Insight

7 Circular economy

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1 STATE OF THE CIRCULAR ECONOMY

48
million tonnes
of organic waste generated each year

69% from agriculture, forestry & aquaculture

4.6%
Australia's overall material circularity rate

Australia has the potential to produce
90
million tonnes
of biological materials for bioenergy, biochemicals or biomaterials

$36.6 billion
cost of food waste to the Australian economy

2 CHALLENGES

- **A large fraction of organic waste** ends up in landfill
- **Only a small share** of biological material returns to the food system
- **Lack of a clear and consistent definition** of what circularity means for the food system

3 OPPORTUNITIES

- **Better integration** of food system waste streams will increase waste avoidance and improve circularity
- **Recycled biological materials** can produce a suite of circular products
- **Establish coordination mechanisms** that enable collaboration between regulators, industry, and communities to manage safety and environment priorities

KEY POINTS

- Australia's overall material circularity rate is 4.6%, while the circularity rate of biological materials, including those within the food system, is 2.8%.
- Australia generates 33 million tonnes of organic waste each year, much of which ends up in landfill.
- Regulatory reform is needed to recognise that historically hard-won protections on human health can be maintained in a more circular economy.

Improving the circularity of the food system will require better integration of food system waste streams into the agricultural, energy and materials sectors.

7.1 Circularity of Australia's food system

Each year, Australia generates around 48 million tonnes of organic waste, of which around 33 million tonnes is generated from agricultural, forestry and aquaculture production. An estimated 9.55 million tonnes of this organic waste is produced pre-farm gate (AgriFutures, 2023). Organic waste includes animal waste, crop residues, product losses and processing waste. Food waste alone accounts for 7.6 million tonnes annually, costing the Australian economy over $36.6 billion.

Despite a relatively high recycling rate for biological materials (63%), most of these materials are currently converted to energy rather than reintegrated into the food system. Because energy recovery is not considered part of circular material flows, Australia's total biological material circularity is only 2.8%. There is significant potential to increase the safe reintegration of biological materials into the food system.

Although Australia's circularity of biological material is low, a substantial amount of food waste is repurposed into new products. Figure 10 shows that large volumes of food waste are used in processed food products, animal feed and non-food applications (e.g. energy). Composting transforms organic waste into soil amendments that can be returned to agriculture, while food rescue and upcycling also help to reduce waste.

Looking ahead, improving the circularity of the food system will require better integration of food system waste streams into the agricultural, energy and materials sectors. Australia has the potential to produce 90 million tonnes of biological materials for bioenergy, biochemicals or biomaterials beyond its current food production. This opportunity is largely driven by crop stubble, grasses and forestry by-products, which could provide a sustainable resource base for a more circular bioeconomy.

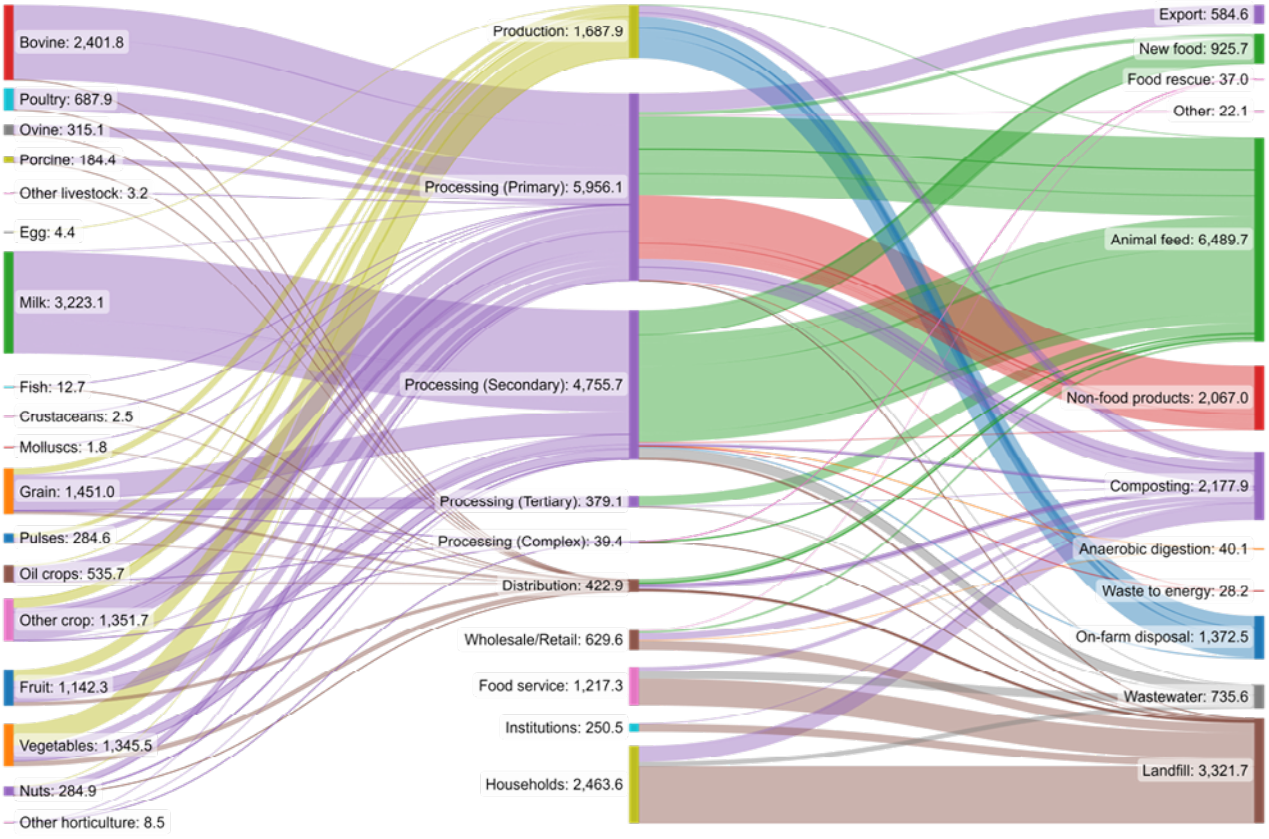

Figure 10: Sources and end destination of recovered, lost and wasted food in Australia (in thousands of tonnes per year). Source: Hetherington et al. (2022)

7.2 Monitoring circularity in Australia's food system

One of the key challenges in advancing circularity within Australia's food system is a lack of a clear and consistent definition of what circularity means and how it should be measured. The integration of circular economy concepts into the Australian food system is relatively new, with commercial applications emerging gradually and limited integration into economic and policy frameworks.

The term circular economy is often interpreted differently across businesses, industries and policymakers. However, the recent release of Australia's Circular Economy Framework by the Department of Climate Change, Energy, the Environment and Water in 2024 represents a significant step towards aligning these diverse perspectives. The new framework sets a national goal of doubling Australia's circularity rate by 2035 and defines a circular economy as 'an economic model that promotes sustainable and efficient use of resources as a way to support environmental, economic and social outcomes'. The framework outlines three interrelated strategies to improve circularity (DCCEEW, 2024):

- designing out waste and pollution
- circulating products and materials in their highest value
- conserving natural resources while also regenerating nature.

Bega Circular Valley

The Bega Circular Valley is a collaborative effort led by the Regional Circular Co-operative to drive circular economy initiatives in the region. The collaboration includes government (e.g. Bega Shire Council, NSW Department of Primary Industries, NSW Decarbonisation Hub, Fisheries Research and Development Corporation), industry (e.g. Bega Group, AACo, Essential Energy, Rabobank, Deloitte) and community groups.

The initiative aims to establish the Bega Valley as the most circular regional economy in Australia by 2030. It will enable projects to connect businesses, who can work together to create an industrial ecology that allows by-products from one industry to be used as resources for another. The program aims to move beyond zero waste and optimised recycling to establish regenerative economic, environmental and social development for the region.

As practical applications of the circular economy emerge (see example in Box – Bega Circular Valley), the demand for robust circular economy metrics, indicators and standards is expected to grow. While technological barriers are often highlighted as obstacles for circular economy adoption, significant policy, regulatory, economic and social challenges also hinder progress across various sectors, including the food system (Arsic et al., 2022). To help address some of these barriers, a range of circularity index metrics can be applied to the food system (Table 3).

Table 3: Examples of Australian circular economy metrics that may be applied to food systems

General circular economy metrics (Miatto et al., 2024)
End-of-life recycling rate (the percentage of a material in waste that is recycled)
Circularity rate (the share of secondary materials against all materials used in the 'domestic material consumption' phase)
Theoretical circularity maximum (the percentage of materials that are used for purposes other than energy generation)
Circularity gap (relative difference between the current circularity rate and the theoretical maximum circularity achievable)
Circular economy metrics relevant for agrifood systems (Circular Australia, 2022)
Food production and waste (waste generated in the production, distribution and consumption of food)
Share of waste recovered for energy (percentage of solid waste diverted from landfill and recovered through thermal processes)
Nutrient capture and reuse (e.g. tonnes of nutrients in organic waste streams that are processed and returned to soils)
Material recycling rate (percentage of solid waste diverted from landfill and recovered through material recycling, e.g. plastic packaging or organics recycling processes)

Significant work remains in defining appropriate metrics for food systems, particularly in managing risks including food safety, pollution avoidance and land-use change. Given the cross-sectoral nature of circular material flows, these risks must be addressed in new and integrated ways. Metrics and measurement frameworks must be carefully designed and selected to accurately represent biological materials, account for variations in scale (from individual businesses to entire regions) and align with available data. The UN Economic Commissions for Europe has begun the global discussion to set the framework for assessing circularity through the Guidelines for Measuring Circular Economy, which provide a set of guiding principles that Australia could adapt to suit our system (UNECE, 2024).

Improving circularity involves connecting surplus or unwanted materials from one part of the economy with areas where they can be repurposed effectively.

7.3 Priorities for action

Several recent roadmaps for the agriculture, food, protein and nutraceutical industries highlight the need to enhance circularity across Australia's food system. Improving circularity involves connecting surplus or unwanted materials from one part of the economy with areas where they can be repurposed effectively. Achieving this will require better alignment of regulation and policy across local, state and federal jurisdictions, ensuring a coordinated approach to circular economy implementation.

Priorities for action include mapping current biological material flows to support food loss and waste reduction through strategies such as:

- increasing food recovery by diverting food to food rescue organisations
- developing new food products and manufacturing processes that transform safe, high-quality, food-grade by-products into new food products (see description of NutriV Goodies vegetable snacks in Box – Fighting food waste with novel food products)
- commercialising upcycled second-grade food products to maximise resource use and reduce waste (see description of Grainstone spent grain flour in Box – Fighting food waste with novel food products).

Fighting food waste with novel food products

NutriV Goodies process pre-retail vegetable losses into powders that are made into snacks. Each pack of snacks contains two servings of vegetables. This company offers an avenue for farmers to sell produce that does not meet certain retail standards and would otherwise go to waste.

Grainstone spent grain flour is made from brewers' spent grain – the mash that remains after brewing beer or spirits. It has been commercialised into a flour with enriched protein content, reduced carbohydrates and high prebiotic value. This is a higher value product than the animal feed that is usually made from brewers' spent grain, and it benefits human nutrition.

Other strategies include:

- developing sustainable and viable pathways for circular agricultural, industrial and energy products
- supporting alternative uses of food and agricultural waste by developing new products and technologies for bioenergy, biofertilisers and biochemicals that can replace fossil fuel–based fuels and chemicals
- reviewing waste-related regulation to recognise that human health and the environment can be protected in ways that enable a more circular economy
- recognising how circular products reduce waste disposal costs and internalise the societal cost of environmental impacts, helping early-stage circular businesses scale efficiently
- establishing efficient coordination mechanisms that enable regulators to collaborate with waste producers, processors and researchers to uphold food safety and environmental standards through measuring, monitoring and mitigating risks such as pathogens, chemical contaminants, odours and excess environmental nutrients
- developing concrete metrics and analytical tools to measure how circular products in the food system contribute to broader sustainability goals and targets.