
1	A	Director	17	Demolition & Salvage
2	B	Sustainability Manager	22	Construction HC
3	C	Contract Manager	20	Construction HC
4	D	Director	11	Building Surveyor
5	E	Sustainability Manager	15	Construction HC
6	F	Sustainability Manager	7	Construction HC
7	G	Project Manager	15	Construction HC
8	H	Sustainability Manager	17	Waste Contractor
9	I	Sustainability Manager	16	Construction HC
10	J	Sustainability Manager	26	Construction HC
11	K	Sustainability Manager	16	Supplier
12	L	Design Manager	11	Construction HC
13	M	Sustainability Manager	10	Construction HC

Analysis

NVivo was used to analyze the audio recordings. The analysis process started with transcribing the audio-recorded interviews into text documents to generate clear information from recordings and minimize misunderstandings and errors [33]. Subsequently, category coding and thematic analysis were used. As stated by Punch [31], qualitative analysis starts with coding, which is significant in discovering regularities in the data. Coding began with assigning labels (names) to the collected pieces of data, which can be used to identify patterns and summarize data into themes. In this research, the codes were created based on the existing literature and the collected qualitative data from semi-structured interviews. Preliminary codes from the existing literature include barriers, motivators, and incentives to sustainable WM. Moreover, analysis of the interview data resulted in identifying new codes added to the preliminary list.

4. Findings and Discussion

The results of the interviews and analysis provided valuable insight into the willingness, barriers and incentives that drive poor sustainable construction waste outcomes in commercial construction in Australia.

4.1. Willingness

The analysis shows that all participants readily acknowledged and confirmed that the current WM practices are not sustainable and have a significant impact on the environment. In addition, all expressed a strong willingness to implement more sustainable WM practices and contribute to a more sustainable environment. Of those interviewed, 10 participants believe the awareness around WM issues in the industry is good. In contrast, the existing literature demonstrates limited knowledge around the possibilities of utilizing recycled materials [5] and a lack of competent staff and awareness about construction waste management [6]. Therefore, most participants concluded that awareness and willingness are no longer key barriers but rather an opportunity.

However, the analysis also shows that HCs believe they are powerless in relation to client and government requirements due to a lack of incentives for more sustainable WM practices. Most participants pointed out that the client and government are crucial in taking advantage of the willingness of HCs. This was best described by Participant E: "Especially at the corporate level, everyone knows that we don't want to send loads of waste to landfill, that we need to recycle waste, and that waste is harmful to the environment. The level of knowledge is pretty good around that, but the challenge is translating that desire to do the right thing into reality and getting the right outcomes on-site. This comes back to the client, the cost, and the program. We do what our client tells us to do, and if we do anything beyond that, we lose money, so where is the incentive?". Participant B highlighted that their company is 'very willing' to improve WM practices and that they see the investor and the stakeholder benefit of being sustainable and the internal benefits. Participants C and L also mentioned being very willing and stated that their company focuses on Green Star, passive houses, and sustainable design. Participant C added: "Similar to many other improvements in construction techniques and site management, it will take some time, but then it just becomes part of normal operations".

Most participants mentioned that WM competes with other important aspects; eleven participants put sustainable WM as the last priority, compared with safety, cost, time, and quality. However, Participant E explained that when you are sustainable, it does not have to be an order of priority: "Take carbon, for example, if you seek to remove carbon from your design, you will reduce your cost, as you are reducing energy. Therefore, it doesn't have to be one or the other. It can go hand in hand. Thus, if we want to focus on cost, we must focus on carbon as well. And when you reuse waste, instead of using virgin materials, it will usually have a lower carbon footprint". Although each participant was willing to contribute to a sustainable environment, it is not yet common.

4.2. Key Motivators

The participants described several key motivators for implementing sustainable WM solutions in the Australian commercial construction industry. The key motivators mentioned by more than five participants are presented in Table 2 and further discussed in Section 4.2.

Table 2. Key motivators highlighted by interviewees.

Key Motivators	Number of Participants
Opportunity to create new markets and job growth	10
Reduced construction costs	8
Circular Economy and reduced embodied energy	8

The opportunity to create new markets and job growth was a top motivator mentioned by participants. This finding is consistent with the related literature, which points out that sustainable WM is an opportunity to create niche markets and job opportunities in the local markets, while this can incentivize the government and several stakeholders in the industry [6]. Participant C stressed that sustainable WM is a great motivator to create small-scale industries in the resource recovery sector. Participant D had the same opinion and added that it would lead to innovations in the recycling industry, which create economic benefits. Participant E thought that besides new jobs, it could foster a (local) CE. It was a common opinion that the construction industry is mainly cost driven. A key motivator for implementing sustainable WM solutions is to reduce construction costs, energy consumption and landfill taxes, which is in line with the findings of Shooshtarian et al. [6]. For instance, Participant B emphasized that cost benefits can be achieved by implementing prefabricated and standardized construction components to the design. This reduces waste generation, time, and costs (mass production, economy of scale, etc.). Participant E had a similar view, pointing out that "it is in our interest to implement the waste hierarchy and reduce the amount of waste that we send to landfill because we save money". In contrast to the findings of O'Farrell et al. [15], which indicate limited awareness about the financial benefits of minimizing and avoiding waste, this research shows that participants are aware of cost savings that can be achieved through waste elimination.

The participants expressed equal interest in contributing to a CE and reducing the embodied carbon for a more sustainable environment. Participant E acknowledged the advantages of making new products from waste materials while fostering an ongoing loop that can occur: "That is what we need to get to right. That is the definition of human sustainability". Participant B had similar views and stated that "environmental and cost benefits can be achieved by using more recycled content in the construction of buildings, as well as by getting those recycled materials back into the CE again. For example, the use of more sustainable concrete, with higher recycled content in it". Participant C agreed, mentioning that recovering resources has significant energy and carbon benefits. Participant D acknowledged this argument and stressed that "it is important for our environment to decrease the use of raw materials and the embodied energy that is used to create materials". In contrast to existing literature, which presents a lack of awareness of the environmental impact caused by poor WM [3], this research shows that participants are mindful of the environmental need for sustainable WM practices in the industry. The participants' consciousness of the CE and its link to sustainable WM is encouraging. However, it is also clear that the CE remains a concept, and the operational task of improving WM practices, including material recycling, is not connected. The key motivators mentioned by participants in this research support existing literature, which denotes that benefits of sustainable WM solutions can include more recycled content and utilizing more secondary materials in construction projects, reduced waste generation, less pollution, lower consumption levels, and decreased pressure on landfill capacities and natural products leading to reduced emissions [13].

4.3. Key Barriers

The participants were asked to mention key barriers to implementing sustainable WM solutions in the Australian commercial construction industry. The key barriers mentioned by more than five participants are presented in Table 3.

Despite the willingness in the industry and the key motivators for implementing sustainable WM solutions, various barriers were mentioned by interviewees, which are challenging to solve. The key barriers pointed out by participants are in line with the findings in the literature review, except for the reporting reliability of waste contractors in the industry, which is a new finding in this research.

Table 3. Key barriers highlighted by interviewees.

Key Barriers	Number of Participants
Reporting reliability of construction waste	10
Site constraints	9
Additional costs, time, and resources for WM on-site	9
Lack of (financial) incentives around sustainable WM	7

During the interview discussions, interview participants expressed a lack of confidence in the reporting reliability of waste contractors. Participant F mentioned a lack of transparency on how their waste is managed at waste facilities. Participant E emphasized that waste contractors who pick up the waste from construction sites mostly conduct visual estimations at their waste facilities to determine the percentage of different waste types rather than automatic checks, which makes the system unreliable. Participant J stressed that the reporting system is based on percentages, which often shows satisfactorily high recycling percentages, while it is unsure how valid those outcomes are, making the system a waste of time. Most participants mentioned a lack of incentives to improve reporting reliability. Participant B strengthened this argument by saying: "People got so used to seeing reports that have a 90% plus recycling rate that government contracts and requirements are framed around that. But those are made up by the waste contractor companies and will realistically be lower. Therefore, there are external drivers that require a high recycling rate, rather than the best actual recycling rate or the best environmental outcome". Participant E admitted that it saves time and cost for their company to use a waste contractor because they use one bin for all the waste, and the waste gets sorted by the waste contractor (off-site). However, they rely on the sorting system of the waste contractor. Participant B had a similar opinion, stating that it would be cost-prohibitive for HCs to sort and weigh the waste on the construction site. Participant B pointed out a lack of audits on waste contractors and that waste facilities are not mandated to publish their average recycling rate. Participant E acknowledged this argument and explained that "waste contractors do not have an incentive from a regulator point of view to give construction HCs 100% accurate waste reports". Most participants expressed their concern regarding reporting reliability, which is the main barrier that was found in this research. When it comes to waste reporting, it was a common belief of the interviewees that we are fooling ourselves in the industry with WM reports that show great recycling rates, while people strongly suspect that the reality is different. This takes away the incentive in the industry to perform better in sustainable WM, as construction companies are confronted with recycling rates that they perceive as inaccurate and unreliable. The participants feel powerless to change this issue, which indicates that solutions from other stakeholders are required to solve this problem.

Several participants raised concerns about on-site space, which is found to be a key barrier for separating different waste materials on-site. As a result, a single waste bin is used on the construction site, and waste gets contaminated. This supports existing literature regarding space constraints for segregating, handling, and storing materials [15] that impact quality and demand for secondary materials [3]. Interviewees B, C and D mentioned that it is unrealistic to have several waste bins on site, especially in urban areas where there is not enough space on site. Participants E, H, and M had similar opinions and emphasized that limited space on site is the main barrier, which restricts the opportunity to separate waste materials. Participant B pointed out that the single-bin solution on-site, which gets sorted off-site by waste contractors, is not ideal because it increases the contamination of different waste materials and reduces the accuracy of waste reporting. Nine participants mentioned that important barriers are the additional time and costs to sort the waste materials on-site, including the required effort to transform towards sustainable WM practices in the daily workplace. For instance, participants B, D and E stressed that there is averseness and lack of care from labour. It was a common statement that waste is a significant cost item for construction projects for the disposal of waste and transportation of waste. Participant E clarified: "Five years ago, we used to sort all waste on our sites ourselves. That has its challenge. It takes up space, is time-consuming, requires extra resources to separate waste on-site, and often people do not put the right waste materials in the right bins, and you need to manage this process". Participants C and D acknowledged this view and pointed out that cost is the biggest challenge a construction company will encounter when separating, sorting, and transporting the waste by themselves. The results confirm existing literature, which implies the additional time and costs associated with separating, transporting, and reprocessing waste, keep builders from implementing sustainable WM practices [6].

Participants are also concerned by the lack of (financial) incentives from the government to encourage sustainable WM practices, including a lack of penalties for unsustainable WM practices, low landfill levies, and a lack of promotion and education around (innovative) solutions that drive better WM outcomes in the industry. The findings are in line with existing literature, which expresses the lack of education around WM issues [3] and a lack of government incentives to support the quality and use of recycled products [5,6].

4.4. Incentivization

The participants were asked how HCs can be successfully incentivized to implement sustainable WM solutions for commercial construction in Australia while complying with regulations. The key incentive strategies proposed by more than five participants are presented in Table 4 and further discussed in Sections 4.4–4.6.

Table 4. Key incentives highlighted by interviewees.

Key Incentives	Number of Participants
Influence the selection of building materials	11
Financial incentives on materials and waste	11
Programs initiated by government & industry regulators	8
More audits and government control	7

The analysis consistently demonstrated that the reason for not improving sustainable WM practices is that the barriers, such as those listed in Table 3, are too substantial and that removing the existing key barriers would enable HCs to implement sustainable WM practices. Most participants raised significant work before sustainable WM practices can be achieved. This is mainly because participants do not want to compensate for other important aspects of construction projects (including cost, time, and quality), which are essential to keep ahead of the competition in the market. It was a common opinion that implementing sustainable WM solutions would only happen if the government, clients, or industry regulators came up with viable programs, incentives, or enforcement. As clarified by Participant E, "We are driven and motivated by what the government and our clients ask us to do. If they allow us to do something and it is the cheapest way to do something, then market forces prevail".

4.5. Incentivization through Influence from Client and Design Team

11 out of 13 participants pointed out that the client has a significant influence on the selection of building materials from a design perspective. Participants B and J emphasized that the client is decisive in choosing between conventional construction and prefabrication. For instance, the client can influence the design of standard column sizes, which enables precast columns. This avoids the need for formwork and in situ concrete pores, which reduces waste (and costs). Another example mentioned by Participant B was "trying not to have 100 different bathroom types, but rather the same types, which allows modular units built off-site". Participant B strongly believes that waste reduction has a significant opportunity in Australia because "in Europe, landfill space is scarce, and they are more efficient with materials you bring to site". This presents an opportunity in the early planning stages that are controlled and incentivized by the client. Participant C also stated that clients should consider the life cycle of the main materials used in construction and have that as a major consideration for selecting materials in design, as "this can flow through to

the types of waste that get generated as well". Participant E has a similar view but also pointed out that prefabrication is not something that develops quickly in Australia, due to the more risk-averse culture, with more hesitance for innovations, compared to Europe. This finding is consistent with the Office of the Chief Economics report [17], which shows that the Australian construction industry is slow in implementing innovations. Participant D clarified that if you get the design stage right, including the right material selection, the rest will take care of itself. This finding confirms the literature review, which indicates that material consumption and waste generation are influenceable from the early stages, and design optimization can contribute to increased recycling and reduced waste remains in construction projects [22], which satisfies the CE concept. Participant D also recommended including KPIs for WM in the tender request, which is controlled by the client. Participant B had the same view and stated that HCs should be assessed against KPIs, and the measures of KPIs should be based on volumes, for instance, the average of waste generated per apartment. "That would incentivize efficient use of materials on site, especially if you know it will be assessed and possibly, somehow linked financially". Participant M supported this and stressed that a WM shift in the construction space needs to come from the client and the architect. The finding that HCs can be successfully incentivized through WM KPIs that are assessed, financially linked, and controlled by the client has not previously been identified in the literature review.

4.6. Incentivization through Influence from Government and Regulators

It was a common opinion that HCs could be successfully incentivized by applying more financial incentives on materials and waste, which can either penalize poor WM practices or provide credits for more sustainable WM practices. Interviewee I mentioned that "the waste levies are not high enough to keep people from going to landfill". Participant E emphasized: "put it in our contract, and either incentivize us with money or take money away from us". Participant C pointed out that the biggest overriding challenge is the low cost of getting rid of waste, whereas, in Europe, they are constrained with limited space, making the cost of waste disposal very high. "When it becomes very expensive to dispose of waste, you would come up with innovative ways of doing other things, for instance, recovering resources". Participant B acknowledged this argument and stated: "the more landfill rates go up, the better". Despite the landfill levy increase of 61% from 2020–2021 to 2021–2022 [20], the results imply that penalties are not high enough to force the industry towards (innovative) solutions that drive better WM outcomes. Participant B also mentioned that independent rating systems, including Green Star, should focus more on construction waste credits to incentivize sustainable WM solutions. Participant E argued that "if materials cannot be disposed of sustainably, companies should not be making things from these materials. To avoid this, the industry needs a stewardship program imposed by the government that holds the manufacturers of such materials to account". Participants C and L had the same view. They mentioned that industries experienced positive effects from penalizing materials you do not want people to use, including materials that are harder to recycle.

The interviewees consistently expressed that programs initiated by the government and regulators are essential to successfully incentive HCs in the industry. Participant C stressed that most of the paid landfill levy goes back to state governments for resource recovery, recycling, and WM programs. However, not many landfill funds focus on the construction sector. Participant C also mentioned that this levy could incentivize construction HCs towards more sustainable WM practices, such as trying out new initiatives. A new finding not identified in the existing literature is that HCs can be successfully incentivized through government programs that promote and support improved site facilities and the behavior of people on-site that use these facilities for better WM outcomes. Participant D clarified that "programs should also focus on providing site facilities that are easy to understand, to incentivize sustainable WM practices on site, for instance, separate waste bins that are clearly labelled, separately for timber, concrete, and so forth". Participant

B had the same view and mentioned that separate waste bins on site would incentivize better WM practices as long as people are trained to use the bins properly and a waste monitor is present on site to monitor whether the bins are correctly used. Waste bins should also be structurally easy, for instance, slots that only allow specific materials to fit through. Participant C stressed that the government and regulators in the industry should create separate waste streams, and places for people to dispose of them, manage them, and recover resources from, adding that "once the pathways are created, you can start to work with the generators of waste to load it all up". Participant I had a similar view and stated that the best way to achieve sustainable WM outcomes is to invest more in waste infrastructure.

Another key incentive raised by all participants was that transparent WM reports should be mandated and that government control is essential to improve the reliability of waste reporting by waste facilities. This has not previously been identified in the literature as an incentive strategy to improve the reliability of WM reporting by waste contractors. Participant B mentioned that waste contractors should be frequently audited by an independent authority. Participant E stressed that real-time tracking of the waste contractor trucks should be enabled to provide transparency around the transportation of waste, while Participant D pointed out that the issue of waste reporting reliability should be completely controlled by the government to overcome the barrier. "This can be achieved by making the council responsible for picking up the waste, processing the waste, and reporting of the waste, which also provides transparency about the transportation, sorting, and recycling of the waste". Participant K had a similar view and added that the government should make suppliers and subcontractors responsible for managing their waste. Participant E agreed and clarified that the government should come up with legislation that enables HCs to send waste (including packaging) back to the suppliers.

5. Conclusions

This research investigated how head contractors (HCs) can overcome barriers to sustainable waste management (WM) in the Australian Construction industry, focusing on the willingness of those involved, key barriers and potential incentives.

Building on the available literature, this research has shown that Australian HCs have a positive perception towards the implementation of more sustainable WM solutions and, thereby, want to contribute to a more sustainable environment, consequently contributing to a circular economy (CE), as well as opportunities to reduce construction costs, create new markets, and foster job growth. This research shows that participants are aware of the environmental need for sustainable WM and the cost benefits that can be achieved through waste reduction and utilizing recycled materials. This willingness presents an undervalued opportunity to increase sustainable WM, which is not yet common. It was identified that the barriers to sustainable WM practices are too substantial and that removing the key barriers would enable HCs to implement sustainable WM practices. The client and government are crucial in taking advantage of the willingness of HCs. Removing the key barriers such as reporting the reliability of construction waste, site constraints, lack of (financial) incentives, additional time and costs for WM on-site, averseness and lack of care from labour, and poor quality of waste data are critical for incentivizing HCs to implement sustainable WM practices. The lack of confidence in the reporting reliability of waste contractors is the main barrier found in this research. Waste reports from waste contractors show recycling rates perceived as inaccurate and unreliable, which takes away the incentive for HCs to perform better in sustainable WM.

The incentivization of HCs towards sustainable WM practices requires several stakeholders to be involved, with the influences from clients and the government most crucial to overcome the barriers. The key incentives identified include more financial incentives on waste and materials, including credits for sustainable WM practices, and increased penalties for poor WM practices, including using materials that are harder to recycle. HCs can be incentivized through programs initiated by the government and industry regulators, including initiatives that support improved site facilities and the behavior of people on site that use these facilities, aiming to increase the proportions of recyclable materials used in construction and encourage a CE. Action from the government is required to mandate transparent WM reports and improve the reliability of waste reporting, either by conducting more audits on waste contractors or by taking over the responsibility and managing waste and recovery facilities by themselves. This improves confidence in the accuracy of WM reports and can encourage HCs to achieve higher actual outcomes. HCs need the government to increase the transparency of WM processes and outcomes at waste facilities, such as published average recycling rates, which enables selecting waste contractors based on actual performance for the best WM outcomes. Participants are aware that design optimization is critical to achieving better WM outcomes. Participation from clients is required to become effective, especially in the early stages, since they influence the design and the way materials are used, including the option for prefabrication as a sustainable WM solution. Therefore, the client has a significant influence on the recycled content, material consumption and waste generation of construction projects. The results also reveal that HCs can be successfully incentivized through WM KPIs that are assessed, financially linked, and controlled by the client. The measures of WM KPIs can be based on volumes, for instance, the average of waste generated per apartment, which would incentivize efficient use of materials on site. The findings in this study are significant for the government, property developers, clients, design teams, and regulators in the industry to help develop strategies to improve WM practices for commercial construction companies in Australia, which benefit the environment, the economy, and society. Of specific value to the industry is the understanding that HCs are generally willing to improve WM practices. However, regulations and additional costs to clients are found to be key barriers. Potential actions include communicating the opportunities and benefits of pursuing sustainable WM for both the project and the environment.

6. Limitations

Despite the contributions of the present study, the findings need to be considered with several limitations. The interviewees were mainly based in Victoria State; thus, their perceptions of WM practices are reflective of the culture and regulatory setting of the Victorian Government. Therefore, the direct application of the findings to other states and territories in Australia needs to be considered with caution. Future research can be conducted considering a wider range of stakeholders and experts in the field. Moreover, the findings are based on the interviewees' perceptions rather than quantitative analysis and performance measures, which provide the field with opportunities for future research.

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