Circular Economy Hub @RMIT Submission to the Productivity Commission

Executive Summary for the Productivity Commission Submission on Circular Economy

Definition

Vision for Circular Economy

The overarching vision for the circular economy in Australia is to create a sustainable, resilient, and regenerative system that minimises waste (waste to be seen as a resource), maximises resource efficiency, and fosters innovation. This vision aligns with global efforts and emphasises the need for systemic change to address the sufficiency problem, ensuring that resources are used efficiently and sustainably. Designing for circularity is central to meeting this vision.

Systemic Connection

The circular economy requires a systemic approach that integrates various sectors and stakeholders. This includes harmonising regulations (national / state / local as well as across sectors such as EPA policies supporting stockpiling so resources may be available for secondary markets, etc), supporting coordination services, and fostering innovation through challenge-based funding and collaboration between industry and researchers.

Summary of issues recommendations and areas of focus

Key Issues and Recommendations

1. **Sufficiency as the Core Problem**
   - **Challenge**: The primary challenge is addressing sufficiency, which involves ensuring that the planet's resources are used sustainably to support the population. This includes managing land use, population density, and resource consumption.
   - **Current Measures**: While current measures and metrics are useful, they do not fully address the sufficiency problem. There is a need for a more comprehensive approach that considers the long-term sustainability of resource use.
   - **Solution**: Develop strategies that focus on sufficiency as the overarching problem, ensuring that all other measures and reforms contribute to this goal.
2. **Transition Research Enablers - CERN-APAC** is a Circular Economy Research Network between RMIT, Monash and Swinburne Universities, together with the CSIRO providing transdisciplinary research capability for facilitating the transition to a circular economy by connecting stakeholders, sharing research outputs and outcomes, and promoting collaboration. CERN-APAC acts as a bridge between different sectors, helping to coordinate efforts and share best practices to support designing for circularity and assisting Australia and the region in its transition to circularity across all sectors.
3. **General Reform Suggestions**
   - **Designing the Circular Economy**: Implement different models, metrics, and indicators to design a circular economy that is tailored to Australia's unique context. This includes considering local environmental, economic, and social factors.
   - **Made in Australia**: Emphasise local production to reduce reliance on imports and support the local economy. This includes promoting the repair movement, ensuring accountability for imported goods, and focusing on high-quality, sustainable products.

- **Repair Movement**: Encourage the repair and maintenance of products to extend their lifespan and reduce waste, linked to slowing the loop (see below).
- **Accountability for Imports**: Implement measures to ensure that imported goods, particularly textiles, meet sustainability standards and the circular economy vision, including extended producer responsibility.

4. Being true to the value capture underpinnings for the circular economy:

- **Slowing the Loop**: Emphasise repair and maintenance to extend the lifespan of products. This reduces the need for new resources and minimises waste.
- **Narrowing the Loop**: Promote energy-efficient processes and the use of renewable energy to reduce the environmental impact of production and consumption.
- **Closing the Loop**: Redesign systems to ensure that materials are reused and recycled, minimising waste. This requires a fundamental rethink of how products are designed and manufactured.

5. **Capacity Building and awareness**

   Capacity building in the 'green skills' areas with 'earn and learn' models. Knowledge and awareness campaigns so people understand the impact of their actions and the impact of their purchasing decisions. Meat vs vegetarian, packaged fruits vs market purchases, etc.

- **Prefabricated Housing**: Encourage the use of prefabricated housing to reduce manufacturing time and improve efficiency. This approach can also reduce construction waste, keep materials and products in use including buildings as material banks and support sustainable building practices.
- **Design for Maintenance**: Promote designs that facilitate maintenance, repair, reuse, and recycling. Try to push the approaches to the higher order of circularity, rather than always thinking about recycling. This includes designing products and buildings with their entire lifecycle in mind. There is a danger of 'lock-in' of solutions that deal with only end of pipe rather than the full design process associated with circularity.
- **Regulatory Framework**: Develop regulations that support circular economy principles and provide industry incentives and regulatory frameworks that support each other (for example, EPA regulations to support stockpiling for secondary markets). This includes creating a supportive regulatory environment that encourages inovation and long-term solutions for sustainable practices.

6. **First nations engagement:** In the current climate focusing on providing a voice to first nations in Australia, there is an opportunity to weave first nations knowledge and thinking in responding to circularity practices. Essential to note that pre-European civilisation in Australia, the country was very circular and sustainable. Bring in cultural thinking into the conversations similar to what is happening in New Zealand.

Specific Areas of Focus

1. **Built Environment**
   - **Recycled Materials in Public Projects**: Reduce regulatory barriers to using recycled materials in public infrastructure projects. This includes harmonising standards and specifications to facilitate the use of recycled inputs.
   - **Sustainable Procurement**: Enhance coordination mechanisms to support sustainable procurement policies. This involves creating platforms for information sharing and connecting suppliers with government agencies.
   - **Prefabricated Construction**: Address regulatory barriers to prefabricated construction to promote efficiency, circular economy and sustainability. This includes updating planning requirements and establishing compliance pathways.
2. **Food and Agriculture**
   - **Food Waste Reduction**: Facilitate greater donation of edible foods to the food relief sector. This includes addressing transport and storage constraints to divert edible food from disposal to food relief organisations.
   - **Biogas Production**: Support biogas production from organic waste by developing certifications and reporting methodologies to accurately value the environmental benefits.
   - **Industrial symbiosis**: Opportunities to support industrial symbiosis where possible to explore the use of resources (waste) that may not otherwise be used (wastewater, waste heat, waste from one sector being used in another across the higher order of circularity in the R-ladder of strategies).
3. **Textiles and Clothing - Product Labelling**: Improve labelling to provide information on the sustainability and circularity of textiles and clothing products. This helps consumers make informed choices and supports circular practices.
4. **Mining - Circular Economy Opportunities**: Reduce regulatory barriers to circular economy opportunities for mining waste and alternative post-mining land uses. This includes streamlining processes and permissions for re-mining and repurposing mining tailings. Cultural considerations in the use of first nations land.
5. **Vehicles** - **End-of-Life EV Batteries**: Establish a robust end-of-life management system for electric vehicle batteries to support a circular economy. This includes implementing a product stewardship scheme and improving traceability and standards for second-use batteries.
6. **Household Electronics** - **Reuse and Repair**: Promote reuse and repair of household appliances and consumer electronics through product stewardship schemes. This includes setting targets for reuse and repair and increasing the use of e-waste tracking devices.

Conclusion

The transition to a circular economy in Australia requires a comprehensive and coordinated effort across multiple sectors. By addressing the sufficiency problem, learning from our first nations peoples, promoting local production and repair, promoting awareness and building capacity, Australia can create a sustainable and resilient circular economy that benefits both the environment and the economy. The significant research capability of CERN-APAC provides a bridge between sectors and stakeholders informing how to design for circularity across sectors.

Sector – specific responses to the Productivity Commission Information Requests by the Circular Economy Hub @RMIT

1. The Built Environment

Information request 4.1: Enabling fit-for-purpose use of recycled materials in public projects

The Australian government should consider the work that is taking place at the global levels associated with circular economy in the built environment sector. The 10 WLC recommendations that Australia can also sign upto, launched at the Green building and climate forum in March 2024, in Paris following the work undertaken by the Breakthrough Agenda at COP 28, signed by 27 countries (Australia is not among them).

Main Topic	Specific request	Response
The PC is seeking information on prescriptive versus performance-based standards	specific examples where prescriptive standards or specifications for infrastructure construction significantly inhibit the use of recycled materials	National construction code (NCC) is performance-based standard. But it contains prescriptive elements such as Deemed-to-Satisfy provisions, which can limit the use of alternative materials, including recycled materials. • For instance, concrete mix design under AS 3600, as referenced in the NCC (Volume Two, Section 3.2.3.1), specify strict cement-to-aggregate ratios and fixed aggregate size requirements, limiting flexibility in material selection. This makes it difficult to substitute recycled concrete aggregate, even when performance tests demonstrate it meets strength and durability requirements.
	what other benefits or objectives these prescriptive standards are intended to achieve (for example, public safety, or to enable clarity for smaller businesses)	Prescriptive standards: • Enhancing public safety and structural integrity by stringent building codes, ensuring buildings are structurally sound, fire-resistant, meet safety requirements, • Ensuring consistency and quality control, by prescriptive standards which reduce risks of defects, specifically for smaller businesses with the lack of technical expertise in alternative material solutions.
	ways that various levels of governments could facilitate greater use of performance-based standards	• Revising and updating the NCC to integrate performance-based criteria for materials, particularly for recycled aggregates and steel (reinforcement). • Developing sustainable procurement guideline to be aligned with performance-based standards. • Training and capacity building for industry stakeholders, by providing programs and workshops to support AEC professionals in adopting performance-based design approaches. • Developing case studies and demonstration projects,

		Example: - Brummen Town Hall in the Netherlands was designed for future reuse and modular assembly, with 90% of its materials capable of being dismantled and reused, and its entire structural assembly documented in a material passport. A building that can be reused: Brummen Town Hall
	challenges, costs and benefits, and implementation issues that need to be considered if moving from prescriptive to performance-based standards (for example, monitoring and enforcement)	Shifting from prescriptive to performance-based standards can enhance flexibility, encourage innovation, and promote circular economy principles, but it also presents challenges related to compliance, costs, and implementation feasibility. Challenges and costs: • Increased the complexity in approval process as performance-based standards require case-by-case assessments and require several testing and certification to reach to the same strength and durability requirements. • Hight testing and certification costs as innovative materials such as recycled concrete or recycled PVC piping require lab testing and detailed engineering analysis. • Lack of industry readiness and regulator training, as government agencies must train regulators and certifiers to assess compliance • Evaluating compliance with performance-based standards requires advanced testing (e.g. modelling and simulations) and continuous monitoring, unlike prescriptive standards that rely on checklists. They also require more documentation, reporting, and auditing, leading to increased administrative costs for the governments and project stakeholders. • Effective monitoring of performance standards requires a comprehensive data collection and analysis approach. However, many government agencies may lack necessary tools and skills to gather and process large volumes of performance data, leading to gaps in compliance assessments. • Requires industry to invest in more robust data systems to enable reliable track, track and assurance that materials used on projects match design standards, for reporting purposes, placing an onus on data quality for compliance reporting.

		Benefits: • Promotes innovation in construction materials and adopting more reused and recycled content in materials support CE goals. This is mainly in the form of designing the system to support closing the loops to allow long term cost saving. • Promotes a proactive approach to risk management by prioritising long-term outcomes over compliance. It allows governmental entities to identify risks early, implement effective mitigation strategies, and strengthen project resilience. • Clear and measurable performance outcomes enhance the monitoring and evaluation of infrastructure projects. This framework enables governments to track performance over time, ensuring alignment with project objectives and providing data-driven insights for future improvements. • Promotes sustainability by allowing governments to set criteria to reduce carbon emissions, conserve water, and improve energy efficiency, fostering greener infrastructure solutions. • Promotes development and adoption of interoperable data systems by constructors that enable track and trace and provenance of materials to enable circular build performance targets are met. This can aid constructors to impute value in assuring that product innovation choices meet circular aims of the project as designed. This can help industry rebuild trust from regulators via improved accuracy and transparency of reported performance data.
Harmonisation of standards	key areas where there is scope to harmonise standards and specifications across states or territories and increase the use of recycled materials	• Standards should be established at the federal level, rather than at the state level • Current product stewardship schemes for the built environment primarily focus on aluminium cladding through industry-led voluntary initiatives. Expanding these schemes to include a broader range of construction materials would significantly enhance building material recycling and circularity. • Federal and state governments can lead by prioritising recycled materials in their procurement policies. This creates demand for recycled products, fostering market growth and encouraging suppliers to invest in sustainable materials.
	specific implications (costs, benefits, risks) of harmonisation (for example, due to lack of flexibility to reflect local	• Regulatory transition costs: updating current state-based standards to a national one which requires coordination with implementation of a phased rollout and allowing each state gradually to integrate national standards.

	conditions), and whether or how they could be overcome.	• Compliance and testing costs: standardised recycled materials approval requires testing and certification process which could be overcome through government certification subsidies for these types of materials. However, it's not always about direct cost—benefits can extend beyond economic gains to include enhanced reusing, recycling etc. Example: Brummen Town Hall in the Netherlands – 90% material reuse A building that can be reused: Brummen Town Hall

Information request 4.2: Coordination mechanisms to enhance the benefits of sustainable procurement policies

Main Topic	Specific request	Response
Coordination mechanisms to enhance the benefits of sustainable procurement policies	the benefits and costs associated with introducing or expanding government-led coordination initiatives to support public procurement policies in different jurisdictions	A centralised information platform for reused and recycled materials would not only increase market demand but also reduce the regulatory fragmentation in their adoption. By providing access to the verified supplier and standardising material approvals, such platform will facilitate procurement, enhance industry uptake, and create jobs which leads to both economic and environmental benefits.
	How further government efforts to facilitate coordination between suppliers, contractors and government agencies could be implemented to maximise net benefits to the community	Expanding interstate governmental initiatives, such as NSW joint procurement support, could serve as an effective model for national alignment. Creating markets for secondary materials, allowing stock piling and ensuring EPA policies are supportive of creating such secondary markets (for instance for timber in Finland). Current sustainable procurement policies only require a policy/plan to source sustainable material, with little to know evaluation after project completion. There is a risk that contractors could identify what sustainable procurement practices will be conducted but not going ahead with such procurement. There needs to be mechanism to check if the policy has been adhered to. **Reference**: • Joint Procurement Funded Support | EPA

		• NSW Waste and Sustainable Materials Strategy 2041 • Waste and Sustainable Materials Strategy | EPA
	specific ways that coordination could assist suppliers of recycled materials to navigate sustainable procurement policy requirements and help government procurement agencies and suppliers identify win-win opportunities.	Establishing national databases and fostering public-private partnerships can help suppliers of recycled materials navigate sustainable procurement policies. A national database would provide clear information on approved recycled materials, verified suppliers, and procurement standards, reducing uncertainty and administrative burdens. Public-private partnerships can drive innovation by connecting suppliers with government agencies and contractors, facilitating collaboration on pilot projects and scaling up the use of recycled materials in public infrastructure. Needs local, state and national coordination to optimise material procurements.

Information request 4.3: Reducing unnecessary regulatory barriers to prefabricated construction

Main Topic	Specific request	Response
The PC is seeking further information on the regulatory barriers to prefabricated construction	The extent to which recently announced measures by the Australian Government (the Australian Productivity Fund and the Voluntary Certification Scheme) will address key barriers to prefabricated and modular construction – how these initiatives could be implemented to maximise the net benefits to the community	While these funding initiatives will help facilitate the adoption of prefabricated construction, a key challenge raised by the architecture, engineering and construction (AEC) stakeholders, particularly builders in Australia, is the long transport distances between manufacturing facilities and construction sites, often exceeding 500 km. The logistical complexity and costs associated with transporting prefabricated elements remain a significant barrier to wider adoption. Can manufacturing hubs in areas of 'need' (based on population, housing needs, material impact, etc) be identified to support such centres? Also essential to support local capacities for repair and maintenance. To maximise the benefits of these schemes, it is essential to involve industry professionals, local governments, and community in the development and refinement of certification standards to be integrated with NCC. These collaborative approaches will ensure that the standards address practical challenges, improve feasibility, and maintain public trust.

Specific regulatory changes (including recommendations from previous reviews that remain relevant) that would have the largest effect on uptake of prefabricated and modular construction	– The magnitude of the environmental, economic and social benefits associated with these changes, and measures and metrics that may quantify this – Costs associated with the changes, including resources required for implementation, compliance and enforcement, and potential impacts on the environment associated with different regulations – How regulatory changes could be implemented to maximise the net benefits to the community.	Updating planning and zoning regulation to support prefabrication and allows local council codes and regulations support off-site facilities. • Cost associated with increasing offsite facilities closer to local councils and establishing manufacturing hubs which minimise transport distance and reduce emissions accordingly. • Training the planning officers and building inspectors on modular and prefabricated approvals to fast track the approval process. • Ensure that demonstrations / pilots are used for learning across all stakeholders. • Implement strategies like pilot programs in high growth areas before rolling out nationally. Prefab housing promised 50 years ago as solution to housing supply crisis - ABC News

Information request 4.4: Other circular economy opportunities in the built environment

Main Topic	Specific request	Response
The PC is seeking the following information on government assessment of public infrastructure projects, and integrated planning	any examples of infrastructure investment decisions proceeding without adequate integrated planning or assessment, which have led to significant unnecessary materials use and waste that may otherwise have been avoided	The Victorian Government decision to demolish and redevelop 44 high-rise public housing buildings, without any analysis or assessment of alternative methods is one example. The Government's lack of transparency regarding the rationale for demolition raises concerns about other factors motivating the choice to redevelop the tower estates. Refurbishment and renovation of public buildings are often overlooked in favour of new construction projects due to political factors, such as short-term political gains associated with new construction and ribbon cutting syndrome; social factors, such as public appeal and media attention to new projects, and; psychological factors, including a tendency to take the service of existing facilities for granted.

		Some major road projects aimed at widening highways and freeway expansion have led to the demolition of existing built infrastructure which generates major construction waste that ends up mainly in the landfill. Further, government office buildings and educational facilities have been constructed with excessive space provisions, leading to wasted materials and underutilised floor areas. Existing (largely) office buildings across major metro centres such as Sydney and Melbourne are lying vacant leading to stranded assets and underutilised spaces. Not all these are appropriate for housing. Other amenities such as medical centres, aged care facilities and the like may be adapted for such spaces. For example; the exploratory research undertaken for adaptive reuse of second grade office building in Melbourne: *Space wars: rethinking underutilised city commercial buildings* **Impact**: • Unnecessary resource consumption in construction (e.g., oversized HVAC, excess steel, and triple glazing windows). • Current regulations require air conditioning systems to maintain temperature standards even when office buildings are vacant or have limited occupancy, further increasing energy waste in large, underutilised spaces.
	the extent to which and ways in which improving assessment of public infrastructure projects could reduce materials use and waste, including quantitative analysis of costs and benefits (where available)	There are little policy considerations on government procurement practices to optimise recovery of building materials. The lack of such targets can have a negative impact on transitioning to a circular built-environment, as premature demolition and shortened lifespan of infrastructure have negative environmental impacts, even with the promotion of more sustainable new-builds. Criteria such as whether buildings/infrastructure are fit for the future, reuse of

		existing assets and components in new developments and higher use intensity of usable infrastructure areas need to be considered as circularity metrics. See example of potential adaptive reuse of space/s. Example Metric: Percentage of reused or recycled materials in project specifications. Assessing upcycling Example: Quay Quarter Tower, Sydney Retaining over 65% of the original structure (beams, columns, and slabs) and 95% of the original core, the project achieved an embodied carbon saving of 12,000 tonnes. Quay quarter tower - world's first upcycled skyscraper | 3xn architects | 3XN
	barriers preventing further adoption of integrated urban planning, which governments could address.	Complexity and fragmentation in regulation and certification rating systems. Governments can unify and regulate certification rating system incorporating CE principles. Building and planning regulations need to work hand-in-hand and to be aligned with each other to support the overall goal of decarbonisation.
The PC is seeking the following information on designing for disassembly in the built environment:	expected growth in design for disassembly for different types of structures in Australia, in the absence of any further government activity	For disassembly to be implemented, education and capacity building in this topic area is critical. Buildings need to be designed to be disassembled. Use of technology such as digital twins, visualisations, etc can assist in design, management / operations and end of life planning. • The social and environmental cost of virgin material use is not considered in the cost of procurement. This skews the market. Bills of quantities and costings are skewed towards the use of more materials rather than less use of materials. “Less is more” is not the norm / trend in building design, construction and operation.

		• Given the Australian residential sector's heavy reliance on timber, implement design for deconstruction to improve reuse and recyclability. • The recycled timber market is constrained by nail removal costs and quality concerns, limiting its reuse potential. Integrating appropriate connection methods at the design stage can improve disassembly and reusability, minimizing material waste and advancing circular economy principles in construction. Time vs cost and quality of materials. • Reusing steel components across multiple lifecycles can offset the embodied environmental impacts associated with their manufacturing phase. Implementing design for disassembly facilitates for steel reuse rather than recycling, reducing overall carbon emissions in the construction sector.
	barriers preventing further adoption of design for disassembly in Australia, which governments could address	Knowledge and market barriers: lack of awareness and Industry examples • Several AEC stakeholders are unfamiliar with design for disassembly (DfD's) benefits and feasibility and few proven case studies limit industry confidence and adoption. Economic Barriers Developers have no financial motivation to design for future disassembly. Higher upfront costs for DfD materials and the rethinking of connection and assembly/disassembly, can increase project costs initially. Government can address: • Government-led training programs and design for disassembly guidelines could drive adoption. • Pilots / demonstrations to showcase value for adoption • Public education campaigns to raise awareness

		• The government could promote design for disassembly by introducing incentives, tax benefits, and regulatory requirements in construction. • Providing financial support or subsidies could encourage wider adoption of design for disassembly practices/projects. • Promoting a material passport or information platform together with a design for disassembly will enhance reuse and recycling. • Use technology to support design for disassembly • Enhance localised recycling infrastructure to improve logistics and processing of salvaged materials efficiently.

2. Textiles and Clothing

CE Hub @RMIT response to the information requests:

Adopting a circular economy is essential for maintaining the value of materials and ensuring their effective use throughout their life cycle. Circular activities should focus on designing products and services to reduce material throughput. Governments can play a pivotal role by publishing guidance on the use of certifications, ideally in collaboration with other governments, and supporting policy implementation through certification bodies. Integrating care, product, and ecolabels into a Digital Product Passport System will enhance transparency and sustainability. A comprehensive approach, as seen in the German Government's environmental initiatives, can facilitate greater circularity across the textile's product life cycle. Introducing a co-regulatory or mandatory product stewardship scheme for textiles and clothing will shift responsibility to producers, ensure financial accountability, and establish a coordinated national framework for environmental and social impact. Implementing minimum sustainability standards on clothing imports and introducing import caps will align with the principle of sufficiency, ensuring that Australia meets its population's needs without incentivising perpetual growth in textile consumption. Finally, transitioning to a co-regulatory or mandatory model will ensure broad business participation and embed circular design requirements, addressing textile waste at its source.

3. Mining

Information request 7.1: Reducing regulatory barriers to circular economy opportunities for mining waste and alternative post-mining land uses

Specific examples of regulations that have impeded circular economy opportunities for mining waste or alternative uses for closed mine sites, and the expected benefits, costs and risks of reducing regulatory barriers (including quantitative analysis, where available)

Mining waste needs to be accounted for in the national waste reports and be taken into consideration for national circular economy targets. This is imperative given the volume of mining waste generated: total mining waste in 2020–21 is estimated at 620 Mt excluding moisture, more than eight times the quantity of core waste plus ash, and 44 times the quantity of MSW.

4. Vehicles

Information request 8.2: Establish the foundations of a robust end-of-life electric vehicle battery industry

Main Topic	Specific request	Response
The PC is seeking further information about government measures that could appropriately facilitate support for and overcome barriers to the development of a robust end-of-life electric vehicle (EV) battery industry. Measures could address supply of end-of-life EV batteries, or demand for second-life batteries and battery products. The following questions can help inform responses:	Are there technological or regulatory barriers inhibiting reuse, repurpose and recycle activities?	**Technological barriers**: • The main barrier includes *safety concerns*. Lithium batteries pose a significant fire risks, especially when damaged or improperly handled. Australia has experienced numerous battery-related fires. Emphasizing for stricter protocols can overcome this barrier overcoming stereotypes surrounding EV purchases. • *Design and Standardization barrier*: The absence of labelling and a standardized battery management system further increases processing costs.

		Regulatory Barrier: • Unlike the EU battery directive, Australia lacks a comprehensive and unified national framework. This can mainly be seen around the lack of a mature and consistent take-back pathways for EV batteries which hampers CE implementation for EV LiBs in Australia. • Regulations surround transportation of EOL EV batteries are complex and not specifically tailored or homogeneous leading to logistical challenges and increased costs
	What are current levels of market demand for second-life EV battery products in Australia (including any supporting data)? Are there barriers to connecting supply of these products with demand?	Second life of EV batteries are emerging. However specific data quantifying this demand within Australia is limited. Nevertheless, the latest data from a global perspective suggests that second-life EV battery market is projected to grow significantly reaching approximately USD 4.7 billion by 2030 (Source: Second-life Battery Market by Type & Region - Global Forecast 2030 | MarketsandMarkets) The main barriers include - • **Lack of Economic viability**: The costs associated with collection, testing, refurbishing and redeploying second life batteries can be substantial. Without economics of scale, these expenses outweigh the benefits contributing to a lack of supply. Hence, a greater collaboration is required between the car manufacturers and second-life stakeholders and potential users. • **Limited awareness**: Limited awareness among potential users about the benefits and availability of second-life battery products restrict market adoption. Education and subsequently building trust in the performance and safety of this product is crucial for market growth.

		• **Policy Gaps**: Comprehensive national policies on second-life of EV batteries mainly repurposing is appalling. These barriers mainly related to a lack of regulatory support on the development of a Circular business model for EV LiBs in Australia
	What costs would the measures place on businesses and consumers, and (for regulation) on government implementation and enforcement (including quantitative analysis, where available)?	**For Businesses**: • *Operational costs*: Businesses involved in recycling, importing or manufacturing may incur expenses adhering to new regulations such as the Extended Producer Responsibility (EPR) scheme. The cost elements may include expenses related to collection, transportation, reporting and awareness initiatives. • Investments in Recycling Infrastructure: Investing in recycling or repurposing requires substantial capital. This includes costs associated with machinery setup, safety systems and environmentally friendly operations. • Research and Development (R&D): R&D is an important element in businesses to improve existing technology and for market competitiveness. Hence, businesses may need to invest to improve the economic viability of second-life applications which is still considered a nascent business. **For Consumers**: • Price Adjustments: The introduction of EPRs and compliance procedures may lead to an increased cost of batteries which is passed on EVs. Hence, some businesses may pass these on to the consumer.

		• Prices associated with battery disposal: Depending on how recycling and collection infrastructures are positioned, consumers may face a fee related to the disposal or recycling of End-of-life EV lithium batteries **For Government**: • Regulatory enforcement: Formulating and implementing regulatory polices entails costs related to policy development, stakeholder consultation, policy monitoring, enforcement mechanisms and feedback loops. • Incentives: To boost implementation and adoption of policies, government may introduce grants or tax incentives to encourage businesses to invest in recycling or repurposing of End-of-life EV lithium batteries. • Awareness Initiatives: Government may invest in educational initiatives to inform the public through various organizations to highlight benefits and processes of battery recycling and reusing. This may incur additional costs. While specific costs may vary depending on unique contexts, evidence related to the economic impact of EV Lithium battery reprocessing is available through: • Estimate of Economic Impact of EVs Li-ion Batteries Recovery - Clean Energy and Sustainability - Full-Text HTML - SCIEPublish ("Based on the chemical composition of the various lithium batteries and their market diffusion, the intrinsic economic value of this waste has been estimated to be around 6500 €/ton") • Second-life EV Battery Market Analysis Report | 2021 - 2030 ("The estimated cost of a second life EV battery ranges

		from $50-$150. However, the new battery pack with similar capacity would cost around $155 which offers significant cost effectiveness in favor of second-life EV batteries over new batteries") • Supercharging Australia's lithium-ion battery recycling industry - CSIRO ("Australia could have a $3.1 billion industry in lithium-ion battery recycling, according to a new report").
	What activities could be undertaken by state, territory and local governments to support any overarching scheme implemented by the Australian Government?	**Aligning policies and providing regulatory support**: • Ensure state and local policies align with national regulations. • Standardize transportation and handling procedures to reduce logistical costs and regulatory confusion. • Introduce and mandate EPS schemes complementing national schemes. ***Investing in recycling and repurposing infrastructure***. • Invest in collection infrastructure and drop-off points to set up accessible facilities including waste transfer stations. • Provide funding to regional battery recycling and repurposing facilities to reduce processing and transportation costs. • Partner with universities and research organizations to improve battery recycling and repurposing infrastructure in regional areas **Industry engagement** • Facilitate public-private partnerships (PPPs) to co-develop solutions on microgrid applications, and vehicle to grid solutions. • Engage with stakeholders to encourage collaboration between manufactures, recyclers and energy companies to boost local supply chains. • Offer incentives where possible to support businesses investing in reprocessing programs

		Community engagement • Local councils can engage with consumers to highlight importance of battery recycling, safe practices and overcoming the stigma around second life applications. • State and local governments can partner with educational institutions on building skills relation to battery technology and development and circular economy of end-of-life EV lithium batteries. ***Data collection*** • State and local governments can conduct feasibility studies given unique market conditions in each state or territory. This can include industry roundtable discussions and monitoring waste recovery rates. Additionally, the results of this feasibility study could inform federal government to overcome challenges related to policy enforcement and monitoring.
	What additional measures are needed to address environmental and safety concerns related to EV battery handling and processing?	**Additional measures could include**: • Develop Australia-wide guidelines on EV battery collection, storage, transportation and recycling aligning with international best practices such as the EU battery regulation and Basel convention. • Introduce stricter pollution measures for battery recycling especially from contamination due to cobalt, nickel and lithium. • Develop a standardized EV battery tracking system (such as digital battery passports) with mandatory labelling containing information such as state-of-charge and chemistry. • Implement mandatory EPR schemes. • Improve emergency response procedures for battery-related fires, train logistics companies on hazardous material transport regulations and mandate specialized containers and storage facilities to prevent thermal runways.

		• Enforce strict workplace safety regulations, develop national certification programs covering disassembly, testing, repurposing and recycling. • Launch nationwide campaigns relates to the importance of proper battery disposal and risks of incorrect handling. • Develop consumer incentives (e.g., deposit scheme returns). • Encourage modular designs, design for disassembly and eco-friendly battery chemistry development wherever possible.
	What are the costs and benefits (including estimates, where possible) of developing further processing capability of black mass in Australia?	Developing black mass processing facilities involves significant investments and offers substantial benefits: **Costs:** *Capital Investments:* Developing a black mass processing facility through recycling may incur high capital costs. For example, a cost study by Neometals on a recycling plant estimates for a 50 tonnes per day a total capital costs of €274 million (AU$452 million), including a 15 per cent contingency. Source: Cost study supports Neometals battery recycling plant *Operational costs*: The study estimates operational costs at around €56 million (AU$92.3 million). Source: Cost study supports Neometals battery recycling plant *Compliance costs:* Adhering to environmental regulations may require investments in emission control, waste management systems and safety protocols.

		R&D costs: Businesses may allocate funds for R&D which is crucial to gain market competitiveness and sustainable processing technologies. **Benefits**: *Market growth*: The Australian battery recycling market is projected to grow from $5.8 million (USD) in 2022 to $81.6 million (USD) in 2030. This will also lead to job creations. Source: Australia Battery Recycling Market Size & Outlook, 2030 *Local supply chain growth*: Developing onshore processing facilities reduces reliance on international markets enhancing Australia's control over critical materials.

5. Household, consumer and emerging electronics

Information request 9.3: Product stewardship for small-scale PV systems

Main Topic	Specific Request	Response
The PC is seeking further information on:	whether large-format or energy storage batteries should be included or excluded in the scheme (including estimates of the costs and benefits, if possible)	
	whether compensation should be provided for PV systems returned in good condition (including any	Compensation (financial incentives) for PV systems returned in good condition can increase the amount of recovered PV systems. However, is important that this compensation does not incentivise

	estimate for this compensation and cost-benefit considerations)	the unnecessary return of efficiently working PV systems. Specific requirements should be highlighted to avoid early retirement of PV systems.
	how best to establish a system of collection points for PV waste, including local government involvement, especially in regional and remote areas, and whether existing collection points such as those under the NTCRS could be leveraged	NTCRS has stated that 98% of the population will have reasonable access to their collection points (Co-regulatory arrangements - NTCRS - DCCEEW) it will be beneficial if these are leveraged for PV waste as well. Nevertheless, PV waste should be handled by trained professionals within the PV installation or PV waste industry. This can ease the process for agreements between local governments and PV companies to establish specific collection points in the areas where major volumes of PV waste are expected.
	which specific industries or markets in Australia, if any, could benefit from the recovered materials of PV waste (including the size of these benefits, if possible)	Australia will generate over 90,000 tonnes/year of PV waste by 2025. The most readily recoverable material from PV waste is the aluminium frame, which comprises an average of 18% of the mass of panel waste. Using the current price of ~$2000/t for recycled aluminium, this market will be worth just over $33 million/year in Australia by 2035. The most abundant material in PV waste is glass, which can make up to 70% of the mass. Australia has a vibrant glass recycling industry; however, the challenge lies in separating the glass from the other components to make it profitable. Silver is the most valuable component theoretically recoverable from PV waste. PV waste only has an average silver content of 0.04%, but at a current silver price of ~$1600/kg, this could potentially equate to over $6 billion/year by 2035. Similarly, recovering the low copper content (0.8%) in PV waste could be worth over $600 million/year, given the current copper price of ~$9000/kg.

	how else the scheme could support circularity earlier in the solar PV system life cycle, including sustainable design and reuse and repair activities.	The scheme should establish standards for high quality of imported PV panels trough stronger certification systems and reliable PV wholesale companies, if possible open the market to overseas companies that are already implementing circular strategies for their PV panels. It is worth to liaise with the existing PV manufacturing companies in Australia to develop possible certifications for reuse, possible design modifications for keeping the modules working efficiently for longer. Repairability of PV modules would need to be investigated to avoid electrical risks.

6. System-wide arrangements

Information request 10.2: Supporting coordination, facilitation or brokering services

Main Topic	Specific Request	Response
The PC is interested in further information on supporting businesses and communities to identify circular opportunities and develop partnerships:	What government initiatives could most effectively support businesses' coordination? – How could governments use or build on existing platforms for information sharing or collaboration? – Are there examples of governments partnering with intermediaries, such as industry associations or other network bodies, to support collaboration? How might this be further strengthened? – What would be the benefits and costs associated with these initiatives, in terms of	Governments can support a 'transition broker' service as in the case of The Netherlands where independent brokers set up the coalition of the willing and provide a platform for engagement. The role of the transition broker is to work across the stakeholders to agree to a shared goal first before working on the details. Since this has not been done yet for Australia, there is no prescriptive approach but given the current discussions in Australia on first nations engagement, the commitments may be used as a catalyst to support circular outcomes. Forthcoming book: *Building a circular future in Australia: why, what and how? by Usha Iyer-Raniga and Jacqueline Cramer is with the publishers (CRC Press).* Information sharing and collaboration can be done through various ways. Schools, libraries, NBH centres can all become hubs of community engagement (including repair movements, etc), similar to the Holland Circular Hotspots. These centres are funded by the

	economic, environmental and/or social outcomes? – What lessons could be learned from successful government initiatives supporting facilitation or coordination in other industries?	government and supported by industry and communities. It also allows for exchange of ideas and information, supporting innovation and sharing of ideas. Spaces are already available, its a matter of booking the spaces for exchange of ideas and activities. Some of the local governments already have grass roots engagements through sustainability committees, clean up Australia campaigns, Earth Day, etc., to engage with their local populations. For very little effort (the will to make the change is needed, however), existing opportunities may be used to accelerate the transition in a place-based manner. Top-down support from government is critical and legitimises the engagement at the grass roots levels. Councils can engage a coordinator, full time or part time for this role who can work across councils, communities, state and federal governments. Existing silos need to be broken down and will take some time to build the momentum. The environmental and social rewards (not just quantitative, but qualitative) An example of coordination and government leadership is extended producer responsibility (EPR) for textiles. Revenue generation models such as that used in textiles may be applicable for other industries as well such as buildings and construction.
	Are there special considerations for how governments might support businesses to identify partners in regional and remote Australia?	Rather than relying on businesses, local and regional governments should work with local communities.
	How could governments support Aboriginal and Torres Strait Islander businesses and communities to identify opportunities and partnerships? What current or new initiatives could be adopted or extended?	Circular practices of first nations peoples may be used as an opportunity to engage with regional and remote communities to support extension of tried and tested cultural practices with 'modern' circular economy needs and practices such as textiles, local food production and composting, etc.

	How do the needs of small and medium businesses or organisations differ from larger businesses or organisations in relation to adopting circular practices, and how might governments best support this cohort?	A planned industrial symbiosis approach will be helpful. Small businesses do not have the funds to invest in R&D even if they want to move to a circular economy. Government can assist with incentives and support through brokering role/s.
The PC is interested in further information on navigating regulatory complexity:	What are the barriers to knowledge (or transition) brokers, project officers, community development officers and the like effectively assisting organisations to navigate regulatory complexity?	The circular economy is inherently a systemic problem. Taking a linear approach to a systemic problem needs capacity building and strengthening. Training is needed across various key stakeholder cohorts and the value chains across different sectors.
	To what extent is there a need for government to provide services, given that there are already private consultant services that can support businesses to navigate regulations?	Regulation is one instrument- it should not be seen to be the only instrument. Regulation establishes a level playing field but does not support innovation in the market.
	What kind of regulations do businesses most need help navigating to pursue circular opportunities? Are these at Commonwealth, state and territory, or local government level?	All levels of government need to be involved. Governments should lead by example, for instance, in procurement.

Information request 10.3: Supporting greater adoption and diffusion of circular innovations

CE Hub @RMIT response to the information requests:
What might be the benefits and limitations to this approach? What are the likely costs?

- While it is helpful to learn from other countries, we need to still consider a place-based response for the Australian context. We need to support the development of Australian solutions.

What are useful models for how government can connect industry and researchers? When is this best done at the industry level, and when by location (such as a region or local government area)?

- Circular Economy Research Network Asia-Pacific is a good start. The intent of CERN APAC is to connect researchers across industry and research, to provide a platform for networking and engagement.

Information request 10.4 Improving investor confidence in the circular economy

Main Topic	Specific Request	Response
The PC is interested in further information on the following questions:	What are examples of sectors or circular activities being impacted by the cost and availability of insurance? What factors or risks currently determine insurance availability (or lack thereof)?	Insurance is becoming more unaffordable. In the context of the circular economy, pollution, biodiversity loss and climate change are all impacting how Australians live and work. Insurers typically use historical data to evaluate project risk; however, projects within the circular economy frequently lack substantial precedent. As a result, insurers may consider such projects high-risk due to structural uncertainties and non-traditional materials, leading to higher insurance premiums, limited insurance coverage, stricter policy conditions, coverage exclusions and un-insurability risks. Projects incorporating recycled materials may face challenges in obtaining insurance coverage due to insurers' concerns regarding structural integrity, fire resistance, the limited availability of long-term

		performance data, and the relative unfamiliarity of unconventional construction methods. The lack of standardisation in reused materials may also complicate property valuation and risk assessments in the insurance process.

Information request 10.5: Government support for place-based circular initiatives

Main Topic	Specific Request	Response
The PC is interested in further information on the following questions:	To what extent are existing precincts (such as those set up for net zero, advanced manufacturing, or Special Activation Precincts) already engaged in circular activities? What are some of the ways to encourage further circular activities in these precincts?	Both top down and bottom-up approaches are required. Some place-based initiatives such as Bega Cheese are more industrial symbiosis rather than holistic circularity-based, whereas others such as Hunter Valley and Hume city council are led by relevant council/s. A network-based approach so all stakeholders gain value is critical.
	What are the barriers (and possible solutions) to expanding or setting up materials recovery facilities? How might facilities provide a basis for place-based circular opportunities? Are there examples of this?	Materials recovery facilities are not always the answer. In some situations, these facilities may not lead to the most appropriate solution/s if the local loops are not closed. It is essential to avoid a repeat of the 'Redcycle' situation again. Alongside material recovery facilities, it is also essential to find a range of diverse markets.
	What service provision and funding models would best support place-based circular activities, including reuse, repair, waste collection and recycling activities in remote and very remote areas?	Generally speaking, the top of the R-ladder is refuse and at the bottom is recycling and waste to energy. There are various options in between and these options are dependent on the materials considered and the sector. For example, timber can be reused and repaired provided it is not coated with toxic materials. However, if the timber is not deconstructed to be reused, it can only be recycled (as wood chips in the garden).
	What are the main regulatory barriers that communities or businesses face in establishing place-based circular initiatives?	Secondary markets that provide confidence with the use of these materials, procurement guidelines supporting the use of reused and recycled materials.
	What other kinds of government assistance or support do communities or businesses need to	Training of procurement officers, performance-based contracts, ensuring a high percentage of reused and recycled materials are used

	enable successful place-based circular precincts (such as coordination or facilitation, as in information request 10.2)?	in procurement guidelines, encouraging service rather than ownership-based models (carpet as a service, lighting as a service), design for disassembly at the point of design / design concepts, work with suppliers and value chain stakeholders to support extended producer responsibility.
	What actions could governments take to facilitate Aboriginal and Torres Strait Islander roles in progressing place-based circular initiatives?	Use traditional knowledge to promote circularity outcomes in the 21st century. Supporting capacity building in repair and maintenance (e.g. solar panels) in remote and regional communities
	What actions could governments take to value Aboriginal and Torres Strait Islander knowledges, in ways that protect Indigenous cultural and intellectual property, to identify and develop place-based circular opportunities?	Provide support and encourage use of traditional knowledge. Give it credibility so first nations knowledge is acknowledged. Offer grants, low-interest loans, and capacity-building programs to Indigenous businesses and organizations working in the circular economy space. Create incubators or accelerators specifically for Indigenous entrepreneurs to develop and scale sustainable enterprises based on traditional knowledge. Fund and support Indigenous-led circular economy projects that leverage traditional ecological knowledge for sustainable resource management, waste reduction, and environmental restoration. One example is that of developing bio-based materials from native plants, guided by Indigenous practices. Invest in digital platforms and tools that enable Indigenous communities to manage and protect their intellectual property online, including blockchain technologies for tracking and verifying.

Information request 10.6: Expanding the set of circular economy indicators

Main Topic	Specific Request	Response
The PC is interested in further information on the following questions:	What are specific examples of how governments (at all levels) and businesses would use the proposed circular economy indicators to identify and track progress of circular opportunities?	• CSR reporting • For SMEs, financial sustainability Examples of use by governments and businesses: Governments can use dual-metric indicators—carbon and money—to evaluate public procurement, infrastructure, and policy impact by tracking embodied and operational carbon through supply chains. Businesses can leverage these metrics for product differentiation, compliance with ESG criteria, and lifecycle assessment to identify opportunities for reducing waste, emissions, and costs.
	What would be the costs associated with gathering data on the proposed circular economy indicators?	Costs of data collection: While initial setup may involve investment in digital tools and capacity building, long-term data collection becomes embedded in procurement and production processes. The real cost lies not in the tools, but in continuing with incomplete data that externalises environmental costs and obstructs systemic reform.
	Which agencies would collect or estimate the data?	The Australian Bureau of Statistics (ABS) in collaboration with state and territory environmental protection agencies (e.g., Sustainability Victoria) could gather data on waste generated by material type and sector. Local councils and waste management companies could provide granular data on waste streams. *Responsible agencies for data*: Data collection could be decentralised and verified via industry-led or third-party systems, with oversight by a national body such as the Productivity Commission or Clean Energy Regulator. The method must be universally applicable but locally adaptable, supporting community engagement and sector-specific expertise.
	How consistent across states and territories is the data needed for circular economy indicators? Does it allow comparison across industries or sectors?	The data needs to be consistent as otherwise, there is no confidence in the data for consumes and stakeholder across the value chain. Data consistency across states/industries: Currently, data is fragmented and inconsistent. A shared metric such as Gross Domestic Utility (GDU) enables

		harmonised reporting by measuring inputs (materials, energy, labour) and outputs (utility, emissions). This supports cross-industry comparisons and encourages convergence around a regenerative standard.
	Are there alternative indicators that would better measure the progress of Australia's circular economy? What would be the benefits and costs associated with these alternatives?	The Circularity rate, which measures the overall percentage of secondary materials that comprise the total mass of materials used in a single year in an economy is a more holistic indicator for circular economy. The ABS measured and reported on this indicator from 2010 – 2023 (Circular economy | Australian Bureau of Statistics) Alternative indicators and trade-offs: Rather than replacing circular economy indicators, the model proposes expanding them with polyvalent metrics—financial, social, and natural capital. The benefit is deeper insight and actionable intelligence; the cost is overcoming institutional inertia and building trust in new methods. Ignoring this shift risks reinforcing outdated, extractive norms.
	What reporting format would be most valuable and accessible to stakeholders using the monitoring data (e.g. including in the Measuring What Matters framework, or a separate dedicated dashboard)?	A centralized online dashboard specifically for circular economy monitoring could be developed. Key features could include interactive visualizations to allow users to explore data by sector, region, or material type. The dashboard could also allow comparisons between sectors, regions, or over time to identify best practices and areas for improvement. Preferred reporting format: A hybrid model works best—core metrics embedded in national frameworks like Measuring What Matters, complemented by open dashboards accessible to business, academia, and civil society. This dual approach ensures top-down legitimacy and bottom-up transparency.
	Over what timeframe could the proposed expanded set of indicators be rolled out? How frequently should the set of indicators be reviewed and updated, so that they can	Roll-out timeframe and review cycle: A phased rollout could begin within 12–18 months, building on pilot sectors (e.g. construction, food, furnishings). Indicators should be reviewed biennially to maintain relevance, with flexibility

	remain fit for purpose to inform government and business decisions about the circular economy?	to adapt as new tools, datasets, and social priorities emerge. A seven-year horizon aligns with global climate targets and systemic change windows.

Further Reading

Circular Economy Rebound - Zink - 2017 - Journal of Industrial Ecology - Wiley Online Library

Frontiers | The Sufficiency-Based Circular Economy—An Analysis of 150 Companies