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FINAL REPORT NO. 400

Delivering sustainable apartment housing: new build and retrofit

From the AHURI Inquiry: Inquiry into housing in a circular economy

Authored by

Hazel Easthope, UNSW Sydney

Jasmine Palmer, RMIT/UNSW Sydney

Andrea Sharam, RMIT

Megan Nethercote, RMIT

Gloria Pignatta, UNSW Sydney

Laura Crommelin, UNSW Sydney

Publication Date June 2023

DOI 10.18408/ahuri7128201

The logo for AHURI (Australian Housing and Urban Research Institute) features the acronym "AHURI" in a bold, black, sans-serif font. A red curved line arches over the letters "H" and "U".

Title

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Authors

Hazel Easthope, UNSW Sydney
Jasmine Palmer, RMIT/UNSW Sydney
Andrea Sharam, RMIT
Megan Nethercote, RMIT
Gloria Pignatta, UNSW Sydney
Laura Crommelin, UNSW Sydney

ISBN

978-1-922498-67-0

Key words

Circular economy, sustainability, apartment, strata title, development, retrofit.

Series

AHURI Final Report

Number

400

ISSN

1834-7223

Publisher

Australian Housing and Urban Research Institute Limited Melbourne, Australia

DOI

10.18408/ahuri7128201

Format

PDF, online only

URL

<https://www.ahuri.edu.au/research/final-reports/400>

Recommended citation

Easthope, H., Palmer, J., Sharam, A., Nethercote, M., Pignatta, G. and Crommelin, L. (2023) *Delivering sustainable apartment housing: new build and retrofit*, AHURI Final Report No. 400, Australian Housing and Urban Research Institute Limited, Melbourne, <https://www.ahuri.edu.au/research/final-reports/400>, doi: 10.18408/ahuri7128201.

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Acknowledgements

This material was produced with funding from the Australian Government and state and territory governments. AHURI Limited gratefully acknowledges the financial and other support it has received from these governments, without which this work would not have been possible.

AHURI Limited also gratefully acknowledges the contributions, both financial and in-kind, of its university research partners who have helped make the completion of this material possible.

The authors would like to thank the following organisations for their contributions to the research:

- Angelo Candalepas Associates Pty Ltd
- Ark Resources
- Atelier Ten, Melbourne
- Aurecon Group Pty Ltd
- Australex Group Pty Ltd
- Australian Building Codes Board
- BlueGreen Engineering Pty Ltd
- Bright & Duggan
- City of Melbourne
- City of Sydney
- CKDS Architecture, Newcastle
- Frasers Property Australia
- Hacer Group Pty Ltd
- Hayball
- HIP V. HYPE
- ICON Developments Australia Pty Ltd
- Klaar
- MGS Architects Pty Ltd
- Meriton Group
- Milieu Property
- New South Wales Department of Planning and Environment
- PJ Project Services
- Sustainable East Pty Ltd
- Sustainability Now
- The Knight – Owners Corporation Managers
- Victorian Department of Environment, Land, Water and Planning

The authors would also like to thank the following people for their assistance in preparing the report:

- Hyungmo Yang
- Jiahang Li
- Danielle Hynes
- Sophie-May Kerr
- Parian Hoseini
- Shixiong Xu

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Acronyms and abbreviations used in this report

ASBEC	Australian Sustainable Built Environment Council	ESD	Ecologically Sustainable Development
ACT	Australian Capital Territory	ESG	Environmental, Social and Governance
ADG	Apartment Design Guide (NSW)	EV	Electric Vehicle
AHURI	Australian Housing and Urban Research Institute	FSR	Floor Space Ratio
APHA	Australian Passive House Association	GBCA	Green Building Council of Australia
APRA	Australian Prudential Regulation Authority	GHG	Green House Gas
BADS	Better Apartment Design Standards (VIC)	HR Fit	Housing-Resident Fit
BASIX	Building Sustainability Index	IPWEA	Institute of Public Works Engineering Australia
BESS	Built Environment Sustainability Scorecard	IRQ	Investigative Research Questions
BCA	Building Code of Australia	IRR	Internal Rate of Return
BTR	Build-to-Rent	JLL	Jones Lang LaSalle (International property advisory)
BTS	Build-to-Sell	LBC	Living Building Challenge
Capex	Capital Expenditure	LGA	Local Government Area
CASBE	Council Alliance for a Sustainable Built Environment	NatHERS	Nationwide House Energy Rating Scheme
CE	Circular Economy	NABERS	National Australian Built Environment Rating System
CHP	Community Housing Provider	NCC	National Construction Code
CLT	Cross Laminated Timber	NHFIC	National Housing Finance and Investment Corporation
DA	Development Application	NSW	New South Wales
D&C	Design and Construct	NSW DPE	New South Wales Department of Environment and Planning
ND&C	Novated Design and Construct	RQ	Research Question
DBPA	Design and Building Practitioners Act 2020 (NSW)	SEPP	State Environmental Planning Policy
DCP	Development Control Plan	SGA	Smart Green Apartments
DELWP	Victorian Department of Environment, Land, Water and Planning	UHI	Urban Heat Island
EPBD	Energy Performance of Buildings Directive	VEET Scheme	Victoria Energy Targets Scheme
ESC	Energy Savings Certificates	WP	Work Package

Glossary

A list of definitions for terms commonly used by AHURI is available on the AHURI website ahuri.edu.au/glossary.

Executive summary

Key points

- A very small proportion of apartment building projects contain sustainability features that exceed minimum standards.
- Resident demand exists for more sustainable apartments, but speculative strata titled development contributes to a disconnect between what gets built and what consumers want.
- Sustainability is rarely embedded in project feasibility. Changes are often made during construction to reduce costs, and performance is not adequately reflected in property valuation.
- Shared services and the inter-dependence of apartment properties offer opportunities for improved sustainability. However, these opportunities are often missed due to the focus on profit maximisation during development and the challenges of shared management.
- The potential to prolong building life through maintenance is hampered by residents having limited access to building performance information, and by the need for joint decision-making about jointly-owned property.
- There is great potential to move towards a circular economy by improving the performance of new and existing apartment buildings through interventions that: i) support development teams to embed sustainability in project feasibility; ii) ensure that built outcomes reflect what was approved; iii) better account for building performance in property valuation; iv) realise the benefits of physical inter-dependence and shared services; v) ensure information on building performance is available to consumers; and vi) account for joint ownership and joint decision-making.

Key findings

A growing number of Australian residents are living in apartments. This growth is concentrated in the states of New South Wales (NSW), Victoria and Queensland. Spatial analysis of sustainable apartment development and major upgrade projects in metropolitan and regional areas of NSW and Victoria indicates that less than 5 per cent of building projects exceed minimum standards for sustainability. Sustainable developments that exceed minimum standards are primarily concentrated in higher value areas.

A review of the published evidence demonstrates that resident demand exists for more sustainable housing in Australia, including apartments. To identify how a transition towards the mainstream supply of sustainable apartments can be achieved, it is necessary to understand how and why the apartment industry resists change.

The sustainability of apartment developments (and retrofits) needs to be considered separately from other residential building typologies because the production, consumption, management and exchange of apartments differs in three important ways: i) apartments in Australia are typically provided as speculative strata titled developments; ii) the apartments themselves are physically inter-dependent; and iii) they are usually jointly owned and managed. Each of these differences has important implications for the transition towards more sustainable apartment living.

1. Speculative strata title development is linked to a disconnect between the production and consumption of new apartment buildings. This is reflected in the fact that sustainability is rarely embedded in project feasibility calculations. This disconnect also means that the apartment 'product' is not optimised in terms of performance. Changes are often made during construction to reduce costs and sustainable building performance is not adequately reflected in property valuation.
2. While the physical inter-dependency of apartment properties has many potential benefits in terms of building performance, these benefits are often lost due to a focus on profit maximisation. Shared services are also linked to shared management in strata titled properties, with associated challenges.
3. A circular economy (CE) approach points to the importance of prolonging building life through maintenance. Strata title ownership makes achieving this more challenging as collective decision-making is required for jointly-owned property. Joint ownership also contributes to the limited information available to consumers about their properties. This is because, rather than responding to the needs of a single well-informed client (like in the commercial sector), developers are speculatively developing apartments for sale to multiple unknown clients.

Addressing these challenges requires reshaping our apartment development and management processes to ensure the following outcomes are achieved:

- Development teams embed sustainability in project feasibility.
- The design and construction of delivered apartment buildings reflects what was designed and approved.
- Property valuation reflects building performance.
- The potential benefits of physical inter-dependence and shared services are realised.
- Consumers have access to adequate information about building performance.
- Sustainability initiatives account for joint ownership and joint decision-making.

Policy development options

Reshaping apartment development and management processes in the ways identified above will require significant policy change. The report presents recommendations for policy reform drawing on the experience of key actors involved in both apartment development and retrofit. The recommendations for reform include suggestions for improvements and alternatives to the current system of apartment development.

Table 1: Recommendations

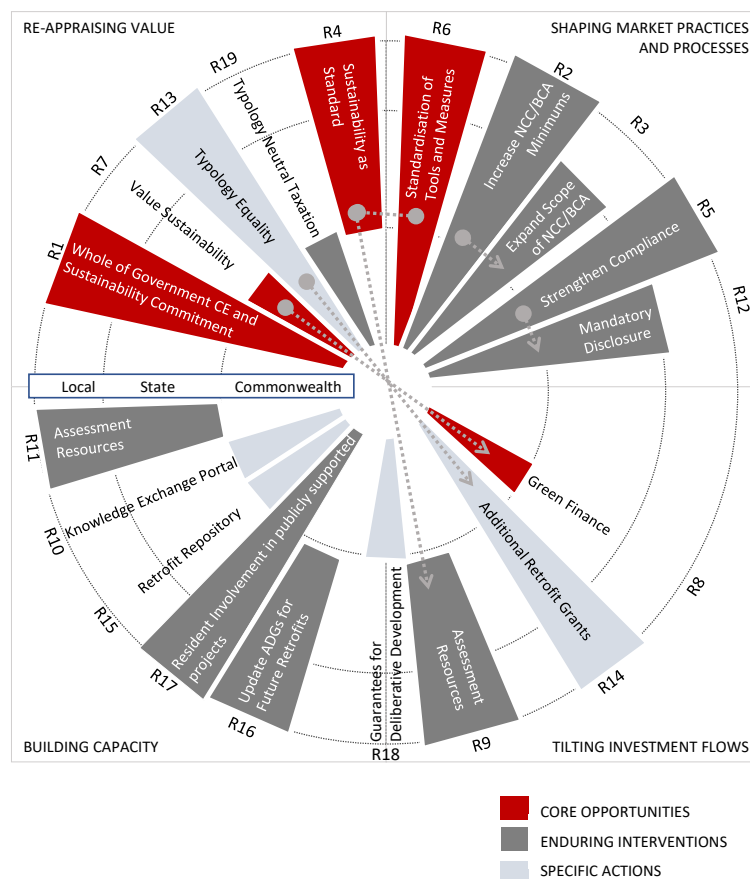
Desired outcome	Recommendations
Development teams embed sustainability in project feasibility	<ul style="list-style-type: none"> • Whole-of-government CE and sustainability commitment. • Increase National Construction Code (NCC)/Building Code of Australia (BCC) minimums: Australian Government commitment to increase minimum standards for energy efficiency in the NCC. • Expand scope of NCC/BCA: Australian Government commitment to expand the regulatory scope of the NCC beyond energy consumption in use. • Sustainability as standard: State, territory and local governments to require high sustainable performance standards in all development application assessments. • Green finance: Australian Government to explore imposing European Union style reporting obligations on financiers and establishing a process to leverage private financing in support of a transition to CE in the housing system. • Knowledge exchange portal: Australian Government support for the development and ongoing operation of an online portal to enable knowledge exchange on Ecologically Sustainable Development (ESD) in construction. • Update Apartment Design Guides (ADGs) for future retrofit: State and territory governments to update ADGs to ensure that the potential for future retrofit is considered before new apartment projects are approved. • Resident involvement in publicly supported projects: All levels of government to require publicly funded apartment projects to involve residents in design, including where publicly-owned land is made available for development.
The design and construction of delivered apartment buildings reflects what was designed and approved	<ul style="list-style-type: none"> • Strengthen compliance: State, territory and local governments to strengthen regulations for pre- and post-occupancy compliance auditing to ensure approved performance standards are met at the planning and building permit stages. • Standardisation of tools and measures: Australian Government and state and territory governments to implement programs to standardise tools, measures and regulations for building performance. • Assessment resources: State and territory governments to ensure that the planning assessment system is adequately resourced to assess building performance for sustainable developments.
Property valuation reflects building performance	<ul style="list-style-type: none"> • Value sustainability: Australian Government support for the development of a process for incorporating sustainability into valuation practice.
The potential benefits of physical inter-dependence and shared services are realised	<ul style="list-style-type: none"> • Knowledge exchange portal: See above. • Additional retrofit grants: All levels of government to introduce additional government grants to incentivise housing retrofit projects. • Retrofit repository: Australian Government commitment to fund the development and ongoing operation of an information repository to support the sustainable retrofitting of apartments. • Resident involvement in publicly supported projects: All levels of government to require publicly funded apartment projects to involve residents in design, including where publicly-owned land is made available for development. • Guarantees for Deliberative Development: Australian Government to provide government guarantees for Deliberative Development construction loans. • Typology neutral taxation: Australian Government to review and amend housing taxation system to identify and amend inequities between housing typologies.
Purchasers and renters have access to adequate information about building performance	<ul style="list-style-type: none"> • Standardisation of tools and measures: Australian Government and state and territory governments to implement programs to standardise tools, measures and regulations for building performance. • Mandatory disclosure: Australian Government to mandate the collection of environmental performance standards for all apartment buildings and their publications on advertising and transaction portals for rent and purchase.

Desired outcome	Recommendations
Sustainability initiatives account for joint ownership and joint decision-making	<ul style="list-style-type: none"> • Legislative and regulatory amendments for retrofits: State and territory governments to explore legislative and regulatory amendments to encourage and support sustainable retrofit in strata schemes. • Typology equality: All levels of government to review existing and future government grants for sustainability upgrades to ensure common property is considered to avoid exclusion of strata properties. • Additional retrofit grants: See above. • Retrofit repository: See above.

We have classified these recommendations under four main themes: re-appraising value, shaping market practices and processes, tilting investment flows, and building capacity. Figure 1 shows how the proposed reforms align with these themes, as well as identifying the responsible level(s) of government, and the nature of the proposed reforms:

- Core opportunities are big-picture, aspirational recommendations. Realising these will require the further development of a suite of more detailed and prescriptive interventions and actions.
- Enduring interventions are more specific recommendations that will need to be further developed with consideration of feasibility and path dependencies, and the engagement of key stakeholders to assist in co-design and implementation.
- Specific actions are more targeted recommendations with suggested actions for implementation.

Figure 1: Recommendations



Source: Authors' Research.

These recommendations are focused on those aspects of apartment development and operation that make apartment developments unique, and on the challenges to the adoption of sustainable apartments specifically. Many of the recommendations also have relevance beyond apartment developments. This includes recommendations relating to government commitments to sustainability, capacity building and information sharing; improvements to building standards and compliance; and improvements to property valuation practice. Because key actors in the apartment delivery system include large-scale developers and major lenders, any wide-scale change in this context is likely to flow through to other parts of the housing system. The adoption of best practice in apartment development and management can therefore play an important role in helping to shift the entire housing system into alignment with circular economy principles.

The study

This research is part of a wider AHURI Inquiry into housing in a circular economy. It aims to identify how a transition towards the mainstream supply of new and retrofitted apartments that are sustainable can be achieved in Australia. This aim sits within the overarching research question guiding the inquiry into housing in a circular economy: 'how can a transition in housing demand and supply be encouraged to provide housing that is sustainable, affordable, and accessible?'

The research draws on interviews and workshops with professionals working in apartment development or retrofit in Victoria and NSW. The interviews (n=33), and industry workshops (n= 27 across 3 workshops) were conducted in 2021 and assisted in identifying barriers and opportunities to sustainable apartment development and developing recommendations for reform. These recommendations were then further developed in a fourth workshop (n=11) in early 2022 with seven policy makers from all three levels of government, along with four of the original research participants. The research also presents novel spatial analysis of the extent of sustainable apartment development and retrofit in Victoria and NSW, with reference to the CoreLogic Cordell Connect property database.

1. Delivering sustainable apartment housing

- **Sustainable apartments are dwellings that deliver on comfort and utility cost reductions for householders while minimising consumption and waste, and maximising energy efficiencies and energy management.**
- **The delivery and management of apartments differs in three central ways from the delivery of detached dwellings: i) most apartment buildings are delivered as speculative strata developments; ii) apartment properties are inter-dependent; and iii) most apartment properties are jointly owned and managed.**
- **Resident demand exists for more sustainable apartments. It is necessary to understand how and why the apartment industry resists change.**
- **Previous research has identified multiple barriers to sustainable apartment development and opportunities for navigating these.**
- **The research draws on interviews and workshops with key actors in apartment production and retrofit, as well as policy makers, to develop recommendations.**

The aim of this project is to identify how a transition towards the mainstream supply of new and retrofitted apartments that are sustainable can be achieved in Australia.

This aim sits within the overarching research question guiding the Inquiry into housing in a circular economy (CE): 'how can a transition in housing demand and supply be encouraged to provide housing that is sustainable, affordable, and accessible?'

A circular economy approach takes a whole-of-life-cycle perspective, which necessitates consideration of the design and construction of new 'future-proofed' housing, the ongoing maintenance of housing stock so that it can perform as designed, and the upgrading of existing ageing and poor-performing stock. We focus on apartment buildings not only because they house a growing number of Australians (ABS 2017) and are substantial contributors to greenhouse gas emissions, water consumption and waste generation (City of Sydney 2015); but also because they present challenges to the adoption of sustainable building practices due to unique aspects of their financing, design and construction, and management. These challenges must be understood and addressed to enable a transition towards the mainstream supply of sustainable housing.

For the purposes of this study, apartments are defined as dwellings located in buildings with two or more floors and featuring horizontal sub-division of cubic airspace. Horizontal subdivision distinguishes apartments from other multi-resident housing types, such as townhouses, which involve only vertical sub-division (Sharam et al. 2015a). We define sustainable apartments as dwellings that deliver on comfort and utility cost reductions for householders while minimising consumption and waste, and maximising energy efficiencies and energy management, both in their construction and throughout their lifecycle (including through the adoption of renewable energy technologies).

In this research we analyse the supply-side processes in Australia that impede or promote sustainability and circularity in apartment provision and retrofit. The supply focus is justified as resident demand is well documented (City of Sydney 2015). We examine the processes specific to the supply of new apartments and the retrofitting of existing apartments for sustainable futures, focusing on i) the speculative development of apartments ii) designing and constructing interrelated dwellings and iii) governing multi-unit properties.

This project generates a new evidence-base to inform policy on appropriate and effective strategies to transition apartments across tenures and price-points towards a more sustainable and circular footing.

Situating the Inquiry research questions in the context of apartment housing, this project is guided by the following research questions (RQ):

- **RQ1:** Who are the key actors in apartment production and retrofits?
- **RQ2:** How do structures of apartment provision and governance influence the adoption of sustainable apartment construction and retrofit?
- **RQ3:** What are the key challenges and opportunities in designing, constructing and adapting sustainable apartments?
- **RQ4:** What financial, fiscal, regulatory and policy settings can help drive sustainable apartment supply and retrofit in a circular economy?

1.1 Policy context

The delivery and management of apartments in Australia differ in three central ways from the delivery of detached dwellings. First, most apartment buildings are delivered as speculative developments and sold as individual strata titled properties. Because this model requires development finance, many apartment projects rely on pre-sales. This has an impact on the profile of purchasers (and hence residents). Until the market peak in 2017, investor purchasers were the most active buyers in the pre-sale market and the cheapest to find and market to (Sharam et al. 2018). For example, over the history of apartment pre-sales in Melbourne, non-resident investors have consistently represented approximately 70 per cent of purchasers (Keck 2013). This is reflected in the proportion of renters living in apartments across Australia (65% of all residents in apartments are renters, with 31% owner-occupiers), which is much higher than in detached houses (22% renters and 75% owner-occupiers) (ABS 2017). While recent years have seen a shift towards marketing new apartments to owner-occupiers (Redman 2022), investor owners still dominate the market. Only a small proportion of apartments are produced for institutional owners (such as social and student housing providers) for rental, although there is a nascent institutional Build-to-Rent sector (Nethercote 2020). This means the majority of private renters who live in apartments in Australia live in strata titled properties.

The speculative development model also has implications for the transition from the design and development stages to the operational stage in the life of a building (Easthope et al. 2014). Because speculative developments are developed for sale to multiple unit owners rather than to a single client, there is little opportunity for client oversight during the design and construction stages. The negative implications of this for subsequent owners and residents of these buildings have been well documented in Australian research with regards to building defects (Crommelin et al. 2021; Nethercote 2022) and building management (Easthope and Randolph 2016). These negative implications may have also contributed to the attractiveness of alternative Deliberative Development approaches in Australia such as the Nightingale model (Palmer 2020b). In this report, we add to this body of research by demonstrating the detrimental impact that the speculative model of apartment delivery can have on the sustainability performance of apartment buildings.

The second way in which the delivery of apartments differs from that of detached dwellings is that apartment properties are inter-dependent. This has implications for the choice of construction materials; apartment buildings require more steel, concrete, and glass compared to detached dwellings that instead use more timber and bricks as well as more insulation material per square metre (Marinova et al. 2020). It also has implications for the energy efficiency of buildings (Stephan et al. 2013; WBCSD 2009). In the case of strata titled buildings, it also means that most plant and equipment and structural components are shared between units and jointly owned by all owners (as common property).

Such shared ownership is the third way that apartments differ from detached houses. Joint ownership in apartment buildings has important implications for the ongoing management and maintenance of buildings. Joint ownership of common property has been linked to under-resourced facilities management and maintenance (Easthope 2015) and to limited awareness among residents and owners of energy and water use within their buildings (Altmann et al. 2018). It also has implications for building retrofits because of the need for collective decision making (Löschke and Easthope 2017). The fact that government schemes and subsidies targeting households are often not fit for purpose in strata titled properties due to shared ownership has exacerbated these challenges in Australia (Altmann 2014).

It is essential to understand these unique aspects of apartment delivery and management to successfully facilitate a transition to the mainstream supply of sustainable apartments in Australia. These unique characteristics are often not adequately recognised in policy. This project generates a new evidence-base to inform policies to expedite the mainstream supply of new and retrofitted apartments that are sustainable.

The supply of new sustainable apartments in Australia has been described as a niche market largely geared towards luxury product (Artopoulos et al. 2018; Mavrigiannaki et al. 2021). Sustainable new developments are offered at a price premium, excluding lower and mid-market buyers and renters (Foong et al. 2017). There is also some evidence that upgrades to existing apartment properties are concentrated in more expensive property markets (Easthope and Randolph 2021), with widespread adoption impeded by the complexities of strata governance (Altmann 2014; Gabriel et al. 2010).

Building performance is important for both the health and financial wellbeing of residents (Baker et al. 2016; Foster et al. 2020). There is evidence that apartment residents are less likely to experience fuel poverty in Australia (Poruschi and Ambrey 2018) and internationally (Horne and Hayles 2008). Yet these benefits are not shared equally. Operating costs and long-term maintenance costs impact housing affordability. These costs are unevenly borne (Haddad et al. 2019; Pignatta et al. 2017) with energy-related poverty concentrated amongst lower income and renter households (Azpitarte et al. 2015; Poruschi and Ambrey 2018). Many lower income apartment residents in Australia struggle with the health and financial implications of living in poorly maintained older apartments (Easthope et al. 2020a), as well as defectively built newer apartments (Johnston and Reid 2019). Given that more than half of Australian apartments are rented (Easthope et al. 2020a), it is imperative that the benefits of sustainable apartments are brought into the mainstream. For housing to be sustainable it must be durable, energy and water efficient, and provide a comfortable living environment for its occupants. Building quality is related to the use of durable and high quality materials that are likely to reduce the overall cost of operating and maintaining a building. Therefore, there is an implicit relationship between sustainability and building quality. Compliance with building codes and environmental performance requirements plays an important role in delivering sustainable buildings and in extending these benefits to apartment residents across tenures and price brackets. While compliance, quality and sustainable performance may not always have a causal relationship, there is an implicit relationship between them.

While there is potential for increases in residential density to improve sustainability outcomes, it is not a given outcome (Bay and Lehmann 2017; Perkins et al. 2009) and the built environment alone does not determine environmental impacts (Gray et al. 2010). Perkins et al. (2009: 377) argue '[a] more vigorous educational, promotional and regulatory approach is required to ... fully realise the emissions-reducing potential of such buildings'. Recent studies of Sydney apartments that integrate the circular economy and resilience concepts demonstrate that a multi-faceted approach engaging multiple stakeholders is needed (Porto Valente and Wilkinson 2019).

1.2 Existing research

1.2.1 Apartment resident experiences and preferences

The design and construction of new apartment buildings in Australia are informed by the regulatory requirements of the National Construction Code (NCC), state specific standards and guidelines, and local government planning requirements. Collectively, these three tiers of regulation aim to ensure new apartments are safe and healthy for residents, meet minimum efficiency standards, and contribute positively to the communities in which they are located. Most occupied apartments in Australia were designed and constructed prior to the introduction of current requirements. Understanding the experiences of residents in existing apartments, developed both prior to the introduction of current requirements and after, provides insights into the opportunities for sustainability improvements in both new buildings and building retrofits.

Apartments in Australia are more likely than other dwelling types to house renters: 65 per cent of all apartments are rented and 27 per cent of all Australian renters live in apartments, despite apartments making up only 13 per cent of all dwellings (ABS, 2017). For private apartments (excluding social housing), almost half (48%) are rented compared to 26 per cent owner occupied (with the balance unoccupied or used for other purposes). Private apartments are also more likely to house migrants (57%), people who speak a language other than English at home (50%) and single-person households (35%) (Easthope et al. 2018). Private apartments also house a substantial proportion of lower income households. Of all private apartment households living in buildings of four or more storeys, 39 per cent have a household income in the bottom two quintiles (Easthope et al. 2020a). Apartment resident profiles in Australia are diverse, with Randolph and Tice (2013) and Randolph and Sisson (2020) identifying distinctive sub-markets of apartment residents in Sydney and Melbourne. These sub-markets often spatially overlap, with multiple groups found living in the same local government area. Recent work by Easthope et al. (2020a) on lower income apartment residents found that lower income residents usually live in local areas alongside apartment households with greater financial resources.

Reviewing international post-occupancy studies of high-rise apartment buildings, Kalantari and Shepley (2020) observe residents' sustainable behaviours are limited by the buildings they occupy, with associated psychological and social impacts. An Australian study by Gower (2021) identifies how capacity for sustainable living in apartment buildings varies with tenure, concluding renters are more disempowered than owner-occupiers in selecting individual apartments with fundamentally sustainable design features such as appropriate solar orientation. A large study of the lived experience of Melbourne and Perth apartment residents shows private rental tenants are disproportionately impacted by poor design and build quality relative to co-resident owners (Nethercote 2022). Similarly, in a study of social housing apartment tenants, Moore et al. (2019: 453) describe tenants as frustrated by 'a lack of control over what they could, or could not, do' to their dwellings compared to owner-occupiers (Moore et al. 2019b). Given the high proportion of Australian apartment residents who are renters, many of whom are on lower incomes (Easthope et al. 2020a), it is imperative that the benefits of sustainable apartments are brought into the mainstream for the wellbeing of all apartment residents.

There is evidence of broad support from end-users for sustainable buildings in all parts of the market, including from renters, social housing providers, and owner-occupiers from the lowest cost dwellings to highest-end apartments (Foster et al. 2020; Gower 2021; Moore and Holdsworth 2019). Examining the Victorian residential construction sector, Shooshtarian et al. (2021) suggest current discourse places much of the blame for the unsustainability of housing on owners and occupiers, with industry arguing they build what people want and they would build more sustainable buildings if people wanted them. However, their study found there is little opportunity to access better performing buildings due to industry resistance to change and the intransigence of government. Market demand for more sustainable housing is not new, with Fielding et al. (2010) having reported similar insights a decade ago.

Resident demand exists for more sustainable housing, including apartments. To identify how a transition towards the mainstream supply of sustainable apartments, both new and retrofitted, can be achieved, it is necessary to understand how and why the apartment development industry resists change.

1.2.2 Barriers to sustainable apartment development

Previous research has identified barriers to sustainable apartment developments and retrofits internationally and in Australia (Bright et al. 2018; Evola and Margani 2016; Jang and Kang 2016; Lujanen and Christudason 2010; Rasekh and McCarthy 2016; Rex and Leshinsky 2012; Turcu 2016). The barriers identified in Australian research are collated and categorised in Table 2.

Table 2: Barriers to sustainability identified in previous Australian research

Regulations	<ul style="list-style-type: none"> • Inconsistencies across jurisdictions^{1,2} • Lacking flexibility^{1,3,4} • Narrow focus on energy and water – lacking holistic view of sustainability^{1,4,5,6} • Focus on lifting the bottom of the market^{3,5,7} • Not driving innovation or setting ambitious agenda³ • Lacking localisation¹ • Lacking linkages to broader government policies and goals^{1,8} • Limited capacity to innovate at local level of governance^{3,9,10} • Exclusion of a portion of dwellings from minimum passive design provisions⁵
Financial	<ul style="list-style-type: none"> • Lack of incentives^{1,11} • Cost / lack of return^{1,11,12} • Split incentives (developer/owner)^{1,13} • Confusion on eligibility for government grant schemes^{14,15} • Lack of appropriate financing mechanisms¹⁶
Knowledge	<ul style="list-style-type: none"> • Lack of awareness of sustainability issues among residents, owners, and industry^{1,7,17,18} • High divergence of opinions between key actors¹
Industry practice	<ul style="list-style-type: none"> • Lack of accountability of actors^{1,7} • Lack of industry capacity^{19,20} • Gap between requirements and as-built outcomes^{1,19} • Contracts and sub-contracts seldom include environmental or sustainability requirements¹ • Strata managers act as gatekeepers of environmental and financial information¹⁶ • Slow action by body corporates / owners corporations^{14,15,21}
Tenure	<ul style="list-style-type: none"> • Perverse housing investment subsidies (e.g. negative gearing)¹¹ • Split incentives (landlord/tenant)^{11,17,21} • Lack of minimum standards for private rental properties¹¹ • Residential tenancy regulations¹¹

References:

- | | | |
|---------------------------------------|----------------------------------|--------------------------------|
| 1. Foong et al. (2017) | 8. Altmann and Gabriel (2018) | 15. Altmann (2015) |
| 2. Fina et al. (2021) | 9. Remøy and Wilkinson (2017) | 16. Altmann et al. (2018) |
| 3. Doyon and Moore (2020) | 10. Moore et al. (2019a) | 17. Shooshtarian et al. (2021) |
| 4. White et al. (2018) | 11. Liu and Judd (2018) | 18. Roberts et al. (2019a) |
| 5. Heffernan et al. (2017) | 12. Dadzie et al. (2018) | 19. Daly et al. (2021) |
| 6. Porto Valente and Wilkinson (2019) | 13. Easthope and Randolph (2016) | 20. Shearer et al. (2016) |
| 7. Mummery (2021) | 14. Altmann (2014) | 21. Gabriel and Watson (2012) |

Source: Authors

1.3 Research methods

The research was undertaken across four staged work packages (WPs). WP1 involved two components. Firstly, we undertook a desk-based review of existing academic literature, policy and practice materials relative to sustainable apartment construction and retrofit in Australia. The purpose of the review was to identify and describe current industry practices, structures of provision and stakeholder experiences, informing RQ1, RQ2 and RQ3. Secondly, existing data from the CoreLogic Cordell Connect property database was analysed to identify key actors in apartment production and retrofits (RQ1). Detail of the method used in the property database analysis is provided in Chapter 2.

Addressing RQ2 and RQ3, WP2 included interviews with 33 key actors in apartment production and retrofits identified by WP1. Interviews focused on the key challenges and opportunities in designing and constructing sustainable apartments and retrofitting existing apartments (RQ3), as well as the influence of different structures of apartment provision and governance (RQ2).

Following the analysis of interview transcripts, WP3 involved workshops with selected interview participants (n=27) to review the interview findings. Three online workshops were held, focusing on the unique aspects of the delivery and management of apartments in Australia to address RQ2, RQ3 and RQ4. Workshop attendees were grouped according to the phase of apartment provision with which they are most directly engaged. Workshop 1 involved actors from project inception, Workshop 2 involved actors in design and delivery of new apartments, and Workshop 3 focused on retrofitting of existing apartments. Using online collaboration tools, the workshops identified opportunities for intervention in the existing structures of apartment provision, developing recommendations to support mainstreaming of sustainable apartment provision.

WP4 consisted of a final Policy Workshop involving key supply-side actors (four of the previous informants from WP2 and WP3), alongside seven key policy makers from the Australian Government, and state, territory and local governments. The recommendations developed in WP3, including opportunities for intervention, were presented for discussion and refinement. This online workshop focused on the financial, fiscal, regulatory and policy levers needed to drive sustainable apartment supply and retrofit (RQ4). The relationship between Work Packages (WPs), Primary Research Questions (RQs) and data collection is described in Table 3.

Table 3: Research questions, work packages and data sources

Research question	Work package				Data sources
	1	2	3	4	
RQ1: Who are the key actors in apartment production and retrofits?					<ul style="list-style-type: none"> Academic, policy and practice materials Cordell Connect
RQ2: How do structures of apartment provision and governance influence the adoption of sustainable apartment construction and retrofit across different apartment sub-markets?					<ul style="list-style-type: none"> Academic, policy and practice materials Interviews
RQ3: What are the key challenges and opportunities in designing, constructing and adapting sustainable apartments?					<ul style="list-style-type: none"> Academic, policy and practice materials Interviews Workshops
RQ4: What finance, fiscal, regulatory and policy settings can help drive sustainable apartment supply and retrofit in a circular economy?					<ul style="list-style-type: none"> Workshops

Source: Authors

The research focused on the two largest apartment markets, New South Wales (NSW) and Victoria, which together represent 70 per cent of all apartments in Australia (ABS 2017). These states have also seen rapid growth in new apartment construction as a proportion of new dwellings over recent years (Easthope et al. 2020b). We considered all apartment buildings of two or more storeys. While many new apartment buildings are larger (Rosewall and Shoory 2017), there is a substantial stock of low-rise older buildings in need of retrofit (Loschke and Easthope 2017).

We considered multiple types of apartment production: Build-to-Sell (strata title); Build-to-Rent (including student housing and social housing); and retrofit. It is important to consider these different structures of provision (despite some overlap between them), as the barriers and incentives to sustainable development or retrofit differ.

For retrofits, we concentrated on whole-of-building upgrades that affect the building envelope or services that are carried out across all units. We considered retrofit of various scales: from single utility upgrades to extensive programs involving upgrades to multiple utilities and amenities, as well as the entire building envelope and the introduction of renewable energy technologies. Single-unit renovations were not considered.

Research participants were providers of new apartments and retrofit services, managers of apartment buildings and key actors involved in policy development. The project did not involve apartment residents nor non-institutional purchasers. Previous research has amply demonstrated the value of sustainable development and retrofits (Tapsuwan et al. 2018) as well as barriers to uptake from the resident perspective (Roberts et al. 2018).

In total, 33 research participants were interviewed, including people who operate in different locations and are involved with different structures of apartment provision and governance (speculative Build-to-Sell, Build-to-Rent and social housing). A balance was sought between participants who self-identify their current practices as 'sustainable' and those who do not.

To ensure a good mix of informants, we sought to recruit people across the range of professional areas outlined in Table 4. Suitable interviewees were identified with reference to the Cordell database, and all suitable interviewees approached until the target numbers were reached, or until all options were exhausted. Once options from the Cordell database were exhausted, the research team sought participants within each area from their professional networks. It was initially intended to recruit informants from both metropolitan and regional areas in both NSW and Victoria. However, this proved unfeasible due to the nascent nature of regional markets, particularly in Victoria. Subsequently only two informants work primarily in regional areas, both from NSW. The number of retrofitting professionals also differs across the states, reflecting the size of the retrofitting sector in NSW compared to Victoria (as demonstrated in the Cordell Database mapping in chapter 2). One half of the NSW participants self-identify as 'sustainable' professionals, with this increasing to two-thirds in Victoria.

All interviews were completed online and transcribed using Microsoft Teams transcription. The automated transcripts were reviewed for accuracy and corrected before undertaking a thematic analysis, following the approach outlined by Braun and Clarke (2006). During analysis, the research team utilised online collaborative software tool Miro to code the data and iteratively identify themes. The recommendations made by interviewees to improve the sustainability of apartments were summarised and informed the basis of discussions in the following workshops (WP3).

The online workshops (WP3) focused on the unique aspects of the delivery and management of apartments in Australia: securing development finance; designing and constructing interrelated dwellings; and governing multi-unit properties. Detailed discussion points for each were developed from the WP2 interviews. A total of 22 participants attended the three workshops, all having been involved previously in the WP2 Interviews. Each workshop focused on a different phase of provision and use of apartments as shown in Table 5.

Table 4: Summary of interviewees

	No.	State		Development type	
		NSW	Vic	Typical	Sustainable
Interviewees	33	18	12	15	18
Professional role					
Developer (project and design manager)	7	3	4	4	3
Architects	4	2	2	2	2
Sustainability consultant (new build)	5	2	2	-	5
Construction manager or builder	4	2	2	2	2
Planner	4	2	2	2	2
Strata manager	3	2	1	1	2
Retrofit consultant and provider	4	4	-	1	3
Financier	3	3 (National)		2	1
Valuer	1	1	-	1	-

Source: Authors

Table 5: WP3 workshop participants

Workshop 1: project initiation	8 participants	<ul style="list-style-type: none"> • 5 developers • 1 planner • 1 strata manager • 1 financier
Workshop 2: design and construction	7 participants	<ul style="list-style-type: none"> • 3 architects • 2 sustainability consultants • 2 project/ construction managers
Workshop 3: retrofit	7 participants	<ul style="list-style-type: none"> • 3 sustainable retrofit consults • 2 strata managers • 1 planner • 1 financier

Source: Authors

The two-hour workshops were audio recorded and transcribed. During the workshops, participants were invited to contribute to a collaborative online white board (Miro), with the contributions used by the convening researchers to identify themes for detailed discussion. The recommendations from the WP3 workshops, which drew on the preceding interviews, were used to develop a conceptual framework summarising the main recommendations from industry stakeholders.

The final Policy Workshop (WP4 and RQ4) brought together three of the industry informants previously involved in WP2 and WP3 (one financier and two industry practitioners) with seven key policy makers. The conceptual framework and recommendations developed through the first three Work Packages were presented at this workshop and used to inform a discussion on the policy landscape needed to support sustainable mainstream apartment supply and retrofit in a circular economy. Key policy makers attending included individuals from the following organisations:

- City of Sydney
- City of Melbourne
- NSW Department of Planning and Environment
- Victorian Department of Environment, Land, Water and Planning
- Australian Building Codes Board

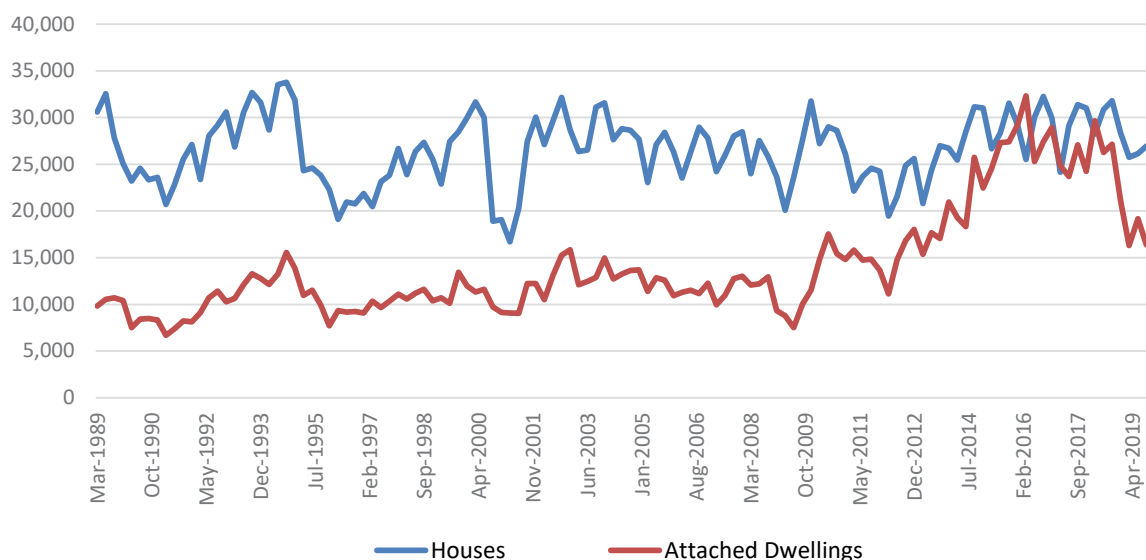
This final workshop directly informed the recommendations of the research (RQ4).

2. The Australian apartment market

- **A growing number of Australian residents are living in apartments. This growth is concentrated in New South Wales, Victoria and Queensland.**
- **Sustainable apartments make up only a very small proportion of all recent apartment building projects in Sydney and Melbourne. They are concentrated in higher value areas.**
- **The sustainability of apartment developments and retrofits needs to be considered separately from other residential building typologies because the production, consumption, management and exchange of apartments is different.**
- **Most apartment buildings are delivered as speculative developments and sold as individual strata titled properties. Speculative development has contributed to buildings built to (only) meet minimum standards. Cyclical boom/bust development cycles provide little incentive for innovation.**
- **The inter-dependency of apartments has implications for their design and construction, maintenance and retrofitting. At the same time, their inter-dependency provides opportunities for improved sustainability outcomes.**
- **Apartment properties are usually jointly owned and managed. Joint ownership, coupled with speculative development, limits the potential for oversight of purchasers during design and construction. Challenges also arise in retrofitting relating to collective decision making.**

In 2015, construction started on more multi-residential properties than detached houses for the first time in Australia's history (Easthope et al. 2020b). At the time of the last Australian Census in 2016, more than two million Australians lived in apartment buildings. The number and proportion of Australians living in apartments has increased rapidly since then, reflecting substantial growth in apartment starts (see Figure 2). Much of the growth in apartments is concentrated in the states of New South Wales, Victoria and Queensland (Australian Bureau of Statistics 2020).

Figure 2: Dwelling commencements, Australia



Source: ABS Building Activity 9752.0

2.1 Unique aspects of the apartment market

Existing literature on realising sustainable housing in Australia focuses primarily on detached dwellings despite notable differences between the detached and apartment sectors (Dalton et al. 2013; Kelly 2020). In 1.1, we explained that the sustainability of apartment development needs to be considered separately from other residential building typologies because the production, consumption, management and exchange of new apartments differs in three important ways from detached housing.

This chapter considers the implications of each of the three key differences in turn. It then summarises existing literature on the experiences and preferences of apartment residents with regards to sustainability, demonstrating that demand exists amongst owners and residents for sustainable apartments. Existing literature suggests the main barrier to transitioning towards the mainstream supply of sustainable apartments is understanding how the apartment development industry resists change and how this resistance can be overcome. The final section draws on existing literature to summarise barriers and opportunities.

2.1.1 The speculative apartment industry

Most apartments in Australia are produced through a speculative development process in which the developer commences a project in the absence of committed demand, aiming to sell all the stock as soon as possible in pre-sales or after completion.

Speculative development has been described by both international and Australian scholars as risk averse and slow to innovate (Ball 2016; Gurran and Phibbs 2013; Parvin 2008; Rowley and Phibbs 2012). In the Australian context, it results in a lack of diversity and innovation as developers adhere closely to past successes, taking a 'why fix what isn't broken' attitude (Rowley and Phibbs 2012; Sharam et al. 2015a) and rejecting risky or novel ideas without previously demonstrated precedents (White et al. 2018).

The dominant speculative development sector, also widely known as 'Build-to-Sell' (BTS), presents multiple challenges to the mainstreaming of sustainable apartment development. One challenge is the perception of apartments as investment commodities for exchange rather than as homes (Brenner et al. 2012; Gleeson et al. 2012; Marcuse 2009; Nethercote 2019; Troy et al. 2020). Another is the separation of stakeholders between the development and use phases of the building lifecycle. Design and construction decisions, impacting sustainability, are made by the speculative developer whose priorities for short-term project success differ from those of long-term residents (Heitel et al. 2015; Lovell and Smith 2010; White et al. 2018). Research in South-East Queensland by Shearer et al. (2016) found very few industry stakeholders identify climate change risk as relevant to property development and, consequently, perceive sustainability features as value-add items rather than essential attributes of apartment buildings.

Once a speculative apartment building is constructed, it is typically sold as strata titled properties to whomever is willing to purchase. Prior to sale, the developer must register the strata scheme and establish an Owners' Corporation or Body Corporate with responsibility for managing common property. Having conceived the project, designed and commissioned the building, and set the rules of the community, actions that each influence the sustainability of the built environment over the building's effective lifetime, the developer has little further role. BTS buildings are most often designed and built to only meet minimum standards. Where developments exceed minimum standards, they tend to do so as a means of differentiation at the high-end of the market (Horne et al. 2014; Martel et al. 2013).

Throughout the BTS development process, decisions made by the developer, consultants and contractors are influenced by the financial systems required to facilitate development and associated risk. Project financing will typically involve a mixture of debt and equity, varying with the size of the development, the market for credit and the needs of the developer. Project finance is short tenor lending with interest capitalised into the loan. Repayment occurs at project completion when apartment sales provide revenue. Financiers typically require the developer meet a range of conditions, including pre-sales. The need to obtain pre-sales often increases project time and hence cost. In theory, a pre-sale contract is a legally binding obligation, reducing project risk. However, in practice, 'settlement failure' is common and developers have little practical recourse (Bryant 2012; Mahaffy 2005).

The impact of financiers requiring pre-sales is significant in the context of sustainability because developers want to expend as little time and money as possible on finding buyers. Until the peak of the market in late 2017 this largely meant focusing on sales to investors as these were the most active buyers in the market and the easiest and cheapest to find. Sharam et al. (2018) argue this reflects an inherent difficulty in matching aspiring owner-occupiers to apartments they would wish to purchase. Apartment product prior to 2018 was primarily designed to satisfy the investment market (Moore et al. 2020). The result is highly generic product, poor design and amenity, and little in the way of sustainability features.

Since the interventions by financial regulators in Australia and the imposition of more stringent capital controls by the Chinese Government, the apartment market has shifted. Peter Chittenden, National Managing Director of Residential Property for Colliers International observed apartment sales in Sydney dropped by approximately 50 per cent between 2018 and 2019, with the proportion of investor purchasers declining from approximately 50 to 60 per cent of all purchasers to approximately 20 per cent (Denman and Chittenden 2019). In this context, development marketing indicates an unprecedented shift in focus to owner-occupiers (Ellis 2020) and a preference for more sustainable products (Delahunty 2021). While this suggests something other than business-as-usual, it also serves to underscore the importance of economic conditions on housing outcomes.

To mitigate their exposure to unexpected cost escalations, speculative developers frequently opt for Design and Construct (D&C) contracts with construction companies. The Australian Standard for Design and Construct contracts (AS 4300 *General conditions of contract for design and construct*) was first introduced in 1995 in response to industry trends moving away from traditional Construct Only contracts. In Construct Only, contractors were engaged via fixed price contracts to realise building based on completed documentation provided by the Principal (developer) and their consultants (architect, engineers and so on). In Construct Only contracts, the contractor carried responsibility for construction, not design. Responsibility for design, material selection, and design quality remained with the consultants directly engaged by the Principal to supervise works. The shift to D&C contracts in recent decades relocates responsibility for design risk to the contractor, who provides a warranty (implicit or explicit) for design quality and *fitness-for-purpose* (Wood 1999; Roberts 2022).

The relevant Australian Standards identify three forms of D&C contracts, each with different relationships between contractors and consultants, and each involving different levels of design resolution at the time of contractor appointment (Wood 1999; Vaz Serra et al. 2021). The most common form deployed in apartment development in Australia today is the Design, Novate and Construct contract (DNC or ND&C) in which the Principal's consultants and any subcontractors are novated to the selected construction contractor (AS 4300—1995; AIA 2019; Roberts 2022). At the time of contractor appointment and consultant novation, design resolution and documentation may range from 20 to 80 per cent complete (Vaz Serra et al. 2021), with the contractor responsible for design completion. Via novation the consultants, including design team and architects, are no longer engaged by the Principal (developer) but by the contractor who may be guided in decision-making by different priorities.

D&C contracts, with or without the novation of consultants, have multiple advantages and disadvantages for different stakeholders (Wood 1999; Roberts 2022; Doloi 2010; Munnings 2004). Developers, property lawyers and financiers prefer D&C contracts due to the legal simplicity of locating risk with one party: the contractor (AIA 2019; Munnings 2004). However, for the Principal (developer) this involves the relinquishing of decision-making powers to the contractor and their design team. This can become problematic during value management when the design may be radically amended by the contractor (AIA 1999). It also has cost implications as the Principal (developer) is relocating all construction and design risk to the contractor, which necessarily involves costs. Earlier research conducted by Akintoye in the United Kingdom (UK) in 1994 focused on contractors' perceptions of ND&C contracts. Akintoye's research concluded that there was an industry preference for traditional Construction Only contracts because the design team is held responsible for the design and specification on the client's behalf (Doloi 2010). From a legal perspective, one of the greatest concerns regarding all D&C contracts, with or without novation of consultants, is the problem of 'future' documents. That is, most if not all design documents come into existence after entering the D&C contract (Munnings 2004). For the design team, the experience of D&C contracts varies greatly depending on the level of design resolution and documentation at the time of novation (AIA 1999; AIA 2022).

In a 2021 project case study of a public building, the Office of the Victorian Government Architect espoused the potential for ND&C contracts to deliver high quality outcomes through innovative collaboration between consultants through early contractor engagement (OVGA 2021a). It is notable however, that the case also emphasises the need for high levels of design resolution and documentation prior to contract finalisation and novation (OVGA 2021b). This ensures the design and documentation are included in the legally binding Principal's Project Requirements document and hence are less likely to be altered by the contractor. In the residential sector, such levels of design resolution and documentation are rare. In 2019, the Australian Institute of Architects conducted a survey of 262 Australian practices that systematically interrogated 480 novated projects carried out over the preceding decade, more than 40 per cent of which were apartment projects (AIA 2022). The Victoria specific data (71 practices, 158 projects) indicated a trend toward ND&C contracts being established earlier in the design process, despite this being the least favoured option by respondents. There was a definite preference for more than 51 per cent of documentation to be complete prior to novation, and the best built outcomes were achieved where 91 to 100 per cent of documentation was completed (AIA 2019: 6). Architects also expressed concerns that ND&C contracts result in a negative impact on the finish and durability of projects (71% of respondents), a reduction in use of sustainable and local materials (63%), and have negative impacts on the architects' ability to deliver quality outcomes for the general public and end user' (67%) (AIA 2019: 2). Of direct relevance to the delivery of sustainable apartments, respondents identified that 'in the value management process under a design and construct contract, there is a much lower commitment to the principles of ecologically sustainable design' (AIA 2019: 1). Architects also reported being denied access to the site, to project meetings and to documentation produced by the contractor, making it impossible to advocate for the preservation of design and sustainability features. 'The responsibilities of the architect changes under novated contracts, where architects have increasing responsibilities for all aspects of construction yet have diminishing power to influence good design and constructability outcomes' (AIA 2019: 2). Drawing on the national survey, the Australian Institute of Architects published a Code of Novation that seeks to define:

standards of conduct that promote good design, safety and quality standards throughout the entire procurement process, thereby mitigating project risk and resulting in significant benefits to the built environment and broader community (AIA 2022: i).

The reliance of the BTS model on investor demand means speculative development is especially vulnerable to economic cycles, and this militates against innovation. Real estate is subject to 'property cycles' reflecting oscillation between growth and stagnation (Hoyt 1970). Jud et al. (1996: 248) found 'multifamily starts [in the US] lead on the downturn and tend to turn up ... with the end of recession'. The result is a 'chronically asynchronous relationship between the demand for and supply of property as evidenced by regular periods of over- and under-building' (Weber 2016:588). Sharam (2019) argues chronic undersupply upholds market prices and ensures project viability. Downturns result in short periods of oversupply. The ensuing lack of market activity and a construction lag ensure demands again builds (Sharam et al. 2018). Rowley et al. (2020: 50) argue:

housing developers ... will logically seek to trickle-feed supply to the market at the rate that ensures that target sales rates and profit expectations are met. Thus, the developer's price signal is not the level or change in market price of housing per se, but the rate of sale.

Chronic asynchronicity has important implications for improving the sustainability of apartments. During growth phases high demand provides little incentive to change and developers have little capacity at such times. Economic downturns see developers exiting the market or shelving developments. Tighter credit conditions foster conservatism. Growth and stagnation therefore work to entrench orthodox practices. This suggests the pathway to apartment sustainability may involve a shift to a less cyclical industry.

The difficulty in achieving change in the BTS sector is highlighted by Daly et al. (2021) who examined decision-making relating to energy efficient apartment design in New South Wales. They identified 14 pressure points in the development process at which key actors make decisions influencing the energy efficiency of apartment buildings. Among other insights, their mapping identifies many key decisions are locked-in prior to engagement with sustainability consultants. This highlights the pipeline nature of the development process which involves many sequential steps. Any shift from orthodox practice involves a raft of transaction costs and potentially quite fundamental variations in processes.

2.1.2 Physically inter-dependent properties

Apartment properties are inter-dependent. The structural integrity, safety, energy efficiency, sustainability and other attributes of an apartment are influenced by and contingent upon adjacent apartments, communal spaces and shared services. The inter-dependency of apartments has implications for their design and construction, maintenance and retrofitting. At the same time, their inter-dependence provides opportunities for improved sustainability outcomes.

The inter-dependent nature of apartment properties requires they be constructed of a different range of materials than detached dwellings to achieve structural integrity and fire safety, as well as to allow necessary maintenance. The dominant materials used for apartment construction (steel and concrete) are more resource intensive than materials used for detached dwellings, although direct comparisons can be problematic.

The inter-dependent nature of apartments also provides opportunity for the uptake of innovative, sustainable materials due to economies of scale; one example being Cross Laminated Timber (CLT). CLT has achieved a sufficient level of industry penetration to make this low embodied energy material a feasible proposition for multi-storey construction in many global locations. It has previously been used for low-cost housing developments in North America, Europe and Australia (Rhee 2018). Despite perceptions of increased risk associated with alternative materials requiring specialised skills and new supply chains, a comparison of a CLT apartment building in Sydney with a comparable steel and concrete building by Cazemier (2017) showed the CLT project had a shorter development timeframe which improved the Internal Rate of Return (IRR). Establishing the economic benefits of more sustainable alternatives demonstrates there are significant opportunities to increase uptake of sustainability and circular economy practices. These opportunities are greater for apartment buildings than one-off detached dwellings due to the economies of scale.

Defined by the presence of shared walls, floors and ceilings, apartments have less external surface area than a detached dwelling of the same floor area, leading to lower conduction of energy to and from the external environment. This makes them inherently more efficient in relation to space heating and cooling, resulting in higher Nationwide House Energy Rating Scheme (NatHERS) ratings. NatHERS measures heating and cooling energy demand per square metre of floor area. However, the extent to which energy efficiency potential is realised is influenced by other factors, including passive design principles such as orientation, ventilation and glazing ratios (Tettey et al. 2016). The most common apartment floor plans in Australia comprise single aspect apartments accessed from a central corridor (Gower 2021; Kennedy 2017). This reflects developers' ambition to maximise site coverage and saleable floor area. However, single aspect apartments limit the potential for cross ventilation of dwellings and inevitably result in most apartments being poorly oriented with either negligible advantageous solar access (south facing) or excess solar gain causing overheating (east and west facing). Hence, the energy efficiency potential of apartments varies significantly within a single building, with limited opportunity for change. Poorly oriented apartments tend to be purchased by investor owners, rather than owner-occupiers, limiting renters to apartments with the least potential for comfort and energy efficiency (Gower 2021).

In addition to structure and construction elements, apartment properties are inter-dependent with regard to shared services such as electricity, water, sewerage, gas, waste, lighting and lifts. All consume resources and energy and incur costs to residents. Hence, the energy efficiency of an apartment property should be considered at two scales: the individual apartment, and the building. Services and systems are initially installed to the specifications set by the development team, and as with all building components, profit and cost inform decision-making.

A 2005 study of buildings in the metropolitan Sydney area (Myors et al. 2005) found that high-rise apartment buildings (nine storeys and above) were the least environmentally sustainable building form, based on annual greenhouse emissions per occupant. Apartment buildings were followed by detached houses and then lower-rise apartments and townhouses and villas. The report speculated that the difference likely results from the additional plant and equipment often found in high-rise buildings, such as pools, lifts and cooling towers.

Later analysis of Sydney apartments found energy usage in common property accounts for up to 60 per cent of an apartment building's total energy use (NSW Fair Trading 2021). The average annual water usage in common areas also increases as the size of the building increases (Schuster 2017). However, use of water within units is responsible for an average of 86 per cent of water consumed in apartment buildings. Sydney Water asserts the most effective means of reducing water usage in apartment buildings is to install individual meters (Sydney Water n.d.). The lack of individual water meters in buildings constructed prior to 2014, when they were made mandatory in new developments, has been identified as a weakness in incentivising water efficiency practices amongst apartment residents (NSW Fair Trading 2021). In Victoria, all new apartments are required to have a remotely read supply meter installed on the drinking water supply and on recycled water supply where available (Yarra Valley Water 2022). These can be either individual meters read by the water company or a sub/check meter used by the Body Corporate to allocate usage costs. Older buildings have the problem of shared billing. Residents in apartments recycle half the amount of water that residents in houses do (City of Sydney 2015).

Building scale energy efficiency may be improved over time within the confines of the building design via maintenance and upgrade programs. An advantage of the inter-dependent nature of apartments is the capacity for installing building-wide integrated systems for energy, water, water heating and space heating. Centralisation of systems improves plant and equipment efficiency, reduces service charges and delivers substantial reductions in operating costs to all residents (Fina et al. 2021; McLean and Roggema 2019; Roberts et al. 2018; Syed et al. 2020). Similarly, it enables the costs and benefits of sustainability interventions, such as photovoltaic panels, plant and equipment to be distributed (Roberts et al. 2019b). However, centralisation of systems can inadvertently result in residents being unaware of energy and water use and waste in their building (Altmann et al. 2018). This is because the costs, both financial and environmental, become externalised.

At the neighbourhood level, the potential contribution that sustainable apartment buildings can make towards the improvement of outdoor thermal comfort and mitigation of the Urban Heat Island (UHI) phenomenon is significant, especially in the context of a changing climate. The global UHI phenomena, which results in higher temperatures in urban and sub-urban areas compared to rural areas, has been widely documented and affects major Australian cities (Santamouris 2015; Santamouris et al. 2017). There is evidence that urban microclimate (including the magnitude of urban overheating and UHI) is affected by the urban morphology and building typologies (Kolokotsa et al. 2022). Assuming the same population allocation potential (number of residents allocated per site area) for apartment buildings and detached houses, apartment buildings provide more land for greenery (Andreeva et al. 2021), significant shade during the day, and a larger surface of the building envelope available to install passive cooling and greening solutions. The cooling potential of such solutions increases with the surface area available for their installation, which is generally lower for detached houses. This suggests that sustainable apartment buildings designed to implement passive cooling and climate mitigation strategies have the potential for improved environmental benefits at the neighbourhood scale (Santos et al. 2021), when compared to those possible in areas dominated by detached houses.

2.1.3 Joint ownership of buildings

Beyond the obligation to remedy building defects and establishing the owners corporation, property developers and construction contractors have limited responsibilities after properties are sold (Easthope et al. 2014). The new owners (owner-occupiers and investor owners) become collectively responsible for the overall structure and services (common property) for the life of the building and individually responsible for costs of operating and maintaining their individual units (lot property). This separation between the key actors responsible for apartment provision and the longer-term owners or occupants presents a key challenge to incentivising the provision of sustainable apartments.

In 2.1.1, we noted speculative development of strata buildings involves multiple purchasers of the individual units created. Taking pre-sales into account these purchases can occur years apart. The extent to which a future owner can influence design and construction is limited to relatively superficial elements such as colour schemes and fixtures inside the apartment. On the other hand, developers have the right to make quite substantial changes subsequent to a pre-sale (Sharam et al. 2015a). This means not only do residents have little input into, or oversight over, the design and construction of the building, but also that there is little oversight on how the building will perform over time. This has been described as a split incentive problem between developers (and their builders and contractors) on the one hand and subsequent owners and residents on the other (Easthope and Randolph 2016).

Multi-ownership of apartment buildings also raises challenges during the life of a building. The impacts of multi-ownership and difficulties in reaching an agreement on (and financing) work to be undertaken in multi-owned properties are well documented in Australia and internationally (Borisova et al. 2014; Easthope 2015; Lujanen and Christudason 2010; Yip et al. 2007). This is often described in terms of the tensions between individual and collective considerations (Altmann and Gabriel 2018; Kern 2011) and the tragedy of the anti-commons (Sherry 2013). Similar challenges arise in respect to upgrades to existing buildings (Loschke and Easthope 2017).

As well as the constraints and considerations facing owners of detached houses in deciding whether to retrofit their properties to reduce their water and electricity use and otherwise improve their environmental sustainability, owners of apartments in strata titled buildings also have to contend with the following additional challenges:

i. Lack of knowledge about their building and utility costs

While apartment residents are typically aware of aspects of their building that use energy and water (such as lighting, lifts and gardens), the majority of owners are unlikely to have the detailed technical knowledge of the building operations required for a retrofit of the building. The increasing size and complexity of new apartment buildings add to this challenge. Often strata managers do not have this knowledge either as it is typically not part of their expected work and many strata properties do not hire a facility or building manager. While strata managers and some committee members will have knowledge of utility costs for buildings, most owners will not (Altmann 2014), obfuscating the case for sustainable retrofitting.

ii. The need to make decisions collectively about how to proceed with works affecting common property

Most changes to a strata property with an impact on environmental performance will either be changes to the common property or changes that impact on common property (such as the installation of solar panels on a roof for the individual use of one lot requires changes to the common property of the roof). The requirement to seek approval and to make collective decisions makes retrofit projects affecting common property more difficult. In their report on the environmental sustainability of private rental properties in Australia, Gabriel et al. (2010) report that many investors who owned apartments said that the owners' corporation represented a barrier to their undertaking energy and water efficiency improvements within their units when the proposed retrofits affected common property. They identified concerns with managers of the owners' corporation not being supportive; difficulty raising awareness of sustainability issues and then obtaining agreement across individual owners; and difficulty getting all owners to pay for energy and water saving measures that affect the common property. It is also difficult for renters themselves to advocate for sustainability upgrades because they do not have a right to vote on such decisions. Gabriel et al. (2010) also note that tenants are often hesitant to initiate or to engage in retrofit programs because of potential increases in rent or concern of being viewed as a 'troublemaker' (Gabriel et al. 2010).

iii. The practicalities of rolling out a plan for retrofitting in a building with multiple ownership

There are also practical issues that need to be addressed in planning environmental retrofits in multi-owned buildings. For example, gaining access to individual units in order to make changes to common property and lot property (such as to plumbing, wiring and so on), which requires cooperation from individual lot owners and substantial coordination (Altmann 2014).

iv. Differential access to government schemes and subsidies

Finally, differential access to government schemes and subsidies has caused frustration for those working to promote sustainable upgrades of multi-owned properties in Australia. Some Australian Government and state and territory government schemes aimed at promoting sustainability upgrades have been specifically targeted at households. Because the majority of sustainable upgrades in multi-owned properties affect common property, rather than an individual's unit property, multi-owned buildings were denied access to these programs (Altmann and Gabriel 2018).

Despite these challenges, multi-ownership and the size of apartment buildings also provides opportunities for sustainable retrofits. Notably, economies of scale and the potential to share resources and costs amongst multiple owners can make some sustainability projects more feasible in multi-owned apartment buildings than they might be in a detached house. For example, Boyd et al. (2013) discussed the off-site construction benefits (such as on-site waste, material transportation, and embodied energy reduction) and barriers (such as major capital investment and low customisation) and explained the advantage of scaling up the solution to apartment buildings to reduce the initial costs and share it among the multiple owners. To balance the extra performance provided by low carbon technologies (i.e. for energy production, energy storage, energy management, or energy conservation) or the extra service provided by monitoring systems, any extra investment cost can be shared among multiple owners resulting in a lower investment cost per unit.

2.2 Spatial analysis of sustainable apartment development

While previous research has mapped apartment development over time in Australian cities (Randolph and Tice 2013), it has proven more difficult to identify and map sustainable apartment development. Doing so is important in order to understand both what proportion of new developments might be considered sustainable, as well as whether these developments are concentrated in particular areas.

To this end, the researchers reviewed detailed information on completed residential and mixed-use development projects in the CoreLogic Cordell Connect database. The research team analysed a sub-set of this database, containing information about new development and substantial building upgrades of apartment buildings across greater metropolitan Melbourne and Sydney, as well as Geelong and Illawarra in the period July 2007 to June 2020.

Each entry in the database includes a written description of the nature of the building project. These written descriptions were searched for key terms commonly used to describe sustainability features of buildings, outlined in Table 6. We were careful in selecting terms that projects would be classified as ‘sustainable’ only if they offered something in addition to those features already required under existing minimum regulations (such as BASIX).

Table 6: Key terms used to identify sustainable projects in the Cordell connect database

Sustainability features	Key terms searched	Sustainability features	Key terms searched
Passive design basics	<ul style="list-style-type: none"> • Orientation • Ventilation • Daylight • Thermal mass 	Energy management technology	<ul style="list-style-type: none"> • Integrated energy • Embodied energy • Master switch • Smart
Water	<ul style="list-style-type: none"> • Fire-system testing water recovery • Rain water • Harvesting • Reuse • Water efficiency 	Sustainable materials	<ul style="list-style-type: none"> • New materials (e.g. CLT offsite manufacturing) • Renewable materials • Reuse • Low carbon • Recycling [do not include if referring to garbage]
Waste water	<ul style="list-style-type: none"> • Waste water recycling • Reuse • Recycling • Grey water 	Ratings / certifications	<ul style="list-style-type: none"> • Green star 6-star rating • NatHERS rating above minimum required
Water heating	<ul style="list-style-type: none"> • Solar water heating 	Construction	<ul style="list-style-type: none"> • Construction innovations (e.g. prefabricated modular design or wall-systems) • Reduction of waste to landfill
Energy generation	<ul style="list-style-type: none"> • Renewable • Solar • Wind • Green power 	Lifecycle considerations	<ul style="list-style-type: none"> • Embodied energy • Lifespan
Energy efficiency in use	<ul style="list-style-type: none"> • Energy efficiency 	Transport	<ul style="list-style-type: none"> • Generous bicycle parking • Electric vehicle (EV) chargers
		Food / garden	<ul style="list-style-type: none"> • Community food garden • Roof top garden

The researchers then searched all 6,531 written entries in the Cordell Connect database (for apartments in the four specified regions) and allocated one point for every sustainability feature identified. Any entry that scored one or more was classified as ‘sustainable’ and all other entries as ‘other’. We then mapped the results across the four areas.

The analysis identified 85 sustainable new build and 11 sustainable major upgrade projects in Greater Sydney, and 186 sustainable new build and three sustainable major upgrade projects in Greater Melbourne. Notably, there were no sustainable new or major upgrade developments identified in the regional areas of Geelong or Illawarra. These 285 sustainable building projects make up only 4.4 per cent of all building projects in the database sample, indicating the small scale of sustainable construction across these locations.

The sustainable upgrade projects identified in the database all include substantial building works (such as adaptive reuse of commercial building to residential, reconfiguration or addition of units and partial demolition and rebuilding). Other sustainable retrofit projects will have taken place across both cities, for example involving replacement or upgrading of plant and equipment, which do not appear in this database.

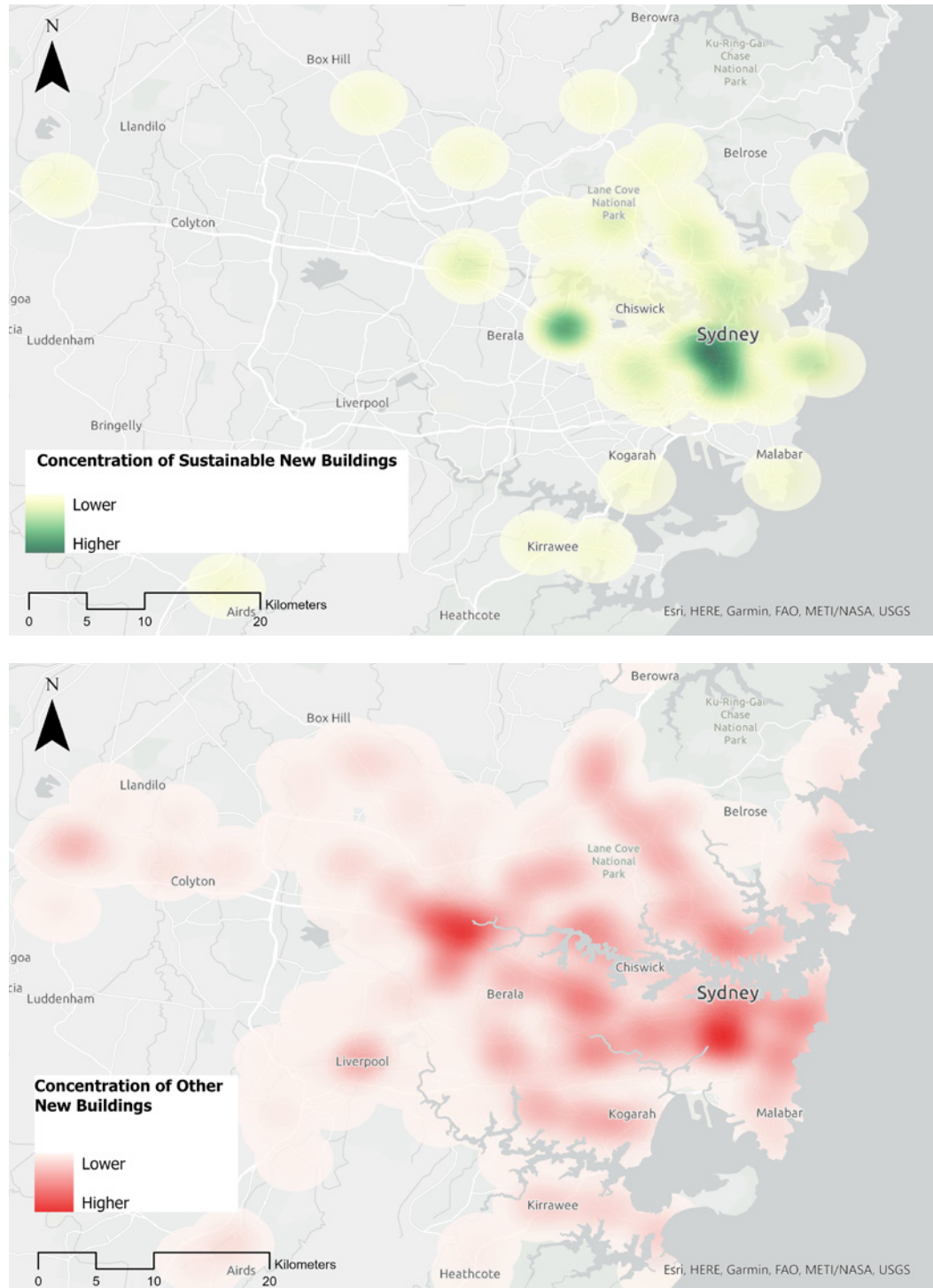
We then mapped individual sustainable and other new developments and upgrade developments across the two cities. As can be seen in Figure 3, new build sustainable projects in Sydney are found throughout the metropolitan region, with developments identified on the city fringe to the north, west and south. The majority of sustainable new developments are found in proximity to the main train lines, reflecting the concentration of apartment development in Sydney more generally. This suggests that sustainable new build developments are occurring in Sydney across the market from higher to lower value locations. However, there are notable concentrations of new build sustainable developments in the higher value locations of inner Sydney and the inner west, with a particularly notable concentration (of eight developments) in the suburb of Homebush in the Local Government Area (LGA) of Strathfield. As can be seen in Appendix 1, some LGAs have a higher proportion of all new developments being sustainable, most notably Strathfield and Sydney LGAs where 10 per cent or more new developments are classified as sustainable. Meanwhile, a large number of LGAs have no sustainable new developments. The sustainable upgrade projects in Sydney (Figure 4) are concentrated in the high-value locations of central Sydney, the inner west and the eastern suburbs.

In Melbourne, new build sustainable developments are concentrated in the inner and middle suburbs, although there are some on the northern and southern fringes of the metropolitan area (see Figure 5). As with Sydney, sustainable projects are mostly found in higher value locations, which include the Mornington Peninsula. However, the LGAs with the highest percentage of sustainable projects largely correspond to Councils (Yarra, Darebin and Moreland) that have a long history of instituting planning controls for improving sustainability or in the cases of Banyule and Boorondara are affluent, leafy green areas (see Appendix 1). The three sustainable retrofit projects in Melbourne are in the higher value suburbs of Kew, St Kilda and Brunswick West (see Figure 6).

Analysis of the Cordell database indicates that sustainable new build development is occurring across both cities in areas where private apartment development is happening more generally. While the sustainable developments are concentrated in higher value areas, they are also found in other parts of the city, especially in Sydney. This indicates that claims suggesting the only market for sustainable development is a prestige market (Redman 2022) may be shifting. It is possible that this is also related to the more recent shift towards marketing new apartments to owner-occupiers (Redman 2022). The absence of sustainable developments in the two regional areas is noteworthy.

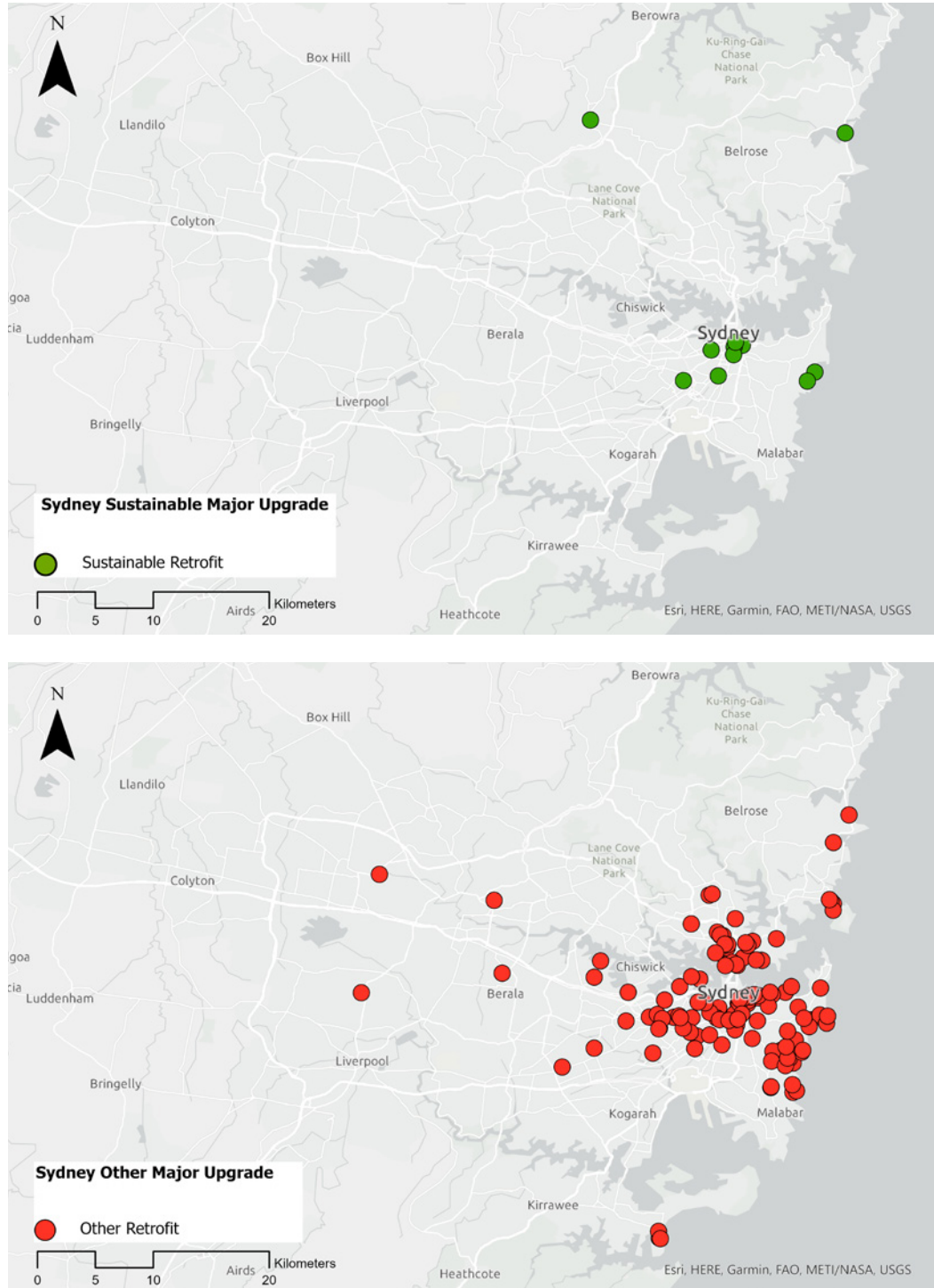
Only a small number of major upgrade projects with a sustainability component were identified in each city and these are concentrated in high value areas only. There is some evidence that these are also the areas where major upgrades to apartment developments are occurring more generally (Easthope and Randolph 2021), perhaps because these are the areas where the risks associated with a major retrofit project are offset by the potential for substantial capital gains resulting from improved property value. This raises the question as to how such works might be encouraged or facilitated in lower value areas.

Figure 3: Sydney new build developments (sustainable and other)



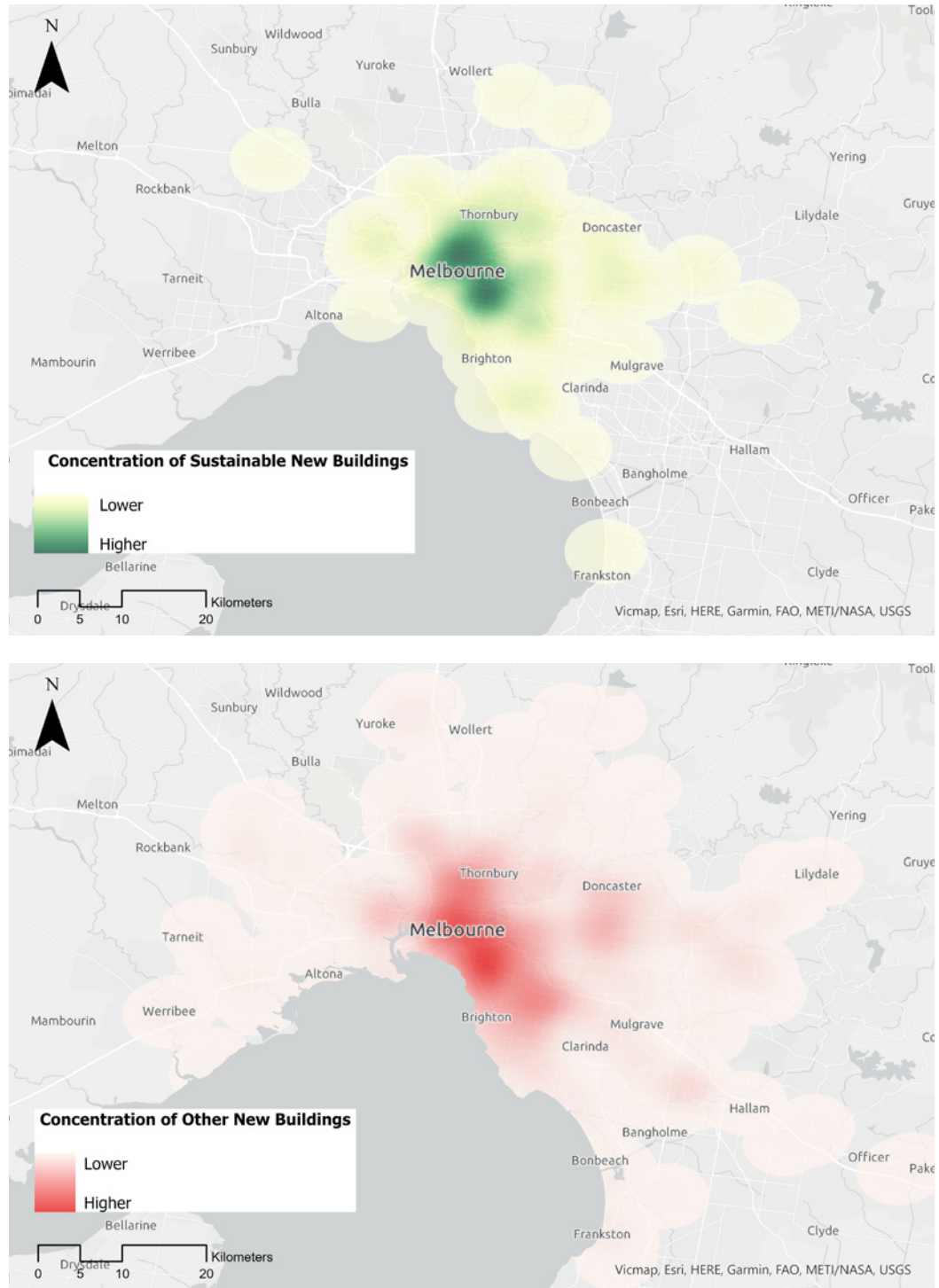
Source: Authors' Research

Figure 4: Sydney major upgrade developments (sustainable and other)



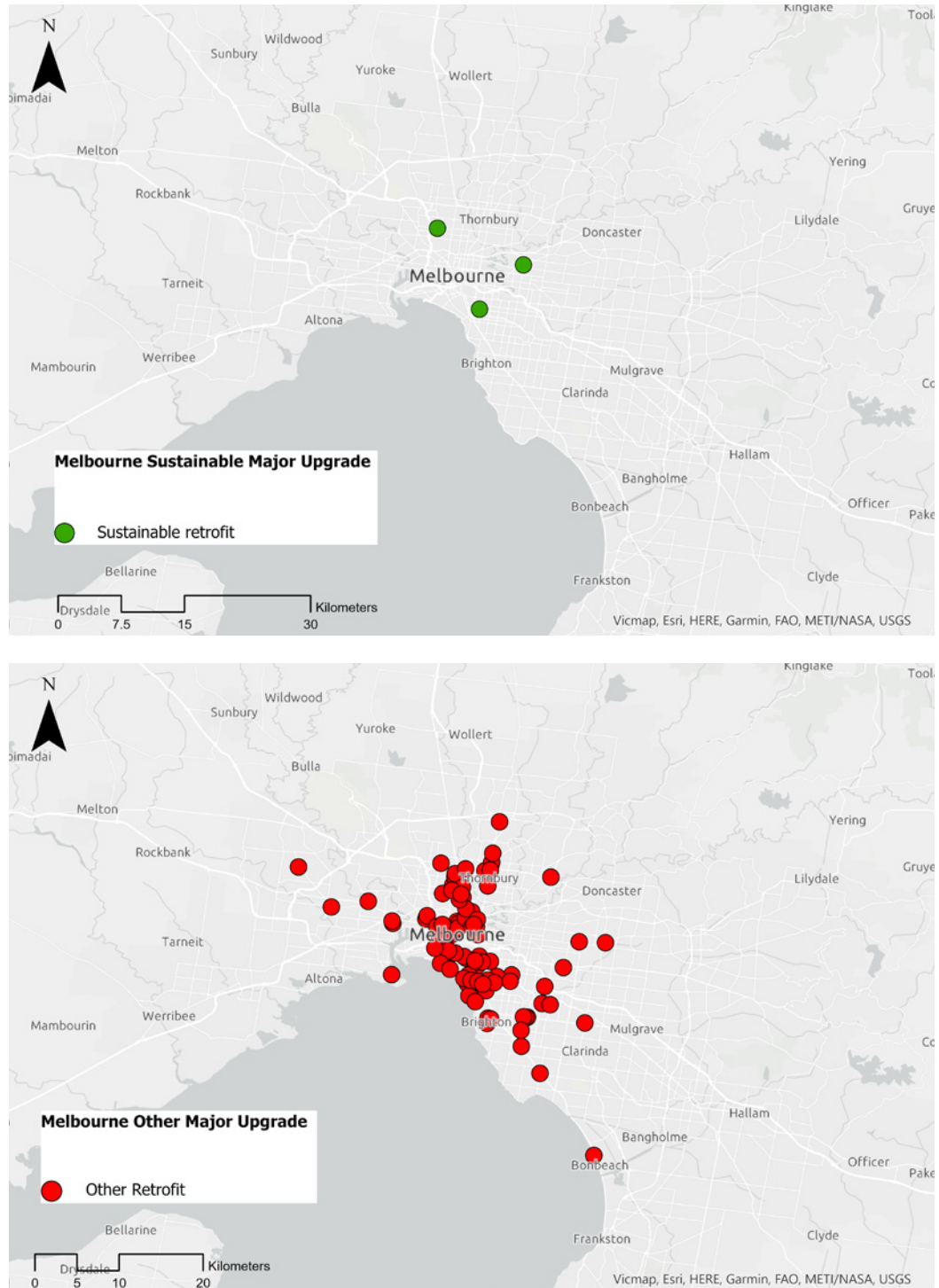
Source: Authors' Research

Figure 5: Melbourne new build developments (sustainable and other)



Source: Authors' Research

Figure 6: Melbourne major upgrade developments (sustainable and other)



Source: Authors' Research

3. Challenges in delivering and adapting sustainable apartments

- **Despite evidence that purchasers desire more sustainable apartments, the market has failed to deliver these at scale.**
- **Speculative development of apartment supply leads to split incentives at all stages of property development that impact building quality and sustainability.**
- **Investor-landlords were regarded by informants as less interested in sustainable buildings. As the largest segment of the market, this impacts on developers' willingness to consider sustainability. This is exacerbated by the fact that sustainable building performance is not adequately reflected in property valuations.**
- **Sustainability is generally not well embedded in project feasibility for speculative apartment developments, the potential benefits of inter-dependence of units are frequently lost due to a focus on profit maximisation, and changes are made during construction to reduce costs.**
- **Multi-ownership of strata titled properties contributes to limited purchaser oversight or input during development. Joint ownership also creates difficulties for building maintenance and retrofits.**

In this chapter, we examine the dominant system of apartment supply and management in Australia (speculative development of strata titled properties) and discuss its implications for delivering and adapting sustainable apartments. The chapter draws upon interviews and workshops with key actors involved in apartment development and retrofit across NSW and Victoria. We begin by discussing the drivers of existing sustainable apartment delivery, before turning to examine the three unique aspects of apartment development.

3.1 Drivers of sustainable apartment delivery

In any market, demand is expressed through exchange. What is purchased determines what suppliers understand is desired by consumers. Mainstream economic theory would therefore suggest that a lack of sustainable apartment production reflects a lack of demand. Market research informs suppliers about unexpressed demand, and marketing can be used to stimulate demand. In regard to housing, developers also understand latent demand through reference to general economic indicators such as economic growth, employment, income, inflation, interest rates and migration. For apartment developers, consumer preferences must be determined years in advance of product being offered to the market.

However, as outlined in section 1.2.1, there is ample evidence that apartment residents and purchasers desire more sustainable apartments. The question then is, given that the demand exists, why is the supply of sustainable apartments so low in Australian cities, as demonstrated in section 2.2? And secondly, what is driving those developers who are producing sustainable product?

Research interviewees and workshop participants indicated that sustainability is being adopted more quickly in the BTR and social housing sectors than in the BTS market (e.g. Interviewee 3, financier). BTR and social housing providers have both financial and environmental impact motivations for adoption.

There is considerable uptake of sustainability by community housing providers who can access green funders and the National Housing Finance and Investment Corporation (NHFIC 2021b). Much of this appears to be driven by conviction, however Community Housing Providers (CHPs) also want to reduce their tenants' living costs, which may necessitate greater capital investment and foregoing return on that investment. The entry of financiers interested in impact and seeking low-risk, long-term investment provides encouragement to CHPs. CHPs increasingly long tenor debt results in their lenders having long-term exposure to the assets, driving improved asset management (Sharam et al. 2021).

BTR, built by or for institutional investors such as superannuation funds, involves holding the assets for the long-term for the purpose of rental yield. Similar to social housing, BTR is concerned with building quality assets, which will reduce lifecycle asset management costs. While demand for sustainability from social housing tenants is mediated by their landlord, in the case of BTR the landlord views sustainability as advantageous in attracting and retaining tenants (Interviewee 3, financier). Retaining tenants reduces costs associated with turnover and voids. However, some BTR is built as BTS, stratified and held only for the short to median term.

In contrast to the CHP and long-hold BTR markets, BTS developers are typically 'build and go', meaning developers have no ongoing role in the building. Developments involve 'short term assets usually liquidated through settlement and sold off to a third party' (Workshop 1, financier). This affects developer willingness to consider building performance, as this becomes a problem for later owners.

Most developers won't do [sustainability] for their brand, but some will. (Workshop 1, developer)

The only reward they're going to get is that someone buys their product if they're in the business on a repeat basis, and [reputation is] one of the problems in our industry. (Interviewee 4, developer)

The 'structure of provision' (Ball 1986) of new apartments and the difficulties in matching supply and demand (Sharam et al. 2018) have also meant most developers respond to the largest, easiest to obtain, and least demanding segment of the market—investors (as discussed in chapter 2). Investor-landlords were regarded as being less interested in the performance of buildings than owner-occupiers (Informants 5, 7, 8, 16, 17, 18, 20 and 23).

As an investor you probably don't, and I think the word 'care' is not the right one, but you're probably a little bit more relaxed in terms of your purchase options, and you probably don't get as involved in understanding what's the life expectancy of this material? Or how is my apartment designed in terms of its siting or orientation? And what are the building heating systems that are in place? Whereas someone that is living in there and that's investing as their home, definitely you see that come through in the customers. They want it. (Interviewee 7, developer)

Understanding demand for sustainability was a key concern of the informants. Generally, demand was considered to be limited but growing. Informant 3 suggested it is difficult to demand something that does not exist.

I don't think that demand exists in the absence of supply ... if people can see it's there then they'll buy it ... but they won't actively go out and look for it and say I want a sustainable home ... if it's an option, they'll take it. (Interviewee 3, financier)

Lack of demand was also attributed to ignorance.

I don't mean that to sound so negative, but buyers not being as educated about the benefits in terms of the long-term occupancy and life cycle costs of a building. (Interviewee 6, developer)

However, even where benefits can be established for residents and buyers, there was concern amongst some informants that buyers are unwilling to pay the price premium required to recoup the additional costs of implementing sustainability (Interviewee 5, architect; 9, developer; 21, builder). Although, some informants indicated there are not always additional costs (7, developer; 10, planning consultant). Declining housing affordability increasingly constrains the capacity of buyers (both investors and owner-occupiers) to offer a premium even if they understand the longer-term financial benefits. One of the developers interviewed with a commitment to sustainability indicated they were obtaining a premium for their BTS product (Workshop 1, developer) but another said they had been unwilling to risk passing through additional costs let alone charge a premium. They envisaged this would change in the future (6, developer).

There is a very small number of developers who have been building sustainable apartments for many years. These boutique developers have been joined by new entrants or companies who have embraced sustainability objectives. These projects tend to target owner-occupiers as this market segment is considered to have the willingness and means to pay the price premium. Some large (often listed) developers with diversified property portfolios now require all their apartment projects to achieve sustainability above minimum standards (for example Lendlease and Frasers Property). This reflects a broader strategy in which all product is of higher quality and performance, effectively becoming tenure blind.

There are a number of elements in play. Firstly, the decision to produce sustainable product is motivated by conviction.

[It] is the desire to do what's morally right. (Interviewee 7, developer)

Conviction reflects personal beliefs, but also collective responsibility. The smaller, boutique companies are often led by very passionate individuals who are mission driven to achieve change. The very large companies are aware of global trends or operate globally themselves. Other companies are foreign owned and the markets they operate in have higher regulatory standards and/or their social license to operate requires they embrace the need to act on climate change. They have large, in-house teams and capacity to develop their sustainability expertise. Reflecting broader environmental concerns, sustainability is an increasingly important part of branding in a market where brand recognition matters (Interviewees 1, 3, 6, 16; Coiacetto 2007; Jaafar et al. 2018; Kömürlü et al. 2013; Newell 2009).

If you don't care in terms of your brand positioning about these issues, then you'll just sell it and not care. (Interviewee 6, developer)

Secondly, the entrance of these developers and the success they have achieved has changed perceptions of what is possible.

I think the market has seen the success of those projects and is seeking to emulate that success. (Interviewee 24, developer/consultant)

In Melbourne, Nightingale Housing developments were identified as important examples of apartments that are high quality, sustainable and well-designed, sparking a shift on both the demand and supply sides (Interviewee 9, developer; 11, planning consultant; 14, architect; 20, architect; 21, builder; 24, developer/consultant).

The research informants noted this success of more sustainable developments had also resulted in a lot of greenwashing. Greenwashing is evidence that developers believe there is a market for sustainability, albeit one they may not or cannot supply.

Informants recognised projects with high sustainability credentials are often concentrated in specific geographical areas where the demographics are predisposed to a green message. Brunswick, in Melbourne's inner north, and home to Nightingale Housing, was frequently cited as a case in point. Capitalising on location and consumer demand for sustainability, Mirvac is currently developing a BTR project in Brunswick with Breathe Architects (designers of Nightingale 1).

Thirdly, developers with in-house marketing teams garner 'a lot of intel on what purchasers like' (Interviewee 8, developer) and feed this into the design process.

While some BTS developers are motivated by conviction to produce more sustainable product, they are a small minority. For others, a price premium is required to justify any additional costs of provision (Interviewee 1, financier; 5, architect; 9, developer; 21, builder). The owner-occupier market was identified as being more likely to pay a price premium as the split incentive between landlords and tenants deters additional capital expenditure by landlords.

If you are thinking from an investor owner's perspective ... they just bought this place, and they might flip it in a year or something like that ... they're not going to hang onto it forever. It's not their forever home. Then those people are probably less interested financially. (Interviewee 33, retrofit consultant)

BTS developers were regarded, in the main, as driven by the need to build and sell as quickly as possible with 'anything that gets in the way of making it more expensive' rejected (23, Building Consultant).

You're just trying to build it and flog it really quickly ... your real driver is lower capital cost. (Interviewee 16, building consultant)

Poor quality building construction was linked to tenants as the primary occupiers.

Sometimes apartments are miracles of construction how such poorly constructed buildings can actually [be built] ... tenants have absolutely no knowledge of whether buildings are well insulated or not. (Interviewee 23, ESD consultant)

While there has always been owner-occupation in apartments, investors dominate the market and have traditionally determined the type and quality of stock. The decline in housing affordability and demand for well-located urban areas however has contributed to a growth of owner-occupiers. This demand crystallised after 2017. 2017 is significant as Chinese investment slowed dramatically, reflecting the imposition of capital controls by the Chinese Government. As prices fell, domestic investors fled the market and selling investor stock was much harder. For the first time, some developers turned their attention very specifically to owner-occupiers. Some boutique developers changed their product offer to appeal to this sub-market.

Investor type products [drove the] ... last cycle ... this cycle is very much about ... owner-occupiers. (Workshop 1, financier)

Around the same time as the market was peaking, building defects were attracting public attention. The combustible cladding fires in Melbourne (Lacrosse in 2014, Anstey Square in 2017 and Neo 200 in 2019) and evacuations due to structural problems in Sydney (Opal Tower in 2018 and Mascot Towers in 2019) highlighted the poor build quality of many apartment buildings. Defects are a significant, ongoing problem (Crommelin et al. 2021). Reputation has taken on increased importance for brands (and impact on share price if a listed company).

Some large multi-residential developers appear to be taking account of the demands of owner-occupiers, producing apartments that are less recognisably intended as rental stock without adding a price premium.

Are your owner-occupiers willing to pay extra to have a sustainably designed and certified building?
... at the moment we're a little bit reluctant to pass [the additional costs] on because we're not sure about whether or not purchasers would take that up, but it's definitely something that we think about. (Interviewee 7, developer)

Citing recent housing price data released by CoreLogic, Domain (Redman 2022) reported that many apartments had been sold at a loss during the pandemic but owner-occupied stock had largely defied this trend. Redman (2022) cited independent real estate analyst Angie Zigomanis who said, 'adding apartments designed for owner-occupiers are likely to perform better than investor-grade product', as well as Melcorp Real Estate director Mark Giuliano who argued:

anything designed for owner-occupiers with more space and amenity in a better location performs better. If it is a good building, it's well designed, it does really well – sometimes you can't get enough of them.

The informants revealed an uncertain picture of consumer demand for sustainable apartments and a less than clear picture of costs. Sustainable developers, however, are educating consumers and testing technologies and applications. As the market for sustainable apartments evolves, our respondents anticipated that both buyers and tenants will be more aware and discerning (Interviewee 7, developer; 9, developer; 14, architect; 16, building consultant; 17, ESD consultant).

These are positive developments and indicate diversification in the structure of provision for apartments (Ball 1986). But it does not represent systemic change and constitutes only a small proportion of the market. It is important to understand how the speculative nature of apartment provision affects uptake of sustainability (and more broadly design and build quality).

3.2 Speculative strata titled development

Property development is a linear process involving sequential steps, some of which overlap. These can be broadly described as project initiation, land acquisition, design and planning approval, pre-sale campaign, building approval, construction, sub-division and title creation, settlement, and post-completion sales. Figure 7 presents a detailed network diagram of the apartment supply system in Australia, developed over the course of the research and adapted in response to feedback from the participants across the four research workshops.

The developer uses their equity to fund all the outgoings until construction, at which time borrowings are used. It is only when the first settlements take place that the project receives any income. The process typically takes many years. Technically, pre-sales can only occur once a planning permit has been obtained. Further design and technical work occur subsequent to the planning permit to obtain the building permit. Pre-sales campaigns and building permit work occur concurrently. Construction commences when the building permit is granted, and pre-sales are achieved (the financier may require a quota of pre-sales). When construction is complete an occupancy permit will be issued paving the way for the sub-division and creation of titles. Pre-sales are settled as soon the titles are available.

Feasibility determines what can be achieved on the land and this will inform the price paid for the land. The feasibility analysis takes account of existing standards and regulation.

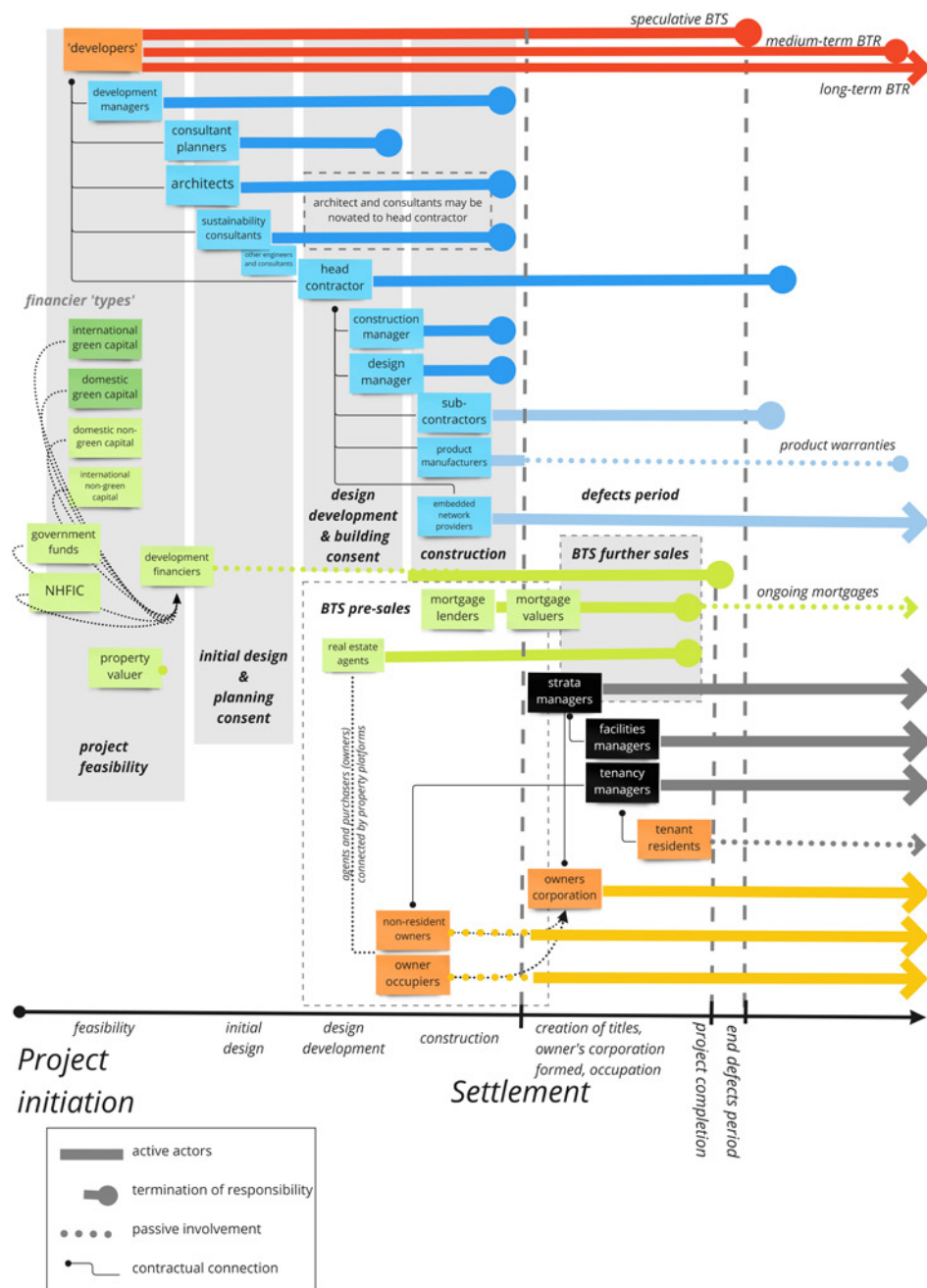
Developers put it in the feasibilities upfront and take it into account at acquisition stage (Workshop 1, developer).

3. Challenges in delivering and adapting sustainable apartments

Any additional impost results in the land price being discounted. If changes in regulation occur after land purchase the impost must be absorbed by the project. As this may mean a project is unfeasible, land will not be developed until apartment prices rise to offset the increased cost of provision.

[What] we saw in New South Wales with the apartment design guide and SEPP65, that did raise costs, and it did make many sites unviable at the time, and took it quite some time for those sites to work through the system and for the market forces to change to make those sites viable. (Workshop 1, developer)

Figure 7: The apartment development system



Source: Authors' Research

The feasibility contains all the assumptions: type, size, build quality, number of apartments, the costs and the sale price(s). Because apartments are inter-dependent there must be (in the main) common provision. Replication also reduces costs. Differential treatments therefore are usually cosmetic. Apartments may be larger (in towers the highest level will typically have premium (penthouse) apartments able to attract much higher prices). As the marginal cost of an additional apartment is low, maximising the number of apartments is a typical objective. The feasibility takes account of the cost of production, the sale price and how quickly buyers can be obtained. Time is money in development and thus the easiest to obtain buyers tend to determine the type of product, and by extension the cost and sale price. The important issue here is that the decision about what is built is made before or at feasibility stage. This decision requires the developer to forecast demand years into the future.

Development is done sequentially, and part of the problem is that there is generally a very long lag between conception and delivery (Workshop 1, developer). The feasibility analysis locks in what can occur downstream.

A lot of what happens in the feasibility stage is done in isolation to the actual delivery. And so when it gets to construction, it's very difficult to then rectify. (Workshop 1, developer)

Apartment development is speculative as developers do not proceed with firm contracts unlike housebuilders. All commence the development process without sales as they are not legally permitted by consumer law to pre-contract unless they have a planning permit. This is to protect consumers. Often financiers will require a quota of presales before releasing construction funds, but presale contracts operate more as options. While legally obliged to honour their contracts, buyers can simply forfeit their deposit. Developers mostly do not pursue them through the courts (Bryant 2012). Developers therefore undertake an educated gamble. With millions if not hundreds of millions of dollars tied up in the development they seek to appeal to the deepest and broadest pool of demand, investor purchasers.

BTS investors and landlords also seek to reduce their capital costs as much as possible. They are typically not interested in higher performing appliances and materials if they cost more, and they receive no financial benefit from the additional performance. This split incentive results in tenants paying for the financial cost of poorer performing infrastructure.

Whereas there are split incentives in selling new apartments in that the developer would have to outlay a higher capital cost for the sustainability features on a punt that those buyers are going to pay back that additional capital cost in appreciating what's been done, which is a very hard sell. (Interviewee 5, architect)

The developers and financiers we interviewed argued unless a rental premium could be obtained, landlords would be unlikely to change their behaviour. Because the developer typically aligns their interest with that of investor purchasers, a split incentive also exists between the developer and owner-occupiers who purchase this stock. As discussed above, the informants' views on whether a buyer's premium was achievable were mixed. International property advisory JLL's 2021 meta-analysis of research on the financial benefits of sustainability found significant evidence for both a sales and rental premium for certified residential properties (JLL 2022). Consumer education was regarded as critical for changing tenant's understanding of the financial benefits.

There was consensus on the benefit of empowering tenants and occupants, but most informants were adamant that regulation to improve minimum standards was also required to overcome the split incentives. Regulation was recognised as adding to costs, at least in the short-term. In the longer term it was argued, economies of scale would reduce the costs.

Everything becomes a lot cheaper, even materials. Now, you know, insulation is a lot cheaper, even double glazing is a lot cheaper now. (Workshop 2, builder)

While it was typical for the informants to claim that sustainability adds to capital costs, a strata manager noted that there are some 'really opportunistic players out there' who reduce their own capital costs through by pushing '*their cost obligation onto the end user*', with the future owners obtaining little financial value and, in some cases, becoming liable for the cost:

Any downstream novation [contracting] to the end user needs to have a distinct benefit offset, so you're getting the benefit of this because you're getting a much lower margin on your electricity or gas, or sustainability or whatever else it may be. (Interviewee 26, strata manager)

This deferred capex model is another example of how split incentives work in the BTS sector.

Another important aspect of apartment development is the role of contracting. It is typical for a developer to contract consultants (such as architects, engineers and sustainability advisors) and the builder. Contracts are a means for the developer to control costs. All contractors in the process are subject to competitive pressure which keeps margins very low. Contract management in and of itself is a costly exercise and lack of oversight is a key reason why design is not implemented as envisaged and build quality issues arise. As one developer (workshop 1) outlined, significant resources are required to ensure a developer obtains the outcomes specified by the contract. Not all developers are motivated to heavily police their contractors. Sustainability features incorporated in the design can be altered or removed at this point (Interviewee 14, architect; 23, ESD consultant).

Some of the large developers, who trade on their reputation, maintain very close oversight of contracts. Some developers with a pipeline of work will maintain in-house teams to provide for quality control. Tight oversight and in-house teams are a reflection of maturity in the market which, in turn, is a reflection of growth in demand.

The BTS market is generally not attracting sustainability funds (as is occurring in the BTR sector) as diversified strata title ownership militates against long-term tracking of performance (Interviewee 3, financier). Design and build quality are also generally of a lower standard than these funders require. There were exceptions, with a sustainability fund manager (Interviewee 3, financier), indicating his company had funded exceptional BTS projects involving 'step change'.

There was divergence of views among the informants regarding the impact of financing. A developer (Interviewee 6) argued 'finance doesn't drive it' because, as Informant 3 noted, debt financiers enter the development process late (after design and permit approval) with sustainability 'typically seen as the equity developer's role'. One sustainability consultant suggested few BTS developers are aware of green financing:

It seems to me that lots of projects get ... conceived and ... get designed without any thought to where the capital is coming from. (Workshop 3, sustainability consultant)

As a developer pointed out, the feasibility determines the price paid for the land.

[It is] almost too late by that stage because someone at the very beginning, when they bought that site, figured out that this is how much the project's going to cost. (Interviewee 8, developer)

However, a builder from a major construction company said:

Financiers are starting to drive ... change in many respects in that there are more conditions ... [to achieve] a certain minimum standard of sustainability. (Interviewee 19, builder)

While there is substantial international debt and equity flowing into Australian projects, Australia's Big Four banks are a critical source of debt funding for BTS projects. The Big Four banks have each adopted ambitious sustainability targets. However, as a financier noted, funding of BTS projects was business-as-usual with no consideration of sustainability.

[Most lenders,] if not all lenders have ... significant triple bottom line reporting and very, very, public facing sustainability goals around their lending book. But in practice they will lend to anything and anyone. (Interviewee 1, financier)

The move of the Big Four banks into housing sustainability is tentative. A boutique developer (Interviewee 24, developer/consultant) said, 'they are genuinely, kind of ... interested to understand this stuff', noting his banker used him as an unofficial source of professional advice regarding sustainable development.

Banks also have a role in relation to mortgages. Green mortgage loans were nominated by informants as stimulating consumer demand and as providing evidence for demand. Green home loans offer concessional interest rates for housing which meets a specified standard. The participation of foreign banks in this market is keeping 'wholesale funding costs down for [green] mortgages' (Workshop 1, financier).

Mortgages, unlike project finance, mean the lender is exposed to the build quality of the dwelling. This has implications for re-sale value (if the mortgagee defaults) and the ability of the mortgagee, if an owner-occupier, to service the loan. As apartments increase their share of dwellings and owner-occupation of apartments increase, banks are becoming more sensitive to what they are financing on the project side.

We want to make sure that we're financing projects that deliver a good product for our ... [mortgage] consumers ... because we're financing them on the other side. (Workshop 1, financier)

In short, retaining market share of mortgages and managing the risks associated with apartment quality and performance is driving reconsideration of the type of product banks will finance.

The role of valuers in the development process is also very important. Valuations are required at multiple points in the development process. As settlement nears, mortgage lenders undertake their own valuation. If the valuation is not high enough the borrower may be left short of funds potentially precipitating settlement failure. Typically, the sales comparison valuation method is used to determine the value, but as one informant (workshop 1, developer) noted 'any property that tends to outperform the market [such as] quality apartments ... tend to sell less', consequently 'pricing signals to market' are weak. That is, valuers have little to compare sustainable apartments with. Without adequate data, valuers are returning conservative estimates of value.

Identifying sustainable homes as an asset class is ... difficult for the finance industry, leading to conservative valuations and artificial caps on lending that do not reflect the broader value of these products from an investor perspective. (Australian Sustainable Built Environment Council 2020).

Estimations are conservative because valuers' professional indemnity insurance is void where the method used to determine value lacks an adequate defence. During the final policy workshop, informants noted that the green office market faced the same issue when governments used procurement policies to drive development of green office buildings. Furthermore, the peak body, the Property Council of Australia included a 4.5-star NABERS (National Australian Built Environment Rating System) rating in their A grade and premium office classifications providing 'awareness to the market'. In the BTR sector rental income is capitalised to provide the valuation, as occurs in the office sector.

The tentative growth of sustainable apartments discussed in section 3.1 reflects, in the main, the conviction of proponents, supported by financiers seeking environmental impact. The presence of split incentives denotes market failure. The developers and financiers we spoke with are optimistic that sustainable product will attract a price premium. However, this market approach does not address the non-premium segment of the market and the possibility the existence of premium product may not drive higher standards. The other informants strongly advocated for the need for higher minimum standards to ensure the performance of all products is quickly lifted in line with the need to mitigate climate change and other environmental damage. This is discussed in more detail in chapter 4.

3.3 Physically inter-dependent properties

As an architectural and residential typology, apartments are physically distinguished by the inter-relatedness of dwelling units. Informants recognised that this inter-dependency presented challenges and opportunities for achieving circular economy.

(Interviewer): How sustainable are the apartments that we're building now?

Pfft, actually pretty bad ... and it's a shame, because I think there's a real opportunity in multi-residential. I live in multi-residential; I love it because you share some facilities. And you've got party walls, where you don't have to have much insulation, so your actual shell of the building you have to manage is way smaller, so you can do great stuff with multi-residential. But at the moment we just build boxes wherever we get the airspace and that's it. And we don't really think about the environment or how the building is even positioned towards the sun or just ... like this is the space we have, and we squeeze as many units in as we can. (Interviewee 31, retrofit consultant)

Informants focused foremost on opportunities realised or forfeited during the design phase. They referred less to construction and far less to post-occupancy opportunities and barriers. Informants indicated opportunities were not regularly realised, and rarely realised consistently.

Design phase

The design phase can present barriers to the uptake of sustainable apartment design, as found in prior research (Edwards and Hyett 2005). Challenges derive from the broader development context, in which future apartment residents are not involved in the design of their homes. This context is specified above and further details of the challenges it raised are elaborated in forthcoming sections.

Developers are the client in architectural design development and current regulatory guardrails do not push or incentivise developers to pursue sustainable design beyond minimum requirements. In traditional BTS apartment developments, the ability to drive sustainable design outcomes can be severely curtailed by developers' profit motives, regardless of architects' or ESD consultants' expertise, skills and ideas (18, architect).

As consultants we want to have earlier involvement and be involved for longer, but there are cost reasons people want us to step out so they can do it more cheaply. That's the nature of the market. (Interviewee 22, ESD consultant)

Several architects suggested developers were disinterested and uneducated about sustainable design (Interviewee 12, architect), and this could give rise to a lack of '*shared vision*' during design development phases (Interviewee 22, ESD consultant).

Developers often settled for minimum standards rather than pursuing best practice sustainable design approaches. Several architects expressed that while design codes such as SEPP65 have a generally positive impact on design outcomes, these instruments nonetheless instil a focus on minimum standard compliance (Interviewee 14, architect) and fail to incentivise innovations that might produce more sustainable apartments (Interviewee 12, architect). Giving weight to this argument, several architects reported that where local councils enforced higher standards, this eliminated the architect's need to 'convince' their clients to pursue sustainable design:

Obviously if a jurisdiction has a particular minimum standard ... for example, City of Melbourne said they had to achieve 5 star Green Star target, so obviously [you] don't have that discussion with the client because it's part of the condition of the permit. Generally, I don't find any too many jurisdictions are too strenuous on that, [it is] kind of best practice really. (Interviewee 18, architect).

Contracting arrangements also impacted design development. D&C contracts disallowed architects from using their design skills to improve sustainable design outcomes. Under novated agreements, architects do not get to 'start from scratch' with the design, and so the chance to secure better design outcomes is frequently forfeited (Interviewee 19, construction manager). Instead, under these contracts, 'builders become designers ... and they're not qualified' and architects, who are contracted to builders, cannot work independently from them even though this would produce better design outcomes (Interviewee 12, architect).

Another barrier to sustainable design is the relative design intensiveness of innovative sustainable design in the context of staid design and construction approaches and methodologies (Interviewee 16, building consultant). Additionally, where stakeholders identify potentially beneficial (new) proprietary technologies, the cost, time, knowledge and skills involved in getting details right can be dissuasive or prohibitive (Interviewee 16, building consultant). A developer committed to sustainable design commented:

And yeah, cost in proprietary technologies. Like, if I had \$1 for every time I talked about an initiative to use in a building and like it's from Europe ... and not really something that builders can wrap their heads around here. Like it's, you often see, the *avant garde* - apart from kind of the *Nightingale* types, which I guess take on a lot of design risk and they are very design cost heavy to be able to study and implement some of the really progressive initiatives - that just would be hard in a normal commercial setting. You'll often see that the most *avant garde* [green] projects are usually delivered by tertiary educational or government institutions, because they have the budgets in the margins to be able to do that. (Interviewee 9, developer)

Other informants similarly noted that developers are often averse to diverting from tried and tested design approaches and minimise risk by rehashing past successes (Interviewee 14, architect).

Securing sustainable design outcomes in this context is therefore strongly contingent on a client's 'will and passion' (19, builder). In government projects, state actors were cited as important potential innovators, with the potential to push for better design outcomes (Interviewee 19, builder).

Beyond the developer, architectural practices themselves may not always advocate for the highest levels of sustainable design. One architect suggested they could be reluctant to 'over promise' to their clients. For instance, where a project could achieve 5 stars, the architect might promise their client 4, so that if a later rating came in at 4.5, the client would not be disappointed or litigious (Interviewee 14, architect).

ESD consultants play a key role in securing sustainability outcomes during the design phase. While consultants are tasked with undertaking ratings, consultants may also play a crucial role during the design phase. Distinguishing this latter role from the 'box-ticking' role of the former is essential, as it underscores how key early inputs from consultants (could) play in shaping sustainable design outcomes. However, consultants often do not influence projects as much as they might. A building consultant described a 'cutthroat' process, where margins on each phase of the development process disincentivised developers to see value in employing consultants to provide the right advice at the right time (Interviewee 16, building consultant).

One of the most significant barriers to ESD consultants optimising their influence on this front was that consultants were typically contracted too late in the design development phase to apply their knowledge to secure the best possible outcomes (Interviewee 23, ESD consultant). Consultants entering into the design development process when design was well underway were stymied in their ability to provide better solutions or add in new sustainability features, since any suggestions were constrained by prior design decisions and a reticence to make design changes:

You can never be engaged too early ... For new development, the best [scenario] is [to be engaged] before the architects drawn up the first set of plans - that gives you the most scope. (Interviewee 33, retrofit consultant).

For instance, one consultant gave the example of how their advice to incorporate a heat pump was knocked back because there was insufficient space in the roof design and the client was unwilling to rework the established design solution.

More generally, interviews revealed that lack of information and stakeholder knowledge about the value of sustainable design - both on the development and purchaser side - could be a major barrier to effective sustainable design processes. For instance, consultants commented that developers (and the public at large) could fail to understand the value proposition of sustainability (Interviewee 16, building consultant), especially the long-term gains associated with a potential upfront cost.

Information is a barrier ... you don't have a market that appreciates the benefit (Interviewee 22, ESD consultant).

Despite these challenges, the apartment design phase also presents novel opportunities. Given building scale, apartment design presents distinct opportunities to innovate and test novel designs, materials and approaches that would be unfeasible in detached dwelling projects (such as CLT construction).

Several informants recognised these opportunities, as one consultant commented: 'There's a lot of opportunities when we have integrated design processes' (Interviewee 22, ESD consultant). Informants suggested the potential to secure better design outcomes during the design phase was corroborated in niche speculative apartment development, where much higher sustainable design outcomes are achieved for higher-end apartment sub-markets where developers were adequately incentivised. Developments with long hold owners, such as BTR, social and affordable housing and public housing, more readily produce the required incentives for developers. As mentioned above and elaborated below, these developers have much stronger incentives to consider the operational costs of the apartment building and may be more receptive to additional capital expenditure to achieve better longer term sustainability outcomes.

Returning to the topic of inter-relatedness, the complexity of apartment design requires an early, team-based, integrated approach to achieve sustainable outcomes which can optimise the opportunities for sustainable development this building typology offers. One retrofit consultant commented:

I always try to explain ... the building industry is more like an eco-system. It's not one person or another, it needs to be everyone along the whole chain, so if you have an architect who designs a beautiful curtain wall right along the north aspect of the building, and then you asked the [HVAC] guy behind it to make it sustainable to cool that building well that doesn't work, so we all need to work together. It needs to be a communal thing, where you think about these things differently, like let's ask ourselves a few key components which we need to change and how we're going to do that differently. And then you can actually come to some really big steps quite quickly, but if you've asked me as a builder at the end of the design process it needs to now be sustainable - it's going to be dearer. Because we're going to try to implement systems and undo things which aren't actually thought through initially. (Interviewee 31, retrofit consultant).

Energy and spatial efficiencies

Informants identified energy efficiencies as a first set of opportunities associated with inter-relatedness. For example, informants cited thermal efficiencies from stacking units (Interviewee 20, architect) and from shared walls and optimised external envelopes (Interviewee 22, ESD consultant; 14, architect). Informants also cited spatial efficiencies, including optimising urban space usage by 'provid[ing] housing for a lot more people in a smaller space' and by sharing amenities, including green spaces (Interviewee 7, developer). In view of these thermal and spatial efficiencies, some informants saw the apartment typology as inherently sustainable (Interviewee 14, architect; 7, developer). These typology-related energy efficiencies opportunities were identified in the literature cited in section 2.1.2.

Informants identified that many of these opportunities were infrequently realised in current practice. Current development practices were associated with poor unit orientation. A particular concern was single orientation preventing delivery on passive design principles, including cross-ventilation of units which requires units with two aspects (Interviewee 20, architect; 6, developer; 24, developer/consultant). This echoes the literature, which recognises that energy efficiencies opportunities are contingent on other factors, such as orientation (Tettey et al. 2016).

Conversely, no informants suggested a focus on energy efficiency standards could result in perverse outcomes by prioritising energy efficiencies over health and liveability, as Mummery (2021) has claimed. On the contrary, informants noted that the failure to achieve energy efficiencies has knock-on effects for the lived experience of Australian apartments, such as higher utilities bills and reduced comfort (Interviewee 18, architect).

Infrequently, informants suggested that apartment typology disallowed for sustainable design. A builder claimed, for example, that the typology 'suffered from spatial constraints relative to lower density dwellings, leading to poorer spatial quality' (Interviewee 13, builder). Several informants reiterated that developers were not incentivised to improve energy efficiencies. For instance, one consultant noted: 'Developers are in business of selling apartments, not managing energy supplies' (Interviewee 16, building consultant). More commonly, informants emphasised good design and the importance of the architect in optimising energy efficiencies. Some informants noted developers' financial imperatives circumscribed architects' capacity to realise established passive design best practice and compromised the uptake of innovative sustainability materials, design features or systems (Interviewee 19, builder).

Social sustainability

Informants identified social sustainability as a second set of opportunities associated with interrelated dwellings. First, apartments have the potential to help optimise existing physical and social urban infrastructure. One consultant explained:

So, sharing is a really big part of that, resource sharing. I think some of the opportunities that we see are making more efficient use of established infrastructure as well. Yeah, we have these areas close to where we have public transport networks, essential amenity, where the city as it stands can support a growing population. (Interviewee 24, developer/consultant)

Second, the provision of shared amenities, such as shared green spaces, could enhance residents' sense of community. Informants noted several social sustainability benefits, including increased social interaction and better mental health (Interviewee 12, architect) by 'increas[ing] the way the community interacts with each other' (Interviewee 7, developer).

Third, the apartment typology could provide a genuine alternative to single family home typology with varied unit sizes (one bed, two bed and so on) to address diverse housing needs and price points, including opportunities to age in place (Interviewee 24, developer/consultant). As a housing typology that incorporates different kinds of dwelling sizes, it could address evolving household needs. For example, BTR specifically provides opportunities for renters to move between units.

However, some informants identified that opportunities for social connectivity and community could be difficult to realise. Creating a sense of community was fairly elusive and potentially required purposeful orchestration through on-site coordinators and/or events (4, developer). Management could foster or curb social sustainability opportunities too. For instance, a developer (4) described an occasion where use of common property to grow a community vegetable garden was halted by the owners' corporation.

Shared services

Informants identified shared systems, such as for water, gas and electricity (Interviewee 17, ESD consultant) as another set of opportunities associated with inter-related dwellings. Informants noted shared metering and embedded networks provided opportunities for more efficient maintenance. However, these systems are also associated with demotivating households to reduce their personal energy consumption since their household consumption is not metered. This reinforces a point raised in the literature that energy efficiencies in apartments need to be evaluated at both the building and unit scale.

Opportunities for shared systems were not limited to standard utilities. Several informants commented that scale and inter-connectivity of units provided enhanced opportunities to innovate. Developers said: 'There are lots of opportunities, the limit is only our own creativity' (Interviewee 6, developer) and 'I don't think there are as many constraints as there are opportunities ... there are so much more opportunities when you have stacking apartments ...' (Interviewee 7, developer). For instance, one developer cited opportunities to mine heat from sewers on large sites, to deep soil landscapes, and for black water sewage treatment (Interviewee 6, developer). The unique physical characteristics of apartments provided opportunities to 'do things you can't do at single-dwelling scale such as water harvesting and re-use and useable roof tops' (Interviewee 8, developer).

Other informants mentioned shared infrastructure and its flow-on sustainability benefits:

There's opportunity for common spaces in terms of laundry facilities, common recreation spaces and the like. Like the Nightingale principle, where there's no laundries ... therefore that's less systems running through it less ventilation required, those kinds of things. (Interviewee 14, architect)

Informants also noted opportunities to secure efficiencies through centralised systems. One consultant elaborated:

We don't need 22 hot water systems across the building, we can use a centralized heating system. Metering technology has really moved on ... we can actually submeter now, we can do it cost effectively and we can administer that through the embedded network which we have in place to buy bulk green power. (Interviewee 24, developer/consultant)

By contrast, informants suggested some shared systems and inter-dependencies introduced more complexity. This could create barriers to realising some of these benefits by making innovative approaches harder to realise (see below on PassivHaus) and by making existing technologies and systems difficult to implement in practice. One example is the design and governance of recycling and waste systems (Interviewee 8, developer). In larger apartments with rubbish chutes, separation of recycling was often done off-site, not using innovative systems available in other large commercial buildings such as composting (Interviewee 25, strata manager). A strata manager explained cost benefits to residents of on-site sorting:

[T]he costs of disposal are massive so it's 6 or 700 bucks per annum for every lot owner within a building to have their waste taken away. They don't know where it goes so it would be a much better story if you were managing to recycle more on site. If you were able to actually have a community composting attached to a community garden or something ... we've got that in a couple of buildings now that we've pushed to manage. (Interviewee 25, strata manager)

How apartments are designed impacts the opportunities for residents to adopt sustainable practices. The developer elaborated, noting how waste management is established prior to building occupancy:

Waste management is purely managed by the builder. There are a lot of ESD kind of sustainability management plans, which we have to submit to council. We will say that we will establish a waste plan and I think they also asked for it in the construction management plan for a waste strategy. So, we could start to dictate a more thoughtful, sustainable way to look after the waste. (Interviewee 8, developer)

This example underscores the need to account for how apartment design and governance interrelate to achieve sustainable through-life outcomes.

Construction

Informants identified that the distinct apartment typology provided opportunities for off-site pre-fabrication or modular construction (Interviewee 16, consultant) and modular designs (Interviewee 20, architect). One consultant suggested pre-fabrication could be delivered for comparable costs, that the build quality was superior and that it enabled time savings relative to traditional on-site apartment construction (Interviewee 16, building consultant).

Informants noted construction-related opportunities were not realised under mainstream BTS, which involved traditional on-site, tried-and-tested construction techniques, materials and skills. Informants' commentary, as captured in one retrofit consultant's (Interviewee 31) reflections at the outset of this section, suggest more sustainable approaches are relegated by profit imperatives, price points and perceived consumer demand as corroborated elsewhere (Higgins and Moore 2015), even as informants recognised 'real opportunities' to secure better outcomes during construction. Several informants noted PassivHaus—as exemplary sustainable design—was especially complex in apartments because of the inter-dependency of apartments. A developer explained how improved thermal bridging and insulation could lead to condensation, for instance, which then introduced the need for mechanical ventilation, which then added further complexity (Interviewee 8, developer). An informant involved in Australia's first PassivHaus apartment (Interviewee 5, developer) listed multiple challenges with delivering the project, including complexities raised by physical inter-dependencies and the lack of local precedents and thus expertise to deliver the project.

Retrofit

Informants less frequently discussed physical inter-dependencies in the context of retrofit challenges and opportunities. However, many common retrofit practices centre on the shared and centralised systems overviewed above, such as lighting, embedded networks, gas networks, solar infrastructure, water metering and EV charging stations (Interviewee 26, strata manager). One retrofit consultant said the biggest opportunities for effective upgrades was to mechanical services, another shared service. This could include, for example, upgrades to cooling towers, upgrades to carpark fans, pool heating, review of lobby and common area air-conditioning systems (Interviewee 28, retrofit consultant). Other common retrofits involved shared spaces such as communal gardens and laundries (Interviewee 26, strata manager).

Conversely, utility systems that were more individuated were typically not identified for upgrades. One retrofit consultant (28) gave the example of domestic hot water: 'that's really built to the occupier, directly to the apartment. So we don't really look at that'. Without data on household energy usage, it was more difficult to quantify the benefits of retrofits to individual systems. The same consultant noted how they would address issues such as uninsulated pipes associated within these heating systems, for instance, but said 'we don't know what the payback is because we don't have all the data to do a payback analysis on domestic hot water systems'. The focus on shared rather than individualised systems makes sense, in the case of shared utilities such as gas and electricity, given that common property elements account for as much as 60 per cent of an apartment building's energy usage (NSW Fair Trading 2021).

Upgrading shared systems and spaces required more management and more trust between stakeholders, relative to single family homes, and therefore more (perceived) risk (16, building consultant). The discussions of apartment governance in section 3.4 below elaborate on these risks. However, informants generally did not elaborate on barriers specifically related to inter-dependent physical dwellings, besides citing the 'inherent complexity' of shared systems. One exception to this was that developers, consultants and strata managers suggested how embedded networks could complicate (and sometimes limit) retrofit opportunities. For instance, an embedded network provider could place conditions on future installation of solar panels (since this would reduce utilities paid to the embedded network operator).

3.4 Joint ownership of property

The multi-ownership of strata titled properties has two main impacts on sustainable development and retrofit. The first relates to the development of new apartments and the second to building maintenance and retrofits.

Limited purchaser oversight

Strata titled apartment buildings are developed speculatively for multiple unknown future purchasers. Those purchasers collectively take control and responsibility for the building in the form of an owners corporation. This is different to the development of other types of property, where a purchaser or group of purchasers commission a building. In these cases, the purchaser is likely to have greater impact and oversight into the design and development of the building(s), and an opportunity to inspect and assess the building works, affording an opportunity to impact upon building components that will improve the longevity and performance of the building over time. Purchasers of strata titled properties typically do not have anyone in place to represent their collective interests at the design and build phases of a development and have little influence or oversight over what is built.

The lack of oversight of the design and development of apartment buildings by those who will be responsible for their ongoing operation of a building is problematic. It allows for split incentives between those developing the buildings (concerned with minimising capital expenditure) and those purchasing them (concerned with maximising operational efficiency). As a strata manager explained:

I mean that you've got to break it into two elements. One is the Capex to install the initiatives and to the ongoing maintenance costs or the ongoing benefit. The developer is principally interested in the ongoing Capex because that's their cost. They're not overly interested in our experience in the post completion maintenance or benefits. I mean, clearly, they wanted to create a connection between the value and therefore the potential uplifting price they can create because of these initiatives. But if it's a cheap upfront install and a long tail of maintenance, there's a disconnect because that's the priority that they will focus on as opposed to a much higher upfront capital and then much bigger downstream benefit to the consumer ... it comes down to how much the developer is willing to pay and how much profit they're willing to leave on the table for the benefit of the owners at the back end. (Interviewee 26, strata manager)

A retrofit consultant elaborated:

I've been doing energy audits on apartments and the base building ... I've seen, during their development, there's no consideration given to sustainability. Absolutely zero sometimes. And then for a lot of these developments, is the lowest cost. However, the owners who pay a premium - they're really not getting much in terms of sustainability ... even with a lot of the new buildings now, we do energy audits, and we find that there are opportunities in buildings that are about two years old ... because no one cares about at that level about sustainability or about saving energy and the benefits. But there are benefits obviously for the environment, also in lower greenhouse gas emissions. But there are also monetary benefits from running buildings at lower costs, which at the development stage, no-one cares about ... purchasers of the units ... they're not aware of what they're getting into. (Interviewee 28, retrofit consultant)

The lack of oversight by purchasers also contributes to the situation where sustainability features initially envisaged for a building are allowed to drop off as the development progresses:

Another thing that I found very interesting is that when buildings are designed, there's probably a sustainability engineer that's separate to the design engineer, that's separate to the project manager, that's separate to the builder or the developer and there's no one in the end, sort of overseeing this project so that design intent ... it doesn't get built in because ... there's a sustainability engineer and that goes to a designer, and then the designer probably says, 'you can't design that', the project manager then says, 'oh, you can't do that'. The developer then probably says it's too expensive 'we're not going to do that', and in the end no one checks anything. (Interviewee 28, retrofit consultant)

Collective management, ongoing maintenance and building retrofits

The fact that strata titled properties are both owned and managed collectively also has implications for their ongoing management and performance, as well as for the practicality and feasibility of undertaking building retrofits.

Strata title ownership is a dualistic form of property ownership (Van der Merwe 1994) with ownership within the building divided between lot (individual) and common (collective) property. This legal division of ownership has important implications in the context of building retrofits, because building elements subject to upgrade or replacement may be located in lot property, in common property, or stretch across both. The location of those building elements will determine who must pay for them and who is responsible for maintaining them. Lot property is the responsibility of individual unit owners, and common property is the responsibility of all owners collectively through the owners' corporation (usually represented by a strata committee and assisted by a strata manager).

We've got buildings that are now 12 years old, and they've got air conditioning plant individually servicing lots. So whilst the owners corporation might maintain the external unit because it's in an inaccessible area on the roof ... the person internally doesn't touch the filters and this thing operates really poorly. I keep coming back to air conditioning system because that's by far your most expensive use of electricity with an apartment that you can affect. The need to have that running efficiently is a big one, so I don't know what you can do in terms of mandating that these things be serviced. (Interviewee 25, strata manager)

A strata manager provided another example of green walls, and the challenges of ensuring these are maintained adequately by lot owners:

The installation of vegetation throughout the property ... can help with the ... thermal aspect of a property ... What we are seeing at the moment is that a lot of those garden beds are located on the facade but located in the private title and owner-occupiers or occupiers are not actually maintaining those garden beds, [and they are] dying. (Interviewee 27, strata manager)

However, he also noted that there are also challenges with maintaining these elements when they are on common property:

The creepers and the other ... vines, which we are now seeing a lot in these boutique sized apartment buildings here in Melbourne, just the ability to easily maintain those boxes ... sustainability in terms of the OC [owners' corporation] fees themselves ... making sure that we're not spending a lot of money on maintenance and the cost to maintain these planter boxers is a lot more than having to maintain at ground level because of the requirement to abseil the side of the building or get your scaffolding in to do the works. (Interviewee 27, strata manager)

The existence of both lot and common property and the requirement for collective management of common property in strata also adds a layer of complexity to retrofit decisions. Figure 8 outlines the actors involved in a retrofit project in strata. When a retrofit project is undertaken in an owner-occupied detached house, a single owner makes decisions about whether and what building works to undertake and how to pay for them. In comparison, in a strata titled property, the single owner-occupier is replaced by a collective of actors, which includes all unit owners as members of the owners' corporation (including resident and non-resident owners), renters (non-owning residents) and their tenancy managers, the group of owners elected to represent the owners corporation (the strata committee), the strata manager who assists the strata committee with their functions and, in some cases, also a facilities manager (or building manager).

Research informants discussed a range of challenges associated with collective ownership and management in strata properties when it comes to undertaking retrofit projects. The first is that for many strata committees only prioritise immediate issues (such as repairs and maintenance) and do not have the capacity to allocate time to forward planning, including planning for sustainability retrofits.

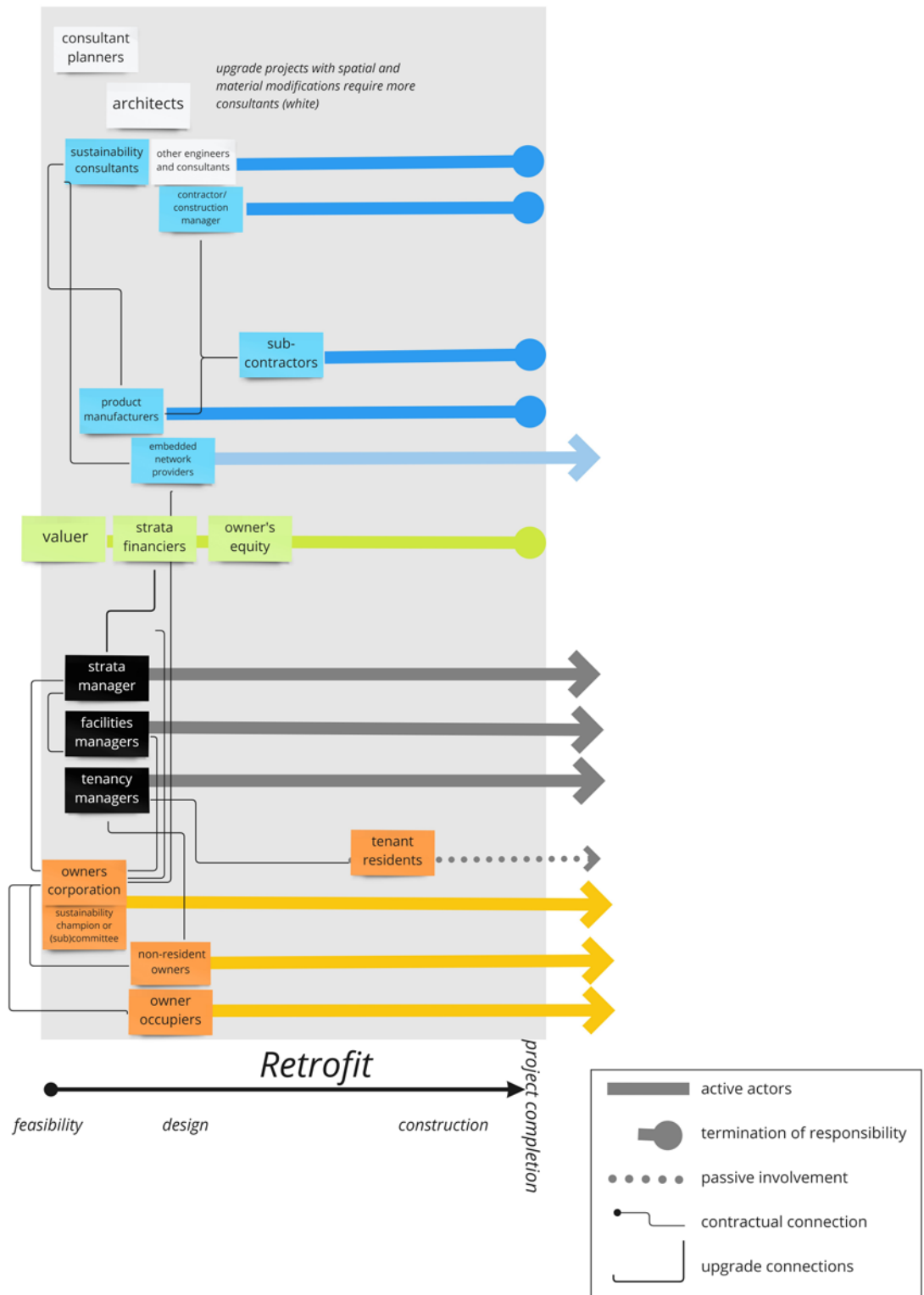
I think there's too much of a focus on just doing what is required to maintain or repair so to actually comply versus here's your opportunity to spend a bit more money and get a much better outcome. (Interviewee 25, strata manager)

One strata manager explained that retrofits tend to be undertaken for one of two reasons - essential repairs or improvement:

Retrofits occur in for two main reasons, one out of necessity. So the building needs to be upgraded and therefore it kicks off a whole series of upgrade and maintenance discussions ... the second is proactively entered into because the committee wants to improve the building's performance or aesthetics ... when it's down on a necessity path, those owners typically are trying to deal with the lowest cost resolution to their common property maintenance, so it's difficult to overlay any substantial sustainability initiatives in those scenarios. Unless there is a very comparable cost outcome ... but if you're going to have to pay a premium in most cases [and] because the nature of collective decision making, particularly around necessary works, is going to likely mean that you're going to lowest cost outcome. Where you get those sustainability - more proactively led - upgrades and retrofits where buildings are looking to unlock value ... Or they're looking to generally uplift their building because they believe in the principle of sustainability, or they believe there's a potential downstream value from it, that's a much greater opportunity to introduce sustainability because you've got a different receptivity from those owners. (Interviewee 26, strata manager)

3. Challenges in delivering and adapting sustainable apartments

Figure 8: The apartment retrofit process



Source: Authors' Research

Informants also said that even where buildings are embarking on upgrades, it is uncommon for sustainability retrofits to be considered alongside other building works, despite the potential for cost savings in doing so (Interviewee 25, 26, 27, strata managers; 28, retrofit consultant):

They tend to be a separate project and we found that buildings that are going through, like facade, repairs and things like that tend to delay their energy efficiency upgrades. (Interviewee 28, retrofit consultant)

Developing a proposal for sustainable retrofits and seeking approval to carry out the works can be a time-consuming task.

But it takes a bit more time, so you need to have longer lead times ... we could start a job tomorrow in a traditional form, but by introducing this new [sustainable] system, we need to do a bit more preparation work, we need to get some drawings, so we have to allow ourselves to do that as well ... there's a bit more prep work involved. (Interviewee 31, retrofit consultant)

Because of the work involved, some informants (Interviewee 2, financier; 26, 27, strata managers) stated that successful sustainable retrofits projects in strata buildings need to be driven either by an individual owner champion, or a sustainability sub-committee made up of interested owners.

Sustainable initiatives typically require champions in those buildings and outside of those major governance leaders ... it relies on people to prosecute those arguments internally and they really challenging and they're challenging because they require one or two people on the owners' corporation to believe passionately about it and then to convince all the other owners and drag them along. (Interviewee 26, strata manager)

If you don't have sub-committees ... there's a lot of business that has to be discussed at a committee meeting and sometimes they would deal with the more pressing matters. And I feel that sustainability may get brushed aside at times ... But having a sub-committee means that you ... talk about sustainability rather than the rest of the committee issues, and that way you can make a recommendation back to the committee as a collective. And what happens is the committee and most of the time or rely on the recommendation from the sub-committee, because they feel that it's been considered properly. (Interviewee 27, strata manager)

Retrofit projects can also benefit from professional assistance. However, again, an agreement to hire consultants will need to be made collectively.

People, especially (in) the bigger stratas, they know that they cannot rely on just volunteers alone ... you need to have a building manager, or you need to have a strata manager and they're paid a bit extra to step into ... a leadership role where they can say 'you need to have a professional xyz to really advise you what you need to do'. And if you have that organized in that way, then we can really present our case better as well, so you get a few people on board, they can help convey that message to other people. (Interviewee 31, retrofit consultant)

In making a case to undertake sustainable retrofits, proponents need to appeal to a diversity of people with different skills and knowledge regarding building operations as well as different interests and drivers.

It needs to be promoted properly and really, we need to understand: what are the drivers for owners, whether it's money ... the sustainability focus. I think a lot of the time it is explaining the system and how it's going to benefit the owners ultimately and then to explain the cost, the payback in terms of if it's going to be in four years and then after that, your fees are going to be reduced by X. So really trying to convey to benefits and I think that's where these types of things fall short because ... [there might be a] letter sent out saying please vote for the solar panels. And you might have some information, but it just gets lost ... so it comes down to that explanation in terms of what the benefit is going to be. (Interviewee 27, strata manager)

While a special resolution is required by law to approve sustainability upgrades, a consultant noted that in practice, many owners corporations operate on a consensus rather than majority voting model, which can be detrimental:

The research tends to assume that, for example, if the NSW Government passes a sustainability infrastructure amendment that lowers the threshold for voting for one of these projects. Yeah, that's great in say, a high-rise apartment building in the City of Sydney ... and that process will be followed there, because they've got the education, the information is coming to them to actually follow that process. But, for example, in a lot of strata schemes, people turn up at the annual general meeting, and the education isn't there for them to know that it's not a consensus model. So basically, if everyone votes for something, it goes ahead, if one person is a little bit against it, people don't want to offend them. So rather than going ahead with the project and creating ill-will towards one person, then they just sidelined the project, because so and so has lived in the building for a lot of years and there'll be unhappy if we do this. (Interviewee 33, retrofit consultant)

These challenges provide a driver to make the easiest case for upgrades, for example by promoting upgrades with the shortest payback periods (33 retrofit consultant; 26, strata manager), such as lighting upgrades, even if these may not have the greatest benefit in terms of building performance. A strata manager also noted that the typically short average length of ownership in apartments can contribute to the prioritisation of retrofit projects with shorter payback periods:

... what the average tenure for an owner is in an apartment, and it's probably something like seven years or thereabouts. I think we need to be looking at those types of horizons. Because what people in apartment buildings want to be able to do is benefit from those within their time of tenure of ownership or habitation. Anything over that, and it starts to become well, why am I investing for the uses, which I'm not going to benefit from? So I'm thinking that seven years ... I think that's the window of opportunity, because that's the typical churn rate when people come sell and go. If you can say within your lifetime, you're going to be able to get that cost benefit return completely, there's an economic argument you could make towards that. (Interviewee 26, strata manager)

3.5 Policy development implications

The challenges in delivering and adapting sustainable apartments outlined in this chapter have important implications for policy development.

Speculative strata titled development

The disconnect between the production and consumption phases of speculative apartment development runs counter to circular economy approaches concerned with whole of lifecycle performance. In new strata titled apartment developments there is no single 'client' driving demand for an apartment building. This increases the risks associated with split incentives between those developing strata titled buildings and the subsequent purchasers and residents. Sustainability is often not embedded in project feasibility and changes are made during construction to reduce costs. In many cases, the outcome is that the quality of the product delivered is poor in terms of construction, design and sustainable performance. In circular economy terms, the apartment product is not optimised, and neither is it designed for durability.

Physically inter-dependent properties

While the inter-dependent nature of apartment buildings offers potential gains with respect to energy efficiency and indoor thermal comfort, these may be lost due to a focus on maximising profit (such as by developing single-facing units). These losses are unevenly borne, with evidence that renters tend to live in poorer performing units (Gower 2021).

Much of the plant and equipment that could benefit from retrofitting is collectively owned as common property requiring joint decision making about maintenance and upgrades. This means that the potential benefits of shared services must overcome the challenges associated with shared management. The fact that the majority of units in strata apartments in Australia are rented also raises important considerations for policy development. It means that during the operational life of a building, the majority of units are also subject to well-recognised split incentive challenges between tenants and landlords (Gabriel et al. 2010).

Joint ownership

Compounding the challenges resulting from speculative development, sustainable building performance is not adequately reflected in property valuation for apartments and 'buyer beware' is largely impossible in practice for both purchasers and renters (Crommelin et al. 2021).

The fact that apartment properties are jointly managed means that business cases for upgrades must cater to multiple interests. The result can be a deadlock or lack of action, which runs counter to a circular economy focus on prolonging the life of a product through maintenance.

When considering building retrofits, which are an essential component in a circular economy approach to housing, ensuring policies and programs will be fit for purpose will require a recognition of the existence of both lot and common property in strata buildings with implications for where interventions or subsidies could most usefully be directed (such as at the householder, or owners' corporation). It also suggests that additional assistance and incentives may be required to help overcome the challenges of collective decision-making.

3.6 Summary

There are important disconnects between the development and operational life of apartment buildings, and challenges associated with joint ownership and decision-making that make a transition towards circular economy particularly difficult. Table 7 summarises these challenges.

A circular economy lens considers the production of an object alongside the use of that object over its life. Our research identifies important disconnects between the production (design and construction) and consumption (occupation) phases of apartment development. The quality of the product (design, construction and sustainability) to start with is often poor (not optimised); there are then disincentives to repair and maintain during the life of the building; and the retrofit process is challenging (prolong life through maintenance).

The apartment building sector in Australia requires a systematic and regulated approach for the commissioning, control and monitoring of the entire life of the buildings, from the preliminary design through the life of the building in order to address these challenges. The following chapters discuss these considerations and their implications for policy in more depth.

3. Challenges in delivering and adapting sustainable apartments

Table 7: Summary of challenges of delivering and adapting sustainable apartments

Unique aspect	Relevance to circular economy	Challenge	Desired outcome
Speculative strata title development	'Product' not optimised	Sustainability is not embedded in project feasibility	Development teams embed sustainability in project feasibility
		Changes are made during construction to reduce costs	The design and construction of delivered apartment buildings reflects what was designed and approved
		Sustainable building performance is not adequately reflected in property valuation	Property valuation reflects building performance
Physically inter-dependent properties	Potential benefits of sharing	Potential benefits of inter-dependence are lost due to focus on profit maximisation	The potential benefits of physical inter-dependence and shared services are realised
		Potential benefits of shared services face the challenge of shared management	
Joint ownership	Potential to prolong 'product' life through maintenance	Limited information on building performance is available to purchasers (or renters)	Purchasers and renters have access to adequate information about building performance
		Joint decision-making is required for jointly owned property	Sustainability initiatives account for joint ownership and joint decision-making

4. Opportunities for reform within the dominant apartment delivery system

- **Industry stakeholders called for a whole-of-government commitment to sustainability as a core value.**
- **A consistent whole-of-government approach to promoting sustainability in housing development is required.**
- **Values are important in driving market leaders and some local governments to embed sustainability in their operations, despite having to overcome obstacles to do so. However, the profitability of the existing speculative development process and risk aversion hinders others.**
- **Regulatory reform, including more stringent regulations and adequate resourcing for enforcement, presents a key opportunity for intervention to improve apartment sustainability in a market-led system.**
- **Clear and consistent ratings tools and changes in property valuation practices are necessary to better account for sustainable building performance.**
- **There is potential to better leverage green finance.**
- **Education and capacity building amongst all stakeholders is essential.**

Our summary of the dominant apartment system provided in chapter 3 identified six key desirable outcomes as we move towards a circular economy approach to apartment delivery and retrofit:

1. Development teams embed sustainability in project feasibility.
2. The design, construction and sustainability of delivered apartment buildings reflects what was designed and approved.
3. Property valuation reflects building performance.
4. Purchasers and renters have access to adequate information about building performance.
5. The potential benefits of physical inter-dependence and shared services in apartments are realised.
6. Sustainability initiatives account for joint ownership and joint decision-making.

In the next two chapters, we develop recommendations for government (at all levels) to support these outcomes. Change will not be achieved by government intervention alone and industry leaders must play a central role in moving towards a circular economy approach for apartment housing in Australia. This is why we have approached industry participants to help us to develop our recommendations. However, an overarching theme amongst our industry participants was the need for a clear whole-of-government commitment and vision for sustainability and a circular economy approach to housing with appropriate follow through to ensure that this vision is realised in practice. Realising this vision will rely on industry buy-in, supported through co-design and collaboration between government and industry in the formation and execution of these recommendations.

We have classified the suggestions for reform provided by our research informants into four main areas:

1. re-appraising value
2. shaping market practices and processes
3. shaping investment flows
4. building capacity.

We have divided the recommendations across two chapters. In this chapter (chapter 4) we discuss changes to the existing dominant system of apartment production, that being speculative BTS strata development. In chapter 5, we consider alternatives to the existing dominant system: building retrofits, Build-to-Rent and Deliberative Development.

4.1 Re-appraising value

Values play a fundamental role in shaping sustainability outcomes. A clear commitment to achieving more sustainable outcomes is essential to overcome the various regulatory and market barriers to sustainable apartment development. Yet simply espousing sustainability values without a clear plan to translate these into practice might be considered 'greenwashing', whereby sustainability claims are made solely for promotional purposes.

This section considers the role of values in shaping whether government, industry and consumers pursue more sustainable apartment development.

4.1.1 Government values

Stakeholders highlighted the important role of government in promoting sustainability as a fundamental value in housing development. Many participants argued that the failure of governments to consistently commit to both environmental and social sustainability as a core value in housing provision shaped the playing field for all other participants:

I say this a lot ... We need to decide what our goal is. What is our purpose? What is our why? Why do we want to do this? What is the purpose of this? And then our regulation and rules and incentives need to fit around that. But there is no common purpose. There is no common ally. And until we work that out we're stuffed ... Is housing there to make money or is housing there to house our society and support those who are getting an education, or their health or their wellbeing?
(Interviewee 6, developer)

Other participants noted that even where individual governments have made clear, holistic statements regarding the importance of sustainability, this is not always translated into operational outcomes. For example, government strategic statements have increasingly focused on sustainability in recent years, with a number of NSW councils declaring a 'climate emergency'. However, these pronouncements have not always been fully worked through in how they shape the day-to-day activities, as one ESD consultant explained:

if you look now, at the sheer number of councils that have lined up to say 'it's a climate emergency, we've got to do something about it', and it's great, fantastic, I applaud that. But when it actually comes down to the stuff that they approved through the planning scheme, it's like a complete disconnect ... if you're a council that is saying there's a climate emergency, why are you passing stuff through that is not appropriate for addressing our future climate? (Workshop 2, ESD consultant)

Similarly, a retrofit consultant recounted a specific example of this disconnect:

I had this tender I put in for [a local council] to build a really big - it's like a testing ground for cricket pitches. And we put all sustainable materials, we also had a concrete supplier who reduces the cement component in the concrete by 80 per cent, so you take almost all the CO₂ embedded in your concrete out. And it was quite funny because [this city council] actually declared a climate emergency, and in a tender review they didn't actually take that into account - so we had a whole section about sustainability and how we reduce our embedded CO₂ in our projects, and that wasn't really measured. So I wrote to the Mayor said 'look, I want to help you guys, because this is important, you know you need to have a matrix to say how things have been constructed and take that into the equation.' I got an email back really quickly! (Interviewee 31, retrofit consultant)

The speedy response from the Mayor suggests that the desire to improve sustainability outcomes is genuine, but more must be done to work through the full implications for implementation.

Stakeholders noted that some local governments had achieved the required integration between principles and operational efforts – in particular, the City of Sydney in NSW and the cities of Moreland and Yarra in Victoria. As a planning consultant explained:

City of Sydney, I think they're raising [the bar] ... if you look at their reporting ...they integrate a lot of their environmental reporting into their annual reporting, like their financial reporting. The other thing is their design standards ... I'm pretty sure [they have] embedded targets for certain things on materials and recycled stormwater and [co-generation] and stuff, so they're into the technical detail. Far more so than any state agency that I've seen. (Interviewee 10, planning consultant)

This consultant also identified a lack of consistency at the state level in NSW, which created confusion and gave the impression that the state government was not fully committed:

Probably the biggest thing in New South Wales that I struggle with is how different each agency treats [sustainability]. It doesn't seem [to involve] too many whole-state mandates, but some agencies are doing really well, others [are] probably more at that early stage. (Interviewee 10, planning consultant)

Some informants also suggested that state actors need to be more consistent in driving sustainability by ensuring their own projects incorporate the sustainability features for which they advocate (such as through adequate metrics). These comments highlight the need for whole-of-government mandates that are proactively translated into meaningful metrics, with resources to enable performance and ensure adequate monitoring of outcomes. Failure to implement sustainability approaches consistently and comprehensively across government sends the message that sustainability is not a core value. This in turn makes it more difficult for the government to expect sustainable practices from industry.

Recommendation 1: Whole-of-government circular economy and sustainability commitment

A long-term stable commitment from all levels of government to circular economy principles and sustainability targets is important. This can include the strengthening and implementation of legal frameworks, regulations and long-term policy and funding contracts. These measures will provide certainty to industry, de-risk investment, and support sustainable organisational practices.

4.1.2 Industry values

Research participants reported wide variations in the extent to which industry stakeholders demonstrate a commitment to sustainability as a core value. Overall, informants identified three categories of industry participants:

- specialist firms that have a clear commitment to sustainability and service niche markets that can pay extra for more sustainable outcomes
- tier one developers who are taking steps towards incorporating more sustainability measures, but without fundamentally shifting their business model
- other developers who are not strongly committed to achieving sustainable outcomes and will not seek to surpass the required minimum standards.

For the first category of industry stakeholders, sustainability as a value is embedded in their operations and shapes decision-making wherever possible. This is underpinned by a moral conviction, as noted in section 3.1 above. As a planning consultant explained:

As a business we have a real passion about being a constructive voice, so we see that as a business that ... we obviously make a living and make reasonable money out of working in this space. And we feel that we do have an ethical and moral obligation, whether you call it a social licence or contract, to put back in. And so as a business, we've made quite a deliberate decision over probably the last decade to also be quite active in advocating for a broad range of issues that are impacting our industry. (Interviewee 11, planning consultant)

Another participant from a boutique development firm explained 'sustainability is something that is really important to us ... as a company, the catch phrase that we have [is] 'sustainability as standard' (8, developer). However, this informant also noted that despite the company's commitment, sustainability outcomes vary from project to project:

The level of sustainability that each of our projects will achieve is very market dependent. In a local area somewhere maybe like Brunswick, where the markets are bit younger and quite progressive, we have a greater capacity and will strive to achieve a much more sustainable development and have the resources to put a bit more into research and development in those buildings. Whereas maybe something where we're focusing on wealthy downsizers, some of them will have a general understanding of sustainability, but ... research and development and the focus would be more on developing something ... more design oriented, that's maybe a little bit more luxurious. So ... there's a sliding scale that we're always dancing along. (Interviewee 8, developer)

A retrofit expert described a similarly variable marketplace, with some clients keen to embrace sustainable approaches, but others being less proactive. Given this, the company sought to fulfil its values by looking for opportunities to convince clients that sustainable approaches would achieve multiple benefits:

Sustainability by itself, it doesn't mean much for people. Like people don't identify with that. So we get a lot of work through just our existing network – people know us. And then we start having that conversation with people. And I think we just have general practices ourselves that we try to use products which aren't toxic, they are more locally produced, we try to reduce the embedded carbon we use and yeah ... so we don't necessarily market ourselves as sustainable per se, it's just like we're really good builders which have a bigger goal. But yeah – it's really hard to just sell sustainability. (Interviewee 31, retrofit consultant)

In a similar vein, another participant described having to convince their planning consultancy that taking on environmental and socially sustainable projects would be financially beneficial:

That's how I convince my other directors ... I'm the one that has really sort of pushed these initiatives, but what has been fantastic is that I can [now] demonstrate that through leadership in this space and increased brand awareness and respect, that our business has grown ... And so that's where I'm now able to justify every year we have a budget that I can spend on pro bono time with myself and others, where we can actually push into various [sustainability] spaces. (Interviewee 11, planning consultant)

These values-driven actors play a significant role in moving the industry forward. At the same time, however, their comments highlight how challenging it is to make progress in the context of limited broader government or industry support.

In the mainstream development context, participants had mixed views about whether sustainability is now being embraced as a core value. Some argued that while the industry has been slow to embrace sustainable practices, the shift is happening. As one development expert working for a major development company explained:

I think morally it's the right thing to do and I think people expect it. I think customers' and clients' expectations are now more vocal and we care a lot about the consumer and what they want. And what people, what our clients are wanting [is] to be living in more sustainable projects and complexes and developments ... So I think if a company or an organisation that you're purchasing from gives consideration to things like sustainability and the environment, and they have the right moral compass, you find more comfort in purchasing from these organizations. You have a little bit more faith that they're not just trying to sell you something that's just going to quickly make [them] a profit and 'see you later' ... Purchasers I think are more educated and more aware of how simple potentially being sustainable could be. I think that's also a driver and then I think with time and the current state of everything people are more informed. (Interviewee 7, developer)

As a long-term industry participant noted, getting the development industry to embrace sustainability also requires a broader shift in culture, which takes time:

It's just a culture of the industry - that very sort of blokey, don't give a s**t about anyone else, get the job done, make it easy, why would you care about all this ... sustainability stuff? But again, that's changing, that's changing. ... Like the industry is generally ... I hesitate to say - more sophisticated ... Building [companies] are getting a bit more sensitive ... And [a] green [approach] can fit with that. (Interviewee 5, architect)

The same informant explained why change is difficult to achieve in the development industry:

People in the building industry don't like change. And there's a good reason [for that] because any change and innovation in construction is very high risk ... and innovation is where you get problems. And you have small margins with very high risk. And the last thing anyone wants is to be consciously adding in more risk. So any sort of change from what has been, what you know works, people just look at it and go: but it could, you know, it could blow the finances or could result in polyp defects and court cases and problems and just being such a high risk financial and liability, high risk industry, people don't like to vary from what they know, which is fair enough. (Interviewee 5, architect)

The resistance to change clearly outweighs the value of sustainability for many industry participants. This explains why, where change is happening at scale, it is driven more by concern for consumer preferences than by a strong moral conviction. However, brand is only of importance to a segment of the industry, with those at the lower end of the market competing primarily on price. This results in mixed levels of commitment across the industry:

There's the issue of brand. Brand is very important to some of these companies and how they place their brand and how they want their brand to be perceived ... [but] you know, some developers don't take their brand so seriously. Some developers do not think that sustainability is part of their brand. I personally think it's becoming more and more, a bigger issue. And, depending on where developer sees themselves in the market, and sees their brand and sees their responses to their stakeholders, that's where this stuff starts to get pushed. (Interviewee 6, developer)

Clearly, while a segment of the market is driven to shape its business model and practices around sustainability as a core value, much of the industry is likely to move towards more sustainable practices only if government or the market requires it. This prompts the question: to what extent is sustainability a core value of consumers?

4.1.3 Consumer (owner and resident) values

The question of whether consumers value sustainability when looking to buy an apartment prompted much discussion among participants. Some industry participants suggested the main reason the industry had not actively pursued sustainable practices was insufficient consumer demand (see section 3.1). In the words of one participant, 'if people wanted [sustainability], developers would do it' (5, architect). Yet while it may be easy to conclude that a lack of market demand is the main reason more sustainable development isn't happening, many participants made clear that the relationship between demand and supply is not so clear cut. As this same participant explained:

I've never had a client who will choose a non-green option over a green option if there's no cost for amenity disadvantage between the two. [But] I've had clients who will say they want a green house but then won't actually compromise their perceived amenity or any cost decisions in favour of sustainability. (Interviewee 5, architect)

This suggests that while consumers do value sustainability, it may not outweigh the value they place in comfort and affordability. This is not surprising; given the nature of housing markets in Australia's major cities (and increasingly in regional areas), many buyers have very little flexibility in their budget, and may already be settling for amenity levels below what they would ideally choose.

Another facet of this issue is the clear market perception that sustainable developments cost more. Participants noted that in practice this is not always true:

I don't think all the clients are too keen [on sustainable approaches]. Because a lot of times it's also price driven and I think there's a real perception that sustainability ... costs more, which is not really the case - it's just a different process, just thinking about things differently. (Interviewee 31, retrofit consultant)

I think part of the challenge is that improved environmental efficiency is perceived, rightly or wrongly, as being more expensive. And that the offer, the upfront costs – I just don't think there's enough awareness about offsetting the long-term costs. (Interviewee 11, planning consultant)

These comments highlight the problem with industry simply saying 'we'd do it if the market would pay for it'. This places responsibility for understanding the full cost on the consumer, rather than industry taking responsibility for communicating this to buyers clearly and effectively. It also negates the responsibility for finding ways to build more sustainably without increasing costs, which is something only industry can drive.

While views on whether consumers value sustainability were mixed, there was more consensus on how sustainability can be promoted to consumers to help increase demand. Simply promoting developments as 'sustainable' was viewed as too amorphous (and risky, if cynical consumers assume this is greenwashing). Instead, a focus on the comfort improvements and long-term cost savings of sustainable building approaches was more likely to succeed. As retrofit consultant explained:

You can even have [petrochemical company] Shell saying they're sustainable, you know, like what does it mean? I think that's [why] we're really trying to sort of focus on quality, quality of living ... It is easy to say you're sustainable, but we want to make it real and tangible for people ... instead of doing a traditional process, we can actually make it so much better, you know, and then people are willing to listen to that. And I think we're a bit young, in that sense that we don't have that many cases we can sort of showcase - because that will make it easier for people to say ... we don't only make it sustainable, we just resolve that heat you're getting from your roof, you know. And just really focus on those tangible aspects of the nuisances we have in our homes. (Interviewee 31, retrofit consultant)

Similarly, an architect explained:

I would like to see a scenario, where developers are saying I want double glazing, heat recovery, ventilation, and thermal brakes, because that's what the market is demanding. Now I think that is changing and I think it's probably changing with increasing speed. Ironically, probably because from a selfish point of view, the people aren't concerned about the greater good, but they are concerned about what's now called resilience, which is looking after yourself while the world burns around you. They're going to be want to be in smoke free, comfortable oases while it's bushfires and heat waves and god knows what happening outside. (Interviewee 5, architect)

Overall, participant perspectives indicate that values are driving market leaders and some local governments to embed sustainability in their operations, despite having to overcome obstacles to do so. Yet while few organisations would openly deny that sustainability is important to them, our participants' responses suggest that many private and public sector organisations have yet to embed sustainable values in their operations and remain concerned about the potential risks of doing so (e.g. the risk associated with innovation in construction).

4.2 Shaping market practice and processes

Informants identified regulatory reform as a key opportunity to improve apartment sustainability in a market-led system. Opportunities relate to:

1. raising minimum standards
2. expanding regulatory scope, including changing regulatory typology (i.e. shifting to performance-based indicators)
3. ensuring consistency and certainty in the application of regulation
4. incentivising best practice and rewarding sustainability inclusions.

In addition, informants stressed the importance of regulatory governance. This section provides an overview of informants' commentary on these opportunities. These findings shift the focus to system-level settings and present regulatory reform as another locus of opportunity.

4.2.1 Improving building standards and planning requirements

Informants suggested the approval and initiation phase of apartment development was the first and best opportunity to secure sustainable apartments. Multiple standards and tools were discussed by informants across the two states. A summary of these is provided in Appendix 2. ESD and retrofit consultants focused almost exclusively on regulation relating to design and production phases. Developers focused almost exclusively on feasibility and approvals phases, perhaps reflecting the risks they associate with those stages. Architects and building contractors tended to have relatively broader perspectives, both cross-sectoral (albeit building contractors did not speak to planning issues) and cross-scale (from materials to scheme design to mechanical systems).

Increasing building standards

Stakeholders argued for increasing minimum standards for energy efficiency. Many stakeholders believed a more stringent NCC would produce better design, construction and environmental performance (Interviewee 23, ESD consultant) and help normalise sustainable approaches within the sector. One strata manager (Interviewee 26) said: 'That's your best and clearest opportunity to get a form of positive obligation'.

Informants noted areas where minimums might best be raised. In terms of design standards, key areas were: size (Interviewee 19, builder), ventilation (Interviewee 19, builder), green roofs (Interviewee 26, strata manager), setbacks (Interviewee 14, architect), daylighting (Interviewee 14, architect), and overshadowing (Interviewee 14, architect). In terms of the construction code, other key areas where informants believed minimum standards should be introduced or lifted included: carbon minimisation (Interviewee 19, builder), airtightness (Interviewee 23, ESD consultant), and insulation (Interviewee 23, ESD consultant). When asked which regulation was most in need of work, a retrofit consultant outlined key areas for improvement:

Probably Section J of [the] ... BCA [Building Code of Australia]. ...that could probably do to be a bit more stringent in terms of energy efficiency. (Interviewee 33, retrofit consultant)

A recommendation to lift minimum standards within Australia's National Construction Code follows international best practice. One international example in this regard is the Energy Performance of Buildings Directive (EPBD)337 and the Energy Efficiency Directive, which was legislated by the European Union in 2010. These legislative frameworks intend to decarbonise and ensure 'highly energy-efficient' building stock by 2050. Critically, since introducing energy performance regulation into national building codes, building stock energy consumption has declined by some 50 per cent from 1980s standards (European Union 2021).

Recommendation 2: Increase National Construction Code (NCC) and Building Code of Australia minimums

Australian Government commitment to increase minimum standards for energy efficiency in the NCC.

Informants identified some barriers to increasing minimum standards, including the lack of financial incentives for developers to include sustainability features:

... I feel like developers probably have a lot of sway politically and will probably hold back, you know drastic changes to the BCA and National Construction Code and that sort of thing, under the idea of keeping costs down, keeping their build costs down. (Interviewee 33, retrofit consultant)

On the other hand, others said raising NCC standards should not be presumed detrimental to affordability. A development director and ESD consultant rationalised this, claiming some buildings were already performing better than their ratings:

NCC minimum has got to be ratcheted up, and it is entirely justifiable. Anyone who suggests that it will lead to lower levels of affordability is wrong. We can achieve at least seven star average with no cost increase basically. Well, there is a cost increase, but no material cost increases. The industry

is already moving in that direction. As an example, like glazing suites coming out of China already minimum standard like they just don't go below a certain level of performance which is above the base spec for a lot of buildings in, say, Melbourne. So what you're finding is people are doing energy reports to say that apartments are rating out at six stars with certain glazing performance assumptions built in and what you're actually seeing is that what's built has higher glazing levels of performance than actually is in the energy reports. So if we were to go through and re-rate those buildings once they're built they would actually be at a higher level of performance (Interviewee 24, developer/consultant).

Another informant argued that the market would adapt quickly to any increase in minimum standards:

Once something becomes the Building Code of Australia, one of our - one of the fantastic things about Australia, one of our superpowers is, we are the world's best at optimizing to minimum standards, you give us a minimum standard, we will optimize to it and we will bring the cost down. So you set the high minimums now that's the standard for everyone. So natural competition takes over in the industry. So you don't get a higher cost because everyone's competing against that one standard. So I don't buy the 'Oh, it's going to cost more' argument. I've been hearing that for the last God knows how long. (Workshop 2, ESD consultant)

Expanding scope of standards

Stakeholders also argued for regulations that were more holistic and advocated for a more progressive, 'forward-thinking' (Interviewee 4, developer) approach to drafting standards.

In terms of regulatory scope, informants suggested the NCC should be expanded from its current emphasis on energy minimisation to include materials and a sustainability methodology (Interviewee 14, architect) with the inclusion of standards for glazing, water, indoor air quality, plans for sustainable retrofitting (Interviewee 17, ESD consultant), solar energy including minimum PVs per unit (Interviewee 13, builder; 29, valuer), landfill diversion including banning construction-related landfill (Interviewee 21, builder), and airtightness (Interviewee 16, building consultant).

Another area noted as in need of more regulation is transparent building material information and performance data. This was deemed necessary because builders and consumers are 'not as informed as they could be' (Interviewee 21, builder). At present, the Australian construction industry adopts Australian-based embodied carbon standard based on the international standards (ISO 14025 and EN 15879). We note that the development of a national framework to measure, certify and benchmark emissions from building materials and construction in a consistent way is ongoing, led by national organisations such as National Australian Built Environment Rating System (NABERS) and the Green Building Council of Australia (GBCA). This framework should allow for accurate comparisons between different projects and the definition of total embodied carbon targets and recognised rating systems. Without this framework, the level of embodied carbon and reduction targets for new apartment buildings becomes a challenging task and their contribution towards the reduction of embodied carbon emissions in the future is hard to assess and communicate.

Recommendation 3: Expand the scope of the National Construction Code and Building Code of Australia

Australian Government commitment to expand the regulatory scope of the NCC beyond energy consumption in use.

Shift to performance-based indicators

The NCC was associated with minimum standards and risked encouraging 'box-ticking' (18, architect) and a compliance, rather than innovation, mentality. Informants advocated for more flexible regulation including a shift to performance targets to ensure functionality; and incentives for excellence to secure an innovation mentality.

A compelling reason for a shift to performance targets was noted discrepancies between 'the as-designed and the as-built' apartment:

I think ultimately the rubber hits the road when the builders get involved. And that's when some things that are DCP [Development Control Plan], aspirations of setbacks and light and shade and all those kinds of things, they can get railroaded a little bit and there's no policing ... apart from a statement from us at the end at the job. The spotlight [is] all on it for the lodgement of the DA [development application]... and then you come out and it's almost like, well, the architects ... just make sure that happens, and some things just can't happen. So at the end we end up writing a compliance statement that says it's generally in accordance with the controls of the ADG and SEPP65, because some things can't achieve [them]. (Interviewee 14, architect)

A retrofit consultant illustrated this discrepancy:

[In] a building that we've seen recently, the design did say that it had smart building management system controls for air conditioning, which would theoretically save a lot of energy. However, only 30 per cent of the systems were connected to this smart building management system, and 70 per cent were not and no one had optimized for energy. So we do see things like that in the marketplace. (Interviewee 28, retrofit consultant)

Informants saw intervention at the level of building codes as necessary on the grounds that planning could only control so much.

Improving planning requirements

In addition to increasing the minimum standards in the NCC, informants offered a range of suggestions for how planning requirements more broadly could be improved to ensure better design, as well as better construction. They also identified a need for greater consistency in how the existing planning requirements are administered.

In terms of achieving better outcomes, most saw the onus on government to use the leverage that exists at the point of approval:

You know [state governments and local councils are] the ones who have the opportunity at the point of approval to get what I think should be the maximum as opposed to the minimum. So, what we see a minimum standards, which deliver in 90 per cent of cases a very ordinary product from a design and sustainability perspective, and they can and need to do more and you know they should be unashamed about it. (Interviewee 26, strata manager)

More specifically, informants in NSW criticised BASIX for measuring technology inclusions rather than performance. For instance, one building consultant (Interviewee 16) contrasted this to the UK Code for Sustainable Homes, noting that it goes beyond a tick-the-box exercise with regards to airtightness requirements. As the consultant emphasised, there is not a 'technology solution' for airtightness, but rather a need for 'good engineering' and regulatory codes must be designed in such a way as to mandate that. For related reasons, BASIX compliance was described as 'putting the lipstick on the gorilla' (Interviewee 6, developer), since it failed to appreciate and mandate for particular design outcomes.

At the same time, informants recognised that there were diverse ways to regulate and that the most appropriate regulation would depend on a wide range of contingencies, including the desired outcomes. A developer also highlighted the importance of careful approaches to how reform is undertaken, advocating for incremental reforms to safeguard profits:

You need certainty around the regulation and you need to bring it in in stages so that the market can adjust. So you need consistency, you need rationality and then you need to give it time. Because if you look at the feasibility of a project you decide what your revenues are and what your costs are and their profit margin and the land price is what's leftover. So, that that's how the system works. And if we want to [add] an additional cost, whether it's for affordable housing or environmental sustainability, you need to let the market know and foreshadow these changes so they can prepare. Some governments have been very bad at doing that. (Interviewee 6, developer)

Offering planning incentives

More controversial was the prospect of using planning incentives to encourage more sustainable development. Some financiers, architects, developers and planning consultants advocated for incentives for sustainability inclusions, such as planning bonuses (Interviewee 20, architect). One ESD consultant suggested there was more value in incentivising best practice rather than policing the lowest common denominator or focusing on 'low hanging fruit' (24, developer/consultant). Architects also advocated for incentives for excellence. They argued for 'carrots' such as planning uplift, rather than 'sticks', suggesting this promoted design innovation and design diversity (Interviewee 18, architect). A planning consultant echoed this, noting developers' concern with FSR (floor space ratios) and suggested potential to incentivise sustainability inclusions with height bonuses (Interviewee 32, planning consultant). From the developers' perspective, discretionary rather than mandatory inclusion of sustainability features gave developers leverage during the planning process in being able to negotiate additional height allowances, which in turn enable increased profits (Interviewee 19, builder):

A reason to go beyond the building code minimum standards ... I've found that to be the single greatest influence on in terms of improving the sustainability of the residential sector ... if you do very well ... in relation sustainability, you can get a bigger building, more height, you can make more money ... The developments where they have better sustainability outcomes tend to be better regarded by the approval authorities ... they tend to be more successful project (Interviewee 22, ESD consultant)

Another developer also supported the idea of planning incentives for more sustainable development, but argued this needed to be done in a way that didn't undermine certainty and involved consistency between state, territory and local governments:

[I]f we want to see that sort of change (adoption of new materials like low carbon concrete and engineered timber high rises), let's incentivise it. Let's give an extra five floors, or 10 per cent of FSR or something if you going to do something like that. But we need to decide how you define that and make it reasonable and consistent. [In] NSW, the state government might give you that incentive and say if you do this, this and this and this, it's really innovative, environmentally sustainable - you could have an extra five storeys. But if the city council doesn't like it, they'll go: "why should you get that extra five stories?" That's not coordinated. So the uncertainty - the risk and the cost of uncertainty within the system. (Interviewee 6, developer)

But while many developers were supportive of an incentive-based approach, one was critical, suggesting that consistency and overall outcomes were better served by improving minimum standards:

And in terms of planning consistency, and the whole concept of raising the bar in terms of sustainability - [I'm opposed to a plan] to provide an incentive to doing what I would consider the right thing from a market perspective. (Workshop 1, developer)

Similarly, a financier argued that increasing mandatory sustainability standards was a viable and effective option:

I've seen great success in local governments overlaying sustainability conditions on as part of planning approvals. I like that model a lot because it all gets reflected in the upfront design, as well as any price someone might be paying for a site. And I think that we've that we've seen some good things come out of that, and things that wouldn't have happened anyway. So I think that's a really strong sort of policy intervention. (Interviewee 3, financier)

Similarly, another informant advocated for more consistency in the implementation of standards, with fewer allowances for trade-offs in standards, giving examples of affordable housing and exempting boarding houses (co-living apartments) from SEPP65 (Interviewee 4, developer).

Overall, there were mixed perspectives on the benefits and disadvantages of planning bonuses to incentivise performance beyond minimum standards, but general consensus on the importance of certainty in shaping investment decisions. This points to a conclusion that governments should focus their attention on finding ways to raise the minimum sustainability standards required for planning approval, and on ensuring that these are being applied consistently.

Recommendation 4: Sustainability as standard

State, territory and local governments to require high sustainable performance standards in all development application assessments.

4.2.2 Enforcing regulation of building performance

Informants noted the need to better ensure that what was designed and mandated was ultimately what got built. A related recommendation, which we discuss later, is to ensure that the building as-operated meets the required standards (see below on operational performance).

Informants noted the need for independent oversight of construction work. Some informants highlighted the lack of oversight at both construction documentation and construction stages (Interviewee 3, financier; 28, retrofit consultant). This led some to call for increased independent supervision of on-site construction. There were several suggestions that we might return to using third-party 'watching brief' or traditional 'clerk of works' during construction to lessen the gap between what is promised and what gets delivered in practice (Interviewee 4, developer).

In closing the gap between as-regulated and as-built, several informants referred to the new *Design and Building Practitioners Act 2020* (NSW) [DBPA], which took effect in June 2020. This Act originated from a NSW response to the Shergold Wier Report (Shergold and Weir 2018), which tabled shortcomings in the implementation of the NCC and issues of accountability. (That report was itself prompted by building defects and cladding problems within the apartment sector.) A retrofit consultant noted that the new DBPA provided certainty for builders and removed 'relying on your sub-contractors to make those decisions for you'.

I think it's really great that that's now forced upon us. To actually have proper documentation to say, this is what we're going to make. And not let everyone figure out - because if you've got like three layers of contractors figuring out what they're doing on the run ... it's just asking for trouble. And it helps us just to introduce [sustainability] changes, like let's put these new concepts in there and then you get a better result. And then it's easier for us to work with our subcontractors. (Interviewee 31, retrofit consultant)

Here, the builder appeared to refer to the DBPA's new compliance declarations, which require design and building practitioners to make declarations that their building work is NCC/BCA compliant, and have adequate insurance, prior to issuance of the occupation certificate. An architect likewise commented on this Act, suggesting it was a step in the right direction:

Right now we're coming into the Design Practitioners Act, then, that's something that we don't completely have a grasp on in terms of the impacts that that's going to have on what we do. From what we can see, it's generally quite positive. I mean, we're worried about any liability side of things, but having said that, I think that the extra checks and balances ... We sign off on the building, sign off on the documentation and the builder then says I can't, I'm going to build what's actually documented. That can only be a positive and then it's got to comply with the National Construction Code. (Interviewee 14, architect)

Relatedly, some informants noted additional opportunities to improve the D&C model for project delivery. This also prompted informant concerns about a disconnect between as-designed and as-built outcomes. Retrofit consultants advocated for mandatory D&C regulation for new builds, with independent specialist oversight of construction:

[Y]ou need an external person that's not influenced [by a builder or developer, who's impartial and independent [...]] Because what happens in reality is ... they have financial ties to the developer and some of the stuff that they're supposed to do isn't being done. (Interviewee 28, retrofit consultant).

A retrofit builder suggested extending builders' responsibilities to 20 years post-occupancy, to create new incentives (Interviewee 31, retrofit consultant).

Recommendation 5: Strengthen compliance

State, territory and local governments to strengthen regulations for pre- and post-occupancy compliance auditing to ensure approved performance standards are met at the planning and building permit stages.

Some informants also advocated for mandatory use of NABERS (a performance assessment tool, relates to energy in use) for apartments, suggesting this would bring apartments more in line with commercial real estate standards for monitoring building performance (Interviewee 25, 27, strata managers; 28, retrofit consultant). Informants suggested this would be effective both for new builds and for existing apartments, with disclosure of ratings at point of re-sale 'so that potential purchasers understand' (Interviewee 27, strata manager). By contrast, others pointed to the limitations of NABERS. For instance, a financier highlighted that NABERS does not 'provide quantifiable, measurable outcomes (unlike commercial buildings)' but, if 'fully developed', could provide a forecast of sustainability benefits and measure outcomes (Interviewee 1, financier).

Another informant (Interviewee 24, developer/consultant) also noted the need for data to verify and quantify any benefits secured through higher quality construction. A revised version of NatHERS (which helps demonstrate NCC compliance) was suggested as one tool to quantify such benefits. For instance, a financier stated that NatHERS could help establish measurable benefits (Interviewee 1, financier). However, another financier pointed out that 'NatHERS isn't consistently applied across all states and territories in Australia ... there's differences in the accreditation requirements' (Interviewee 3, financier), and suggested further standardisation could assist.

Architects (Interviewee 20, 18) expressed concern that the minimum energy requirements for new apartments are, in some cases, lower than that allowed for other dwelling typologies. Some apartments in a building may have NatHERS ratings a full star below the minimum provided the building average meets the minimum (DCCEE 2022). One informant (Interviewee 20, architect) viewed this as unacceptable, allowing apartments to be of a lower living standard than other dwelling types.

Several informants commented on the need for universal rating frameworks and regulations, and the benefits of consistency in standards across jurisdictions. This issue was cited by a specialist financier, for instance, since regulatory standards and their enforcement impacts asset valuations:

I think where greater consistency, especially across the states would be beneficial is when we get into looking at things like a green mortgage products ... I think standardisation could certainly be helpful when we're talking about mass product. (Interviewee 3, financier)

Recommendation 6: Standardisation of tools and measures

Australian Government and state and territory governments to implement programs to standardise tools, measures and regulations for building performance.

During the final policy workshop, informants discussed the fact that regulations will need to adapt and change over time, and that this can sit uncomfortably with regulations that are updated infrequently such as the NCC:

Innovation is always happening and to from my perspective, the baseline of what sustainable development looks like is could constantly be changing (Workshop 4, developer)

This suggests the need for a regulatory timetable that allows for reviews of minimum standards over time.

4.3 Tilting investment flows

An important consideration in supporting sustainable apartment development is the linking of sustainable development to profit. This is the incentive required by suppliers and is central to market response.

A key concern of the research informants was whether apartment sustainability measures can attract an adequate return on investment. Split incentives and lack of information regarding building standards and performance were viewed as major problems for financialising sustainability. As detailed in section 4.2, rating the performance of apartment buildings was a major concern of informants. This included confusion surrounding the proliferation of rating schemes, and the gap between design and as-built performance. Rating is critical as certification of buildings is the mechanism linking 'building performance to profits' (Workshop 4, policy maker).

[We] have to have a measurable quantifiable mechanism ... Until you have that ability ... [it] doesn't become a market. (Interviewee 1, financier)

However, certification is a technical assessment that still requires a communication strategy. This is because 'you can't really see ... better thermal performance ... [it's] not something you can see or touch or talk about really ... It's not very marketable' (Interviewee 3, financier).

The immaturity of the market (Workshop 3, developer) and concern that returns may not 'warrant putting the extra effort in' (Interviewee 1, financier) meant the informants saw a role for grants or concessions as incentives, alongside regulations. 'A financial incentive ... or ... some lower outgoings' (Interviewee 4, developer) would support growth.

So, they [developers] firstly go through that filter of what's obligated under the DA to what the market looks for, but then it goes through the very pragmatic filter of what they can afford within their feasibility budget, and that's where we often see the desire fall away. Because unless there's a distinct uplift or support in the end sale price by the end user, a lot of these [sustainability] initiatives do tend to fall away. (Interviewee 26, strata manager)

Any measures that could reduce capital costs or save time were generally supported. While informants provided little direction on what exactly these incentives could be, they indicated that they want meaningful programs that the industry could support.

A lot of the time [grant programs are] cooked up pretty quickly in ... a fair amount of secrecy.
(Workshop 4, policy maker)

Banks also play a key role as mortgage lenders and can support demand. A developer highlighted the difficulty in seeking a return on investment in sustainability when housing affordability is a challenge.

People aren't going to spend an extra 10 per cent [premium] on an apartment ... they're almost always borrowing at their limit and so they're constrained by their access to funds. (Interviewee 5, architect)

Green home loans are a measure that can incentivise buyers through interest rate discounts or more favourable loan to value ratios. However, it is a market that has had numerous false starts (Palmer 2020a). A financier indicated that shifts in the wholesale capital market were supporting an emerging green home loan market in Australia. However, it is constrained by the 'lack of [national] standardisation [of] energy efficiency schemes... [and lack of] certainty around their robustness' (Interviewee 3, financier). The myriad of existing rating tools and schemes increases the transaction costs associated with green loans. This highlights how standards and performance have an impact on the ability to financialise sustainability.

While project financing and mortgage finance are distinct types of financing, they are tightly related in apartment development. A price premium is a market-based mechanism - effectively a 'pull' factor. In the absence of a premium, or the inability to capitalise on it, grants were nominated as a pull factor for both the demand side and supply side which could support the development of the market. The difficulty in capitalising sustainability benefits is represented by the challenges in determining if there is any increase in the value of the dwelling. Uncertain demand for sustainable dwellings is reflected in a lack of commitment by major financiers.

On the 'push' side, taxation - specifically a carbon tax - was suggested (Interviewee 31, retrofit consultant). A carbon tax re-prices inputs and could mean a sustainable development is financially feasible whilst the alternative, unsustainable development, is not.

While there are 'green' financiers, mainstream financing (banks and the shadow banking sector) is making only tentative steps. This is likely a reflection of the broader institutional arrangements, which do not support lenders making a transition to a CE (Park and Kim 2020; Shan et al. 2017).

4.3.1 Green finance, building performance insurance

Central banks are incorporating climate-related risks in their thinking about financial stability (Schmieder et al. 2021). In Australia, the Australian Prudential Regulation Authority (APRA) released its final prudential practice guide on climate change financial risks in November 2021. The guide is 'designed to assist banks, insurers and superannuation trustees to manage the financial risks of climate change' (APRA 2021). As noted in the media release, the guide does not impose any new regulation but establishes climate risk as a risk which company directors should consider as part of their fiduciary duties. It does not yet make it mandatory as is required in Europe (see below).

While risk disclosure is not mandatory everywhere, many financiers—globally and in Australia—have adopted Environmental, Social and Governance (ESG) objectives. ESG objectives can work to prohibit activities by screening out undesirable investment proposals, such as divestment from carbon intensive industries like oil and gas production. Positive screening encourages investment into qualifying activities. ESG objectives can require deep change. Lendlease, for example, is aiming for zero carbon by 2040 (Lendlease n.d.) and Bank Australia has positioned itself as carbon-neutral. However, ESG objectives sometimes require only very incremental change and sustainability objectives are often greenwashing (Schmieder et al. 2021).

As highlighted in section 3.2, green financiers—both international and domestic— are investing into apartments in Australia, albeit mostly in BTR and social and affordable housing. The BTS sector is mostly serviced by the Big Four banks and shadow banking sector. As revealed by one financier (Interviewee 1), the ESG objectives of some large banks do not extend to development finance. While the decision of what is developed is typically determined in the very earliest stage of a project—well before external financiers are involved—informants nevertheless saw a role for financiers in driving sustainability.

Financial institutions hold that much power that they can certainly drive that change and we have seen that a little bit of late. The Australian financial institutions, I don't think, have come into step ... [green finance is] generally coming out of Europe and the US. (Interviewee 19, builder)

One informant noted that Australian financiers' commitment to sustainability is not as deep as it could be:

There's an opportunity for [lenders] to actually own that space and be more proactive with their debt covenants to say if you borrow from us, particularly...in a more constrained capital market which we're entering, there's no reason why they shouldn't demand that buildings have a certain output requirement in terms of the sustainability. (Interviewee 26, strata manager)

Effectively, this informant is arguing it does not matter if financiers enter the process late. If conditions are imposed on loans the proponents for projects at feasibility stage will change their proposal in order to gain access to the cheapest funds available. Projects with permits seeking funds would have fewer options. A major bank adopting this policy when other banks do not would risk their market share. In short, any major shift in financing of development in Australia requires major lending institutions to work in concert, which then raises issues of competition policy.

In international markets the need for financiers to change their lending practices has been externally imposed, creating a level playing field. In Europe, for example, finance is being redirected towards the European green deal. Financiers have obligations regarding 'the content, methodology and presentation of information to be disclosed ... concerning the proportion of environmentally sustainable economic activities in their business, investments or lending activities'. This obligation positions sustainability as a fiduciary duty (European Commission 2021).

JLL (2022) notes the numerous pressures promoting the shift to sustainable real estate in the European and US markets reflects a combination of social change, rising market costs and actual or impending carbon taxes. The lack of obligations on Australian banks to abate carbon and the BTS model creates difficulties for Australian banks. The banking industry could use its influence to progress changes to the property finance eco-system by advocating for changes to the NCC and BCA, the adoption of a uniform rating scheme, education of consumers to create demand for sustainable apartments via green mortgage loans, and by assisting the valuation sector as described in section 4.3.2 below.

Insurance is a financial mechanism being used to drive improvement in building quality. Decennial Liability Insurance (being introduced in NSW) is expected to impose higher insurance premiums on developers with a poor track record of building defects. A strata manager in Workshop 3 suggested DLI could be a model for driving sustainability performance, although how this could work was not explored.

4.3.2 Valuation

Valuation is the means by which the capital value of an existing or proposed dwelling is determined for purposes of lending, insurance and municipal rates. It is a proxy for the market when there is no sale to reveal the value. Valuations are conducted at various points in the apartment development process: by developers in their feasibility analysis; by project financiers to confirm the likely profitability of a project (and closer to completion to confirm funds will be available to repay loans); and by mortgage lenders to ensure the funds they will commit can be recouped in the event of a mortgagee-in-possession sale.

Developers nominated valuation for mortgage purposes as a key barrier to the market and limiting innovation.

Market value puts a cap on it because people have had comparable sales and then people are getting [mortgage] finance and valuations and there was only a certain amount that the market was willing to bear. (Interviewee 5, architect)

One developer argued:

If you push up the price of off the plan apartments too much, valuers won't be able to support the value. So there is a ceiling in terms of what you can just add in and even if people like what they can pay for [it], the valuation or what stacks up in terms of banks and lending. (Interviewee 9, developer)

However, they noted there had been change over the previous 18 months with financial institutions becoming more focussed on ESD (Interviewee 9, developer). Energy efficient properties moreover are commanding price premiums, particularly in Victoria and Queensland (Burke 2022). But despite this, there is considerable inertia with the typical valuer focussed on very general characteristics of properties.

Valuation is comparing apples and apples... if a unit on the next street sold for X with two beds two baths and two cars, then that is what yours is worth. Valuers don't go on the roof, don't know if it is insulated. I might look from the street, from the foyer or the level of the apartment. That is all. Two beds equals two beds. (Interviewee 29, valuer)

In a nascent market, the sales comparison method of determining residential property value is problematic as there is an inadequate number of sales to compare. Complicating the development of this market is that high quality and sustainable properties are believed to be more tightly held so the market price is not revealed through sale. Faced with a lack of properties against which an individual property can be compared, the Certified Practising Valuer will make a conservative assessment. This reflects the need for a legal defence based on accepted methodologies.

In key research on the impact of energy efficiency and valuation practice, Kain et al. (2019) note empirical evidence of the positive impact of sustainability is not being translated into valuation practice in most states in Australia. Separate research by Fuerst and Warren-Myers (2018) identified valuer awareness of mandatory energy efficiency disclosure in the ACT appeared to contribute to premiums.

Prevalence of the comparison approach across all valuations means that the comparison of characteristics and features that may have an effect on value is paramount. This is especially true of residential property valuations, where the comparison approach is the primary method. Accordingly, it is critical to establish valuer knowledge of sustainability, energy efficiency initiatives as well as perceptions of their influence on market value (Kain et al. 2019).

Step four of the Australian Sustainable Built Environment Council's transition action plan is to 'provide financial value proposition', which aims to:

- Establish a partnership with the property valuation industry to correlate sales prices with sustainability features.
- Implement sustainability marketing tools and associated training for the real estate industry.
- Deliver incentives through the finance industry (Australian Sustainable Built Environment Council 2020:7).

Correlating sales prices with sustainability features requires research to understand the number of sustainable properties, their sustainability features, and the impact of these features, as variables, on prices. The reference to real estate agents points to the importance of agents in creating market awareness. Delivering incentives through the finance industry refers to valuers not being 'explicitly directed to consider energy efficiency or sustainability by the client (mostly banks)' (Kain et al. 2019). While not explicitly stated in these aims, education of valuers themselves is also critical.

The roadmap for transition developed by the Australian Sustainable Built Environment Council (ASBEC) is informed by the success of the GBCA in fostering green office buildings. As the GBCA acknowledges, Australian Government funding through AusIndustry and the then Victorian Building Commission, was instrumental to this success (GBCA 2006). Further financial support is warranted to enable the ASBEC's strategies to be realised as quickly as possible. Grant funding could be provided within the next budget cycle. Industry engagement would likely have an immediate impact, although systematic change would take several years.

Recommendation 7: Value sustainability

Australian Government support for the development of a process for incorporating sustainability into valuation practice.

4.3.3 Taxation

Some informants supported financial incentives such as tax breaks for projects that could demonstrate high performance.

I just think for investors ... the [current] tax incentives and so on don't reward anyone, or punish them if they've got a poor apartment. (Interviewee 23, ESD consultant)

A strata manager (Interviewee 26) suggested local governments could play a role in incentivising sustainable development through their ability to levy a differential rate. In general, local government has broad and flexible powers to impose differential rates. In practice, it means providing a rates concession (unless non-sustainable properties were to attract an additional impost). Land tax and stamp duties were viewed as simple ways of incentivising sustainable retrofits (Workshop 3, ESD consultants, strata manager).

The difficulty with this form of local government funding is concessions erode the rate base. Local government is subject to extensive cost shifting from the Australian Government and state and territory governments and, in some cases, rates are also subject to capping. The capacity of councils to fund any kind of incentive program is affected by the relative weakness of local government funding bases, with the exception of capital city councils.

Taxation, in whatever form, is an additional cost that needs to be factored in at the feasibility stage.

Because if you look at the feasibility of a project you decide what your revenues are and what your costs are and their profit margin and the land price is what's leftover ... that's how the system works. And if we want to add an additional cost ... you need to let the market know and foreshadow these changes so they can prepare.' (Interviewee 6, developer)

Carbon pricing

Apartment production and operations involve a vast array of material inputs and technologies. Informants described a market failure in that the ultimate consumers (either tenants or owner-occupiers) are not sufficiently informed about the financial benefits of sustainability measures, at least in part because the benefits cannot be adequately quantified. The result is that consumers are not incentivised to pay a price premium, which would in turn incentivise developers to produce sustainable apartments. The high cost of housing was also seen as a factor influencing consumer willingness to pay. There was less recognition that many sustainability measures simply do not involve financial benefits for apartment consumers. The latter are externalities which need to be addressed by other means such as taxation.

A provider of retrofit services (31) was particularly interested in materials and embodied energy arguing embodied energy needs to be measured and that 'we should have, like a little carbon tax' as a means of accounting for carbon and addressing its impact. Remarkably a tax on carbon was not raised by the other informants. This may reflect their very specialised roles and the highly technical nature of their knowledge. It is possible that it simply reflects the political impasse in Australia on introducing a price on carbon. Nevertheless, it is striking that imposing a tax on carbon emissions was not uppermost in the informants' minds given apartment development and management is a highly complex system and a carbon tax could drive change along the entire supply chain. It is also in contrast with JLL's (2022) assessment that the shift to sustainable real estate internationally is informed by the impact of existing or imminent carbon taxes.

Externally imposed conditions provide regulatory certainty and a level playing field for financiers. Obligations such as mandatory reporting create data required to track performance. Initiatives such as signing international agreements and imposition of a carbon tax are not only globally accepted mechanisms to facilitate a transition but are increasingly important for Australia's international competitiveness.

Recommendation 8. Green finance

Australian Government to explore imposing European Union style reporting obligations on financiers and establishing a process to leverage private financing in support of a transition to a circular economy approach in the housing system.

Another mechanism for linking building performance to profit discussed by informants was the mandatory disclosure of building performance rating systems. This is discussed in more detail in Section 5.1

4.4 Building capacity

Information and public awareness

Lack of information, knowledge and understanding was frequently raised by informants as a barrier to transitioning to sustainable apartments. Many emphasised the lack of awareness or knowledge about the sustainability performance of apartments, both amongst householders who were considering buying the apartments (Interviewee 18, 20 architects) and among real estate agents tasked with selling them (37, planner). Informants also said households were ill-equipped to distinguish green from greenwashing and continued to make ungreen purchase choices, such as carparks even when these were sold separately from units (Interviewee 9, developer; 6, developer). Informants suggested consumers needed to be educated on the full range of through-life benefits that buying green delivered, such as 'lower running costs and also a more comfortable home and a healthier home as well' (Interviewee 32, planning consultant). In this same vein, another planning consultant elaborated:

I think part of the challenge is that improved environmental efficiency is perceived, rightly or wrongly, as being more expensive ... I just don't think there's enough awareness about offsetting the long-term costs. So I think there's a huge opportunity in terms of firstly establishing what is the true genuine cost of taking a bog-standard two bedroom apartment in a six storey building in the middle suburbs in an activity centre, to take that from six star to seven star, or you know, however you might grade it? What's that cost and in terms of reduced energy bills and of course comfort, which is much harder to measure, how quickly do you actually get that back? ... there's a really great opportunity there for better education and awareness. (Interviewee 11, planning consultant)

Many informants insisted there was limited user demand for sustainable apartments, suggesting this market was niche, concentrated geographically in trendy inner-city areas (such as Brunswick, Melbourne) and associated with a price premium. All the same, some informants conceded that: ‘...if people had a choice that in 95 per cent of people will say, I want a more sustainable apartment as opposed to a traditionally built apartment’ (Interviewee 17, ESD consultant). Still, informants commentary frequently made assertions such as:

If people demand more sustainable features developers will not have any opportunity to develop shoddy apartments (Interviewee 17, ESD consultant).

Information is a barrier ... you don't have a market that appreciates the benefit (Interviewee 22, ESD consultant).

Informants make a valid point that (future) apartment residents lack knowledge and information about the environmental performance of apartments and how this impacts operational costs they will be lumbered with. While we did not engage with apartment residents in this research project, this information deficit aligns with prior research (e.g. Altmann 2014). Yet we should be wary of how a narrative of limited market demand for sustainable apartments potentially over-emphasises the agency of the end-user as creating a barrier to sustainable apartment CE. Indeed, findings tabled throughout this report suggest myriad other limits to this transition that have little to do with homebuyers.

In terms of tenanted apartment buildings and retrofits, one ESD consultant suggested owners' corporations need better financial education to shift the focus from quick fix solutions such as LEDs, to other interventions that could have more beneficial environmental and financial outcomes for the building (Interviewee 33, retrofit consultant). A retrofit consultant suggested energy saving certifications as well as improved owners' corporation-resident communication and owner education strategies could also be helpful (Interviewee 28, retrofit consultant). Strata managers provided a range of suggestions including information nights for owners, information tools for owners to undertake retrofits, and creation of sustainability sub-committees in owners' corporations (Interviewee 27, strata manager). Another strata manager emphasised strata managers' knowledge sharing practices, but also the disconnect between ESD consultants and (smaller) apartment strata managers that limits access to adequate information:

What we see now is strata managers share a lot of IP and intelligence internally, both within their business and also within the industry about their experiences, which can help people. So, it's facilitating that knowledge sharing and making sure that proprietary knowledge that's built up around how to do it is passed on internally [...]

[Interviewer:] Do you think there's enough sustainability consultants out there with the necessary skills to provide that specialist support?

I think there probably is, [but] whether the managers have access to them, or know ... how to contact them is probably a different story. I don't think it's a lack of people with the expertise. It's probably a lack of people being able to connect or understanding how to connect with those people. (Interviewee 26, strata manager).

In terms of this targeted advisory by ESD consultants to strata managers, several consultants corroborated the difficulties they too faced in attempts to engage directly with strata managers. As one ESD consultant explained, there is no ready means to reach this target market: there is no central database and so their marketing efforts to reach strata managers were expensive and not always effective (Interviewee 33, retrofit consultant). They also highlighted that their market was effectively constrained to ‘well funded strata in a high net-worth area’ including due to a persistent association of sustainability upgrades with additional costs, rather than potential cost-savings:

So, the acquisition cost of customers in strata is incredibly high to the point of making the provision of advice untenable which is why a lot of the local council programmes actually subsidise the reports. The direct market is very difficult to reach. So, for example, we do YouTube videos. We tried digital marketing, but it's expensive to do the digital marketing when you can't narrowly target through a digital channel, someone as a strata committee member, because they don't go online and type that there. Strata committee members, it's not their primary function. So for that reason, you have to market to heaps of people that are not strata committee members, to get the strata committee member and really even strata committee members, you probably need a chairperson or secretary of strata committee to make inroads. Look, to my knowledge, there's no way to accurately target a chair or secretary of strata committee member through the digital channel. (Interviewee 33 retrofit consultant).

Relatedly, a developer/consultant suggested the need for more systematic collection of post-occupancy data to accurately quantify how best practice apartment developments outperformed standard apartment stock:

We don't have enough data on how much better these market-leading projects are performing to create the case that they are in fact worth doing things a little bit differently, taking on a little bit more risk, and being able to communicate those benefits to consumers. So, there's convincing the developer, convincing the bank, convincing the consumer. It's question of which comes first. But the key there is, we don't have enough data on how they're performing. (Interviewee 24, developer/consultant)

Integrative approach

Many informants emphasised the need to work together rather than in isolation or in competition, and to work iteratively to optimise the design outcome. This included better teamwork between the council ESD officer and the architect and client (Interviewee 18, architect) and a shift in focus away from ESD reports as the primary output, to truly integrated design collaboration on ESD (Interviewee 8, developer).

We need ... a much better integrated design process ... the architect and the engineer developing solutions together ... if you get everyone in the tent working together through an integrative design process, it's our experience that you can deliver much higher quality at no extra design cost or even construction cost later on ... you want active and brave ESD consultants, not ones who are timid and just filling in tick boxes at the other end. (Interviewee 23, ESD consultant)

Other tabled suggestions, as previously noted, include early engagement of ESD consultants or ESD integration into architect teams (Interviewee 24, development director/ESD consultant) and early contracting to realise potential efficiencies in construction (Interviewee 19, construction manager) and to involve builders in design and material specification (Interviewee 21, construction manager).

The earlier that you can come in, the more you can influence in terms of the services agreement [and] there's the obvious opportunities in terms of materials selection. (Interviewee 19, builder)

An integrative approach can also assist in widening the focus beyond building and site, to precinct level (Interviewee 10, planning consultant).

Technical means and methods

There was appetite amongst some informants to see apartment development adopt alternative technologies (such as new construction techniques, including CLT or offsite construction and pre-fabrication), new technologies (such as low carbon concrete, pre-insulated panels and improved glazing systems), and new systems (such as Heat Recovery Systems and proprietary ESD technologies). For now, some new technologies were deemed cost prohibitive, required development of local expertise (Interviewee 9, developer), and/or required more data to demonstrate through-life costs (Interviewee 20, architect; 17, 23 ESD consultants). Informants suggested the uptake of innovative technologies could be incentivised (6, developer), and could help transition away from 'concrete obsession' and associated disadvantages of concrete use (Interviewee 19, builder) towards other forms of local production and manufacturing technologies, including 3D printing (Interviewee 24, developer/consultant).

Other opportunities include encouraging large contractors, who wield influence over supply chains, to encourage greener practices, such as reduced packaging (Interviewee 19, builder). Provision, ready access and facilitated sharing of information and data on materials would also be beneficial (Interviewee 21, builder).

Skills and training

Informant interviews additionally revealed knowledge and skill gaps amongst supply-side stakeholders. This included a 'massive skill shortage', including with regards to technical sustainability analysis at design stage, around procurement and supply chain certification, and skilled on-site labour (Interviewee 24, developer/consultant).

At the design phase, architects underscored a lack of understanding amongst council ESD officers about the negative impact of their ESD requirements on other aspects of the design (Interviewee 18, architect). Conversely, and as noted earlier in this report, architects and ESD consultants also emphasised their own need to stay abreast of trends in sustainable design as well as new sustainable technologies, approaches and materials (Interviewee 18, architect). Some informants specified the cost of education as a barrier to supply-side upskilling (Interviewee 8, design manager, private developer). Conversely, however, upskilling in environmental aspects of development was also seen as smart business (Interviewee 11, planning consultant).

Recommendation 9: Assessment resources

State and territory governments to ensure that the planning assessment system is adequately resourced to assess building performance for sustainable developments.

In terms of project financing, informants suggested the need for educating financiers about sustainable design features. One developer gave the example of a financier who confused passive design with Passive Haus (24, developer/consultant).

Several informants mentioned the challenges they faced with finding builders and trades adequately trained and knowledgeable about novel environmental design practices and technologies (Interviewee 9, developer; 16, building consultant), for instance their ability to appropriately substitute materials (Interviewee 13, builder). A construction manager (Interviewee 19) qualified this, suggesting lead contractors were frequently extremely knowledgeable but that knowledge diminished as you 'go further down the line', to the sub-contractors and suppliers who would benefit from upskilling.

Some people in the industry know this stuff, but they're not spreading that knowledge quickly enough (Interviewee 23, ESD consultant).

Upskilling challenges were blamed on general inertia in the construction industry, including reliance on traditional ways of building frequently mentioned (Interviewee 5, architect) and constraints on innovation under D&C contracting (Interviewee 4, developer). Others suggested that real change would not simply come from the use of new materials and technologies, but instead required changes to supervision and training (Interviewee 4, developer).

Previous literature highlighted the necessity of delivering training courses for building professionals to ensure they will uphold sustainable design and construction practices and requirements across Australia (Darko et al. 2017; Fastenrath and Braun 2018; Graham and Warren-Myers 2019). But we also note that Australia already has several training programs that support (a) training and apprenticeships into existing trades that include green methods and technologies; and (b) up-skilling construction workers with green skills. These initiatives include: Green Skills Agreement, Queensland Green Building Skills Fund, Skills for the Carbon Challenge, and the Jobs Fund (European Union 2011).

Turning to the point of sale, several informants suggested both real estate agents (Interviewee 32, planning consultant) and strata managers (Interviewee 25, strata manager) could be better educated about how buildings operate and where the energy saving were being made.

Recommendation 10: Knowledge exchange portal

Australian Government support for the development and ongoing operation of an online portal to enable knowledge exchange on ESD in construction.

5. Alternatives to the existing dominant apartment supply system

- **Alternatives to speculative development, in which the client has an ongoing interest in the performance of their building, can mitigate the disconnect between construction and in-use stages of development.**
- **The challenges associated with coordinating projects in strata buildings mean that the potential for sustainable retrofit of apartment buildings is often unrealised. Additional support for retrofitting is warranted in the form of government grants, regulatory and legislative amendments, mandatory disclosure of building performance and support for capacity building.**
- **Concerns about the potential for newly built buildings to be retrofitted in the future demonstrate the importance of designing and constructing new buildings to facilitate retrofits.**
- **Build-to-rent presents opportunities to embed sustainability in project feasibility, budgeting and briefing, and creates stronger financial imperatives to ensure operational efficiencies.**
- **Resident engagement in building design can mitigate split incentives and is important for fostering a culture that promotes sustainability and circular economy practices across the lifecycle of a building.**

The disconnect in speculative strata developments between the construction and in-use stages poses a series of challenges, as outlined in the previous chapters. These can be mediated in a variety of ways, as discussed in chapter 4. Further to these recommendations, alternatives to the existing dominant apartment supply system that involve end-users more closely in the planning, design, construction and management of buildings also have the potential to mitigate this disconnect. Three such alternatives were discussed by informants: retrofit of existing apartment buildings, Build-to-Rent and Deliberative Development. In each case, the client has an ongoing interest in the performance of the building, shifting the incentive to pay more attention to, and invest more heavily in, operational lifecycle costs.

5.1 Retrofit of existing buildings

The disconnect between the construction and use phases of apartment development in Australia poses a challenge not only because of the limited incentives to optimise the operational performance and longevity of buildings but also because of the limited consideration given to how these buildings can be upgraded as they age. This is especially problematic in the context of strata titled buildings because of the added difficulties that multi-ownership places on the process of undertaking retrofits (outlined in chapter 3). Despite reports showing the cost-effectiveness of sustainability upgrades such as solar panels, uptake remains low in apartments compared to other housing types (Pitt and Sherry 2016).

The challenges associated with coordinating projects in strata buildings mean that the potential for sustainable retrofit of apartment buildings is often unrealised in Australia. As can be seen in Figure 8, there are multiple stakeholders involved in apartment retrofit projects, complicated by strata ownership systems (as discussed in chapter 3).

In working towards a sustainable retrofit of a strata titled apartment building, a retrofit consultant (Interviewee 33) explained that there are five main steps:

1. developing a business case
2. education and information sharing amongst owners
3. formal agreement of the owners corporation
4. project management
5. evaluation of the outcomes of the project.

Having a clear and fairly unambiguous business case is probably the first step ... then [helping] the owners to understand that business case and then work out whether or not it fits within their budget ... every once in a while, I get invited to speak at a general meeting where these things are voted on. To help answer any questions and there's always a contingent in these meetings of people who just don't want to do anything ... once it gets through the meeting and gets approved, there's a question of project management ... do the owners corporation have the in-house capability to do that? Does the building manager have the capability to do the project management and then do the measurement verification at the end ... having some assistance with that is always good as well. (Interviewee 33, retrofit consultant)

Re-appraising value

Many informants explained that while a sustainability champion in the building may be driven by a desire to improve the sustainable performance of their building, in a strata property it is important to also understand other drivers of owners. Important drivers beyond sustainability included reduced utilities bills, improved indoor comfort, improved property values, and building reputation.

[For] the sustainability champion, the main driver would be a greenhouse gas emissions. Everyone else is cost. And as [they] get onto the journey, they find that being part of a community ... is a driver as well, and they want to do more ... there is some [interest in reputation]. Buildings that have high NABERS rating they are regarded as higher and I don't know how that would relate to increased property values ... but I know that buildings that are more sustainable have higher ratings. Potentially that they have a bit of solar as well, means that they're more desirable. (Interviewee 28, retrofit consultant)

In considering recommendations to support sustainable retrofits in apartment buildings, it is therefore important to consider each of these drivers.

Shaping market practice and processes

One of the barriers to undertaking sustainable retrofits (discussed in chapter 3) is motivating owners to undertake this work when there are multiple competing interests at play. This motivation can be driven by the values of owners and supported through capacity building, information and financial incentives (see below). However, there was also support from some informants for stricter housing standards and regulations to mandate improvements in building performance.

Some informants suggested obligation, rather than incentives, was necessary because of strata owners' diverse motivations and 'irrational' decision-making:

Incentives do not work, there is limited opportunity for economic gains which is the angle ... motivating strata owners, although their behaviour is irrational even in this regard. (Interviewee 2, financier)

One strata manager advocated for lowering the voting threshold for sustainability initiative resolutions, demoting it from 'special resolution' status so that 'it's allowed to go ahead based upon approval of the committee' (Interviewee 27, strata manager). We note that NSW has recently passed the *Strata Schemes Management Amendment (Sustainability Infrastructure) Bill 2020* to enable sustainability infrastructure resolutions to pass with a simple majority vote (50%) rather than a special resolution (75%). A similar change could be considered in Victoria.

Lowering the threshold for passing a resolution for sustainability initiatives for an owner's corporation. In Victoria, if you want to change the external appearance, so if you want to undertake works of common property, that's going to result in significant change, you needed special resolution. But if we can say that there is some criteria there it says, well, it was for sustainability and is going to be a payback of less than 10 years ... then it's allowed to go ahead based upon approval of the committee. (Interviewee 27, strata manager)

However, one informant warned that such legislative changes do not guarantee changes in practice:

Most of the research that I've seen assumes that strata committees and corporations actually follow the letter of the strata law in how they operate ... in reality, they're not ... the research tends to assume that, for example, if the New South Wales Government passes a sustainability infrastructure amendment, that lowers the threshold for voting for one of these projects. Yeah, that's great in say, a high-rise apartment building in the City of Sydney and that process will be followed there, because they're got the education, the information is coming to them to actually follow that process. But, for example, in a lot of strata schemes, people turn up at the annual general meeting, and the education isn't there for them to know that it's not a consensus model. So basically, if everyone votes for something, it goes ahead, if one person is a little bit against it, people don't want to offend them. So rather than going ahead with the project and creating ill will towards one person, then they just sideline the project. (Interviewee 33, retrofit consultant)

One strata manager advocated for mandatory reviews of building performance at annual general meetings, which would provide valuable opportunities to identify what needed upgrading:

Add as a mandatory motion for general meeting agenda ... that some sort of process is undertaken for review every couple of years ... the cost of one of these reports is four or five hundred dollars and you end up basically getting that back because [the consultant] will find some things which may have been contemporary and great five years ago, but can be upgraded now. (Interviewee 25, strata manager)

Another strata manager (27) also proposed that owners corporations should have to meet carbon emission requirements, and that this requirement could be introduced in a staged way, commencing with buildings of over 100 units. There are international precedents for approaches seeking to mandate minimum performance for existing buildings. For example, the French Energy and climate act has introduced mandatory audits of buildings from 2022 (CCAC 2022).

Recommendation 11: Legislative and regulatory amendments for retrofits

State and territory governments to explore legislative and regulatory amendments to encourage and support sustainable retrofit in strata schemes.

Titling investment flows

A large proportion of informant recommendations for encouraging the sustainable retrofit of apartment buildings related to actions aimed at influencing flows of investment. One of the challenges is the need to measure the performance of both the individual dwelling and the building as a whole. This has meant that some incentives available to households have not translated to apartment owners. One financier explained:

[The] retail side of the bank, they are providing additional loan to value ratios and or pricing discounts for clients that have solar panels on their roof or a far more energy efficient home ... they are providing that preferential discount now ... not so much in the apartment sector because there's no measurable element of the sustainability for the apartment ... You can measure the whole building, but you can't measure the output of the individual of the individual unit. (Workshop 4, financier)

Suggestions for tilting investment flows in this context included mandatory disclosure of building performance rating tools and government grants.

Mandatory disclosure

Many informants (Interviewee 25, 27, strata managers; 28, 33 retrofit consultants) advocated for mandatory disclosure of NABERS for Apartment Buildings ratings as an important regulatory measure to encourage greater adoption of sustainable retrofits in apartments.

NABERS was launched to great esteem some years ago and there were a lot of people who signed up to be assessors ... there's no mandatory requirement for buildings to have a rating. There should be ... it would be good to have a requirement ... that these buildings have to do a review ... every couple of years. (Interviewee 25, strata manager)

Mandatory disclosure of NABERS ratings, I think, would drive efficiency. (Interviewee 33, retrofit consultant)

Informants noted that NABERS was useful because it is an operational tool that measures performance. A retrofit consultant noted that the use of NABERS ratings alongside annual reporting under the NSW Energy Saving Scheme can be very effective:

NABERS looks at the actual energy, so it's an operational tool ... I find the New South Wales in energy saving scheme [with] the metered baseline method a great tool as well ... it's audited by an external auditor, so that's a great tool. So [the combination of] the New South Wales Energy Saving scheme with the NABERS tools is great. (Interviewee 28, retrofit consultant)

The NSW Government is already providing small grants to support buildings that have not previously had a NABERS rating to obtain one, as well as offers for new buildings (NABERS 2022). This is an important initiative. However, many informants argued that a shift from voluntary to mandatory NABERS for apartment buildings had great potential to improve building performance of both new and existing buildings. A strata manager noted that it is important to disclose information about the performance of existing buildings to help inform potential purchasers:

It should be a requirement that we have to include the rating of the property so that potential purchasers understand what it's rated as ... I think that will create an environment where people want to do better and increase their rating to get to that the highest rating available. (Interviewee 27, strata manager)

The connection between mandatory disclosure of building performance and better price signals in the property market was also raised by a retrofit consultant (Interviewee 33). This consultant said that linking retrofits to property valuation and requiring environmental performance ratings on property advertising portals such as realestate.com could help build consumer awareness, and link environmental performance to property values:

The connection between a sustainable retrofit and property valuation uplift hasn't been established. So the promise of the NABERS for apartment buildings rating system is that it would create that connection between uplifting the resale value of the apartment. That's the premise. However, until domain.com.au, and realestate.com publish information on the apartment buildings in the ads related to sustainability ... information like whether there's solar panels on the roof of the building, what the NABERS energy and water ratings are ... until that occurs there won't be effective way to prove to a sceptical strata committee member that there is a connection between Property Valuation uplift and sustainable return. (Interviewee 33, retrofit consultant)

Recommendation 12: Mandatory disclosure

Australian Government to mandate the collection of environmental performance standards for all apartment buildings and their publications on advertising and transaction portals for rent and purchase.

Government grants

Grants for retrofits were considered important because they can help overcome some of the financial costs of retrofitting, change perceptions about the value of sustainability, and are a key tool in educating 'on long-term costs of unsustainable buildings' (Workshop 3, policy maker). The Smart Green Apartments (SGA) program run by the City of Sydney was identified by multiple informants as an example of a successful grant and education program.

The City of Sydney is also got some programs like the Smart Green Apartments program ... they also have grants, so some buildings are becoming aware of this, I know that Waverley Council is also doing some work, also Canada Bay, but it's mainly council and local government who are pushing the changes. And we did find a lot of benefits ... we have cases where we've found that we would say spend, for example, spend \$70,000 now and save 1.2 million in the next 15 years. (Interviewee 28, retrofit consultant)

This consultant also spoke about the role of grants and incentives as an educational tool:

The projects would stack up without the energy saving certificates so over 10 years the energy savings ... I'm just using it as an education tool for people to get interested on the performance of their buildings. And so, there's a meeting at the end of the year where we present the results, and they can see how their building has performed over the last year. The metrics are easy ... like we started with 200 say certificates for this building and we've gone up or down and they can be part of the discussion. And in the end though, they get paid for it as well ... I know that the ESS probably wasn't set up to be [an education tool], but I just find that metered baseline method is really ideal for that, because a lot of the methods are, you know, get 10 years upfront ESCs ... So although the metered baseline method wasn't set out to be as such, it is a great educational tool. (Interviewee 28, retrofit consultant)

Two strata managers (Interviewee 25, 26) also noted that the existence of Energy Savings Certificates in NSW had encouraged the proliferation of suppliers of sustainable technologies. Those suppliers had then proactively approached strata committees offering their services for retrofit projects:

It's very rare to come across a building where they haven't now done a lot about low hanging fruit because fire companies, electricians, etcetera, pretty quickly jumped on the back of it. So if they were servicing a building, they would identify that they didn't have LED lighting, for example, and they would then be that advisor. (Interviewee 25, strata manager)

The real catalyst was the government incentive program, because without that...we wouldn't have seen the suppliers in the marketplace. Who then obviously built the momentum and the... demand for their products by pitching it to managers and other owners corporations about what could be achieved. So I think if there was any catalyst for all of that, I would say it was government. (Interviewee 26, strata manager)

A strata manager noted that there appeared to be fewer grants and subsidies available to strata buildings in Victoria than in NSW. However, he reflected that previous Victorian subsidies had been helpful:

There have been incentives there in the past. Things like the VEET scheme, the Victoria energy targets scheme, there's those incentives which help the cause. (Interviewee 27, strata manager)

The same strata manager also noted that some grants available to commercial properties are not available to owners corporations:

Just being conscious of the fact that we have such a huge ability to you know create energy efficiency in apartment complexes and I guess some of the lack of government involvement in terms of funding, you know Sustainability Victoria they provide funding for the commercial properties but not for residential properties. (Interviewee 27, strata manager)

The unavailability of grants to support solar installation in strata properties in Victoria prompted this firm to provide a small grant of their own to one of the owners' corporations under their management as a demonstration project:

... he championed the installation of solar panels himself with us supporting him. In terms of, you know how we can overcome some of these barriers. How can we pass a special resolution? How can we potentially get some funding? ... we actually provided a grant ourselves from our own pockets. We said look guys, here's \$1000 to contribute to your quest to install solar panels and we just wanted to see you get this across the line so we can then promote it to other clients ... We had 150 people at that information night two weeks ago and the feedback from others was fantastic because they could actually relate to this committee member talking about his journey to install solar panels... and here's the lessons learned and how they can then apply them to their own situation. (Interviewee 27, strata manager).

Meanwhile, grants provided by the City of Sydney have provided an excellent return on investment:

Through our work in Smart Green Apartments and also through our grants program in which we've been giving out grants of around \$6-8,000 on average to fund NABERS ratings; in the evaluation of those grants we found the financial investment that was unlocked pretty staggering ... for every dollar the City invested, we saw \$5 Once they had that NABERS rating and the action plan and knew where to start ... I think it is really valuable to show government the value of investing and what can be unlocked just by providing that information. It's not going to happen by itself, without some government support, because this space is so cluttered with governance and decision-making challenges just by the nature of the complexity of ownership. (Workshop 4, local government)

Informants also stressed the importance of ensuring that government grants and support are fit for purpose for apartment properties and allow for upgrades to common property:

Sustainability upgrades, including solar, must be tailored for apartment buildings as well as houses; centralised services and complex plant and equipment in the common area of apartment buildings is expensive to run and collectively owned. Grants and support for common areas is essential to enable net zero buildings and resilient communities in the future. (Workshop 4 participant, personal communication 22.06.22)

Recommendation 13: Typology equality

All levels of government to review existing and future government grants for sustainability upgrades to ensure common property is considered to avoid exclusion of strata properties

Recommendation 14: Additional retrofit grants

All levels of government to introduce additional government grants to incentivise housing retrofit projects.

Building capacity

In a report commissioned by the City of Melbourne 11 years ago, Rex and Leshinsky (2012) advised there was a need for 'tailored information and guidance about sustainable retrofits in apartment blocks' and proposed the development of an online tool for all stakeholders. Since then, online tools and resources have been developed, including Smart Blocks, Green Strata, and a sustainability retrofits tool (City Futures Research Center 2015). However, dissemination of this information and these tools has been piecemeal, and two of them no longer exist (Green Strata and Smart Blocks). A local government informant noted 'ongoing funding and support to resource and keep updated over time is always the issue' (local government, per comm 24.06.2022). However, online resources such as these are highly valued:

Our role...it's quite a broad church in terms of what we're required to do, and I think when it comes to promoting sustainability we, certainly here in Victoria, need some tools to help with that. Now I think government can create a resource area for strata and residential buildings and commercial buildings that provide similar to Smart Blocks that was promoted by City in Melbourne, that basically we can reference, and owner's corporation communities can go there and understand OK, what are the top 10 things that can be done in apartment complex that will help with the overall footprint. I think that's really important because while we might be heavily involved ... a lot of management companies out they don't have the time to really get heavily involved in this. You know they've got other things to focus on, so it's about directing their committees to a central repository where they can look for themselves if required. (Interviewee 27, strata manager)

This central repository of information could also provide a database of products and efficiency ratings, that is updated over time:

The pieces of plant and equipment in those buildings is not hugely different. They all have one of ten types of pump, one of ten types of light, and so if there was a central database which just noted these are older products, and what their efficiency rating was ... we should be able to have a rating system understands what general servicing and what general lifetimes on any of those pieces of plant and equipment is. (Interviewee 25, strata manager)

Recommendation 15: Retrofit repository

Australian Government commitment to fund the development and ongoing operation of an information repository to support the sustainable retrofitting of apartments.

Informants pointed to a need for improved knowledge sharing between developers, builders and their sub-contractors, ESD consultants, strata committees and strata manager.

... talk to other buildings as well, so have a community that also where they know about the paybacks and the saving. It's not coming from me, it's coming from other people. That's very strong. If other people in similar situations have stories to tell. That's a very strong message. (Interviewee 28, retrofit consultant).

Local government programs working with strata owners' corporations to coordinate and implement sustainability retrofits have proven very effective in some Australian jurisdictions. These programs do more than provide funding for retrofit programs; they also enable capacity building amongst owners corporations. Examples include the City of Sydney's Smart Green Apartments program (City of Sydney 2020), and Waverley Council's Building Futures and Solar my Strata programs (Waverley Council 2019a; Waverley Council 2019b). As of March 2020, the 10 year SGA program had supported 150 apartment buildings to improve their energy and water efficiency, realising cost savings of around 35 per cent or \$57,234 per building per year (SUMS+ 2020). One building achieved a 30 per cent reduction in water use, saving 144 litres of water per bedroom per day (SUMS+ 2020). The NSW State Government funded WaterFix program administered by Sydney Water (Mourad 2020; Sydney Water n.d.) is another example of a supported retrofit program. Focusing on individual dwellings, including apartments, it demonstrates the potential for partnerships with utility companies, giving owners corporations access to pertinent information for improving the sustainability of building systems.

Notably however, the local government supported initiatives have been run by Councils in wealthier areas of the major cities. One informant suggested that some support from the Australian Government or state and territory governments for similar grants rolled across other local government areas could go a long way to democratising these opportunities:

The benefits are financial ... We've seen projects with payback two years it's a no brainer, so I'd have a look at the barriers so is money always the underlying factor why things happen? I don't think so. We have a look at the solar industry in the last few years it's been in the less affluent suburbs where most of the PV solar systems have been installed. So I don't think ... affluence is an issue, I think that education of communities is the biggest issue ... and possibly councils that don't have the funding to do that. Maybe the federal government or the state governments could help with that to have a more programs equally for councils. Just to kick start the industry because once it gets started, I think I think it'll go by itself. (Interviewee 18, architect)

It may also be possible to link the recommended information repository (recommendation 15) with a hub to enable apartment owners and residents to connect with each other and share their experiences of apartment retrofits. As mentioned above, such online resources have existed before, but have not been sustained due to insecure funding and resourcing.

Build to enable retrofit

To facilitate the sustainable retrofit of existing apartment buildings in the future it is important to ensure that new buildings are constructed that will enable retrofitting. According to informants, we are facing a much bigger challenge in the future than we do now. This is because many existing older buildings can support retrofits, while many recently constructed building cannot.

For example, many older brick walk-up apartments can accommodate the addition of units on the roof, or are on larger land lots and can develop additional units within their land parcel. These additional units can be developed and sold to fund upgrades, including sustainability upgrades to the building (Loschke and Easthope 2017). However, newer buildings are typically engineered to maximise the use of land and minimise cost and would not support later addition of units:

I find that the older buildings are much more capable of being retrofitted ... any building that's being delivered in the past 20 years has had its envelope maximised and has very little capability to introduce additional infrastructure easily. It's had its substation maxed out, it's had its common property utilised with zero available or spare space, so it's really difficult to get anything into those buildings. All the older buildings, particularly those you know, walk up buildings which have much simpler facilities have huge potential for upgrades. They've typically got flat rooves ... They've got common property elements and gardens that haven't been fully maximised and utilised. They've got common areas that are available for infrastructure to be installed. They've got plant rooms that haven't been taken up with all the modern infrastructure that you would expect in new building, so those buildings are much more capable of having things retrofitted in because they've got the capability around their size and the fact that they haven't been maximised and tapped out. (Interviewee 26, strata manager)

This is in contrast to newer buildings:

What we see at the moment is buildings built to the maximum capability of the of the current design limitations ... we get buildings that are handed over and the [electricity] substations are at capacity. The buildings are at capacity from a usage perspective, there's no consideration for downstream upgrades or for potential repurposing of those common property spaces ... retrofitting EV into an existing building is very challenging because the electricity infrastructure throughout the building hasn't been scoped for individual units to be upgraded for cabling to be installed, or for the additional draw on the system to be accommodated. [Also] the repurposing of common property spaces to future uses. It is very likely within a short period of time we're going to see autonomous vehicles at a whole bunch of other you know, common technology in society, yet buildings haven't been built with a view to adopting any of those types of ... uses or trends into their buildings ... That's where I think there is a huge role that government can play through the approvals process to make sure this stuff is provided up front and is built to a higher standard than the bare minimum. (Interviewee 26, strata manager)

A retrofit consultant provided a further example:

Interviewer: What would you say is the main design or construction related opportunities or challenges in retrofitting?

Roof access. So the more modern buildings typically have a manhole to get onto the roof, older building stock had a lift overrun, and the fire escape opened a door onto the roof. It actually cheaper to install solar panels on an apartment building that's got to lift overrun, and maintain the solar panels where you can walk up a fire escape and open a door onto the roof. So my number one advice in the planning stage is make roof access for carrying a two by one metre solar panel on onto the roof without having to hire a crane, a scissor lift or an elevated work platform ... There should be persuasion to put more metal Colorbond roofs down and less concrete water proofed rooves down. Because it's, it's better for solar installation to install on a Colorbond ... If the only way to get a solar panel on the roof is a ladder from an individual lot owners, top floor balcony then you're impacting, and that person can just block going ahead [with the retrofit]. (Interviewee 33, retrofit consultant)

Recommendation 16: Update ADGs for future retrofit

State and territory governments to update apartment design guidelines to ensure that the potential for future retrofit is considered before new apartment projects are approved.

5.2 Build-to-Rent

The BTR model appears to satisfy several of the opportunities identified through stakeholder workshops to intervene in apartments CE to improve sustainability outcomes. Most notably, BTR presents opportunities to i) embed sustainability in project feasibility, budgeting and briefing; and ii) to create an integrated design process where developers have stronger financial imperatives to ensure operational efficiencies and end-user experiences. BTR additionally benefits from access to 'green' capital, such as through NHFIC funding. BTR may further alleviate challenges to apartment CE associated with collective management in strata apartments.

Informants identified potential for the BTR model to provide improved sustainability outcomes and, for some, to deliver benefits above and beyond BTS development (Interviewee 16, building consultant; 23, ESD consultant). However, informants did not identify or specify all aspects of BTR that may be relevant to CE. As one example, informants did not discuss retrofit opportunities in relation to BTR, a finding which likely reflects the immaturity of the local BTR market.

BTR represents an alternative development model to traditional speculative BTS. The BTR sector involves ownership of purpose-built apartment buildings as a long-term revenue generating asset. If BTR is defined expansively, public housing might be seen as the original BTR where apartments were built and managed by the state or more commonly nowadays by Community Housing Providers (Nethercote 2020). Most commonly in Australia the term 'BTR' most refers to a for-profit or 'market BTR' sector that attracts market rents. There are other forms of market BTR that contain a share of affordable or social housing units. There are definitional inconsistencies surrounding what is being called BTR in Australia and Australia lacks a formal definition (Nethercote 2020).

When informants were asked which segments of the apartment market were particularly interested in sustainable apartments, they frequently cited BTR actors. The financial model behind BTR helps explain why BTR actors are interested in sustainable apartments and, moreover, incentivised to care about sustainability.

The longer-term investment horizons of BTR asset owners creates different incentives for BTR developers and investors. The financial model behind BTR relies upon rental income and operational efficiencies so that BTR investors receive acceptable returns on their investment. This potentially creates stronger vested interest in designing and developing apartments that can deliver operational efficiencies to reduce costs and improved liveability to retain tenants over the lifetime of the building asset (Nethercote 2020). On scale, BTRs operational efficiencies are best achieved through large developments. This is reflected in Australia's emergent market where BTR development typically contains at least 100 units and often many more (Nethercote 2020). For these reasons, BTR potentially encourages design and development of (more) sustainable apartment buildings (IPWEA 2020), such as with reduced energy and water usage.

Informants directly involved in the funding of BTR apartment developments also described the involvement of institutional investors such as superannuation funds as potentially leading to:

a real transformation in what becomes accepted practice or standards in apartment design. And of course then that raises market expectations as well. (Interviewee 11, planning consultant)

A developer (Interviewee 9) described BTR financing as involving 'a lot more mature' capital, with longer-term investment timeframes, but requiring more time intensive, specific and tailored finance arrangements for each project. A financier (Interviewee 1) suggested BTR provides opportunity to access green capital from Europe and North America, where suitable financial products service more mature BTR markets.

Informants identified the potential for BTR to: incentivise uptake of sustainable design elements and diversify; and expand household access to sustainable apartments.

First, informants recognised how a revised focus on operational efficiencies potentially motivated the uptake of more sustainable apartment design and construction. The BTR model removes the split incentive associated with BTS development (Interviewee 1, financier). BTR also incentivises developers' adoption of design elements that reduce operational costs over the life of the building. One architect described how sustainability for those apartment actors with 'the long-term hold...are actually willing to invest in [sustainable design elements]' (Interviewee 18, architect). Architects, developers and planning consultants noted how the BTR model revised BTR investors and developers' incentives to consider apartment operating costs:

I guess [sustainable design is] in the best interests of Build-to-Rent developers because there's ongoing savings of operating costs [...] I think there would still be a relatively big sway towards [sustainable design], because the payback periods are there and the value is they're designing something long-term that's not just sold off the plan. (Interviewee 9, developer)

So, to me, the real incentive about building sustainable apartments happens when they're going to be rented on a long-term basis and the builder is then responsible for the ongoing long-term, not just energy costs, but maintenance costs. And so then that requires much greater attention to detail across all the elements of the building's construction. (Interviewee 11, planning consultant)

Informants alluded to buildings with reduced energy consumption but were generally non-specific about how designs would achieve this or other operational efficiencies. Some developers, architects and ESD consultants cited better insulation (Interviewee 23, consultant) and energy and utilities infrastructure as means to reduce building energy usage and BTR operators' operational costs:

So if you can lower their occupancy costs in terms of energy and utilities, and equally lower your costs of ownership for the Build-to-Rent operator over a longer time frame then that is an issue. (Interviewee 6, developer)

These revised incentives also mean that BTR actors are privy to 'green' capital. This was recognised by one financier (Interviewee 1) who described how green capital from Europe and North America are investing into Australian BTR.

Second, informants suggested BTR might diversify and expand household access to sustainable apartments. Affordable BTR would potentially deliver sustainable apartments beyond the current niche sub-markets in boutique BTS developments. The feasibility of delivering affordable BTR developments in the emergent Australian BTR market was recognised as limited pre-pandemic, with further government subsidies required (Pawson et al. 2019). Nonetheless, affordable BTR is being delivered through a limited number of BTR projects including private actor-led BTR developments by Assemble in Melbourne, and state-led BTR development delivered by the Queensland Government Build-to-Rent pilot project in Brisbane.

Since affordable BTR, like other government funded housing, includes environment reporting and social sustainability requirements in contracting (Interviewee 19, builder), this model offered a means for more stringent governance of sustainability. As some informants also recognised, the state (as providers of public housing) and community housing providers shared BTR's interests in reducing operating costs, liveability and security of tenure (Interviewee 18, architect).

Informants identified social sustainability benefits that might be secured through the BTR model. BTR promises improved security of tenure relative to the standard private rental sector, including longer leases and the possibility of staying indefinitely. This security of tenure was recognised by one architect at least as a necessary feature of truly sustainable apartments:

Our projects need to be sustainable, and they need to be long life, enduring, accessible to many, answering the demands of our society long-term, whether you're the richest or the poorest. We think there's some value to understanding that ... and I think even the prospect of tenure—rental, 10 year or, affordable housing tenure—the fact that your tenure is actually sustainable, both in a financial sense that you can afford to live there, but also that you're not going to get kicked out in 12 months' time. I think that contributes to well-being and sustainability of our cities, of our lives. (Interviewee 18, architect)

A planning consultant suggested BTR could become a driver for sustainable apartments across all development models, in particular because BTR provided the scale of development to 'push' the whole apartment sector forward.

[W]e are starting to see it more and more over the last couple of years. But if we start to see big institutional players like the superannuation [funds] and other big builders getting into this space, we could see a real transformation in what becomes accepted practice or standards in apartment design. And of course then that raises market expectations as well. (Interviewee 11, planning consultant)

Informants also noted several issues or challenges that may circumscribe the sustainability of BTR apartments. First, some informants recognised that for-profit BTR usually involved a rental premium; rents above local market private rents (Interviewee 26, strata manager). The majority of Australia's BTR pipeline comprises market rate BTR rather than affordable BTR. These rental premiums will limit household access to BTR housing to those who can afford to pay more for it. If BTR can deliver sustainability benefits, many of the household benefits, such as enhanced liveability or better security of tenure, may flow to wealthier apartment residents. Note these wealthier households already benefit from relatively better access to sustainable apartments as the target markets for boutique sustainable developments.

BTR is also unlikely to expand access to sustainable apartments geographically. BTR is predominantly being delivered in inner city sites such as Brunswick in Melbourne (Nethercote, forthcoming) which is also where BTS is delivering niche sustainable apartments. In addition, BTR is delivered via predominantly very large-scale developments of upwards of 100 units as required to achieve operational efficiencies (Nethercote 2020). This will also limit where in cities BTR can deliver apartments.

Some informants also challenged whether BTR would actually deliver more sustainable design. A developer and strata manager questioned whether local BTR was actually true purpose-built rental accommodation or whether it was BTS development that had been retained by developers struggling to sell in a stalling BTS market:

I think some of the current Build-to-Rent that's been delivered is still a build to sell solution that just hasn't been sold as opposed to a defined prime location building with a highly desirable tenant framework. (Interviewee 26, strata manager)

Look, there should be a difference, but for [Development Company] there isn't, and I think that's an opportunity still to be taken. [...] [Development Company] has ... residential units which we retain and own as Build-to-Rent ... we do that almost as an afterthought. We've sold enough of this development that everything is fine. Let's keep 25 per cent of the units right? Well, let's keep 30 per cent of the units. And we keep them knowing that one day we might sell them. You know we're not required to keep them. There's not a Build-to-Rent requirement from a statutory point of view, and we're not keeping them because they're affordable or anything like that. So, we just treat them as the same as the stuff we sell. It's just that we happen to keep owning it. (Interviewee 6, developer)

For now, the local BTR sector is small and immature. The sector's local credentials are unproven and the potential risks to households, neighbourhoods and cities poorly understood (Easthope et al. 2020a). Some informants recognised this, noting there was a lack of BTR precedents and therefore a lack of accurate data. One strata manager who consulted to BTR groups explained this:

I've got a fair understanding of it, but we don't have enough of what I consider live examples that I could build a database of reference - where we've got, you know, a really definitive understanding of the benefits yet. (Interviewee 26, strata manager)

Endorsement of BTR as a sustainability pathway for the apartment sector is therefore qualified. More research is needed, including of the ongoing maintenance and management of BTR tenancies and buildings assets (Nethercote 2020). Informants' identification of the potential of BTR to secure improved environmental and social sustainability outcomes over the life of the building broadly aligned with BTR research which recognises the potential synergies between financial imperatives and long-term investment horizons and improved tenure security and liveability. More evidence is needed to understand how these investment priorities produce particular design, operational and tenancy outcomes (Nethercote 2020).

Informants did not mention other aspects of BTR that will also shape sustainability outcomes, such as the differences in BTS and BTR apartment designs (level of amenity, ratio of apartments, and so on), material selections, or the use of property technologies. BTR also offers opportunities for reduced time from project initiation to completion, since pre-sales are not required to secure financing (Nethercote 2020). Other issues not tabled include the BTR specific planning regulations, whether as a barrier or enabler, and BTR specific design guidelines and concessions.

Informants focused on how BTR might reshape the design and construction phases of an apartment's lifecycle. There was little discussion or critical engagement with the operational aspects, including the credentials of the operators involved and how they would secure sustainability outcomes into the future, including relative to owners' corporations in strata apartments. Given the issues raised in relation to the collective ownership of strata apartments, including complexity and owners' interests, we can hypothesise that single BTR ownership would helpfully avoid some of those issues. However, we lack sufficient data within this project on which to make any recommendations about BTR.

5.3 Resident participation in development

Poor et al. (2018) refer to the (mis-)match of residents and their homes as the Housing-Resident Fit (HR Fit). They suggest that a poor HR Fit indirectly affects dwelling sustainability and energy consumption. They argue improving HR Fit by involving end-users in apartment development should be central to realising sustainable apartments and is essential to enabling pro-environmental behaviours. Similarly, advocates of resident participation in apartment development (Palmer 2014; Sharam et al. 2015a) argue more sustainable outcomes can be achieved by involving residents in design development.

An architect described designers as disconnected from residents and owners, expressing the view that the mediation of design by developers and their representatives has a negative impact on sustainability outcomes:

There's that disconnect because we are kind of one step removed ... we find if we've got a project manager [as] the client ...the work that we do, it's not as good a job as if we've got a direct line to the client. It's a way better job and any job we've done where the project manager is kind of a mediator, it's just terrible. That's what's happening, there's a middleman to the future owner. (Interviewee 14, architect)

As future owners and residents are not clients but amorphous demand in BTS development, developers necessarily make speculative decisions regarding purchasers' values and preferences. Architect informants universally expressed concern regarding the assumption by speculative developers that purchasers value high-quality finishes and appliances over sustainability. An architect discussed the challenges faced by developers in markets where items previously perceived as luxury additions have become standard expectations for many purchasers:

The challenges are around people's expectations in terms of what they get in an apartment. What generally people expect in an apartment is an ensuite bathroom, a big master bedroom, a walk-in laundry, a secondary bathroom. Sometimes in a higher end apartment, two banks of ovens, big wide ovens. All these kinds of things ... the more expensive than more that kind of demand comes from it. Ducted air conditioning to all the rooms, definitely, that's a buyer expectation. It's not an optional extra like 10 years ago [when] air conditioning might have been an option, now it's just a given - and it went from a split system to ducted, so now the expectation is ducted air conditioning in all bedrooms and living rooms. So that's a challenge if you remove that, what are people going to think? Probably you could remove it as a standard and make it an option, but I guarantee a lot of people would take the option. (Interviewee 18, architect)

For architect informants (Interviewee 12, 14, 20) this poses a challenge in balancing sustainability and affordability as the need to include luxury additions precludes sustainability features on the grounds of cost. One described the potential for change in this regard, including the suggestion a group of residents or industry professionals act collectively in a non-speculative manner to realise more affordable and sustainable apartments:

I'm seeing just from our own office in terms of people trying to get into the housing market and where they want to live and where they want to be, compared to where they can afford to purchase a house or even an apartment. And I think that the model that is untested in our Newcastle market is something where the units are a bit more basic and I think that first homeowner or someone who's looking at a more affordable unit would be completely comfortable with ... and then you know, common laundries, one bathroom, simplification of the fit out, those kinds of things. Maybe less cars. And that all has an impact on the feasibility of the project and the cost to build the project, but it would lower the sale price. That's not a tested thing that I've seen in the Newcastle market, but I think that it actually [is] ... a pretty good opportunity, and I've even thought myself in terms of getting together a group of people to do something like that. Where you go really strongly down a sustainable route in terms of the building design that translates into unit size, limits what you're providing in the fitout, number of cars, those kinds of things get reduced. You pitch the unit sale prices down low, get other investors involved that are all ... I think it actually has a possibility and I really think it would work, but haven't seen anybody do it, so maybe it wouldn't work. Why don't we see that? (Interviewee 14, architect)

The above description of an alternative to the existing dominant apartment supply system places future residents at the centre of provision where their specific preferences determine design and sustainability.

A small number of BTS developers are actively engaging future residents in design. For example, Assemble Communities in Melbourne (Whitten 2021) and Nightingale Housing in Melbourne, Perth and Adelaide (Doyon and Moore 2019; Moore and Doyon 2018). In these two cases, resident input is introduced post sketch design and project feasibility phases and is limited to design resolution only. These models are not intended to provide bespoke apartments to individual households. Instead, they are intended to create a building that suits the collective needs of the resident community that forms around and within it. In the case of Nightingale Housing, a key purpose is to provide a high level of sustainability.

While speculative BTS development is motivated by profit, these alternatives that offer resident participation are motivated by social, environmental and professional commitments (Palmer 2018). The industry professionals instigating the projects are dedicated to providing high-quality, sustainable buildings that exceed the minimum regulatory energy efficiency requirements (Palmer and Tummers 2019).

An alternative that varies from the dominant speculative apartment system to the greatest extent is Deliberative Development. Coined by Sharam et al. (2015a), the term refers to projects that aggregate:

like-minded intending owner-occupiers who commission their own multi-residential building in accordance with the preferences of the collective members ... Group members become the project proponent, assuming legal responsibility for the entire development, raising development finance, appointing architects, project managers and builders (Sharam 2020).

Known by alternative terms in other countries, such as Baugruppe or building groups in German-speaking regions, these non-speculative and non-profit apartment projects provide housing at a cost to the owners and can realise significant savings in comparison to market prices. Like their international counterparts, the Australian examples (such as Property Collectives) exceed the regulatory minimums for sustainable design and aim to develop healthy and resilient resident communities. Deliberative Development empowers residents as they become key actors in the development of their own homes. By initiating their own development they control the resources required for development and become primary decision-makers alongside their future neighbours (Palmer 2020b), realising their collective vision with the assistance of specialist industry professionals (Palmer 2019). Member households building together are the developer, the owners, and the future residents, eliminating split incentives and freeing the group to stretch sustainability targets as far as they desire within their budget constraints. As future residents, Deliberative Development proponents tend to have greater concern about the impact of their building on the neighbourhood.

An architect expressed interest in apartment developments of this type but identified funding as a key challenge:

They are funded by banks, I suppose. So they've got [to] prove up a business model with the development. The clients that we're dealing with ultimately have to prove up that the sale costs, the sale prices, pay at a certain point it triggers the start of the project and they might be able to speculate ... There is an expectation around getting the banks approval to get the funding, from what I understand, so maybe we are seeing some impact of the financing then on what our design options are. (Interviewee 14, architect)

This funding challenge for Deliberative Developments has been identified in previous research (Sharam et al. 2015b; Sharam 2019). Lending practices developed in response to the speculative development system are applied, restricting the participation of asset poor households (Sharam 2020). This limits the opportunity for lower income households to benefit from sustainability measures that can contribute to affordable living. However, as Alves (2020) observes, the success of alternatives can influence the mainstream:

Now that emerging facilitators of deliberative development ... have demonstrated strong underlying demand for quality, affordable owner-occupied apartments, (as well as its design benefits and strong environmental performance), lenders are becoming cognisant of the lower risks involved in development of such non-speculative, consumer-led, multi-unit housing and have been willing to consider more favourable lending terms.

Project financiers are not familiar with Deliberative Development and are reticent to fund inexperienced groups (Sharam et al. 2015b). However, awareness is growing and some financiers understand the connection between Deliberative Development and sustainability. Impact investors, for example, were early backers of Nightingale Housing and Bank Australia recently funded a Property Collective project. To realise the social, financial and environmental sustainability benefits of Deliberative Development requires supportive financiers. If modest income or asset poor households are to benefit, mechanisms are required to address the equity gap.

Resident participation in decisions about what an apartment development will look like and how it will function in Australia are extremely limited. Only a small number of boutique BTS developers and not-for-profit social housing providers provide such opportunities. Both the BTS and BTR sectors can benefit from increasing opportunities for resident participation in development.

Recommendations regarding resident participation in apartment delivery systems

In seeking a CE future, resident engagement is important for fostering a culture that promotes and rewards sustainability and CE practices across the lifecycle of the building. It also has the potential to mitigate split incentive problems, which have been identified as a systemic barrier to the uptake of sustainability in apartments.

These recommendations intend to remove identified barriers to resident participation in apartment delivery systems, including social and community housing and privately owned developments. They do not aim to prescribe resident participation in all new apartment developments or retrofits in Australia. Instead, they aim to encourage and support alternatives to the existing systems of provision that can act as examples to motivate change in mainstream design and development practices over time.

The recommendations apply to new developments and retrofits, and owner-occupied and tenanted apartments; recognising the need to ensure all resident cohorts are invited to participate in housing-related decisions regardless of tenure or dwelling age.

Low-cost projects with constrained budgets, such as community, affordable and public housing, require expedient design processes to minimise project costs. Funding processes frequently require substantial design and costing works to be undertaken as part of a funding application, restricting the capacity for resident engagement in design subsequent to confirmation of funding. Participation of residents is similarly constrained by a lack of funding for designers or other consultants to dedicate time to resident participation in the design process.

It is recommended that apartment (re)developments receiving public funds equivalent to 20 per cent or more of the overall development (or retrofit) cost include sufficient funding in the project budget to meaningfully engage future residents (or a representative resident cohort) in the design briefing, concept design and design development. The direct engagement of future residents in design can lead to more socially and environmentally sustainable outcomes, as noted by one of our architect informants (18). Project timeframes, funding deadlines and funding submission requirements should also allow time for this participation to occur.

Competition for land and the need to recoup land costs is a major constraint to affordable housing in existing urban areas. It is also a major barrier to groups of households seeking to undertake Deliberative Development (Palmer 2014). Providing opportunity for resident-led groups or not-for-profit entities to access land can overcome this challenge to realise more sustainable apartments. Multiple jurisdictions in Europe and the UK have tried schemes to achieve this outcome, with varying degrees of success, from which lessons can be drawn (Palmer 2016).

Recommendation 17: Resident involvement in publicly supported projects

All levels of government to require publicly-funded apartment projects to involve residents in design, including where publicly-owned land is made available for development.

Low-income, moderate-income and asset poor households are prevented from participating in the Deliberative Development of apartments by the equity requirement of 30 per cent or more. In contrast, unsustainable low-density housing requires a deposit of 20 per cent (if the purchaser is to avoid Loan Mortgage Insurance). The First Home Loan Deposit Scheme administered by NHFIC and the New Home Guarantee provided by the Australian Government in the 2020–21 Federal Budget both provide(d) guarantees to lenders enabling households to buy or build a home with a deposit of 5 per cent or less (NHFIC 2021a).

In the absence of affordable, sustainable apartments there is a role for government guarantees to increase the participation in Deliberative Development apartment projects to provide both quality housing and promote sustainability. Provision of a guarantee equivalent to that for the construction of low-density dwellings would attract financiers and participants. An eco-system of consultants would emerge in response. In time growth would mean there is a viable alternative to BTS (Ring 2013).

Recommendation 18: Guarantees for Deliberative Development

Australian Government to provide government guarantees for Deliberative Development construction loans.

Currently in Australia, building a new free-standing dwelling has taxation advantages compared to a household participating in a group to develop a new apartment building. Significant differences exist in stamp duty liabilities and general sales tax. If both households have the same purchasing power, this situation leaves the apartment building household with less funds to spend on the dwelling, negatively impacting capacity to integrate sustainability and CE attributes. An analysis of existing circumstances is necessary to identify where and to what extent taxation regimes vary by typology and how to address these.

Recommendation 19: Typology neutral taxation

Australian Government to review and amend housing taxation system to identify and amend inequities between housing typologies.

6. Conclusion

This research project is part of a broader AHURI Inquiry program that asks: how can the transition to a circular economy in housing be implemented to provide more sustainable housing? In this report we have considered the answer to this question with respect to apartment developments, with the stated aim of identifying how to transition towards mainstream support of new and retrofitted sustainable apartments. The three unique aspects of the apartment market justify the separate focus on apartment development: i) speculative strata titled development; ii) physically inter-dependent properties; and iii) joint ownership.

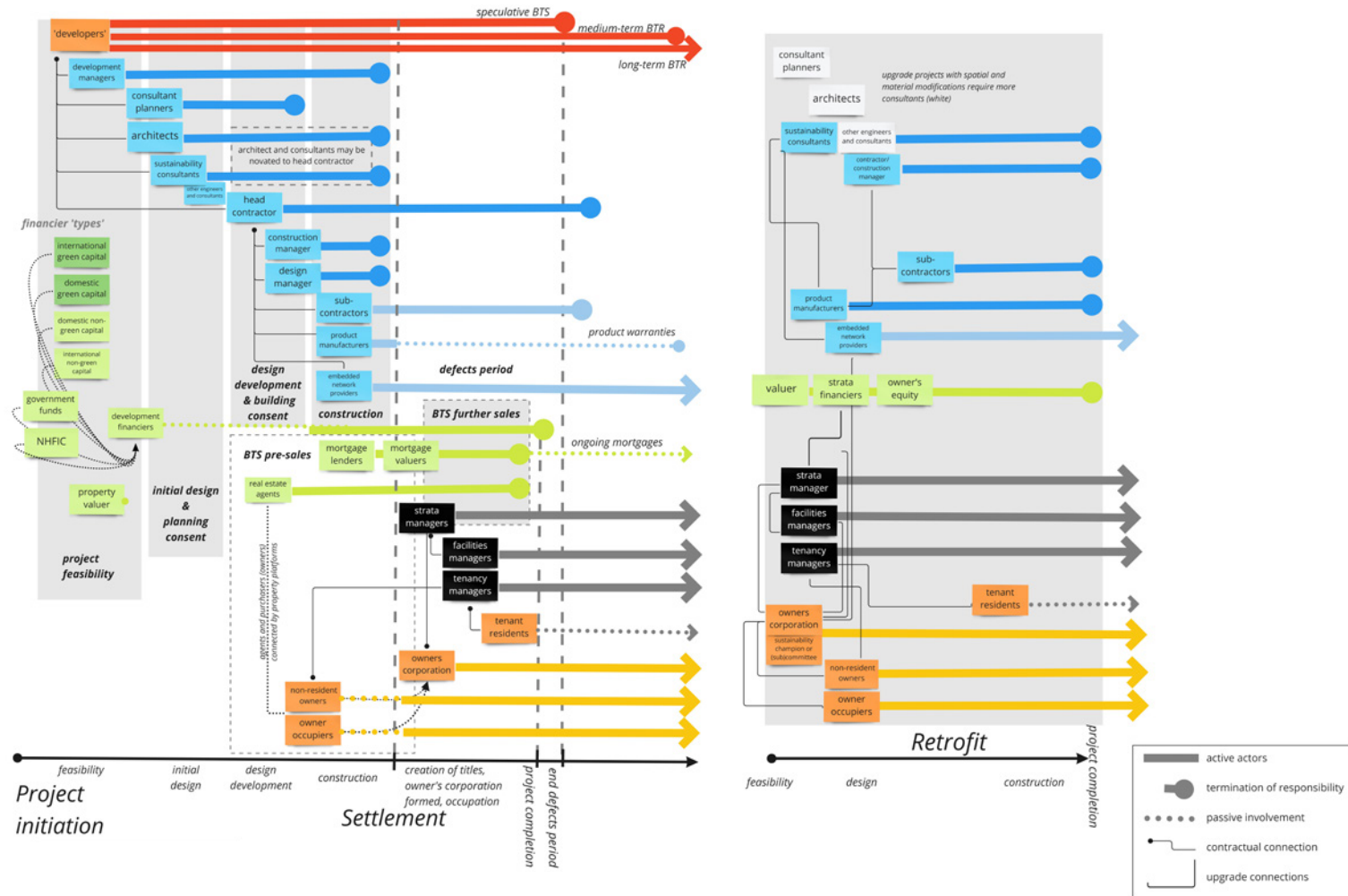
6.1 Who are the key actors in apartment production and retrofits?

The key actors involved in apartment production and retrofits are indicated in Figure 9. The key actors can be grouped into five categories (represented by different colours in the figures).

1. developers (red)
2. financiers, valuers and estate agents (green)
3. consultants, sub-contractors and product manufacturers (blue)
4. property managers (black)
5. owners and residents (orange).

There is very little overlap between those involved in delivering buildings (blue and red) and those involved in their ongoing operations (black and orange). Notable exceptions are the ongoing involvement of developers in BTR developments and the involvement of strata managers towards the end of the construction phase and into the operational phase. The disconnect between the development and operational phases of apartment developments poses a particular challenge for a transition to a circular economy in housing.

Figure 9: The apartment delivery and retrofit system



Source: Authors' Research

6.2 How do structures of apartment provision and governance influence the adoption of sustainable apartment construction and retrofit?

The ways in which structures of apartment provision and governance differ from other housing development types have important implications for the adoption of sustainable apartment construction and retrofit, and hence the transition to a circular economy in housing (see Table 8).

- Speculative strata title development is linked to a disconnect between the production and consumption of new apartment buildings, reflected in the fact that sustainability is rarely embedded in project feasibility calculations. This disconnect also means that the apartment 'product' is not optimised in terms of performance. Changes are also made during construction to reduce costs and sustainable building performance is not adequately reflected in property valuation.
- While the physical inter-dependency of properties has many potential benefits in terms of building performance and sustainability, we have demonstrated that these benefits are often lost due to a focus on profit maximisation. Shared services are also linked to shared management in strata titled properties, with associated challenges.
- A circular economy approach points to the importance of prolonging building life through maintenance. Strata title ownership makes achieving this more challenging as collective decision-making is required for jointly-owned property. Joint ownership also contributes to the limited information available to consumers about their properties, because instead of responding to the needs of a single well-informed client (like in the commercial sector), developers are speculatively developing apartments for sale to multiple unknown clients.

Table 8: The challenges to the adoption of sustainable apartments

Unique aspect	Relevance to circular economy	Challenge
Speculative strata title development	Disconnect between production and consumption	Sustainability is not embedded in project feasibility
	'Product' not optimised	Changes are made during construction to reduce costs Sustainable building performance is not adequately reflected in property valuation
Physically inter-dependent properties	Potential benefits of sharing	Potential benefits of inter-dependence are lost due to focus on profit maximisation
		Potential benefits of shared services face the challenge of shared management
Joint ownership	Potential to prolong 'product' life through maintenance	Limited information on building performance is available to purchasers (or renters)
		Joint decision-making is required for jointly owned property

6.3 What are the key challenges and opportunities in designing, constructing and adapting sustainable apartments?

The key challenges are outlined in section 6.2 above. The key opportunities lie in responding to these challenges. We have identified six key shifts that are needed in how the design, construction and adaptation of apartments occurs if we are to produce more sustainable apartments in the future:

- development teams embed sustainability in project feasibility
- the design and construction of delivered apartment buildings reflects what was designed and approved
- property valuation reflects building performance
- the potential benefits of physical inter-dependence and shared services are realised
- consumers have access to adequate information about building performance
- sustainability initiatives account for joint ownership and joint decision-making.

6.4 What finance, fiscal, regulatory and policy settings can help drive sustainable apartment supply and retrofit in a circular economy?

Chapters 4 and 5 developed 19 recommendations drawn from our interview and workshop informants. The recommendations are numbered in the order in which they appear in the report (see Figure 10). Together they provide a vision of what a sustainable apartment development and management sector based on circular economy principles looks like.

While the recommendations are aimed at government, the changes needed to realise this vision cannot be achieved by government alone. Industry leaders must also play a central role in moving towards a circular economy approach for apartment housing in Australia. However, as discussed in chapter 4, our industry participants stressed the need for governments to lead with a clear whole-of-government commitment and vision for sustainability and a circular economy approach to housing, to ensure that this vision is realised in practice. It is for this reason that we have focused on the development of recommendations for government. Realising these recommendations will rely on industry buy-in, supported through co-design and collaboration between government and industry in their formation and execution.

Figure 10: Key recommendations

Recommendation 1: Whole-of-government circular economy and sustainability commitment.

Recommendation 2: Increase National Construction Code and Building Code of Australia minimums. Australian Government commitment to increase minimum standards for energy efficiency in the NCC.

Recommendation 3: Expand the scope of the National Construction Code and Building Code of Australia. Australian Government commitment to expand the regulatory scope of the NCC beyond energy consumption in use.

Recommendation 4: Sustainability as standard. State, territory and local governments to require high sustainable performance standards in all development application assessments.

Recommendation 5: Strengthen compliance. State, territory and local governments to strengthen regulations for pre- and post-occupancy compliance auditing to ensure approved performance standards are met at the planning and building permit stages.

Recommendation 6: Standardisation of tools and measures. Australian Government and state and territory governments to implement programs to standardise tools, measures and regulations for building performance.

Recommendation 7: Value sustainability. Australian Government support for the development of a process for incorporating sustainability into valuation practice.

Recommendation 8: Green finance. Australian Government to explore imposing European Union style reporting obligations on financiers and establishing a process to leverage private financing in support of a transition to circular economy in the housing system.

Recommendation 9: Assessment resources. State and territory governments to ensure that the planning assessment system is adequately resourced to assess building performance for sustainable developments.

Recommendation 10: Knowledge exchange portal. Australian Government support for the development and ongoing operation of an online portal to enable knowledge exchange on ESD in construction.

Recommendation 11: Legislative and regulatory amendments for retrofits. State and territory governments to explore legislative and regulatory amendments to encourage and support sustainable retrofit in strata schemes.

Recommendation 12: Mandatory disclosure. Australian Government to mandate the collection of environmental performance standards for all apartment buildings and their publications on advertising and transaction portals for rent and purchase.

Recommendation 13: Typology equality. All levels of government to review existing and future government grants for sustainability upgrades to ensure common property is considered to avoid exclusion of strata properties.

Recommendation 14: Additional retrofit grants. All levels of government to introduce additional government grants to incentivise housing retrofit projects

Recommendation 15: Retrofit repository. Australian Government commitment to fund the development and ongoing operation of an information repository to support the sustainable retrofitting of apartments.

Recommendation 16: Update ADGs for future retrofit. State and territory governments to update apartment design guidelines to ensure that the potential for future retrofit is considered before new apartment projects are approved.

Recommendation 17: Resident involvement in publicly supported projects. All levels of government to require publicly funded apartment projects to involve residents in design, including where publicly-owned land is made available for development.

Recommendation 18: Guarantees for Deliberative Development. Australian Government to provide government guarantees for Deliberative Development construction loans.

Recommendation 19: Typology neutral taxation. Australian government to review and amend housing taxation system to identify and amend inequities between housing typologies.

Table 9 provides a summary of how each of the 19 recommendations can contribute to the six desired outcomes identified in section 6.3 above.

Table 9: Desired outcomes and relevant recommendations

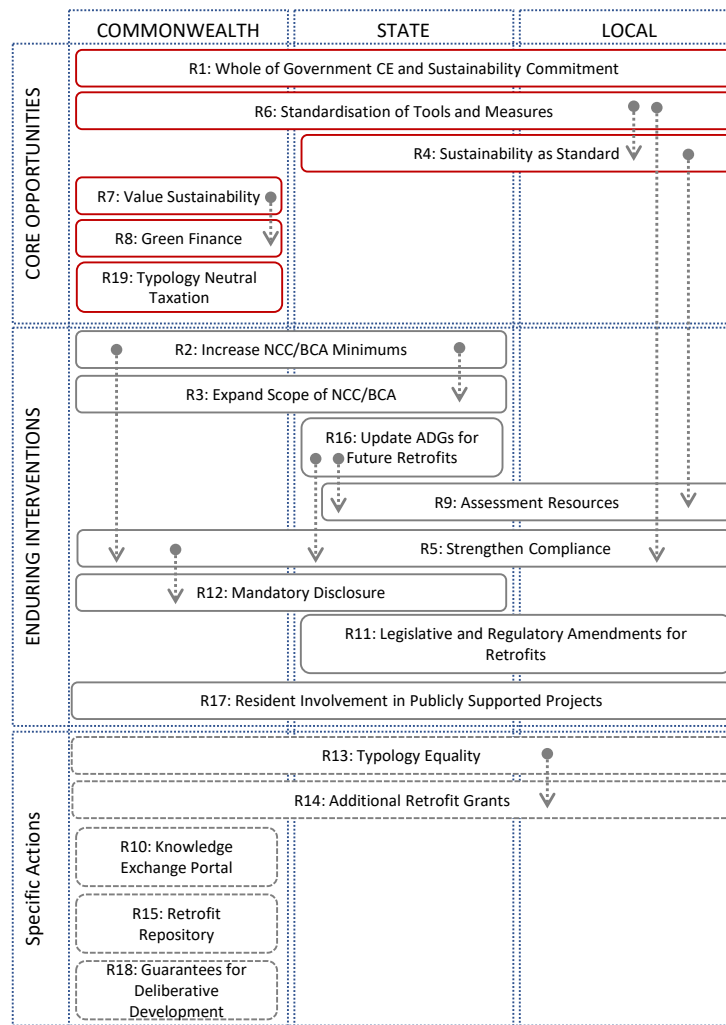
Desired outcome	Relevant recommendations
Development teams embed sustainability in project feasibility	R1, R2, R3, R4, R8, R10, R16, R17
The design and construction of delivered apartment buildings reflects what was designed and approved	R5, R6, R9
Property valuation reflects building performance	R7
The potential benefits of physical inter-dependence and shared services are realised	R10, R14, R15, R17, R18, R19
Purchasers and renters have access to adequate information about building performance	R6, R12
Sustainability initiatives account for joint ownership and joint decision-making	R11, R13, R14, R15

Our recommendations are based on the suggestions of the research informants. Some are more detailed and prescriptive than others and most will require further development before they can be implemented. The recommendations can be organised into three groups:

- **Core opportunities:** These are big-picture, aspirational recommendations. Realising these will require the further development of a suite of more detailed and prescriptive interventions and actions.
- **Enduring interventions:** These are more specific recommendations that will need to be further developed with consideration of feasibility and path dependencies, and the engagement of key stakeholders to assist in their co-design and implementation.
- **Specific actions:** These are more specific recommendations with suggested actions for implementation.

Figure 11 presents the recommendations and indicates whether primary responsibility for these interventions sits with the Australian Government, state and territory or local governments. The arrows in the diagram indicate path dependencies and relationships between the recommendations.

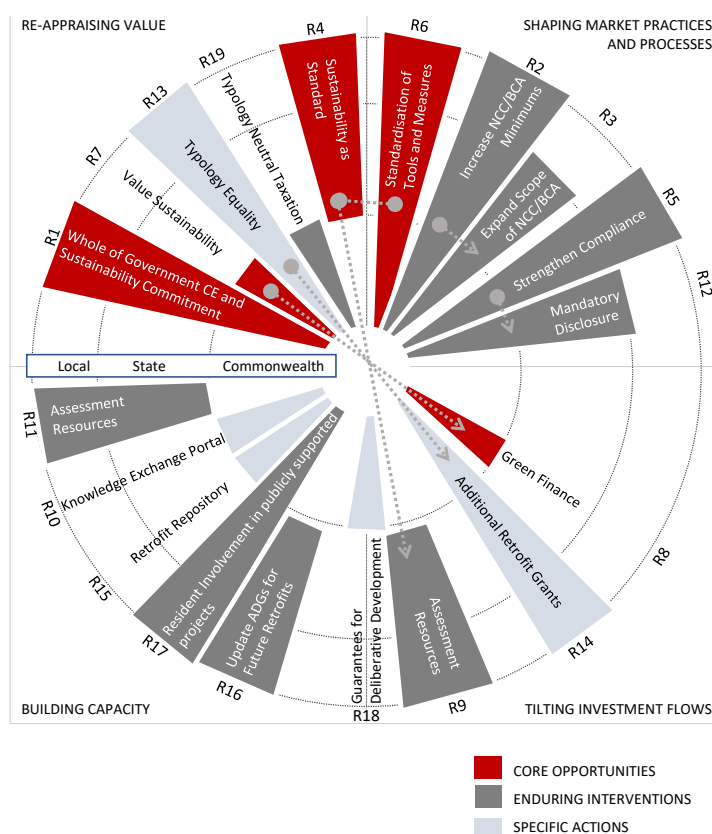
Figure 11: Summary of recommendations by type and responsibility



Source: Authors' Research

Figure 12 presents the recommendations in a different format, this time identifying recommendations according to whether they relate to re-appraising value, shaping market practices and processes, tilting investment flows or building capacity.

Figure 12: Summary of recommendations relating to conceptual framework



Source: Authors' Research

6.5 Final remarks

This report has provided an overview of apartment development in Australia with a view to understanding how more sustainable apartment housing can be developed and retrofitted to contribute to a transition to a circular economy in housing.

We have focused on those aspects of apartment development and operation that make apartment developments unique, and on the challenges to the adoption of sustainable apartments within this context, with respect to circular economy principles.

Many of the other recommendations that have been developed through the broader Inquiry project and the other Inquiry sub-projects will also apply to apartment developments. Recommendations regarding materials, neighbourhood development and retrofit in the context of social housing (the other sub-projects in the Inquiry) will also have relevance to apartment developments. Similarly, many of our recommendations will also have relevance beyond apartment developments. This includes our recommendations relating to government commitments to sustainability, capacity building and information sharing, improvements to building standards and compliance, and improvements to property valuation practice, to name just a few. Further, given that key actors in the apartment delivery system include large-scale developers and major lenders, any wide-scale change in the practices of these actors is likely to flow through to other parts of the housing system. Successful projects and best practice applied to apartment buildings can therefore influence other sectors to implement change toward the real application of circular economy principles.

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Appendix 1: Sustainable developments by LGA

The Tables below provide summary data from the CoreLogic Cordell Connect database on sustainable developments and substantial upgrades across Sydney and Melbourne.

Table A1: New build developments in NSW by Local Government Area (LGA)

LGA	Sustainable	Other	Proportion sustainable
STRATHFIELD	9	76	12%
SYDNEY	29	293	10%
HUNTERS HILL	1	11	9%
WILLOUGHBY	4	49	8%
NORTH SYDNEY	5	95	5%
WAVERLEY	4	78	5%
CAMPBELLTOWN	1	21	5%
RYDE	4	105	4%
THE HILLS SHIRE	2	57	4%
CANADA BAY	3	93	3%
MOSMAN	1	32	3%
INNER WEST	4	163	2%
KU-RING-GAI	3	145	2%
SUTHERLAND	2	97	2%
NORTHERN BEACHES	2	127	2%
WOOLLAHRA	1	70	1%
RANDWICK	2	143	1%
PENRITH	1	72	1%
CITY OF PARRAMATTA	4	338	1%
HORNSBY	1	95	1%
GEORGES RIVER	1	145	1%
CANTERBURY-BANKSTOWN	1	202	0%
AUBURN		80	0%

LGA	Sustainable	Other	Proportion sustainable
BLACKTOWN		52	0%
BLUE MOUNTAINS		5	0%
BURWOOD		64	0%
FAIRFIELD		23	0%
HOLROYD		152	0%
LANE COVE		47	0%
LIVERPOOL		68	0%
WINGECARRIBEE		3	0%
WOLLONGONG		85	0%
Grand Total	85	3086	3%

Source: CoreLogic Cordell Connect database

Table A2: New build developments in Victoria by Local Government Area (LGA)

LGA	Sustainable	Other	Proportion sustainable
YARRA	28	195	14%
STONNINGTON	33	288	11%
BANYULE	7	64	11%
WHITTLESEA	2	19	11%
DAREBIN	15	150	10%
MELBOURNE	25	274	9%
MORNINGTON PENINSULA	1	12	8%
BOROONDARA	13	182	7%
MARIBYRNONG	7	98	7%
WHITEHORSE	8	134	6%
BAYSIDE	6	106	6%
BRIMBANK	1	18	6%
KINGSTON	3	54	6%
MAROONDAH	2	37	5%
MORELAND	14	263	5%
FRANKSTON	1	21	5%
MANNINGHAM	5	113	4%
PORT PHILLIP	7	229	3%
HOBSONS BAY	1	34	3%
MONASH	2	79	3%
KNOX	1	52	2%

LGA	Sustainable	Other	Proportion sustainable
GLEN EIRA	4	315	1%
CARDINIA		3	0%
CASEY		5	0%
GREATER DANDENONG		59	0%
GREATER GEELONG		21	0%
HUME		19	0%
MELTON		14	0%
NILLUMBIK		4	0%
WYNDHAM		16	0%
YARRA RANGES		8	0%
Grand Total	186	2886	6%

Source: CoreLogic Cordell Connect database

Appendix 2: Sustainability standards and tools

Table A3: Sustainability standards and tools

Standard / tool		Responsible authority	Jurisdiction	Mandatory/voluntary	Measurement
National Construction Code (NCC) / Building Code of Australia (BCA)	Section J Deemed-to-Satisfy Pathway	Australian Building Council Board	National	Mandatory (pathway optional for Class 1 dwellings).	Sets minimum, mandatory standards for energy efficiency and GHG emissions performance for Class 1 dwellings
	Star Rating Pathway (NatHERS)	Department of Industry, Science, Energy and Resources	National	NatHERS star rating mandatory for Class 2 (apartments)	Measures energy efficiency of residential dwellings, estimating maximum heating and cooling loads. Class 1 and 2 dwellings
Building Sustainability Index (BASIX)		NSW Department of Planning and Environment (NSWDPE)	NSW	Mandatory	Use of potable water and energy (greenhouse gas emissions)
SEPP65 and Apartment Design Guide (ADG)		NSW Department of Planning and Environment	NSW	Mandatory	Establishes a consistent approach to the design and assessment of apartments. Regulates solar access, ventilation and apartment size and layout.
Better Apartment Design Standards (BADs)		Victorian Department of Environment, Land, Water and Planning (DELWP)	Victoria	Mandatory	Sustainability related items include Building Performance and Amenity. Past version (2017) exceeded minimum requirements of the BCA. Since BCA2019 the performance requirements of BADs (updated 2021) have been comparable with the BCA. Main items of difference relate to spatial planning and amenity.
Green Star Buildings		Green Building Council of Australia (GBCA)	National	Voluntary	Assesses management, indoor environmental quality, energy, transport, water, materials, land use and ecology, emissions, innovation
Green Star performance		GBCA	National	Voluntary	Rates operational performance of buildings

Standard / tool	Responsible authority	Jurisdiction	Mandatory/voluntary	Measurement
NABERS for apartment buildings	NSWDPE on behalf of the State and Territory governments of Australia	National	Voluntary	<p>Benchmarking tool measuring environmental performance re. energy, water waste & indoor environment quality.</p> <p>Focuses on common areas not considered by NCC/BCA. Does not rate individual apartments.</p>
Residential Efficiency Scorecard	DEWLP	Victorian	Voluntary	<p>A retrofit energy assessment tool. Used to ensure home upgrades are effective and appropriate. Used by funding agencies to evaluate program impacts. Pilot studies (2019) by COAG Energy council in other states in preparation for nationalisation and possible integration with NatHERS for future Mandatory Disclosure.</p>
Built Environment Sustainability Scorecard (BESS)	Council Alliance for a Sustainable Built Environment(CASBE)	26 Victorian LGAs	Mandatory for all applications to participating LGAs (including apartments)	<p>"This tool aims to assist builders, developers and community members in showing how a proposed development design meets sustainable design benchmarks and requirements." (Bess Assessments n.d.)</p>
The Living Building Challenge	Living Future Institute Australia	National	Voluntary	<p>The LBC is a philosophy, certification and advocacy tool for projects to move beyond merely being 'less bad' toward becoming truly regenerative.</p>
Passive House	Australian Passive House Association (APHA)	National	Voluntary	<p>The Passive House standard is applicable to all building types, including both new and existing dwellings.</p> <p>Passive House Standards far exceed the NCC standards and include strict requirements for airtightness and air exchange to ensure healthy indoor air quality.</p>



Australian Housing and Urban Research Institute

Level 12, 460 Bourke Street

Melbourne VIC 3000

Australia


+61 3 9660 2300

information@ahuri.edu.au

ahuri.edu.au

 twitter.com/AHURI_Research

 facebook.com/AHURI.AUS

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