This submission is presented on behalf of the RMIT University Circular Economy Hub to the Productivity Commission of Australia

I. Information request 1: Circular economy success stories and measures of success

Circular economy (CE) principles dictate that stakeholders should consider and undertake all R-strategies (Cramer 2022) based on their order of preference. However, CE initiatives are subject to context-specific drivers and barriers and hence should be designed using a systemic approach. Therefore, we shed light on the following case-studies to promote a comprehensive approach on CE initiatives:

1) Case study 1: CE for end-of-life (EOL) electric vehicle (EV) lithium batteries (LiBs).

EOL EV LiBs are a growing concern in Australia due to the risk of toxic materials ending up in landfills. However, EV batteries at EOL contain up to 80% of charge capacity that could be repaired and reused in EVs, repurposed in energy storage systems, and recycled for material recovery. One such Australian business contributing towards these CE initiatives is "infinitev". More information on their business model can be found through the following link: Building a Circular Economy: The Hierarchy of EV Battery Waste Managem – Infinitev

Q. How these activities affected business and economic outcomes (including costs), environmental outcomes (including waste and pollution) and social outcomes?

From a business perspective, commercialisation of second-hand batteries is possible due to partnerships with manufacturers, recyclers, and peak body organisations. These partnerships enable brand reputation and an influx of first-hand batteries to support their business model. Costs vary based on size, chemistry, and volume of batteries however made clear upfront which is essential. The obvious outcome from an environmental perspective is the prevention of EOL batteries ending up in landfills. Moreover, reusing EV batteries delays recycling processes which is costly, complex, and potentially hazardous. It is also noteworthy that the organisation advertises multiple employment opportunities further contributing to their value proposition.

Q. Levels of uptake

Levels of uptake are dependent on the number of sales of EVs. Presently, more than 180,000 EVs were sold which is still low but growing based on the rate of sales over the past years. However, the company engages in 'repair' and reuse' operations for first-hand EV batteries while actively promoting the remaining R-strategies.

Q. Reasons why businesses, consumers and communities adopted circular economy activities.

Consumers were promoted to adopt their services based on testimonials highlighted on their website. Additionally, the company actively promotes their CE 'success stories' on professional networking platforms such as LinkedIn spreading awareness among the community.

2) Case study 2: Commercial grade workstations and office furniture (Egans | Office Relocations | Sustainable Office Workstations and Furniture)

Egans provide a product as a service model that enables circular economy benefits for their customers, providing them office furniture products with known circular value, elevated to the

high end of R strategies, with reporting provided to clients based on their landfill avoidance from the project. An example case study from Egans is 'Westpac'. This included the following:

a) REQUIREMENT - In May 2024, Egans completed stage 1 of a recycle program in South Australia for Westpac. The project included 375 workstation, chairs and pedestal.
b) REFURBISH AND REUSE - The chairs were graded refurbished for reuse through the rest of the Westpac property portfolio.
c) RECYCLE - The workstation bases and screens were stripped to material level for recycling.
d) REMANUFACTURE - The tops were sent to Egan's joinery workshop for use in their remanufacture program.

These initiatives resulted in a 91% landfill avoidance from 63,000kgs.

Q. How these activities affected business and economic outcomes (including costs), environmental outcomes (including waste and pollution) and social outcomes?

For Egans this provides a feasible and viable business model that incentivises identifying optimum circular design among manufacturers of office furniture. This then supports their value proposition of circular economy benefits to their customers, which is evidenced by accurate reporting on landfill avoidance. For their customers, such as Westpac this presents an evidence-based story of circular economy initiatives that align with their organisation's objectives and values. For Egans, having over 20 years' experience working with suppliers, deconstructing products and knowing the circular pathways of reduce, reuse, repair, refurbish, remanufacture, repurpose and recycling enables them to have accurate data on product composition and manufacturing to enable accurate predictions of the circular product lifecycle. This is vital for assisting their client organisations to trust data provided to feed into their own internal and public reporting of their circular economy activities and impact.

Q. Levels of uptake

Egans product as a service model has expanded servicing an expanding list of large private and public organisations, who set targets for complying with regulatory circular economy frameworks, for which their brand purpose and organisational objectives and targets have been focused in addressing.

Q. Reasons why businesses, consumers and communities adopted circular economy activities.

Research conducted with Egans as a case study demonstrate the critical nature of accurate and verifiable data on the product elements, to accurately predict the circular lifecycle of products and to accurately report on circular outcomes both internally and externally to their clients. Accurate and verifiable data is a key ingredient as without assurance of the product elements the ability to extract circular value would be unproductive and reduce circular outcomes.

For Egans their verification process has grown organically, working with manufacturers and suppliers over time, having deconstructed their products throughout the product lifecycle process. When they expand their product list (selection options to meet clients extended needs in office furniture) they currently rely on their experience with products, manufacturers and suppliers to make judgements independent of reported verification certifications claimed by products.

Risks may occur where a business extends its product range to include products for which no reliable data verification process can provide provenance (assurance) that the product purchased contains the elements claimed (i.e. fraudulent product substitution is the main risk)

Q. The effectiveness and costs of these activities (such as from project evaluations, participant surveys).

Egans success in managing costs and margins on their product as a service model is predicated on being able to provide assurance of circular value to their clients, that less experienced companies may struggle to provide, given the reliance on data that is often unverifiable, based on certification claims attached to imported (supplied) products. Product substitution is a major risk and the need for fraud proof, trusted data driven verification of product provenance is a key success factor, when scaling beyond the organic growth a SME like Egans has successfully navigated.

3) Case study: CE pathways for solar photovoltaic (PV) panels

Another example is CE principles applied to photovoltaic (PV) panels (APSRC 2023). Currently, majority of PV panels are sent to landfill even if they are completely functional. One of the main reasons for this are renovations on PV installations. There are a couple of Australian companies that are addressing PV waste through different solutions as repurpose, reuse, and recycle PVs. Companies such as Second Life Solar, PV Industries, Lotus Energy, Elecsome, Circular PV Alliance, PV Lab and Solar Recovery Corporation to name a few.

Q. How these activities affected business and economic outcomes (including costs), environmental outcomes (including waste and pollution) and social outcomes?

PV panels have materials embedded, such as lead, that can leak and pollute the soil and potentially water sources, these are a toxic hazard for the environment and human health. If the PV panels are recovered and properly directed to circular destinations, it can represent creation of new jobs to process the materials in PV panels, or test the PV panels for reuse, avoid the use of raw materials and recover rare valuable materials.

Q. Levels of uptake

Currently, companies that test, reuse and recycle PVs are increasing in Australian context. Nevertheless, they are dependent on the waste flow of PVs, technologies to reprocess PVs and end of life markets for recovered materials and reused PV panels.

Q. Reasons why businesses, consumers and communities adopted circular economy activities.

A clear example of the value of PV panels reuse was the case proposed by Second Life Solar where the residual value of a recycled PV panel is significantly small compared to the residual value of a reused PV. The amount of PV panel waste is set to increase significantly from 2030, which can represent a business opportunity for Australia as it is one of the top countries with PV installations per capita.

Overall, Research (Gajanayake, Ho & Iyer-Raniga 2024) on why businesses adopt CE activities has shown that the major drivers for SMEs to adopt CE and sustainability activities were ethical and social conscience, while for larger businesses it was business strategy/organizational policies and leadership/strategic commitment. Although financial

returns were not considered a major driver, the results reveal that firms may not implement environmental activities if it is not financially viable.

Research (Dinesh, Gajanayake & Iyer-Raniga 2024) on specific environmental actions of businesses show that ethical conscience of managers drives waste, energy and water related actions, while external factors such as supply chain imperatives and customer demand drive circular business actions. New technology and industry guidelines were major barrier for implementing most types of CE actions. The finding that technological innovations could impede CE actions implies that governments need to consider broader environmental outcomes of technology adoption, as they incentivize research and development within businesses.

Q. The effectiveness and costs of these activities (such as from project evaluations, participant surveys).

4.4 billion is the potential value of PV panels reuse in the Victorian region of Gippsland by 2035 according to Blue Tribe Company and Second Life Solar.

- **Australia's overall potential to move to a more circular economy, as well as how best to monitor progress and measure success**.

As more first-life products reach their end-of-life, the need for CE becomes apparent, hence the need for systems thinking and design is critical. The potential for CE in Australia can be highlighted from different perspectives mainly:

i. Economic: CE has positive economic impacts by using resources more efficiently and reducing the need to extract virgin materials. Higher order CE strategies that extend the life products and parts like repair, refurbish, remanufacture, and repurpose will results in less reliance on imports and increase employment.
ii. Environmental: CE contributes to reducing carbon emissions, reducing pollution, and achieving national net-zero targets.
iii. Social: Promoting circular products ultimately leads to a reduction in over-consumption potentially saving consumer costs and promoting a better quality of life.

Monitoring progress needs a systems approach. To bring in circular business models for slowing, narrowing and closing loops, the full value chain needs to be engaged. Governance of such approaches is essential – using multiple approaches to secure both qualitative and quantitative data. For qualitative data, surveys and interviews will assist in understanding systems related blockages, while for quantitative approaches, data transparency may be supported through various means.

Nevertheless, measuring the success of Australia's CE progress needs to take a national approach. A reliable circularity metric needs to be an absolute figure (not relative to another metric), so that real progress could be measured. One such example is the Circularity Gap which can be used to measure CE progress at national level. The ABS currently measures the circularity of the Australian economy and this could be used as the overarching metric.

Research (Gajanayake & Iyer-Raniga 2025) has shown that the lack of a clear metric/indicator to measure CE has multiple negative effects on the CE transition. For example, the current targets which focus on recycling and resource recovery, which are lower order CE strategies, have led to a common misconception that CE is all about recycling better and recycling more. This misconception was seen across communities and government agencies a like. The lack of

accepted circularity metrics at industry level is a major barrier for the the adoption of CE activities at an industry level.

The current national targets fall short of this as they are not absolute indices. For example: achieving the target of "80% average resource recovery rate from all waste streams following the waste hierarchy by 2030" may not result in reduction of waste going to landfill, if waste generation increases. Another target of "Reduce total waste generated in Australia by 10% per person by 2030" comes with a footnote which states, "Environment Ministers will consider the definition of "per person" at their first meeting in 2020, informed by analysis of any potential unintended impacts on waste reduction initiatives from growth in construction and infrastructure developments." This highlights that such targets only consider a few, easy to manage waste streams, while broader economic activity in construction and infrastructure sectors are left out.

Other methods to monitor progress is by implementing mandatory product stewardship schemes enabling data transparency. Additionally, progress could also be monitored using digital tools such as 'Artificial intelligence' or 'Block chain technology' where knowledge transfer is facilitated through efficient and reliable means for data validation.

A valid approach to monitoring success is one that measures social, environmental, and economic value. This can be achieved through the following but not limited to:

i. Feedback from communities.
ii. Employment opportunities.
iii. Waste diverted from landfill (in tonnes), carbon and GGH measures (such as through life cycle assessments).
iv. Percentage of product/material inflow vs product/material outflow contributing towards CE initiatives.

II. Information request 2: Priority opportunities to progress the circular economy.

- **Opportunities in Australia to improve environmental and economic outcomes through greater adoption of circular economy activities.**

1) The opportunity discussed below is provided for the case of EOL EV LiBs in Australia:

EV LiBs have significant potential for reuse, remanufacture, and repurpose as they retain up to 80% of their charge capacity at EOL. Ideally, research suggests adopting a 'reuse – repurpose – recycle' circular business model to gain maximum value from EOL EV LiBs (Chirumalla, Reyes & Toorajipour 2022; Olsson et al. 2018). However, there exists multiple barriers such as a lack of volume of EV LiBs at EOL and an immature market scenario for repurposed batteries. Hence, it would be worth considering adopting a business model which focuses on repair or refurbishment of LiBs for reuse in EVs followed by recycling in the immediate 5 to 7 years until considerable volume of EV LiBs reach their EOL. Simultaneously, pilot initiatives for repurposing EV LiBs could be encouraged from the government through grants, funding and procurement policies until considerable volume of EOL EV LiBs.

Q. How these opportunities could affect business and economic outcomes (including costs), environmental outcomes (including biodiversity, climate and water, land and air quality), and social outcomes?

Adopting a 'repair-reuse-recycle' strategy for EV LiBs could prolong the first life of EV batteries. From an economic perspective, this could provide EV manufactures with a competitive advantage. Additionally, this strategy could postpone costly recycling contributing to overall cost reductions from a holistic perspective. Environmentally, the reuse of EV LiBs contributes towards reducing overall carbon emissions. The repair and reuse of EV LiBs also presents employment opportunities for engineers, mechanics, and technicians.

Q. Feasible levels of future uptake or adoption in Australia

The adoption of CE strategies for EV LiBs is dependent on the rate of EV sales and the present number of EVs in Australia. Considering these factors, we propose adopting a 'repair-reuse-recycle' strategy in the immediate 5 to 7 years. Thereafter, transitioning to a 'repair-reuse-repurpose-recycle' strategy.

Q. How their effects could best be monitored or measured, and how opportunities could be prioritised?

Effects of this strategy could be monitored using a 'battery passport' indicating information such as the chemistry, size and state of health. Furthermore, opportunities for circular economy strategies could be prioritised by grading batteries based on their state of charge.

Q. How Aboriginal and Torres Strait Islander knowledges could be valued, in ways that protect Indigenous cultural and intellectual property, to identify and develop these opportunities?

First nations people have been following CE practices for over 65,000 years. For instance, the indigenous culture prioritises R-strategies such as 'reduce' and 'regenerate' contributing towards the social and environmental gains for CE. Hence, the Aboriginal and Torres Strait

Islander people should be involved in the co-designing, co-creating and co-producing processes at a local and national levels supporting the creation of infrastructure, urban planning, and EOL management.

2) The opportunity discussed below is of Product as a Service Models (PASM)

PASM present significant opportunities in Australia as the onus on provenance and measuring circularity of products their elements and components rests with the product owner – Their business model depends on trust and reliable data to be viable and competitive. Therefore, this model can help fast-track uptake of circularity from clients who effectively lease products (via a service fee) that covers repair, through to remanufacturing – as they are effectively paying for circular products that perform and provide reliable data on their embodied carbon, their landfill reduction, their circular value in reduced virgin resources entering the supply chain.

Q. How these opportunities could affect business and economic outcomes (including costs), environmental outcomes (including biodiversity, climate and water, land and air quality), and social outcomes?

Cost efficiencies extend to the circular business owner and their subscription/fee paying customers, as this model helps incentivise the development of circular supply chains – as the imperative for accurate data and minimised product substitution fraud, based on the core value proposition presented by circular businesses providing Product as a Service Models. This could extend to mass consumption products such as Solar Panels (as an example), where Australian circular business owners adopting this model could ensure supply from local manufacturers of circular designed solar panels and enable the network of organisations that engage in reuse, refurbishment, and Recycling. Partnering with a circular solar panel product owner can reduce risks for manufacturers, and ensure partnerships are formed to provide assurance around purchase quantities, where all supply chain partners share in the provenance story and circular value of their product lifecycle.

Q. Feasible levels of future uptake or adoption in Australia.

The feasibility of (for example) solar panels manufactured in Australia, being part of the Product as a Service Model of circular economy has potential to provide economies of scale and assurance to balance risk, costs, and viability of a solar circular economy market locally.

Q. How their effects could best be monitored or measured, and how opportunities could be prioritised?

Product as a Service business models are centralising the measurement process for circular activates as the service provider (e.g. leasing solar panels) owns the data regarding the elements and such service providers become the ideal conduit for innovation technologies for improving panel design, manufacturing, reuse, recovery and recycling opportunities – as the service provider effectively runs a logistics business in managing the lifecycle stages of panels across their client network. Provenance and data accuracy are key and thus measurement of panels as a circular resource can be tracked, traced, and measured for embodied carbon, landfill avoidance, and across each of the R Strategy lifecycle stages. Innovation over time will likely increase the higher circular value generated, and the adoption of emerging technologies into the ecosystem can be forecast accurately against known actual data relative to forecast futures for innovations in circularly.

Q. How Aboriginal and Torres Strait Islander knowledges could be valued, in ways that protect Indigenous cultural and intellectual property, to identify and develop these opportunities?

Having a product as a service model presents a more controlled and trusted circular economy marketplace. They also enable scalability of businesses due to the trust and value in data stored and processes adopted to optimise the circular value as part of the competitive value proposition. This aligns with government policy on circular economy and has implications for social procurement policy where indigenous ownership, and/or employment within circular businesses adopting this model can extend meaningful, sustainable employment for indigenous persons. This business model approach has been found within literature to present known examples of successful circular businesses to thrive, and given the centralisation of data quality, measurement, and trust (critical to business success) the alignment with public policy supports multiple stakeholders, the circular service businesses, and their clients (via social procurement compliance, and/or compliance with broader circular economy frameworks at state and federal levels.

3) <u>The opportunity discussed below is for Solar PV panels:</u>

In a recent publication by Circular Australia, it was expressed that Australia spends $1.4 billion in directing $26.5 billion worth material to landfills. In 2016, a report by the International Renewable Energy Agency stated that for PV panels, the value of recovered material can reach 15 billion by 2050 (Weckend, Wade, & Heath 2016).

Q. How these opportunities could affect business and economic outcomes (including costs), environmental outcomes (including biodiversity, climate and water, land and air quality), and social outcomes?

There are benefits in the uptake of solar panels as renewable energy, one of the most popular uptakes at the moment is the interest on the benefits for crops in solar farms. Additionally, toxic materials would be kept out of landfills (Madrigal, Iyer-Raniga & Yang 2024).

Q. Feasible levels of future uptake or adoption in Australia.

Australia needs to adopt CE practices for PV use and waste management due to the number of PV panel installations and waste that are projected from 2030. Nonetheless, solutions need to go beyond reuse and recycling. Reducing amount of early decommissioned PV panels, ensuring the quality of PV panels installed and skilled workforce to uninstall and process PVs at their EOL. This is feasible as the awareness of PV value is starting to gain momentum.

Q. How their effects could best be monitored or measured, and how opportunities could be prioritised?

Having digital passport for PVs, such as the one proposed by PV Lab (PV PASS), is a monitoring tool that can provide enough information for PV use and ultimately something similar can be used for PV reuse and PV recycling.

Q. How Aboriginal and Torres Strait Islander knowledges could be valued, in ways that protect Indigenous cultural and intellectual property, to identify and develop these opportunities?

Collaboration with Aboriginal and Torres Strait Islander people should be sought before planning solar farms and PV processing facilities. Learnings from them can provide more CE practices that go beyond reducing, reusing, recycling, and reprocessing.

- **Analysis of which circular opportunities provide the greatest scope to improve environmental and economic outcomes in Australia and why?**

1) <u>The opportunity discussed below is provided for the case of EOL EV LiBs in Australia</u>:

The greatest scope to improve environmental and economic outcomes in Australia based on the order of prioritisation would be to:

- Reduce reliance of virgin materials.
- Redesign batteries to include considerations for ease in disassembly.
- Repair EV batteries to facilitate reuse.
- Reuse EV LiBs to prolong first-use application.
- Repurpose EV LiBs for use in energy storage applications.
- Recycle EV LiBs at its true EOL to extract virgin materials.
- Recover energy.

The above proposed strategy has the greatest scope in Australia due to the following reasons but not limited to:

a. Repurposing EV LiBs for use in energy storage applications can contribute towards the national net-zero targets.
b. Prioritising and promoting repair and reuse over repurpose and recycle respectively can delay costly, immature, and complex reprocessing. Thereby, this strategy provides Australia an opportunity to overcome barriers associated with repurposing and recycling through research and development.
c. Prioritising 'redesign' early on could potentially automate complex disassembly as opposed to current manual disassembly. Thereby mitigating risks around safety.

Q. *Metrics used to inform this analysis.*

Evidence of this analysis can be based on the following indicators but not limited to:

a. The total number of EVs in Australia as of 2023.
b. The rate of EV sales compared to overseas.
c. The cost value of repurposing and recycling lithium ferro-phosphate vs nickel-manganese-cobalt-lithium.
d. Australia's position in the global supply chain related to the manufacturing of EVs and batteries.
e. Current policies, trade agreements, and political agenda of the federal government.

Q. *Modelling or analysis relating to the potential benefits and costs of implementing specific circular economy opportunities at the sector, product, or supply chain segment level (including, but not limited to, life cycle assessments or cost-benefit assessments).*

The proposed immediate strategy is based on the findings published by Furtado (2024) where in semi-structured interviews conducted with relevant stakeholders' groups within the EV LiB value chain revealed:

a. Repurposing of EV LiBs faces greater challenges than recycling due to competition with vanadium flow batteries and newer lithium-ferro-phosphate batteries. Moreover, repurposing EV LiBs is still considered as nascent due to the lack of volume of EV LiBs at EOL in Australia.
b. Recycling technology of mixed chemistry batteries is still emerging. Particularly, recycling in Australia is limited to the disassembly and formation of 'black mass' which is then exported overseas.
c. Recycling of EV LiBs in Australia is considered as expensive due to the value of materials present in lithium-ferro-phosphate relative to nickel-cobalt-manganese battery as seen in the table below:

Table 1: Current battery component value and range as of July 2024 (Source: a) Trading Economics (2024); b) Zhao et al. (2021))

Battery material component	Value (US dollars per tonne)[a]	Composition (%)[b]
Lithium (Li)	11,839.97	1 to 7
Iron (Fe)	106.25	5 to 25
Aluminium (Al)	2,259.50	4 to 24
Nickel (Ni)	16,541.00	5 to 15
Cobalt (Co)	26,625.00	5 to 20

2) The opportunity discussed below is provided considering a holistic perspective on Australia's CE progress:

Q. *Metrics used to inform this analysis.*

Measuring the success of Australia's CE progress needs to take a national approach. A reliable circularity metric needs to be an absolute figure (not relative to another metric), so that real progress could be measured. One such example is the Circularity Gap which can be used to measure CE progress at national level.

Analysis (Iyer-Raniga, Gajanayake & Ho 2023) of industry standards and guidelines in Australia also illustrate that CE related aspects focus on reducing waste and using recycled content. This is in contrast to more advanced circular economies where criteria such as whether buildings are fit for the future, reuse of existing building components in new developments and higher use intensity of usable building areas are assessed as circularity metrics. Direct policy actions from governments that can drive product re-use from a top-down perspective and including mandatory re-use targets within policies could also drive a more holistic CE transition (Milios 2021).

- **Information on specific opportunities and risks for Australia resulting from international developments, including circular economy policy**.

1) The opportunities and risks discussed below resulting from international developments, including circular economy policy are provided for the case of EOL EV LiBs in Australia:

Considering the global supply chain, Australia is a major importer of batteries and EVs. Moreover, Australia is dependent on the policy settings and industrial practices adopted in the EU. Hence, one such specific opportunity resulting from this scenario is transitioning to 'vertical integration' much of what's happening in the EU. Conversely, due to an increase in dependency, Australia is prone to a reactive approach rather than a proactive approach.

Another opportunity to consider for businesses adopting circular business models is gaining a competitive advantage through the accreditation gaining from the International Standard Organisation (ISO 59020, ISO 59010, and ISO 59004)

Q. Affect Australian exports, such as by opening or creating new markets, or by placing regulatory requirements on the design and production processes of Australian exports.

Presently, critical materials extracted from EV LiBs are converted into 'black mass' and subsequently exported overseas. However, implementing CE policy ultimately delays the production of black mass as 'recycling' is situated in the lower order of preference. Alternatively, Australia could consider exporting repurposed EV LiBs in turn creating an opportunity for Australian businesses to engage in repurposing processes. The risks arising are dependent on the terms of the free trade agreement, and current political agenda around in-house manufacturing and recycling of EV batteries.

Q. *Affect Australian imports, such as changes to production methods internationally, or developments in international markets.*

Development of newer chemistries can affect recycling capabilities locally. Additionally, changes in production methods can affect standardisation criteria and ease in disassembly. This puts Australia at a risk due to its position in the global supply chain. To minimise the adverse effects of this risks, Australia could set up regulatory requirements around what is imported into the country mainly through stewardship schemes.

Q. *Innovative processes that could be adopted in Australia*.

Innovation processes such as battery passports, use of digital tools, vertical integration could be considered for the EV LiB value chain.

2) The opportunities and risks discussed below resulting from international developments, including circular economy policy are provided for the case of solar PV panels in Australia:

Although there are a couple of PV manufacturing companies in Australia, 90% of the PV panels are imported from overseas countries such as China. Therefore, policy and regulations on the quality and quantity of imports can affect the circularity journey of PVs in the Australian context.

Q. Affect Australian exports, such as by opening or creating new markets, or by placing regulatory requirements on the design and production processes of Australian exports.

Rare valuable materials that are embedded in PV panels, such as silver, silicon and copper, are commonly mismanaged when the PV panel goes to landfill, or the materials are contaminated in the recycling processes. Nevertheless, if recovered uncontaminated, these materials can open new markets as in jewellery, ink and other electronic uses.

Q. *Affect Australian imports, such as changes to production methods internationally, or developments in international markets.*

If there is a circularity goal for the solar industry in Australia, PV panel imports are critical. Engagement with wholesale companies that include a waste management plan from the whole panel lifecycle (including take-back systems of faulty panels and proper management of these),

and material and performance certificates can start the transition to a PV circular use and waste management.

Q. *Innovative processes that could be adopted in Australia.*

Product passports, leasing business models for PV installations, training for PV panels uninstallations, incentives for PV reuse.

III. Information request 3: Hurdles and barriers to a CE.

- **Major hurdles and barriers to implementing a CE in Australia**:

One of the major barriers is the competing policy objectives of different government departments. Overarching policy objectives, and the socio-political narrative tends to focus on economic growth, which is typically measured using GDP. Economic growth (avoiding a recession) is achieved through the increase in production and consumption, which is the anti-thesis of a circular economy. As long as the main policy objective is around increasing GDP, it will be challenging to move towards circularity. For example, Australia has a relatively mature reuse market through op-shops. However, these activities have little to no impact on economic (GDP) growth, as they trade second hand goods and are typically run by volunteers. Although there are studies and forecasts on how CE can add to economic growth, as GDP is a measure of the linear economy, implementing higher order CE strategies such as keeping products in use for longer will have a negative impact on GDP, as no new production or consumption (purchasing of a new product) has taken place.

Research (Ho, Gajanayake & Iyer-Raniga 2023) shows that another major barrier is the misunderstanding that CE is recycling (or a more mature form of recycling). The terminology used by governments can exacerbate this issue. Few examples from Victoria are:

- The government's CE strategy is named "Recycling Victoria: A new economy".
- The government agency tasked with delivering the circular economy plan is named "Recycling Victoria".

The high political and economic influence of the waste and resource recovery sector can have a detrimental effect towards adopting higher order strategies, which aim to reduce waste. If absolute waste reduction takes place, this may render some of the waste infrastructure redundant, which can have negative impacts to such businesses.

There are practical challenges in applying circular thinking at the design stage given the global nature of products being consumed within Australia. With more complex products being imported to the country it poses a challenge on how circular aspects could be included in all products being consumed within the country.

- Additional barriers/ hurdles to implementing a CE in Australia include:

- Lack of government incentives and mandatory targets around reuse, repurpose and repair.
- Lack of homogenous policies across the state governments especially CE targets.
- Lack of knowledge and understanding on CE and circular business models leading to a narrow value perception.
- Insufficient data particularly around material composition, size, and design constraints.

- Lack of digital mechanisms designed to provide provenance on materials that enter product manufacturing and into the built environment – this undermines data stored on products and thus their actual circular value – fraudulent product substation is a major concern. This has been addressed in the wine industry, in food exports to markets with high product substation. It needs to be extended into products entering the built environment.
- Increase dependency on the EU.
- Lack of collection and transportation infrastructure to support CE initiatives.
- Lack of a systemic approach in formulating and implementing CE targets.
- Lack of collaboration across the value chain.
- Intellectual property concerns around proprietary technology
- Lack of standardisation especially around design constraints.
- Cost of operation for CE strategies, cost of transportation and cost of labour.

IV. Information request 4: Governments' role in the CE.

- **The extent to which policy or regulatory changes (national, state and territory, or local; or for specific sectors, products, or supply chains segment level) could better enable the pursuit of circular economy activities.**

- *Financial Incentives:*

  Financial incentives and penalties could include taxing of non-renewable resources, which can encourage more circular activities. In developing financial incentives and taxes, the three conditions required to achieve a sustainable society (Cahn & O'Brien 1996) can be used as a guidance. These three conditions are that a society's rates of use of renewable resources should not exceed their rates of regeneration; its rates of use of non-renewable resources should not exceed the rate at which sustainable renewable substitutes are developed; and its rates of pollution emission should not exceed the assimilative capacity of the environment.

- *Regulatory changes*

i. The government could consider providing grants and funding for engaging in reuse and repurposing EV LiBs and other CE initiatives in Australia. In the same vein, the government could consider setting up pilot initiatives through government owned-fleets and procurement policies.
ii. Mandatory requirements around design for disassembly, reuse, repurpose, and recycling can be considered providing an incentive for stakeholders to engage in CE initiatives.
iii. Government could also mandate 'product stewardship schemes' to facilitate data transparency.
iv. The government could urge education provides to include CE considerations in every academic curriculum to overcome barriers such as 'lack of knowledge and understanding on CE'.
v. Collaboration needs to be facilitated across state-governments to mitigate hurdles around lack of homogeneity. Furthermore, collaboration should not only occur between industry and government but also including academic stakeholders.

vi. The government could incentivise, or mandate digital approaches to ensuring data collected on products entering the built environment reliably provide assurance of their certification (fraudulent, non-compliant product substation being a major threat to circular economy feasibility and viability).

- **The extent to which current policies or regulations hinder the pursuit of circular economy activities. Specific examples of how current settings are acting as barriers would be welcome**.

The terminology used within policy documents leads to a misunderstanding that CE is synonymous with recycling. Few examples from Victoria are:

- The government's CE strategy is named "Recycling Victoria: A new economy".
- Circular Economy (Waste Reduction and Recycling) Act 2021
- The government agency tasked with delivering the circular economy plan is named "Recycling Victoria".

Caveats in government targets on definitions of what is and is not included in waste targets are a major barrier. The footnote on page 8 of the National Waste Policy Action Plan is an example. With steady growth of the construction and infrastructure sectors, CE targets need to include these waste streams.

Currently, the lack of homogeneity among state policies particularly around CE targets acts as a barrier especially for activities undertaken across multiple states.

- **What actions governments could take to facilitate Aboriginal and Torres Strait Islander roles in progressing the circular economy, including in drawing on Indigenous knowledges in policy design in ways that recognise and protect Indigenous cultural and intellectual property**?

i. The government could include First nations stakeholders not only via consultations but also through including them during the decision-making process.
ii. The indigenous stakeholders have been practising CE for over 1000 years focusing on R-strategies such as 'regeneration'. The government could implement similar practices while designing policies to protect indigenous culture.
iii. The government could also consider setting up CE precincts or state-based CE hubs which involve Aboriginal and Torres Strait Islander representatives. These hubs could act as an advisory body for local and state governments for CE implementation.
iv. The government could seek to identify business models of CE that are suited to providing stable ongoing employment – such as Product as a Service Models (that align with policy on social procurement) to ensure trust, value creation and scalability of circular businesses supplying government projects.

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