ENGINEERS
AUSTRALIA

Productivity Commission
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Canberra City ACT 2601
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Via online submission form

1 November 2024

Re: Inquiry into opportunities in the circular economy

Dear Chair,

As Australia's national body for engineering, Engineers Australia is the voice and champion of our 127,000-plus members. We provide them with the resources, connections, and growth they need to do ethical, competent and high-value work in our communities. A mission-based, not-for-profit professional association, Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

Engineers Australia is formally accredited as an observer to the business of the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Environment Assembly (UNEA) and United Nations Environment Programme (UNEP). We are gold supporters of Infrastructure Net Zero and members of the Australian Sustainable Built Environment Council. Our Chief Executive Officer is a Member of the Circular Economy Ministerial Advisory Group (CEMAG).

Engineers are essential enablers of Australia's circular economy. Their involvement spans all aspects of resource policy, governance, management, and compliance, ensuring the efficient, safe, and sustainable use of materials and the optimal management of Australia's resource systems.

Engineers Australia is available to participate in future opportunities to discuss the issues raised in this submission. Please contact Caitlyn Baljak – Senior Policy Advisor, Climate Change (cbaljak@engineersaustralia.org.au) to continue the discussion.

Sincerely,

Jenny Mitchell

General Manager, Policy and Advocacy

Submission: Opportunities in the Circular Economy

Engineering is the essential link between thinking and doing. Between idea, and implementation. It is our means for positive, sustainable change, with an influence on every aspect of the economy, environment and society. Engineers identify problems and seek opportunities. They are engaged daily in handling circular economy principles of designing out waste and pollution, preserving and enhancing material value, conserving natural resources and regenerating nature.

The Role of Government in the Circular Economy

This submission highlights Engineers Australia's recommendations to the Productivity Commission on the Australian Government's role in a circular economy, before an examination from an engineering perspective of:

(1) Hurdles and barriers to a circular economy
(2) Priority opportunities to progress a circular economy, and
(3) Circular economy success stories.

Recommendations

Engineers Australia has highlighted two key recommendations for the Australian Government's role in supporting a transition to a circular economy.

Establish a Chief Engineer role within the Australian Government.

This role would provide strategic and technical advice to the government on national systems challenges reliant on Australia's engineering capability, including the transition to a circular economy.

Harmonise and make transparent existing measurement tools and data repositories to support decision-makers.

A plethora of data on circular economy indicators currently exist but are not centralised nor systematised in a way that is utilitarian for trans-sectoral collaboration and action. Existing data and measurement methods will need to be harmonised between jurisdictions to allow for consistency, efficiency, and scalability to lower barriers for businesses, decrease compliance costs, and foster innovation. This will require working with businesses to strike a balance between data transparency while protecting intellectual property and proprietary information.

1. Hurdles and Barriers to a Circular Economy

Transitioning to a circular economy in Australia is not without its challenges. Australia has the third highest material footprint per capita in the Organisation for Economic Co-Operation and Development (OECD), and the fourth lowest rate of material productivity.[1] Many barriers stand in the way of a circular economy transition.

> **Example barrier: Regulatory limitations on product warranties and risk appetites for personal indemnity insurance**.
>
> The construction industry has some of the biggest opportunities for circular design practices, with examples including building and material reuse, dematerialisation, design for disassembly (modular design), the use of reusable products and ingredients (e.g. fewer components, avoiding adhesive fixings, eliminating toxins etc.).
>
> At present, legislation and consumer expectations often require new and fit-for-purpose materials and products to be used in construction, where material selection and product design are key to remaining compliant with the National Construction Code. When material reuse is proposed, the responsibility for product performance is shifted onto the specifiers conducting evaluations, as product warranties are often expired or voided. This leaves the assessor, rather than the manufacturer, to bear the liability. Many professional indemnity insurers for engineers are unlikely to provide comprehensive cover for this risk, and thus engineers cannot sign off on re-used materials in many cases without fear of violating their insurance coverage.
>
> It is critical to ensure that the Productivity Commission seeks out feedback from financiers and insurers regarding their understanding of, and risk appetite for circular economy products, projects and processes, as the business-as-usual approaches of these sectors have significant flow-on impacts for economy-wide application of circular economy principles.

The above example illustrates the complexity and interdisciplinary problem-solving that is required in just one sub-section of circular economy challenges (material reuse) within one sector of the economy (construction).

Below is a list of additional hurdles to achieving circular practices across the economy, noting that many of these hurdles carry the same (or higher) orders of complexity as the limitations of product warranties and personal indemnity insurance outlined above.

- **Policy frameworks inadequately supported by financial commitments:** The existing policy environment is configured towards a linear economy, making it difficult to implement circular practices on a large scale without sufficient government investment.
- **Inconsistent language and standards across jurisdictions**: Outdated waste definitions, inconsistent regulations across states and territories, and the absence of national standards for circular economy practices hinder progress.
- **Lack of capability:** Insufficient understanding of material origin or the skills and resources to conduct lifecycle analysis. This can also be exacerbated by a lack of partner networks for the procurement of circular materials.
- **Lack of data and/or transparency**: The absence of a common language and central data hub for circularity (including product characteristics such as durability, origin, ingredients, strength grade, quality, toxicity etc.) hampers product certification, and creates a gap for the comparison between circular products.

[1] OECD (2024), "Material resources: Material resources", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00695-en, accessed 11 October 2024.

- **Siloed procurement**: Fragmented procurement processes reduce economies of scale in supply chains, purchasing power, and the effectiveness of circular practices.
- **Market competition barriers**: Many circular products compete with large, well-established products where market power exists between just a few influential players, many of which receive government support (for example, the traditional liquid fuels industry). Establishing new niches in well-established markets is almost impossible for new players with limited bargaining power or guarantee of sales (for example, in the emerging low-carbon liquid fuels industry).
- **Unmet innovation and research needs**: A shortfall in targeted research and innovation, particularly in areas like material substitutions, waste minimisation, and emissions abatement technologies, stalls advancements in circular economy practices.
- **Uncertain pathways from research to commercialisation**: New circular products face challenges in scaling up to commercial viability.
- **Technical and process limitations**: Designing products and processes that are both efficient and easily recyclable and reuseable presents many technical challenges.
- **"Tunnel vision" of traditional business models:** Many industries are still focused on short-term profitability rather than long-term sustainability. Further, there is a lack of accountability for the environmental costs of a product across an asset's lifecycle, which is required to incentivise structural change.
- **Lack of confidence in reused and remanufactured products**: Stigma over secondary materials, often due to a lack of understanding, can impact consumer preferences and limit the adoption of circular practices.
- **Cost of certified products and the certification process:** Many recycled/upcycled and reused products currently carry a price premium, and the cost of certification itself can act as a deterrence to introducing new circular products, reinforcing the price premium by keeping the pool of circular certified products low.
- **Additional time added for circular projects:** Because more than 80 per cent of the environmental impact of a product is determined at the design stage[2], more time is often required for the design of circular projects within the constraints of our (current) linear economy, which can be a deterrent to engaging in circular planning (as additional time usually adds additional cost).
- **Contamination risk:** Maintaining the purity and integrity of a product when it is recycled and reused varies in difficulty depending on the product.[3]
- **Antiquated design standards:** Reassessing product designs and processes for materials and resource circularity will need to be a core function of virtually every engineering code. Re-evaluating engineering codes is a time-intensive process (i.e. can take multiple years from review to publication).
- **Lack of regulatory incentives and enforcement:** The lack of a nationwide mandate (e.g. a minimum mandatory use of low-carbon liquid fuels in the transport sector) weakens the efficacy of state-level regulation. Even where regulatory incentives exist (e.g. via biofuel minimums in New South Wales and Queensland) they are not always enforced.
- **Sector silos:** Silos between sectors hinder the circular economy by limiting collaboration and knowledge sharing across industries, which is essential for creating closed-loop systems that reuse and recycle resources. These divides prevent sectors from aligning on standards, technologies, and policies that could facilitate resource efficiency and reduce waste on a national scale.

[2] Ellen MacArthur Foundation (2022), An introduction to circular design, accessed 10 October 2024

3 *The risk of contamination can have a variety of impacts and can be benign, but undesirable (for example, if water aesthetic characteristics are impacted via water recycling even if health characteristics are not impacted) or can pose a threat to people and the environment (for example, through Per- and polyfluoroalkyl substances (PFAS) accumulation through the same water recycling process, which then presents a risk to human and environment health).*

2. Priority Opportunities to Progress the Circular Economy

Establish a Chief Engineer role within the Australian Government

A priority opportunity to progress circular economy is to apply systems thinking approaches to achieve multi- and trans-sectoral collaborations for solutions, especially when it comes to waste valorisation – converting waste materials into valuable products. The establishment of a Chief Engineer role within the Australian Government would support this by bridging technical and policy expertise and applying a systems approach to problem-solving. We have provided some specific, engineering-relevant examples of cross-sector circularity to illustrate the benefits of a systems approach to a circular economy.

- **Sugar cane waste for low carbon liquid fuels (LCLFs):** Agricultural by-products, such as sugar cane waste, could become a key feedstock for the LCLFs required to achieve our net zero targets in the transport sector. While the Department of Infrastructure, Transport, Regional Development, Communications and the Arts has undertaken significant consultation on LCLFs (both as a single issue and as part of the Transport and Infrastructure Net Zero Plan[4]), these consultations have focused heavily on just one aspect of the circular economy, emissions reductions, which could be broadened to other measures of circularity.
- **Wastewater for biochar, hydrogen or road base:** While wastewater is often seen as a burden to be treated and returned to the environment by our city councils and heavy industry, by working with other industries in mind it can be reframed as a resource to be extracted from. From the pyrolysis of waste-water solids for carbon-storing biochar, to the reuse of high-aluminium sludges for road-making material, to the application of electrolysis on treated wastewater for hydrogen production, there are a myriad of wastewater applications that could prove to add value to other industries.
- **Production of graphene from microwave pyrolysis of organic waste:** Microwave pyrolysis is a promising approach for processing organic waste, including plastic, biomass, and other carbon-rich materials, to produce high-quality graphene. Industries generating large volumes of carbonaceous waste, such as agriculture (biomass) or petrochemicals (plastics), can use microwave pyrolysis to create graphene, which can then be used in the energy, construction, health, and electronics sectors. This fosters a circular flow of materials and encourages collaboration across industries.

Harmonise and make transparent existing measurement tools and data repositories to support decision-makers.

Although many of our members identified opportunities to improve environmental and economic project outcomes via circular economy practices and products, they noted that decision-making power for implementation was ultimately with their clients. Ensuring that decision-makers are informed of the benefits of circular approaches and have the data to back up these claims is key to securing pro-circular choices.

To equip engineers with measuring and reporting one indicator of circularity we have developed the Carbon Measurement Fundamentals for Engineers[5], a tool for measuring, understanding and mitigating embedded carbon in products and projects. With appropriate resourcing and investment, tools such as these could be expanded to measure other indicators of circularity (from singular characteristics such as water intensity and renewable energy use, to more complex metrics such as resource productivity and material recovery rates). This could in time create a rich source of data for supporting circular economy decision-making from the project, product and process level up to an economy-wide level.

[4] Engineers Australia (2024), Engineers Australia Submission: Transport and Infrastructure Net Zero Consultation Road Map, accessed 18 October 2024

[5] Engineers Australia (2024), Carbon Measurement Fundamentals for Engineers, Version 1, accessed 18 October 2024

Finally, there is a plethora of existing data on circular economy indicators, however, these data are often in the hands of the private (rather than public) sector. Making these data available will require working with businesses to strike a balance between data transparency while protecting intellectual property and proprietary information.

3. Circular Economy Success Stories

A key barrier to circular economy adoption is that it is not a widely understood concept. The presentation of case studies, such as those requested by the Productivity Commission, is a pragmatic mechanism to educate various industries about relevant circular economy opportunities. Engineers Australia looks forward to learning from the many success stories that will be submitted to this inquiry.

Engineers Australia regularly features circular economy success stories in our annual Climate Smart Engineering Conference and our professional magazine, *Create*. This open-access source of information is an excellent resource for the Productivity Commission to seek circular economy case studies specific to the engineering profession. Example articles include:

- Circular construction involved designing for multiple lifetimes
- Ready to roll: Bringing the circular economy to life
- Recycled timber a boon for the circular economy
- RMIT researcher charts path to circular economy using excess PPE
- Infographic: How tyres are entering the circular economy
- This startup brings the circular economy to a café near you
- Meet one engineer helping people see the huge possibilities in the circular economy
- New cement products could kickstart the construction industry's circular economy

In addition to the stories featured in *Create*, our members have brought to our attention additional success.

Success Story #1: Collie Green Steel Mill in Western Australia

Western Australia is set to become home to the country's first green steel recycling mill in Collie, expected to begin operations in 2026. Green Steel Western Australia's $400 million facility will process 400,000 tonnes of scrap steel annually, converting it into long steel products such as rebar, with minimal environmental impact.[6]

The electric arc furnace technology will be powered by renewable energy, cutting carbon dioxide emissions by an estimated 562,000 tonnes per year compared to traditional methods. It highlights how engineering innovation can support circular economy principles by reusing existing materials and reducing reliance on raw resources like iron ore.[7]

The project is estimated to generate over 200 local jobs and 600 construction jobs, contributing to the economic transition of Collie, historically a coal and energy hub. It exemplifies how green manufacturing can foster regional economic resilience while promoting sustainable engineering practices.[8]

By leveraging renewable energy and advanced recycling technology, the Collie mill demonstrates a viable path toward decarbonising the steel industry, setting an example for future heavy industry projects in Australia.

Success Story #2: Samsara Eco – Climate Repair via Infinite Plastic Recycling

Samsara Eco is pioneering a method to break plastics down into their fundamental components, offering an innovative recycling solution that helps cut emissions by minimising plastic waste in landfills. In collaboration with the Australian National University, Samsara has developed a process that enables the

[6] Green Steel of WA Pty Ltd (2024), Collie Green Steel Mill, accessed 24 October 2024
[7] ibid
[8] ibid

endless recycling of plastic through the use of enzymes, which break the material into its core components, allowing it to be remade repeatedly.

This method involves modified enzymes that swiftly degrade plastic into smaller molecules, ensuring that the recycled material retains the same structural quality as new plastics. The technology is particularly effective for recycling difficult plastic mixtures, such as coloured, multilayered, and composite plastics.

According to Samsara, one tonne of recycled plastic saves 5,774 kWh of electricity; 2,593 litres of oil; 98 million btu (British thermal units) of energy and 23 cubic metres of landfill.[9]

Success Story #3: Circular Industrial Precincts with Circular Ecosystems Pty Ltd

Circular Ecosystems Pty Ltd is transforming industrial precincts and regions through a systems-level approach to material, energy, and water flow management. By prioritising value retention within systems, the company creates systemic efficiency through industrial circularity. Their advanced circular intelligence platform delivers real-time, contextual data for strategic interventions, enabling visualisation and reporting at precinct and regional levels.

This approach enables the development of cross-sector value networks, catalysing new opportunities for innovation and shared infrastructure. The platform enables precinct owners and government entities to gain data-driven insights for informed decision-making. Circular Ecosystems is partnering with the Kwinana Industry Council in Australia to digitise the world's largest existing symbiotic model, setting a new global standard for industrial symbiosis.

Success Story #4: Sustainable Buildings Research Centre – University of Wollongong

The Sustainable Buildings Research Centre, located at the University of Wollongong Innovation Campus, has achieved Living Building Challenge 'Living Certified' status – a great example of circular economy success in the built environment.[10] The Centre has delivered a range of circular initiatives including:

- A large proportion of reused building materials, including disused telegraph poles, railway tracks, pieces and bridges and components of a demolished house
- A high proportion of environmentally certified materials
- Use of non-toxic building materials
- Dematerialisation in design
- Close to 100 per cent diversion of construction waste from landfill
- 100 per cent on-site renewable energy generation and no non-potable water from potable sources

[9] Clean Energy Finance Corporation (2024), Samsara Eco scales up infinite recycling for plastic waste, accessed 4 October 2024
[10] University of Wollongong (2024), Sustainable Buildings Research Centre, accessed 29 October 2024