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Informing a strategy for circular economy housing in Australia



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

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Related reports and documents

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Inquiry panel members

Each AHURI Inquiry is supported by a panel of experts drawn from the research, policy and practice communities.

The Inquiry Panel are to provide guidance on ways to maximise the policy relevance of the research and draw together the research findings to address the key policy implications of the research. Panel members for this Inquiry:

- Asa Jonasson, Green Industries, South Australia
- Damien Crough, PrefabAUS
- Heinz Schandel, CSIRO
- Jacob Wallace, Homes Victoria
- James Waddell, National Australia Bank
- Joana Correia, Master Builders Association of Victoria (MBV)
- Megan Peacock, Master Builders Association of Victoria (MBV)
- Philip Alviano, Master Builders Association of Victoria (MBV)
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Acronyms and abbreviations used in this report

AHURI	Australian Housing and Urban Research Institute Limited
ARENA	Australian Renewable Energy Agency
CE	circular economy
CEFC	Clean Energy Finance Corporation
EE	embodied energy
EPBD	Energy Performance of Buildings Directive
ESG	environmental, social and governance
EU	European Union
G20	international organisation of governments with largest economies
GHG	greenhouse gas
HIA	Housing Industry Association
ICMA	International Capital Market Association
MBV	Master Builders Association of Victoria
MFA	material flow analysis
NCC	National Construction Code
OECD	Organisation for Economic Co-operation and Development
SHP	social housing providers
UNEP	United Nations Environment Programme
VET	Vocational Education and Training

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

- Given the urgency to decarbonise Australian housing, the housing industry needs support to shift practice to deliver more sustainable housing outcomes.
- The circular economy (CE) concept calls for closed-loop material flows that minimise environmental burdens, while also delivering social and intergenerational equity, local economic opportunities and resource efficiency (Geissdoerfer, Savaget et al. 2017; Kirchherr, Piscicelli et al. 2018).
- Drawing on evidence from four interconnected Research Projects, this overarching Inquiry report informs a strategy towards CE housing.
- The starting point of this report is recognising the distinctive structure and actors across the housing industry, with varying capacities to respond to such a strategy (Dalton, Dorignon et al. 2022).
- To ensure a just transition to CE housing that creates decent work and housing opportunities, a cross-sectoral and multi-institutional approach is required (Mazzucato 2014; 2018a; 2018b).
- This Inquiry proposes a quadrant framework for CE housing. This comprises four components to be progressed in tandem: reappraising value and prioritising sustainability, shaping markets for a sustainable purpose, tilting investment flows, and building capacity.
- The quadrant framework amounts to a coordinated suite of policy and supporting measures across the housing system, as outlined in this Inquiry report.

Key findings

- Currently, policy frameworks and processes do not support the implementation of a circular economy (CE) across the housing industry. In the face of the climate crisis and the housing affordability crisis, the shift to CE housing is urgently needed and requires multi-directional effort.
- Low or unspecified standards, adverse actor motivations and incentives, up-front costs (despite long-term cash benefits) to investors and consumers, as well as a lack of professional awareness and training inhibit the adoption of CE for housing in Australia in different fields of action: the neighbourhood; apartment construction and renovation of social housing; as well as across building materials supply chains.
- The widespread adoption of high quality, durable, low-impact, low-risk materials and maintenance systems aligned to extend asset life is held back by additional up-front costs, incomplete markets, and insufficient know-how and incentives.
- An array of interventions and instruments are required to address these deficiencies and support more sustainable homes and neighbourhoods—both retrofit and new-build. Combined interventions are required to ensure effective implementation and sustained outcomes. Strategies can vary in terms of coverage, often related to how centralised, comprehensive or bottom-up and diverse their application (Lawson and Dorignon 2021).
- While the design and composition of policy instruments is typically enacted and facilitated by governments, innovation and implementation necessarily involves industry and civil society participation. While metropolitan areas have the potential to make 'key decisions determining economic growth, social well-being and environmental benefits' (OECD 2020), a multi-level governance approach and robust national leadership—of the type seen in Finland and France—seems to offer a more comprehensive and less fragmented path towards CE.
- The qualities of strategic frameworks include a politically astute vision, robust legal footing, industry-relevant application and capable enforcement. Specialist in-depth investigation of Australian institutional settings, market processes and stakeholder capacities are required to inform suitable instruments adapted to local conditions.
- In the first instance, further reform of regulatory standards is needed, often in combination with fiscal and financial frameworks, business support schemes, and education and training.
- New partnerships between governments, private developers and local communities with suitable governance approaches will be required to implement more sustainable neighbourhoods and circular processes for production, use and reuse of goods and services (Dühr, Berry et al. 2023).
- There is great potential to improve the performance of new and existing apartment buildings through interventions that embed sustainability in the work of development teams, project feasibility, valuation and post-occupancy monitoring.
- Information on building sustainability, including common areas and services, can also inform the decision-making of residents and owner-managers (Easthope, Palmer et al. 2023).
- Retrofit of social rental housing competes for scarce budgetary resources. Building managers need to address the very real concerns of residents as well as the imperative to tackle climate change through CE housing reforms (Baker, Moore et al. 2023).
- Understanding the structure and conduct of building materials supply chains is essential for policy development seeking to reduce carbon intensity of new material choice and use in the housing industry (Dalton, Dorignon et al. 2022).
- Measures to increase housing and material durability, performance, reuse, recycling and resource recovery will require the development of new design and retrofit skills and practices, together with an efficient and responsive 'used' materials market (Dalton, Dorignon et al. 2022).

Policy development options

A CE approach can contribute to a more sustainable housing system. To achieve this requires a clear vision of the desired transformation in the most relevant fields, mobilising responsible leaders and engaging key stakeholders with the right regulatory frameworks, incentives, resources and capacities.

To drive change in the housing system requires an appreciation of the role of key actors. There is no evidence that housing industries are wilfully adopting or prolonging unsustainable practices. Rather, these unsustainable practices are sustained by gaps in market settings and institutional capacities. A comprehensive strategy is needed that applies relevant tools to:

- lift sustainability as a priority
- shift market processes
- tilt incentives to attract the appropriate investment
- build capacities towards circular and sustainable outcomes.

Recognising the complexity of the housing system, this Inquiry and associated four Research Projects focussed on key fields of:

- neighbourhood development
- apartment construction
- renovation of social housing
- construction materials.

These distinct but connected fields across the housing system involve multi-level forms of governance, specific ecosystems of activities and processes, diverse stakeholders, and varying skills and resources. To inform a strategy, this Inquiry identified relevant tools designed to drive circularity in each field. These tools involve strategic guidance, knowledge development, collaborative platforms, business support schemes, and regulatory frameworks, as well as purposeful public investment and taxation. While a strategy is needed that is specific to Australian housing, it also must reflect on best international practice, not only to catch up, but also to innovate and excel in Australian conditions.

Radical decarbonisation is needed along with shifts in materials and practices. Simply relying on demand to drive the supply of circular goods and services would neglect the weakness of consumer voice and the nature of current supply chains—for example, about a third of all households are tenants, and have little influence on the material sustainability of their housing.

The findings from the Inquiry and the Research Projects suggest that effective change requires measures that actively shift perceptions of value and priority-framing in decision-making to those that favour CE housing outcomes. Housing industry organisations cannot meet this challenge without purposeful public intervention and stakeholder cooperation. This is not to absolve the housing industry from a key role in the transition. Indeed, it is critical that:

1. The housing industry steps up.
2. Leading CE practice is incentivised and supported.
3. Economy-wide changes are instituted on sustainability and carbon neutrality, which will reinforce shifting social structures, institutions, discourses and priorities across society.

The mutual reinforcement between the housing sector and society is central in a successful transition to CE housing. Figure 1 presents the quadrant framework emerging from these findings. It proposes four key areas for reform: reappraising value and prioritising sustainability, shaping markets for a sustainable purpose, tilting investment flows, and building capacity.

Figure 1: Quadrant framework for a CE housing strategy



Source: Authors

Greater awareness of CE, through strategic research and discussion of results—as well as through demonstration of good practices—can foster new professional norms that prioritise sustainability, circularity and decarbonisation. These values must inform leadership, training and sense-making, as well as the setting of targets and key assessment frameworks, such as procurement and auditing of assets, and reporting.

Regulation is essential to shape housing markets to reinforce CE approaches, from the micro level of building materials, to construction and ongoing maintenance, to the macro level involving precinct-level spatial planning. Alongside legislative reform, clear targets and performance standards need to be enforced by monitoring, as well as being made accountable via appropriate reporting systems that sustain improving practice.

To tilt circular investment flows to promote sustainable housing relevant to Australia, public sponsorship of industry best practice will be an essential instrument to showcase and raise standards. Accredited training and professional awareness-raising on the practice and advantages of CE housing could shift practices and attract additional investment flows. Furthermore, grants, incentives and subsidies have the potential to lever resources of investors, building providers, local communities and residents. Procurement policies will be an essential tool to shift commissioning practices and support major CE retrofit programs and foster CE market development.

Internationally, there are a wide range of financial and regulatory incentive mechanisms that can be drawn upon and applied in the Australian context, as well as innovation and capacity-building programs. Regulation of carbon and pricing is one mechanism to help with redirecting investment flows and de-risking CE housing investment. De-risking investment can be part of a mechanism of change. By providing certainty and commitment, as well as investment and demand in the CE housing system, the normalisation of CE housing is made realisable.

To support effective implementation, professional and skilled work is required, as well as digital systems, monitoring and enforcement. This will require rigorous engagement with the principles of economic and industry training policy, as well as review of how the economic processes and outcomes for workforces is measured.

The transition to a low-carbon construction sector will require a higher-skilled, reskilled and more diversely skilled workforce, and may imply the embrace of new or different business models. To facilitate a just transition, the uneven impact on the nature of work, industry practices, and the consequential impacts on the broader economy and society must be properly accounted for. To build capacity for a just transition towards CE housing, training and education is vital for key stakeholders, including policy makers and administrators, as well as private-sector actors across a range of trades and professions, from carpentry to finance to urban planning. Re-skilling, inclusive employment opportunities and fair work are all necessary, and present fresh opportunities for the industry.

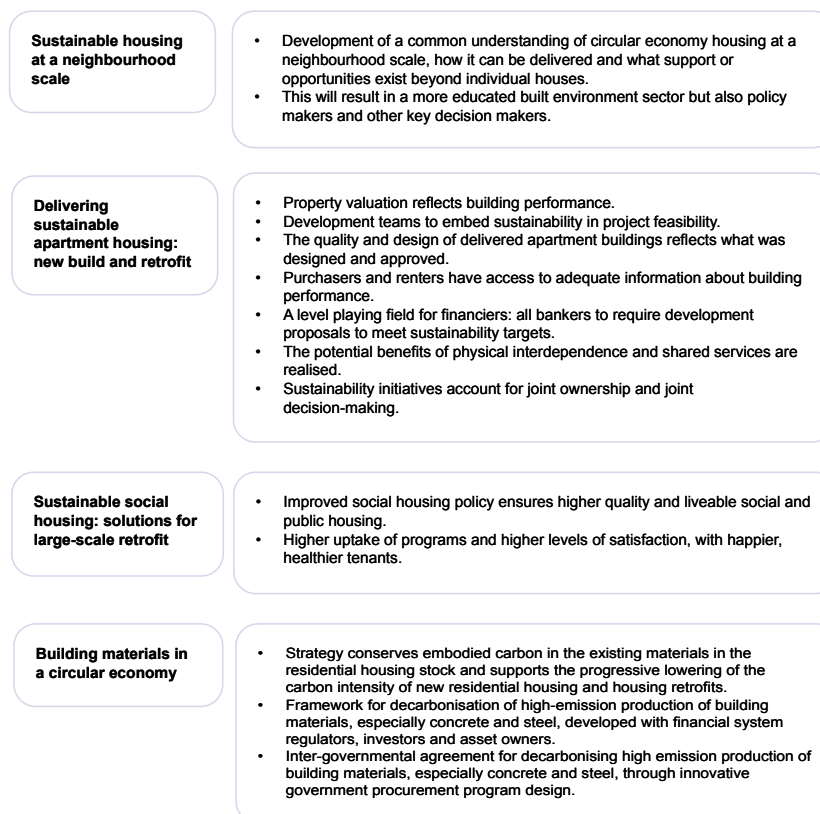
The scale of change required is significant. Specific industries, such as local government planning and the construction demolition industries are singled out for tailored capacity-building to catalyse reform, such as the development and use of material passports and preparation and application of precinct design guidelines to promote steps towards circular forms of development.

High-level principles to drive reform for each field (see Figure 2) and the tasks of responsible stakeholders (see Figure 3) are summarised below. Five policy development options are made to inform a strategy for CE housing in Australia:

- **Policy development option 1:** Adopt the quadrant framework.
- **Policy development option 2:** Set up a vehicle.
- **Policy development option 3:** Confirm goals and roles.
- **Policy development option 4:** Establish tools and phasing.
- **Policy development option 5:** Test and rollout action plans.

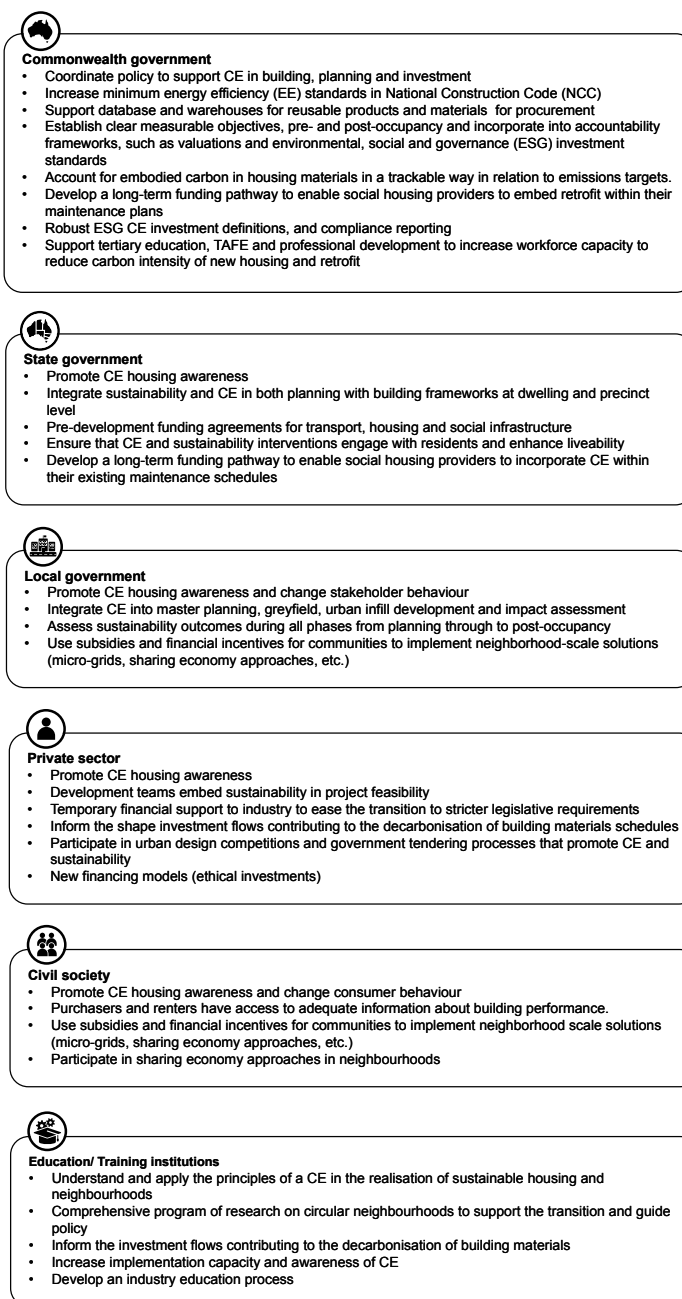
'The Policy Framework: Actions towards Circular Economy housing in Australia' provides quick-reference materials that can be used as an agenda for integrated action—to inform and guide conversations about the transition to CE housing in Australia. A Visual Summary is also available to illustrate the report's findings.

Figure 2: Focus and directions of reform for each housing field



Source: Dühr, Berry et al. (2023) ; Easthope, Palmer et al. (2023) ; Baker, Moore et al. (2023) ; Dalton, Dorignon et al. (2023).

Figure 3: Tasks for responsible leaders



Source: Dühr, Berry et al. (2023) ; Easthope, Palmer et al. (2023) ; Baker, Moore et al. (2023) ; Dalton, Dorignon et al. (2023).

The study

This Inquiry establishes a framework and evidence-base to support a transition to CE housing in Australia. It is informed by analysis of national and international data, industry and building practice, and key informant sources.

A shift towards CE housing depends upon the selection and enactment of appropriate levers for change, to guide transformation in the many linear processes involved in housing production. This Inquiry addressed the overall research question:

How can the transition to a circular economy in housing be implemented to provide more sustainable housing?

This question was examined via four Research Projects in different fields of action of the housing system. Each collected evidence and industry insights from the expert Industry Panel and from other experts and evidence from Australia and internationally. Each project had a different focus:

- **Sustainable housing at a neighbourhood scale:** This project identified opportunities for a CE approach at neighbourhood scale, to achieve a transition towards sustainable housing in urban infill and new-build development locations. The analysis considered geographical variation and learned from international progress to inform Australian policy makers.
- **Delivering sustainable apartment housing: new build and retrofit:** This project examined financial, fiscal, regulatory and policy levers that can facilitate a transition towards the mainstream supply of sustainable apartments in Australia. It did this by identifying processes—relating to financing, design and construction, and management—specific to the supply of new apartments and retrofitting existing apartments that impede or promote sustainability.
- **Sustainable social housing retrofit? Circular economy and tenant trade-offs:** This project investigated CE approaches to large-scale retrofits of social housing, and the implications for the broader housing and retrofit industry.
- **Building materials in a circular economy:** This project used a CE framing to investigate use and waste in material supply chains, to enable the housing construction sector to reduce, reuse, recycle and recover resources and rely much less on use of virgin materials.

In addition to five cross-cutting Inquiry research questions answered by lead experts in Scoping Papers, discussions with the expert Industry Panel also informed the four contributing Research Projects.

1. Introducing circular economy housing

- **Addressing climate change, economic stability and social cohesion are major policy challenges. They are also concerns that are shaped by Australia's housing system and urbanised way of life.**
- **The circular economy (CE) concept calls for closed-loop material flows involving low-emission, recyclable and durable assembly while also meeting sustainable development objectives of social and intergenerational equity, local economic opportunities and resource efficiency (Geissdoerfer, Savaget et al. 2017; Kirchherr, Piscicelli et al. 2018).**
- **In dialogue with the public and in partnership with business and communities, Australian governments can promote effective strategies towards a circular approach and processes.**
- **This Inquiry examines what can be done to facilitate CE housing.**

Approaches to date have not delivered sufficient or rapid enough change in housing systems and processes to meet the challenge of climate change—nor to tackle the housing affordability crisis. Australian standards for building performance are very low in international comparison (Hurlimann, Browne et al. 2018), and there are few mechanisms for achieving CE outcomes at the precinct scale. Although desirable, the widespread adoption of high quality, durable, low-impact, low-risk materials and maintenance systems aligned to extend asset life is held back by high up-front costs, incomplete markets, information asymmetries about split incentives and insufficient know-how and incentives (Mummery 2022). It is also important that the transition towards CE in housing is a just one that respects human rights, including the right to adequate housing, and the need for more sustainable and appropriate housing and shelter as the climate changes. There is an opportunity to achieve housing reform towards greater resilience. Specifically, this requires us to call upon 'wider knowledge and governance systems than utilised in traditional building codes and standards and tease-out embedded understandings of the purpose of the regulation' (Mummery 2022: 210).

Australian governments increasingly recognise the problems associated with a linear economy, where finite resources are extracted, consumed and discarded. Australia has begun to address CE requirements via federal legislation (including the 2021 long-term emissions reduction plan by the Department of Industry, Science, Energy and Resources) to achieve net-zero emissions by 2050 in Australia, and the trajectory specific to Low Energy Buildings. State-based strategies, direct investment in relevant infrastructure, the sponsorship of strategic R&D

as well as public-private partnerships and non-government and non-profit promotional organisations all have a role. However, such efforts are in preliminary stage and do not provide strong enough frameworks to support the major transition needed. The EU and other countries have shown that CE transition needs to be led by all-society strategies and coordination between different policy sectors and levels of government. Meanwhile, in Australia, longstanding challenges in housing and urban production and consumption systems indicate a lack of preparedness to achieve CE housing in the foreseeable term, given current settings.

The adoption of the Glasgow Climate Pact (GCP) at COP26 confirmed that climate change requires urgent action. Since May 2022, Australia's Nationally Determined Contribution (NDC) to reduce greenhouse gas (GHG) emissions has been revised upwards from 26–28 per cent to 43 per cent by 2030—based on 2005 levels (Australian Government Department of Industry, Science, Energy and Resources, 2022). This commitment is proposed to be legislated as part of the Climate Change Bill (Parliament of the Commonwealth of Australia 2022).

It is also positive to see responsible Ministers commit to increasing minimum residential energy standards as proposed in the new Climate Change Bill (Parliament of the Commonwealth of Australia 2022)¹. This legislated commitment will drive ongoing reforms. However, the long-awaited increase to 7-star minimum requirements for buildings is still a modest change—and it will not be sufficient to allow Australia to catch up to other advanced economies nor to guide the transition to sustainable building practices.

Moreover, it also leaves the remainder of the housing stock in need of retrofit from an energy-efficiency perspective. Poor energy-efficiency standards have produced a legacy stock with sustained high and increasing GHG emissions. Moreover, current building practices produce high embodied CO₂. Typically, new housing and infrastructure are built with steel, concrete, bricks, asphalt, aluminium, plastic and glass. These materials have high levels of embodied CO₂. Clearly a change in direction is required, guided by an effective strategy. This report builds on momentum and informs further progress.

There is evidence of broad support from end-users for sustainable buildings in all parts of the market, including from renters, social housing providers (SHPs) and owner-occupiers, from the lowest-cost dwellings to highest-end apartments (Foster, Hooper et al. 2020; Gower 2021; Moore and Holdsworth 2019 in Easthope, Palmer et al. 2023). However, Australia has a set of zoning plans, building codes, design guides and development approval systems that have incorporated vague sustainability definitions that are not supported by measurable targets, along with weak energy-efficiency provisions. Fragmented governance and lack of integration between planning, design and development processes present considerable barriers to achieving better outcomes (Dühr, Berry et al. 2023).

Moreover, construction waste still makes up a sizeable proportion of landfill, with a significant fraction of this coming from housing construction and retrofit. While there are policy ambitions to reduce waste—for example, the Recycling and Waste Reduction Act 2020—the diversion of construction and renovation waste from landfill remains extremely limited. Further, this Inquiry recognises the need for the housing industry to include end-of-life and post-end-of-life materials, and to better involve itself in the waste and recycling industries. A key observation from this Inquiry is that the waste and housebuilding industries are disconnected from each other when it comes to CE housing, and do not have shared interests, institutions, language or understanding.

The momentum provided by the recent commitments to improve housing energy efficiency can also propel CE efforts on land-use planning, sustainable energy infrastructure, and the retrofit of existing housing—including rental housing. Special attention must be given to measures that ensure a just transition in building capacity. This means specifically supporting low-income households that may be trapped in poor-quality rental accommodation in the private and public sector, or facing a variety of disadvantages that hold back their engagement in and access to the benefits of CE housing.

¹ <https://thefifthestate.com.au/business/the-ncc-mandating-7-star-homes-will-cut-the-cost-of-living-but-theres-more-to-be-done/>

This Inquiry informs a circular housing strategy for Australia, based on the values of a just and equitable transition. Research undertaken for this Inquiry and across the four associated Research Projects has generated an extensive evidence-base. From this work, it is clear that any transition towards CE housing needs to be values-driven (see Section 4.1 of Delivering sustainable apartment housing: new build and retrofit Project B Final Report) rather than simply a raft of technology and market-based mechanisms. Four overarching and intersecting approaches are identified to drive reform:

- reappraising value
- shaping market practices and processes
- tilting investment flows
- building capacity.

Across these agendas, CE housing emerges as a social project as much as a topic for regulatory reform: acknowledgement and acceptance across all levels of government, civil society, private sector and education/training institutions is crucial.

A strategy can only be successful if it attracts buy-in from diverse stakeholders, so a key action is to leverage the findings of this Inquiry project through a design-implementation process involving a wide spectrum of industry and policy stakeholders. The policy development options in Section 4 form the starting collateral for this process.

1.1 Existing research

The CE concept implies the transformation of all major processes in the housing ecosystem, affecting a wide variety of scales and processes. Processes of extraction, production, consumption and disposal are all in need of change to achieve more resource-efficient and sustainable use, reuse and reprocessing. In the housing system, linear or circular processes influence housing design, construction, maintenance and (re-)use, as well as patterns of urban development and their liveability.

A CE promotes resource efficiency, emission reduction and closed loops rather than linear use of resources and energy (Prieto-Sandoval, Jaca et al. 2018a; Prieto-Sandoval, Ormazabal et al. 2018b). Careful consideration must be given to ensure a just transition. CE initiatives internationally have been linked to the achievement of the UN Sustainable Development Goals (SDGs)—especially SDGs 7,12 and 13. The G20 forum, the Organisation for Economic Co-operation and Development (OECD) and the European Union (EU), along with diverse countries such as China, Japan, Finland and France, plus many businesses, have already committed to playing an active role in the promotion and implementation of a CE (Korhonen, Honkasalo et al. 2018; Lawson and Dorignon 2021).

Australia is a relative latecomer to CE, and interest has grown in parallel with the effective ending of waste exports to China and South-east Asia (Lasker 2017). The Australian Waste Policy 2018² describes the five key elements of the CE as:

1. **Avoid waste:** Prioritise waste avoidance, encourage efficient use, reuse and repair; redesign products so waste is minimised, they are made to last, and we can more easily recover materials.
2. **Improve resource recovery:** Improve material collection systems and processes for recycling; and improve the quality of the recycled material we produce.
3. **Increase the use of recycled material:** Build demand and markets for recycled products.
4. **Better manage waste material flows:** To benefit human health, the environment and the economy.
5. **Improve information:** To support innovation, guide investment and enable informed consumer decisions.

² <https://www.environment.gov.au/protection/waste/publications/national-waste-policy-2018>

Australian governments (via the Council of Australian Governments [COAG]) agreed to ban the export of waste plastic, paper, glass and tyres (Australian Government 2020), while building Australia's capacity to generate high-value recycled commodities and associated demand. Since late 2020, Australia has not only banned its own export of waste but importantly passed legislation on Recycling and Waste Reduction. Federal legislation, among other related matters, now specifically mentions the goal for developing a CE that maximises the continued use of products and waste material over their life cycle, and accounts for their environmental impacts³. The legislation follows a Commonwealth Inquiry in 2018 into the waste and recycling industry in Australia that also made key recommendations towards a CE⁴.

This national effort sits alongside a suite of state and local government strategies designed to hasten a CE, as in NSW⁵, South Australia⁶ and Victoria⁷. The implications of these strategies for housing and the built environment need to be given more explicit attention to contribute towards a broader CE approach.

While there is a focus upon resource constraints and limiting waste processes, the CE concept also extends to access and equity. Hence it is also concerned with housing affordability and sustainability challenges across housing tenures, types and income groups. It also takes place in the context of policy and research debates concerning the implications of credit conditions and taxation settings that have promoted rising house prices by making investment in residential real estate very attractive, dominating access and equity concerns.

Legislation, policy support and directives matter. The focus may involve international considerations, as well as national, regional and local governance arrangements. More generally, legal, financial, fiscal and other regulatory instruments have played a key role in promoting adoption of CE objectives internationally—especially in China, South Korea, the UK, the USA, the Nordic countries, and the EU (Murray, Skene et al. 2017; Patala, Hämäläinen et al. 2014). Such instruments for promoting a CE in housing involve both barriers and enablers (Çetin, Gruis et al. 2021). These instruments have been applied differently across diverse contexts, and their design and implementation needs to be considered in relation to various aspects of the Australian housing system.

Attention must also be given to the barriers to the introduction of CE practices and processes. Barriers to innovation include:

- pricing and costing in fledgling markets
- learning rates in new and emerging processes and practices
- externalities and other market failures in existing systems that support fossil-intensive and wasteful practices.

3 Objects and instruments of the Recycling and Waste Reduction Act (2020) are as follows: (a) to reduce the impact on human and environmental health of products, waste from products and waste material, including by reducing the amount of greenhouse gases emitted, energy and resources used, and water consumed in connection with products, waste from products and waste material; (b) to realise the community and economic benefits of taking responsibility for products, waste from products and waste material; (c) to develop a circular economy that maximises the continued use of products and waste material over their life cycle and accounts for their environmental impacts; (d) to contribute to Australia meeting its international obligations concerning the impact referred to in paragraph (a).

These objects are to be achieved by: (a) regulating the export of waste material to promote its management in an environmentally sound way; and (b) encouraging and regulating the reuse, remanufacture, recycling and recovery of products, waste from products and waste material in an environmentally sound way; and (c) encouraging and regulating manufacturers, importers, distributors, designers and other persons to take responsibility for products, including by taking action that relates to: (i) reducing or avoiding generating waste through improvements in product design; and (ii) improving the durability, reparability and reusability of products; and (iii) managing products throughout their life cycle.

4 Recommendation 1: The committee recommends that the Australian Government prioritise the establishment of a circular economy in which materials are used, collected, recovered, and reused, including within Australia. https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/WasteandRecycling/Report

5 <https://www.nswcircular.org/wp-content/uploads/2020/10/NSW-Circular-Strategic-Plan-2020-2023.pdf>

6 <https://www.greenindustries.sa.gov.au/driving-the-circular-economy>

7 <https://engage.vic.gov.au/circulareconomy>

Financial barriers and enablers include:

- uncertainty of costs for reuse/recycled/new circular materials
- initial cost of implementing new technologies or processes
- robustness of CE business cases
- investment costs
- uncertainties around urban mining—collection/dismantling/reselling
- the availability of suitable funding for circular projects.

Regulatory factors include:

- political prioritisation
- sufficient standardisation
- existence of design guidelines
- degree of integration in regulations and their enforcement.

Investment in CE is directly affected by policies concerning procurement of CE products and services, and the level of certainty about future legislation or regulation. Appropriate regulation is an important incentive for CE—with the need to provide clarity, certainty and a level playing field.

There are also important framework instruments that impact the whole economy, including the built environment. The regulatory ban on exporting waste has already been mentioned. Another highly relevant example from the EU is the sustainable financial framework ‘EU Taxonomy on Sustainable Investment’. Industry standards now guide private capital to invest in accredited socially sustainable goods and services—using International Capital Market Association (ICMA) social bond principles—and both the taxonomy and social bond principles are used for assessing investments in affordable housing.

1.2 Research methods

1.2.1 Conceptual approach: CE housing towards sustainability goals

For the purposes of this Inquiry, CE housing is defined as housing that is produced and consumed utilising closed-loop principles, prioritising local employment, resilient and functional design, and carbon-neutral or energy-efficient operation (Table 1). This definition, including carbon, is important. It is designed to avoid negative trade-offs, where, for example, recycling is pursued at the expense of energy efficiency. Without this broader definition, CE could be reduced to a smokescreen initiative, producing perhaps more recycling—but also fuelling consumption, emissions and various costs and externalities in the process. There is also important scope for including community bottom-up or local-scale initiatives to complement top-down policy intervention and the dominance of global supply chains.

CE promotes affordable, accessible, fit-for-purpose housing that is appropriately located, so that it addresses social, environmental, economic and intergenerational equity concerns. While desirable, the widespread adoption of high quality, durable, low-impact, low-risk materials, and maintenance systems aligned to extend asset life, is held back by high up-front costs, incomplete markets, and insufficient know-how and incentives. With such initiatives, the logistics of sourcing and provision of materials may be challenging. Furthermore, this Inquiry advocates for measurement systems that will give the ability to better define and acknowledge circular processes, as previously emphasised by Çetin, Gruis et al.: ‘measurement methods and standardisation of circular processes and materials are believed to be very crucial for catalysing a wider adoption of the concept in the housing sector’ (2021: 17).

Sustainability also has the broader triple bottom line meaning in this Inquiry, to avoid siloing effects that exacerbate one dimension while addressing another. Thus, sustainability means:

- reducing the environmental footprint while also addressing housing access and affordability
- providing housing that is resilient, future-proofed against flooding, bushfire and other increasing climate change hazards, despite a skilled labour shortage.

At the neighbourhood scale, sustainability means:

- thinking more systemically about place, mobility and connectivity between housing and other ecosystem and socio-economic services
- scaling-up of retrofit, including of apartment housing
- addressing long-term shortages of social housing
- promoting climate-friendly practices and materials for the building materials industry.

The Inquiry uses key terms from housing scholarship, as defined by the four projects that make up this Inquiry:

- **Apartment:** dwelling located in buildings with two or more floors and featuring horizontal subdivision of cubic airspace. Horizontal subdivision distinguishes apartments from other multi-resident housing types, such as townhouses, which involve only vertical subdivision (Sharam, Briant et al. 2015).
- **Neighbourhood:** a physical place, as a cluster of residences, sometimes in conjunction with other land uses, and with shared infrastructure (Galster 2001), and a social construction based on how a group of people perceive their environment (Dühr, Berry et al. 2023: 6).
- **Just transition:** a transition that integrates the 'social' dimension of green transitions, such as affordability and access to housing, and including fair labour relations (Clarke and Sahin-Dikmen 2020).
- **Energy efficiency:** a set of strategies intended to reduce energy need and consumption towards 'a higher overall decrease in cost and faster transition towards net zero operational carbon' (Prasad, Kuru et al. 2022: 60).

Table 1: Definitions of CE housing and sustainable housing applied across this Inquiry

Key concepts/Projects	CE housing	Sustainable housing
Inquiry Program	<p>CE housing is housing that is produced and consumed in compliance with closed-loop principles, prioritising local employment, resilient and functional design, and carbon-neutral/energy-efficient operation.</p> <p>It is affordable, accessible, fit-for-purpose and appropriately located so that it addresses social, economic and intergenerational equity concerns.</p>	<p>Sustainable housing is environmentally, socially, economically, culturally and equitably durable. Housing that is energy efficient and closed loop would be described as environmentally sustainable housing.</p>
Project A Neighbourhood-scale housing developments	<p>The definition of CE used in this project extends beyond the focus on closed-loop material flows of avoiding the use of non-renewable resources, reducing waste, designing products and materials for reuse and recycling.</p> <p>Our definition of CE encompasses longstanding sustainable development goals of social and intergenerational equity, environmental protection—for example, through energy efficiency—and economic prosperity.</p>	<p>Spatially, the focus of this project is on the 'meso-scale' between individual buildings and the city or town, with this scale of a precinct or neighbourhood defined as a collection of buildings with shared infrastructures and services.</p> <p>The neighbourhood scale is not determined by an administrative boundary, but by identification of the residents with the area. A focus on this scale will offer possibilities to consider:</p> <ul style="list-style-type: none"> • sustainable infrastructure options for supplying power, water and waste services • wider efficiencies for urban heating and cooling approaches beyond the individual dwelling • mixed-use developments and integrated approaches to land use and transport planning loops. <p>Working at this scale allows an acknowledgment of the relevance of communities and social capital for achieving a sustainability transition.</p>
Project B Sustainable apartment housing	<p>A CE approach to the apartment industry takes a whole-of-life-cycle perspective, which necessitates consideration of the design and construction of new future-proofed apartments, as well as upgrading existing ageing and poor-performing stock.</p>	<p>Sustainable apartments are dwellings that deliver comfort and utility cost reductions for householders while minimising construction waste and maximising energy efficiencies and energy management, both in their construction and throughout their life cycle.</p>
Project C Large-scale housing retrofit	<p>CE in large-scale housing retrofit is about:</p> <ul style="list-style-type: none"> • interventions to improve the energy efficiency of existing buildings • promoting the transition to the use of alternative energy technologies, • minimising construction waste • extending the life of multiple dwellings. 	<p>Sustainable large-scale retrofit is concerned with the durability of existing stock, applied on a large scale.</p>
Project D Building materials supply chains	<p>CE applied to diverse materials recognises that supply chains can be looped to avoid waste, so the housing construction sector can reduce, reuse, recycle and recover resources without having to rely on new raw materials.</p>	<p>Sustainability of materials is concerned with the resource efficiency of finite materials used in residential construction supply chains.</p>

1.2.2 Inquiry design

The overall aim of this Inquiry is to establish how a CE approach can contribute to more sustainable housing outcomes. This Inquiry addressed this question:

How can the transition to a circular economy in housing be implemented to provide more sustainable housing?

This question was examined via four Research Projects in different fields of action of the housing system. Each project collected evidence and industry insights from the expert Industry Panel, and from other experts and evidence from Australia and internationally. Each project had a different focus:

- **Project A - Sustainable housing at a neighbourhood scale:** This project identified opportunities for a CE approach at neighbourhood scale, to achieve a transition towards sustainable housing in urban infill and new-build development locations. The analysis considered geographical variation and learned from international progress to inform Australian policy makers.
- **Project B - Delivering sustainable apartment housing: new build and retrofit:** This project examined financial, fiscal, regulatory and policy levers that can facilitate a transition towards the mainstream supply of sustainable apartments in Australia, by identifying processes specific to the supply of new apartments and retrofitting existing apartments that impede or promote sustainability (relating to financing, design and construction, and management).
- **Project C - Sustainable social housing retrofit? Circular economy and tenant trade-offs:** This project investigated CE approaches to large-scale retrofits of social housing, and the implications for the broader housing and retrofit industry.
- **Project D - Building materials in a circular economy:** This project used a CE framing to investigate use and waste in material supply chains to enable the housing construction sector to reduce, reuse, recycle and recover resources and rely much less on use of virgin material.

These Research Projects were informed by responses to five cross-cutting Inquiry research questions that were answered in scoping papers by leading experts:

1. How are housing producers organised for a shift to CE housing?
2. What drivers and dynamics are critical in shifting demand to CE housing?
3. What needs and opportunities are there for workforce training and Australian jobs?
4. What are the key innovation challenges and opportunities from industry 4.0 and new materials?
5. What financial, fiscal, regulatory and policy instruments are used and might be used to advance CE housing in Australia?

In addition to scoping papers, the four contributing Research Projects were also informed by discussions with an expert Industry Panel. A quadrant framework was developed based on this Inquiry and the Research Projects, and used to organise relevant tools designed to drive circular processes in each field (see Section 4).

A CE approach can contribute to more sustainable housing outcomes. It also means considering:

- the principles that inform the processes of change
- whose interests are impacted
- what measures are appropriate.

To affect change requires an understanding of how change is brought about, and this involves identifying the context and motivations that influence the relevant stakeholders. Clearly, the transformation towards CE processes also has normative implications for the nature of market relations, including how we value housing, set standards, promote investment, and develop and apply skills.

An important opportunity and challenge is to ensure a just transition for the housing sector integrating the ‘social’ dimension of green transitions, such as affordability and access to housing and including fair labour relations (Clarke and Sahin-Dikmen 2020: 402). The normative value of a just transition would be embedded in a set of agreed goals and actions that focus efforts of leading and implementing stakeholders towards desired outcomes, such as a mission-oriented and market-shaping approach (Mazzucato 2014; 2018a; 2018b). Such an approach:

- embraces the reappraisal of value, including by stakeholders in the housing and related industries (see for example Lützkendorf and Lorenz 2015)
- promotes purposeful market processes and investment frameworks
- builds necessary capacity to support circular processes across the life cycle and use of our homes and neighbourhoods.

1.2.3 Research methods

Methods used in the overarching Inquiry consist of document and data analyses of national datasets, including a review of international good practice documentation, and focus groups with key practitioners and experts. Each project has been informed by an elaboration and interrogation of a set of key questions that were devised and elaborated upon by a set of experts. Each expert provided an informed insight into the key themes that each project should address. Moreover, expert advice from policy makers and practitioners was sought and informed the research outcomes. Table 2 provides a summary of the projects, questions, methods and data sources proposed by each project.

Table 2: Research questions, methods and data sources used in the Inquiry Projects

Project	Research questions	Methods	Data sources
A Sustainable housing at a neighbourhood scale	<ol style="list-style-type: none"> 1. Who are the key institutional actors for achieving CE precincts in different locations? 2. What drivers and dynamics are critical in supporting a transition to CE precincts in different locations? 3. What are the needs and opportunities for professional training and Australian jobs to support a transition to CE precincts? 4. What are the key policy instruments of relevance to achieve a transition to CE precincts in different locations? 	<ul style="list-style-type: none"> • Document analysis • Online survey of members of Urban Development Institute of Australia, Housing Industry Association (HIA), Australian Institute of Architects, Property Institute of Australia, property council and government agencies (123 responses) • Case-study analysis of ‘good practice examples’ of CE precincts in WA, SA, VIC, QLD and the ACT, along with five CE neighbourhoods in Europe (15 case studies altogether) • Policy workshop with key representatives from government, industry, and civic society (21 participants) 	<ul style="list-style-type: none"> • Desk study of academic, policy and practice materials (national and international) • Online survey of key stakeholders for volume housebuilding in Australia • Case studies of CE precincts in Australia and Europe (desk analysis and semi-structured interviews) • Two online policy workshops (60 minutes each, 21 participants), requesting prior input from participants in response to workshop statements and with workshop discussions guided by questions informed through previous stages of research

Project	Research questions	Methods	Data sources
B Delivering sustainable apartment housing: new build and retrofit	<ol style="list-style-type: none"> 1. Who are the key actors in apartment production and retrofits? 2. How do structures of apartment provision and governance influence the adoption of sustainable apartment construction and retrofit? 3. What are the key challenges and opportunities in designing, constructing and adapting sustainable apartments? 4. 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"> • Document analysis • Apartment stock and key actor analysis (using Cordell Connect dataset) • Document analysis • Interviews with 33 key actors • Three industry workshops • Policy workshop 	<ul style="list-style-type: none"> • Academic, policy and practice materials • Cordell Connect dataset • Interviews • Workshops
C Sustainable social housing retrofit	<ol style="list-style-type: none"> 1. What acceptable standards and minimums frame retrofit decisions for the social housing sector? 2. What are retrofit priorities, options, and limitations for SHPs? 3. What are the retrofit priorities and trade-offs for tenants? 4. Which retrofit interventions should be prioritised, and how can they be operationalised, effectively bundled, and delivered 'on-the-ground' at scale? And what are the opportunities for broader translation to the private rented and owned stock? 	<ul style="list-style-type: none"> • Document analysis on minimum quality and retrofit standards. • Semi-structured interviews with social housing decision-makers • Survey exploring forced-choice exercises of hypothetical retrofit scenarios • Expert panel of policy makers and social housing providers (SHPs), and interviews with key retrofitters 	<ul style="list-style-type: none"> • Literature and policy documents and retrofit academics • SHP stakeholder interviews • DCE data collection • Policy makers, SHPs and retrofitters
D Building materials in a circular economy	<ol style="list-style-type: none"> 1. Who are the key institutional actors in the supply chain supplying materials for use in the Australian residential housing system? 2. What supply-side/demand-side drivers can increase the contribution that materials production and distribution can make to a CE? 3. What are the needs and opportunities for training and Australian jobs in the creation of the materials supply chain within a developing CE? 4. What are the key innovation challenges and opportunities from industry 4.0 and the use of materials in the Australian residential housing system? 5. What are the challenges and opportunities—financial, fiscal, regulatory and policy—for material use resulting in more sustainable design and build outcomes? 	<ul style="list-style-type: none"> • Document analysis; onsite inspections and interviews; industry interviews and a practitioner workshop • Assess demand and supply through modelling, case-study audit, industry interviews and practitioner workshop • Assess extent and nature of innovation through modelling • Assess challenge and opportunities through two case-study audits; industry interviews with 20 building materials stakeholders; and a practitioner workshop (with 20 participants) 	<ul style="list-style-type: none"> • Literature review; stocks and flows data; audit documents • Building professionals interviews • Industry interviews

1.2.4 Process and outcomes

The Inquiry began in May 2021 and was completed in October 2022. It was informed early on by five cross-cutting scoping papers, which responded to the research questions outlined in Table 2, and made ongoing contributions to discussions and Research Projects. Expert panels took place in August 2021, which further informed the design of the research, and in August 2022 in response to research findings. Input from the panels informed the final shaping of the conceptual framework and the interpretations of the data. The four Research Projects were completed by September 2022.

Based on this process, Research Project leads were invited to develop policy development options, using a coherent framework. This was based on framework proposed by Easthope, Palmer et al. (2023) and informed further team collaboration. It organised and focussed strategic actions along the following axes:

- **Reappraising value:** value inclusion and prioritisation, market setting, institutional frame. This relates to the original research questions 1 and 2.
- **Shaping market practice and processes:** regulatory/steering instruments, performance-drivers, market-shapers etc. This relates to the original research questions 2 and 5.
- **Tilting investment flows:** finance, capital, and tax incentives. This relates to the original research question 5.
- **Building capacity:** skills, knowledge, and training. This relates to the original research question 3.

The outcomes of this exercise informed the policy development options in Section 4 of this Final Report. An additional illustrated guide 'The Policy Framework: Actions towards Circular Economy housing in Australia' has been devised to promote public awareness, discussion and progress policy development, as well as a Visual Summary to share these findings with a broader public.

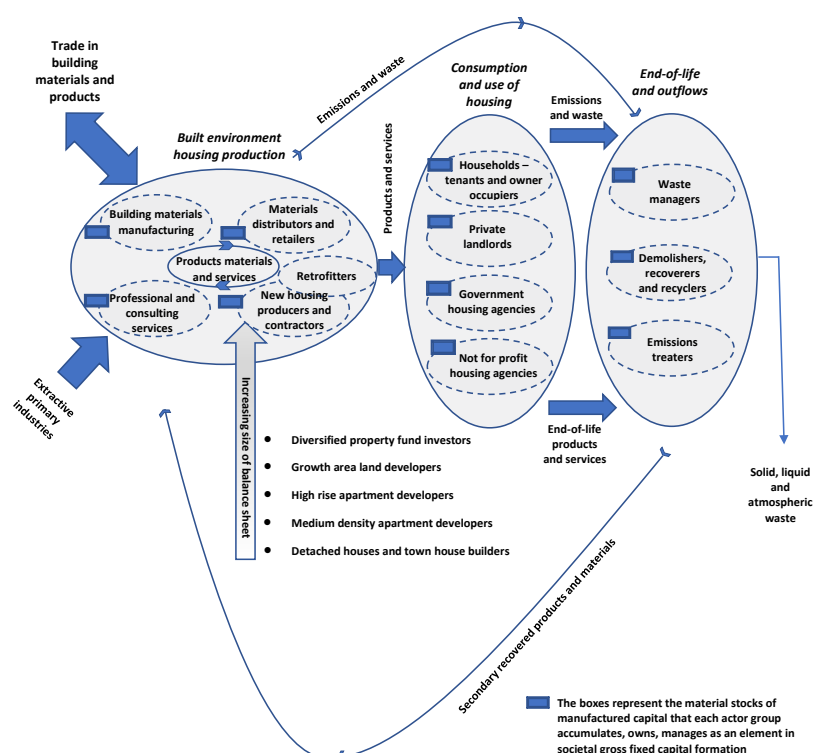
2. Cross-cutting insights for Australia

- **CE housing initiatives are best informed by recognising the dynamic and differentiated composition of (a) housing industries, (b) related supply chains, and (c) consumption of housing.**
- **Direct consumer demand for circular-economy goods and services is weak for many reasons, including market failures, and a stronger alignment between appreciated CE qualities and its value would incentivise relevant actions and investment by housing owners and builders.**
- **In developing a just transition towards a CE strategy, Australia can learn from previous construction, maintenance and retrofitting projects, as well as from new developments in prefabrication and building practices that recognise current workforce and economic constraints.**
- **There is a role for renewable energy technologies as well as energy-efficient design and practices, and the adoption of advanced digital technologies across the housing life cycle to deliver fit-for-purpose affordable sustainable housing.**
- **A CE strategy must include: a politically astute vision, robust legal footing, industry-relevant application, and capable enforcement. Specialist in-depth investigation of Australian institutional settings, market processes and stakeholder capacities are now required to reflect and propose suitable instruments adapted to local conditions.**

2.1 Organising for CE housing

Housebuilding and retrofit currently require large-scale investment and extraction of primary resources, the manufacture of building materials, as well as the onsite work of construction of new dwellings and dwelling improvements. Housing producers interact with many other societal actors, including those involved in the use and consumption of housing and the waste streams flowing out of the housing system. These housing producers vary in their characteristics and specialise in different types of housing morphologies. In each of these producer segments, capacities and forms of organisation shape the capacity of owners, staff, consultants and contractors to innovate and change the way housing is produced and retrofitted (Dalton 2021).

Figure 4: Circular economy housing schema



Source: Based on Figure 14.3 in Wiedenhofer, Pauliuk et al. (2020).

Figure 4 presents a stylised picture of three interconnected spheres:

- production
- use and consumption
- waste.

The 'production' sphere constitutes businesses producing new housing and retrofitting existing housing by using materials, manufactured products and services. This sphere is connected to the broader economy of natural resource exploitation, trade in materials and products, labour supply and finance.

The 'consumption and use' sphere constitutes owners and consumers of housing services structured by the social and economic relations of housing tenure and housing markets. They facilitate the flow of households through the housing stock.

The 'end-of-life and outflows' sphere constitutes waste managers, demolishers, recovery agents, recyclers, emission traders and landfill companies. It is shaped by the physical properties of dwellings such as morphology, structure and materials—as well as by household use and consumption.

Diverse interests traverse these spheres, all working within a financialised ecosystem:

- real estate stakeholders
- developers
- suppliers of building materials
- construction industry—including volume builders and builders of bespoke housing
- waste industries.

(For the role of the real estate industry in inhibiting or promoting sustainability outcomes, see Project B Final Report, including Section 4.) An institutional framing sheds light onto the split nature of the Australian building industry, with some blurred lines. For example, timber continues to be used extensively in detached residential housing, while concrete and steel dominate in the medium-density and high-density multi-unit sector. Understanding this is important, as these differences are likely to shape how the industry will respond to a CE.

A transition towards a CE can only be implemented through changes in the way that businesses and households enact their recurring supply and exchange relationships across time and place, in response to the climate crisis. The place and sub-sectoral specificity of change is a key consideration for promoting this transition, as these relationships play out in specific ways across localities, industry segments and cultures.

Institutional arrangements across the industry have implications for the four Research Projects of this Inquiry, as outlined below:

- **Project A Sustainable housing at a neighbourhood scale:** Residential development at the neighbourhood or precinct scale is generally delivered through master-planned estate models and through urban infill projects. Detached house and townhouse builders are cashflow businesses that construct to-order dwellings for purchasers who make progress payments to the builder, building on land previously purchased by the home purchaser from a developer. At issue is builder and land developer support for sustainability and CE measures in the land development and housebuilding partnership. By contrast, urban infill development models and apartment construction can be more speculative and capital-intensive. At issue is the financial risk being carried by the developer for CE projects compared to 'standard' projects. Furthermore, current valuation and exchange requirements do not reinforce sustainability.
- **Project B Delivering sustainable apartment housing: new build and retrofit:** Medium-density and high-density housing developers are capital-intensive businesses that produce strata-titled properties for purchase by owner-occupiers or landlord investors. This model is speculative, and there is always uncertainty about the level and nature of demand. An issue for consideration is that support for innovation—such as increased sustainability and CE—is limited because of market uncertainty and financial risk.
- **Project C Sustainable social housing retrofit? Circular economy and tenant trade-offs:** Large-scale social housing retrofit is undertaken by construction firms and contractors, many of which also produce new housing. SHPs seeking to include CE measures are likely to have two issues: the absence of inhouse design and specification expertise required for tendering out consultant professional services and construction/retrofit projects; and the financial outlay for retrofit, when set against drivers to deliver more housing, and the lack of opportunity for cost recovery.
- **Project D Building materials in a circular economy:** Building materials supply chains are dominated by oligopolistic building-materials manufacturers. There are also innovators and risk-takers seeking to change materials design, production, distribution, disposal and reuse. At issue are the opportunities and constraints for CE innovation within both oligopolistic supply-chain arrangements and smaller innovative risk-taking companies.

2.2 Demand for CE housing

The influence of ‘consumer power’ on the nature of the housing product or housing stock is complex. It could arise through the housing-consumption behaviour of buyers or renters bringing about better alignment of a dwelling’s CE quality and its market value. However, the housing market is riven with market failures—as a result, investment and benefit are often not clearly aligned, and information asymmetry further complicates matters. A stronger alignment between appreciated CE qualities of a property and its market value would incentivise relevant investment by housing owners and builders to improve existing homes or better equip new homes to maximise supplier returns.

Housing demand is usually conceptualised in terms of individual consumers—people interested in renting a home or buying a dwelling, either to live in or to rent out. In determining the price they are willing to pay, a prospective consumer would be expected to gauge a unit’s functionality and its economy as a dwelling in use, as well as its potential resale value in the future.

However, demand for CE housing is not restricted to individual homebuyers or renters. As commissioners (and as corporate landlords), managers of residential buildings, firms and other organisations can also be cast as consumers. Australian housing has usually been regarded as a ‘build-to-sell’ (BtS) commodity—intended for disposal to an individual owner upon completion. However, it would be expected that the commissioning developer’s building specification will be significantly influenced by their market intelligence about their potential buyers’ anticipated priorities and level of understanding.

A smaller but growing cohort of ‘housing demand’ organisations are the developers of buildings intended for long-term rental use. This includes low-cost social housing developed by not-for-profit agencies (or state housing authorities), as well as purpose-built student housing, some higher-end boutique strata-title apartments, and so-called ‘build-to-rent’ (BtR) accommodation targeted at a more mainstream market.

The potentially influential role of housing consumers and finance industry players

Regarding CE considerations, organisations commissioning or managing housing will factor in relevant end-user (or end-purchaser) priorities and government regulations into their building design preferences. Beyond this, other parties may also wield influence—especially the financial institutions that provide development and mortgage finance for most housing construction projects and consumer acquisition decisions.

Since most people commissioning or buying housing will be reliant on debt for the transaction, the policies and practices of financial institutions are influential. In Australia, as well as overseas, there is already firm evidence of rental-building developers being steered towards more energy-efficient specifications by finance providers seeking an outlet for ‘green capital’—and which are willing to offer preferentially priced debt for projects that comply with defined environmental performance standards.

Understanding the demand for CE in housing has implications for businesses involved in producing different types of housing—such as apartments and social housing retrofit. These businesses are dependent upon existing financing arrangements and notions of product demand.

Energy performance labelling of buildings can help inform dwelling valuations. Such schemes could powerfully and progressively influence building design across all typologies, with the following provisos:

- **Project A/B:** ‘Medium-high density housing developers’ could investigate finance sector influence in channelling preferentially priced green capital into development and mortgage funding into CE-compliant buildings’ (Dühr, Berry et al. 2023). Another relevant consideration is: what if the build-to-rent apartment development form embodies a commissioning and incentive structure that is better aligned with CE principles than the standard build-to-sell model? However, Easthope, Palmer et al. (2023) found evidence that environmental, social and governance (ESG) objectives of some larger banks do not extend to development finance, and major shifts in financing for development are unlikely to emerge from individual banks. External regulation would be more effective in supporting greater sustainability and circularity in investment, while ensuring a level playing field for the banks.

- **Project C: Sustainable social housing retrofit? Circular economy and tenant trade-offset:** SHPs are conceptualised as 'housing demanders' because of their role in commissioning new buildings and retrofitting existing rundown stock (Baker, Moore et al. 2023). To the extent that such activity needs to be debt-financed, ESG conditions and discounts could help compound existing 'social mission' and business logic incentives for social landlords to prioritise investment in energy efficiency and durability.

2.3 The implications of transition for the workforce

According to the HIA, designers, builders, trades and suppliers will need to re-educate and re-engineer their processes over the next decade to achieve steps towards CE outcomes⁸. This imperative is addressed by research question 3:

What needs and opportunities are there for workforce training and Australian jobs?

This research question focusses on contemporary experiences in construction, maintenance and retrofitting practices; current workforce arrangements; and economic planning approaches. This research question considers how these socio-economic realities can be reformed towards a more sustainable CE orientation. The challenge is also to achieve a just transition for the housing sector in a CE, involving 'the "social" dimension of green transitions, including labour standards, and worker agency, alongside a strong government role' (Clarke and Sahin-Dikmen 2020: 402).

The implications of a CE for the nature of work will need to be supported via an appropriate training and learning strategy (Stroud, Walker et al. 2015; UNEP 2011: 5). In turn, this work needs to consider the structure of Australia's housing construction workforce, as well as contemporary training arrangements and their capacity to support the required CE transition.

Uneven impact and need for a just transition

Moves toward a CE housing sector will have major job and employment impacts. The International Energy Authority estimates that between nine and 30 jobs in manufacturing and construction would be created for every million dollars invested in retrofits or efficiency measures in new builds (UNEP 2020: 9). To facilitate each step in the overall transition, policy makers should have some insight into the uneven impact that such changes will have on the nature of work and industry practices, as well as on the broader economy and society. For example, the transition to a low-carbon construction sector will require a higher-skilled, reskilled and more diversely skilled workforce, new business models, different and smarter building archetypes, along with more extensive industrialised construction methods (De Groote and Lefever 2016: 13). Attention should also be paid to spatial differences—for example, across urban and non-metropolitan regions—as well as gender implications and opportunities for balanced regional development.

The European Commission's Just Transition Mechanism (European Commission, 2020) provides one example of the kind of strategic thinking and instruments that may be required to transition economies towards greater circularity.

Value of CE

Attention should also be given to defining, monitoring and attributing value in CE housing. This will require rigorous engagement with the principles of economic and industry training policy, as well as reviewing how we currently use quantitative and qualitative data to measure economic processes and outcomes.

⁸ See Housing Industry Association's discussion on CE here: https://hia.com.au/housing/in-focus/2020/waste-not?utm_source=Policy&utm_medium=social&utm_campaign=Facebook&utm_content=101220

Tasks, jobs and relations in the Australian housing and construction industry

The work of housing construction involves a range of tasks, from designing, planning, and construction to maintaining the building. This work involves utilities, suppliers, approvals and compliance arrangements. It is performed by trades (electricians, bricklayers, concreters, plumbers, carpenters, etc.) who are linked to designers, architects, planners, and building inspectors and, ultimately, to facility managers and other building maintenance and renovation professionals and DIYers. These relationships vary by project, typology, locality and innovation context. Developers and volume builders engage individual building skills and firms, which are dominated by high competition among small to medium firms, self-employment and short-term contracting (IBISWorld 2022).

How labour is organised and engaged is also critical to the pursuit of more energy-efficient buildings. However, this has been frustrated by the predominance of small firms, self-employment and a fragmented labour process with low levels of formal training and certification (Clarke and Sahin-Dikmen 2020). There are persistent concerns about the sector's conservatism and capacity to meet future skills needs in the economy. Furthermore, the Australian housing and construction industry is highly gender-segmented. Women comprised 11 per cent of the overall sector in 2016—which was a decline from 17 per cent in 2006—and make up only 1 per cent of the trades workforce⁹.

More detailed understanding of Australia's current labour markets across the construction value chains in each of the four Research Projects can be used to develop a 'linear' baseline from which a circular transition would start. Such a consideration needs to include:

- understandings about the nature of work involved
- dynamics of upskilling, de-skilling and re-skilling
- gender composition
- migrant composition
- subcontracting arrangements, pay rates and the role of labour organisations.

Innovation and skills issues include the possibilities of offsite prefabrication, and jobs and employment relations outside Australia.

In developing a CE strategy, Australia can learn from past experiences in construction, maintenance and retrofitting practices, new developments in building practices and prefabrication, and in reconsidering current workforce arrangements and economic planning approaches.

Quality and availability of CE housing training

Training for green skills or a just transition is neglected and underfunded. Since the Green Skills Policy of the 2007–2013 federal government, there have been no major policy or funding developments in Green Skills Training. Indeed, there are persistent concerns regarding quality and unlawfulness that hinder the current performance of the training system and its capacity to meet future skills needs in the economy. While training is increasingly publicly funded, it is delivered by private or quasi-privatised vocational education and training (VET) colleges. This makes changes in the overall design of training content and assessment difficult, and has also created the conditions for opportunism and a reduction in the quality of VET delivered (Parliament of Australia 2015). Furthermore, funding restrictions have reduced the capacity of Technical and Further Education (TAFE) institutes to keep up to date with new technologies and deliver the volume of training in accordance with required developments (Toner 2014).

Despite recent interest from the incoming federal government, at the current time there are no formal or systematic links between government, VET and tertiary sector organisations and the housing industry assessing and developing the necessary skills to address the climate crisis and institute CE housing. Given this context, more CE-focussed and attentive training will be required in any future strategy, along with relevant learning objectives, curriculum and assessment, skills standards and their certification.

⁹ See <https://workfast.com.au/blog/women-in-construction-increasing-diversity-in-the-workforce/>

2.4 Challenges and opportunities for materials supply chains and digitisation

Delivering integrated renewable energy systems and using advanced techniques will require purposeful and concentrated effort. Innovation can come from:

- developing and using materials that minimise energy loss at the building and settlement level
- adopting advanced digital technologies in housing design, delivery and through end-of-life to minimise environmental impacts
- delivering fit-for-purpose affordable housing.

Industry 4.0 is the ‘fourth industrial revolution’—the ongoing automation and digitalisation of traditional industry processes and practices. Within construction practice, there has been a lag in the uptake of Industry 4.0 (Newman, Edwards et al. 2020). The main barriers and challenges are in people, both as individuals and societies, in knowledge of CE housing and in a shared vision and practice towards it (Pomponi and Moncaster 2017). The issue of financial cost is also particularly important in the construction industry, where the cheapest tenders are often selected rather than those that are the best value (Oswald, Ahiaga-Dagbui et al. 2020). This reduces the likelihood of high quality sustainable materials being chosen (see Sections 1 and 3 of *Building materials in a circular economy* Project D Final Report).

The housing construction industry is dominated by heavyweight, carbon-intensive materials such as concrete, bricks and steel. Improving data capture on the material stocks and flows of these will assist in developing CE practices. Development of large databases and the capacity to use the data will require significant innovation. Digitisation information about materials through digital passports will also help with tracking materials for reuse or recycling. As the case studies showed, materials reuse tends to be labour-intensive and inefficient, and may not meet building code requirements. The use of 3D printing in the housing industry has begun, and is having an impact across the design, construction and end-of-life planning for dwellings.

Innovation can emerge from each relevant subsector using a wide range of strategies and guidelines that have already been tested in many parts of the developed world and delivered positive outcomes. International concepts and approaches in a CE for housing that hold immediate potential application in Australia include the following.

- The design, fabrication and use of durable, high-service life, reusable, recyclable and non-polluting materials and components.
- The development and use of systems, components and assets able to supply clean and renewable energy with the minimum generation of wastes and the minimum environmental load.
- Net-zero-energy buildings and communities.
- Radical and systemic residential sector retrofit and upgrades to maximise energy efficiency, including a focus upon low-income and social residential to eradicate energy poverty.
- Technologies to counterbalance the negative effects of urban overheating on energy demand.

Across these opportunities, disruptive digital innovation from building information modelling (BIM) to artificial intelligence (AI) to virtual reality (VR) presents an emerging frontier for a new era of innovation in CE housing— if sufficiently enabled by regulatory and industry incentives.

Specific implications for each Research Project are as follows.

- Sustainable housing at a neighbourhood scale:
 - Enhanced CE planning and building codes, including measures designed to tackle urban overheating.
 - Demonstrations of the viability of net-zero and positive energy neighbourhoods and collective housing.
 - Innovative CE-rating systems for housing developments.
 - Incentives to industry to produce and commercialise CE developments, building products and housing.
- Delivering sustainable apartment housing: new build and retrofit:
 - Utilisation of measures to improve building energy production systems, including more widespread use of advanced renewable energy systems.
 - Techniques to optimise the thermal quality of the envelope.
 - Implementation of solutions to improve the management of the energy and environmental resources and systems using smart and intelligent control devices.
- Sustainable social housing retrofit? Circular economy and tenant trade-offs:
 - Use of innovative advanced digital strategies to improve energy performance and the local microclimate.
 - Smart monitoring and management of energy and environmental quality.
 - Smart and systemic retrofitting.
 - Special provisions for social housing to ensure affordable sustainable energy and quality—including indoor environmental quality.
- Building materials in a circular economy:
 - Innovation challenges regarding building materials, including enabling commercialisation pathways for CE materials and products
 - Addressing externalities, learning rates and unit-cost reductions through development, trials and upscaling production that delivers CE outcomes and local jobs.

2.5 The financial, fiscal, regulatory and policy instruments to advance CE housing in Australia

This subsection responds to research question 5:

What finance, fiscal, regulatory and policy instruments are used and might be used to advance CE housing in Australia?

Circular economies can be shaped and reinforced by an architecture of financial, fiscal, and regulatory instruments. This subsection examines CE strategies undertaken internationally at the national and city scale, including jurisdictions where progress has been made over the past 15 years. It defines the instruments used when enacting these strategies that are of relevance to the Inquiry and to each Research Project. Potential instruments are defined in Table 3.

Table 3: Potential CE strategic instruments: brief definitions

Financial instruments	Fiscal instruments	Regulatory instruments
<p>Increase the availability of (or access to) capital for investing in energy-efficient neighbourhoods and buildings, retrofits or recycling and reuse of building materials.</p> <p>Key aspects of the CE in housing include:</p> <ul style="list-style-type: none"> • financial frameworks guiding market participants • financial intermediaries channelling investment • promotional banks with CE investment platforms • various types of debt and equity instruments • sustainability and social impact bonds • venture capital funds 	<p>Government support in the form of direct expenditure or revenue allocation, grants, procurement policies, and indirectly through tax incentives such as:</p> <ul style="list-style-type: none"> • research and development grants • technical and feasibility studies • start-up subsidies or low-interest loans for innovative enterprises • green books or purchase lists • investment in training schemes that support CE • tax credits, reliefs and allowances • payments for waste, infill • guarantees on products 	<p>Binding or voluntary rules, standards, compliance mechanisms and enforcement that limit, steer or otherwise control actor's behaviour, such as:</p> <ul style="list-style-type: none"> • banning waste export • energy performance directives and promoting circular building standards • progress indicators • energy performance certificates, eco-labels • requirements to use, recycle, redesign, etc. • land-use strategies to promote energy efficiency and reuse of buildings, etc.
<p>Other instruments: industry alliances and partnerships, research, and platforms for innovation, collaboration and exchange are also relevant strategies (see Lawson and Dorignon 2021).</p>		

These financial, fiscal and regulatory instruments can serve a number of strategic goals and address specific bottlenecks or barriers to CE. They can be customised to address specific technical constraints, support strategic innovations, and address knowledge gaps, which are economically transformative and offer job benefits. Instruments can also mobilise private co-funding, attract participation of financial intermediaries and specifically target (low-income) households to address their affordability concerns. Shifting the tax incentives from non-renewables to renewable resources is also an overarching market-shaping approach.

Given the rapid development of policy and financial innovation in different jurisdictions internationally, it is appropriate to provide a global orientation to potentially relevant policies, networks, research hubs and their publications to consider when developing appropriate instruments for Australia. Globally, CE strategies utilise differing approaches. These policies and networks have been analysed using the typology of CE policy intervention established by Prendeville, Cherim et al. (2018) to demonstrate their varying emphasis. Among them are:

- knowledge development
- collaboration platforms
- business support schemes
- regulatory frameworks
- procurement and infrastructure
- fiscal frameworks
- other strategic approaches—for example, awareness-raising.

See Table 4 for detail.

Table 4: Overview of CE strategic approaches

Countries with CE strategic domains	Knowledge development			Collaboration platforms	Business support schemes	Regulatory frameworks	Procurement and infrastructure	Fiscal frameworks	Other CE strategic approach
	Communicate best practices	Research and development	Measurement methods						
Argentina	●								
Belgium					●●	●●●			
Canada	●	●		●					
China	●●●	●●			●●●	●●●	●	●●	
Denmark	●	●		●●	●				
Finland		●	●			●●●	●●	●	●●●
France	●●	●●●	●●	●●●	●●	●●●	●●	●●	●●
Germany			●			●		●	
India	●●●	●●			●	●●			
Japan	●●●	●			●●	●●●	●		
Luxembourg	●	●				●			
New Zealand	●	●			●				
Portugal	●	●	●		●	●			
Rwanda	●	●●							●
United Kingdom	●	●●	●	●●	●●	●●●		●	●
USA	●	●							
Spain	●●	●●	●			●			
Sweden	●	●						●●●	
The Netherlands	●	●	●	●●●	●●	●●●	●●	●●	●●

Note: This overview aims at indicating the emphasis given to each national strategy. For that purpose, the red dots on the table represent the scale/magnitude of the instruments employed as follows:

- minimal scope (e.g., non-binding framework, guidelines, roadmap, consultation process, working groups, lab, toolkit, case-studies)
- intermediary scope (e.g., quotas, collaboration, pilot project, financial incentives/reward, tax preference, public/private partnerships, competitive tenders, labelling/certification)
- considerable scope (e.g., legally binding frameworks, by-laws, legal reforms, publicly led investment and management, enforced behavioural change, taxes levied).

Source: Lawson and Dorignon (2021)

More effective implementation and sustained outcomes can be obtained by combining tools. Strategies used vary in terms of their coverage, often related to how centralised, comprehensive or bottom-up and diverse their application is. While the design and composition of these instruments is typically enacted and facilitated by governments, innovation and implementation necessarily involves industry and civil society participation to varying degrees. Although metropolitan areas have the potential to make ‘key decisions determining economic growth, social well-being and environmental benefits’ (OECD 2020), a multi-level governance approach (e.g. China) or a robust national leadership (e.g. Finland, France, UK¹⁰) seems to offer a more comprehensive and unified path towards CE.¹¹

Specific instruments are relevant to different fields of action: neighbourhood development, apartment construction, social housing retrofit and building materials. These instruments are detailed in Table 5 through Table 8.

Table 5: International CE field of action: neighbourhood development

Financial instruments	Fiscal instruments	Regulatory instruments
<ul style="list-style-type: none"> • EU taxonomy incorporating CE, influencing investment proceeds • State investment bank loans: EIB investment mandates, CE platforms • Leasing arrangements, e.g. home appliances (Flanders) • Pay on CE outcomes, e.g. proportion of waste recycled • Profitable reinvestment, using food waste to power waste-collection fleet (Prague) • ARIF—not yet applicable to residential buildings • Clean Energy Finance Corporation (CEFC) invests in green social housing, e.g. SGCH 	<ul style="list-style-type: none"> • Grants for demonstration projects, e.g. 100 circular cities • Land banking combined with city plans (STEP and <i>Wohnfond</i>, Vienna) • Co-investment in CE businesses • Green, low-carbon CE procurement • Circular tendering processes • City deals, challenges, competitions, e.g. Four Pillar developer competitions (Vienna) • Taxes levied to discourage waste • Fund programs from waste levies • Education programs training housebuilders, planners, etc. 	<ul style="list-style-type: none"> • Green mobility plans: Scotland's 20-minute cities, Paris 15-minute city, etc. • Neighbourhood planning and investment agreements (Finland, MAL) • Local bi-laws: health, safety product stewardship (US) • Mandated recycling relationships, e.g. Milan, China • Certification as per Living Building Challenge (LBC) standard • ‘Soft renewal’ processes (Vienna) • Performance measurements that focus on circular values, emissions, pollution, destruction, social value, natural value, e.g. the Environmental Meter tracking tool for waste in Milan • Co-location hubs, and enterprise zones (China) • —Positive Energy Districts, local heat plans, <i>Warmteplan</i> (The Netherlands)

Other instruments: note China's legislation, France's inventories, and Rwanda's plan, as well as several research collaborations, CE City labs, cross-departmental working groups.

Notes: ARIF = Accelerator Regional Innovation Fund; SGCH = St. George Community Housing; EIB = European Investment Bank; MAL = the Finnish national Land use, Housing and Sustainable Transportation Network.

Source: Lawson and Dorignon (2021)

¹⁰ Further details on relevant international case studies can be found in the final reports of each Research Project.

¹¹ More detail on specific international case studies can be found in the Projects A, B and C Final Reports.

Table 6: International CE field of action: apartment construction

Financial instruments	Fiscal instruments	Regulatory instruments
<ul style="list-style-type: none"> Philanthropic efforts (WRAP) Crowdfunding Impact investing Venture capital Sustainable bonds (debt) Conditional public investment (debt) Guarantee insurance Revolving maintenance funds for renovation of co-operative housing (LBF in Denmark) Dedicated revolving funds for affordable housing (Estonia, Slovenia, Denmark, Austria) Lease and sale to support modular components, e.g. kitchens and bathrooms Potential state investment banks CEFC and National Housing Finance Investment Corporation (NHFIC) 	<ul style="list-style-type: none"> Collaborative research with industry or along supply chains on resource efficiency in building process Housing2020 Houseful project (EU) Direct investment (ELENA EIB) Tax on vacant underused dwellings (France) Low Income Housing Tax Credit (US) channels profit-rich tax credits towards investment towards affordable housing 	<ul style="list-style-type: none"> EU energy targets, certificates and EU Energy Performance of Buildings Directive Energy standards for social housing (Scotland) German Building code, Energy Conservation Act and DGNB-rating criteria France's Energy and Climate Act, soon mandatory audits City of Melbourne high-rise recycling program (Australia) 2021 draft Apartment Design Guidelines for Victoria (Australia) Design standardisation and guides for modular construction (UK) EU taxonomy and ICMA voluntary codes for sustainable finance

Other instruments: many alliances, platforms, peer networks and dialogues.

Notes: WRAP = Waste and Resources Action Programme, ELENA EIB = European Local ENergy Assistance, European Investment Bank, DGNB = German Sustainable Building Council, ICMA = International Capital Market Association

Source: Lawson and Dorignon (2021)

Table 7: International CE field of action: social housing retrofit

Financial instruments	Fiscal instruments	Regulatory instruments
<ul style="list-style-type: none"> Sustainability bonds in affordable and green housing (e.g. EU taxonomy, incorporating CE definition) Revolving dedicated maintenance funds for renovation of co-operative housing (LPHA Austria, LBF Denmark, Housing Fund Slovakia) SDG investment in <i>Energiesprong</i> retrofitting through bill savings, ensuring no net additional cost to tenants (Netherlands) Lease and sale to support modular components, such as kitchens and bathrooms Programs run by third parties and private sector 	<ul style="list-style-type: none"> Collaboration tools for developing circular buildings Direct investment, e.g. EC Renovation Wave, Estonia's long-term renovation plan Facilitating new circuits of (re) investment, e.g. Dutch <i>Energiesprong</i> Victoria's Resource Recovery Infrastructure Fund (Australia) Investing in training to support renovation efforts, establishing specialist courses, certification (France) 	<ul style="list-style-type: none"> Energy Performance of Buildings Directive (EPBD; EU) EU energy targets, certificates Scotland's energy standards for social housing German Building code: Energy Conservation Act France's Energy and Climate Act, soon mandatory audits Design guides, tools for ease of modular design and disassembly in housing, e.g. design standardisation and guides for modular construction (UK) City of Melbourne high-rise recycling program (Australia)

Other instruments: much sharing and piloting of good practices occurring in Europe.

Notes: SDG = Sustainable Development Goals

Source: Lawson and Dorignon (2021)

Table 8: International CE field of action: building materials

Financial instruments	Fiscal instruments	Regulatory instruments
<ul style="list-style-type: none"> • EU Taxonomy Angel investing networks • CEFC co-investment • Australian Renewable Energy Agency (ARENA) • PPPs, e.g. Macquarie investment and international funds management company DIF combined with funding from the CEFC and ARENA 	<ul style="list-style-type: none"> • EU financial support for CE transition (ESIF) • Horizon 2020 research program, e.g. Houseful (EU) • EU structural funds for waste management. • Procurement policies • Dutch 'raw materials agreement' reached in 2016; the government is driving circular innovation through industry initiatives such as Green Deals and Top Sector policies • Taxation frameworks guiding resource use and applied across life cycle from tax on raw materials, to tax relief on reuse and repair and tax on waste, carbon credits to prevent emissions and reduce them, e.g. the Landfill Tax (UK, 1996) • French CO2 tax (2014) and UK Climate Change Levy (2001) • Promotion of repairs through tax incentives (Spain) 	<ul style="list-style-type: none"> • Ban on waste import or export • Obligation to reduce biodegradable wastes to landfill through the Landfill Directive (EU) • Climate Change Act Finland (2015) pledging to reduce emissions by at least 80% by 2050 • Producer-responsibility laws (US) • Standards for reused products (China); EU Environmental Technology Verification (ETV) • Obligations to use renewable materials, e.g. wood (Finland) • UK Climate Change Act 2008 sets binding emissions targets for 2050 • Common measurement methodology and indicators to measure various aspects of resource consumption • Design guidelines or standards • Regulation of products, reuse of products (water) • Eco-labelling • Compulsory green public procurement (EU)
<p>Other instruments: many industry alliances and cross-sector partnerships in Europe and US to build on.</p>		

Notes: CEFC = Clean Energy Finance Corporation

Source: Lawson and Dorignon (2021)

Overall, the qualities of strategic frameworks include politically astute vision, robust legal footing, industry-relevant application and capable enforcement—all of which are likely to be vital qualities of Australia's own approach. While this international review demonstrates the potential range of strategies for a CE applied to housing, Australia's own approach needs to reflect both global context and local institutional relations (Çetin, Gruis et al. 2021). In sum, suitable instruments must be adapted to the specific conditions of Australian institutional settings, market processes and stakeholder capacities.

3. Learning from diverse housing fields

- **Relevant levers to drive change are specific to institutions and current practices.**
- **Overall, higher regulatory standards are needed, often in combination with fiscal and financial frameworks, business support schemes, and education and training.**
- **New CE housing partnerships are needed across governments, private developers, training and research organisations, and local communities—with suitable governance arrangements.**
- **There is significant potential to improve the performance of new and existing apartment buildings through interventions that embed sustainability in the work of development teams, project feasibility, valuation and post-occupancy monitoring.**
- **Independently verified information on building sustainability—including common areas and services—can inform the decision-making of residents and owner-managers.**
- **The retrofit of social rental housing is a major opportunity to test and advance CE housing, but competes for scarce budgetary resources and is held back by lack of clarity and transparency about processes and outcomes.**
- **The material flow analysis (MFA) found that data for tracking material stocks and flows throughout the residential construction sector is inadequate.**

- **Analysis of two sustainable housing developments in Victoria highlighted systemic challenges facing the introduction of CE.**
- **Through case-study material supply chain analyses of concrete, steel and timber, it is clear that CE housing considerations are largely absent. All three supply chains have local and global features, which means that reducing emissions requires governance arrangements that span multiple jurisdictions.**

There are various levers for change towards a CE that are potentially appropriate to different fields of action in the housing system. They include:

- strategic frameworks guiding overall action
- knowledge development of various foci and depth
- collaboration platforms involving different stakeholders
- business support schemes piloting, co-investing and enabling
- regulatory frameworks applicable to various materials, processes, actors
- procurement policies strengthening demand
- purposeful public expenditure and taxation.

This section examines each field of housing action in Australia, and their ecosystems of institutions and current practices, to inform the design of relevant levers that can drive change. This examination also considers international strategies, as well as the issues raised in Section 2 concerning market structure, supply chains, the nature of demand, and capacity-building requirements.

3.1 At the neighbourhood scale (Project A)

The focus of *Project A Sustainable housing at a neighbourhood scale* (Dühr, Berry et al. 2023) was to understand how a transition towards sustainable housing developments can be achieved by harnessing the potential of neighbourhood scale. It examined how key built-environment professionals in Australia experience the challenges and opportunities to planning, designing and implementing sustainable housing developments at this scale, and in different geographical and institutional contexts. It also examined the strategies and policy levers employed in good practice eco-neighbourhoods from across Australia and Europe that may prove instructive to improving Australian policy and practice.

The definition of 'sustainable neighbourhoods' used in this project extends beyond the focus of the CE concept on closed-loop material flows—that is, avoiding the use of non-renewable resources, reducing waste, designing products and materials for reuse and recycling. It also encompasses longstanding sustainable development goals of social and intergenerational equity, economic prosperity and environmental protection—for example, through energy efficiency.

In comparison to the notion of sustainability that is embedded in Australian urban planning discourse—although rarely clearly defined—CE approaches are not yet widely used nor understood. By contrast, the more recent European examples in the research have been explicitly framed around the concept of a CE in the built environment and pay detailed attention to efficiencies in production and consumption patterns that may provide instructive to Australian policy makers and practitioners.

The policy and regulatory framework for sustainable urban development in Australia is fragmented—largely due to complex division of responsibilities across jurisdictions. Building regulations are set at federal level; states and territories are responsible for urban and regional planning policies, and there is now a wide range of sustainability-rating tools available to assess building performance but also community-scale aspects of new developments. The research found that even built-environment professionals can find it challenging to navigate this governance and policy landscape, and to identify the relevant tools to plan, design, develop and evaluate sustainable housing at a neighbourhood scale.

In Australia, there are numerous built-environment professions involved in realising sustainable housing at a neighbourhood scale. The research found that awareness among them about the value of incorporating CE actions in precinct-scale residential urban developments is growing—but that they experience many barriers to working at the precinct scale and to incorporating CE principles into housing developments.

There is a growing number of 'eco-precincts' internationally. However, such initiatives are still regarded as niche experiments that often faced considerable challenges in their realisation. Experiences from such projects are rarely mainstreamed into planning and development processes. As traditional housing developments, Australian 'eco-precinct' developments mostly focus on the building scale, with the potentials of the neighbourhood scale underused. The experiences from Europe might offer inspiration for how the precinct scale might be used as the central consideration to develop sustainable communities and to consider the location and connections of housing, infrastructures, services and other uses on the site and within the wider spatial context.

The key institutional actors involved in eco-precinct development are developers, urban designers/consultants, state government planners and local council planning departments. It is the interaction between these groups of actors that determines what, if anything, can be done in relation to CE at a precinct scale beyond any minimum planning and construction requirements. Statutory planners and local councils are critical gatekeepers of more progressive opportunities in relation to CE at a larger scale.

State and territory governments are important actors for setting policy frameworks and initiating policy change; in some cases they also act as developers or large-scale eco-demonstration projects. However, given the weak policy frameworks available to realise sustainable housing at a neighbourhood scale in Australia, political support at every government level is a key factor to allow an eco-precinct to be realised, and will determine whether such practices become more mainstream.

The research found that there is a need to educate all actors about what CE or urban sustainability means in practice—especially at a scale beyond the individual building. It is evident that even in these examples of Australian good practice eco-precincts, there is limited engagement with a comprehensive understanding of sustainability or CE. While CE may still be a new concept in Australia, there has been much work on defining and operationalising sustainable development, and on developing targets and indicators to measure whether sustainability is achieved in urban development. Yet the research found little evidence of such frameworks being used, which suggests a need for education and exchange to ensure their wider use and further refinement.

The complexity of realising sustainable housing at a neighbourhood scale requires:

- new governance approaches
- partnerships between public-sector and private-sector actors (and the professions involved in planning, designing and building housing at this scale)
- better coordination of planning policies and building regulations across administrative borders and across scales.

The central message from this Research Project is that there is a need for much stricter regulatory requirements on urban sustainability in general, and for policy frameworks and development models supportive of realising housing developments at precinct scale specifically. Policy expectations for sustainable housing at a neighbourhood scale should be performance-based rather than prescriptive, and they should be supported by objectives and targets so that achievements can be measured and compared.

Most of the research participants called for mandatory targets over voluntary targets, and for coordinated policies and systems across levels of government and jurisdictions. This indicates a growing realisation by many stakeholders that a sustainability transition cannot be realised based on voluntary industry action—it requires strong steering from governments at all levels.

To support the transition to the requirements needed to achieve sustainability and climate-change mitigation, other policy levers—such as information, education and training—could usefully support stronger regulation, and begin to change the professional and public discourses on CE in the built environment. There may also be a role for temporary financial or fiscal incentives to support the uptake of new practices in industry.

Realising sustainable housing at a neighbourhood scale requires new governance models and partnerships of governments, private developers and local communities. More support is needed for local councils to reduce the risks attached to 'untypical' developments such as eco-precincts, which are currently seen to place higher demands on planning and development processes, and imply higher costs for the maintenance of public assets that were developed as part of such projects. This could, for example, take the form of partnership models with developers to share the benefits and additional up-front costs of such developments, as have already been trialled in some of the case studies analysed for this research. Also, new models for community engagement, beyond statutory requirements, would be useful to ensure that eco-precincts can thrive through bottom-up initiatives, and to support a shift in behaviour of residents to internalise sustainable lifestyles.

Financing has been identified as one barrier for eco-precincts, with costs often increasing due to delays in the process and lenders reluctant to support projects that are perceived as higher risk (see Section 2.2.7 of Project B Final Report *Sustainable housing at a neighbourhood scale*). Policy support to change the financing landscape to facilitate such complex projects would aid their realisation—for example, through ethical investment practices that prioritise quality and legacy of development projects over quick financial returns.

In terms of the actual planning processes, the research highlighted the value of preparing integrated urban-development vision for neighbourhood developments that place sustainability at their core. Such strategic master-planning documents can provide a decision framework over many years of implementation of large-scale precincts. Design guidelines and similar tools can be useful complementary instruments to ensure that the expectations for the sustainability of the development become a binding requirement for developers and builders.

Policy change is needed that prioritises previously used and recycled materials over new materials, so that a market for such products can develop. There is a lack of consideration for end-of-life/reuse of materials—new products and materials are still cheaper to procure than recycled ones, and are favoured by regulatory standards. There needs to be a focus on reuse in policy so that an industry for reused and recycled products and materials can develop. 'Digital warehouses', such as those trialled in some of the European case studies, may be a useful tool to support efforts to procure reused or recycled building materials and products.

3.2 In the apartment market (Project B)

The focus of the Research Project *Delivering sustainable apartment housing: new build and retrofit* (Easthope, Palmer et al. 2023) is to ensure that a CE is embedded in current practices shaping the production, use and reuse of Australian apartment buildings, along with more robust and specific regulations that are required to enable more precise project planning. Such an approach would make it easier to include sustainability at the project feasibility stage. Furthermore, property-valuation processes need to take better account of building performance over time, in order to facilitate consumer demand for greater sustainability. Other important stakeholders, such as strata property owners, must be considered and where possible included in sustainability initiatives that affect them.

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. Thus, successful projects and best practice applied to apartment buildings can influence other sectors to implement change toward the real application of CE principles.

Long-term stable commitment—for example, provided in a legal framework, building code and long-term policy and funding contracts—can provide certainty, de-risk investment and organisational practices to allow for and enable learning through innovative piloting and development. This issue has become much more important with rising energy and housing costs and increasing cost of building materials used in retrofitting.

As shown in Europe, and in the UN report *Housing2030*, much can be achieved with the improvement of building standards. The EU established a legislative framework under the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive. Together, the obligatory strategies promote national-level policies and regulations to achieve a highly energy-efficient and decarbonised building stock by 2050, and to create a stable environment for investment decisions for both consumers and investors. The impact of these directives has been considerable. The directives have ensured the introduction of energy performance rules into national building codes, which means that new buildings today consume only half as much energy as typical buildings from the 1980s (Lawson, Norris et al. 2021).

There are also European efforts to monitor existing buildings. For example, French regulations require all buildings of the energy classes F and G to be renovated by 2028. The French Energy and Climate Act includes innovative ideas on how to deal with the worst-performing buildings—for example, by introducing mandatory audits from 2022 (Lawson, Norris et al. 2021).

A very high proportion of apartments are rented in Australia, so it is of central importance to consider the energy standards for rental properties so that energy poverty can be addressed. This could include:

- obligations on landlords to meet energy-efficiency standards upon letting or reletting
- requirements for long-term maintenance of housing assets
- moderating the costs passed through to tenants via asset management requirements and, when necessary, subsidies.

Putting vacant homes back in use is also important to circularity. Vacancy taxes can be used to ensure effective use of needed housing, and to reduce underutilisation and speculative practices. Related to this is the appropriate harnessing of the sharing economy:

- enabling collaborative group housing solutions and modular living to expand opportunities
- making use of underutilised buildings
- supporting inclusive access to affordable housing.

However, care must be undertaken in monitoring the affordability of CE—especially for low-income households. Higher standards of energy efficiency and circularity can also increase up-front costs and exclude low-income households, so it is important to design policies that ensure social equity of outcomes, and provide measures to smooth and facilitate industry transformation.

3.3 Retrofit of social housing (Project C)

The focus of Research Project *Sustainable social housing retrofit? Circular economy and tenant trade-offs* (Baker, Moore et al. 2023) was to collect the rarely considered preferences and retrofit trade-offs of tenants. These preferences and trade-offs were then presented to key potential stakeholders to build a better view of retrofit practice and implementation, and to make explicit the role of CE and how retrofitting can contribute toward it.

The focus of sustainability retrofit activity in housing has been driven largely by energy efficiency and alternative energy technologies. Other CE housing priorities have drawn less attention—for example, minimisation of construction waste, durability, passive design and extending the life of dwellings. Moreover, most retrofit programs have been market-based, and thus overlooked need as the key driver, noting that many people lack access to even a basic quality of housing—a place that:

- is safe and warm
- does not leak when it rains
- supports the daily functions of cooking or cleaning.

These households are generally the least likely to be targeted by retrofit or able to fund or access retrofit (see Section 2.1 of *Sustainable social housing: solutions for large-scale retrofit* Project C Final Report).

In general, retrofit activity has been piecemeal, through individual and often local and time-limited programs or demonstration projects, and focussed on individual dwellings. This has shaped costing and pricing, learning rates and the nature of businesses involved. Also, given the short-term, localised nature of initiatives, it has shaped the level of upskilling, commitment and investment. This places current practice far from approaching comprehensive, reliable, widely available and affordable CE retrofit availability across the housing stock.

The research in this project found that households' preferences for housing retrofit and upgrades did not generally align with what housing energy-efficiency technology experts consider to be optimal retrofit priorities, nor with the upgrades that generally receive co-funding in retrofit programs—with the exception of solar panels.

The activities that are often considered by housing energy-efficiency technology experts to have the best cost-benefit outcomes—such as sealing draughts and ensuring appliances are operating efficiently—were not on the radar of most households. These options were less 'visible' and the benefits were not immediately evident, well communicated or recognised by householders. In general, low-cost, high-benefit (for energy use or CE) activities aimed at improving the lifespan and performance of the existing base dwelling and appliances fell into this category.

Social housing providers (SHPs) are challenged to balance their competing obligations as a business with their social obligation to assist their residents. They must maintain what is often poor-quality dwelling stock, improve it, build more, and remain solvent as a business. These competing obligations temper their ambition to embrace CE and environmental sustainability. Regarding a recent new-build development, one panel participant said that they had *'hoped we would have enough surplus to build 6-star, but with a smaller surplus [due to the recent rise in construction costs] we just do the best we can'*.

SHPs also rely on access to tied government funding to maintain or improve the quality of their stock over time. The structure and timing of this funding was raised by most panel participants. It was noted that such government administered programs were a central means for retrofit and upgrades to their dwelling stock, but that this funding was almost always 'themed', so the retrofit activity that occurs in the sector is largely driven by the themes of funding available—rather than, for example, tenant requirements, the specific needs of a housing provider's dwelling stock or CE considerations. In addition, tied, themed funding may be designed to have impacts beyond the housing system, so it may often have a rapid-spend requirement. This is known to limit the types of retrofit that can be achieved, as 'quick-win' interventions may not optimise benefits to tenants or engagement with them.

The objectives underlying retrofit programs vary between stakeholders. For example, SHPs may be motivated to assist their tenants to reduce energy poverty, while industry groups may be principally focussed on sustainability outcomes, while many tenants may be motivated by improving the liveability of their home. The different and often competing objectives of retrofit limit success and ease of retrofit programs.

The research has revealed the complex, conflicted and, until now, hidden differences in how retrofit is understood and engaged with across social housing stakeholders. Discussion of retrofit in policy quietly assumes that every stakeholder group has a shared goal, but that has not been indicated by this research. Moreover, retrofit, at least in the social housing sector, is a haphazard process, guided by good but often conflicting intentions.

3.4 Building materials supply chains (Project D)

The Research Project *Building materials in a circular economy* (Dalton, Dorignon et al. 2023) found that there is limited consideration and engagement with CE principles within the residential housing industry and its material supply chains.

A starting point for informing the development of CE is to analyse the institutional arrangements of material supply chains that supply manufactured building materials containing embodied GHG emissions to the residential housing industry. This type of analysis can assist in showing how the housing industry and its supply chains can contribute to reducing GHG emissions by using low-carbon materials and relying less on virgin materials. It can also assist by showing how the industry can close loops by reducing waste through reusing, recycling and recovering resources in the industry and its supply chain.

Important findings were identified during the research, which focussed on the following:

- Mapping and analysing the flow of materials into and out of the housing system, and the availability and quality of the necessary data.
- Design and onsite decisions about material choice and material reuse for low-rise and multi-unit apartment housing construction.
- The institutional arrangements of manufactured-material supply chains that supply materials to housing industry builders.

The Research Project established the following.

First, the material flow analysis (MFA) found that data for tracking material stocks and flows through the residential construction sector is inadequate. This applies to new and existing materials as they move through the construction and demolition waste streams. A novel approach, using top-down available datasets and bottom-up generation of data, was developed. It showed that the use of concrete is continuing to increase—which is increasing the carbon intensity of housing. Further, while the number of houses constructed each year has not changed significantly over the past 50 years, the size of houses constructed and changes in materials has significantly increased the carbon intensity of new housing. The improved understanding of material flows is important for developing an industry CE. The analysis can be extended and improved through the development of better data systems.

Second, analysis of two sustainable housing developments in Victoria (The Cape and Nightingale Village) highlighted the challenges facing the introduction of CE. Both case studies are widely regarded as best practice examples of sustainability, and the research examined their design and construction and searched for practices that could be regarded as CE practices. The Cape builders sought to respond to CE principles by facilitating stakeholder collaboration in the design, construction and occupation phases. At the Nightingale Village, while the building life cycle was considered, the emphasis was on reducing up-front costs and meeting environmental objectives by reducing material use. These cases highlighted the challenges the industry faces. Some changes were easy, such as brick reuse, while others, such as timber reuse, were more difficult because of concerns about structural integrity. Also, material reuse was constrained because of the lack of onsite storage between deconstruction and construction. The cost of disassembly and material reuse is a barrier that builders cannot overcome on their own.

Third, the research found through three case-study analyses of materials supply chains—concrete, steel and timber—that builders source materials from suppliers without assessing embodied carbon created by manufacture. All three supply chains have local and global features, which means that reducing emissions requires governance arrangements that span multiple jurisdictions. High-emission concrete and steel industries have committed at a global level to staged emission reductions. Their decarbonisation ‘pathways’ will require significant reinvestment in plant and equipment, product innovation and change in design and patterns of use in downstream supply chains. Timber is used extensively in detached residential housing. However, use of timber in the multi-unit apartment industry has stalled. This means that the carbon intensity of housing is increasing as new detached housing as a proportion of all new housing decreases and the proportion of multi-unit housing increases. Material supply chain decarbonisation and CE development will require close attention to supply-chain institutional arrangements, and collaborative reform supported by broader public policy.

Institutional arrangements and required changes to achieve CE

The institutional perspective reveals how industry fragmentation continues to shape the flow of building materials in housing construction. Builders draw materials for house and multi-unit apartment construction from many supply chains, and draw products and services from at least 27 industries. Building materials supply chains are dominated by oligopolistic building-materials manufacturers. There are also innovators and risk-takers seeking to change materials design, production, distribution, disposal and reuse. There are various opportunities and constraints for CE innovation, both within oligopolistic supply chain arrangements and smaller innovative risk-taking companies. All key institutional actors in the supply chain will need to change if there is to be systematic and deep reduction, reuse, recycling and recovery of resources.

Reducing the use of new resources and lowering emissions must recognise actor groups and supply chain relationships (De Groote and Lefever 2016). These arrangements are important, because implementing CE arrangements requires disruptive change as it begins to decouple economic growth from exploitation of natural resources.

Challenges and opportunities for CE material supply chains

In the Australian housing industry, implementing CE will need to face the dominance of small businesses and the limited presence of larger companies. The preparedness of businesses, particularly small detached housing and multi-unit housing businesses, to participate in disruptive change is likely to be an issue. Already, through their associations, they have resisted the proposed increases in energy efficiency (Bleby 2022; Crabtree and Hes 2009; Hannam 2022). Nevertheless, innovators and risk-takers, both small and large, do seek change in product design, production, distribution, disposal and reuse. The Green Building Council Australia (GBCA; 2021) Green Star Home Standard supported by some businesses is an important example.

This structural feature of the housing industry and its history suggest that the development and implementation of required and regulated CE supply-chain arrangements would meet with resistance. This resistance will be through industry intermediary organisations that act as agents or brokers in innovation or change processes, even though some may support proposed changes (Barrie and Kanda 2020).

Another challenge for the housing sector is to develop strategies to decarbonise the flow of materials into the housing stock, increase material reuse, and reduce the use of new materials. CE principles are best put in place at the design phase—which can be difficult, given the lack of expertise and the constraints of financing which mitigate against offsite manufacturing. The recovery and reuse of building materials is also difficult in the absence of regulation, underpricing of landfill, the absence of markets, and poor waste stream data collection.

There is some reuse of materials—principally, concrete and steel, where there is a market. However, timber reuse is limited to niche or boutique initiatives. Reuse of timber is problematic because of the costs of removing nails, and questions about its compliance with standards. Similarly, kitchen and plumbing supplies are rarely reused or recycled. Reusing bricks is labour-intensive—they require cleaning prior to reuse, and transport is expensive.

4. Informing a circular economy housing strategy

- **A CE approach can contribute to more sustainable housing outcomes if supported by a set of agreed goals, measures, targets and suitable monitoring.**
- **To affect change requires an understanding of the context and motivations influencing relevant stakeholders.**
- **CE housing requires multi-level governance and integration of effort across policy portfolios. This includes planning beyond market processes. For example, including the innovation-driving role of technical universities; inviting participation from private-sector and non-government stakeholders from different segments of the affordable housing system; purposeful procurement in major publicly led renovation schemes.**
- **Sections of the housing industry are undercapitalised and lack the resources to be able to unilaterally develop the skills and resources required to lead, experiment and shoulder the inevitable risks of the CE housing transition.**
- **Strategic efforts are required to minimise these risks, such as more accurate property valuations incorporating CE and embodied energy (EE) certification, CE definitions in investment mandates and planning requirements, as well as clear and consistent regulation and pathways of reform.**

A CE approach can contribute to more sustainable housing outcomes. This requires a set of agreed goals and long-term plans that focus efforts of stakeholders towards desired outcomes, and that are supported by measures, targets and suitable monitoring systems. It necessarily traverses the realm of varying institutional capacities, as well as multi-level governance and partnerships. It also incorporates evidence-based standards, their supervision, and implementation by mission-focussed agents, as well as the involvement of consumers and users of housing—the owners, managers and residents themselves holding varying market power (Lawson, Norris et al. 2021: 6).

Knowledge of the context and motivations influencing relevant stakeholders is required in order to inform change to deliver CE outcomes. It also means considering the principles that inform the processes of change, whose interests are impacted, and which measures will enhance a just and equitable transition.

This Inquiry applies this understanding in a practical and coherent way, examining the processes affecting circular practices in various micro-systems of the broader housing system. The scope of CE points to the need for multi-level governance and integration of effort across policy portfolios. It also requires planning beyond market processes. For example, including the innovation-driving and facilitative role of technical universities, and inviting participation from private-sector and non-government stakeholders from different segments of the affordable housing system. Also important is purposeful procurement in major publicly led renovation schemes.

Research undertaken for this Inquiry shows that the adoption of CE for housing in Australia is inhibited by:

- low or unspecified standards
- adverse actor motivations and incentives
- up-front costs to investors and consumers
- lack of professional awareness and training (Easthope, Palmer et al. 2023).

The widespread adoption of high quality, durable, low-impact, low-risk materials, as well as maintenance systems aligned to extend asset life, is held back by:

- high initial cost
- incomplete markets
- insufficient know-how and incentives (Dalton, Dorignon et al. 2023).

Barriers to ‘market-led’ CE transitions in housing include those areas where there is:

- lack of investment and revenue resources—low-income households, social housing
- market failures—private rental system.

Sections of the housing industry are undercapitalised, and lack the resources to be able to unilaterally develop the skills and resources required to lead, experiment with and shoulder the inevitable risks of the CE housing transition. Strategic efforts will be required that minimise these risks, including:

- more accurate property valuations that incorporate CE and EE certification
- CE definitions in investment mandates and planning requirements
- clear and consistent regulation
- pathways of reform.

There are opportunities to supplement planned improvements in building code stringency by developing CE-oriented supporting measures, including:

- energy efficiency and zero-waste policies
- better regulations on material flows
- upscaling technological improvements
- further conditionality in contractual arrangements.

A more industry-relevant approach—including appropriate definitions, standards and policy instruments—can be developed to accelerate the transformation towards CE in Australian housing. Policy instruments and supporting measures should address the fact that various initial, up-front costs are involved in the shift to CE housing, and many stakeholders are unable to bear these, despite the fact that total life-cycle costs are clearly beneficial to these stakeholders, as well as to society and the planet. Instruments such as energy performance contracting are longstanding in the energy-efficiency field, as are industry innovation vehicles to subsidise the costs of leading innovation for individual participants. As practice becomes widespread and learning rates established, such incentives can be reduced.

4.1 Policy development option 1: Adopt the quadrant framework

A summary of the findings across the Inquiry projects and the Inquiry work itself follows.

- Currently, there are insufficient policy frameworks and processes to support the implementation of a CE across the housing industry, necessitating a coherent strategy. There are many examples of approaches internationally, and Australia can learn from these (Lawson and Dorignon 2021).
- The adoption of CE for housing in Australia is inhibited by low or unspecified standards, adverse actor motivations and incentives, up-front costs to investors and consumers, as well as a lack of professional awareness and training in different fields of action. These factors apply to the neighbourhood, to apartment construction and renovation of social housing, as well as to the materials sectors (Baker, Moore et al. 2023; Dalton, Dorignon et al. 2023; Dühr, Berry et al. 2023; Easthope, Palmer et al. 2023).
- The widespread adoption of high quality, durable, low-impact, low-risk materials, and maintenance systems aligned to extend asset life is also held back by high up-front costs, incomplete markets, and insufficient know-how and incentives (Pawson 2021).
- Different types of policy intervention are required to address these deficiencies and support more sustainable homes and neighbourhoods over time (Lawson and Dorignon 2021).

Regarding policy frameworks, higher regulatory standards are needed, often in combination with fiscal and financial frameworks, business support schemes, and education and training (Baker, Moore et al. 2023; Dalton, Dorignon et al. 2023; Dühr, Berry et al. 2023; Easthope, Palmer et al. 2023).

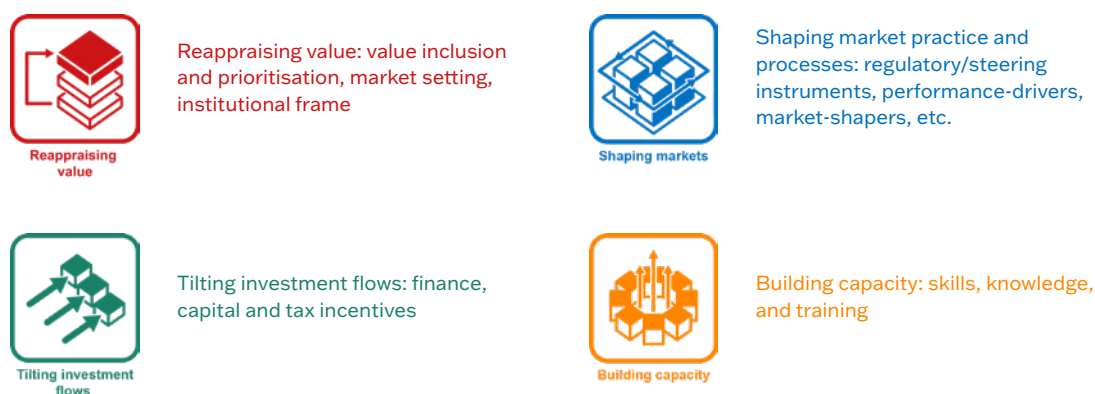
- Furthermore, new partnerships need to be fostered between governments, private developers and local communities with suitable governance approaches in order to implement more sustainable neighbourhoods and circular processes for production, use and reuse of goods and services (Dühr, Berry et al. 2023).
- There is great potential to improve the performance of new and existing apartment buildings through interventions that embed sustainability in the work of development teams, project feasibility, valuation and post-occupancy monitoring (Easthope, Palmer et al. 2023).
- Information on building sustainability, including common areas and services, can also inform the decision-making of residents and owner-managers (Easthope, Palmer et al. 2023).
- At present, the retrofit of social rental housing competes for scarce budgetary resources. The preferences of tenants are little understood, and they may prioritise liveability and affordability over energy-efficiency concerns. Building managers need to address residents' very real concerns (Baker, Moore et al. 2023).

- Understanding the structure of building-material supply chains is essential for policy development seeking to reduce carbon intensity of new material choice and use in the housing industry (Dalton, Dorignon et al. 2023).
- Housing industry engagement with the CE and reducing GHG emissions through reuse, recycling and resource recovery rather than using virgin materials will require the development of an efficient and responsive 'used' materials market (Dalton, Dorignon et al. 2023) as well as an education and training strategy (Fairbrother, Banks et al. 2021).

This array of evidence points to the need for reform to be undertaken across four thematic areas, or quadrants. Each quadrant provides a coherent suite of actions and initiatives. When combined with the other three quadrants, this provides a framework that can be used as a basis for a strategy towards CE housing. The thematic quadrants are as follows (see also Figure 5):

- **Reappraising value:** value inclusion and prioritisation, market setting, institutional frame. This relates to research questions 1 and 2.
- **Shaping market practice and processes:** regulatory or steering instruments, performance-drivers, market-shapers, etc. This relates to research questions 2 and 5.
- **Tilting investment flows:** finance, capital and tax incentives. This relates to research question 5.
- **Building capacity:** skills, knowledge and training. This relates to research question 3.

Figure 5: Quadrant framework for a CE housing strategy



4.2 Policy development option 2: Set up a vehicle

The thematic quadrants in Figure 5 provide a picture of what needs to change. This section addresses the question of *how*.

A strategy can only be successful if it attracts buy-in from diverse stakeholders. Therefore, a key action is to leverage the findings through a design-implementation process that involves a wide spectrum of industry and policy stakeholders. A Commonwealth Task Force should be set up to undertake this work.

Such a process will involve:

- multiple industry sectors
- engagement with and across the capacities of all three tiers of government
- pilot programs to develop and test new business models
- agreement on the adoption and procurement of platform technologies—such as approved online applications to source, check, trade and transfer second-hand building materials.

A think tank could be charged with the task of linking housing and waste in new ways. This think tank could involve:

- researchers
- training organisations
- waste industries and their representative bodies
- housing industries and their representative bodies
- related finance, marketing, software development and other sectors.

It could also monitor and evaluate pilot projects and initiatives, both in Australia and overseas, as the CE strategy is implemented over time—thus providing a mechanism for industry learning and progress.

Transitioning to CE housing is a shared responsibility that involves actors across the housing system. It flows from the recognition that all stakeholders—planners, local government authorities, developers, property valuers and builders—are part of a single industry, albeit a splintered and heterogeneous one. Therefore the task is to build capacity and shape practice across this diverse industry, including across the phases of construction, occupation, maintenance, renovation and demolition, and the businesses and policy actors involved in each of these.

Moreover, CE housing cannot be achieved by the housing industry alone. Purposeful public intervention is required, together with broad stakeholder cooperation from allied sectors of finance, construction, planning and project management, as well as from other sectors, from care and health to waste and manufacturing.

However, this is not to absolve the housing industry from a key role in the transition. It is critical that:

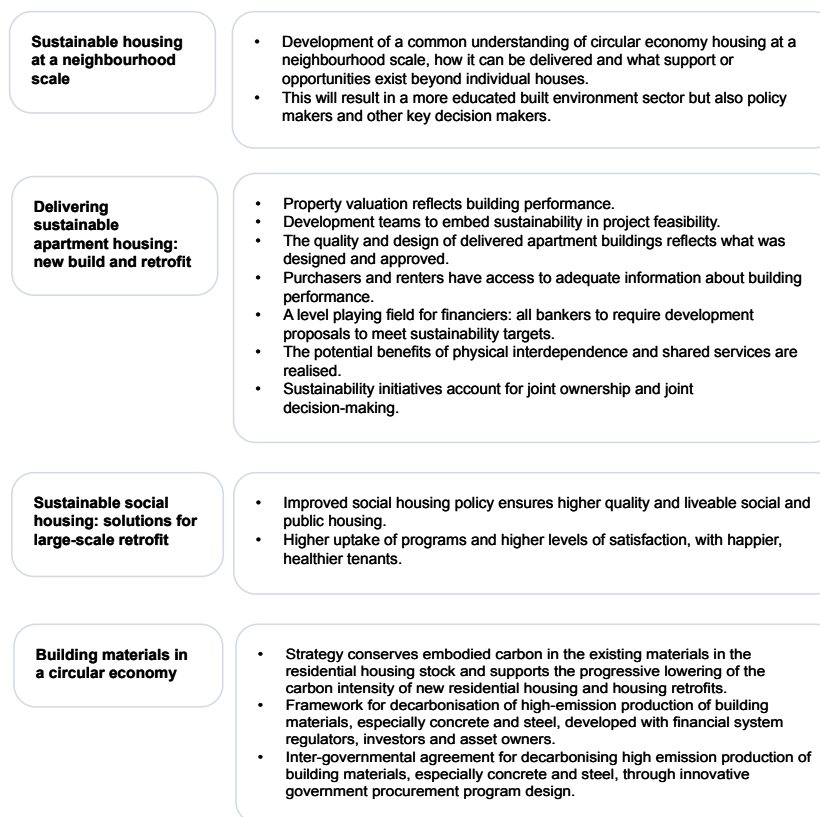
- the housing industry steps up
- leading CE practice is incentivised and supported
- economy-wide changes are instituted on sustainability and carbon neutrality. This will reinforce shifting social structures, institutions, discourses and priorities across society.

Mutual reinforcement between the housing sector and society is central in a successful transition to CE housing.

4.3 Policy development option 3: Confirm goals and roles

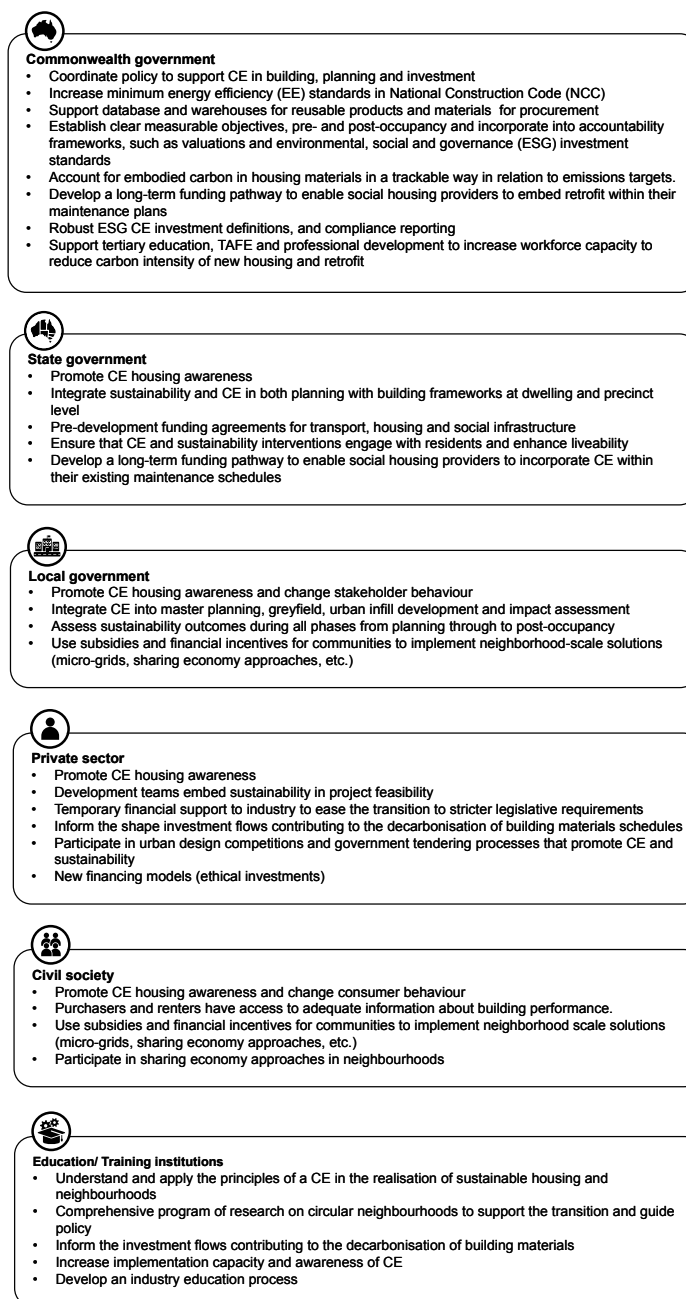
High-level goals have been established for each of the four housing fields that are the focus of this Inquiry research (see Figure 6). This Inquiry has also established a list of tasks across six actor groups (see Figure 7). Policy development option 3 is to use these goals as inputs into Commonwealth Task Force deliberations and consultation, with the aim of confirming key goals and roles in the CE housing strategy.

Figure 6: High-level goals for each housing field



Source: Dühr, Berry et al. (2023) ; Easthope, Palmer et al. (2023) ; Baker, Moore et al. (2023) ; Dalton, Dorignon et al. (2023).

Figure 7: Actions and tasks for responsible leaders



Source: Dühr, Berry et al. (2023) ; Easthope, Palmer et al. (2023) ; Baker, Moore et al. (2023) ; Dalton, Dorignon et al. (2023).

4.4 Policy development option 4: Establish tools and phasing

A toolbox of six key instruments has been established from the Inquiry research as a starting point for organising and engaging in action towards CE housing. Each instrument will have different applications across the fields of housing, in enacting the quadrant framework (Figure 8). Of course, there is a need to sequence and prioritise actions over time, as indicated in Figure 9. Policy development option 4 is to use these instruments as inputs into Commonwealth Task Force deliberations and consultation, with the aim of confirming tools and phasing in the CE housing strategy.

Figure 8: Elements of the quadrant framework for CE housing

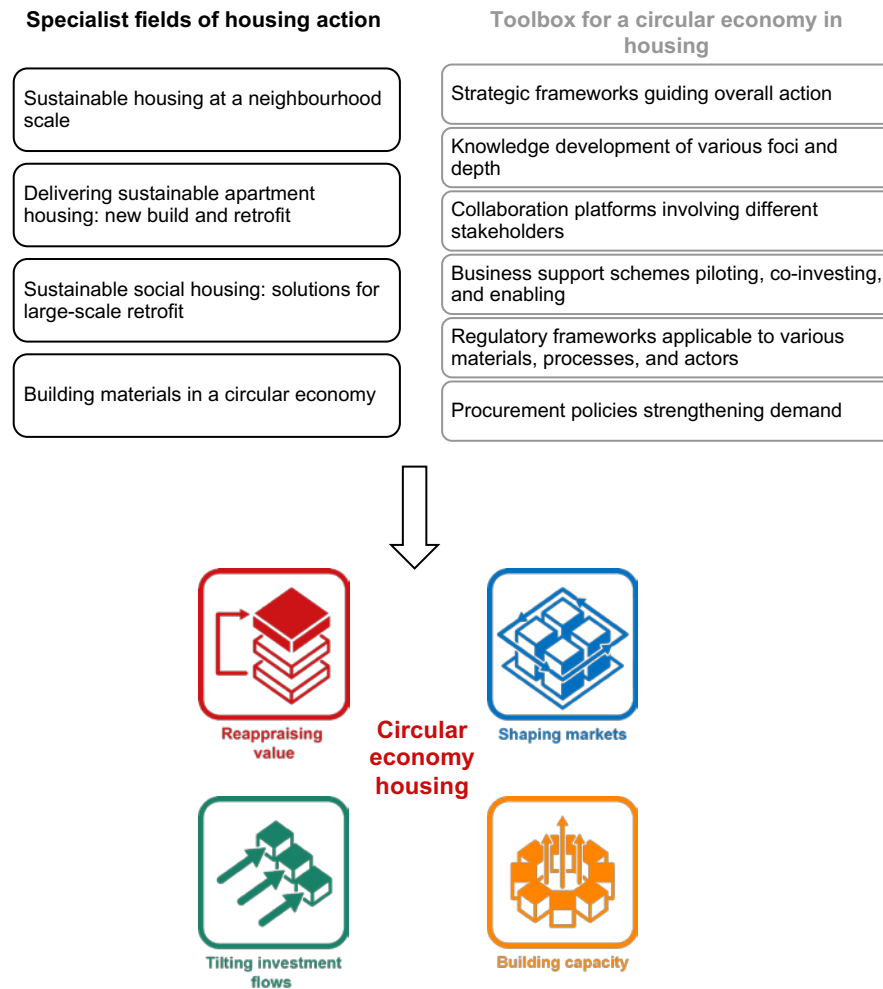
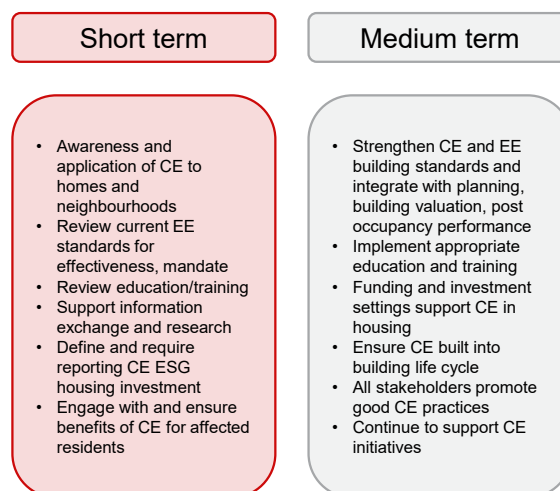


Figure 9: Phasing considerations



4.5 Policy development option 5: Test and rollout action plans

In 'The Policy Framework: Actions towards Circular Economy housing in Australia', an agenda for integrated action across the four quadrants is tailored to distinct fields of the residential sector. The actions are presented in graphic form. Policy development option 5 is to test and utilise this material in order to facilitate engagement, discussion and agency in the CE housing strategy. For example, the following sheets could be used as prompts in meeting with planning agencies and stakeholders, and to inform the Commonwealth Task Force on the CE housing strategy for sustainable housing at the neighbourhood scale. There are four to six sheets on each Inquiry Research Project:

- *A Sustainable housing at a neighbourhood scale.*
- *B Delivering sustainable apartment housing: new build and retrofit.*
- *C Sustainable social housing: solutions for large-scale retrofit.*
- *D Building materials in a circular economy.*

4.6 Conclusion

This Inquiry report has established that current policy frameworks and processes do not support the implementation of a CE across the housing industry.

In the face of both the climate crisis and the housing affordability crisis, the shift to CE housing is urgently needed and requires multi-directional effort. A wide range of deficits has been identified that are holding back progress towards CE housing in Australia, including:

- inappropriate standards
- adverse actor motivations and incentives
- lack of professional awareness and training.

The widespread adoption of high quality, durable, low-impact, low-risk materials, and maintenance systems aligned to extend asset life, is held back by:

- high up-front costs
- incomplete markets
- insufficient know-how and incentives.

An array of interventions and instruments is required to address these deficiencies. In the first instance, further reform of regulatory standards is needed, often in combination with fiscal and financial frameworks, business support schemes, and education and training. New partnerships between governments, private developers and local communities with suitable governance approaches will be required.

High-level principles to drive reform have been developed through the research and the tasks of responsible stakeholders summarised. Five policy development options are made to inform a strategy for CE housing in Australia:

- **Policy development option 1:** Adopt the quadrant framework—a comprehensive range of interventions is necessary as illustrated in the framework developed through this research.
- **Policy development option 2:** Set up a vehicle—this report proposes a Commonwealth Task Force be established and charged with oversight of the CE housing strategy.
- **Policy development option 3:** Confirm goals and roles—the research has established high-level goals and a set of activities across six key actor groups.

- **Policy development option 4:** Establish tools and phasing—the research has established six tools and advocates that each is applied across housing subsectors and over time in specific ways.
- **Policy development option 5:** Test and rollout action plans—'The Policy Framework: Actions towards Circular Economy housing in Australia' is available as an agenda for integrated action, to inform and guide conversations about the transition to CE housing in Australia. A Visual Summary is also available to illustrate the report findings.

The Inquiry findings are limited by the scope of the work, which was limited to four projects and an overarching Inquiry linking them. While this is sufficient to inform a CE housing strategy for Australia, in the next phase it is inevitable that further areas will emerge between and beyond these four projects. In turn, these will indicate further research needs.

The key next phase is to translate the research of this Inquiry into a delivery phase, where a national strategy can be established and implemented. This will involve wide consultation and coordination. The gravity and urgency of the climate emergency and the housing affordability crisis together warrant a significant, coordinated national effort to recalibrate the housing industry and ensure its sustainable future.

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