

Examining the Transition towards the Supply of Sustainable Apartments in Australia: A Design Perspective [†]

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Abstract: The built environment in Australia accounts for about 25% of total greenhouse gas emissions (GHG), where only the multi-unit residential buildings account for a quarter of these emissions. Moving towards sustainable constructions and green buildings can help in reducing GHG emissions and their negative effects. In this context, integrating Circular Economy (CE) principles into buildings' projects can further help in reducing the environmental impact of the building stock. The purpose of this research is to explore the embracing of CE in the apartment industry. Personal experiences and perspectives of 5 stakeholders from Vitoria and NSW involving sustainable new and retrofit apartment buildings are investigated by drawing on the results of the semi-structured interview. Results underlined barriers and opportunities for designing sustainable apartments.

Keywords: new build; retrofit; sustainability; circular economy; residential buildings; Australia



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1. Introduction

In Australia, 25% of total GHG emissions are attributed to the built environment sector [1]. The multi-unit residential category accounts for a quarter of these emissions, making it the highest weighting [2]. Australian population growth contributes to the fast development of apartment buildings [3]. Most significantly, high-density apartment buildings have accounted for one-third of all residential building approvals in 2015 [4], and according to the 2016 Australian census, over 2 million Australians chose to live in apartment buildings.

The population of Sydney City is forecast to grow by over 45% from 2011 to 2030. By this time, approximately 80% of residents will be living in apartments, and at least 90% of the newly built dwellings will be high-rise buildings with more than six storeys. In Sydney, apartments alone are responsible for approximately 10% of the City's GHG emissions [5], 38% of potable water consumption [6], and 14% of the total waste generation [7]. In Melbourne, more than 83% of the residents live in apartment buildings, and each year, apartment living contributes to approximately 9% of GHG emissions, 22% of the city's water usage, and more than 20,500 tonnes of waste [8].

The growing apartment population in Australia and the corresponding substantial contribution to GHG emissions, high resource consumption, and waste generation are considered an issue of great concern that needs to be addressed [9]. As a large contributor to the global GHG emissions, Australia is also assessed through the achievement of the Nationally Determined Contributions targets [10]. However, due to a high level of friction in the building sector, the actions put in place to meet those targets have not provided a significant impact on the built environment yet, especially in the apartment industry [11].

Sustainable constructions and green buildings have been considered and investigated as solutions for reducing GHG emissions and their negative effects [12]. It is well known that sustainable housing is more than environmental benefits; it is about benefits for all

pillars of sustainability: social, environmental, and economic pillars [13]. Past studies identified that the centre of attention of the Australian sustainable housing sector is on detached houses despite the high and growing influence of apartment buildings [14,15].

Apartment developments differ from other building typologies throughout their whole life cycle; therefore, along with a sustainable design approach, it is also important to consider the nature of its development strategy. In order to achieve greater operational and embodied energy efficiency in apartment buildings, it is necessary to identify new methods and design approaches and promote them through educational, promotional, and regulatory programs [16]. The application of promising methodologies, such as Circular Economy (CE), is based on a comprehensive examination of the overall needs of delivering sustainable apartment buildings [17]. This study presents a preliminary attempt aimed at examining how a transition towards the supply of sustainable apartments in Australia can be encouraged particularly from a design perspective.

2. Materials and Methods

Figure 1 shows the framework of the research background associated with the present study (a) and summarizes the concept of CE applied to the built environment (b).

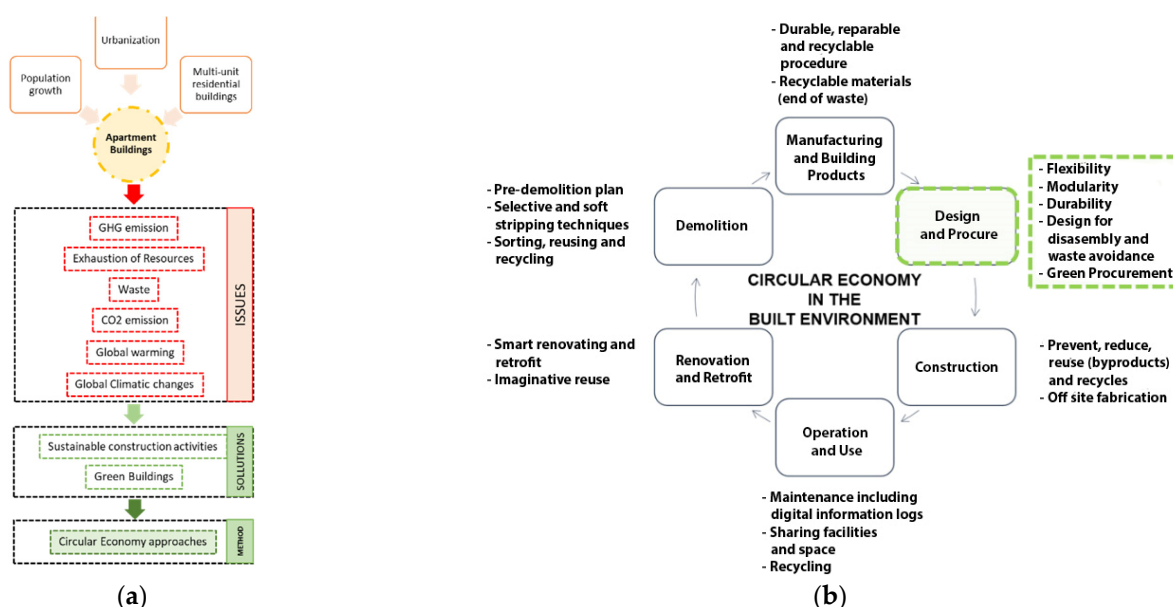


Figure 1. (a) Framework for the research background and (b) CE in the built environment (BE) in summary.

The research is based on a qualitative methodological approach, where dedicated remote interviews oriented at collecting information on the personal experience and perspectives of apartment building industry stakeholders, from across the Victoria and New South Wales Metropolitan and Regional areas, has been carried out. To identify the delivery, designing, and construction differences among typical and sustainable apartment developments, 5 stakeholders, i.e., builders and consultants, were selected from each state.

Due to Human Research Ethics requirements, the identification of these stakeholders is confidential, but a purposeful sampling was used to recruit participants based on the available information pertinent to the research question. An interviewee data code was developed based on (i) stakeholder's role, (ii) typical or sustainable apartment developments, (iii) state, (iv) metropolitan, or regional area. Data were collected through recorded 1-h structured interviews with an informal conversational tone. The questions aimed to explore the participant's perspective and experience on opportunities, challenges, and barriers concerning the design, delivery, and construction phase of sustainable apartment developments. NVivo 12 pro was used for qualitative data analysis [18]. This approach aims to explore solutions to promote the transition towards sustainable apartments.

3. Results

The total work involvement of the selected stakeholders during their work time period is presented in Figure 2. Table 1 presents the key messages extrapolated from the five interviews for each phase. The five participants are associated with the following codes: (i) BT2NM, builder working on typical apartment buildings in NSW metropolitan area; (ii) CS2NM and CS2NM, consultants working on sustainable apartment buildings in the metropolitan area of NSW; and (iii) CS2VM and CS2VM, consultants working on sustainable apartment buildings in the metropolitan area of Victoria.

Table 1. Summary of design opportunities and challenges indicated by participants during the interviews for each identified phase.

Identified Opportunities and Challenges in Design and Procedure					
Phase	BT2NM	CS2NM	CS2NM	CS2VM	CS2VM
Preliminary planning - Consultancy tenders - Site Investigations - Precedent studies - Brief preparation	The developer, or the client, has any prerequisites and sustainable requirements.	Cost: I do not necessarily think they do cost more.	Circular Economy: regulations and opportunities available to help and educate local suppliers and builders	Marketing net-zero carbon buildings, improve standards, experienced work force to deliver sustainable buildings.	Cost: that is only a temporary thing. There is a niche in the market and massive opportunity to educate industry.
	Financial gain: developer has to understand the need of sustainable developments. Cost: acquisition and maintenance cost of sustainable materials. Clients are interested in the costs associated with the life cycle of their ownership. Supplier's capacity to produce substitute materials in larger scale is less. Strength and procurement process of substitute materials to be considered.	Profit/Education/Cost: investors think commercial/office properties with higher sustainable credentials worth more. Developers are motivated by increasing their profit and forget the longer term impact. Apartments are delivered by lower tied consultants, developers, contractors. Increased consultant fees to take initiatives. Projects follow the developer's corporate strategies.	Affordability: market is high for build to rent. Affordability vs. Investor's intend to rent. Educating people: people do not know what to do with the climate change issue. Mentality of the upfront costs, making things more about the long term gains. Regulatory influence: government is not supporting for these developments.	Cost: biggest barrier Education/Information lack of understanding (both on the development side and the purchaser's side, And the marketing person)	Knowledge: poor knowledge of people in construction, both in on the design side and on the construction side.
Schematic design phase - Concept - Drawing/Reports/Models - Estimates	Recyclable materials, natural and durable products, energy efficient aspects. Initial design phase: elements can be used in architectural, services, hydraulic for sustainable development.		To get the approval quickly, the developers tend to include higher standard (integrating sustainable features) to their developments.	Main opportunities are virtual power plant, renewables and batteries, not a precinct scale and how they link into buildings. Opportunities when we have integrated design processes.	
				Design optimization: no same vision from the beginning.	

Table 1. Cont.

Identified Opportunities and Challenges in Design and Procedure					
Phase	BT2NM	CS2NM	CS2NM	CS2VM	CS2VM
Design development phase - Planning, Building, and other legislation - Permit drawings			State a revenue version of the current standard codes and guidelines. Codes to achieve sustainability are starting to put, but changing is not fast enough.	For a fast approval process tendency to do better buildings. Victoria has sustainability objectives and standards. Planning trivial and building regulations	
	None of the regulations have enforced solar energy or electric car charges. The only regulation is on the use of recyclable material minimizing them during construction.	National construction code: Basics, which is not great.	Some codes are not mandatory and not enough to deliver sustainable apartments. Building code needs to not just focus on energy efficiency but other aspects and cover retrofitting.	Rating system is not a strong factor and effective in residential development The regulation at the base level: no strong impact.	Regulation: poor regulations and the difficulty of changing those regulations.
Construction document phase - Working drawings - Specifications - Co-ordinate consultants drawings		Technology is there to reduce energy consumption in apartments.	LCA: essential at the beginning of the project. People ask for comfort, clean air, acoustic. Codes to achieve sustainability. Consultants engaged in detail designs. We have technology to assess the building before build.	Chosen Framework: ex. Green star requires a great deal of technical assessments, details, management Integrated design process: great deal of opportunities	Technology to design better building is out there. (modularization of the system by using the buying power of developments, heat recovery ventilation systems, putting in efficient lighting)
	Apartments buildings are physically inter related				
	Energy efficiency (shared resources). Less maintenance (shared services). Bigger scale reduce the environmental impact.	Centralised systems can be more cost effective to build into operate, and that has an associated sustainable benefit.	Generate more efficiencies (common systems). Shared resources, Communal spaces. Save individual spaces.	Shared walls: limited external fabric, can get a much better energy efficiency, more comfort, shared services.	Encourage people to things in most efficient way (tenants: using stairs more instead of lifts).
	Internal/external constraint. Services become more challengeable. Less spatial quality.	Managing centralised system. Developers sell apartments, not managing energy supplies.	Lot more controls required (management). Trust issues when using shared resources.	Low facilities, poor orientation and poor amenity for some units	

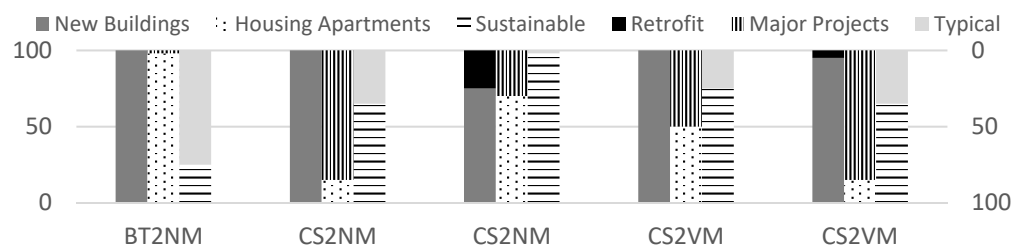


Figure 2. Work involvement of the interview participants during their professional career.

4. Conclusions

This paper reports on the design perspectives in the context of a CE within the Australian apartment sector. It emerged a clear need and demand for new build and retrofit sustainable apartments; yet, stakeholders raised the difficulty in changing the business as usual, and the issue related to the fact that the transition toward sustainable apartments is not fast enough. It is found that the financial impact on sustainability is only an assumption,

and it is temporary. Regulation and policies are the natural intransigencies in the industry. There is a massive opportunity to put in place new regulations and actions in the industry, embracing the CE-based concepts relevant for the apartment development sector. Results from this preliminary study provide some pieces of evidence on the fact that more time is taken for the investigation of the nature of the problem than for the investigation of possible solutions. A high level of complexity of the design process can be simplified by providing more time for the investigation of alternative solutions to identify the optimal solution. A more comprehensive analysis including interview results from different stakeholders will be performed in continuation of this work.

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