Circular Australia

Four Steps to place-based circular economy in Australia

Circular Precincts Guide

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aurecon

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Acknowledgement to Aboriginal people

We acknowledge the traditional custodians of Country and pay our respects to Elders past, present, and emerging. We recognise that our built environment and activities are on Aboriginal land and commit ourselves to thoughtful, inclusive, and respectful ongoing management of these places.

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Making circular economy actionable and scalable in precincts

Circular precincts create physical spaces for new businesses to leverage sustainable infrastructure - like renewable energy systems, waste management facilities, recycling, repair, remanufacturing and reuse solutions, low-carbon transport, and green spaces.

They stimulate economic growth, creating jobs, new sustainable products and services, all while supporting liveable and sustainable communities.

Experience has shown there are a number of important steps to consider in order to create a successful and thriving circular economy precinct.

Kwinana Western Australia.

Circular Economy Defined & Applied

Circular Economy

The circular economy is a systems transition across the entire economy. Countries around the world including Australia and G20 Members are embracing circular economy to design out waste and pollution, extract maximum value from resources, regenerate natural systems and reduce carbon emissions.

When we describe our current economy we 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. Circular precincts are physical spaces to share resources and tools, innovate, and stimulate economic growth, which creates jobs and enables liveable communities.

Definition:
Circular economy is a framework that promotes sustainable and efficient use of resources by:

1. **Designing out waste and pollution from materials and products**
2. **Retaining assets, products and materials at their highest value**
3. **Conserving natural resources and regenerating nature**

Circular Precincts

A circular economy precinct aims to keep assets and materials at their highest value, locally. Clusters of activity in the precinct act as engines to close waste and material ‘loops’, while providing a fertile ground for implementing, demonstrating and replicating innovative circular solutions. In applying the circular economy framework to precincts and place-based planning it is important to remember to:

- **Position the precinct within the broader ecosystem**
- **Foster exchanging knowledge, testing concepts and building trust**
- **Deeply understand local context - First Nations, community, economy, resources, nature**

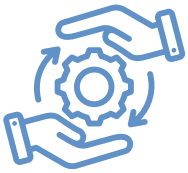
The Four Steps

These four-steps will guide your organisation to activate circular economy outcomes in both existing and future precincts.

STEP 1

Engage & Explore

Bring stakeholders onboard early to understand the system, shape the vision and build long lasting capability and trust.



STEP 2

Design & Deliver

Establish hard infrastructure that allows for sharing of resources and regeneration of natural ecosystems.

STEP 3

Attract & Activate

Create an environment that attracts investments and enables synergies across the community, businesses and nature.

STEP 4

Monitor & Manage

Collect data and insights to measure progress, performance, outcomes, share successes and learnings, and effectively manage and adapt operations.

Step 1: Engage & Explore

Establish your precinct for the Circular Economy

Successfully developing a circular precinct relies on understanding the context of the place and its people, exploring how it will fit into the broader system, considering existing policy, industry and environmental opportunities and constraints. This scoping phase involves building a connection to people and the land, mapping current needs and conditions and responsively, co-designing precinct scale, vision and objectives with stakeholders.

Barriers include:

- Limited awareness and understanding of circular economy among stakeholders
- Silos across governments and industries
- Challenges in building relationships and collaboration between stakeholders
- Lack of engagement, awareness, and participation from stakeholders due to cultural barriers and dominant narratives
- Challenges in overcoming vested interests, political hurdles, and traditional ways of operating in sectors and industries
- Lack of consideration for all inputs and outputs in the design processes, leading to flaws and potential problems later on
- Challenges in navigating regulatory frameworks and obtaining approvals for circular initiatives
- Overemphasis on growth models and a lack of recognition for the importance of circularity in achieving sustainable outcomes
- Need for clearer economic cases and incentives to drive circularity at various scales, from local to regional and national levels

Overcoming those challenges means to:

- **Understand people & place**
- **Co-create the vision & guiding principles**
- **Build networks, capacity & trust**

“There are silos present across governments and industries. In a circular precinct, all of those must be talking to each other.”

Sandra Qian, Infrastructure Australia

STEP 1. ENGAGE & EXPLORE

Understand people & place

Mobilising and mapping the ecosystem

Stakeholder engagement at an early stage of the circular journey will ensure that diverse ideas, options, and views are considered. It increases acceptance and buy-in for proposed changes, establishing a firm foundation for cooperation and collaboration in the design, delivery, activation and management of the precinct.

Create a stakeholder map or matrix to visualise the relationships between stakeholders and the project or organisation. Stakeholder mapping can be done using a variety of formats, such as an ecosystems map, power/interest matrix or an influence/impact matrix. This helps identify different stakeholder groups and their level of influence, interest, or impact on the project.

Impact or influence of key stakeholder groups will shift across the lifecycle of a precinct. Consider the below table, and how it looks the same or different in your context.

Stakeholder engagement heat map and involvement in circular precinct lifecycle

	Engage Explore	Design Deliver	Attract Activate	Measure Manage
First Nation peoples custodians of the land	High	High	High	Med
Land owners (private/public)	High	High	High	Med
Citizens/Users Workers, parents and children, older persons, students, etc.	High	Med	High	Med
Government Local and/or state governments, regional authorities	High	High	High	Med
Utility providers Water authorities, energy providers	Low	High	Med	High
Business and industry	High	Med	High	High
Infrastructure developers	Low	High	Low	Low
Investors	High	High	Med	Low
Research organisations	Low	Med	High	Med

STEP 1. ENGAGE & EXPLORE

Co-create the vision

A clear vision, concrete objectives, guiding principles and targets

Setting a clear vision with concrete objectives, targets and guiding principles across environmental, social and economic pillars should be co-designed with core stakeholder groups in line with the key opportunities, challenges and problems uncovered to date.

The vision will drive further strategic planning, design and implementation, tailored to the precinct's unique characteristics.

Guiding principles will be developed to translate the vision and enable effective decision making across the precinct lifecycle.

Examples of guiding principles:

- Use less
- Use longer
- Use again

CASE STUDY

Bega Circular Valley 2030 was launched in November 2023 with a two-day event featuring a circularity expo at the Bega Commemorative Civic Centre, attended by hundreds of people to showcase circular initiatives from local businesses and community groups. The event included a dinner and panel discussion on circular economy challenges and opportunities, and launched the National Centre for Circularity in North Bega.
Aiming to connect regenerative economic and environmental development with social equity across the region while achieving efficient water and energy use, the programme is driven by a community-owned co-operative. The cooperative will deliver circular projects, invest in critical infrastructure and community initiatives, and seek global leadership in product areas. A diverse array of stakeholders such as SMEs, innovators, researchers, indigenous leaders, social ventures, NGOs, governments, investors and philanthropists are being engaged to implement nine enabling projects that will foster a vibrant regional circular economy.

"Our goal is to create a legacy for the future generations of the Bega Valley, and be an example for other regions to follow as the most circular Valley in Australia."

Barry Irvin AM – Bega Group Executive Chairman

Bega Circular Valley

STEP 1. ENGAGE & EXPLORE

Build networks, capacity & trust

Circular precincts may be a new concept for many stakeholders

Circular precincts require a different mindset and way of designing, delivering and managing the place. Creating shared language and understanding while building capacity will be important. Circular precincts rely on coordination across value chains to circulate and share resources and assets. It is crucial that organisations operating in circular precincts trust other partners and are willing to share knowledge and resources. To establish this environment, the circular precinct can:

Build awareness and new skills Offering in-context practical training increases the understanding of what circularity is, how to collaborate and what tools and ways of working to use in order to solve problems differently, integrating circular economy and placed-based key principles and business models.

Create spaces for relationship building Physical and virtual networking events allow for connections to be made and ideas to be shared, supporting the early stages of building a circular community. These forums can provide the right environment for partnerships and trust to be built.

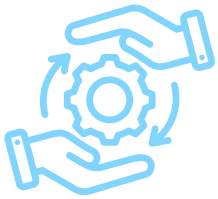
Incentivise knowledge sharing The governing authority can establish financial and/or legal incentives to normalise and create a low-risk environment to share information across the value chain.

Co-locate entrepreneurs Co-working spaces and living labs are experimental spaces, providing a testing ground for new solutions and businesses. Operating alongside each other also facilitates material exchange across the value chain and allows for tools and infrastructure to be shared.

Government attracting and facilitating partnerships between like-minded collaborations Governing bodies are well-positioned to provide the relevant enabling conditions (such as planning approval or funding mechanisms) to attract businesses and industries with potential for circular synergies to establish clusters, based on principles of industrial symbiosis.

> **"The systems are not going to work unless we have an engaged community. This is an organic process. We need to support social cohesion and connect the community to this place where they will work, live and visit."**
>
> Lucy Sharman, Bradfield Delivery Authority

Step 2: Design & Deliver



Designing and delivering your circular precinct

Circular design strategies, procurement processes, innovative construction methods, integrated utilities, and digital-enabled infrastructure are crucial elements in achieving sustainable and future-proof precincts.

Barriers include:

- Insufficient flexibility within environmental approval codes to manage waste differently
- Limited education on circular economy concepts for stakeholders, particularly in the procurement space
- Challenges in transitioning established urban and infrastructure frameworks to support circularity
- Lack of specific clauses and regulations around circularity in procurement and waste management processes
- Challenges in demonstrating the commercial reality and market viability of sustainable and circular practices
- Difficulty in changing established urban spaces and infrastructure to support circularity
- Lack of set standards for circular economy practices in certain environments, such as hospitals
- Need for guidelines and benchmarks that promote circularity in design and construction processes
- Technical challenges and opportunities in adopting new technologies for sustainable construction

To overcome challenges adopt:

- **Circular design strategies**
- **Procurement processes**
- **Innovative construction approaches**
- **Integrated approach to utilities**
- **Digital-enabled infrastructure**

“There are barriers around product availability and market development. You have either one or the other, and it can be frustrating.”

Helen McGettigan, Infrastructure Western Australia

STEP 2. DESIGN & DELIVER

Circular design strategies

Design out waste and pollution

Design plays a critical role in reducing environmental impact. Adopting circular design strategies will help deliver on the vision for the precinct and shape the procurement, delivery and operations of the infrastructure and assets. The NSW Government released in February 2023, 13 circular design strategies for the built environment, forming a valuable guide for any place-based projects in Australia.

The key strategies to consider include:

Reuse of existing assets/materials Reduce the need for new resources.

Design for longevity Create durable infrastructure/products to reduce waste and increase sustainability.

Design for flexibility and adaptability Acommodate for future changes to extend the lifespan of infrastructure/products.

Design to maximise materials circularity Enable easy disassembly and separation for better reuse/recycling.

Design for materials efficiency Minimise material use without compromising performance.

Design for best practice waste management Include efficient waste separation, recycling, and reduction during operation.

Incorporating green infrastructure Enhance biodiversity, manages water, improves air quality, and offers ecological/social benefits.

An important strategy to ensure upfront is:

Design with Country integrating First Nations Design a culturally responsive place in line with culture, stories and natural characteristics.

> **"We've embedded those principles in our masterplan and its influenced the way we've designed our infrastructure networks and how we've set aside areas for different land uses and regeneration... We've identified 'no go' areas to regenerate - increase the overall biodiversity."**
>
> Azaria Dobson,
> Department of Regional NSW

STEP 2. DESIGN & DELIVER

Procurement processes

Use your purchasing power

The procurement process needs to align with the circular designs from the definition of the objectives, scope and requirements to the evaluation criteria and contract management. By incorporating these activities into the procurement processes, you can maximise circularity and contribute towards sustainable and circular infrastructure development.

Supplier Engagement Engage with suppliers who prioritise circularity by assessing their commitment towards sustainable and circular practices. Look for suppliers who offer products or services with a focus on recyclability, reusability, and responsible sourcing.

Material Choice Adapt material/product selection approach based on application and required performance considering options such as low-impact, recycled content, designed for disassembly, and/or clear end-of-life use. This can be informed by lifecycle assessment.

Supplier Collaboration Collaborate with suppliers to explore opportunities for circular economy initiatives. Encourage suppliers to take back products at their end-of-life for proper recycling or refurbishment. Explore options for shared ownership or leasing models for infrastructure assets to extend their lifespan.

Performance Metrics Define performance metrics and evaluation criteria that consider circularity aspects. Evaluate suppliers based on their contribution to circularity, such as the percentage of recycled content in products, carbon footprint reduction, or adherence to circular design principles.

Waste Management Implement effective waste management practices throughout the procurement process. Incorporate requirements for responsible waste disposal, sorting, and recycling of construction and demolition waste.

Stakeholder Engagement Involve relevant stakeholders, such as designers, contractors, and end-users, in the procurement process. Seek their input and expertise to ensure circularity principles are integrated into the infrastructure design, construction, and operation.

CASE STUDY

The Arden Precinct in Melbourne is a prime example of circular procurement in action. This 44.6-hectare development aims to be a zero-waste, net-zero carbon emissions precinct by 2040, powered entirely by renewable energy. It will support 34,000 jobs and house 15,000 residents, integrating sustainable urban renewal principles from the outset. The project highlights how circular economy strategies can drive significant environmental and community benefits. Locally sourced, recycled, and low-impact materials are prioritised and the precinct has partnered with suppliers committed to sustainable practices, significantly reducing waste and carbon emissions throughout the construction process.

STEP 2. DESIGN & DELIVER

Innovative construction

Circular construction opportunities

Where possible, project owners should look at innovative construction approaches which reduce time, cost, carbon emissions and waste, and optimise the use of materials. Modern Methods of Construction (MMC) as an example, focus on off-site construction techniques, in a controlled environment, and provide a fast and effective way to delivering new assets by maximising the efficiencies of materials and labour. These methods are well aligned with circular design strategies and include 5 key techniques:

Offsite Construction/Prefabrication involves manufacturing and/or assembling building components, such as walls, floors and roofs, in a factory or workshop. These components are then transported to the construction site for assembly, resulting in faster construction timelines.

Modular Construction extends the benefits of prefabrication by maximising repeatable componentry and design elements. In addition to the fast construction timelines and waste reduction, leaning into modularity increases the ability to reconfigure and adapt the building, or even deconstruct and reassemble elsewhere.

Sustainable Construction focuses on using environmentally friendly materials and practices to reduce the carbon footprint of construction projects. It involves using renewable materials, energy-efficient technologies, and sustainable construction methods.

Digital Construction refers to the use of digital technologies and tools, such as Building Information Modelling (BIM) and Computer-aided design (CAD), to create virtual models of buildings and systems, allowing for better planning, design, coordination and communication throughout the construction process.

Innovative Materials and Technologies encompasses the use of new and advanced building materials, such as cross-laminated timber (CLT), engineered glulam timber (GLT), insulated concrete forms (ICFs), and high-performance glass. These materials offer improved energy efficiency, durability, and sustainability in construction projects.

CASE STUDIES

XFrame, an innovative modular construction company operating in Australia, transforms traditional building practices by focusing on efficiency, sustainability, and adaptability. By producing building modules in a factory and assembling them on-site, they drastically cut down construction timelines, reduce material waste, and lower costs. Their approach has delivered a new school in Sydney, completed under budget and in half the time, highlighting the potential of rapid, eco-friendly, cost-effective modular construction.

Allmould Plastics & St Vincents Hospital Project Circular Australia and UNSW led this hospital plastics project which diverted used ampules and needle caps from St Vincents hospital from landfill to turn them into wind farm components and roller door wheels at Allmould, a plastics remanufacturing business, in regional Orange, NSW.

STEP 2. DESIGN & DELIVER

Integrated utilities

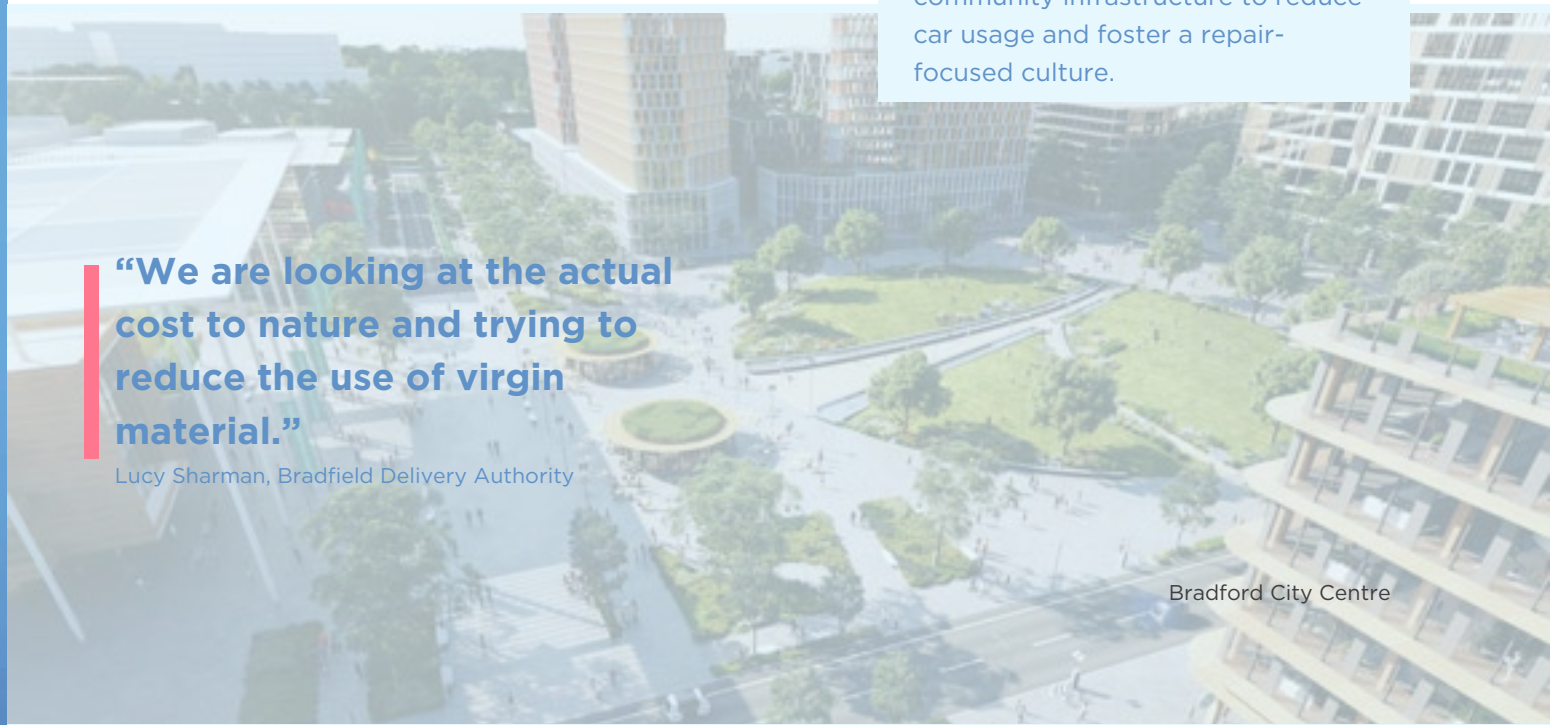
Decentralised circular utilities/ mobility

By implementing integrated systems for energy (including heating and cooling), water supply, and waste management, the precinct can enhance resource efficiency. This can include:

- Shared production and storage of renewable energy
- Strategically located industries sharing heating and cooling
- Low-carbon transport options, such as walking, cycling, and public transport
- Energy-efficient building design, optimising energy-efficient heating and cooling strategies (e.g. through shading, natural ventilation, insulation)
- Localised food systems and organics waste reuse
- 'Fit-for-purpose' water treatment, matching the quality of water to its intended use. For example, drinkable water in taps, recycled water for toilets, storm water capture for irrigation.

CASE STUDY

Bradfield City Centre, the 114-hectare government-owned site south of a new 24-hour airport, has been designed as Australia's premier hub for advanced and emerging industries, focusing on future economies, innovation, education and skills. It will generate 20,000 direct jobs, has a metro train station, and will create 10,000 new Western Sydney homes. The NSW Government has invested in critical infrastructure, enabling a multi-utility servicing project that integrates water, energy, and waste management across the entire city. Decentralised and local utility solutions include a block-level food waste collection, using predictive modelling of future waste volumes, and connecting to the nearby Sydney Water advanced treatment plant. The city's design promotes a sharing economy with shared transport, repair shops, and community infrastructure to reduce car usage and foster a repair-focused culture.



"We are looking at the actual cost to nature and trying to reduce the use of virgin material."

Lucy Sharman, Bradfield Delivery Authority

Bradford City Centre

STEP 2. DESIGN & DELIVER

Digital-enabled infrastructure

From AI to digital passports

Digital technologies have enormous potential to accelerate the shift to a circular economy as they play a valuable role in connecting entities open to circular collaboration. Digital-enabled infrastructure is key to the Measure & Manage step as it supports collaboration, fosters community engagement and participation in sustainability initiatives, as well as enabling predictive maintenance of infrastructure, reducing downtime and enhancing operational efficiency. This can include:

Digital Twins are dynamic and interconnected digital representations of a physical asset or system. They enable monitoring and optimisation in real-time, helping to pinpoint inefficiencies and areas of improvement, predictive maintenance, resource tracking and better end-of-life reuse/recovery.

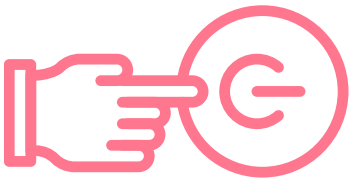
Artificial Intelligence (AI) enables fast processing of vast quantities of data to unlock new insights on how we use assets, products and materials in a precinct. It can support reverse logistics, for example, by helping businesses process product, consumer and market data to improve supply and demand instability.

Internet of Things (IoT) refers to the communication and exchange of data between individual products or parts of products via the internet. IoT can be used to monitor key infrastructure to identify preventive maintenance requirements, prolonging their lifespan and conserving resources.

Robotics & Automation enable precise, repeatable and consistent movements with minimal human intervention. They can help make high value material recycling viable by streamlining sorting systems adn support rapid prototyping for innovative manufacturing.

Digital Passports hold and transfer comprehensive details about products, including material composition, manufacturing process, and usage history. If connected to digital twins, they can enable a smooth exchange of information throughout the lifespan of an asset or product and ensure the stability and accessibility of information – facilitating practices such as repair, reuse, recycling, and waste management.

Step 3: Attract & Activate



Building the right ecosystem and enabling outcomes

Building the business case, defining the value proposition and setting up a fit-for-purpose governance will attract finance and users, bringing to life combined social, environmental and economic outcomes.

Barriers include:

- Lack of awareness, education, and incentives for businesses to adopt circular practices
- Limited resources and funding to support circular initiatives
- Difficulty in attracting investment and financing for circular projects, particularly in regional areas
- Lack of structured plans and guidelines for transitioning to circularity in sectors and industries
- Limited coordination, collaboration, and innovation within the building industry
- Limited leadership and framing of the circular economy at national, state, and local levels
- Challenges in balancing commercial interests, regulations, and policies
- Cultural barriers and resistance to change in existing governance systems and decision-making processes
- Complexity and interdependencies in driving circularity, requiring innovative strategies and stakeholder coordination
- Lack of awareness and understanding of the business case and opportunities for circularity in regional economies
- Limited remanufacturing capabilities in Australia, leading to the export of recycled materials
- Accounting rules that do not enable a circular economy by failing to account for the value of maintenance and revaluation

Overcoming those challenges means to:

- **Build a different business case**
- **Establish fit-for-purpose governance**
- **Attract finance**
- **Attract and on-board users**

> **"Accounting rules as they exist, do not enable a circular economy. Challenges persist when planners come in with these concepts without accounting for all the inputs and outputs of a process."**
>
> Helen McGettigan, Infrastructure WA

> **“To create a governance structure that works, you need to manage the ownership arrangements and you know who the stakeholders are to build it up from scratch.”**
>
> Dr Steven Liaros, Cevco

STEP 3. ATTRACT & ACTIVATE

Build a different business case

Build a circular business case

Connecting to place and people and understanding the baseline of material, financial and knowledge flows (from Engage & Explore steps) shape a rich and diverse range of drivers for the precinct. These include reducing environmental footprints, promoting efficiency gains and cost effectiveness, enabling community cohesion, increased resilience to various types of risks, providing better access to finance and technical support, creating/ maintaining jobs and capability, and enhancing competitiveness.

The business case will therefore need to account for benefits to be achieved across various time and physical scales, and through multiple stakeholders working collaboratively.

As an example, Infrastructure NSW has recently released a framework to decarbonise infrastructure delivery which includes upfront carbon reduction ambitions from the business case stage. Circular precinct business cases need a similar approach which defines from the start, holistically, the type of environmental, social and economic outcomes that need to be demonstrated.

This will then be cascaded across the entire lifecycle. The value proposition is, as a result, richer and more comprehensive.

ADAPTING BUSINESS CASES

Research by Circular Australia found proponents delivering precincts operate within a framework established by government regulation and fiscal policy which are not enabling circularity.

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 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.

"Infrastructure Australia business cases are not just looking at the economics they are also looking at environmental, social and cultural values."

Natasha Ashford, NT Government

STEP 3. ATTRACT & ACTIVATE

Fit-for-purpose governance

Clear governance and leadership

Circular precincts are transformational undertakings. To be successful, they require strong leadership and an enabling environment that welcomes circular technologies, behaviours, and ideas. A clear governance framework and dedicated governing body will guide strategic decision-making and establish oversight, to set and deliver on a precinct's circularity goals.

It is essential in:

- Garnering political support
- Setting objectives, scope and level of ambition
- Coordinating action, including through the development of policies and procedures that manage risk, establish circular procurement practices, ensure ethical conduct, and comply with legal and regulatory requirements
- Where necessary, challenging the linear status quo and advocating for change (to planning regulations/standards and specifications/laws) to enable circular activities
- Facilitating or conducting monitoring and evaluation processes

"Funded coordinators in regions are the way to kick start place-based circularity, working with government to support businesses."

Ben Fee, RDA Murraylands & Riverland

GOVERNING BODIES

The precincts such as Special Activation Precincts, Bega Valley, Kwinana or Tonsley have one thing in common. From the beginning, they've been governed by a dedicated governing body, either setting a different planning and approval approach, shaping the vision, educating, attracting, activating all relevant stakeholders and/or ensuring the precinct operates efficiently and effectively.

These bodies are focused on delivering a good outcome for the precinct and surrounding communities, often supporting with the transition from one land use or industry specialisation to another.

They play an essential role in setting up the frameworks required for long-term success, attracting the right developers, and articulating the benefits of operating in a circular precinct to the right businesses.

"We established a regional circularity cooperative. It's a not-for-profit, non distributing cooperative, deliberately set up independent to other organisations and certainly independent from corporate entities. Collaboration is at the core."

Andrew Taylor, Bega Group

STEP 3. ATTRACT & ACTIVATE

Attract finance

Finance

With the increase of ESG requirements and the growing importance of sustainable finance, investors are supporting the decarbonisation transition, taking a broader range of environmental and social factors to review and approve projects. Circular economy is still an emerging topic with no clear targets or requirements and is underpinned by the need of system wide change of our economy, where balancing risks and returns is challenging. Educating the finance sector will therefore be important to secure funding.

A place-based approach allows for this systemic change to happen in a controlled environment, providing clearer and less risky conditions for investors to get involved. Project owners should be clearly articulating the vision and value proposition of the circular precinct as well as the innovative economic models that underpins it. The value creation of a circular precinct can be quite different to conventional projects. Therefore, it will be important to justify how the overall precinct and individual components working together deliver financial returns.

Taking investors on the journey from the beginning of the project is essential (as per Explore & Engage) so they understand the circular economy principles, business models, where and how value is being captured and reused. Government intervention also plays a critical role in supporting the earliest stages of the transition as a de-risking exercise to kickstart collaborations and partnerships through:

- Grants, incentives or direct funding enabling partnerships across organisations or the community to conduct investigations, start the transition, and/or enable shared infrastructure, assets and equipment
- Funding for public space/land to provide the enabling conditions required by the stakeholders using and/or operating in the precinct

“Big loans in that space are sometimes as useful as grants. That’s a call for government intervention but that will have a greater impact over time. Running a structured triage feasibility to commercialisation to financing with low-interest loans, if not no-interest loans, for enterprises below a certain level will drive impact.”

Kelly-Anne Saffin, Regional Development Australia Adelaide

“One of our innovation district’s goals is to promote further investment into the district and State through strategic partnerships, infrastructure delivery, business expansion, research funding and venture capital.”

Diane Dixon, State Project Lead, Lot Fourteen

STEP 3. ATTRACT & ACTIVATE

Attract & on-board users

Attract anchor tenants and partners

Similarly, precinct users – particularly key or "anchor tenants", businesses or organisations – need to be brought into the precinct's vision and value proposition. Users need to see the benefits of participating in a circular economy ecosystem, such as access to shared resources, cost savings, business opportunities, and a collaborative community environment.

The governing body will play a critical role in defining the plot allotment, setting expectations and benefits of joining the precinct. These can be captured in a catalogue of services available to users such as shared equipment, resources, green energy services, low-carbon local transportation, reuse of resources, repair services, as well as the ecosystem of organisations it will integrate and co-create synergies with. The benefits from settling in the precinct could be modelled to quantify the anticipated cost efficiencies, reduced emissions and additional economic value.

In parallel, setting clear expectations on the role each user will play in the effective management of the place is equally important so that the circular systems being implemented (behavioural, material and financial) are being effectively adopted and measured. For instance, data and knowledge sharing are prerequisites to ensure effective management of the precinct (see Measure & Manage step).

Contractual arrangements should support circular choices and practices - which can be challenging when benefits and responsibilities are split across multiple parties. Standard leasing, utilities and partnership agreements will need reviewing to cover shared assets, infrastructure or products, exchanges of materials between parties or required behaviours at end-of-life.

CASE STUDY

NSW Special Activation Precincts (SAPs) are led and partially funded by government. Leveraging the UNIDO eco-industrial park framework, SAPs have established streamlined planning and approval processes to cut red tape and provide certainty and confidence to businesses and investors. Investment is provided to address the specific infrastructure needs of the precinct and a dedicated business concierge team is in charge of attracting investment and supporting organisations established in the precinct.

> **"Without some sort of facilitation it's not going to happen. The circular economy and the hub could be that facilitator and that's some of the initial benefits and opportunities that we've been exploring."**
>
> Tim Askew, Hunter Joint Organisation

Step 4: Monitor & Manage

Measuring what matters

As often stated, “we only manage what we measure”. Translating the vision into clear metrics across the lifecycle of the precinct is important to track performance and adjust the course where necessary. Successful precincts have set up a robust, evidence-based, flexible measurement framework.

Major barriers include:

- Difficulty in obtaining data and information on the recycling and reuse of materials, hindering decision-making and transparency
- Limited visibility and knowledge about the recycling and transformation of recycled materials
- Challenges in measuring and benchmarking the amount of waste generated and its destination.
- Need for improved data collection and measurement systems to support decision-making and transparency
- Technological barriers and opportunities in harnessing digital technologies for a circular economy

“The challenge is that everyone is going to measure something that's a bit different... It's going to be really hard to get measurements fully standardised across everyone.”

Azaria Dobson, Department of Regional NSW

Overcoming those challenges means to:

- **Develop a baseline**
- **Set a performance framework**
- **Manage data and analytics**
- **Monitor progress towards precinct vision**
- **Maintain momentum**
- **Commit to continuous improvement**
- **Leverage storytelling**

“From a political perspective, we're still getting measured on things like capital investment value and the amount of jobs created.
That's not really that meaningful in terms of circularity.”

Azaria Dobson, Department of Regional NSW

STEP 4. MEASURE & MANAGE

Develop a baseline

Baseline factors

At the very start of the precinct development, understanding existing conditions is necessary to identify where and how circular solutions will support the precinct and understand the constraints to manage. The baseline factors may differ depending on the precinct's context, but can consider:

- Environmental conditions, considering biodiversity, natural habitats, air and water quality
- Socio-economic factors, including demographic profile, employment patterns, knowledge and skills, social infrastructure and community needs
- Resource flows: materials, energy and water inputs and outputs can be mapped and measured, for example through material flow analysis or waste audits. The broader resource flows at regional, national, and global levels should also be considered to keep the insights in context
- Strategic, policy and stakeholder environment, including land use planning
- Current and emerging industries – including an assessment of their circular potential
- Underutilised assets: stocks of existing assets should be considered, with a view to optimise use of underused buildings, infrastructure, or space
- Mobility and transport network, including measures of walkability and accessibility, and logistics options
- Digital infrastructure, including services and equipment required for the delivery of digital services, such as data processing, cloud computing, asset tracking and material sharing applications

METRICS

Circular Australia & UTS's Circular Economy Metrics identifies more than 30 circular economy metrics for organisations to use including: Carbon savings from recycling; New investment in recycling infrastructure capabilities capacity; Sustainable procurement; Industrial ecology performance; Jobs in reuse, repair, and recycling

Circular Economy ISO Standards

- **59020:** Measuring and assessing circularity performance
- **59010:** Guidance on the transition of business models and value networks
- **59004:** Vocabulary, principles and guidance for implementation

"Measuring the construction use of virgin materials and progressively trying to reduce the amount of virgin materials that comes into the system through imports or Australian resources would have the fastest impact."

Gwyneth Elsum, Sustainability Victoria

"What is a whole economy circularity baselining? It's everything from material flow, carbon, emissions, biodiversity, carbon sequestration, social, such as the community attitude to local food systems and nutrition. All these metrics could underpin a baselining of circularity."

Andrew Taylor, Bega Group

STEP 4. MEASURE & MANAGE

Set a performance framework

Go above and beyond

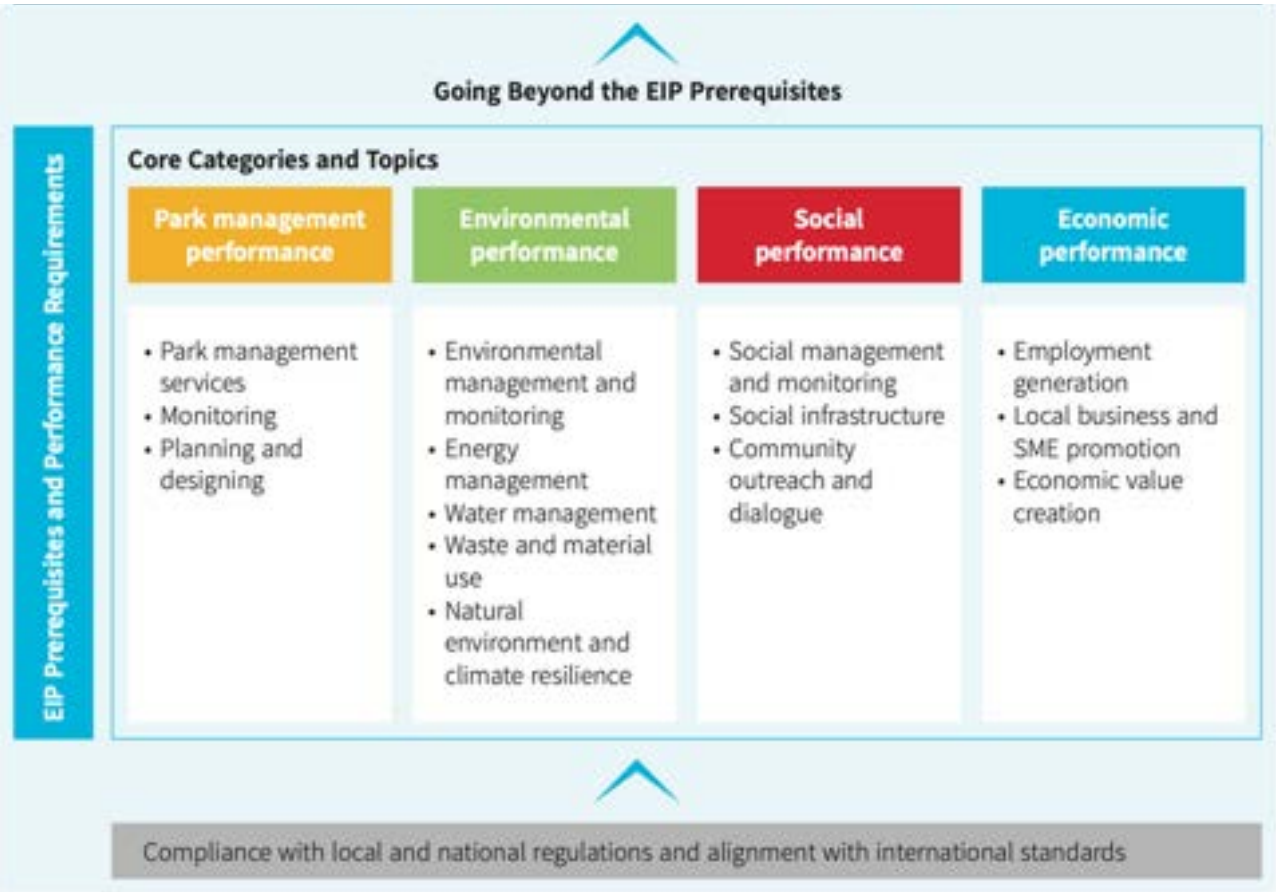
A performance framework should be defined to measure and monitor progress across its lifecycle. The International Framework for Eco-Industrial Parks leading framework as an example, outlines clear requirements for precincts to demonstrate sustainable management of the place, economic, social and environmental outcomes that align with broader ambitious national or industry targets.

An EIP framework helps to manage these risks and maximise sustainable development opportunities.

With the growth of industrial output in developing and emerging economies alike, there is significant scope for EIPs to drive efficiency and contribute positively to socio-economic development at local and national levels.

Mitigating and managing the adverse impacts of industrial parks is crucial. It is increasingly important to maximise sustainable development opportunities, particularly in those economies in which legislation and risk management are weak.

Table: Process of Continuous Improvement Going Beyond EIP Performance Requirements



An international framework for eco-industrial parks v2.0.pdf (unido.org)

STEP 4. MEASURE & MANAGE

Manage data & analytics

Know your performance

Establishing robust data systems is crucial to developing a sound evidence base for decision-making, in accordance with confidentiality and intellectual property rights. New systems may need to be set up to collect, organise and translate the data into actionable insights.

Obtaining data to monitor progress in the circular transition may not be readily accessible. For example, data concerning the origin, nature, volume and mass of different waste streams is essential to devising different strategies. The type and granularity of data collected over time may change, as the precinct evolves or starts to target higher-order circular strategies, for example moving from recycling approaches to repurposing or avoidance.

Nicola Plunkett-Cole, ACT Government says there can be data sets and information that is not utilised but available to map pogress over time: “There is a certain amount of mapping that could be done that actually won't take long.” For example when demolition of a building is approved, there will be data about the type and volume of materials being demolished.

Material Passports

A materials passport is a documentation system that tracks information about materials in a construction project, whether in a digital asset register structure or physical label format. It can include detailed data on the composition, origin, quality, and potential reuse or recycling options of each material component. In a circular precinct, it promotes reuse and recycling, informs sustainable design choices, assists in maintenance planning and enhances resource efficiency.

Material passports also help create market demand for circular materials. By providing transparency and substantiated claims regarding the sustainability and origin of materials, it stimulates the development of a circular construction market. This, in turn, incentivises the recycling and upcycling of materials, fostering an ecosystem that values and promotes circularity.

“Just start doing something and set yourself some targets and goals. Learn from others what they’ve done and what they’ve tried.”

Dr Kendra Wasiluk, Monash

“People don't make decisions unless they've got data, or unless there's a really obvious case for change.”

Azaria Dobson, Department of Regional NSW

STEP 4. MEASURE & MONITOR

Monitor progress towards precinct vision

Understand trends

Key data points are selected to monitor the performance and outcomes of circular initiatives.

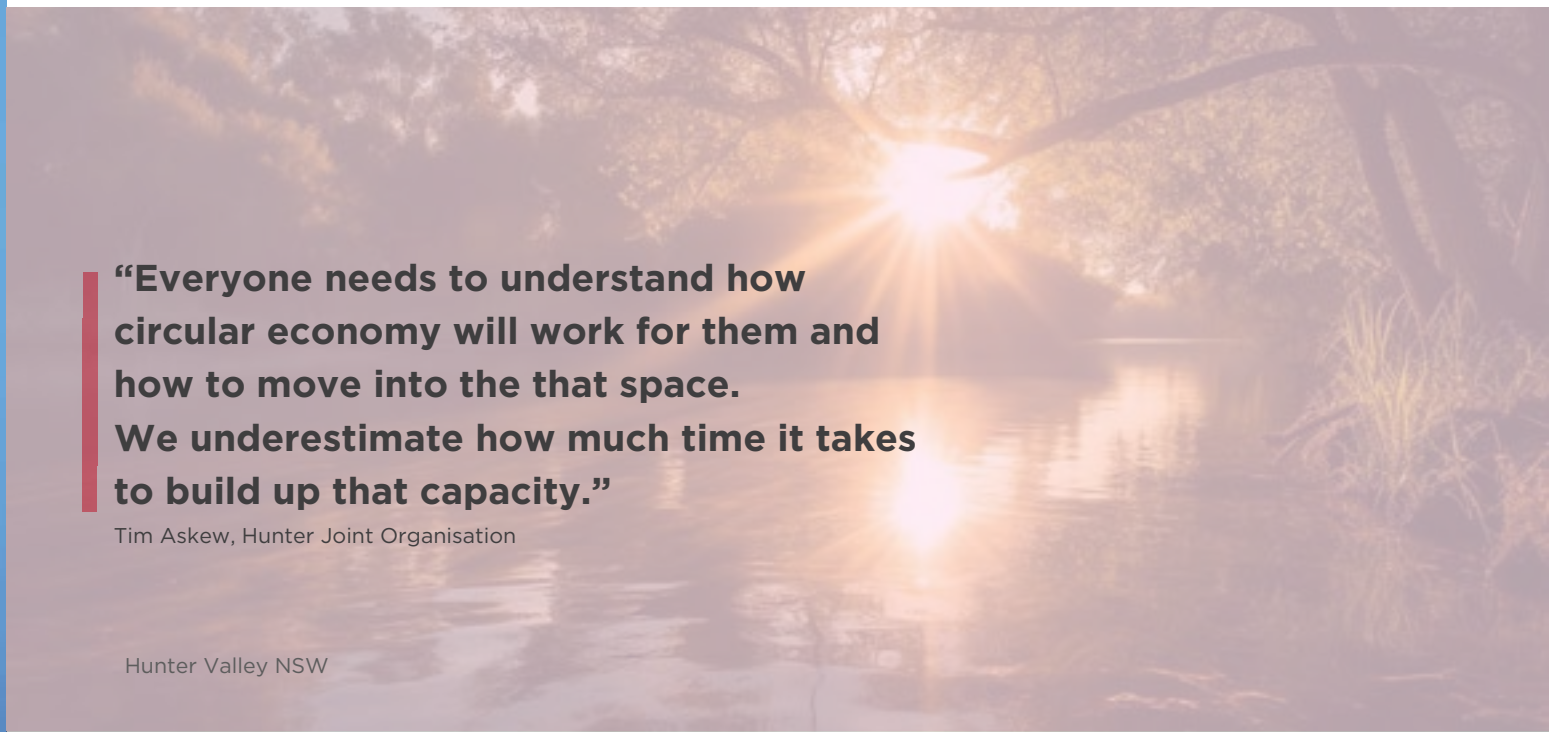
This data is then analysed to gain insights into the progress of the circular transition. Post impact assessments help understand social, economic, and environmental changes, aiding in future planning and fine-tuning of initiatives.

This can require measuring:

- The percentage of virgin material used in products
- Avoidance of virgin resources and how this impacts productivity
- The use of recycled content normalised against the total use of resources, or avoided extraction

CASE STUDY

The Hunter Joint Organisation is implementing circular precincts in the region to unlock $600 million in investment, catalysing the establishment of circular materials processing, renewable energy production, and value-added businesses. This initiative not only diversifies employment opportunities and industries but also positions NSW as a leader in circular economy practices, fostering economic certainty and informing strategic development across the state.



"Everyone needs to understand how circular economy will work for them and how to move into the that space. We underestimate how much time it takes to build up that capacity."

Tim Askew, Hunter Joint Organisation

Hunter Valley NSW

STEP 4. MEASURE & MONITOR

Continuously improve

Maintain momentum across users

Building on the Engage & Explore step, regular engagement needs to continue for the sharing of ideas, concerns, and expertise, ensuring that the development and management of the precinct align with the interests and needs of all those involved. This collaboration helps in shaping sustainable practices, promoting innovation, and addressing any potential challenges. Moreover, engagement encourages a sense of ownership, fostering a deeper connection between stakeholders and the precinct, ultimately resulting in a thriving and resilient circular economy.

Commit to continuous improvement

Embracing an iterative mindset is essential and acknowledges the complexity of systems change. Progress in circular precincts requires ongoing refinement of systems and processes. This involves identifying when actions become ineffective and adapting strategies accordingly. Over time, challenges including varying measurement standards and regulatory barriers will need to be addressed to ensure a smoother circular transition. For example, increased flexibility in environmental approvals and waste management practices is necessary to enable a more effective circular economy. Overcoming these hurdles will necessarily uncover new challenges to be resolved.

> **"Let's measure progress and learn as we go. Use the best available information and science so that we're quickly iterating. It's about where we have to head and how we're tracking along the way."**
>
> Ben Fee, RDA Murraylands & Riverland

> **"Circular Economy is the real opportunity to fast track our thinking about how we measure the regenerative piece. (It's) the link into biodiversity, not just climate change."**
>
> Gwyneth Elsum, Sustainability Victoria

CASE STUDY

Tonsley Innovation District has dramatically transformed from its initial aim of reviving Adelaide's manufacturing sector to becoming a global benchmark for repurposing former industrial sites. Underpinned by circular thinking, it has driven Adelaide's shift to high-value manufacturing, bolstered the state's sovereign capability, and created significant economic impact, now employing around 2,000 people across 150 organisations. The district also hosts 8,500 students annually from Flinders University and TAFE SA, alongside a growing residential community of over 660 people. Tonsley's success is attributed to its strategic focus on four sectors—health, cleantech, automation, and mining services—and continuous improvement efforts, positioning it as a leader in innovation and attracting further investment.

STEP 4. MEASURE & MANAGE

Leverage storytelling

Listen and share your learnings

Learnings from circular precinct initiatives should be disseminated widely to benefit others on similar journeys. This includes sharing success stories, challenges faced, and strategies implemented. By sharing experiences and insights, stakeholders can learn from each other's successes and failures, accelerating the adoption of circular economy principles globally. Effective communication is vital to inform stakeholders and the public about progress and impacts achieved through circular transitions. Strategies like sharing success stories, utilising visual representations, and engaging stakeholders through regular updates help foster involvement and ownership in the circular economy journey.

There is a unique opportunity to also articulate how circularity can support biodiversity and address the challenges of climate change, by connecting the dots between the use of virgin materials, regenerative approaches to land use, manufacturing and consumption practices in precincts.

"You can't unsee circular economy. Once this critical economic framework is introduced, understood and applied by businesses and governments - there's no going back.

Evidence, knowledge, stories of circular journeys need to be shared so we can accelerate Australia's circular transition to 2030."

Lisa McLean, Circular Australia

"Looking at the percentage of virgin material used in products together with the actual cost in nature and waste reduction targets."

Dr Kendra Wasiluk, Monash University

Precinct Types

The following precinct types are leading the circular economy transition:

Industrial ecology or symbiosis precincts

Where intense collaboration between companies in resource or manufacturing (usually colocated in an industrial park) lead to exchanges of materials, energy and water between businesses. These precincts often feature shared infrastructure, such as centralised waste treatment facilities and energy generation plants, to facilitate resource sharing and collaboration among industries. Industrial ecology precincts need a minimum critical mass of industries and material flows to be effective.

- *Examples: Kalundborg in Denmark and Kwinana in Western Australia*

Circular material hubs

Where reuse and recycling businesses are colocated, often with a landfill or waste to energy facility. Circular material hubs provide an ecosystem that supports entrepreneurship, knowledge, technology and resource exchange, driving economic growth and competitiveness. By aggregating material flows these hubs make more types of reuse and recycling economically viable. Close access to landfill or waste-to-energy facilities also helps the viability of many recycling activities, which still have to manage with non-recyclable process waste.

- *Examples: Alelyckan Recycling Park in Gothenburg and Eastern Creek Recycling Ecology Park in Sydney*

Circular communities

Typically involve a mix of residential, commercial and public spaces, along with green infrastructure such as parks, gardens and streets that enable low-carbon transport such as walking and cycling. These precincts can exist at the scale of a neighbourhood or suburb and incorporate circularity approaches through adaptive reuse of built form, regeneration of natural ecosystems, and platforms and business models that enable repairing, sharing and reuse of goods.

- *Examples: Carlsberg Byen in Copenhagen and Yarrabilba in Queensland*

These types of circular precincts can overlap. For example, at Tonsley Innovation Precinct a circular community is developing alongside a leading business precinct featuring shared infrastructure and cutting edge research. Circular precincts can also be hubs of resource consumption and waste generation, such as hospitals or schools, where there is high potential for the adoption of circular principles.

Case Studies

Case studies by precinct type

	Case studies	Industrial Ecology/ Symbiosis Precincts	Circular Materials Hubs	Circular Communities
NSW 1	**Hunter Joint Organisation (HJO)** CE precincts & futures hub (all different based on industry, ecosystem of precincts & enabling hub).			
2	**Special Activation Precincts (SAPs) Wagga & Parkes** Unique masterplanning approach, UNIDO framework, based on local industry, geography sustainability.			
3	**Western Sydney Parkland Authority (WPCA) Bradfield City Centre** Government owned buildings, influence on procurement & design.			
4	**Sydney Water Purified Recycled Water (PRW)** The Discovery Centre to educate, provide technical, regulatory and global information to shift behaviour.			
5	**Bega National Circular Economy Centre** Private sector led with NSW Government funds for a Centre for Circularity for community education, to present evidence and change behaviour.			
SA 6	**Tonsley Innovation District** Industry, innovation, government enabling precinct focusing on health, cleantech and renewable energy.			
7	**University of Adelaide:** Mandated all campus food packaging be 100% compostable. Behaviour change, cross retailers waste focus.			
8	**Royal Adelaide Hospital Problematic Waste** The Royal Adelaide Hospital is one of six South Australian Government Sustainability Precincts driving circular waste outcomes.			
ACT 9	**Molonglo Group: Dairy Road** Adaptive reuse on 14-hectare Canberra industrial site bordering Jerrabomberra Wetlands with community of makers/producers: brewery, coffee roasters, co-working, gallery and industrial design.			
NT 10	**NT & Infrastructure Australia** $440M Regional logistics hubs with terminals, rail sidings and warehousing along the Darwin-Tarcoola rail line, creating jobs, activating new industies including rare earth minerals, solar.			

Case Studies

Case studies by precinct type continued

	Case studies	Industrial Ecology/ Symbiosis Precincts	Circular Materials Hubs	Circular Communities
VIC 11	**Barwon Water Biochar Circular Agriculture Project** Regional Renewable Organics Network - agreements with councils to harvest biosolids from wastewater into biochar.			
12	**Upper Yarra Regeneration and Biodiversity Protection** Yarra Valley Water & Greening Australia regenerating Helmeted Honeyeater and lowland Leadbeater's Possum habitat.			
13	**Monash University Circular Campus** Diverting waste from landfill, waste-free dining experience, circular asset design, repurposing materials, low carbon transport strategy, circular procurement.			
14	**Melbourne Pollinator Corridor** Research-based project to create a connected 8km-long wildlife corridor for native bees and other native pollinators.			
15	**Frasers Property Sustainable Shopping Centre** Burwood Bricks achieved the world's strictest environmentally-friendly certification - The Living Building Challenge™.			
16	**Hazelwynde Development Project** Sustainable mixed use development underpinned by best practice water management by Yarra Water on their land.			
WA 17	**Kwinana Industria Precinct** Industrial precinct, with industrial symbiosis where companies located in the region engage in product and by-product exchanges and innovative collaborations.			
DK 18	**Kalundborg Eco Industrial Park in Denmark** The first full realisation of industrial symbiosis. A model for private planning of eco-industrial parks - established by private sector.			
19	**Marselisborg Water Treatment Plant Denmark** Plant optimises all processes, converts wastewater into green energy, achieves 25% reduction in power and surplus energy forentire water cycle.			
UK 20	**Anglian Water Sewage Treatment for Heat/Food** Closed-loop heat pumps used to transfer waste heat from Anglian Water water recycling centres to the greenhouses to accelerate tomato and plant growth.			

Acknowledgements

Circular Australia Precinct and Infrastructure Taskforce Members

Circular Australia has built a national network of committed experts and organisations working to transition Australia to a circular economy by 2030. Circular Australia's Precinct and Infrastructure Taskforce committed to deliver this research, leveraging the extended network of experts available through its members to build more place-based circular economy projects across Australia. Collaboration and co-design between industry, government and research is the way to create a circular pathway for Australia. The circular economy is a systems transition - not a business or sector can make the transition on its own.

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