



Embedding circular economy principles within precincts and infrastructure business case processes in NSW

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About the authors

Dr Steven Liaros is a polymath and futurist with qualifications in civil engineering, town planning, environmental law and political economy. He is an honorary associate at The University of Sydney and director of town planning consultancy, PolisPlan. Steven is co-creating a new category of land development referred to as Circular Economy Villages.

Emeritus Professor Will Rifkin, University of Newcastle, addresses 'collective impact' strategies for regional economic development. He led the first 'Circle City Scan' in Australia in 2021 assessing the circular economy potential of the Hunter and Central Coast. He has degrees in science, environment and sociology from MIT, UC-Berkeley and Stanford.

Dr Sally Ann Walford is a Circular Economy and Sustainability Project Specialist at Regional Growth NSW Development Corporation. With over 15 years' experience in R&D, commercialisation and strategic partnership management she is committed to regional economic development and promotion of innovation and industry to support circular economy within the Special Activation Precincts.

Professor Ali Abbas is Professor of Chemical Engineering and Acting Head of School of Chemical and Biomolecular Engineering at The University of Sydney. He is also Founding Director of the Waste Transformation Research Hub. Ali works on problems in close partnerships with industry and government on applications in low-emissions technologies, Eco-industrial parks, waste, and clean energy. Ali is Chair of the Australian Circular Economy Conference.

Dr Tim Baynes investigates resource use and environmental impacts from precinct to international scales at CSIRO. He is a co-founder of the Australian Industrial Ecology Virtual Laboratory (the IELab), Honorary Associate Professor at the Fenner School of Environment and Society at ANU, and Secretary of the International Society for Industrial Ecology.

Simon Wright is a Research Principal at the Institute for Sustainable Futures (ISF) at UTS and brings almost 20 years of sustainability experience in industry, consultancy and academia. Simon's primary research focus is on large-scale sustainability transitions and the role of government in accelerating the move to renewables and a more circular economy.

Professor Vladimir Strezov is professor at the School of Natural Sciences, Faculty of Science and Engineering, Macquarie University. He has expertise in industrial ecology, impact

assessment, sustainability, pollution control and renewable energy. Prof Strezov has edited 4 books and is author of over 280 scientific publications.

Dylan Gower is an architect and advocate for Ecologically Sustainable Development, applying its principles to urban and regional environments. Dylan is a director of CLEAN Core Development & CLEAN Cowra Ltd, enabling the transition of a regional town in central west NSW to a low carbon economy. Dylan was awarded a Churchill fellowship in 2018 and researched: “Designing Local initiatives: exploring place-made development within regional communities.”

Dr Gordon Weiss is an Associate with Energetics, a specialist climate change consultancy. He has a broad knowledge of resource management and advises large public and private sector organisations on ways to reduce their carbon footprint. He also advises governments on policies and programs to achieve net zero emissions.

Executive Summary

Circular Economy in NSW Government Business Case Processes - This review identifies opportunities, approaches and tools to help embed circular economy principles within NSW government business case processes for precincts and infrastructure. It is understood that these multi-stage business case processes can inform and underpin infrastructure decisions, which then significantly shape the form and operation of our current and future precincts, towns, and cities. So, the business case process can be seen as a point of leverage. Small shifts in phrasing, emphasis, guidelines and tools can lead to significant changes in billions of dollars invested in the construction and operation of precincts and infrastructure and in the waste streams, emissions, employment and contributions to GDP that they generate.

Business case processes invariably begin by defining the problem. That has guided this review to focus primarily on informing this project definition stage, helping to guide future decisions about what infrastructure – within or outside precincts – would be needed to facilitate a transition to a circular economy.

It is important to note that circular economy principles have strong resonances with certain Indigenous perspectives related to place, the environment, and communities. However, there was insufficient scope to adequately address this connection between circular economy and the cyclical worldview of indigenous peoples and its application to business cases processes. It is highly recommended that this area be explored further.

The following is an overview of the findings to support embedding CE principles in business case processes for precincts and infrastructure. They also include potential policy recommendations, pending suitable investigation of the promise and potential viability suggested in this rapid review.

Fundamentals - To contextualise the recommendations provided in this report, detailed discussions are provided on various perspectives on the circular economy.

Stocks and flows, the role of precincts and infrastructure in an economic system:

Descriptions of the economy tend to focus on gross production and the flow of resources through the economy, often ignoring the spatial dimension of this activity. Precincts and infrastructure are fixed to the ground and are the pathways, origins, and destinations of this economic flow. The application of CE principles to the built environment therefore requires a broader perspective than just product design and waste management. This distinction contrasts a 'stock' of fixed assets with the 'flow' of materials, resources and products.

Global megatrends, disrupters & exemplars - The structure of economic activity is undergoing substantial change with the emergence over recent decades of disruptive digital and other technologies that bring with them new business models. Economic approaches that held in the Industrial Age are being undermined as IT secures its place and as circular business opportunities emerge. These shifts have implications for factors

considered in NSW government business case processes. Best practice case studies illustrate some of the emerging possibilities. Duplicating these successes, we argue, requires certain regulatory changes without which the financial return on investment can be considered to be less viable than business as usual.

Soft infrastructure – Construction and operation of circular infrastructure within a precinct involves a plethora of stakeholders, often with competing and, at times, conflicting agendas—individual property owners, various levels of government and their different departments, local councils, the various utility providers, and many others. Experience in the state's Special Activation Precincts suggests the need for 'soft infrastructure' that creates capacity, connection, collaboration opportunities and community amongst participants. Soft infrastructure relates to the operational management processes and systems for ongoing governance within a precinct that are essential for the efficient and effective operation of the hard infrastructure, managing the flow of resources between businesses within a precinct. It can also apply to human capital – what decision-makers, builders and operators understand and can implement.

Enablers – The importance of soft infrastructure highlights the necessity to attend to the role of people and processes, not just the built environment. This review included a set of interviews to assess the current state of literacy about circular economy principles and their application amongst senior decision-makers. The analysis of responses indicates that there is a hidden army of impatient sustainability experts across a range of professions in the private and the public sectors who are keen to expand CE in their activities. They recognise CE as an important strategy for achieving sustainability outcomes. Barriers and enablers that they recognise and that emerged in other aspects of our investigation are outlined below.

Misunderstanding - The limited understanding of the CE, and particularly its conflation with recycling, suggests that there is a need to establish parameters for an overarching education process. Such an educational effort could begin by attempting to better align the views and expectations of various stakeholders who already appear to be accepting of CE initiatives.

A need for alignment - A critical aspect of this educational effort can be seen to be the engagement of parties with key, but often problematic, 'threshold concepts'. They include **systems thinking** approaches, the benefits of **localisation** and **regeneration**, and incorporating expanded frames of references—such as contrasting spatial circularity with temporal circularity or life-cycle planning.

Shift primary objectives – An important aspect of systems thinking is for individuals and business operators to appreciate the role of any one element or decision within a larger economic, environmental and social system. It is therefore necessary to investigate the pros and cons of employing CE as one primary objective of infrastructure and precinct investment, rather than as a peripheral objective.

Assess the potential for broader benefits – Our literature review notes a divergence between the objectives of industrial precincts and housing precincts. In the former, CE

principles can reduce operating costs and maximise profit, while in the latter, CE principles can be adopted primarily to reduce living costs. Different business case processes would be required where the objective is to maximise profit for producers, compared with the objective of minimising costs for consumers. A decision has to be made as to the extent to which the P&I will be designed to privatise or to socialise the financial benefits.

Align regulations across themes of environment, economy and place development - A key theme that emerged was the perception of the professionals interviewed that one of the main barriers to the implementation of CE principles relates to bottlenecks and roadblocks in government regulations and processes along with gaps and inconsistencies in guidance documents, incentives and information. That suggests a need for better alignment between regulatory enablers, fiscal incentives, and elements in business case development.

Align policies for settlement patterns with CE opportunities - Rather than assessing each item or project on an individual basis, the investigation reported on here points to the value for a more strategic approach. It seems worth exploring the value in applying a Circular Economy lens to a state-wide settlement planning process.

Networked versus centralised facilities - There may be a need to overcome potential bias in current business case assessment criteria and explore options such as the development of business cases for numerous small-scale, waste-to-resource micro-factories, scattered across the state, compared with a few large facilities in major centres. In addition to reducing transport costs, decentralisation could create local opportunities, attract investment, and build resilience in towns throughout the state. However, centralisation of certain facilities and capabilities also has attractions, such as related to economies of scale and availability of a suitably skilled workforce.

Land use definitions - A potential obstacle to the delivery of CE-related infrastructure is their permissibility under planning provisions. Problems may arise due to these facilities potentially having a mix of agricultural, industrial, business, community, and educational uses. Circular precincts can be designed to involve productive integration of different land uses rather than separating such uses into different zones.

Tax settings - NSW Circular has undertaken a separate review that is considering tax settings and broader fiscal policies. The investigation conducted for this study indicates that it may be appropriate and useful to explore opportunities for the modification of tax settings to incentivise the incorporation of CE infrastructure in precinct-scale industrial developments as well as in new housing developments.

Data, modelling and metrics - Progress in digital model development, including digital twins and integrated models of industrial networks, can improve aspects of business decision-making. Visualisation of data and spatial-temporal representation of precincts and infrastructure enables design, analysis, monitoring and reporting capabilities to be exploited for scenario assessments, focusing on CE metrics and benchmarks.

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1 Introduction

This Rapid Review has been prepared by researchers from several universities and other organisations for NSW Circular, whose mission is to deliver a zero-carbon circular economy in New South Wales. NSW Circular is a government-funded body created by the Office of NSW Chief Scientist & Engineer and hosted by UNSW. Their objective is to provide positive environmental, economic, and social outcomes for government organisations, industry and people.

This review identifies practical approaches and tools to embed circular economy (CE) principles within business case processes for the built environment. It is understood that business cases can inform and underpin infrastructure decisions, which then can significantly shape the form and operation of our current and future precincts, towns, and cities. Business case processes of the NSW government are the primary focus of this review, how the government decides which infrastructure and precincts to invest in. This focus reflects the terms of reference for this project. There is relevance to be drawn, though, for the more general meaning of 'business case' - what a business or financial institution or superannuation fund would consider worth investing in. In a similar way, reference to the 'NSW government' should be taken to imply a wide array of government activities, and not all of those activities related to the circular economy have been described in this report. It is important to acknowledge up front the wealth of individual and departmental initiatives to boost the circular economy being undertaken within federal, state and local governments as well as within large and small businesses throughout the state.

An early realisation in this review was that businesses – and decision-makers within government considering NSW government business cases - operate within a framework that is established by government regulation and fiscal policy. This context is particularly relevant for precincts and infrastructure, which are developed through a town planning policy framework and a taxation system that can be seen to incentivise current linear practices at the expense of innovative circular approaches. While it is recognised that there are other reviews commissioned by NSW Circular that are addressing government regulation and fiscal policy, we considered it necessary to identify and note the influence of regulatory domains on investment decisions as certain business cases require regulatory changes and adjustments to tax settings.

Business case processes in different settings can vary, but the first step is invariably to define the problem. This review is primarily focused on informing this project definition stage, helping to guide future decisions about what infrastructure – within our outside precincts – would be needed to facilitate a transition to a circular economy. Our preferred definition of a CE is that developed by the Ellen MacArthur Foundation (EMF, 2021):

The circular economy is based on three principles, driven by design:

- Eliminate waste and pollution
- Circulate products and materials (at their highest value)
- Regenerate nature.

The principle of eliminating, rather than reducing, waste and pollution, as well as that of regenerating nature, expand the concept well beyond the common focus of recycling, waste management, product design and material flows.

Circular economy principles have strong resonances with certain Indigenous perspectives related to place, the environment, and communities (Liaros, 2021c). One obvious resonance involves notions of caring for Country and the CE principle of regeneration of natural systems. It is recommended that these resonances and opportunities for regulatory synergy - between Indigenous concerns, needs and aspirations, environmental and waste management plans, and economic and place development strategies - be explored in future studies. These Indigenous touch points in aspects of NSW government business case processes could not be investigated adequately in this rapid review.

It should be appreciated that there is little consensus on the definition of a 'circular economy', making it difficult to define what would be involved in a 'transition' to a CE. For example, different strategies would be needed if the CE simply implied better recycling practices compared with a CE that enabled regenerative practices and had a net positive impact on ecosystems. Similarly, different approaches to the business case would be required for large, centralised waste management facilities, compared with a distributed network of waste-to-resource micro-factories.

Another relevant distinction is between infrastructure designed to maintain the current system of global trade and associated global supply chains, which have proven to be fragile and energy intensive, compared to infrastructure designed to circulate resources locally within a precinct or bioregion. Importantly, it is recognised that infrastructure is a public good. Therefore, a business case that justifies financial viability for the provider would be different from a business case that sought to reduce the living costs for consumers or offered other 'socialised benefits', benefits experienced by an array of current and future businesses, residents, and other stakeholders.

This report provides an overview of business case processes employed by the NSW government in section 2. Subsequent sections address the various components of this problem definition issue. Firstly, in section 3, we seek to understand the role of precincts and infrastructure within an economy generally and within a CE in particular. CE debates tend to focus on the flow of resources through the economy, often in a rather abstract manner, ignoring the spatial dimension of this activity. Precincts and infrastructure are fixed to the ground and are the pathways, origins, and destinations of this flow of economic activity. The application of CE principles to the built environment therefore requires a broader

perspective than one that focuses on product design and waste management. In the literature, this distinction is made by reference to the 'stock' of fixed assets contrasted with the 'flow' of materials and resources.

In section 4 we have recognised that, irrespective of the proposed transition to a CE, the structure of economic activity is undergoing substantial change. We highlight the emergence of disruptive digital and other technologies with new business models over recent decades. Economic approaches that held in the Industrial Age are being undermined and replaced by new approaches in the Information Age. For example, digital platforms with new business models are disrupting numerous industries.

Similarly, the energy revolution is also rearranging business activity. Large scale, fossil fuel-powered, energy generators are being replaced by a distributed network of renewable energy providers, with many consumers becoming producers. Notably, this transition is not only from fossil fuels to renewables but also from centralised (one-way) systems to distributed networks (2-way systems).

In proposing tools or offering guidance in relation to CE business cases, it is important to ensure alignment with, and taking advantage of, these other growing trends in economic activity.

We have also formed the view that the Circular Economy has become an effective 'banner'. That is, it is a useful narrative for a range of different movements beyond waste management imperatives, including disruptive digital technologies, the energy revolution, the need to address environmental destruction and climate change, regenerative agriculture, regenerative development, localization and place planning and other movements. Circular Economy helps to describe both the necessity for transition – 'from linear to circular' and the cyclical character of a future economic system. It connects with existing accepted concepts such as recycling as well as more advanced and emerging concepts such as regenerative development and biomimicry. As an economic concept it is also perceived as practical and implementable with a defined end point, unlike sustainability, which has been criticised as being too general and vague.

Section 5 explores various perspectives of what a circular economy (CE) is. It includes best practice case studies related to CE in the built environment, highlighting possibilities as well as identifying specific opportunities for NSW Circular to lobby for modification of regulatory or fiscal policy. In many of these cases, it is these policy settings that inhibit viable business cases from being developed. For example, the Lochiel Park housing precinct was developed by the South Australian government on its own land, showing what is technically feasible. We note that current engineering expertise can deliver CE precincts, and the required business cases arguments have also been identified. Yet without certain regulatory changes, the business financial return on investment can be considered to be less viable than business as usual. The key point here is not simply to identify elements to be considered in

the NSW government's business case processes but to ensure that including these considerations result in a more circular project that is preferred over business as usual.

The review of literature, together with a number of case-studies, in sections 3, 4 and 5 illustrate best practice possibilities. Findings from interviews of senior professionals and government managers offered in section 6 characterise executives' 'literacy' about circular economy principles and their applications. Four questions were asked in these interviews:

1. How can the CE be applied to precincts and infrastructure?
2. How have CE and sustainability concepts changed over the last 10-20 years?
3. What are the main hurdles for understanding and implementing the CE, or what features can accelerate the transition?
4. Who can make a difference?

Through these discussions, a number of key themes and threshold concepts were identified. For example, numerous sustainability experts in the private sector, keen to implement CE concepts, cite bottlenecks and roadblocks in government regulations and processes along with gaps and inconsistencies in guidance documents, incentives and information. Yet it is also clear that with the wide disparity in understanding, as well as capacity and willingness to implement, there is a need for an overarching education process that enables a better alignment of the views and expectations of various stakeholders who already appear to be accepting of CE initiatives. A critical aspect of this educational effort is the engagement of parties with the threshold concepts, expanding knowledge of the Circular Economy, appreciating the systems thinking approaches, the benefits of localisation and regeneration, and incorporating expanded frames of references—both spatially and in terms of life-cycle planning.

Section 7 synthesises the information, ideas and opportunities from the previous sections to identify key success factors, enablers and barriers, which are outlined as a set of key findings and concludes with a summary list of the recommendations identified throughout the report.

2 Overview of business case processes

A business case for a precinct or infrastructure involves much more than a calculation of potential profit or loss, economic gain, or stranded investment. For government, a business case incorporates a series of stages of consideration of needs and opportunities, a general assessment of options for addressing them, and then a refined analysis that goes through detailed scrutiny. A consistent theme is cost, as is return on investment – as it is in the private sector.

The cost consideration becomes a challenge in relation to the circular economy. Questions arise about when the cost is incurred, when investments might pay for themselves and who bears the cost or reaps the benefits when considering current residents and businesses in a locality versus future residents and businesses that can be enticed into the area.

An overview of the business case process for the State of NSW, developed by NSW Treasury, establishes strictures for assembling a business case in this state. Guidelines and assessment criteria are also offered by Infrastructure NSW through the Infrastructure Assurance Framework as part of the NSW Gateway Policy. Gateway is a project assurance process which provides independent assurance using peer reviews in a project or program's life cycle at key decision points or Gates. It provides the NSW Government as the investor, with a level of confidence that State projects and programs are effectively developed and delivered on time, on budget and in accordance with the Government's objectives.

Elements of business case processes that are more conducive to circular economy development are emerging in relation to special activation precincts in NSW and in relation to industrial precincts and infrastructure development highlighted in domestic and international case studies in this report.

Business cases are central to informing evidence-based investment decisions by the State Government. Their main objective is to ensure that resource allocation decisions are well timed, offer value for money, consider and mitigate risks, and are consistent with Government priorities and objectives.

The development of a business case for the NSW government is organised along three stages:



Included in these stages are five types of analyses designed to indicate that the investment proposal:

- is supported by a compelling case for change – the ‘Case for Change’
- optimises value for money – the ‘Cost Benefit Analysis (CBA)’
- is financially affordable – the ‘Financial Analysis’
- is commercially viable – the ‘Commercial Analysis,’ and
- is achievable – the ‘Management Analysis’.

Stage 0: Problem definition

The problem definition outlines the need or the case for change and provides context for an investment decision and high-level cost estimates. This is key to identifying the reason for government intervention and supports a decision to proceed to further stages of the business case process. The problem definition stage identifies and defines:

1. Business need/opportunity
2. Objective of the intervention
3. Strategic context/intention and contribution to government priorities/outcomes
4. Expected benefits and risks
5. Relevant stakeholders
6. Potential strategic responses/interventions.

This review is primarily focused on informing this project definitions stage, helping to guide future decisions about what infrastructure would be needed to facilitate a transition to a circular economy.

Stage 1: Strategic Business Case

The Strategic Business Case (SBC) follows the Problem Definition Stage of a Business Case. The main purpose of this stage is to reconfirm the need for government intervention that was identified in the case for change (Problem Definition Stage), as well as to identify and select a list of available and feasible options. The SBC is also referred to as a Needs or

Strategic Analysis. Its purpose is to provide decision makers with the information needed to consider whether to further progress the proposal through:

1. Assessment of whether the proposal is aligned with government and the agency's strategic plans
2. Demonstration of the best value means of servicing community needs
3. Development of preliminary justification for procurement.

The SBC stage includes a:

- Review of the Case for Change
- Options Analysis in which a list of Options developed and refined
- Assessment and narrowing down of options in which a CBA is conducted and Financial Appraisal and Financial Impact Statement are prepared.

Stage 2: Detailed Business Case

The Detailed Business Case or Final Business Case (FBC) builds on the options analysis undertaken as part of the SBC and provides a more comprehensive and detailed analysis of the proposal. A full CBA, FA and FIS are conducted on the short list of options being considered for investment. This step helps to determine whether the proposal is feasible in the context of the State's financial position. This stage includes selection of the preferred option that ranks the highest in providing value for money, affordability and a high probability that it can be delivered as envisioned. Preference would be given to options that, for example, maximise social welfare and optimise value for money. The selected options need to demonstrate that genuine policy solutions have been identified and assessed and highest value for money is being achieved. This analysis would provide alternative feasible options if a compromise position is required. In addition, the FBC sets up the commercial and management arrangements for the successful delivery of the project.

Commercial Analysis involves:

- the development of a procurement strategy
- specification of technical requirements
- identification of contractual issues.

Management Analysis provides confidence that an economically and financially viable solution is also realistically implementable, its risks are manageable and its benefits can be tracked and realised. It includes:

- establish governance arrangements
- develop project management plan
- develop a change management plan
- develop a benefits plan and register
- establish a risk management plan
- establish a post implementation plan.

Establishing suitable governance arrangements for circular economy is key to the realisation of the benefits identified in a business case. Early consideration of shared governance structures, roles of government, data-privacy, ongoing engagement model, and the like are key to the successful utilisation of the infrastructure being proposed and the intended outcomes being achieved. The business case should include funding for soft infrastructure related items, including but not limited to:

- development of governance protocols for securely sharing information that will enable the flow of materials and services (including in relation to privacy and intellectual property),
- facilitation of 'matchmaking' between tenants/businesses offering different materials and services that may be suited to one another's operations,
- establishing the best occupation patterns for co-locating businesses that have the greatest materials/services synergies,
- advocacy to influence policy change where it restricts or limits the opportunity for circularity.

2.1 CE Hurdles in Business case processes

The first two stages of a business case are central to

- (i) the definition of the problem (i.e. what is business need or opportunity) and;
- (ii) the objectives to address that defined problem.

The infrastructure investment decision cannot be conducted in isolation as cities and regions are made up of interconnected environmental, social and economic systems. The built

environment is a system of buildings, utilities, transport and public domain, which operates within the wider geographical system or region. The problem definition forms within this context to identify the need or opportunity and the best options to leverage the existing systems to maximise the investment.

The next stage clarifies government intervention and determines whether a number of proposed options are achievable from an economic point of view together with the social impact. A list of options or ways to achieve the objectives are considered and checked against alignment with the state government policy as well as the financial impacts. The cost and benefits of infrastructure investment versus no infrastructure investment are weighed up. Once the case is clear that an intervention is necessary, the best value for money solution is considered. This incorporates the best social as well as economic outcome in alignment with the agreed objectives.

Hurdles emerge and missed opportunities arise in these first two critical stages, which if addressed properly, could result in an improved transition to CE. These include:

Alignment - There are high level issues arising from this process in relation to investment decisions for infrastructure to drive CE in precincts. The case for change needs to align with government policy and strategies. A key issue with this process is a current lag in policy support to drive a transition to a circular economy.

Engagement with key stakeholders - Additionally, stakeholders are not always clearly defined at the early stage of precinct design, particularly in regional NSW where the NSW government strategy is to attract industry, create jobs and drive economic development. The key stakeholders include government entities, regulatory bodies, businesses within the precinct, local councils and utility suppliers. The lack of clarity constrains strategic responses and cost estimate predictions and can result in missed opportunities to provide additional infrastructure to support CE. For example, the provision of enabling infrastructure for sharing of resources (e.g., energy microgrid), will allow a future utility supplier to obtain private benefit from shared infrastructure creating a revenue stream and environmental benefits over the long term. The business case also needs to capture the deferred/avoided investment that such infrastructure would enable, from network transmission and supply infrastructure associated with traditional, linear electricity distribution infrastructure.

Adjust to growing understanding of the context - In the SBC an objective is defined and the options analysis is based on current data and current policies. As our knowledge of material flows in the domestic and international economies grows, and as policies change in response to that, options that were dropped may actually become more financially viable.

This shifting knowledge about the context raises the question of how to align business cases with state and national policies and strategies that are likely to evolve in order to maximise circular economy opportunities with long-term outcomes that one can expect from precincts. In other words, our understanding of the need and potential for the circular economy has come to evolve fairly rapidly, and that evolution is not yet accommodated by

policy. That lack of policy support is evident in that investment in infrastructure to optimise resource flows in the region is not a primary objective. Instead, the focus on material flows enters in the form secondary objectives or principles that underpin the delivery of the main objectives, such as boosting jobs.

2.2 CE Opportunities in Business case processes

Making CE one of the primary objectives - The Parkes SAP (discussed below) provides an example of this issue. The main objectives of the SAP program are job creation and increased regional economic development in alignment with NSW government strategy. Improved environmental outcomes and industrial clustering are included as secondary objectives and are supported through the inclusion of circular economy principles in the planning of the precinct. But what if the primary objective was focused on investment in infrastructure to optimise resource flows within the regions, which would then deliver on job creation and economic growth? Creating a strong business case and delivering on such an outcome would require sound financial analysis to identify optimal resource flows. That would need to be underpinned by quantified circular economy metrics for the Australian context.

Timeframe for financial analysis - Another point at issue to be considered in this process is the time frame for the financial analysis. In economics, that is where the time-value of money comes in, essentially the discount rate. Value for money considerations are traditionally weighted toward the near term for political reasons, as well, given election cycles. What time frame is required to assess the extent to which providing infrastructure or a precinct delivers jobs or other economic value?

Accounting for externalities - The CE transformation will undoubtedly involve costs that are not reflected in our current markets. It raises questions about what economic factors are captured, and which ones remain as 'externalities'. In decades past, environmental impacts were not assessed in monetary terms. However, the cost of environmental impacts, or the cost of avoiding them – e.g., the costs of creating environmental offsets or shifting a precinct or road to another location, is more commonly included now.

Longer-term costs of impacts from climate change are being discussed but have not been included consistently in business case considerations in NSW in relation to factors such as the cost of concrete (an example due to its high level of greenhouse gas emissions). The costs of climate change are increasingly addressed in the environmental ratings of buildings and building designs, and examples of extending that to a precinct level or across a piece of infrastructure are being explored in this report.

CASE STUDY: Parkes SAP Business Case

Parkes Special Activation Precinct was announced as the first SAP in regional NSW in July 2018. SAPs are dedicated areas in regional NSW that have been identified by the NSW government to create jobs, attract business and investors, and drive economic development. The precincts bring together industry, research institutions and government to create world-class economic zones. Regional Growth NSW Development Corporation is leading the delivery of these precincts. The establishment of the SAPs were announced alongside the 20-Year Economic Vision for Regional NSW and are funded through the \$4.2-billion Snowy Hydro Legacy Fund. Development is supported through six key activities:

- Master planning and government-led studies
- Fast track planning
- Land assembly and management
- Government led development
- Infrastructure investment
- Business Concierge.

The Parkes precinct covers an area of approximately 4,800 hectares and is strategically located three kilometres west of the Parkes Township in NSW. It is centred on the existing Parkes National Freight and Logistics Hub, which means that products can reach 80% of Australia's population overnight. The ambition of the Parkes precinct is not only to become Australia's largest inland freight and logistics hub but also to be a leader in sustainable regional enterprise areas. The precinct has been developed with the United Nations Industrial Development Organization (UNIDO) Eco-Industrial Park (EIP) Framework, UN Sustainable Development Goals, Ecologically Sustainable Development (ESD) and circular economy principles embedded.

It aims to leverage the employment and investment opportunities associated with its strategic location at the crossroads of the Inland Rail from Brisbane to Melbourne and the existing east-west Sydney to Perth/Adelaide Rail corridor. It will build on existing strengths of Parkes in agriculture and freight logistics and will facilitate exploring opportunities to activate its manufacturing and renewable energy industries.

The precinct consists of 6 sub-precincts, which allow a range of land uses - including freight and logistics, agribusiness and value-add agriculture, enterprise and manufacturing, intensive livestock agriculture and resource recovery and recycling. The sub-precincts are tailored to strategic environmental impact and economic development

aspirations and embed strong sustainability and circular economy principles. The development of the Resource Recovery and Recycling sub-precinct will establish a circular economy within the precinct aimed at minimising waste and making the most of resources. In this circular system, resource inputs and waste, emissions and energy leakage are minimised by slowing, closing, and narrowing energy and material loops. The precinct, and in particular the resource and recycling sub precinct, will be the first of its kind in Australia. It will lead the way as an innovative example of a true eco-industrial park into the future. Parkes will be the first dedicated resources and recycling precinct with direct rail access in NSW

While the long-term vision and aspirations of the SAP will be delivered over 50 years, the investment decision for stage 1 has focused on the activation of a portion of the SAP through infrastructure solutions developed to address:

- A lack of access to suitably zoned industrial land that is serviced with enabling infrastructure for businesses looking to expand and establish in Parkes.
- Poor coverage, speed and reliability of communications and digital infrastructure in Parkes compared to metropolitan areas
- Significant first-mover costs for businesses, which relate to infrastructure investment including road upgrades and utility connections/extensions.

The two main objectives of the investment decision for stage 1 of the Parkes precinct are strongly aligned with the key NSW government policy, commitments, legislation and strategies - job creation and increased regional economic development. A number of secondary objectives underpin the delivery of the precinct . They include improved environmental outcomes (managed under the UNIDO Eco-Industrial Precinct framework with CE principles embedded within the plans), promotion of industry clustering (to encourage industrial symbiosis), reduced red tape, increased industry investment, and increased business establishment and expansion. The objectives also support the Government's 20-year Waste and Sustainable Materials Strategy. They allow Parkes to capitalise on a first-mover advantage associated with investment in sustainable waste generation, resource recovery and landfill diversion.

This initial infrastructure investment removes barriers to entry for first movers through government investment in common-user infrastructure and government led development to support the growth of existing and new businesses. Key infrastructure required to service the precinct and connect into existing infrastructure networks will ensure a coordinated approach to the delivery and implementation of enabling infrastructure. This infrastructure, together with guidance around location of development into clusters of compatible businesses and land uses, will start to direct opportunities to grow industries to optimise resource flows in the region.

This investment decision is centred on infrastructure to attract businesses to the precinct to create jobs and encourage economic development in the region. Currently circular economy principles are an underlying enabler of the main objectives, embedded in the Parkes SAP Master Plan. It raises the question, should investment in infrastructure to support optimised resource flows (CE) in a region be a primary objective in a business case that would drive delivery of other objectives as required by government policy and strategy? That is, what benefits are likely to accrue if CE gets a 'seat at the main table'? This approach requires careful consideration of circular economy metrics relevant to Australian conditions. These metrics could underpin a business case to drive investment in infrastructure supporting optimal resource flows within a region while remaining in alignment with the 20-year economic vision for Regional NSW.

It must also be kept in mind that while it is a key part of the process, the business case for infrastructure investment is one part of the whole process to deliver a truly circular precinct. Constraints can be introduced by the lack of well-founded strategies to identify and co-locate businesses to optimise the regional resource flows. This together with difficulties associated with unintentionally difficult to navigate EPA regulations and approvals and engagement with utility suppliers to connect renewable energy sources to the current infrastructure can diminish true circular aspirations.

To promote the vision of the precinct and alignment of stakeholders, early engagement with local councils, utility providers and community groups is vital. These efforts are also best supported by the development of a suitable governance structure for the operations of the precinct early in the undertaking to ensure that collaboration supports the delivery of an industrial ecosystem. These issues are important considerations that warrant further exploration.

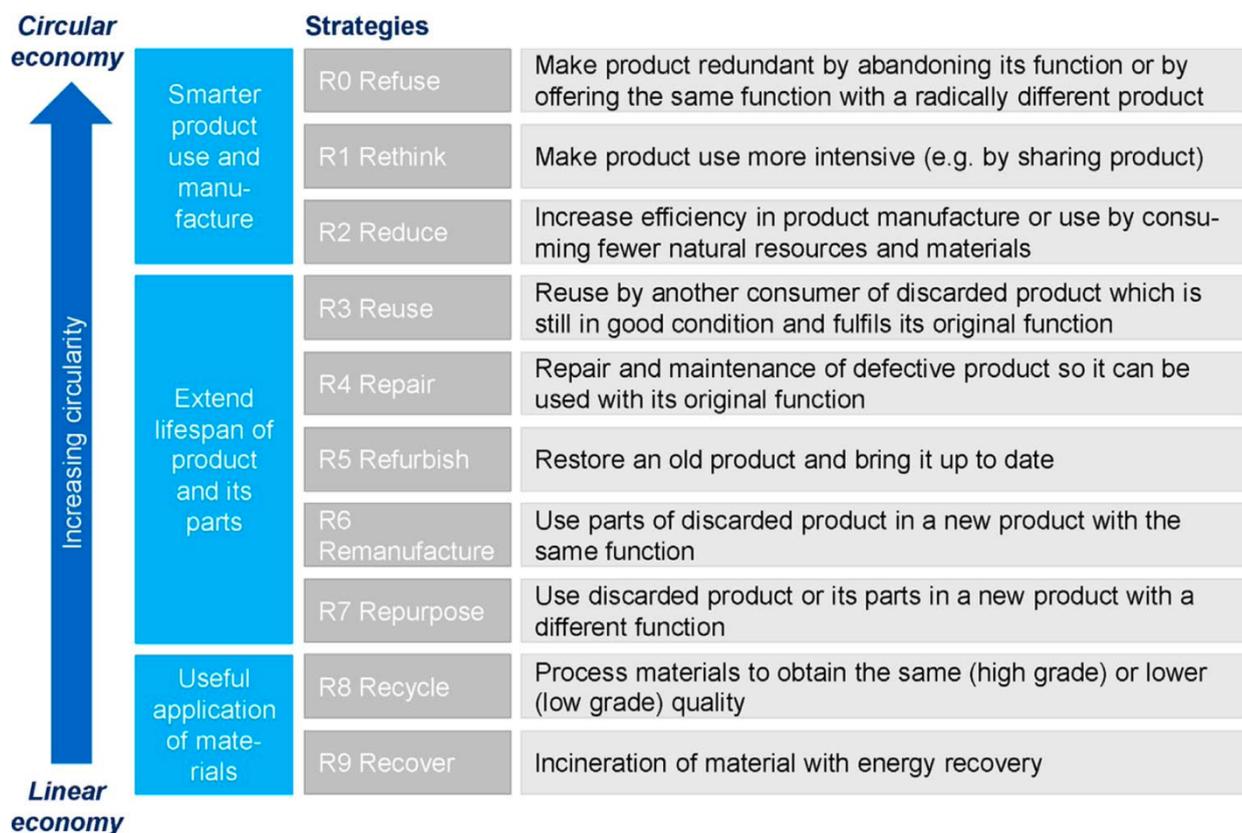
Recommendation: NSW Circular engage with NSW Government agencies, such as Regional Growth NSW Development Corporation, to review the business case process in the SAP program. That would enable assessing the potential impact of incorporating CE as a primary objective of the infrastructure investment that is synergistic with employment and regional development. This analysis could explore near-term and long-term implications for economic development and employment of alternative pathways – business as usual, modest CE implementation or aggressive CE implementation.

3 Precincts & Infrastructure in the Circular Economy

The concept of a CE appears to have entered mainstream political and economic debate in Australia when we were no longer able to export waste to Asia in late 2017. The transition to a CE was identified as necessary for the continued, efficient functioning of economic activity in Australia. Since then, it has been viewed as an economic opportunity whereby waste could be converted into resources or new products and “generate jobs, increase the robustness of the economy, increase the accessibility of goods, maximise the value of resources, and reduce waste” (NSW CE Policy Statement 2019).

A number of strategies have emerged for enabling this transition, with Kirchherr et al (2017) identifying ten R-strategies, listed from most to least circular as shown in Figure 1: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover.

Figure 1 R-strategies for a CE from Kirchherr et al (2017)



These strategies can be classified into five main approaches:

1. Eliminating resource flows,
2. Narrowing resource flows by replacing goods with services,
3. Slowing resource flows by making products more durable
4. Closing resource flows, for example, through recycling, repair and refurbish
5. Reducing distance travelled by resources as they flow through the economic cycle, therefore increasing local economic productive capacity and reducing reliance on global supply chains that may be affected by various political, economic, or environmental disruptions.

This last approach recognises the spatial or geographical nature of the economy. That is, that waste and pollution arise not only through the production and consumption of goods but also through the distribution process. Long supply chains, that is, large distances between the producer and consumer have been identified as one of the reasons why one-third of all food produced is wasted (Liaros, 2021a).

In defining the problem for the development of business cases for a CE precinct or infrastructure, it is necessary to address this issue: Does a CE continue to expand global trade and rely on long supply chains with numerous intermediaries, or is there a case for localisation, at least in relation to some resource flows? These are not mutually exclusive options. For example, long supply chains may be retained for solar photovoltaic panels if this allows consumers to produce their own energy and dramatically reduce demand for fossil fuel energy. What resource flows should be localised and what should rely on longer supply chains? Answering these questions helps to define what infrastructure is required.

The application of CE principles to precincts and infrastructure—which we will occasionally refer to as ‘P&I’ or the ‘built environment’—requires a somewhat broader perspective than a consideration of resource flows alone. This is because, in contrast to materials flowing through the economy, precincts and infrastructure are fixed to the ground, providing the pathways through which economic activity flows. In the literature, (Daly, 1973, p. 19, Boulding, 1973, p.123) this distinction is made by reference to the ‘stock’ of fixed assets contrasted with the ‘flow’ of materials and resources. Whilst the boundary between stocks and flows is contested—and fixed assets can also eventually end up in landfill—the distinction is useful for this discussion.

In developing business cases for the stock of built assets, it is important to acknowledge that the built environment is shared by numerous businesses and affects their business cases. Stock and flow are interrelated and interdependent. If the built environment is designed to facilitate linear flow—from a mine to landfill, or in the case of water infrastructure, from a dam to ocean outfall—then it becomes difficult to retrofit circular flow patterns. Ultimately, to create a circular economy it is essential that the built environment is designed and built to facilitate circular flow. Figure 2 illustrates the stock of physical assets needed for resources to flow through their economic cycle, while Figure 3 illustrates the physical infrastructure and

components of the built environment that may become unnecessary—or less necessary—as the economy becomes more circular.

Figure 2 Linear economy

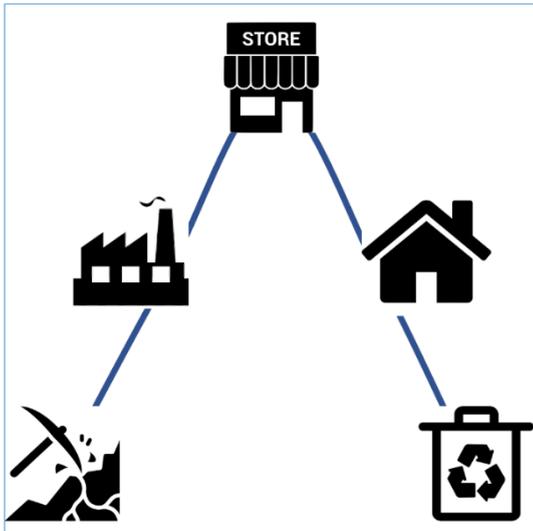


Figure 3 Circular economy

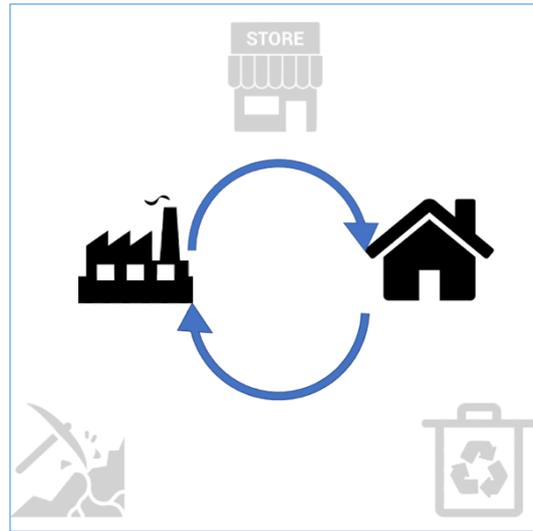


image credit: Steven Liaros using free stock icons

If, in Figure 1, the mine is in Australia, the factory in China and the shop back in Australia, then an array of intermediate logistics infrastructure is also required including major transport networks, port facilities, warehouses and so on. As suggested previously, localisation of production potentially reduces the need for certain infrastructure, while still delivering the same output. Whilst it is sometimes argued that the CE would seek to maximise the flow of materials in the economy, the objective should be to optimise, increasing certain flows (e.g., from homes to factories) and reducing other flows (e.g., from mine to factory and from homes to landfill).

In summary, this discussion suggests that a discussion on business cases for CE infrastructure must explore what to build and where, what not to build, what to expand and what to close down. These are not questions to be addressed separately for each piece of infrastructure or each new precinct but must be addressed strategically and holistically. We would argue that this involves a process of settlement planning, examining where people are located, where to incentivise the development of new precincts and associated infrastructure that contributes to a comprehensive arrangement for the state or nation as a whole.

This aligns with the recommendations of the Federal government's inquiry into the 'Australian Government's role in the development of Cities' (Australian government, 2017). As a result of numerous submissions, the first recommendation of that inquiry reads:

The Committee recommends that the Australian Government, in conjunction with State and Territory governments, and in combination with the governance arrangements set out in Recommendation 28, develop a national plan of settlement, providing a national vision for our cities and regions across the next fifty years, providing for:

- growth and change in population
- growth and change in employment
- the economically, socially and environmentally sustainable development of cities and regions
- the relationship between cities and regions on a national, regional and local scale
- connectivity within and between regions, and between residence and employment
- resources for the implementation of the plan.

Recommendation: Investigate implications of applying a Circular Economy lens to state-wide settlement planning processes. Focus, in particular, on connecting work by Infrastructure NSW with the regional planning processes delivered by the Department of Planning for new housing and population growth.

A settlement planning process can then also capture innovative new development concepts such as the East Coast Hydrogen Corridor, which is proposed to provide a network of hydrogen fuelling stations along the east coast.

Case Study: East Coast Hydrogen Corridor

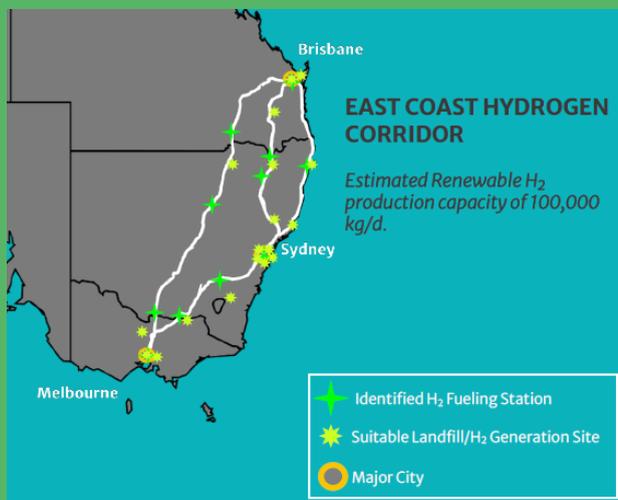


image credit: Scimita Ventures

ScimTek Hydrogen proposes to supply renewable hydrogen produced in novel small-scale modularised containerised plants, which use biomethane as feedstock. The plants are designed to be positioned near H₂ fuelling stations, eliminating the need to have an expensive transport pipeline, further reducing the cost of delivering H₂.

ScimTek Hydrogen aims to solve three major problems in Australia: the high cost of producing renewable hydrogen, the high amount of unutilised landfill gas, and the decarbonisation of the transport sector.

Benefits of circular thinking in this project:

- Far better utilisation of resources (the resources stay in the consumption cycle for longer)
- Improved fuel security as fuel is now produced locally, not depending on overseas imports and escalating fuel prices
- Substantially less CO₂ emissions associated with production, distribution, and use of fuel
- Use currently available infrastructure, such as the natural gas pipeline, for longer.
- Using smart tech (modular plants) to suit the nature of feedstock (waste) and product (H₂) (distributed feedstock for distributed end-use)
- Reduce emissions and create jobs at much lower price point.

Disclosure: A director and shareholder of Scimita Ventures, which operates the joint venture Scimtek Hydrogen, is a member of the Rapid Review team.

4 Global megatrends as context for the CE transition

Any discussion seeking to identify business models to facilitate the transition to a CE should acknowledge the significant economic disruptions in recent decades. Certain megatrends (Hajkowicz et al, CSIRO, 2012) such as digital transformation and the energy transition are disrupting economic systems and introducing new business models facilitated by new technologies (Rifkin 2014). According to Benkler (2006) in *The Wealth of Networks*, a critical aspect of these new models is social collaboration, which contributes both to the growing array of open access systems.

An appreciation of these megatrends, and resulting economic disruptions and business models, provides context when developing CE business models. The CE should be developed within the context of the Information Age and not the Industrial Age.

4.1 Digital transformation

In addition to the impact of the internet in enabling production on demand and the creation of distributed systems and business models, digital transformation has numerous other implications for business models. They include:

- (a) **Online retailing:** The growth of online retailing can result in an overall increase in consumption or it can, in some circumstances, replace physical stores.
- (b) **Utilising spare capacity in existing assets:** platforms such as Uber and Airbnb reduce the need for new assets. While there may be some debate about the specific practices and impacts of these corporations, they do point to a general principle of identifying and utilising the spare capacity in existing assets before building new assets.
- (c) **Commuting to work and working from home:** With respect to commuting to work, numerous platforms now enable people to work from home. This transition has been accelerated by the COVID-19 pandemic. As a global megatrend, this has the dual effects of reducing the overall demand for transport infrastructure and assets, as well as changing the location of that demand. For some people working from home means they no longer need to be within commuting distance of a major city, potentially resulting in some dispersion of populations to regional areas.
- (d) **Internet-enabled monitoring:** digital technologies are now well developed for energy systems, allowing anyone to monitor and manage energy generation, storage in batteries and consumption. Similar systems are being proposed for water micro-grids, with links to the Bureau of Meteorology providing estimates of likely rainfall, gauges measuring water

storage and pumps triggered automatically by algorithms to ensure continuous availability of water.

Case study: A circular food economy in a housing precinct

A circular food economy is being developed in a partnership between Lend Lease, QUT and the FoodAgility CRC at Yarrabilba in South East Queensland. Like the systems for monitoring energy and water, this is a digitally enabled smart food grid. Key outputs of the project are:

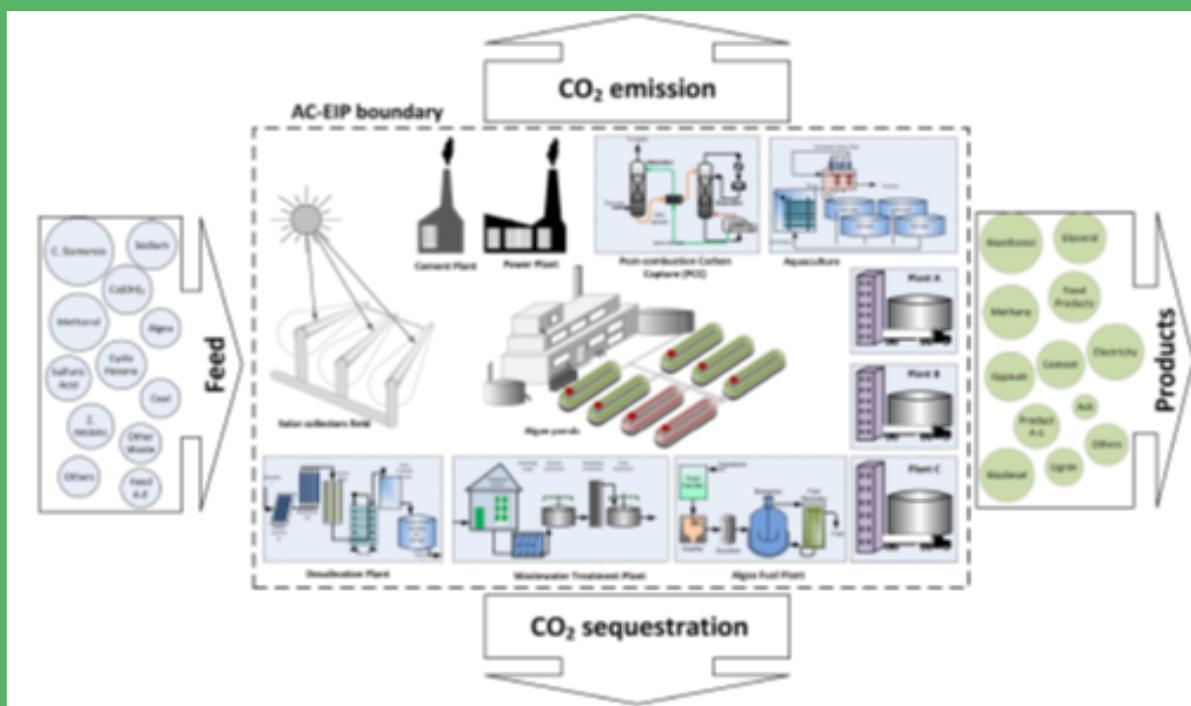
- New, scalable model for urban agriculture that can be applied in other Australian towns and cities.
- Prototype digital community composting system with in-built sensors, dashboard and incentive system.
- Smartphone-enabled community credit/bartering system where people can exchange goods and services related to food.
- Community engagement program to build local skills and knowledge.

(e) **Digital models:** Progress in digital model development including digital twins and integrated models of industrial networks are paving the way for business decision making (Tumilar et al., 2021). These digital technologies offer visualisation of data and spatial-temporal representation of precincts and infrastructure. This enables precinct design, analysis, monitoring and reporting capabilities to be exploited for scenario assessments with focus on circular economy metrics and benchmarks.

Case study: Digital modelling for Special Activation Precincts

The University of Sydney, with support from, and collaboration with, Regional Growth NSW Development Corporation and NSW Circular are progressing industrial symbiosis digital modelling platforms for eco-industrial parks with application to Special Activation Precincts (SAPs). Such a platform lends utility to other precincts and districts, where materials are modelled and tracked, including circular smart cities and even larger regional networks of resources integrations and resources sharing.

image credit: Tumilar et al. (2021)



There are many other ways in which digital technology is having a deep and broad impact on all economic activity. Any business cases to be developed to create a CE in the built environment should align with, and take advantage of, the digital transformation of the economy. The scale of this issue would require a separate and more comprehensive study to be undertaken.

Recommendation: Support a comprehensive study to explore and illustrate the various ways in which the digital transformation of the economy can influence CE practices. Identify scenarios for digital transformation in CE-related sectors as potential touchstones

to inform business case assessment that addresses long-term outcomes for precincts and infrastructure.

4.2 Large-scale and centralised versus small-scale in distributed networks

The emergence of the internet over recent decades—a distributed and networked information system with no centre—has highlighted the distinction between centralised systems and distributed networks. The internet has also enabled the development of new businesses that are also distributed in character. The commonly cited example is Amazon's book publishing model that disrupted this industry. Setting aside the impact of e-books, Amazon does not mass produce physical books as expected with economies of scale business models. Instead, electronic files, of the cover design and internal material, are uploaded to the website and no material resources are used to print a book until an order is made by a customer. Amazon then has a global network of printers, and the electronic files are sent to the printer nearest the consumer for production of a book. This example is relevant to the creation of a CE for the following reasons:

- (a) Production on demand minimises waste in the production process, when compared with mass production that must estimate demand or fabricate demand through marketing (Reduce).
- (b) Production on demand, minimises the scale of factories and warehouses, thus reducing embodied energy and the emissions from their construction (Reduce).
- (c) The distributed network of printers minimises the transport distance and associated emissions (Reduce).

In developing business cases for waste-to-resource facilities it would be useful to compare feasibility assessment for large, centralised facilities with that for a distributed network of small facilities. This comparison should include, in both cases, the cost of transportation.

The idea of distributed networks is further amplified by the energy transition, which is not just a shift from fossil fuels to renewables, but also a shift from centralised power plants to a distributed network of power providers and a 2-way grid. Operational cost for a range of activities can be reduced (although partly offset by increased capital costs) through the installation of local renewable energy systems

4.3 Infrastructure as urban commons

It is now well recognised (Benkler, 2006, Rifkin 2014) that social collaboration is critical in the development of software services, which receive constant feedback from users. This voluntary and non-monetary collaboration provides a significant contribution to economic activity. Both Benkler and Rifkin identify the substantial advantage that collaborative network business models have over proprietary models. The former draw on the knowledge, skills and experiences of a wide range of end-users, while the latter rely on in-house knowledge and market research.

This concept of acknowledging the benefits of collaborative networks can be translated from the virtual into the physical world. Shared infrastructures in a precinct represent the pathways along which resources and materials flow. The business case for providing infrastructure that benefits everyone should not be proprietary. That is, the feasibility should not be based on an attempt to provide a profit margin for a single entity that owns and operates it. Instead, the capital investment should be collectively funded by the beneficiaries of the asset, to reduce the operational costs of this same group, thus socialising the benefits of the infrastructure.

This is another reason why the distinction between stocks and flows is important is that business cases for fixed assets generally involve life-cycle costing, aiming for high quality, durable assets that have the lowest possible operational costs over their lifetime. In contrast, business cases for product flows are less concerned about operational costs, often designed with built-in obsolescence to continually generate demand for new products.

Consistent with circular design practices, financing strategies should also adopt a life cycle costing approach. Liaros (2021b) argues that life-cycle costing would drive the design and construction process towards maximising durability to achieve the longest possible life for an asset, while also minimising maintenance costs.

Case study: Local Government waste management facilities

Over recent years, many regional councils have been keen to explore the potential of the circular economy as a business strategy to reduce costs and emissions associated with waste and energy and to optimise the deployment of scarce resources. Recent experiences with waste highlight the challenges of distance and scale, issues that are currently being discussed in the context of the Parkes SAP. For example, some of the larger regional councils in the Central West of NSW such as Bathurst & Orange have explored the possibility of establishing a variety of local waste processing hubs. Inevitably these aspirations are stymied by the significant capital cost required to establish these facilities and the consequent need to import waste from other councils to justify the high level of investment, often negating the environmental benefits of

recycling through the increase in carbon emissions from transporting waste large distances. This was the experience of the biomass pilot in Lithgow some 10 years ago where mallee eucalypt was used as a replacement for coal but was trucked several hundred kilometres prior to processing.

Perhaps alternative approaches to the design and financing of this infrastructure may be explored. Rather than a few large facilities, Councils could create a collaborative network of shared facilities. These could be connected and optimised using digital technology and collectively financed by the community who will benefit from reduced costs.

We understand that the EPA is leading a program for joint procurement of council waste management services, which may be the vehicle through which these matters are considered.

Connecting the above ideas – networks of facilities designed as urban commons – raises the potential for a network of waste-to-resource micro-factories operating as community facilities rather than businesses—urban commons rather than business enterprises. That is, Councils may incorporate small scale technologies into existing community facilities. Rather than seeking to develop business cases for large scale facilities, towns across NSW could create a network of small-scale activities as community education and training centres. This process could support start-ups and activate the community to develop processes for the more effective use of resources that would otherwise be wasted. As an example, waste plastic can be shredded and then extruded to make ribbon for a 3D printer. This activity can then be connected to a maker-space, where communities can be trained in small-scale manufacturing processes, thus creating an innovation hub in communities across NSW.

Recommendation: Explore the pros and cons and investment required to develop a network of small-scale, waste-to-resource micro-factories across NSW to allow communities to manage their waste in their own town or community. This analysis can consider technologies for a variety of waste streams including but not limited to various plastics, glass, rubber tyres, e-waste and solar panels. It can also look at the utilisation of available spaces in existing Council facilities. It can also explore the viability and timeframe for connecting such facilities with maker spaces and innovation hubs where waste material can be converted into new products using 3D printing technologies.

5 Circular Economy perspectives

A review of the literature related to the Circular Economy (CE) identifies a broad range of perspectives with respect to the concept generally, as well as how it may be implemented. Different business cases may be appropriate depending on the interpretation of CE adopted.

As previously mentioned, much of the public discourse tends to focus on waste management, product design and product life cycles. The application of CE principles to precincts and infrastructure requires a spatial perspective that considers the circulation of resources within a geographical area. Therefore, to effectively respond to the required tasks, the review team has sought to provide various perspectives of the CE to illustrate how the concept may be applied to the development of business cases for circular precincts and infrastructure. This section includes 'case studies' of projects that offer specific lessons regarding the implementation of CE concepts.

A critical aspect identified in this section relates to the various ways in which government regulation and policy frameworks can hinder or enable the development of successful business cases for CE projects. Accordingly, our recommendations include policy change that NSW Circular can advocate for and areas in which it might offer relevant expertise to facilitate and enable CE projects.

5.1 Adjusting the existing system or a new paradigm

Numerous proponents argue that the transition to a circular economy is a fundamental change or paradigm shift in world economic systems, and not merely a tweaking of existing systems (Bauwens et al, 2020, Weigend et al, 2020). In seeking to adopt CE strategies, many businesses suggest they are 'becoming more circular'. That is, they are modifying existing processes or practices within the context of the prevailing economic paradigm. Few would ask: What would a fully circular, zero waste, zero pollution, economic system look like? How would our product or service contribute to the realisation of a fully circular economy?

Weigend Rodríguez et al. (2020) suggest that CE debates rarely explore alternative futures. They argue that the future is unknowable and should not simply be assumed to be an extrapolation of present conditions. This mere extension of what exists currently would be the consequence of adopting CE definitions that pursue the various R-strategies, making existing economic systems a little less wasteful. Policies could instead, or additionally, pursue the objective of a fully circular economy. A useful way of distinguishing the two approaches is to compare 'backcasting' with forecasting the future. Rather than projecting present circumstances to determine a likely future, the backcasting method starts with the

specification of goals—a desirable future—and then determines how those goals can be met.

The Ellen Macarthur Foundation (EMF), a leading advocate of the CE based in the United Kingdom, models the CE on cyclical ecological systems where there is no waste. They remain focused on the objective of a new and potentially disruptive economic system. The definition of a CE offered by EMF has three principles underpinned by a transition to renewable energy and materials, emphasising the role of design:

- Eliminate waste and pollution
- Circulate products and materials (at their highest value)
- Regenerate nature.

There is a stark difference between incremental *strategies* and the *objective* of a fully circular economic system—one that is designed to continuously circulate materials, and eliminate waste and pollution, while regenerating natural systems in the process. The former proposes incremental changes to the status quo, while the latter proposes a paradigm shift. The former seeks to minimise harm, while the latter seeks to create an economy in which daily economic activities have a net positive impact on ecological systems. Policy proposals for building a circular economy have the opportunity to embrace the paradigm shift, whereby this desirable future is the goal and then a path is plotted to achieve it.

CASE STUDY: Paradigm shift for water cycle infrastructure

image credit: Renewal SA

Lochiel Park in Adelaide is a property development project by Renewal SA (the state-owned property developer). It was designed to incorporate a circular water system. Reservoirs collect water, which is circulated through the site and a constructed wetland cleans grey water so that it can be reused on site and to irrigate the significant open space and community food garden. “Water efficiency measures include rainwater for re-use as hot water and... recycled stormwater for toilets, washing machines and irrigation”. These “contribute to reaching a target of 78 per cent saving of potable water (against the 2004 average).”



Such projects illustrate a paradigm shift in property development, focusing on circular, precinct-scale infrastructure and delivering a high-quality environment for residents and substantial savings to the wider community in terms of reducing requirements for large scale water infrastructure beyond the site.

Yet, in the present economic paradigm the policy settings incentivise developers to maximise dwellings per hectare and minimise land used for water management, bush regeneration, community food gardens or for recreation.

Recommendation: Undertake a study to identify costs, benefits, alternatives and options needed for consideration in the aspects of business cases that encompass incorporating water cycle management within residential development precincts.

The increased available land area and management of the water cycle in a precinct makes local food production more viable, too, opening the possibility for incorporating a diverse, regenerative food system. Liaros (2021a) argues that a fully circular food economy—one that eliminates waste and pollution, keeps materials in circulation and regenerates natural systems (EMF)—would require a significant restructuring of cities and patterns of human settlements. This analysis of the food system points to the need for a shift away from large scale industrialised monoculture to a decentralised network of diverse, regenerative, polyculture farms, co-locating food producers with food consumers as much as possible. He argues that just as the Agricultural Revolution led to the building of the first cities and the industrialisation of food production with the Industrial Revolution led to the creation of modern mega-cities, so the transition to a CE can result in a significant reorganisation of human settlement patterns

CASE STUDY: Networks of Circular Economy Villages

image credit: Valentino Gareri Atelier

A new category of land development, referred to as Circular Economy Villages (CEVs), seeks to integrate precinct-scale infrastructure including an energy micro-grid, water micro-grid, and a diverse, regenerative food system around the built environment. Developed by town planning consultants, PolisPlan, the development model represents a paradigm shift in greenfield land development. The buildings and infrastructure offer Housing-as-a-Service, together with co-working opportunities so that the resident community can deliver food, water, energy, and shelter efficiently and affordably to each other in a closed loop system.



The business plan for a pipeline of such developments can readily be established based on those of other Housing-as-a-Service providers. Shifting away from property development as a form of land speculation, the approach would require debt funding from social impact investors seeking a moderate but consistent return on their passive investment in a Managed Investment Trust. This would be complemented by equity funding from future residents.

The principal hurdle for the development of CEVs relates to obtaining development approval through a town planning system that had not anticipated this development form. PolisPlan have now been engaged by the NSW Government's Sustainability Advantage team to establish a development assessment pathway for the Bellingen Local Government Area.

Disclosure: The director of PolisPlan is a member of the Rapid Review team.

Recommendation: Explore with the Department of Planning the array of opportunities in projects that are already underway in NSW to incorporate an ecosystem of precinct-scale infrastructure.

Recommendation: Identify through case studies in Australia and overseas the most effective means to support the development of pilot projects and documentation of their operation in demonstrating circular economy infrastructure in practice.

5.2 A new economic system based on circulation of resources

To define a CE as a *new* economic system based on the circulation of resources, it is useful to start from first principles and consider what an economic system is. An economic system may be generally defined as:

A system of resource allocation, production and distribution of goods and services within a given geographical area.

In the transition to a CE, it is important to be cognisant of implications not just for production processes and waste management, but also for systems of resource allocation and distribution. These systems relate to the circulation of resources in a geographic area and accounting for the waste and pollution caused by the transportation of resources and goods. For example, in a linear economy, water is harvested in a reservoir, piped through all the buildings in a catchment and then disposed as waste into the ocean. Food is similarly harvested from outside the city limits and then delivered to households in the city. While in the past nutrients were disposed of via wastewater piped into the ocean, there are now many examples wherein water authorities harvest the nutrients and create biosolids that can be used as fertilizers on farms. While this represents a dramatic increase in circularity for nutrients. In the context of a circular economy, each resource flow would be considered in this way to ensure resources are returned to a place of production. Indeed, the emphasis of the CE is on this *circulation* of materials, products, and resources, based on new business models and driven by networks of people within a geographical area.

The movement or flow within the economy is dependent upon the stock of fixed infrastructure in the subject precinct, town, city, or region. This infrastructure provides the pathways upon which economic activity flows. The economy is writ large in the landscape, and so a CE would be characterised by infrastructure that facilitates and enhances the circular flow of resources. The master-planning of new precincts, such as the various Special

Activation Precincts (SAPs), offer the opportunity to design infrastructure and attract relevant businesses in this manner.

The NSW State Government has recently adopted the State Environmental Planning Policy (Activation Precincts) 2020. The SEPP aims to “facilitate strategic and efficient development of land and infrastructure” in the specific identified precincts. These precincts are unique to regional NSW and bring together planning and investment to focus on growing jobs and economic activity in the region. They represent unique opportunities for the incorporation of circular principles in the design of new precincts at the strategic planning and concept development stage. We are aware that there are substantial efforts to incorporate the CE into the strategic planning of these precincts but include this as a recommendation, nonetheless.

Recommendation: Circular design of Special Activation Precincts. Take an active role in contributing to the design of precincts that have already been identified, and in recommending the inclusion of additional precincts in the SEPP (Activation Precincts).

An important starting point for the incorporation of CE principles in new precincts is for the inclusion of an explicit statement requiring the adoption of these. For example, the recently adopted the Western Sydney Aerotropolis Plan 2020 adopts as one of its 11 objectives: “A sustainable low carbon Aerotropolis that embeds the circular economy”. The vision outlined in the plan is for the aerotropolis to feature “next-generation energy, waste and water infrastructure [to] minimise waste and pollution, retain water in the environment, reuse energy and regenerate natural systems to increase the tree canopy and urban cooling. Sustainable food production in the Agribusiness Precinct minimises food miles and reduces food wastage.”

The plan also adopts the three key CE principles developed by the Ellen MacArthur Foundation and mentioned previously.

Recommendation: Work with the Department of Planning to explore effective ways in which new development precincts could incorporate CE objectives, vision statements and principles in their strategic documents. Identify not just suitable clauses and phrasing, but supporting material, such as guidelines and educational programs that would suitably support such a move.

The strategic planning for precincts also includes the adoption of land use definitions that enable the delivery of CE activities and infrastructure. For example, the Western Sydney

Aerotropolis Plan 2020 identifies a range of desirable land uses that may be developed in various Aerotropolis precincts including, 'circular economy uses', 'circular economy enabling infrastructure', and 'circular economy hub'. As far as we are aware, these terms have not yet been formally defined, nor have they been legally adopted in an Environmental Planning Instrument (e.g. State Environmental Planning Policy or Local Environmental Plan).

Recommendation: Work with the Department of Planning to identify land use terms relevant to CE and to define more clearly such terms that can enable effective development and delivery of CE activities and infrastructure. Test this terminology for viability with key stakeholder sectors.

Recommendation: Explore potential avenues employed elsewhere to enable the adoption and inclusion of Circular Economy land use definitions in planning instruments. Use interviews and hypothetical cases to assess the extent to which they could apply across the State by incorporation into the Standard Instrument. Such an instrument could include the glossary of all land use definitions. A pilot version for feedback could be assessed to characterise the ease of incorporation into the Local Environmental Plans of Councils in the State.

5.3 Macro-, Meso- and Micro-level Circular Economies

Different CE strategies and actions can be applied at different geographic scales, such as for Australia, for New South Wales, for a region, a major city, or a small town, or district an individual business. To maximise CE outcomes there should also be synergies between actions at the different scales. Su et al (2013) note that a “successful implementation of the CE policy requires efforts at three different levels: micro-level, meso-level, and macro-level”.

Micro-level CE policies refer to the life-cycle management of individual products or product categories. This tends to be the principal focus of discussions about the CE, resulting in the growing list of R-strategies—refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover. For example, the *NSW Circular Economy Policy Statement* (2019) and *Recycling Victoria: A New Economy* (2020) both focus almost exclusively on these strategies.

Macro-level strategies consider the net result of all activities within a nation or state across all resources, while meso-level activities examine the net result of all economic activities within

a city or precinct. These consider the economic system as a whole, rather than any individual resource stream.

5.3.1 Macro-level strategies

To determine relevant national and state policies, it is useful to firstly contrast the Australian economy, with its relatively small market and manufacturing sector, and high dependence on resource exports, with the economies of the European Union and China, which have a significant manufacturing sector and are highly dependent on resource imports. Australia has historically perceived its role in the global economy as a resource exporter, so the transition to a CE must be tailored to the uniquely Australian situation.

Our dependence on global trading partners means that as they transition to a CE, they could be expected to require fewer of certain Australian resources, such as iron ore being replaced by scrap steel. Therefore, while there are many benefits of a transition to a CE, there are also risks of not transitioning. Accordingly, a CE can also be interpreted as a way of keeping both money and resources circulating within the specified geographical area. Value added sovereign resources will boost the Australian economy and reduce our reliance on resource exports and imports.

Another macro-characteristic of the Australian economy is the large distances involved in the distribution of goods. This attribute implies that policies that reduce transport costs could have benefits across the entire economy. One example of such a policy is to reduce national dependence on oil imports for transport fuel through a transition to electric vehicles powered by local renewable energy. Another example is to locate Special Activation Precincts (SAPs) providing business location opportunities at the intersection of major road and rail corridors, as currently proposed with the Parkes SAP.

CASE STUDY:

Circular Oslo as part of a Circular Regions initiative

Circular Oslo is a “cross-sector multi-stakeholder network initiated in 2018 connecting industry, SMEs, nonprofits and social enterprise, as well as research and the public sector with the aim of accelerating the Circular Economy in the Greater Oslo Region by bridging top-down and bottom-up initiatives. “It is part of a broader Circular Regions initiative that activates the development of circular ecosystems with specific regions.

CASE STUDY:

Hunter and Central Coast Circular, the first of many NSW Circular Regions

Local Councils in the Hunter and Central Coast Region, under the auspices of the Hunter Joint Organisation and with the support of the NSW Government's Sustainability Advantage team, have established Hunter Circular (www.huntercircular.com.au): "Accelerating the Hunter and Central Coast Region towards a Circular Economy". The website provides an online platform for connecting waste streams of industry, Councils and NGOs with others in the network. They are currently developing a strategic roadmap to advance implementation of the Circular Economy in the region.

Fundamentally, the literature (Bauwens et al 2020, Kirchherr et al 2017, Liaros 2021a & 2021b, Weigend et al 2020, Su et al 2013) indicates that the transition to a CE involves far more than reduce, reuse and recycle of existing products and processes, and requires that governments examine the net result of all activities within a region. At the national and state level, recovering and circulating resources also keeps money and wealth circulating within that region. The current emphasis on the balance of trade outside the region neglects the opportunities arising from the internal circulation of resources. For cities, towns and villages this internal circulation can be facilitated through the provision of circular infrastructure. As suggested by Gonios & Lounsbury (circulist.com, 2021), creation of circular infrastructure requires a shift in thinking from business cases for individual products to the design of material or resource ecosystems.

5.3.2 Meso-level strategies

Meso-level strategies are those that seek to manage the circulation of resources or energy within a precinct. These strategies are therefore place-based and engage with the property development industry, town planning processes and environmental planning (ensuring land is zoned appropriately early in the planning process). There is already a significant body of literature related to concepts such as industrial ecology, industrial symbiosis, urban metabolism, and urban ecology (eg. Feiferyte-Skiriene, A, & Stasiskiene, Z., 2021; Zhang et al, 2010). Each of these concepts involve the built environment mimicking natural ecosystems. All explore the inter-relationship between different co-located activities, seeking to improve the efficiency of an economic ecosystem, connecting outputs of all activities with inputs of other activities.

CASE STUDY: Eco-industrial precincts

Kalundborg Eco-Industrial Precinct claims to be the world's first industrial symbiosis precinct beginning in 1959. The main principle is to use waste sources from one company as a resource for another. Having local partnerships ensures that resources are shared and reused in a cost-effective manner, minimising transport costs.

Burnside Industrial Park is another example of an eco-industrial park. It is Canada's largest industrial park with over 2,000 businesses. The Burnside Eco-efficiency centre was established between 1998 to 2012 to provide information on strategies which included waste reduction, pollution prevention, environmental auditing, and industrial symbiosis and waste exchange. This project utilises an existing industrial park, implementing an improvement process towards circularity and resource sharing and expanding the park to create sustainable outcomes.

Burnside has seen a veritable explosion of new companies taking advantage of the availability of materials at the park. The success is due to both public pressures to recycle, but also bans on disposal of some materials in Nova Scotia landfills. At least 25 new companies have located or been created within a few years to capitalise on these opportunities. Burnside has created a strong ecosystem around various types of waste, from recycling to repair, reclamation, and remanufacturing.

To create such precincts, it is necessary to engage with strategic town planning processes and policy as recommended in the previous section. Capital investment will only flow when there is sufficient certainty that a precinct with circular infrastructure can be developed. No business case can be developed without some level of certainty that a development approval can be achieved. Relevant town planning policies and infrastructure plans and policies should therefore be designed to deliver precinct-scale CE infrastructure, perhaps even through innovative business models for property development.

Even with the mechanisms in place to enable development consent to be issued for a CE precinct, the difficulties involved in the ongoing coordination of operational activities remains. For resources to flow between different land uses within a precinct, it is necessary to firstly have the appropriate mix of activities, such that the waste of one business can be used by another. Secondly, it is necessary to have a management regime that binds or encourages the various activities to cooperate.

Recommendation: Undertake further studies to explore mechanisms for incorporating 'soft infrastructure' that creates capacity, connection, collaboration opportunities and

community amongst participants. This should include systems for attracting the appropriate mix of activities into a CE precinct and governance mechanisms for ensuring that they collaborate on an ongoing basis in the collective management of resource flows.

5.4 Maximise income or minimise costs

The literature review by Kirchherr et al (2017) of CE definitions examined and compared 114 definitions. They noted that the most common conception, particularly amongst practitioners, was the original 3R strategies—reduce, reuse, recycle. Even then, demand-side strategies that reduce consumption tend to be neglected, and the CE becomes no more than the re-badging of recycling strategies. This review also identified that despite the broad interest amongst governments and corporations in the CE, social and environmental considerations remained secondary to the economic expectations of corporations.

One approach that prioritises social considerations is where the business case is to minimise living costs for consumers. The prevailing logic in the linear economy is that by maximising consumption and production everyone will benefit by 'growing the economic pie'. In CE debates there is a clear tension between the development of business cases to maximise production output and business cases that seek to minimise consumption and therefore living costs. In a CE, where everything is connected, reducing consumption decreases total energy use and consequent pollution. By minimising, or rather optimising, consumption the economic objective is to reduce the cost of living for consumers rather than to increase profits for producers.

One way of illustrating the difference between these strategies is through a comparison between a CE industrial precinct and a CE housing development. In both cases, the CE is implemented through a process of planning, designing, and financing infrastructure, facilities and assets that enable the circular flow of resources within the precinct. An industrial precinct operates with the aim of supplying goods or services to the broader community, whereas consumers in a housing precinct generate the demand for goods and services. The former would likely adopt CE principles to reduce operating costs and maximise profit, while residents of a housing precinct would adopt CE principles to reduce living costs.

In the housing precinct case study below, the resource flow (circulation) being considered is energy. It shows that energy efficient buildings reduce demand and therefore reduce pollution. The design of the precinct seeks to harvest energy from the sun, store it in

batteries and use it on site. By increasing supply close to demand, energy losses in transmission are substantially reduced.

CASE STUDY: Housing precinct demand management

The Cape (www.liveatthecape.com.au) is a housing development estate in Cape Paterson, Victoria. All homes are architecturally designed to minimise energy demand and have a minimum 7.5-star energy efficiency rating (compared with the regulated 6-star requirement for new homes). Each house also has a minimum of 2.5 kilowatts of solar energy, with electric vehicle charging points also available for residents who want them.

A study by RMIT University (published in January 2020), found that homes at The Cape imported 88 percent less energy from the national energy grid than typical Victorian 6-star rated dual fuel (electricity and gas) homes.

This project demonstrates the substantial reduction in pollution due to reducing demand for imported energy, while at the same time providing higher levels of comfort, lower costs, and a far more aesthetically pleasing living environment than traditional subdivision developments. The project also illustrates the potential for facilitating the transition to electric vehicles when new housing developments generate their own electricity and provide charging points.

At the time of writing, the final stages of The Cape are being constructed and the RMIT study is continuing.

5.5 Everything as a Service

It is becoming increasingly clear that the shift from ownership to access—and therefore to products-as-a-service business models—is a global megatrend (CSIRO, 2012). Aligning with this transition is consistent with the principles of a CE as allows producers to retain ownership and therefore management responsibility for all the materials contained within their products. That allows them to reclaim end-of-life products, recover materials that would otherwise be wasted and reconstitute them into new generation products.

CASE STUDY: Products-as-a-Service

Rather than selling jet engines the Rolls Royce (RR) Total Care Program offers jet engine usage services, maintaining the engines for customers for their entire life cycle. This

reduces associated management risks for customers, while also providing a guarantee of quality as the engines are constantly monitored and maintained by RR. From a CE perspective, this also extends the engine life, minimising demand for new engines.

Most software providers now provide Software-as-a-Service (SaaS) on a subscription basis, rather than selling a box with a DVD. As well as reducing material usage, the customer has an improved experience, with software regularly being updated. The language has recently been adopted by the transport industry, where companies are proposing Mobility-as-a-Service (MaaS). Uber, Ola, Lyft and other car sharing services arguably already offer MaaS. The emergence of these mobile phone-enabled services has driven the rise of the so-called sharing economy, wherein Millennials are increasingly preferencing access over ownership. Accordingly, product-as-a-service business models are becoming more widely accepted in other industries. Yet this situation is not the end game. The vision of Zoox (owned by Amazon), Waymo (owned by Alphabet/Google) and Uber is to own and operate fleets of electric, autonomous vehicles and offer MaaS at a price point that makes car-ownership uneconomic.

Should their vision be realised, the total number of cars and areas for car-parking would be dramatically reduced. Given that most cars are parked for more than 90% of the time, the argument is that this new business model would result in a corresponding reduction in the number of cars needed in a region, with even less car parking. This change would have significant implications for infrastructure, generating demand for new systems and resulting in much existing infrastructure becoming obsolete.

While not yet labelled as such, housing-as-a-service (HaaS) is emerging as a significant new development category. The NSW State Government recently added a suite of planning and taxation policies to encourage emerging forms of development such as build-to-rent and co-living. These models are not simply rental housing but offer a range of services such as co-working spaces, concierge services, property management, spaces for entertainment and various activities for residents to meet.

CASE STUDY:

Housing-as-a-Service - Sydney's emerging build-to-rent sector

There is growing interest in build-to-rent as an emerging development category and asset class. LIV by Mirvac ([LIV | A new way to live \(livmirvac.com\)](http://livmirvac.com)), opened in September

2021 and is one of the first such projects. Their tagline is: “we give you the flexibility of renting with the security of ownership”.

In conjunction with apartments, they offer a range of co-working spaces, a shared kitchen and dining areas, cinema, gym, as well as concierge and property management services.

This is relevant to discussions about the transition to a CE because it offers a business strategy for financing, investing in, and delivering shared, circular infrastructure within a precinct. Rather than individual ownership of houses or apartments, residents would own shares (units) in a Managed Investment Trust that owns the entire precinct. Property developers and other development professionals would bring their expertise to the delivery of such projects. Post-construction, the precinct could be transferred to an operating entity. A separate resident-owned trust could then be established to progressively purchase the buildings and infrastructure in the precinct.

This lessens the land tax implications for the developer. Recognising land tax obligations as a major obstacle to these projects, the NSW Government announced, on 16 February 2021, a 50 percent land tax discount for new build-to-rent housing projects. The Australian Housing and Research Institute (AHURI) identifies policy obstacles (land tax and GST) and notes that with the right policy settings, build-to-rent could become a more attractive development option.

Unlike developments that are subdivided into individual house lots, Housing-as-a-Service developments are operated post-construction as a single precinct. Examples include retirement villages, seniors housing, build-to-rent, co-living, student housing and hotel resorts. NSW Circular could advocate for policy settings that incentivise the inclusion of precinct-scale circular infrastructure in such projects. While it may be difficult to test these ideas in existing urban areas or on greenfield sites that have already been rezoned, it would be possible to develop and test appropriate policy settings in rural areas.

Recommendation: Identify methods to support the growth of the emerging build-to-rent industry, and explore avenues for the inclusion of precinct-scale CE infrastructure within them by assessing case studies and interviewing key stakeholders.

Recommendation: Explore attitudes toward and economic arguments for the inclusion of CE infrastructure, particularly related to food, water and energy flows within precinct scale developments such as retirement villages, seniors housing, build-to-rent, co-living, student housing and hotel resorts.

5.6 The organic circular economy

Descriptions of the CE sometimes differentiate between organic or biological cycles on the one hand and inorganic or technological cycles on the other. With the advent of composting, worm farms and biodigesters, the organic CE appears to be resolved and so the emphasis of many CE initiatives is on inorganic materials.

Yet the dominant linear paradigm prevails with regional producers sending nutrients to urban areas with little returning to regenerate the farmland. A closed loop system would keep valuable resources in circulation, returning organics and water to a farm for the next cycle of food production.

CASE STUDY: Clean Cowra Biomass to energy project

The CLEAN Cowra Biomass to Energy project seeks to deploy anaerobic biodigesters in regional NSW to convert agricultural waste into biogas and digestate. The biogas is primarily methane and can be used as a fuel for a range of purposes including to generate electricity. The digestate is the organic material that remains after the anaerobic digestion process is complete. It is rich in nutrients such as nitrogen and phosphorus.

The initial project is proposed for Cowra. Its proximity to existing agricultural activity minimises transport costs both for the waste input and biodigester outputs making the end products affordable for local farmers. The strategic priorities of the CLEAN Cowra project are to:

- ENHANCE biomass-to-energy conversion as a commercially viable, regional solution
- REDUCE costs of inputs for energy and nutrient intensive agriculture and other local industries

- INCREASE the capacity of regional communities by providing local clean energy infrastructure.

Disclosure: The director of the Clean Cowra project is a member of the Rapid Review team.

Recommendation: Assess the cost, scale, long-term return on investment and feasibility for the development of a network of biodigesters or similar technologies in regional areas for the conversion of agricultural waste into biosolids for use on local farms.

6 Executive Literacy about the Circular Economy

The current level of knowledge and understanding of the CE amongst senior executives in Australia has been assessed in this project through a series of interviews. The interviews, and an associated scan of corporate annual reports and executive surveys, sought to gain an appreciation of the capacity and willingness to implement CE as well as views about obstacles and barriers.

When a precinct in Western Sydney, for example, is slated for planning and development, how are circular economy strategies and features – such as waste minimisation and energy conservation – considered by senior executives? That is, how is the business case for these elements for the precinct or associated infrastructure viewed – are they seen to pay for themselves? More correctly, given the modest uptake to date of circularity in planning and design of precincts and infrastructure, what is needed for it to be seen as yielding an attractive return on investment? Looking upstream of these considerations, have elements of CE been considered on whether to build the precinct in that location, whether a precinct as currently envisioned is the right sort of development, and where to place associated infrastructure and what sort of infrastructure?

These questions have been explored in this study in several ways. We conducted interviews of 20 individuals, such as consultants and middle level and more senior staff in local and state government with experience in dealing with executives and business case processes. They came from the Sydney metro area, Western Sydney, the Hunter region, Wollongong, and the Central Coast. Private sector firms included Urban Apostles, Sense Strategy Consulting, MRA Consulting Group, KPMG, BECA, Borg Group and Beveridge Williams. Public sector organisations included Western Parklands Councils, Lake Macquarie City Council, Western Parkland City Authority, Department of Regional NSW, NSW Department of Planning and Environment, NSW EPA, Transport for NSW, and Sydney Water. Non-profits included Narara Eco Village and MECLA (Materials & Embodied Carbon Leaders Alliance).

These findings can be viewed in the context of circular economy 'literacy' in a few salient academic pieces on decision-making by managers, and the management training of students, in relation to the circular economy or sustainability more generally. Review of a modest number of corporate annual reports in the development industry as well as annual sustainability reports suggests that circular economy is very peripheral, even where sustainability gains significant treatment.

Findings from these efforts have been combined with insights gained in the circular economy arena over the past few years to identify what senior executives need to know in order to take the circular economy seriously in their business case considerations. These key ideas or frames of reference can be seen as 'threshold concepts' (Myer and Land, 2005).

Threshold concepts are problematic but significant ideas, where once they are mastered, the learner never sees a problem or opportunity in the same way. An example cited in economics is opportunity cost, the value that is lost by not selecting a particular option. Threshold concepts related to the circular economy encompass consideration of 'return on investment' from a range of perspectives (what in technology transfer literature has been called 'contingent effectiveness' (Bozeman, 2000)). For example, can the notion of a 'return on investment' come to include social benefits and environmental benefits that are lacking definitive or agreed economic value?

6.1 Interviews

The people interviewed for this rapid review tended to share a belief in the value of the circular economy. They did not all see the circular economy as paramount, though. Some viewed it as part of environmental sustainability, which they further explained needed to be augmented by addressing social and economic equity (outcomes) and social justice considerations (processes).

Interestingly, the interviewees tended to share an attachment to environmental and social sustainability that they traced to their teen years. So, it was something that persisted throughout their professional life and was pursued with more vigour very early and then much later in their professional careers. They can be seen to be part of what might be called a 'hidden army' of believers – individuals who will support expansion of the circular economy given the opportunity and the needed tools.

The analysis here is presented in terms of responses to the four interview questions:

1. How can CE apply to precincts and infrastructure;
2. How have views of sustainability, more generally, changed in the last 10-20 years;
3. What are the main hurdles – and the main enablers – to boosting understanding of the circular economy in relation to development of precincts and infrastructure; and
4. Who can make a difference to consideration of the circular economy in business cases.

For the first question, insights from all 20 interviews are provided below. For the other three questions, an analysis of just four selected interviews is given here. That is due to restrictions on staff time and space in completing this report, restrictions that were reached due to the complex nature of circular economy opportunities and constraints in the precinct and infrastructure arena.

The range of points offered below – and in the interview responses not summarised below – suggest that making consideration of the circular economy more salient in executive

assessment of business cases for precincts and infrastructure is not going to result from use of a single 'silver bullet'. Rather, there are many points on which pressure can be applied, suggesting a need for 'silver buckshot'.

6.1.1 How CE can apply to precincts and infrastructure

Strengths

Big picture frameworks - Experienced planning consultants portrayed the circular economy as one element to be considered in an overall philosophical approach or paradigm for an ideal planning and development process. The elements of CE were described as key parts of a new mindset that is needed in urban planning, project delivery and governance. This mindset resembles aspects captured by the doughnut economics model (Raworth, 2017), addressing environmental sustainability and social justice and wellbeing. It is more fully articulated by the widely recognised, five capitals framework – financial capital, built capital/ infrastructure, human capital, social capital and natural capital.

Planning and operations - A more ideal process was described as covering planning and elements of ongoing governance for both infrastructure and buildings. A key element highlighted was taking into account long-term operations. This expanded scope in looking at operations is echoed in request to expand topics covered. It was noted that, to date, sustainability strategies have mainly been around water use and energy use and not so much about other dimensions of the circular economy, such as material use or regeneration of natural environments.

Hyperlocal economy - A 'hyperlocal economy' was described – either explicitly or implicitly – as important (Reed, Twill and Christensen, 2018). That can be construed as having a place-based focus being seen as desirable, at the very least taking into account the cost of moving material inputs and outputs. The idea is to reduce the volume of materials, food and energy going through international supply chains in a linear fashion by increasing local sourcing, repurposing, and reuse.

Along these lines, precincts were portrayed as not merely defined by arbitrarily drawn property boundaries but through notions of a precinct being an economic entity, offering circular economy efficiencies, and being environmentally sustained and enhanced. The local focus was also described as having a potential for achieving equity and justice, rather than prolonging or exacerbating income disparities and power disparities or political marginalisation.

This 'hyperlocality' vision would also encompass local jobs providing the value added, with locally residing workers ensuring preservation and regeneration of the local environment. It links into ideas of urban development where service workers, for example, can afford to live

in city centres, close to their jobs. In other words, this vision was offered as localising both material flows and economic flows.

Design criteria would include addressing human social and economic dimensions as well as natural dimensions of the precinct. Criteria would also consider up-front costs, operational costs and resilience to potential climate disruptions.

Assessment criteria - Circular elements in a precinct or infrastructure were presented in the interviews as being specified by the government in planning requirements and tenders. Interviewees explained that circularity elements can be built in as assessment criteria. More specifically, it was noted that there seems to be a growing emphasis on project KPIs in the operational phase of a precinct, not just in the design and construction phases. They are seen as 'non-cost KPIs', a standard for engagement of contractors. Instances to date have focused on achieving certain social/community engagement outcomes, for example. These 'non-cost KPIs' (the interviewee's term) are now included by Infrastructure NSW in its *Business Case Toolkit* for contractors to help with their 'gateway reviews' (Infrastructure NSW, 2022).

Companies in the construction industry were characterised as reluctant to respond to greater government regulation, such as in relation to the circular economy. However, criteria added to tender assessment processes could provide rewards for appropriate circular plans and behaviour. That can be seen as a form of 'positive reinforcement'. For example, it was suggested that companies are exposed to regulation through the necessity to file a waste management plan for a construction project. The guidelines for waste management plans could be a useful avenue for introducing companies to CE strategies.

Post construction, operational efficiency - There was an emphasis in the interviews of some more senior people on viewing CE as contributing to operational efficiency and effectiveness after construction of a project. That was framed as an appealing option for developments where long-term monitoring is implemented, and there are governance structures in place to make this monitoring meaningful, such as in being able to enforce a response to meet targets. In other words, there is what has been known in the environmental regulation arena as a 'compliance regime' relative to operations, not just relative to design and construction. Data on performance is required, and a governance mechanism is needed so that that data is used to inform decisions. An initial example of these elements is visible in guidelines from Infrastructure NSW on preparing cases for 'gateway decisions' (cited above).

It was suggested that this focus on operationalisation reflects a growing emphasis on 'benefits realisation', beyond the more familiar benefits identification. A focus on long-term performance has shown appeal to infrastructure professionals, but less appeal to politicians/ministers with what were portrayed as shorter, election-driven, time horizons. It was argued that the political angle can be attended to by involving consumers more fully in decision-making and planning. Consumers need to be consulted by business and

government but are not yet adequately engaged in decision-making nor in judging performance/accountability, interviewees stated.

Precinct synergies - The value of circular economy in relation to industrial precincts was described as enabling enhancement of the 'precinct ecosystem'. That can be understood to mean that a precinct's potential to offer economic synergies – e.g., in terms of complementary company and workforce capabilities – would be enhanced by better use of materials and energy, the circularity elements.

The precinct offers synergies if supporting structures and partnerships are in place, one interviewee stated. A core group of people – a critical mass - needs to provide leadership and foster discussion and collaboration, while boosting the appetite of all parties for trialling new things that enhance circularity, the interviewee added. They concluded that policies and incentives are not sufficient; a suitable collection of leading figures is needed, whose circularity inclinations can be supported by market pressures and social license to operate considerations.

Window dressing no more? - One interviewee explained that the concept of sustainability has been around for a long time, but it seems to be more of a buzz word rather than something practical for someone who is planning a precinct. Precinct development in regional areas was described as different from that occurring in urban areas. A constraint seen was 'ownership' of the precinct by local councils, though the state government was promoting the precinct. Implied was a lack of expertise in local governments to support circular economy elements in precinct development.

The attraction of sustainability – and implying circularity as well - was portrayed as rising due to the bushfires. The bushfires were felt by local communities, voters, which meant that political parties found sustainability harder to ignore, it was stated. These comments are consistent with other comments about certain business leaders and investors being keen to address sustainability issues. That appears to be related to personal values but also a sense that there is a market for it – with recognition of billions of dollars being earmarked by the financial sector for 'green' investments.

Weaknesses

Limits of government influence - It was explained that assembling a precinct of complementary businesses is undertaken by the state government – such as the Richmond Valley regional job precinct in Casino. However, that can involve suggesting that a company in one location moves to another location, which is hard to do.

Data availability – A need for data on material use was portrayed as important, for example, in relation to assessing how long a 'waste' material would need to be stored on site before another local business would need it. That is an example of how circular economy/sustainability considerations are rising while data capability under the smart city banner is also rising. An array of sensors installed for a set of councils in Western Sydney was

described as contributing to an open data platform, from which circular economy opportunities could be generated, such as in relation to use and reuse of water.

Data sharing in an open data portal was cited as being consistent with commitments made to land the Western Sydney city deal, though funding for the portal requires convincing city managers of the value to be added. This example was offered to show how a circular economy could be addressed through a 'back door' – smart city elements. The interviewee suggested that the example also illustrates how circularity is not yet a compelling driver at the council level, though it is increasing in strength.

Space need for recycling and more - An interviewee noted that circular economy tends to be dealt with currently as shorthand for recycling. There is promise despite that current limitation, she stated, with particularly opportunity in greenfield sites, such as Bradfield in the Western Parkland City, where space can be allocated to enable handling of incoming goods, packaging materials and waste. That space tends to be less available in built up settings. An example would be having to find a place to store partitions, desks and monitors removed as part of an office refit.

New precincts rather than existing ones - Missing in the explanations of those interviewed was discussion of existing precincts, except to the extent that they were being redeveloped. In other words, the focus of attention seemed to be on big projects rather than on more modest changes to existing places.

Opportunities

Consistent use of CE-related terminology - Mention of CE in guidance documents for planning and pre-approval processes align with similar notions arising in conversations in government. It was recommended that the government should get key concepts and terminology related to CE defined and used consistently across a range of guidance documents.

Opportunities in Western Parkland City - Circular economy considerations did come into development of Western Parkland City, in part through the impetus of Sydney Water and its own interest in water conservation, water recycling and effective reuse of organic byproducts from sewage treatment. For example, a residential precinct with 1,000 homes, such as in Rouse Hill, could support a recycled water plant. That in turn justifies installing a third pipe (alongside town water and sewage pipes).

Small wins occurring in industry - Progress was depicted as being made incrementally by progressive contractors in the construction industry supported by forward thinking clients. More sustainable homes in a precinct were described as selling more quickly than traditionally built homes, a result that surprised the developer, due to the higher cost of the more sustainable homes. This sort of innovation was attributed to a suspension of a sole focus on near-term profit.

Threats

NIMBY - The 'circularity' principles may promise greater environmental protection, but at least one example suggests that resistance can persist based on fears of local impacts. The example is a plastics recycling facility near Kiama, where local residents expressed concern about truck movements and potential groundwater contamination.

Design opportunities missed due to cost and speed - One interviewee speculated that assembling partners in a precinct might face similar challenges to assembling partners in single building development. That is, early design progresses on the scent of an oily rag until an anchor tenant is secured. The lack of funds for such design early in the process can result in missed opportunities, as aspects of a design that could support circularity get locked in, or locked out, early in the process. The lock out occurs as the commercial window for refining a design – such as in the tender process for work on Sydney's Central Station - can be quite small, just a few weeks. The lack of time can mean that project management drives the design and construction, with a lack of iteration among the different design professions. A degree of iteration, this interviewee noted, was essential to incorporating circular economy elements. The competitive nature and compressed timelines drive contractors to strive for profits through offering cheaper solutions, implying near-term savings in construction rather than long-term operational savings.

Different professions, different focus - An interviewee in the waste management sector noted that large developers and Mirvac and Landcom would have a focus building infrastructure and precincts, rather than on waste management. A real hurdle to increasing circularity, the interviewee stated, is a lack of design of materials and goods so that they can be more readily reused and recycled. That implies that regulations and guidelines applying to precincts and infrastructure will have limited impact as they are indeed addressing necessary elements of circularity – how to handle goods and materials - but not the essential elements – what materials are used in those goods. So, the guidelines or application of expertise in waste management could be used to 'green up' a precinct, but the hurdles inherent in the types of materials and goods used remain, the interviewee stated. Another barrier is the low cost of landfill in Australia, which makes it a far cheaper option than reuse or recycling alternatives. The interviewee added that waste or recycling precincts, which could begin to make a difference, get no special protections in Australian or NSW law as a preferred use of land, which results in course cases seeking overturn planning approvals.

6.1.2 How views of CE and sustainability have changed in the last 10-20 years

Key elements of the circular economy were seen as familiar to the four individuals interviewed whose statements we are analysing for this section. These four individuals

recognise elements of circular economy as having been considered in other frameworks, such as sustainability, and within their own practice for decades.

Non-commercial elements - One interviewee offered that non-commercial elements have been incorporated in the past by the building and development industry in addressing work health and safety and quality assurance requirements. Auditing was implemented, and there was a well-funded enforcement bureaucracy, including WorkSafe and Australian Standards. Marked improvement was seen over 20-30 years. Quality assurance was internalised by some, though not by others. It was stated that quality is now falling away, as seen by the concerns of owners of apartments about cracking in the walls of new housing blocks in Sydney. What has survived from that period is professional training of project managers, said this interviewee. The thrust of efforts of professionals in project management and other areas remains toward ensuring profit, it was noted, with triple bottom line discussions being uncommon.

A decade ago, sustainability was seen to be joining safety and quality as a non-commercial consideration, but interest in the government pressing the case is reported to have waned. Nonetheless, it was noted that 'sustainable urbanism' has progressed in the past decade. A parallel trend in the rise of smart city thinking was not referred to by any of this group of four interviewees.

Data 'reliability' - Data on employment, consumer spending, transportation ridership and greenhouse gas emissions is now more plentiful and more geographically specific (e.g., postcode level and below) with a proliferation of dashboard tools, but it is not clear yet that these data are contributing to better decisions, the interviews suggest. Data could actually be helping to sideline consumers, one interviewee stated, as the data are not 'reliable', suggesting that data are not readily understood and interpreted by consumers. Data on things that consumers deal with is needed as well as data on consumer behaviours that affect circular economy outcomes, this interviewee stated.

Roles for large companies - In another interview, it was offered that what large companies do, and do visibly, smaller companies would be inclined to adopt over time. That is, the larger organisations can be seen to be setting informal industry standards. It was noted that smaller companies would lack the capital to invest in facilities to reprocess materials, for example. However, one can extrapolate that interest from SMEs could stimulate launch of commercial reprocessing facilities that can service smaller companies. That is, economies of scale come from single, larger companies or from multiple smaller companies.

Value of university involvement - In recent years, one interviewee offered, collaboration between the construction industry and universities has provided an avenue through council approval processes. That is, a business trying to do something novel – e.g., more 'circular' – might be knocked back by council assessors, unless the change effort has a university partner involved.

6.1.3 What are the main hurdles for understanding and implementing CE? What are key features that can accelerate adoption?

Complex array of disciplines - Making the circular economy and information about the circular economy 'relatable' was described by one interviewee as a key challenge. The relatability challenge arises in the circular economy encompassing an array of professional disciplines. Compounding this lack of relatability, it was offered, are implications that the circular economy is 'all encompassing' – meaning that it involves a combination of interacting environmental, economic and social systems. In other words, scope and complexity are deterrents. Features of the circular economy that are more specific may be easier to grasp and adopt, it was noted.

Potential flow-on effects - On the plus side, sustainability concerns, in general, or circular economy concerns in particular, can drive changes in operation in one domain, such as at home or in a client's operation. Then, flow-on effects (pardon the pun) could result in water conservation measures for other businesses supported by Sydney Water, one interviewee noted.

Competition as a driver - Competitive sensibilities can be a hurdle or a source of incentives. A company that believes that it is very good may not be willing to listen about alternative approaches to try, one interviewee stated. However, the growing attention to sustainability and circularity can make CE measures credible as sources of competitive advantage. For example, a company can then tout that it has been first to implement a particular 'green' strategy.

Along these lines, an interviewee argued that larger development firms can be told that the performance of their projects that deliver against KPIs related to being efficient in operation can contribute to winning further projects in 10-20 years' time. In other words, the return on their investment in sustainability today would be arriving in 20 years at a time when the company is bidding on another project.

Similarly, a stubborn focus on profitability and the need for capital can be tapped into. Government and business audiences can see that places that are attractive to young workers will attract employers who are pursuing good staff and investors that are pursuing companies to invest in. That attractiveness has to align with the values of today's young professionals, which extend to include environmental and social values. For this target market of young professionals, the more traditional profit-driven paradigm in development has led to unaffordable land values, one interviewee explained. So, the framing is that the old paradigm can be blamed for the inability of young professionals to find a decent, affordable place to live.

Include industry, consumers, financial sector - Government and utilities need to be educated in order to provide criteria and incentives to lead business in the right direction and to remove barriers to doing things in a different, more sustainable way. Insights from

several interviews suggest an argument that industry can usefully be included in these conversations, as can consumers and the financial sector.

Engaging with the financial sector was described as important. They are considering risks at various points in their financing of a precinct or infrastructure. They are also typically working with timeframes of expected returns in 3, 5 and 10 years. There is an opportunity to cultivate and engage with 'patient capital', generating 40-60 year loans, for example. These longer time horizons can enable higher initial investment and then return greater net present value, one interviewee explained.

Additionally, investments that are in the public good can ultimately reduce government expenditures, one consultant noted. Given those expected savings, e.g., lower healthcare costs or less maintenance on roads or facilities, a local or state government can invest funds up front in order to realise long-term reductions in expenditure.

The Australian financial sector, though, has little historical experience with long-term property investment. For example, there is not much investment to date in build-to-rent premises, which are plentiful in Europe and the US.

Education - The interviews suggest a need for education to help drive a shift in paradigms as well as accompanying education about how to shift practices, how to rewrite guidelines and provide the right sort of incentives.

6.1.4 Who can make a difference?

Peak bodies - Professional bodies were described as important in getting the message out about the circular economy and the need for change.

Government - Government initiatives and regulations in relation to quality assurance and safety were cited as examples of strategies to spur adoption across sectors and across institutions. One would see the head of a company being as eager to engage and see these strategies implemented as a member of government regulatory staff, or a union representative. So, interviewees suggested that this cross-sectoral understanding and engagement is important, and it is not sufficiently present now, with the only common understanding being about making money.

Industry - Change in the sector is described as needing industry leadership – by larger, better resourced, companies - and positive reinforcement from government – through explicit reference and education on the CE in guidelines and tender criteria.

Industry needs to see incentives and not just enforcement strategies, one interviewee cautioned. The industry has to retain access to capital, which can mean a need to engage with the financial sector to enable them to pilot models of financing that are new in their domain, such as community land trusts. The financial lens can incorporate the same hyperlocal focus as considerations of water, energy and food, it was explained. The

interviewee offered that a focus can be on maintaining local equity for commerce, retail and housing.

Consumers - Consumers were portrayed as a key avenue for 'making a difference'. A connection with the consumer would involve a combination of data on materials and emissions, data on consumer behaviours, and opportunities for participation in decision-making. The engagement would occur through data and products that are relatable and appealing beyond their conservation/environmental attributes. That is, an electric car provides environmental benefits, but it also provides personal benefits for the owner beyond that.

6.2 Summary of interview findings

Across these interviews, three themes appear to be salient.

- A. **Hidden army** – There appears to be a 'hidden army' of professionals who can be seen as true believers, people with years or decades of experience in a range of sustainability-related initiatives. The big picture paradigm that they tend to share addresses not just wiser use of materials, energy and water but notions of regeneration and overcoming biases and inequity in the current economic system. One avenue to achieving their aims, which the circular economy appears to offer, is through greater 'localisation' of economies.
- B. **Impatience** – The individuals interviewed with greater experience in the private sector noted that there are businesses and investment institutions that are ready to forge ahead to invest their funds and expertise in more circular developments. They cite bottlenecks and roadblocks in government regulations and processes along with gaps and inconsistencies in guidance documents, incentives and information.
- C. **Expanding scope** – The circular economy transcends the traditional focus of sustainability initiatives on water and energy use, according to those interviewed. It includes materials, a sense of regeneration (as noted above), and enhancing life in communities, in part by localising economies (as noted). A leverage point for putting circular economy consideration into business case processes would be adopting a long-term perspective, such as assessing not just benefits identified during planning stages but benefits realised during operations.

6.3 Threshold concepts in executive literacy

Some of the interviews explored what decision-makers need to know about the circular economy to help them to make more insightful decisions with better long-term consequences – outcomes aligned with elements of the circular paradigm that these true believers appear to have adopted. These insights resonate with the grey literature and academic literature on the circular economy that is familiar to many (and will not be specifically cited here). The problematic but transformational threshold concepts tend to fall in three, somewhat overlapping domains.

- A. **Systems thinking:** That encompasses a range of areas, from understanding of industrial ecology and the Ellen MacArthur Foundation's 'butterfly' diagram to recognising the connections between technical and organisational elements – e.g., the need for state planning guidelines and materials to support technical solutions that can bolster the circular economy. These elements were generally captured by the importance of understanding the 5 capitals – financial, built, human, natural and social as well as understanding interactions among these 5 capitals.
- B. **Frames of reference:** There has been repeated mention of departmental silos within government but also stark differences between professions on the business side, in the building and development sector. Personal beliefs – which in this group tended to seem to be long-term and more holistic - appeared to be one frame of reference that differed from professional practices – more orientated toward the linear economy and a necessity to focus on shorter timeframes. Issues around stigma and marginalisation were also noted, particularly in relation to materials labelled as 'waste' and the locations where they would be handled, which contrasted with a view of those materials as a 'resource' that requires space to enable redirecting it to new uses in precincts.
- C. **Knowledge:** Some knowledge about the nature and use of materials, energy and water appears to be fundamental. That includes a sense of how much it costs to transport and dispose of materials, the scale of materials being used in terms of tonnage and environmental impacts, and insight around technical feasibility and basic chemistry, e.g., what materials can replace what other materials and with what consequences. Also evident is a need for knowledge of the business world and the growing public salience of environment, social and governance (ESG) considerations in corporate and investment decision-making.

What percentage of the executive sector has mastered a fair number of these threshold concepts? That is not clear, but initial evidence suggests that the proportion is small. A survey in 2021 by the Australian Circular Economy Hub reached 500 business decision-makers across Australia (ACE Hub, 2021). Nine out of ten respondents agreed that the circular economy would be important to the future of their business. Eight out of ten

said that they felt knowledgeable about the concept of the circular economy. Just one in four could correctly identify the definition of the circular economy.

A quick review of publicly available annual reports and a couple of sustainability reports from enterprises in the building and development sector reveals scant mention of the circular economy specifically. These organisations include Downer, Lendlease, Mirvac Property Trust, Simonds Group, Landcom, Nexus Infrastructure, Stockland and Transport for New South Wales. Sustainability, more generally, has garnered more attention.

From the current state of play, one can conclude that shifting an entire economic system – as some of those who were interviewed envisioned - is daunting. Making headway toward a more circular economy in the near term requires education as well as closing gaps and eliminating bottlenecks in policy, regulation, information and, essentially, in professional socialisation as well. On the positive side, there is a highly engaged array of knowledgeable and experienced professionals across a range of sectors who are bringing their expertise and commitment to bear. Aligning and coordinating their activities is of paramount importance.

Recommendation: Identify methods to enable more effective collaboration among professionals who are supporting development of the circular economy for precincts and infrastructure in their work – across government and in the private sector.

Implementation of the circular economy is a complex, cross-sector process – essentially a set of interlinked wicked problems that will respond best to an array of approaches from diverse sources, resulting in collaborations among ‘strange bedfellows’. Assess the viability of approaches employed in other domains, such as collaborative governance and collective impact, the latter now being the banner labelling a campaign by the Australian Packaging Covenant Organisation and an umbrella for strategies employed by the Hunter and Central Coast Circular Economy facilitators group.

Disclosure: A consultant to the Hunter and Central Coast CE facilitators group is a member of the Rapid Review team.

7 Analysis and Recommendations

7.1 Analysis of barriers and enablers

The interviews of professionals in government and industry sought to gain an appreciation of their understanding of the CE, how it can be applied to P&I, how it has changed over time, what are the barriers and enablers, and who can make a difference. The analysis of responses suggests that there is a hidden army of impatient sustainability experts in the private and the public sectors who are keen to expand CE in their activities as they recognise it as an important strategy for achieving sustainability outcomes. Some of the barriers and enablers are outlined below.

7.1.1 Education

The limited understanding of the CE, and particularly its conflation with recycling, suggests that there is a need to establish parameters for an overarching education process. Such an educational effort could begin by attempting to better align the views and expectations of various stakeholders who already appear to be accepting of CE initiatives. A critical aspect of this educational effort can be seen to be the engagement of parties with the threshold concepts, expanding knowledge of the Circular Economy, appreciating the **systems thinking** approaches, the benefits of **localisation** and **regeneration**, and incorporating expanded frames of references—such as contrasting spatial circularity with temporal circularity or life-cycle planning.

7.1.2 Shifting priorities among criteria in business case assessments

The opportunities identified here for CE development and the array of supportive stakeholders suggest that it would be useful to investigate the pros and cons of employing CE as one primary objective of infrastructure and precinct investment, rather than as a peripheral objective.

7.1.3 Privatised or broader, socialised financial benefits

The literature review noted a tension in CE debates between advocates who view the CE as a strategy primarily for achieving sustainability outcomes and those who view it as an economic opportunity. While these outcomes can sometimes co-exist, the tension between maximising profits and minimising the cost of living can be seen as a classic 'wicked problem' related to achieving sustainability. In terms of business case objectives, the question is about the extent to which financial benefits are privatised—where they flow to the provider of the infrastructure—or they are 'socialised'—where they flow on as lower costs to consumers more generally. This balance immediately highlights two kinds of business strategies being developed in relation to P&I—those that are usually adopted for a CE industrial precinct and those that can be used for a CE housing development. In both cases,

the CE is implemented through a process of planning, designing, and financing infrastructure, facilities and assets that enable the circular flow of resources within the precinct. The former, industrial example adopts CE principles to reduce operating costs and maximise profit, while in the latter instance, residents of a housing precinct would adopt CE principles to reduce living costs.

As it has been argued that increased profits do not 'trickle down' to ultimately benefit everyone, a decision has to be made as to the extent to which the P&I will be designed to privatise or to socialise the financial benefits. It is worth investigating cases where this balance between public and private benefit has been reset from a business as usual approach and to assess long term satisfaction and viability.

7.1.4 Regulatory and fiscal policy alignment with business cases

A key theme that emerged from discussions with professionals in industry and government is that, in their view, one of the main barriers to the implementation of CE principles relates to bottlenecks and roadblocks in government regulations and processes along with gaps and inconsistencies in guidance documents, incentives and information. While antagonism and blame between private and public sectors does not help, there is a clear need for better alignment between regulatory enablers, fiscal incentives, and elements of business case development.

This notion also emerged from the literature review. Businesses - and political aspirations for infrastructure and precinct development - operate within a framework that is established by government regulation and fiscal policy. This context is particularly relevant for precincts and infrastructure, which are developed through a town planning policy framework and a taxation system that can be seen to incentivise current linear practices at the expense of innovative circular approaches. It is also important to align policies that relate to particular materials, products or resources; land use and infrastructure policies that relate to particular localities; and broader state and national policies. These micro, meso and macro-level policies each make different but complementary contributions to enabling a CE.

It is easy to recommend alignment, but formulation and implementation can be much more difficult, given different drivers and historical silos among different government departments. One way forward is to characterise settings where such alignment has been achieved to identify success factors. An example emerging from the interviews was development of workplace health and safety practices in the building construction industry in the past two decades.

7.1.5 Infrastructure design and technology

It would not be unreasonable to suggest that a good array of technology needed to convert various waste streams into usable materials has already been developed or is in development. With respect to organics, technologies include, to name a few, composters, worm farms, aerobic and anaerobic biodigesters, composting toilets, constructed wetlands as well as a range of other constructed systems used in various forms of regenerative

agriculture and water sensitive urban design. With respect to inorganics, technologies are available to convert various waste streams—plastics, glass, aluminium, clothing, tyres—into usable resources. The engineering skills needed to design the infrastructure that incorporates these technologies is also well developed. While there may be more work to be done, infrastructure design capabilities and technologies appear not to be, in themselves, obstacles to the implementation of a CE.

Our review, though, highlighted the importance of minimising transport costs, both for waste going to a waste-to-resource facility, and resources being transported from the facility to market. To minimise these costs, it is useful to explore options such as the development of business cases for numerous small-scale, waste-to-resource micro-factories, scattered across the state, compared with a few large facilities in major centres. In addition to reducing transport costs, decentralisation would create local opportunities, attract investment, and build resilience in towns throughout the state. However, centralisation of certain facilities and capabilities also has attractions.

7.1.6 Settlement planning

Rather than assessing each item or project on an individual basis, the investigation reported on here points to the value for a more strategic approach. It seems worth exploring the value in applying a Circular Economy lens to a state-wide settlement planning processes. That could, for example, connect work undertaken by Infrastructure NSW with the regional planning processes delivered by the Department of Planning for new housing and population growth. An analysis of cases where CE perspectives have entered settlement planning would be worth undertaking to identify possibilities, success factors, key actors, and possible timeframes for change.

7.1.7 Planning considerations and definition of land uses

A potential obstacle to the delivery of CE-related infrastructure is their permissibility, under planning provisions. Problems may arise due to these facilities potentially having a mix of agricultural, industrial, business, community, and educational uses. To facilitate the delivery of CE enabling infrastructure, NSW Circular can assess the viability of developing or helping to speed the implementation of the following strategies:

1. Identify specific precincts where CE hubs and CE precincts can be developed and incorporate them in the State Environmental Planning Policy (Activation Precincts); and/or
2. Clearly define relevant CE land uses and incorporate them into the Standard Instrument—Principal Local Environmental Plan. This move will allow these definitions to be incorporated into the Local Environmental Plans of all Councils in the State and allow them, in conjunction with their community, to identify appropriate localities for these activities. For example, terms like ‘circular economy uses’, ‘circular economy enabling infrastructure’, and ‘circular economy hub’ have been used in the Western Sydney Aerotropolis Plan. These definitions may serve as a starting point for describing the

desired collection of activities using standard terminology, which is essential to ensure that delivery is consistent and that facilities are located in appropriate land use zones.

This process, of defining land use terms, may result in a distinction being made between organic CE hubs and inorganic CE hubs, with the former permissible in rural zones and the latter in industrial or business zones. The Lochiel Park case study points to the potential for new housing estates to incorporate CE enabling infrastructure for organic materials and water management and the Circular Economy Villages pilot project shows how such development could also integrate a regenerative agricultural system. The Clean Cowra case study offers an example of more intensive management of organic material. In defining terms, a distinction may also be made between CE hubs (such as sites hosting waste-to-resource micro-factories) and eco-industrial parks that include more traditional industries connected by CE enabling infrastructure.

The challenge with all of these definitions will be to ensure that they are not so specific that they stifle innovation and the development of creative solutions. The key point is to assess how definitions of land uses can be reconsidered to enable more circular development.

7.1.8 Soft Infrastructure and governance systems

A critical barrier to agreement on construction of circular infrastructure within a precinct is the plethora of stakeholders who can have competing and at times conflicting agendas—individual property owners, various levels of government and their different departments, local councils, the various utility providers, and many others. This challenge applies not just to the construction phase but also post construction, during the operation of a range of integrated and interdependent facilities within the precinct.

Experience in the Special Activation Precincts suggests that the business case for CE precinct infrastructure needs to carefully consider investment in 'soft infrastructure' that creates capacity, connection, collaboration opportunities and community amongst participants. The focus on the built environment and investment in hard infrastructure alone will not bring to fruition the intended outcomes without investment in shared governance systems and ecosystem facilitation. This investment needs to begin at the earliest stages, so that once the hard infrastructure has been delivered, participants are in a position to utilise it to its best capacity.

This soft infrastructure can include the development of mechanisms to assure an optimum land-use mix to support industrial symbiosis. These mechanisms would be designed to attract the appropriate mix of activities into a CE precinct. It can also provide governance mechanisms for ensuring that businesses in the precinct collaborate on an ongoing basis in the collective management of resource flows.

A variation on this approach for new development precincts is for them to be developed, owned and operated by a single entity. This coordinating body could ensure that the land and CE infrastructure is owned, in perpetuity, by a single entity. Numerous business activities could then operate within such precincts, but the ownership structure should provide for

them to be shareholders of an entity that manages the precinct holistically. This approach is the ownership structure proposed for Build-to-rent precincts, retirement villages and proposed Circular Economy Villages.

The recommendation here is to characterise options for suitable soft infrastructure – organisational mechanisms – for CE orientated precincts and infrastructure.

7.1.9 Tax settings

NSW Circular has undertaken a separate review that is considering tax settings and broader fiscal policies. The investigation conducted for this study leads to a suggestion that it may be appropriate and useful to explore opportunities for the modification of tax settings to:

1. Incentivise the incorporation of CE infrastructure in precinct-scale industrial developments.
2. Incentivise the incorporation of CE infrastructure in greenfield and brownfield housing developments. This action may be more readily applicable in Housing-as-a-Service developments that are operated post-construction as a single precinct. Examples include retirement villages, seniors housing, build-to-rent, co-living, student housing and hotel resorts.

7.1.10 Metrics, data and modelling

Creating a strong business case and delivering positive outcomes requires sound financial analysis to identify optimal resource flows. This analysis would need to be underpinned by quantified circular economy metrics for the Australian context.

It is noted that progress in digital model development including digital twins and integrated models of industrial networks is paving the way for business decision making. These digital technologies offer visualisation of data and spatial-temporal representation of precincts and infrastructure. This capacity enables analysis, monitoring and reporting capabilities to be exploited for scenario assessments with a focus on circular economy metrics and benchmarks.

It is recommended that NSW Circular engage with NSW government departments and agencies, such as Regional Growth NSW Development Corporation, to assess the extent to which business case processes, particularly for the Special Activation Precincts, can practically include CE metrics and exploit modelling capabilities that enhance decisions making.

7.2 Summary of Recommendations

The following list summarises the recommendations emerging from the analysis conducted in this review. Feedback suggests that some of these initiatives may already be under way in the NSW government. The NSW government's business case processes provide a lot of 'touch points' - opportunities for consideration of the circular economy in precinct and infrastructure development – from preliminary generation of options to detailed assessments of the potential return on investment. This range of touch points means that the recommendations here are varied.

Additionally, recommendations are phrased in terms of what deserves greater investigation, characterisation of case studies, and assessment of what stakeholders think and see as viable. That is because this rapid review was not intended to be sufficiently in depth and extensive to land on specific recommendations for policy and practice. Given this caveat, an array of opportunities listed below should be investigated to bolster the CE:

1. **Education about the Circular Economy:** Characterise the content, methods, and reach of education programmes that could advance the understanding of the circular economy and identify the mechanisms required for the implementation of such educational initiatives.
2. **Settlement planning:** Explore how one could apply a Circular Economy lens to a state-wide settlement planning processes that connect work undertaken by Infrastructure NSW with the regional planning processes delivered by the Department of Planning for new housing and population growth.
3. **Indigenous perspectives:** Explore the resonances that circular economy principles and practices have with certain Indigenous perspectives on place, the environment, and communities. Explore opportunities for regulatory synergy - between Indigenous concerns, needs and aspirations; environmental and waste management plans; and economic and place development strategies.
4. **Impacts of digital transformation:** Undertake a study to assess the various ways in which the digital transformation of the economy and digital modelling platforms can and will influence CE practices.
5. **Networks of small-scale facilities versus large, centralised facilities.** Assess the extent to which the current business case processes favour large, centralised facilities versus networks of small-scale facilities, such as by neglecting the transport costs for materials over the entire life of the facility. Consider what elements can be added to the assessment processes to capture cost savings and education opportunities of incorporating small facilities in existing local council buildings, as well as the opportunity of bulk purchases for capital equipment by numerous councils. Consider how to include the value, practicality and methods for connecting these facilities with maker spaces and innovation hubs where waste material can be converted into new

products using 3D printing technologies. This process could be applied to bio-energy technologies for organics and to waste-to-resource micro-factories for inorganics.

6. **Business cases for water-cycle infrastructure in residential precincts:** Undertake a study to identify how NSW government business case processes can address incorporating water cycle management within a residential development precinct.
7. **Enable projects incorporating an ecosystem of precinct-scale infrastructure:** Work with the Department of Planning to assess the CE and economic development potential for projects already underway in NSW that can, or are already scheduled to, incorporate an ecosystem of precinct-scale infrastructure.
8. **Identify means to support demonstration projects:** Identify an array of ways to support the development of pilot projects that seek to demonstrate circular economy infrastructure in practice, drawing on domestic and overseas examples.
9. **Circular design of Special Activation Precincts:** Explore the potential for organisations, such as NSW Circular and the experts on its task forces, to play active roles in contributing to the design of precincts that have already been identified, or in recommending the inclusion of additional precincts in the SEPP (Activation Precincts).
10. **Circular Economy objectives and principles in planning documents:** Work with the Department of Planning to assess the viability and potential long-term return on investment of having all new development precincts incorporate CE objectives, vision statements and principles in their strategic documents.
11. **Define Circular Economy land uses:** Explore with the Department of Planning the feasibility and potential impact of defining land use terms that enable the delivery of CE activities and infrastructure. These terms may include 'circular economy hub', 'circular economy precinct', 'circular economy enabling infrastructure' and 'circular economy villages'.
12. **Land use definitions in planning instruments:** Assess the viability and desirability in the eyes of different stakeholder groups for the inclusion of Circular Economy land use definitions in planning instruments that would apply across the State by incorporating them in the Standard Instrument. This instrument includes the glossary of all land use definitions and ensures that they are incorporated into the Local Environmental Plans of all Councils in the State.
13. **Soft Infrastructure and governance systems:** Undertake further studies to explore mechanisms for incorporating 'soft infrastructure' that creates capacity, connection, collaboration opportunities and community amongst participants. This functionality should include systems and leverage digital technologies for attracting the appropriate mix of activities into a CE precinct and governance mechanisms for

ensuring that participants collaborate on an ongoing basis in the collective management of resource flows.

14. **Support build-to-rent with Circular Economy Infrastructure:** Explore strategies employed domestically and overseas to support the growth of the emerging build-to-rent industry and assess the viability for the inclusion of precinct-scale CE infrastructure within them.
15. **Circular Economy Infrastructure in precinct developments:** Analyse the value and practicality of the inclusion of CE infrastructure, particularly related to food, water and energy flows within precinct scale developments, such as retirement villages, seniors housing, build-to-rent, co-living, student housing and hotel resorts.
16. **Develop metrics to inform CE investment decisions:** NSW Circular should engage with NSW Government agencies, such as Regional Growth NSW Development Corporation, to assess the extent to which the business case process in the SAP program can practically include CE metrics, with CE as a primary objective of the infrastructure investment, and bolster digital capabilities, e.g., industrial symbiosis precinct digital models/platforms.
17. **Tax settings to incentivise precinct-scale CE infrastructure.** Explore opportunities for the modification of tax settings to incentivise the incorporation of CE infrastructure in precinct-scale industrial developments as well as new housing developments.

Appendix

Initial observations on current knowledge about circularity in business cases for infrastructure and precinct development

Circularity is still marginal in planning - The circular economy garners supportive discussion in Infrastructure Australia's *2021 Master Plan*, but under the heading of 'waste' in the last content-focused chapter of the long report. The chapter mentions that the government should make the business case for CE to industry, that chapter's only mention of a business case. So, one can see IA as supportive in this large investment arena but not necessarily leading in making CE consider 'business as usual' for the infrastructure sector.

A challenge even in the most sustainability oriented companies - The need to normalise CE elements in business cases is echoed in the opening pages of WBCSD's *8 Business Cases for the Circular Economy*, where it states, "Even some of the most revered corporate sustainability companies face challenges in understanding what the circular economy is, its implications for their business and which methods to use for identifying the business case."

Experience with Parkes SAP - Two years ago, the NSW Department of Planning led a design workshop to draft a masterplan for a SAP in Parkes. Such planning activity was informed by technical investigations and expert industry knowledge, including one of the researchers in this rapid review study. Prof Abbas noted that CE principles were absent from those planning considerations, and he stressed the need to embed CE principles in the SAP design and development, including environmental design.

Shifting attitudes to CE in relation to Hunter precincts - This situation was also evident in practice in 2019-2020 in analysis of the SAP for the aerospace development near the Williamstown air base, home to Australia's F-35 Joint Strike Fighters. Consultants from a major firm conducted a series of interviews (including one of our team members) and tacked a circular economy section onto their report. There has subsequently been a more focused analysis on circularity opportunities for this SAP contracted for from Edge Environment. This initial marginalisation of CE considerations was also evident in 2018, when circular economy was not mentioned by NSW Health Infrastructure or the researchers in early analysis of potential economic effects on the region of the \$700m redevelopment of the John Hunter Hospital (which a team member's centre conducted).

Early days - These observations suggest that circularity elements have begun to enter SAP assessments. However, circularity has yet to be addressed from conception through to implementation, that is according to a recent presentation by Alison Rowe of the Infrastructure Sustainability Council. That indicates a need not just to identify suitable models for business case assessment but also a need to harvest information to spur adoption. That would include insights from relevant case studies, as provided in this report,

as well as identification, characterisation and cultivation of target audiences of decision-makers who can be engaged and informed.

Recent interviews highlight aspects of 'early adopters' - Interviews in August 2021 of a dozen senior managers and sustainability staff in mining, manufacturing, consultancy and local government, who already had a positive disposition toward the circular economy, suggest that these 'early adopters' have a longstanding orientation toward reducing waste. That orientation seems to reflect a combination of personal values, personal interests and business rationale.

Literature review – These initial insights – from before undertaking this study - have now been expanded on in this report. That has been through review of academic and grey literature on executive perspectives toward a range of environmental challenges and opportunities, from renewable energy to climate change and then assessing how these insights might apply to executives making decisions about the circular economy and its related supply chain choices.

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