Circular Australia

Integrating circular economy climate & biodiversity

Current practices and future directions

MARCH 2025

UTS Institute for Sustainable Futures

Citation

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Citation

Ruoso, L.E.; Retamal, M.; Talwar, S.; McLean, L. (2025) Integrating circular economy, climate change and biodiversity. Current practices and future directions. Prepared by the Institute for Sustainable Futures, University of Technology Sydney and Circular Australia

About the authors

The Institute for Sustainable Futures (ISF) is an interdisciplinary research and consulting organisation at the University of Technology Sydney. ISF has been setting global benchmarks since 1997 in helping businesses, governments, organisations and communities achieve change towards sustainable futures. We utilise a unique combination of skills and perspectives to offer long term sustainable solutions that protect and enhance the environment, human wellbeing and social equity. For more information: www.isf.uts.edu.au.

Circular Australia is an independent, not-for-profit, national peak body working to transition Australia to a circular economy by 2035. For more information www.circularaustralia.com.au

Published in December 2025 by Circular Australia and UTS for Circular Australia's National Circular Economy Council of State government members

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.

Queensland Government

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1. Amplifying benefits with a systems approach

The world is faced with a triple planetary crisis related to climate change, biodiversity depletion, and pollution and waste generation. The UNEP highlights "increasing resource use is the main driver of the triple planetary crisis"[1], with material extraction responsible for 90% of impacts on water and biodiversity[2]. Evidence overwhelmingly demonstrates the dominant linear 'take-make-dispose' economic model contributes to GHG emissions, land-use change, pollution and waste generation fuelling both the climate and biodiversity crises.[1] Taking a systems approach bringing together the powerful agendas of climate, biodiversity protection and circular economy can accelerate the transition to a more sustainable future.

Photo

1 UNEP, "Global Resources Outlook 2024: Bend the trend - Pathways to a liveable planet as resource use spikes," Nairobi, 2024.
2 IRP, Global Resources Outlook 2019: Natural resources for the future we want. Nairobi, Kenya: United Nations Environment Programme, 2020.Ellen MacArthur Foundation, "Completing the picture: How the circular economy tackles climate change," 2021.

2. Introduction

To date, the energy transition has been the focus of efforts to address climate change. However, as resource use and waste challenges emerge, integration of the circular economy and energy transition has become more important than ever. With rising concern for nature and biodiversity, it is critical that policymakers and industry consider these sustainability challenges together and aim to reduce the net demand for virgin materials and energy.

Under the current 'take, make, waste' linear economic model, the amount of wasted materials including critical minerals and resources continues to grow. More than 90% of materials are discarded, lost or unavailable for reuse, putting the Global Circularity Rate (GCR) at a diminishing 7.2%.[1]

The ambition for a circular economy therefore must move beyond a focus just on recycling towards a reduction in absolute resource demand. This needs to occur along with a net reduction in demand for virgin materials and fossil energy.

This report *Integrating Circular Economy, Climate and Biodiversity* builds on the important work of Australian State, Territory and federal Governments in establishing a circular economy. It recommends Australia's circular economy approaches begin to move beyond the development of policies and market incentives for private sector practices and jobs, to now include policies and agendas that prioritise resource sufficiency strategies along with efficiency gains.

The newly released Australia's Circular Economy Framework sets ambitious targets to "lift material productivity by 30%" and "safely recover 80% of resources" currently wasted. Importantly, it also promotes sustainable consumption and production which can alleviate pressure on habitats caused by resource extraction activities.[2]

In striving for the circular advantage in Australia, policy-makers and industry can activate clear benefits by integrating circular, climate and biodiversity agendas. This report defines six *Key Principles of Integration* to inform future policy priorities and directions:

1. **Systems thinking**
2. **Social dimensions**
3. **Consumption reduction**
4. **Regenerative agriculture**
5. **Nature positive-Net Zero linkages**
6. **High value resource recovery**

By applying the above principles it is possible to achieve the full spectrum of circular economy benefits.

1 https://www.circularity-gap.world/2024
2 https://www.dcceew.gov.au/sites/default/files/documents/australias-circular-economy-framework.pdf

2. Introduction cont.

As Australia heads into a resource and carbon-constrained future with increasing demands on resources and negative impacts on nature - the circular economy is providing a powerful integration framework. Bringing together climate, biodiversity and circularity into a systems policy approach across government portfolios delivers important solutions and benefits.

The full spectrum of benefits include:

- A more holistic approach to environmental challenges
- Complementing the renewable energy transition and reducing biodiversity impacts generated by renewable energy infrastructure
- Reducing climate change impacts and improving biodiversity outcomes
- Equal emphasis on the 'biological cycle' of the circular economy alongside the 'technical cycle' [3]

This report and its Appendix provide evidence and recommendations which if implemented, will drive an integrated circular approach to policy-making for State and Territory governments.

This report recommends:

- **Reducing absolute demand for virgin materials**
- **Employing sufficiency practices in consumption**
- **Reducing deforestation and impact on natural systems**
- **Scaling-up circular business models that promote avoidance and reuse for resource utilisation and demand reduction**
- **Aligning circular economy goals in both the decarbonisation and nature positive agendas**
- **Considering social impacts, including addressing ethical and equity issues in circular strategies**
- **Bringing First Nations peoples into planning and management for a circular economy**
- **Putting greater emphasis on enabling high value material recovery through scaling of infrastructure**
- **Embedding circular economy into agricultural and farming practices and approaches**

Circular Australia encourages policy-makers and industry to better align on jurisdictional and sectoral priorities to support the integration of these three crucial agendas - climate, biodiversity, and circular economy. This will unlock a multitude of benefits to the Australian economy.

3 Ellen Macarthur Foundation, The Butterly Diagram. https://www.ellenmacarthurfoundation.org/circular-economy-diagram

3. Circular Economy Hierarchy

A circular economy refers to the slowing and narrowing of resource flows to keep useful materials and components in circulation longer. It promotes sharing, reuse, repair and recovery to enable closed loop systems for technical and biological components.[1] Circular Australia's Hierarchy below is inspired by Prof. Jaqueline Cramer's Building a Circular Future[2] and International Organization for Standardization's (ISO) new 59,000 series.[3] It prioritises avoidance and upstream design changes over recycling and recovery, enabling reduction in overall material demand and highest value use and reuse before disposal.

1 E. Blinova, T. Ponomarenko, and V. Knysh, "Analyzing the concept of corporate sustainability in the context of sustainable business development in the mining sector with elements of circular economy," Jul. 01, 2022, MDPI. doi: 10.3390/su14138163.
2 https://circulareconomy.europa.eu/platform/sites/default/files/building-a-circular-future-jacqueline-cramer-amsterdam-economic-board.pdf
3 ISO59004:2024 Circular economy — Vocabulary, principles and guidance for implementation

4. Research Approach

About the research

Building on the national and international momentum of the circular economy, this report:

- **Investigates the intersections between circular economy, climate change and biodiversity agendas, globally and in Australia**
- **Identifies areas of synergies and gaps towards achieving an integrated policy approach.**
- **Outlines key considerations for Australian policymakers, to drive better integration between circular economy, climate change and biodiversity agendas**

Drawing on conceptual intersections in the academic and grey literature, interviews with leading experts in Australia and internationally, and feedback from policy-makers on emerging areas of interest, the report presents a synthesis of latest scholarly thinking, industry initiatives, policy approaches, programs, and practices.

The report is structured as follows: High-level considerations on the *Benefits of Integration* in different sectors, followed by key *Integration Principles* to inform and contribute to discussions on policy priorities. The final sections are *Evidence of Integration* which highlights the intersection points of circular economy, climate and biodiversity, followed by *Recommendations* on how to integrate the policy agendas.

Audience

This report was commissioned by the NSW, Queensland, South Australian and Victorian government members of Circular Australia's **National Circular Economy Council.** The Council was established in 2020 with membership of State and Territory governments to promote circular economy policy reforms, approaches and best practices to drive national circular economy outcomes by:

1. **Information sharing including circular metrics**
2. **Commonality of approach (Harmonisation)**
3. **Projects (Sub-working groups)**

Through this Council, Circular Australia has an important role to play in continuing to build collaboration between States and Territories to accelerate the transition to a circular economy.

The principles and recommendations are targeted at policymakers and government stakeholders in Australian states and territories, and nationally, to support the development of a holistic circular economy agenda, considering the scope for integration with climate change and biodiversity goals and trade-offs.

5.Benefits of Integration

The links between circular economy, climate change and biodiversity

With the circular economy gaining momentum in policy and practice, emphasis has been on understanding and mitigating resource use, with little attention paid to climate and biodiversity. More often than not, the relationships between circular economy and sustainability are implied rather than demonstrated.[1, 2]

In addition, climate and renewable energy agendas need to consider wider system impacts and can benefit from integration with the circular economy. This research contributes to the emerging body of work investigating the links between circular economy, climate mitigation and biodiversity. It articulates key principles promoting better integration both in policy and practice. Overall, an integrated approach can help reduce the impacts of the 'triple planetary crisis' - climate change, biodiversity depletion, waste and pollution.

Biodiversity improvement

Circular economy can benefit from integration with biodiversity considerations to ensure regeneration of natural systems

Climate Change & carbon mitigation

A considered approach to the circular economy can reduce embodied carbon in food and products at every stage in the lifecycle

Waste & pollution reduction

Circularity can design out waste and pollution at every stage of production, consumption and end of life.

1 A. P. M. Velenturf and P. Purnell, "Principles for a sustainable circular economy," Jul. 01, 2021, Elsevier B.V. doi: 10.1016/j.spc.2021.02.018.
2 Ellen MacArthur Foundation, "The nature imperative: How the circular economy tackles biodiversity loss," 2021. [Online]. Available: www.ellenmacarthurfoundation.org

5. BENEFITS OF INTEGRATION

Biodiversity + circularity

The links between biodiversity and circular economy

A circular economy has the potential to positively influence biodiversity by:[3,4,5]

- **Reducing land use for production of biological and technical components, freeing space for nature**
- **Designing waste and pollution out, so that less waste and harmful substances end up in the environment**
- **Enhancing biodiversity and nature conservation in areas used for production**

Several studies have identified economic sectors or industries that should be prioritised to achieve an integrated circular economy approach. The United Nations Environmental Program (UNEP) found that the built environment along with transport, food and energy systems drive demand for resources and fuel the climate and biodiversity crises.[6] The Ellen MacArthur Foundation identified the food systems, the built environment, the plastic packaging and textiles as key sectors to address biodiversity loss,[3] while SITRA focused on the food systems, the built environment, forestry and textiles.[4]

The Ellen MacArthur Foundation found farm-level impacts on biodiversity could be reduced by 50% in the European Union and the United Kingdom (UK) if 'circular design' is used in agriculture i.e. 'diverse, low impact, upcycled regeneratively produced food.[7] SITRA estimates that, by 2050, the land footprint of human activities could be substantially reduced if circular practices are adopted in the food, textiles construction and forestry sectors.[4]

For example, the clearing of 280 million hectares of forest could be avoided if a range of changes are made along the forestry value chain, including reduction in paper use, recycling of paper and adoption of regenerative forestry principles.

The Australian context

In Australia, the most recent State of the Environment report identified a range of pressure on biodiversity, some directly relevant to the circular economy, notably: [8]

- **Agricultural production**
- **Mining**
- **Urban expansion**
- **Increasing demand for products and materials**
- **Waste generation and pollution impacts**

Australia's agricultural sector features as a key opportunity for biodiversity improvement through adoption of circularity principles. This is also supported by evidence internationally where the food systems change can deliver significant benefits through an integrated approach.

Reducing impacts from mining is also critical to biodiversity improvement in Australia, along with adopting circular production and consumption practices for products and materials. While net zero sectoral plans are underway for the resources sector, circular approaches in the supply chains of the transport, energy, built environment, textiles, construction and electronics sectors can also contribute to reducing their overall environmental impacts and demand for virgin materials.

3 Ellen MacArthur Foundation, "The nature imperative: How the circular economy tackles biodiversity loss," 2021. [Online]. Available: www.ellenmacarthurfoundation.org
4 SITRA, Tackling the root causes. Halting biodiversity loss through the circular economy. 2022. [Online]. Available: www.sitra.fi
5 S. Vlieger de Oliveira and T. Lindskog Ohlson, "Turning the tide on biodiversity loss : critically exploring the potential of a circular economy for a nature-positive future," Circular Innovation Lab, 2023.
6 UNEP, "Global Resources Outlook 2024: Bend the trend - Pathways to a liveable planet as resource use spikes," Nairobi, 2024.
7 Ellen MacArthur Foundation, "The big food redesign. Regenerating nature with the circular economy" 2021 [Online]. Available: www.ellenmacarthurfoundation.org
8 H. Murphy and S. van Leeuwen, "Australia state of the environment 2021: biodiversity," Canberra, 2021. doi: 10.26194/ren9-3639.

5. BENEFITS OF INTEGRATION

Waste, pollution + circularity

The links between circular economy, pollution and waste

Designing out waste and pollution is one of the core principles of a circular economy, alongside keeping materials and components in circulation with maximum value and the regeneration of natural and social systems.[9]

In a circular economy, materials and components can remain in use longer, which enables the slowing and narrowing of resource loops, thereby reducing dependence on virgin materials and energy. Circular approaches can reduce waste and pollution by actions throughout the lifecycle, starting with design and manufacturing through to consumption and post-consumption.

A system-wide circular approach encourages a rethink of the way we design, manufacture, use and manage products and materials, reducing resource use, increasing efficiency, eliminating unsafe chemicals, and enabling circular material flows, with quality materials recovered at the end-of-life. These links are highlighted in detail in the Circular Economy Hierarchy on page 7.

The use and lifetime of products and materials, as demonstrated by the CE Hierarchy are central to minimising overall waste and pollution. Strategies that prioritise refusal and avoidance, followed by changes in sourcing and design, are important to:

- ensure product design, material and component use is optimised
- enable repair and reuse

Sharing materials and resources can also improve resource use efficiency through repeated use and higher lifetime of materials and components in use. Approaches that enable higher value resource recovery through recycling (not downcycling) and the associated infrastructure to enable collection, sorting and recycling are crucial to support market development for recycled materials, thereby reducing demand for new virgin materials. Energy recovery and re-mining need adequate investment and policy support to provide meaningful pathways for value recovery from end-of-life materials.

9 A. Hailemariam and M. O. Erdiaw-Kwasie, "Towards a circular economy: Implications for emission reduction and environmental sustainability," Bus Strategy Environ, vol. 32, no. 4, pp. 1951–1965, May 2023, doi: 10.1002/bse.3229.

5. BENEFITS OF INTEGRATION

Climate change + circularity

The links between circular economy and climate change

A circular economy has the potential to address climate change by:[10,11]

- **Driving reduction in demand for virgin materials**
- **Supporting the renewable energy transition with markets for secondary critical minerals**
- **Making products more energy-efficient through changes in design, production and use**
- **Creating processes and systems to reduce waste and pollution**
- **Assisting in carbon storage and capture**

A World Resources Institute (WRI) report identifies six sectors where circular economy can drive GHG emissions reductions: transport, built environment construction, plastics, textiles, agriculture/food systems and electronics.[11] Those are the sectors that have been singled out as 'key product value chains' by the European Commission in its 2020 Circular Economy Action plan,[12] while also representing 85 to 95% of GHG emissions globally.

As such, those sectors may benefit from circular economy strategies that will reduce GHG emissions. An illustration of this point is provided by Ecofys and Circle economy who found that the adoption of circular economy strategies in the agriculture, construction, transport, and chemical sectors would provide 50% of the emissions reduction 'gap' needed to meet the 1.5 degrees target of the Paris Agreement.[13] The WRI report also highlights the importance of considering how the circular economy can reduce the resource and material use needed for renewable energy.[11]

The Australian context

In Australia, the National Inventory report for 2022 shows 'energy generation' which includes both electricity and transportation to be by far the largest emitter. 'Energy industries', 'transport', 'fugitive emissions from coal, oil and gas' and 'manufacturing industries and construction' are the four main sub-sectors responsible for GHG emissions. 'Agriculture', 'industrial processes, product use' and 'waste' follow behind.[14] Critical sectors and materials not to be forgotten in the Australian context are plastics and textiles and food systems.

In a recent report, Circular Australia identified market opportunities for lithium-ion batteries for mobility, Polyethylene terephthalate (PET) bottles for beverages, low carbon cement and green steel for the built environment and textiles for fashion, upholstery and other goods.[15] The report highlights the need for "circular planning, procurement, design and material requirements for energy projects with whole-of-life carbon assessments". This will assist in driving reduction in virgin material demand by supporting secondary markets particularly for critical minerals needed for the renewable energy transition.

10 A. Hailemariam and M. O. Erdiaw-Kwasie, "Towards a circular economy: Implications for emission reduction and environmental sustainability," Bus Strategy Environ, vol. 32, no. 4, pp. 1951–1965, May 2023, doi: 10.1002/bse.3229.
11 Wang, K., M. Costanza-van den Belt, G. Heath, J. Walzberg, T. Curtis, J. Barrie, P. Schroder, L. Lazer, and J. C. Altamirano. 2022. "Circular economy as a climate strategy: current knowledge and calls-to-action." Working Paper. Washington, DC: World Resources Institute
12 European Commission, "Circular economy action plan. For a cleaner and more competitive Europe," 2020.
13 Ecofys and Circle economy, "Implementing circular economy globally makes Paris targets achievable," 2016.
14 Department of Climate change energy the Environment and Water, "National Inventory Report 2022. The Australian Government submission to the United Nations Framework Convention on Climate Change. Volume 1," 2024.
15 Circular Australia and Arup report Unlocking Circular Markets in Australia 2024

6. Integration principles

Considerations for integrating circular economy, climate change and biodiversity agendas

The following principles emerged from the literature evidenced in this report and could enable better integration between circular economy, climate change and biodiversity goals and agendas.

Systems thinking

Systems-thinking can help identify positive synergies and minimise unintended consequences

Social dimensions

Social dimensions are critical to drive an integrated circular economy transition

Consumption reduction

Reducing consumption provides the clearest benefits across all three agendas - circular economy, climate and biodiversity

Regenerative agriculture

A holistic approach to regenerative agriculture is needed to enable balanced environmental and social outcomes

Nature positive - net zero linkages

Better linkages between circular economy, nature positive and net zero agendas can drive co-benefits

High-value resource recovery

Focus is needed on high-value and high carbon impact recycling, such as metals

6. INTEGRATION PRINCIPLES

Systems thinking

Systems thinking can help identify positive synergies and minimise unintended consequences

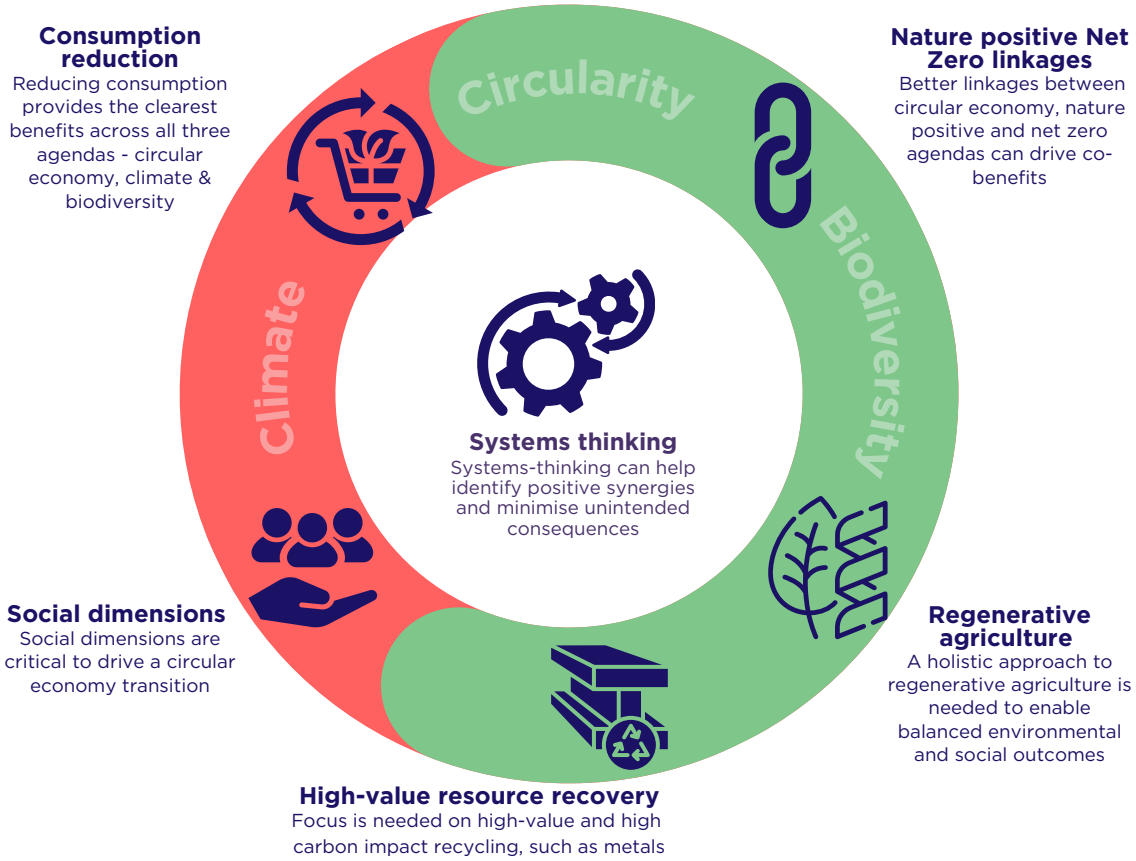
Adopting approaches that are truly circular, while also contributing to climate mitigation and limiting biodiversity impacts requires systems thinking, with a specific focus on lifecycle impacts and supply chain involvement in seeking solutions around material use, product design, use and recovery.

Some of the thematic intersections identified in this report (see Summary Table p. 22-23 and Appendix) suggest the absence of systems thinking can result in unintended consequences, negatively impacting nature and societies. For example, the use of crops for bioenergy in a bioeconomy can increase the demand for crops and land clearing, thereby adversely impacting the carbon capture and biodiversity potential of natural ecosystems, while also threatening food security.

In the context of large-scale renewable energy infrastructure deployment there are known negative biodiversity impacts due to the increased demand for minerals and rare earths, and the large quantities of waste generated at end-of-life. Systems thinking requires the application of circular economy approaches to the energy transition, such as demand reduction, lifetime extension, material recovery and recycling, all of which are emerging but require greater emphasis.[1]

To minimise unintended consequences on natural systems, circular economy and climate change strategies need to integrate biodiversity considerations, especially around land-use and resource extraction, to enable holistic outcomes. Systems thinking is at the heart of this integration, as outlined below in Circular Australia's Circular economy Integration Cycle below.

Circular Economy Integration Cycle



1 M. Simas, F. Aponte, and K. Wiebe, "The future is circular: Circular economy and critical minerals for the green transition," SINTEF, 2022, [Online].www.sintef.no

6. INTEGRATION PRINCIPLES

Social dimensions

Social considerations are critical to drive a circular economy transition

The circular economy aims to transition societies to new ways of producing and consuming. People are central to the circular economy transition so it must ensure:

- **Social acceptance**
- **Fairness and equity**
- **Recognition of First Nations peoples' knowledge, perspective and leadership**
- **Avoidance of land-use conflicts**

Circular economy research and practice so far have focused on the development of policies and market incentives to influence the practices of the private sector.[2] In doing so, the social dimensions of the circular economy transition are often overlooked, except to narrowly examine specific areas of interest, such as job creation.[3,4,5] However, it is increasingly acknowledged that for the circular economy transition to be effective, fair and socially acceptable - the social ramifications of a system-wide economic transition need to be considered. Four key issues need attention:

New social practices to support the techno-economic shifts in the circular economy:

- Social practices are a key consideration in order to foster sharing, repair and reuse.
- Individuals and communities need to develop new skills, know-how, sense-making processes, habits and routines. [6]
- Enabling physical environments need to be created to facilitate adoption of new practices.
- Putting emphasis on the role of social practices brings individuals and communities back to the centre of the transition and away from being 'passive consumers'. [7]

A just and fair circular economy transition that does not disadvantage people must consider:

- Affordability, including costs of goods and services.
- Access to information, resources and services to support the transition.
- Development of skills, knowledge and tools to participate in the circular economy.
- Avoidance of reproducing, entrenching or worsening inequalities or inequities.[2,8]

First Nations recognition

- Bringing First Nations peoples knowledge into policy and planning.
- Embedding First Nations expertise, values and Caring for Country approaches in circular practices.
- Ensuring First Nations peoples' participation in the circular economy.

Avoiding land-use conflicts

- Supporting land-use practices that contribute to improving and regenerating natural systems.
- Balancing the transition to new land-use practices, in particular renewable energy systems deployment in Renewable Energy Zones (REZs) with traditional ownership, land-use and agricultural economy.
- Respecting and integrating First Nations ownership and ensuring the fair distribution of benefits e.g. renewable energy projects.[9]
- Identifying safe locations to process, store, and remanufacture secondary resources to drive new markets.

It is essential that circular economy initiatives consider the social dimensions as part of a holistic approach to integrating sustainability issues.

2 M. Calisto, M. Ripa, M. Pansera, and T. Doezema, "Chapter 3. A Framework to Critically Understand the Multidimensional Social Justice Implications of a Circular Economy Transition."
3 A. P. M. Velenturf and P. Purnell, "Principles for a sustainable circular economy," Jul. 01, 2021, Elsevier B.V. doi: 10.1016/j.spc.2021.02.018.
4 D. D'Amato and J. Korhonen, "Integrating the green economy, circular economy and bioeconomy in a strategic sustainability framework," Ecological Economics, vol. 188, Oct. 2021, doi: 10.1016/j.ecolecon.2021.107143.
5 M. Geissdoerfer, P. Savaget, N. M. P. Bocken, and E. J. Hultink, "The Circular Economy – A new sustainability paradigm?," Feb. 01, 2017, Elsevier Ltd. doi: 10.1016/j.jclepro.2016.12.048.
6 Rabiu, M. K., & Jaeger-Erben, M. (2022). Appropriation and routinisation of circular consumer practices: A review of current knowledge in the circular economy literature. Cleaner and Responsible Consumption, 7, 100081-. https://doi.org/10.1016/j.clrc.2022.100081
7 W. Spekkink, M. Rödl, and M. Charter, "Repair Cafés and Precious Plastic as translocal networks for the circular economy," J Clean Prod, vol. 380, Dec. 2022, doi: 10.1016/j.jclepro.2022.135125.
8 Leipold S, et al (2023). Lessons, narratives, and research directions for a sustainable circular economy. Journal of Industrial Ecology, 27(1), 6–18. https://doi.org/10.1111/jiec.13346
9 Chandrashekeran, S. (2021). Rent and reparation: how the law shapes Indigenous opportunities from large renewable energy projects. Local Environment, 26(3), 379–396. https://doi.org/10.1080/13549839.2020.1861590

6. INTEGRATION PRINCIPLES

Consumption reduction

Reducing consumption provides the clearest benefits across all three agendas

The ambition for a circular economy must move beyond recycling and towards reductions in overall demand as well as net reduction in the demand for virgin and fossil materials. The potential for a circular economy rebound means that resource sufficiency strategies need to be supported as a priority in addition to efficiency gains.[10, 11]

This includes strategies to avoid and reduce deforestation, natural resource extraction and employing sufficiency practices in consumption. Business models that promote avoidance and reuse are found to offer opportunities for resource utilisation and demand reduction. Material Economics (2018) found circular business models to be one of three major strategies for decarbonising hard to abate sectors in the EU.[12] For example, sharing models in the built environment and transport, otherwise material- and energy-intensive sectors, had the potential to reduce annual carbon emissions by 62 Mt. Sharing provides higher utilisation of buildings and vehicles, thereby lowering demand for virgin metals and plastics.

Similarly, shifting consumption patterns is paramount in the context of the renewable energy transition to avoid counter impacts in the form of supply chain disruptions, over-reliance on mining for critical minerals and ineffective end-of-life management for renewable energy technologies. These complexities illuminate the systems thinking lacking in current practice and the need for an integrated approach to a circular and sustainable energy transition.

What is Circular Economy Rebound?
Circular economy rebound refers to situations where an increase in the resource efficiency of a product is negated by an increase in the production and consumption of this product.

What would resource sufficiency look like from a government and industry perspective?
Sufficiency approaches for government and industry can include:

- **Reconsidering the lifetimes of goods in private and public procurement, to extend use, reconsider the need for goods and avoid replacement and disposal**
- **Furniture and equipment used can also prioritise repurposing and adapting over replacement**
- **Development and use of online platforms to facilitate reuse between organisations**
- **Industry, government and consumers can also make use of circular business offerings such as leasing and service models for vehicles, building fitouts, textiles and e-product**

10 F. Figge and A. S. Thorpe, "The symbiotic rebound effect in the circular economy," Ecological Economics, vol. 163, pp. 61–69, Sep. 2019, doi: 10.1016/j.ecolecon.2019.04.028.
11 F. Figge, W. Young, and R. Barkemeyer, "Sufficiency or efficiency to achieve lower resource consumption and emissions? the role of the rebound effect," J Clean Prod, vol. 69, pp. 216–224, Apr. 2014, doi: 10.1016/j.jclepro.2014.01.031.
12 Material economics, "The circular economy: A powerful force for climate mitigation. Transformative innovation for prosperous and low-carbon economy."

6. INTEGRATION PRINCIPLES

Regenerative agriculture

A holistic approach to regenerative agriculture is needed to enable balanced environmental and social outcomes

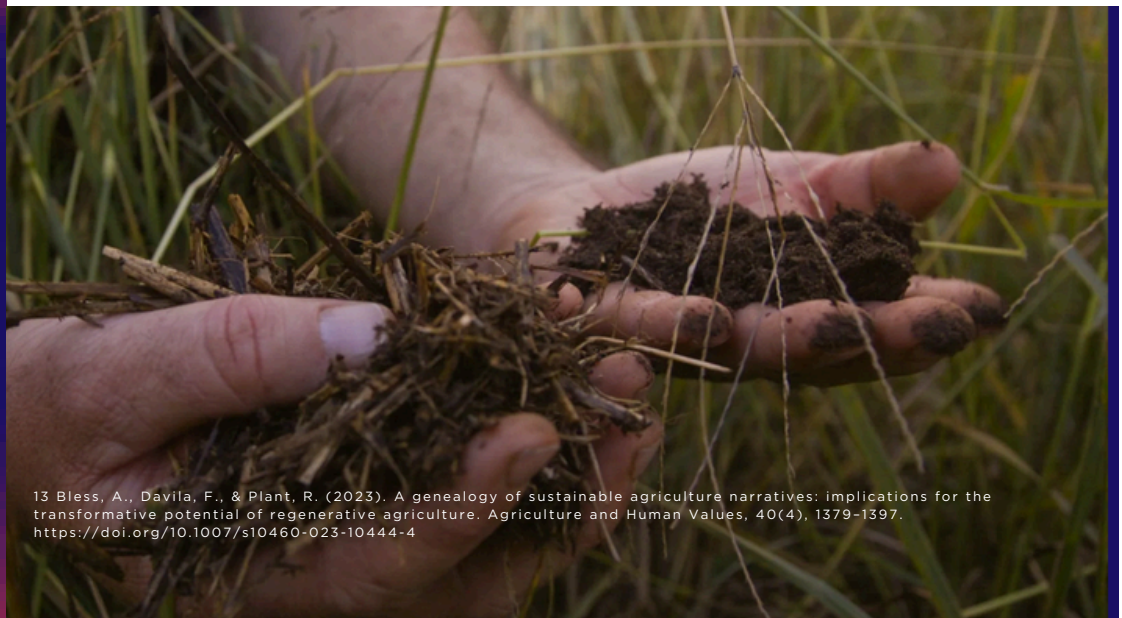
Our research found many examples of regenerative agricultural practices being considered an important aspect of a regenerative circular economy. However, evidence also pointed toward the need to expand current regenerative approaches beyond soil health and carbon sequestration to embrace key principles of the Circular Economy Hierarchy. Opportunities include, recovering valuable resources and connecting into circular markets beyond the farm gate, such as recycled water and nutrients from organic waste.

While regenerative agriculture is increasingly perceived as a successful approach to address a range of environmental issues - greater uptake and integration is required. A critical examination of the ability for regenerative agriculture to deliver holistic environmental and social benefits in a circular economy is needed. This includes, for example, support to implement practices that move beyond improving soil health and toward the restoration of ecological communities across regions. The central role of First Nations peoples in developing regenerative practices also needs to be recognised, and viable and equitable regional economies for diverse farm types and sizes need to be enabled.

Finally, the types of regenerative practices that lead to carbon sequestration need to be further ascertained, and barriers and enablers to farmers' adoption of those practices need to be better understood.

Key focal points:

- **Identifying opportunities for broader regenerative agricultural practices that deliver circularity, biodiversity and climate outcomes.**
- **Better measurement and quantifiable data on the above outcomes to fully assess benefits.**
- **Policy enablers for a more comprehensive approach to regenerative agriculture that recognises heterogenous practices and knowledge.**
- **Approaches to ensure positive environmental outcomes are balanced with equity and fairness for farmers.[13]**
- **Understanding how regenerative agriculture can contribute to addressing inequities in the food system[13]**



13 Bless, A., Davila, F., & Plant, R. (2023). A genealogy of sustainable agriculture narratives: implications for the transformative potential of regenerative agriculture. Agriculture and Human Values, 40(4), 1379–1397. https://doi.org/10.1007/s10460-023-10444-4

6. INTEGRATION PRINCIPLES

Nature Positive-Net Zero

Better linkages between circular economy, nature positive and net zero agendas can drive co-benefits

Decarbonisation pathways to net zero have been heavily supported by the finance industry and investors which is helping deliver renewable energy technology and process transformation, at scale, and within short timeframes. The nature-positive cocept is beginning to attract interest from private industry and government.

There is an opportunity to align circular economy goals within the decarbonisation and nature positive agendas, to ensure a systemic approach to sustainability issues. Indeed, bringing the three agendas together would direct the focus toward strategies that sit higher on the circular economy hierarchy, as they are more likely to deliver both climate and biodiversity outcomes. The following priorities can activate the integration:

- **Maximising investment** will help scale-up circular business models such as sharing and reuse. If done with social consideration in mind it could also contribute to addressing inequities around access to circular services, products and infrastructure which have mainly been implemented through local approaches to reuse.
- **Innovation** in material science and technological improvements will help support material recovery and reuse, thereby reducing pressure on virgin materials and resources.

This report has highlighted the importance and significant potential of integrating the circular economy and net zero agendas. With momentum, there is potential to integrate the nature positive agenda to ensure alignment of goals and strategies. The integration principles in this report can all contribute to policy alignment. Operationalising circular economy is in its infancy in Australia and requires knowledge sharing, investment, innovation as well as policy reform and political leadership.

What is Nature Positive?

'Nature Positive is a global societal goal which aims to 'halt and reverse nature loss by 2030 on a 2020 baseline, and achieve full recovery by 2050'.[14]

The intention is increase nature and biodiversity until 2030 and enable continued recovery until 2050. Specific goals relate to 'retaining and restoring species, ecosystems and natural processes at all scales. [15]

This aligns with the UN's Kunming-Montreal Global Biodiversity Framework, where 30% of land and waters should be protected or restored by 2030.[16]

Australia hosted the Nature Positive Summit in October 2024 to build consensus on an approach to enabling greater private investment in nature repair. This has been billed as a more holistic approach to environmental markets incorporating water and carbon.[17]

There is a need for care in implementation to ensure genuine improvements, including ensuring that biodiversity increases are absolute.[18]

14 https://www.naturepositive.org
15 https://www.naturepositive.org/app/uploads/2024/02/The-Definition-of-Nature-Positive.pdf
16 https://www.cbd.int/gbf
17 https://theconversation.com/australia-is-hosting-the-worlds-first-nature-positive-summit-what-is-it-and-why-does-it-matter-236236)
18 https://theconversation.com/want-genuine-progress-towards-restoring-nature-follow-these-4-steps-240569

6. INTEGRATION PRINCIPLES

High-value resource recovery

Focus is needed on high-value and high carbon impact recycling, such as metals

We found evidence that recycling metals such as steel and aluminium provides carbon mitigation benefits, in addition to being circular and avoiding further biodiversity loss from natural resource extraction.[19,20,21]

Given heavy metals are infinitely recyclable and can retain shape and form, we recommend a renewed emphasis on urban mining in the Australian context. Urban mining refers to the recovery of valuable metals from waste and particularly from existing electrical and electronic products.

This will also help address the issue of embedded energy losses when circulating metals within the economy and promote further investment in take-back and recycling infrastructure, to promote local recycling and recovery of high-quality secondary materials, supporting demand creation for recycled metals.

Scale-up of onshore recycling capability generally will be essential to Australia's preparedness for a 2030 circular economy and beyond.

Appropriate collection and recycling infrastructure can mitigate inefficiencies in metals recovery and reuse, where currently there are losses at end-of-life and downcycled applications. Contamination of secondary steel and aluminium with copper and alloys has so far limited higher value secondary resource use.[21]

Due to the high production impacts of virgin metals, recycling offers clear carbon mitigation benefits and can drive up the demand for secondary materials.[22] This will benefit from a renewed focus in terms of policy and investment, to scale up local recovery and reuse.

Looking beyond steel and aluminium, secondary critical minerals extraction also presents significant opportunities for carbon abatement and environmental benefits.

Further examples of high value resource recovery opportunities are described in Circular Australia and Arup's Unlocking Circular Markets report. It highlights lithium-ion batteries for mobility, green steel and low carbon concrete for the built environment, textiles for fashion, upholstery and other goods, and polyethylene terephthalate (PET) bottles for beverages - as potential circular markets driving co-benefits.[23]

19 Material Economics, "The circular economy: A powerful force for climate mitigation. Transformative innovation for prosperous and low-carbon economy
20 M. Calisto Friant, W.J.V. Vermeulen, and R. Salomone, "A typology of circular economy discourses: Navigating the diverse visions of a contested paradigm" 2020. Resources, Conservation and Recycling 161:104917 · doi: 10.1016/j.resconrec.2020.104917
21 B. Cundiff, C. Trottier-Chi, R. Smith, M. Beck, and C. Bataille, "How circularity can contribute to emissions reductions in Canada," 2023.
22 Sen, L. Meini, E. Napoli, and C. Napoli, "Beyond energy : Incentivizing decarbonization through the circular economy.," The Oxford Institute for Energy Studies and Enel Foundation, 20219
23 Circular Australia and Arup: Unlocking Circular Markets 2024.

7. Evidence of Integration

This research identifies conceptual intersections and leading approaches to integrating the three agendas. This section summarises the evidence base of best practice examples and international case studies The examples below are intended to expand the ambition of the circular economy by integrating agendas and maximising co-benefits. The overarching objective is to promote a systems-thinking approach within policymaking and to help inform jurisdictional priorities for a circular economy that is holistic.

Six key themes emerged which highlight opportunities for better integration. These are summarised on the next two pages. The themes describe the intersections between circular economy, climate change and biodiversity, based on our findings from the literature review, expert interviews, as well as discussions with representatives from Australian states and territories.

Six key themes:

- **Reducing material consumption**
- **Recycling metals**
- **Bioeconomy and land-use**
- **Resourcing renewable energy**
- **Regenerative agriculture**
- **Nature-based solutions**

The first two themes - reducing material consumption and recycling metals - highlight important circular economy strategies that are highly likely to achieve co-benefits for climate and biodiversity.

The next two themes - bioeconomy and resourcing renewable energy - identify activities where there is potential for co-benefits and also challenges which must be given greater attention.

Finally, the last two: regenerative agriculture and nature-based solutions, present emerging approaches and practices that need further scrutiny and rigour to assess their contributions to circular economy, climate change and biodiversity. The Appendix provides more detail about each of the six themes, by looking deeper into the synergies, trade-offs and leading examples.

7. EVIDENCE OF INTEGRATION

Summary Table

The following examples present evidence of where integration is occurring in policy and practice. The examples run across sectors and systems, providing insights into synergies, impacts and opportunities in a circular economy. The Research Appendix provides further detail.

Intersections	Research evidence	Leading approaches/strategies
Reducing material consumption	• Reducing material consumption must be prioritised to minimise trade-offs e.g. in the bioeconomy • Built environment, food and mobility sectoral approaches can bring substantial benefits • Circular business models, such as vehicle sharing can reduce transport-related GHG emission and promote reuse	• Shifting diets (Case Study 1) • Building compact neighbourhoods • Enabling active transport • Sharing economy (Case Study 2)
Recycling metals	• Owing to the high production impacts of virgin metals, recycling metals offers clear carbon mitigation benefits • Contamination of secondary steel and aluminium with copper and alloys can limit applications. • Redesigning metal containing products for disassembly and recycling is important to expand recycling opportunities	• Redesign for disassembly • Limit use of alloys • Minimise downcycling • Improve post-consumer collection of aluminium
Bioeconomy and land use	• Bioeconomy approaches are considered to reduce fossil fuel use and carbon emissions • There are trade-offs from increased land-use for growing bio inputs, often competing with land needed for food production or nature • Specific feedstock e.g. organic waste and approaches e.g. biorefining may generate less trade-offs.	• Use of organic waste for high-value products, nutrient/compost and energy • Biorefining
Resourcing renewable energy (wind, solar, lithium-ion batteries)	• Renewable energy plays an important role in decarbonisation and has increased the demand for critical minerals • Mining and construction can cause water and soil pollution and habitat destruction • At end-of-life renewable energy technologies can release toxic leachate when landfilled	• Reducing energy demand • Using less critical minerals in design • Lifetime extension • Recovery of resources from renewable energy technology • Responsible mining practices

7. EVIDENCE OF INTEGRATION

Summary Table cont.

Intersections	Research evidence	Leading approaches/strategies
 **Regenerative agriculture**	• A variety of regenerative practices are relevant to circular economy, carbon mitigation and biodiversity conservation • While regenerative agriculture can result in biodiversity improvement and carbon mitigation, the outcomes lack real-world evidence, and the risk exists of overstating the climate and biodiversity benefits of regenerative practices • Solutions need to go beyond stop-gap approaches, towards achieving holistic outcomes that consider the long-term impacts and trade-offs	• **Avoiding or minimising soil disturbance through no-till** • **Cover crops** • **Reducing or avoiding mineral fertilisers use** • **Avoiding pesticide use** • **Grazing management** • **Agroforestry**
 **Nature-based solutions**	• NbS can provide a range of co-benefits, including biodiversity enhancement, climate mitigation/adaptation and circularity, especially in urban settings • While circular economy approaches have focused on consumer products, NbS enables a refocusing on natural cycles, such as those for water and nutrients • The effectiveness of NbS is heavily dependent on the design of the solution and the context of where it occurs	• **Rainwater management** • **Vertical greening systems or green roofs** • **Remediation, treatment and recovery** • **River restoration** • **Soil and water bioengineering** • **Green space** • **Food and biomass production** **(Case Study 3 & 4)**
 **Policy approaches in Australia**	• Building materials, plastics and organic waste sectors are prioritised for their potential to mitigate climate change. • Land and plastic pollution in waterways have implied links between circular economy and biodiversity • While the role of circular economy in reducing environmental impact is acknowledged, biodiversity aspects are not explicit. Regenerating nature is sometimes mentioned as a principle of the circular economy but remains under-explored.	• **Circular Economy Strategy and Action Plan (ACT, 2023)** • **NSW Circular design guidelines for the built environment (NSW, 2023)**
 **Policy approaches - international**	• An expansive framing of the circular economy is adopted with references to regeneration, planetary boundaries. • Emphasis is put on the forestry sector and the substitution of biomaterials. • Other areas of interest are the food systems and nature-based solutions.	• **Finnish roadmap to a circular economy 2016-2025** • **The Netherlands National Circular Economy Program** • **Roadmap for a circular Chile by 2040**

CASE STUDY 1 CONSUMPTION REDUCTION

Reducing food waste & shifting diets

Reducing food waste, calories and carbon intensity of food

The food and beverage sector in the UK contributes 30% of their territorial carbon emissions and is consequently a focus of decarbonisation and resource efficiency measures. Of this footprint, 40% relates to the livestock and poultry industry and 16% relates to food waste. The WRAP UK & University of Leeds reports focus on net zero and resource efficiency, proposing three food related initiatives as the top priorities:

1. **Tackling food waste**
2. **Cutting calories and carbon**
3. **Changing the carbon intensity of diets.**

As part of tackling food waste, the voluntary Courtauld Commitment asks signatories to aim for a 50% reduction in food waste by 2030. The report proposes large food and beverage businesses develop strategies to "target, measure, act" on food waste across the whole food supply chain. As part of the strategy to cut calories and carbon, the report puts forward a systemic approach to health and environment. It considers a 'value for calories' approach to incentivise uptake of food with high nutritional quality per calorie. It also suggests the food service sector consider food portion sizes and packaging to promote healthy eating.

Reducing the carbon intensity of diets is also a priority. WRAP UK is working with the UK meat industry to become an example of resource efficient meat production and supply to minimise waste and emissions. They are encouraging the food industry to better target and measure scope 3 emissions.[1]

Outcomes

WRAP UK has proposed three priority strategies to address resource use and carbon emissions associated with UK food production and diets in the UK.

Under the Courtauld Commitment, WRAP UK has developed scope 3 greenhouse gas measuring and reporting protocols for the food and beverage sector, and there has been a 12% reduction in emissions of UK food and beverages since 2015.

All major grocery retailers have signed up to the Courtauld Commitment amongst 300 food businesses committing to a Food waste reduction roadmap. [2]

1 WRAP, "Net zero: Why resource efficiency holds the answers. Our eight priorities."
2 WRAP UK, "The Courtauld Commitment 2030: Progress and Insights Report 2022." Accessed: Oct. 02, 2024. [Online]. Available:

CASE STUDY 2 CONSUMPTION REDUCTION

Sharing business models

Circular business models and sharing

Businesses that enable sharing of goods offer opportunities for higher utilisation of resources and opportunities to reduce demand for materials, which minimises associated impacts on waste, carbon emissions and land use.

In the European Union (EU), circular business models are one of three major strategies identified by the Material Economics report, for decarbonising hard to abate sectors in the EU.[3]

With the built environment and transport identified as high consuming sectors, circular business model strategies of car sharing - also known as Mobility as a Service (MaaS) - and higher utilisation of buildings are ways of reducing demand for high impact materials such as metals and plastics.

Sharing of vehicles and buildings was estimated to enable a 62 Mt reduction in carbon emissions per year in the EU. Modelled data also calculated that a shared mobility system could reduce the CO2 impact of materials in cars by 70% and reduce the total cost of car ownership by 77%.[3] This is due to higher utilisation and management through car fleets, as well as lightweighting of components, electric drivetrains and higher quality parts enabling prolonged lifetimes, and design for reuse and remanufacturing

Outcome

The future car sharing scenarios modelled in the Material Economics[4] report are yet to be realised, as they involve fleets of electric vehicles that are redesigned to minimize carbon and resource consumption.

However, we can connect these projections of resource impacts with existing studies on the effectiveness of car sharing schemes in reducing consumption. A meta review of the impact of car sharing schemes collated the results from studies of 21 different car sharing schemes across the United States, EU, Asia and Australia.[4]

They found that 40-60% of carsharing users avoided purchasing a vehicle after joining a service. Across the studies they found that each car sharing vehicle can remove 4-15 cars from the road. In relation to land use, estimates in the EU have determined that each car occupies 150m2 of urban land. So, removing cars from the road through carsharing could reduce demand for primary production and land use over time.[5]

3 Material economics, "The circular economy: A powerful force for climate mitigation. Transformative innovation for prosperous and low-carbon economy."
4 S. A. Shaheen and A. Pan, "Behavioral and sociodemographic impacts of carsharing," in Handbook of Travel Behaviour, North Hampton, Massachusetts: Edward Elgar Publishing Ltd., 2024, pp. 339–363. doi: 10.4337/9781839105746.
5 B. Bondorová and G. Archer, "Does sharing cars really reduce car use?," 2017.

CASE STUDY 3 NATURE POSITIVE-NET ZERO

Nature-based solutions

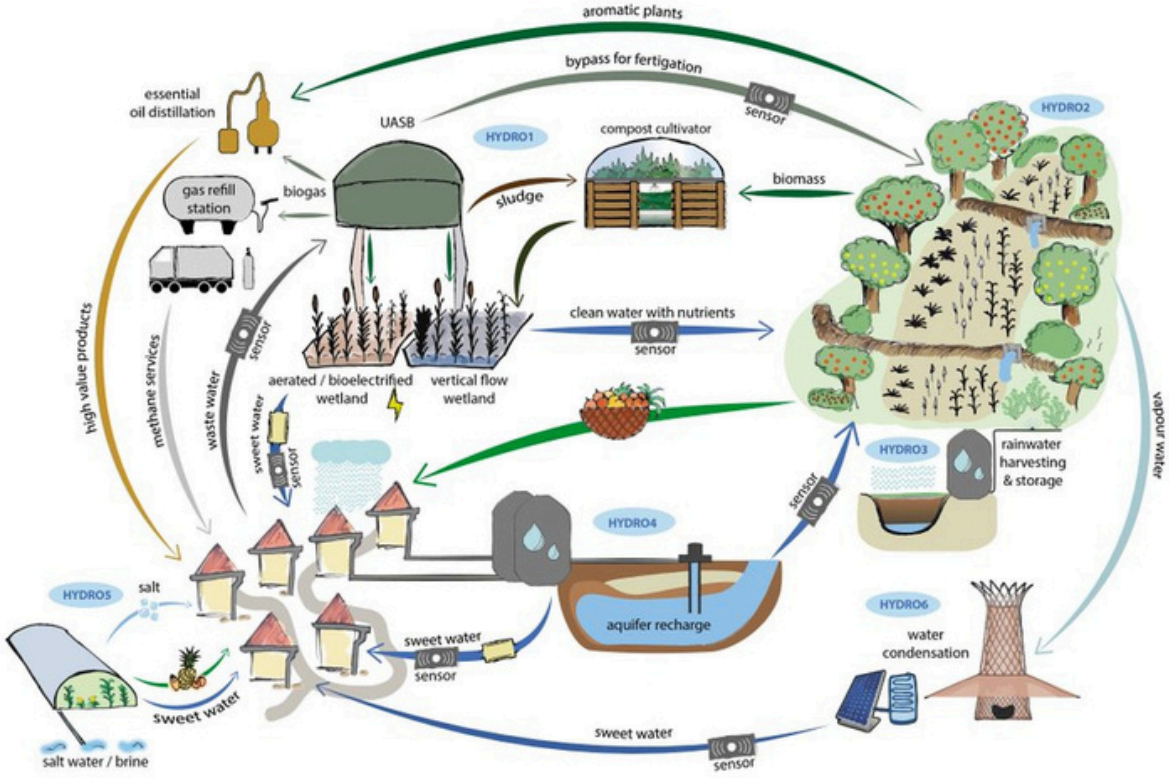
Nature-based solutions (NbS) embed circular economy and biodiversity principles

HYDROUSA is an EU Horizon 2020 Innovation project implemented in Lesvos, Mykonos and Tinos in Greece. The project aims to test and implement technologies such as upflow anaerobic sludge blanket technology, constructed wetlands, compost cultivator, agroforestry system, to treat and reuse water and wastewater from rainwater, groundwater, wastewater, water vapour, seawater.[6,7]

This NbS aims to achieve circularity and biodiversity outcomes by enabling the use of wastewater to irrigate the agroforestry system. For instance, wastewater will be processed in the upflow anaerobic sludge blanket technology, to produce biogas, sludge and water. The sludge can be composted in a compost cultivator, and water will be further treated in a constructed wetland, to provide clean and nutrient-rich water in the agroforestry system.

Outcomes

Biodiversity considerations were included in the design of the constructed wetlands and agroforestry systems. The project will also help address water scarcity during summer in Greece. While climate change adaptation is not explicitly mentioned in this NbS example, the systems used to manage water stress are likely to be a useful climate adaptation strategy elsewhere in the world, e.g. Australia [6,7]



6 A review of nature-based solutions for urban water management in European circular cities: A critical assessment based on case studies and literature
7 Hydrousa website

CASE STUDY 4 NATURE POSITIVE NET ZERO

Regenerating nature in cities

Regenerating nature in cities

Vitoria-Gasteiz in Spain implemented a regeneration plan through its Green Urban Infrastructure Strategy, to upgrade the city's urban belt with green infrastructure. The masterplan prioritises accessibility, an active and healthy lifestyle for its people and encourages community participation and social interaction.

Example:

A Green Urban Infrastructure Strategy was developed by the City Council, which aimed to regenerate and improve local biodiversity and create a connected network of green spaces. As a result of this strategy, a number of parks connected by bike and pedestrian lanes were developed, forming a 30 km circle around the city. In parallel, 'an intermodal transport scheme' has been implemented which has led to a 64% rise in pedestrian areas.[8]

Outcomes

Since the launch of the strategy, the community has planted 165,000 trees, recorded lower pollution and noise, improved the visual appeal as well as biodiversity of its urban centre. A range of co-benefits were recorded, including cooling the city, carbon sequestration, improved stormwater management, and improved air quality, with the overall result of a healthy and liveable city. Vitoria-Gasteiz has received numerous accolades for its regenerative urban planning and implementation, it was named as the European Green Capital in 2012 and the UN's Global Green City award in 2019.[9,10,11,12]

8 Ellen MacArthur Foundation, "Regenerating nature — the foundation of a healthy, vibrant, and resilient city: Vitoria-Gasteiz." Accessed: Oct. 02, 2024. [Online]. Available: https://www.ellenmacarthurfoundation.org/regenerating-nature-the-foundation-of-a-healthy-vibrant-and-resilient-city?_gl=1*1ldvssq*_up*MQ..*_ga*MTA0OTg1NDc5NS4xNzI3NDE5MDU4*_ga_V32N675KJX*MTcyNzQxOTA1NS4xLjAuMTcyNzQxOTA1NS4wLjAuMA..

9 1Regenerating nature — the foundation of a healthy, vibrant, and resilient city: Vitoria-Gasteiz

10 The urban green infrastructure of Vitoria-Gasteiz. Proposal document

11 Implementation of the Vitoria-Gasteiz Green Urban Infrastructure Strategy

12 Building prosperity: Unlocking the potential of a nature-positive, circular economyfor Europe

8. Recommendations

The following recommendations are to assist in policy settings, strategies and agenda setting:

1 Include resource sufficiency strategies in policies and programs to support reductions in consumption as well as a net reduction in the demand for virgin and fossil materials:

- The ambition for a circular economy must move beyond a focus on recycling. The potential for a circular economy rebound means that resource sufficiency strategies need to be supported along with efficiency gains.
- This includes strategies to avoid and reduce deforestation, natural resource extraction and employing sufficiency practices in consumption
- Business models that promote avoidance and reuse are found to offer opportunities for resource utilisation and demand reduction.

2 Align circular economy goals within the decarbonisation and nature positive agendas to ensure a systemic approach to sustainability issues and to maximise investment and innovation:

- To scale-up circular business models such as sharing and reuse, and address inequities around access and infrastructure, which have thus far only enabled localised approaches to reuse.
- To further innovation in material science and technological improvements that support material recovery and reuse, reducing pressure on virgin materials and resources.

3 Ensure circular economy approaches consider the interdependencies across social dimensions:

- Social acceptance is essential to all sustainability transitions. Therefore the development of new practices, sense-making processes, skills and habits by individuals and communities need to be given greater focus
- For the transition to a circular economy to be effective, fair and socially acceptable, its social ramifications need to be addressed.
- Circular economy should focus beyond the development of policies and market incentives influencing private sector practices and jobs.
- Emphasis should be placed on:
  - The development of new social practices,
  - Addressing ethical and equity issues
  - Bringing First Nations peoples into planning and management.

4 Prioritise development of recycling infrastructure and systems for high impact materials with co-benefits for carbon mitigation and biodiversity:

- A focus on recycling metals can mitigate carbon intensive metals production.
- Urban mining of e-waste can mitigate impacts from resource extraction and waste.
- Introducing safe circular practices such as design for disassembly, adaptive reuse, dematerialising, ‘as a service’ business models, shared and digital inclusion.

5 Circular economy and climate change strategies need to integrate biodiversity considerations:

- In order to enable holistic outcomes, biodiversity should be given full consideration particularly in relation to land-use and resource extraction.
- This is essential to avoid or minimise unintended consequences on natural systems

6 Including regenerative agriculture where it delivers positive outcomes for nature and farmers:

- A critical examination of the ability for regenerative agriculture to deliver holistic environmental and social benefits in a circular economy, including:
  - Identifying and quantifying practices that deliver genuine circular, biodiversity and climate outcomes.
  - Ensuring that policies fostering regenerative agriculture recognise and integrate heterogenous practices and forms of knowledge, notably Indigenous knowledge.
  - Ensuring that regenerative agriculture provides equitable and fair outcomes for farmers and contribute to address inequities in the food system.

9. Acknowledgements

Circular Australia National Circular Economy Council Members

Circular Australia has built a national network of committed experts and organisations working to transition Australia to a circular economy by 2030. Along with our Precincts & Infrastructure, Industry, and Finance & Investment Taskforces is the National Circular Economy Council which was established in 2020 with membership of State and Territory governments. The Council's aim is to promote circular economy policy reforms, approaches and best practices. Circular Australia acknowledges the support of the Victorian, NSW, Queensland and South Australian governments.

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