Response to the Circular Economy Inquiry

The University of Melbourne has significant expertise across a range of disciplines central to the circular economy. This includes international recognition in supply chain management, technology-driven sustainable practices, inter-organisational systems adoption and impact, consumer culture, consumer behaviour, life cycle analysis, waste recycling, regulation, environmental monitoring, energy distribution networks, building and product design. We have particular strengths in circularity within the healthcare profession, in the minerals and mining industry and in construction. Through our Sustainability Business Clinic, we provide pro-bono legal assistance in partnership with global law firm Ashurst to small businesses working in the circular economy and observe the regulatory barriers to achieving circularity.

The University of Melbourne is also working to incorporate circular economy principles, into its own organisational operating practices, within design, construction and operation of its buildings and public realm, resource consumption for utilities and community purchasing habits. There is a significant focus on reducing up stream consumption, retaining items on campus in their original state for as long as possible, better material selection via reuse and adaptation, and better quality of materials leaving our campus for reuse and recycling. Circular economy principles apply to all material consumption for waste, energy, water and biodiversity.

The University of Melbourne has made a public and enduring commitment to lead on sustainability, defined through its Sustainability Framework which is enshrined in its Sustainability Charter, and delivered via its Sustainability Plan 2030. Within the Plan there is a priority area **Just and Circular Economy**, with four targets, one specifically aimed at Circular Economy practices.

- The University has reduced waste to landfill to10kg per person.
- The University has reduced the flow and improved the circularity of materials passing through the University.
- The University has principles for ethical and sustainable consumption and service provision embedded into operations and procurement practices.
- The University tracks spend with social and Indigenous suppliers setting target for 2024.

The University's operational approach to waste and resource management is also modelled on the circular economy, meaning that we 'close the loop' on materials we produce by feeding them back into the material cycle. We are actively working towards this through waste education initiatives, improving waste collection streams, providing reuse options and rethinking procurement.

Our suggestions on the four questions posed by the Productivity Commission are provided below.

CIRCULAR ECONOMY SUCCESS STORIES AND MEASURES OF SUCCESS

Success Stories

1. Healthcare

There are efforts to increase the circularity of medical equipment which have been led by the University of Melbourne and affiliated hospitals, notably at Western Health. Efforts have been focussed upon hospitals since they are large users of equipment and generate considerable waste. Within hospitals, the operating theatres and the Intensive Care Unit are considerable users of medical equipment. As examples:

a) ***Reducing consumption*** - extending the use of anaesthetic breathing circuits from daily to weekly changes (with microbiological evidence of no change in contamination rates) saves $20,000 p.a. at Western Health alone and halves the associated plastic waste[1].

b) ***Reusing*** - the use of reusable anaesthetic equipment in place of single use, saves approximately $100,000 p.a. at Western Health alone[2]. As renewable energy penetrates the Australian energy market, it can also result in reductions in CO_2 emissions.

c) ***Reusing*** - hospital staff find reusable gowns to be more comfortable and their use is cost neutral to Western Health[3]. This program has now been expanded to include other reusable linens such as surgical drapes, pads, sterile wraps, etc. Since 2022, Western Health has replaced approximately 400,000 disposable gowns with reusable gowns.

d) ***Recycling***- Commenced at Western Health in 2009, PVC medical plastic recycling is now in over 150 hospitals in Australia and N.Z[4].

2. Battery Recycling

Envirostream Australia (now owned by Lithium Australia) is the first onshore company to offer lithium and mixed battery recycling[5]. By utilising advanced technologies, they recover valuable materials from lithium-ion batteries, such as cobalt, nickel, copper and mixed metal dust. These metals are sent to local recyclers, ensuring materials are kept in the domestic economy. This approach also reduces the social and environmental costs of mining and shipping, including the CO_2 emissions associated with these activities.

However, Envirostream currently produces only black mass—a mixture of metals and carbon—which cannot be directly used for battery production. Further development of refinement processes is needed to convert black mass into high-value battery-grade metal precursors. This would not only maximise the economic benefits but also fully close the circular loop by enabling the materials to be directly reintegrated into battery manufacturing.

---

[1] McGain et al., Anaesthesia (2014), 69, 337–342 https://doi.org/10.1111/anae.12563

[2] McGain et al. Clinical Practice (2017) 118(6) 862-869 https://doi.org/10.1093/bja/aex098

[3] Angelopoulos et al. Australian Health Review (2022) 47(1) 131-133 https://doi.org/10.1071/AH22223

[4] https://www.vinyl.org.au/pvc-recycling-in-hospitals

[5] https://lithium-au.com/battery-recycling/

3. Walking the Talk - best practice at the University of Melbourne

a) Choose to reuse

The Choose to Reuse Plate program (C2R) was originally formed by a group of students in 2013 called 'wash against waste' and relaunched by the University in 2019. It reduces the need for single use disposable food and beverage packaging by replacing the items with reusable crockery and cutlery. This was implemented by all retailers within our Student Precinct from 2021, with all other retailers across the University following suit as contracts renew. Sustainability clauses have been added to all contracts, mandating the use of reuseable items. The University has invested in back of house infrastructure (multiple dishwash hubs) to ensure items can be washed and redistributed. Since 2022 this included an Events Services, Swap Cup and other reuse initiatives. This program has been recognised nationally, with many visitors to the campus including State Government- DEEC, Sustainability Victoria, other institutions, and private enterprise to view the service, as well as winning a number of state and national awards. The program has diverted approx. 1,000,000 items from landfill since 2019.

b) Furniture & Equipment Reuse

The Furniture and Equipment Reuse Centre provides University of Melbourne faculties, departments and affiliate organisations with a cost effective and immediate solution to their furniture needs. Since 2012 it has reused and redistributed items across the University, keeping items in their original state for as long as possible and out of landfill. The centre has reused approx. 50,000 items since 2012.

c) Update of Design Standards

Circular economy principles have now been incorporated into the University Design Standards (end 2023) for new buildings, as well as refurbishments and fit outs. A waste management and circular economy plan is now needed for all projects, or a sustainability brief to outline opportunities at all stages of design and construction. It also requires all projects to report on waste metrics monthly. This also includes opportunity for reuse across projects and campus, as well as improved sustainability around material selection, including recycled content.

d) Drafting first CE & Waste Strategy

The University is drafting its first public facing Circular Economy and Waste Strategy which is due for release at the beginning of 2025. It outlines the high-level principles to be adapted across all areas of the business. It will be a suite of three documents: 1 Circular Economy and Waste strategy, 2 Campus Operational Plans 3. Materiality Framework. Within the strategy it will set University wide metrics to measure circularity. This may include a space metric, or flow of materials via input/output, as well as the existing circular economy targets via the Sustainability Plan 2030.

e) Circular Economy Metrics

The University of Melbourne was the first University globally to submit an application for the Ellen McCarthur Circulytics program, in 2023 to try and understand and assign a metric to our circularity practices. We received a score of D- (rating from A-E). The program has since been wrapped up but it gave us a baseline to work towards for the opportunity to understand our circularity processes.

f) Waste Management

The University is continually improving its waste management practices. An Australian University first, it is weighing all retailer waste via scales on site as well as utilising 'actual' weight-based metrics, as opposed to industry averages, for all its waste leaving campus, within its waste contractor. This is to gain a clearer understanding of where waste is being generated and how it can increase its diversion rates, including reuse and recycling.

g) Embedding Procurement into contracts

Sustainability clauses, including those around circular economy are now embedded into all retail contacts, as well as standard EGS principles ate being drafted for across the tender and supply chain process. Priority areas include circularity around lab consumables and reduction of packaging types and volumes. Sustainability reporting is also now required for all new service contractors and key suppliers.

Measures of Success

The Platform for Accelerating the Circular Economy (PACE) network has issued a report on suitable measures of success for businesses[6]. "Top indicators" for circular economy initiatives are straightforward conceptually: the primary objective is to reduce waste (or leakage) of biological and technical materials – and, conversely, to improve resource recovery rates – during production, distribution, consumption, and disposal processes. Achieving this objective leads to reduced environmental impacts, supports Australia's Net Zero commitment, and enables regenerative business.

The University of Melbourne can add value by developing indicators for intermediary goals and outcomes – such indicators enable ongoing assessment of progress. These could relate to consumer attitudes, awareness and readiness, but also to information exchange and joint problem-solving amongst supply chain partners. Other intermediary indicators could include job creation and the technology readiness level of innovative technologies. Working in the education sector, universities and schools can also influence behaviour change regarding consumption.

The University of Melbourne also has expertise in the analysis of which circular opportunities provide the greatest scope to improve environmental, social and economic outcomes in Australia and why, with metrics used to inform this analysis. This includes life cycle assessments, materials flow analyses and cost-benefit assessments that can be used to determine the distribution of benefits and costs, and whether they will occur in the short, medium or long term. One specific example is the Environmental Performance in Construction (EPiC) database[7], a free resource that contains embodied environmental flow coefficients for a broad range of construction materials using a comprehensive hybrid life cycle inventory approach.

[6] Circle-Economy-Circular-Metrics-for-Business.pdf

[7] www.epicdatabase.au

PRIORITY OPPORTUNITIES TO PROGRESS THE CIRCULAR ECONOMY

1. Leverage existing research

The Productivity Commission should be aware of the significant volume of research that has already been conducted for exploring circular economy opportunities in Australia. The 'Wealth from Waste' project, comprising expertise from the University of Technology Sydney (UTS), Monash University, The University of Queensland (UQ), Swinburne University of Technology (SUT) and Yale University explored barriers and opportunities for achieving a Circular Economy of metals in Australia over several years. Their findings are published in a summary report[8], covering aspects such as assessing resource potential, tech-economic assessments of recycling technologies, understanding social barriers and the business/economic dimensions of the circular economy. This multi-disciplinary project is just one of many that have explored circular economy issues in Australia, and it is critical that future policies do not promote the double-up of the work of the past.

2. Industry and stakeholder collaboration

Collaboration is key to accelerating the adoption of the circular economy model and enabling capacity development and behaviour change. Many businesses, practitioners and policymakers recognize the need to step beyond entrenched industry structures and practices and are experimenting with novel approaches[9]. Businesses are seeking to self-support, and share legal guidance across circular economy sectors, in the absence of regulatory direction and a deficient legal framework. The World Economic Forum points to first-mover advantages for firms that forge strategic partnerships with industry peers, competitors and stakeholders that enable this knowledge and information flow[10]. The University of Melbourne can help illuminate what enables effective social learning and joint action in such partnerships and provide an evidence-base for innovative policy interventions in key industries in Australia and APAC. The University also has the capacity to use our campus as a living laboratory to link operations and research outcomes, via pilot programs, leveraging the existing expertise and applying it to real world challenges that are prevalent on campus. This can be seen in some of the examples above but there is much more to do.

Fundamental rethinking on product, business model, and operating model redesign is needed[11]. This requires deep changes in product design, infrastructure for material flows, retailing systems, and product choice and use patterns. At the core of many of these challenges are transformations in exchange relationships throughout the supply chain, all the way to the end consumer.

3. Consumer culture, consumption and use practices

The promotion, adoption and design for more sustainable consumer behaviour is fundamental to supporting a circular society in Australia. Currently, Australia has one of the highest rates of

[8] http://wealthfromwaste.net/wp-content/uploads/2017/11/Wealth_From_Waste_Report_WEB.pdf
[9] e.g. https://www.sginnovate.com/open-innovation
[10] https://www.weforum.org/publications/circular-transformation-of-industries-the-role-of-partnerships/
[11] For example, see https://www.greenpeace.org/usa/reports/circular-claims-fall-flat-again/

Municipal Solid Waste generation per capita in the world[12] and has surpassed the US as the world's biggest consumer of textiles per capita[13]. Interventions for more sustainable consumption can be designed and implemented using behavioural, regulatory and practice theoretical approaches.

One way to close the green gap - the discrepancy between consumers' positive attitudes towards sustainability and their actual consumption behaviours - is to shift the focus from changing individual behaviour to changing social practice. Everything we do (e.g. cleaning the house) is not one individual behaviour but a practice made up of the materials we use (e.g. cleaning products, disposable wipes, water), the skills we have (e.g. how to degrease a stove), the motivation to behave one way rather than another, the capacity to be able to perform the behaviour, and the meanings we connect to the practice (e.g., cleaning quickly is efficient). Collectively, this is a shared understanding of how a practice, in this case cleaning the house, is 'supposed to go' and how it fits into our collective lifestyles. Tailored interventions can help reconfigure these social practices (i.e., changing materials, meanings, or skills connected to the practice). University of Melbourne can support policymakers and social marketers with intervention design, monitoring and adjustment to manage and overcome consumer resistance that may emerge after implementation. The university and school sectors can also play a role in educating younger generations, who can adopt such changes more readily.

The Productivity Commission has already considered the right to repair in Australian law[14]. The findings of the right to repair report, that consumer laws are presently sufficient, highlights a gap between attitudes and behaviours. Under existing laws, consumers do have rights when they receive defective goods. However, those rights overwhelmingly trigger a right of replacement for a short period of time, rather than a durable right of repair, which is seen as the manufacturer's responsibility.

4. Information gathering for material stocks and flows

Studies on material flows are critical to developing an understanding of where inefficiencies exist in the supply chains and identifying where materials exist as potential stocks for future recovery. Such studies can occasionally provide unexpected findings on where to prioritise future interventions. For example, Werner et al.[15] found that a single slag dump in Tasmania contains more indium than all the country's smartphones, laptops, TVs and solar panels, combined. As another example, decommissioning offshore oil and gas facilities can provide materials for re-use in local infrastructure development. Synchronisation and planning of such decommissioning projects can save transportation costs and carbon emissions. Understanding the usage, trade patterns and stock accumulation of materials is essential to informing criticality assessments that are heavily defining Australia's trade and sectoral investment policies[16].

[12] https://www.unep.org/resources/global-waste-management-outlook-2024

[13] https://australiainstitute.org.au/post/australians-revealed-as-worlds-biggest-fashion-consumers-fuelling-waste-crisis/

[14] https://www.pc.gov.au/inquiries/completed/repair#report

[15] Werner et al. Environ. Sci. & Technol. (2018) 52(4) 2055-2062 https://pubs.acs.org/doi/10.1021/acs.est.7b05022

[16] https://www.industry.gov.au/publications/critical-minerals-strategy-2023-2030; Ciacci et al. Resources (2016) 5(4) 29 https://www.mdpi.com/2079-9276/5/4/29; Kelly http://hdl.handle.net/11343/353551

5. Establish commercially viable business models and develop new innovations

The end objective is to make a circular approach as attractive, if not more attractive, than purchasing new. This requires appropriate policymaking for circularity (including incentives for manufacturers, resellers, consumers and recyclers and fines for polluters and wasters, including the original manufacturers and resellers). Circularity certifications are needed, as are circular procurement requirements at all levels of government. Further, research and investment in identifying new opportunities for not only recycling (closing the loop), but prolonged use (slowing the loop) and reuse, refurbishing and repurposing (tightening the loop) is necessary. There are ongoing projects on the repurposing of complex systems (ranging from oil and gas rigs and airplanes to bicycles) aiming to identify technically, economically and environmentally viable options before resorting to materials recovery only. At best this is a great opportunity to start new innovative industries based on reuse and repurposing.

6. Healthcare

Healthcare in Australia contributes to 10% of our national GDP and about 7% of our national carbon emissions. Since the sector is increasingly reliant on single-use equipment, it reflects a linear economy ('take, make, waste') rather than a circular economy. Most of the medical equipment used in Australia is imported. The financial costs of discarding medical equipment are relatively minor compared to the purchasing costs but these costs do not account for the impact on Australian ecosystems from the resulting incineration and landfill burden.

Circularity can be promoted by reducing unnecessary equipment and medication use. For example, converting from intravenous to oral medications whenever possible, reducing syringe and gown use when not required and encouraging reusable equipment in lieu of single use equipment. This is particularly important for high volume, often relatively low-cost equipment such as medical textiles, bowls, jugs, etc. Other examples include encouraging recycling of equipment that cannot be reduced or reused (e.g. intravenous fluid bags) and supporting research that potentially will reduce equipment and drug use.

7. Minerals and Mining

Given Australia's geographically dispersed and comparatively small population, we cannot expect to achieve the same economies of scale that might support a recycling industry in a larger jurisdiction such as the European Union. At the same time, it is reasonable to expect that Australia's future is heavily tied to the extraction of minerals. The volumes of waste generated by the mining sector are enormous and we should not lose sight of the contributions that can be made to reducing these volumes and increasing material efficiencies[17]. This priority area should include the following opportunities:

a) ***Reprocessing of "green energy" waste to recover and recycle valuable energy metals and minerals:*** Decarbonisation of Australia energy system requires a range of green energy solutions, from solar panels to battery storage to wind turbines. These systems require significant quantities of energy minerals and metals. In the absence of a circular economy systems approach, this means more primary mining and processing, not less. Further, Australia faces a looming challenge in effectively managing and reprocessing this "first generation" green energy infrastructure. The reprocessing of

[17] Golev et al. AusIMM Bulletin, December 2016, 30-32 https://search.informit.org/doi/abs/10.3316/ielapa.591613914644705; Lebre et al. J. Industrial Ecology (2017) 21, 662-672 https://onlinelibrary.wiley.com/doi/10.1111/jiec.12596

spent batteries and panels to recover valuable minerals and metals is in its infancy, albeit with a small number of Australian companies emerging. The barriers to successful commercial uptake cover a range of factors, including lack of policy drivers, logistic challenges[18], energy component and system design, and the nascent state of suitable processing technologies.

b) ***Reprocessing of mineral wastes (tailings) to recover and recycle valuable minerals and metals:*** Mining invariably results in the generation of large amounts of waste materials which currently are stored in tailings dams. For example, a high-quality copper ore contains up to 2% copper with the remaining 98% treated as waste. Globally the generation of tailings material is vast, estimated at over 10 billion tonnes annually. Tailings are typically fine (sub 100 micron) and contain water. Tailings dams rely on structural integrity to permanently contain and store these materials. Unfortunately, there are numerous and recent examples where tailings dams have catastrophically failed resulting in the loss of life[19]. Further, harmful pollutants (dust and leachates) can escape from these dams into the environment. Tailings do, however, offer a specific opportunity. They typically contain significant quantities of useful materials and metals that could be extracted for subsequent use. For example, they contain many rare earth and energy materials that are critical in battery technology. Australia has the potential (and critical mass) to be a global leader in the reprocessing of tailings. The challenge is to find the right mix of policy and technology solutions to make recovery economic.

HURDLES AND BARRIERS TO A CIRCULAR ECONOMY

1. High costs

There is a disconnection between manufacturing and resale costs vs. end-of-life costs. Manufacturing and reselling are cheaper than remanufacturing from reused or recycled components and materials. The cost of disassembly, sorting, and storage is huge and is borne not by the original manufacturers but by those trying to cycle value back into the economy. Product takeback is an example where the cost of waste or reuse is directed back to the manufacturer or reseller.

2. Consumer awareness and readiness to change

Consumers are familiar with established products and their prices. Many are inclined towards circularity but are unwilling to pay more than a token amount and to change their consumption and usage patterns. Incentives must be provided by governments to influence such behaviour - container deposit schemes being one example. Governments must also make it easy to act – providing access points for drop-off of items for repair, repurposing and recycling. Consumers also resist circular economy initiatives when they perceive that other actors are not taking their

[18] https://miningbeyondhotair.org/2024/02/22/single-use-vaping-and-lithium-waste-a-uk-perspective/
[19] https://www.afr.com/companies/mining/bhp-tables-45bn-plan-to-settle-brazilian-quest-for-dam-disaster-cash-20241019-p5kjm4; https://www.wsj.com/video/the-moment-the-vale-sa-dam-burst/BF4F43B3-F146-4D2A-A64E-15EFB7DB3714

share of the responsibility in the process[20]. This resistance can be mitigated through a careful design of policy interventions based on consumer responsibility research.

Beyond familiarity, consumer readiness (or lack thereof) to change consumption and recycling behaviours hinders progress toward circular economies. Using Prochaska and DiClemente's transtheoretical model of change[21] highlights the need to find behaviour change levers to move people through stages of precontemplation, preparation, action, and maintenance. Addressing familiarity or knowledge alone will be insufficient to engineer the needed changes in consumer behaviour.

3. Risk aversion in adopting circular economy initiatives

In business-to-business (B2B) and business-to-government(B2G) relationships, moving toward new or untested solutions is risky, particularly where there is a lack of market demand and a lack of infrastructure. It is difficult for companies to scale solutions to a level where they become sustainable, leading to market failure. Regulation and incentives must be provided by governments to encourage such behaviour and to support small players to persist until their business models become sustainable[22].

4. Inadequate infrastructure to support recycling

Recycling infrastructure and supporting technology are currently inadequate. The capacity to separate and recover valuable materials in central facilities is often limited, leading to low recycling rates and increased reliance on exports of waste such as battery black mass for processing overseas.

Australia lacks well-integrated 'reverse supply chains' that allow items to be collected at point of use or point of sale for refurbishment, repurposing, recycling, waste recovery or re-distribution. Such supply chains are expensive to implement and there are currently insufficient incentives to do so. Further, there are often many tiers of suppliers and interconnected networks especially for global supply chains that means it is difficult to even decipher the original source.

These inadequacies can lead to illegal dumping of waste, as the barrier to recycling becomes too high. This is already a major problem throughout Australia with the illegal dumping of waste tyres and waste chemicals. By increasing the costs of disposal, we can inadvertently strengthen illegal dumping markets. The appropriate infrastructure for recycling and reuse must be in place before regulatory barriers are introduced to prevent disposal[23].

5. Cost pressures in competitive markets

Globalisation means that it is inexpensive to produce single use, disposable or less durable equipment, clothing or devices in countries with low wages and export to Australia. These cheap imports compete with more expensive, reusable or more durable equivalents.

---

[20] Gonvales-Arcos et al. J. Marketing (2021) 85(3), 44-61 https://doi.org/10.1177/0022242921992052

[21] Mattos et al. Eval. & Program Planning (2022) 92 102069 https://doi.org/10.1016/j.evalprogplan.2022.102069

[22] E.g. https://erinlewisfitzgerald.medium.com/lessonsfrombrightsparks-8d56714356ad

[23] Bedford et al. Int. J. Crime, Justice & Social Democracy, (2022) 11(1) 167-181 https://www.crimejusticejournal.com/article/view/2191

Consumers need to be made aware of 'good news' stories[24], where financial gains can be made by using reusable equipment, contrary to popular belief that single use variants are always less expensive.

The healthcare industry suffers from mandates and/or regulatory encouragement towards such single use equipment, often without the engagement of relevant experts to determine the necessity of these options. Sales representatives routinely market single use healthcare products as 'safer' (less infections), without any robust evidence. Further, the diminution of hospital sterilisation and supply departments due to cost pressures has led to inability to process as many reusable devices/linens as in the past. It is easier and cheaper to 'chuck it out' as clinical waste rather than to sterilise and re-use.

6. Undesirable recycling

As we increase the recycling and reuse of consumer products, we can also inadvertently increase the circularity of toxic chemicals and pollutants. The most well documented issue here is the recycling of 'forever chemicals' such as PFAS within our waterways. Another example is the potential buildup of heavy metals due to recycling of ash from waste-to-energy and other fuel systems. Research is needed to ensure that pollutants do not build up in soils, waterways and the atmosphere, due to inappropriate recycling of some materials.

GOVERNMENTS' ROLE IN THE CIRCULAR ECONOMY

Governments must play a central role in the circular economy through policy development, regulatory innovation, business support, and procurement practices. Govindan and Hasanagic[25] argue that the governmental perspective has the maximum positive impact on the implementation of the circular economy in supply chains. Here, the circular economy can be promoted through laws, policies, risk reduction (through tax levies) and strict governance.

1. Procurement

All government procurement contracts should include clauses that encourage circular economy practice. Two specific cases where governments play a large procurement role are in infrastructure and in healthcare. Major infrastructure projects should be mandated to consider circularity at the early design stage before decisions are made that prevent innovative approaches. Infrastructure contracts should also include minimum targets for circularity such as a mandatory application of a percentage diversion of items going to landfill.

Procurement of reusable devices and regenerative materials in healthcare can also do much to advance this economy. The inclusion of food, beverage and hospitality contracts is also important due to their visibility to the public and as another large producer of waste.

2. Standards and Policy Development

[24] E.g. https://airseacontainers.com/blog/reusable-packaging-6-industries-that-are-using-reusable-shipping-materials/; https://theconsciousinsider.com/sustainable-packaging-statistics-market/#1-the-problem-with-non-sustainable-packaging-key-figures ;Sadiq et.al., NZ Med. J. (2024) 137(1600) 62-65 https://doi.org/10.26635/6965.6557

[25] Govindam & Hasanagic Int. J. Production Res. (2017) 56(1-2) 278–311 https://doi.org/10.1080/00207543.2017.1402141

Accelerating effective deployment of the circular economy will require new national safety standards and policies. A standard set of metrics is needed that can be adopted and applied holistically across business and governments to enable organisations to measure circularity. From there organisations can measure baseline and apply initiatives across the business.

Strategic leadership through government policy is needed to guide implementation of circular economy principles across the built environment, service provision and community engagement. The government has a large role in guiding actions by the wording of policy and consequently in rewarding or taxing particular practices. For example, the 'single use plastic ban' could be expanded to include a percentage inclusion of recycled content across products to drive change.

The current call, while it acknowledges the idea of slowing the loops, is heavily focused on material inflow and waste management, and less so on slowing the loop, or retaining the value in the system. It has been shown that policies targeting maintenance and reuse can have a much greater impact than policies focused on waste reduction and recycling[26]. The recent ISO standard (59004:2024) and the circular design principles being developed by the National Institute of Standards and Technology (NIST) both focus on value retention. Depending on the industry, this can take many forms, but the key is to focus on reusing for multiple life cycles where possible and repurposing into new applications when the original functionality is lost. These standards discuss products and components, not only materials. Generally, the various R-frameworks have been developed to support this (e.g. Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle and Recover**).**

3. Regulation

Effective regulation to ensure robust environmental outcomes must be afforded priority for success in achieving a circular economy. Ideally, this should be achieved alongside compliance with all regulatory requirements. However, the reality is that regulatory conflict, cost and the disproportionate impact on small businesses in dealing with multiple regulatory demands can undermine this aim. Within the Sustainability Business Clinic, we have seen multiple small businesses conceived in response to general government strategic support for and policy development around circularity. However, these companies encounter regulatory challenges and a lack of support from the government to navigate through complex and competing laws – around waste, risk and safety, and insurance. Regulatory conflict, where compliance with one regime makes it impossible or very difficult to comply with another, has been found between occupational health and safety (OHS) and competition law[27] and more recently OHS and economic regulation of the gas industry[28] Further, the use of intractable pollutants such as multiple varieties of plastic[29], are often the cheapest method to comply with regulatory requirements around infection control and food hygiene, as well as preserving the shelf life of food[30].

Parker and Haines[31] have proposed *ecologically responsive regulation* as a helpful lens to understand the specific requirements for regulatory reform that will be required to ensure we

[26] Jaeger & Upadhyay J. Enterprise Info. Mgmt (2020) 33(4) 729-745 https://doi.org/10.1108/JEIM-02-2019-0047
[27] Haines and Gurney, Law & Policy (2004) 25(4) 353-380 https://doi.org/10.1111/j.0265-8240.2003.00154.x
[28] Chester and Hayes, Law and Policy (2024) 46(1) 63-86 https://onlinelibrary.wiley.com/doi/full/10.1111/lapo.12231
[29] MacLeod et al., Science (2021) 373 6550 61-65 https://www.science.org/doi/10.1126/science.abg5433
[30] Matthews et al., J. Cleaner Production (2021) 283 125263 https://doi.org/10.1016/j.jclepro.2020.125263
[31] Parker & Haines, J. Law & Society (2018) 45(1) 136-155 https://onlinelibrary.wiley.com/doi/full/10.1111/jols.12083

can live within ecological limits. One suggestion they make is to study the regulatory environment surrounding businesses that are making significant progress with respect to their environmental footprint. They emphasize the importance of understanding the regulatory challenges for small businesses that are achieving strong environmental gains and adapting regulatory requirements that can help such small businesses to flourish and to be copied by others. Essentially, the regulatory environment must be conducive to ensure those businesses making significant gains in achieving a circular economy are competitive. This also applies to public sector services such as health. The case study of Western Health and infection control cited above also provides fertile ground for understanding how existing regulatory regimes both enhance and undermine such initiatives.

7. The Right to Repair

Many products currently marketed to consumers are intentionally designed for limited repair opportunities. A classic historical example was the design of a lightbulb so that the filament had a limited lifetime and eventually required replacement. Many electronic and digital devices fit into this category. As noted above, 'Right to repair' legislation is needed to ensure that consumers have the capacity and knowhow to repair products over long periods of time, rather than to simply replace them[32].

[32] Bedford et al. Int. J. Crime, Justice & Social Democracy, (2022) 11(1) 167-181 https://www.crimejusticejournal.com/article/view/2191