Australia’s National Science Agency

Circular Economy: Potential and Economic Implications

Keynote Presentation at the Waste Expo Australia, Melbourne, 30 October 2025

Heinz Schandl

Economic Development and SGDs trade-offs

Human well-being needs:

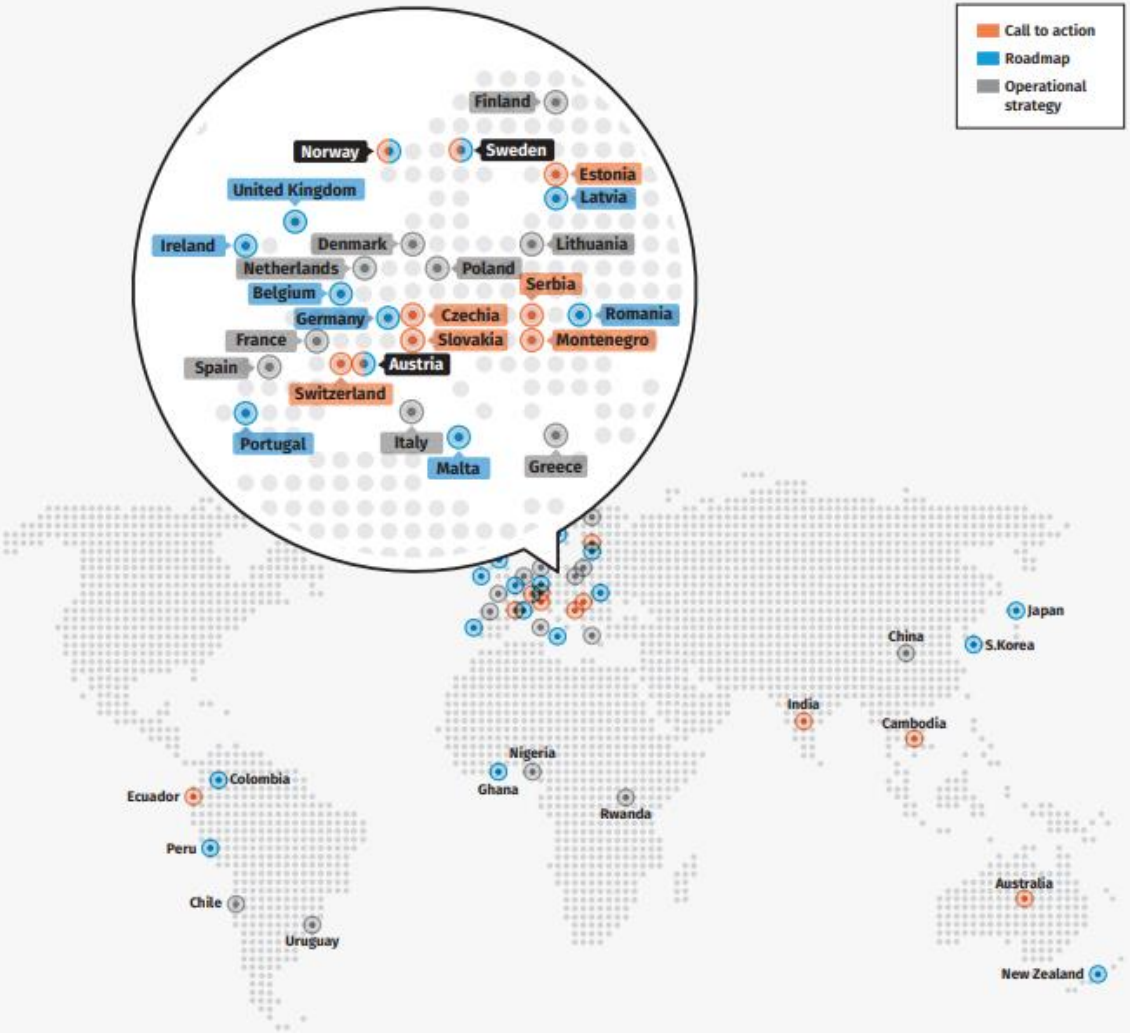
- Buildings
- Infrastructure
- Disposable income
- Even distribution

These activities result in:

- Emissions
- Resource extraction
- Biodiversity loss

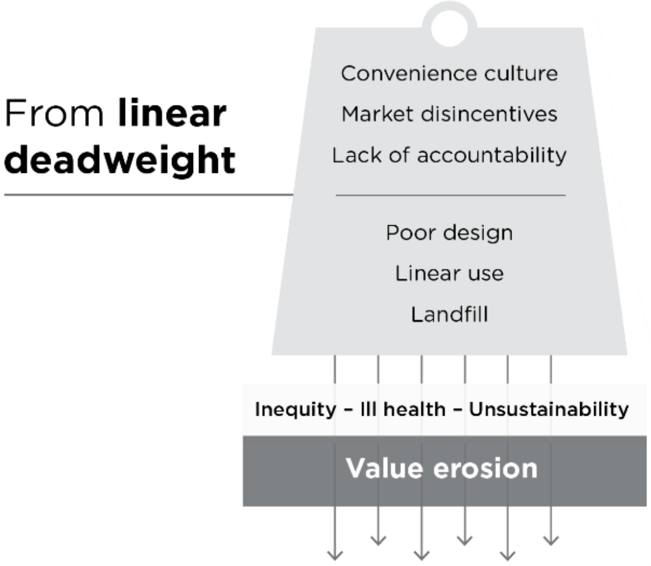
Undermining these achievements…

- At some point the environmental pressures will undermine these achievements



Call to action
Roadmap
Operational strategy
Finland
Norway
Sweden
Estonia
Latvia
United Kingdom
Ireland
Denmark
Lithuania
Netherlands
Poland
Serbia
Belgium
Germany
Czechia
Romania
France
Slovakia
Montenegro
Spain
Austria
Switzerland
Portugal
Italy
Malta
Greece
Japan
China
S.Korea
India
Cambodia
Nigeria
Ghana
Rwanda
Colombia
Ecuador
Peru
Chile
Uruguay
Australia
New Zealand

Circular Economy Theory of Change



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Benefits of a Circular Economy

- **Environmentally,** it means lower emissions, less pollution, and healthier ecosystems.
- **Economically,** it gives us stronger trade competitiveness, greater resilience in supply chains, and drives innovation in design and materials.
  For **industry**, this opens new markets in recycling technologies and product-as-a-service.
- For **communities**, it means cleaner environments, regional jobs, and affordable access to goods.
- And **socially,** circularity helps tackle housing, cost-of-living, and productivity challenges.

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RESEARCH ARTICLE

JOURNAL OF INDUSTRIAL ECOLOGY WILEY

Australia's circular economy metrics and indicators

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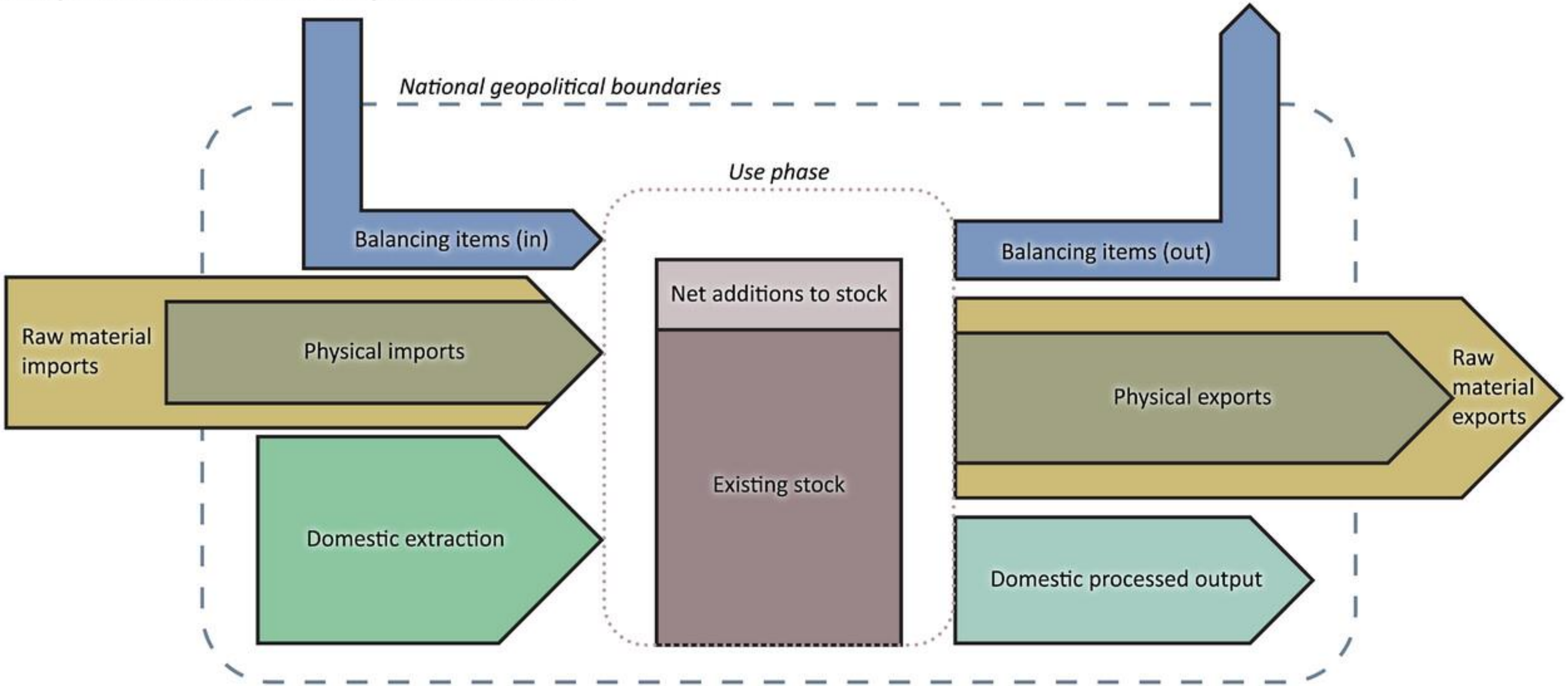
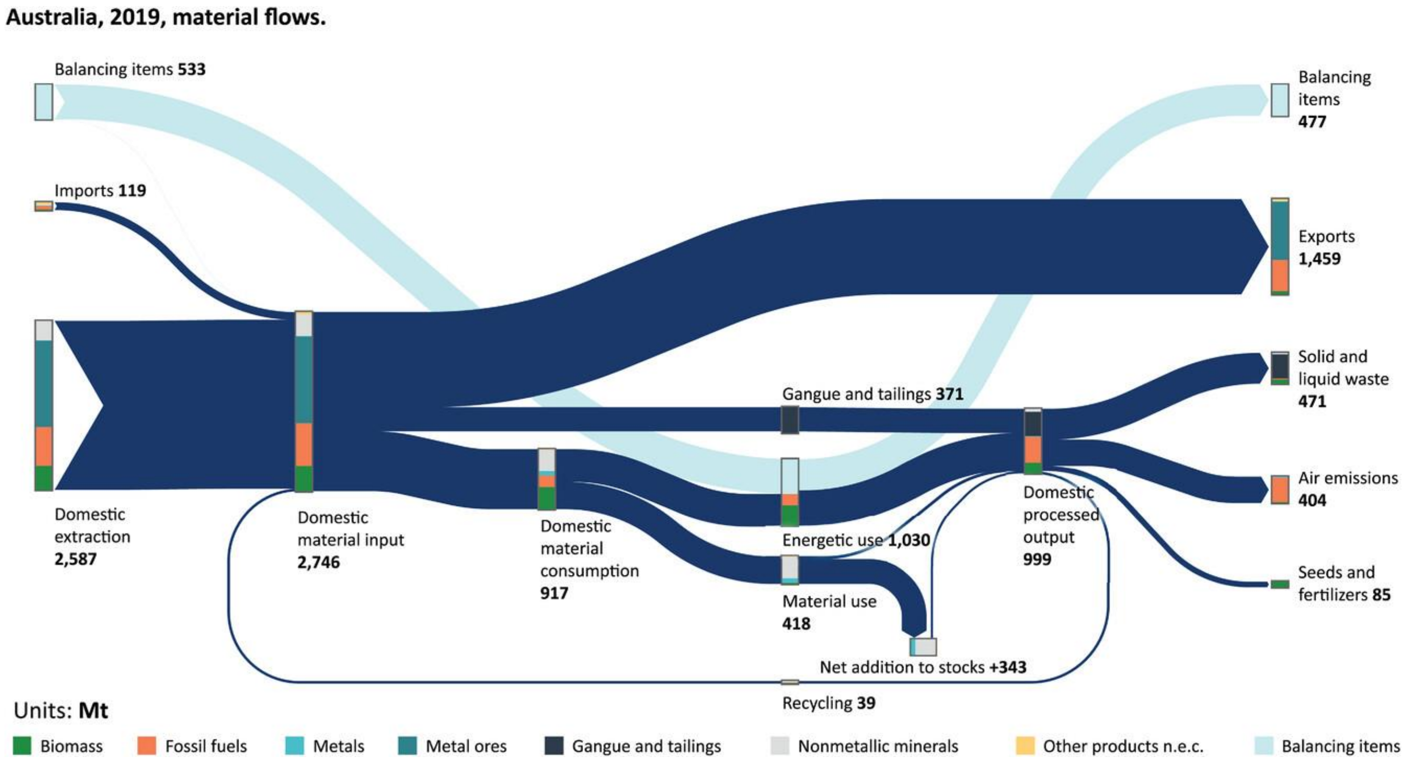
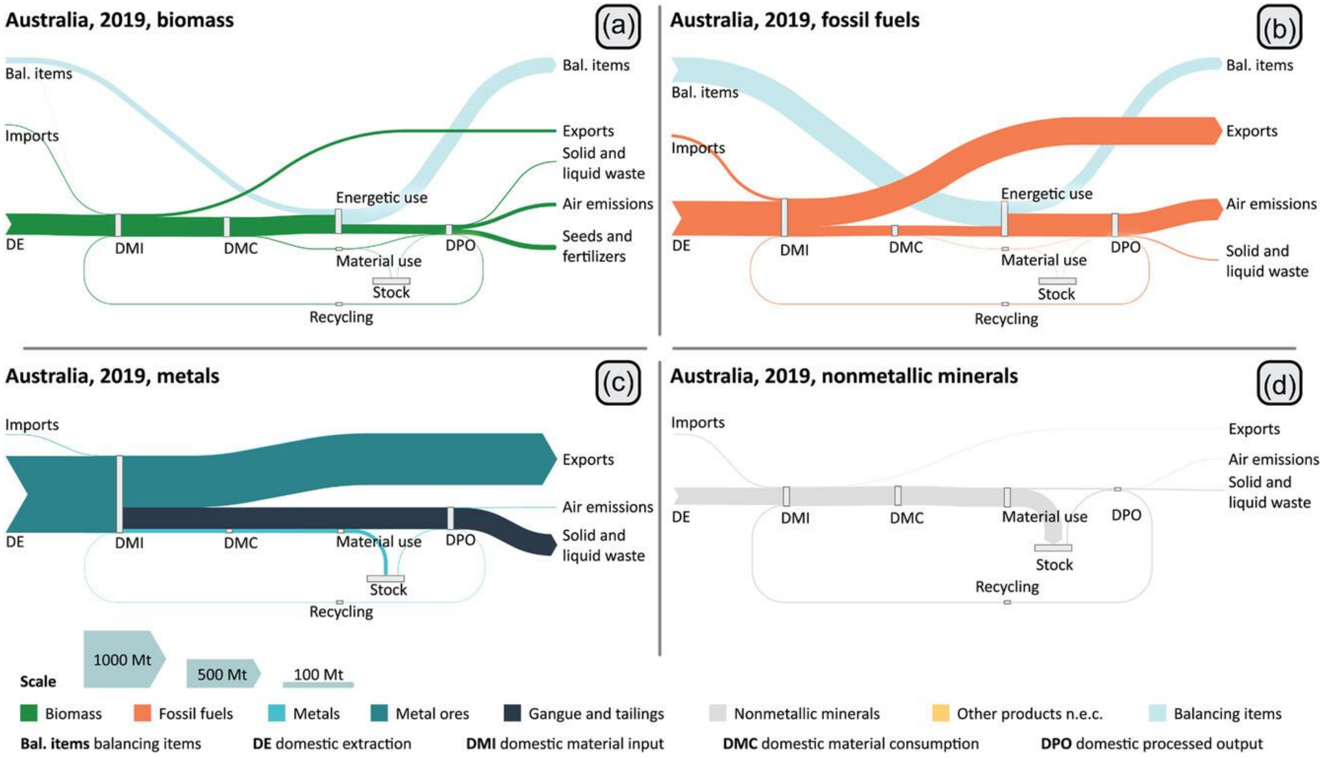
Conceptual material flow analysis framework.



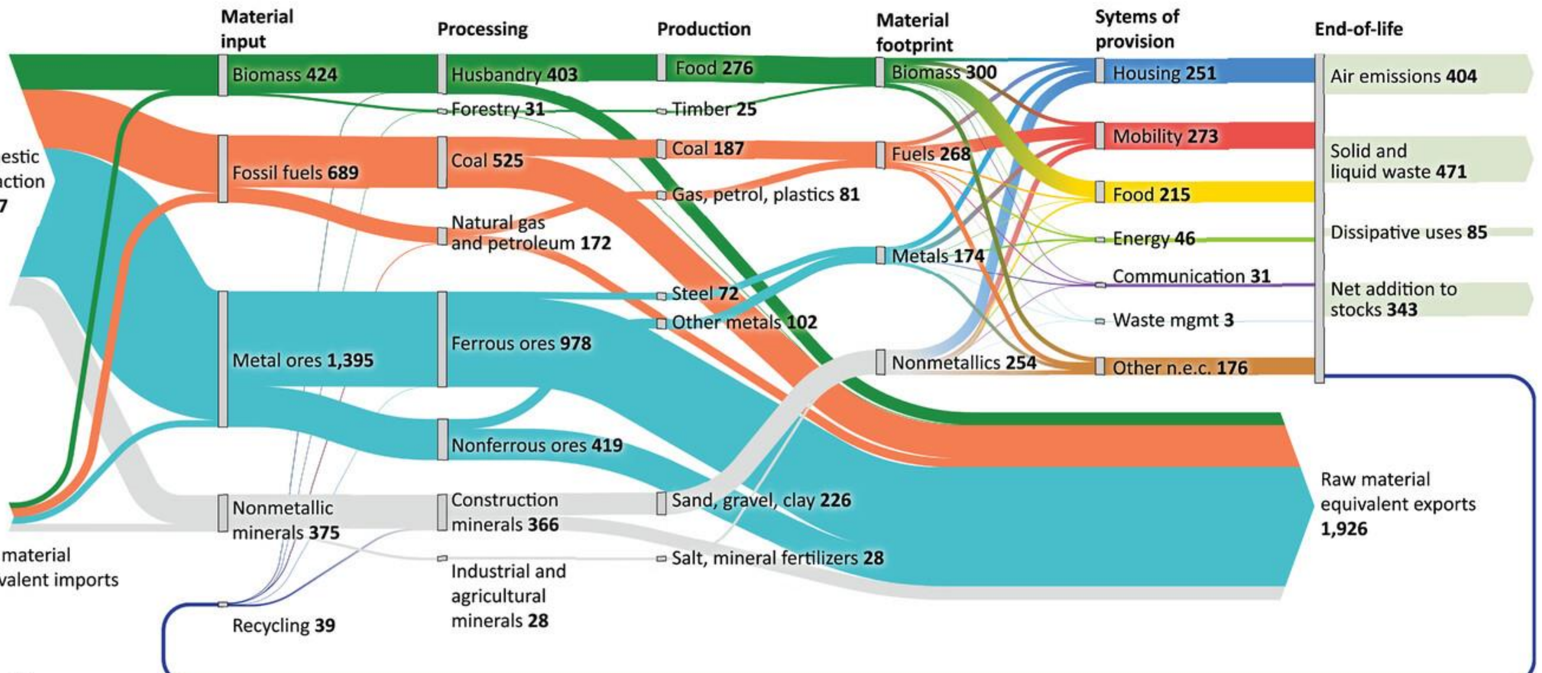
Material Flows in Australia





Australia, 2019, biomass
(a)
Bal. items
Imports
DE
DMI
DMC
Energetic use
Material use
Stock
Recycling
DPO
Bal. items
Exports
Solid and liquid waste
Air emissions
Seeds and fertilizers
Australia, 2019, fossil fuels
(b)
Bal. items
Imports
DE
DMI
DMC
Energetic use
Material use
Stock
Recycling
DPO
Bal. items
Exports
Air emissions
Solid and liquid waste
Australia, 2019, metals
(c)
Imports
DE
DMI
DMC
Material use
Stock
Recycling
DPO
Exports
Air emissions
Solid and liquid waste
Australia, 2019, nonmetallic minerals
(d)
Imports
DE
DMI
DMC
Material use
Stock
Recycling
DPO
Exports
Air emissions
Solid and liquid waste
Scale
1000 Mt
500 Mt
100 Mt
Biomass
Fossil fuels
Metals
Metal ores
Gangue and tailings
Nonmetallic minerals
Other products n.e.c.
Balancing items
Bal. items balancing items
DE domestic extraction
DMI domestic material input
DMC domestic material consumption
DPO domestic processed output

Australia, 2019, material footprint.



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Full length article

Detailed waste flows and circularity rates reveal the limits of the circularity gap concept

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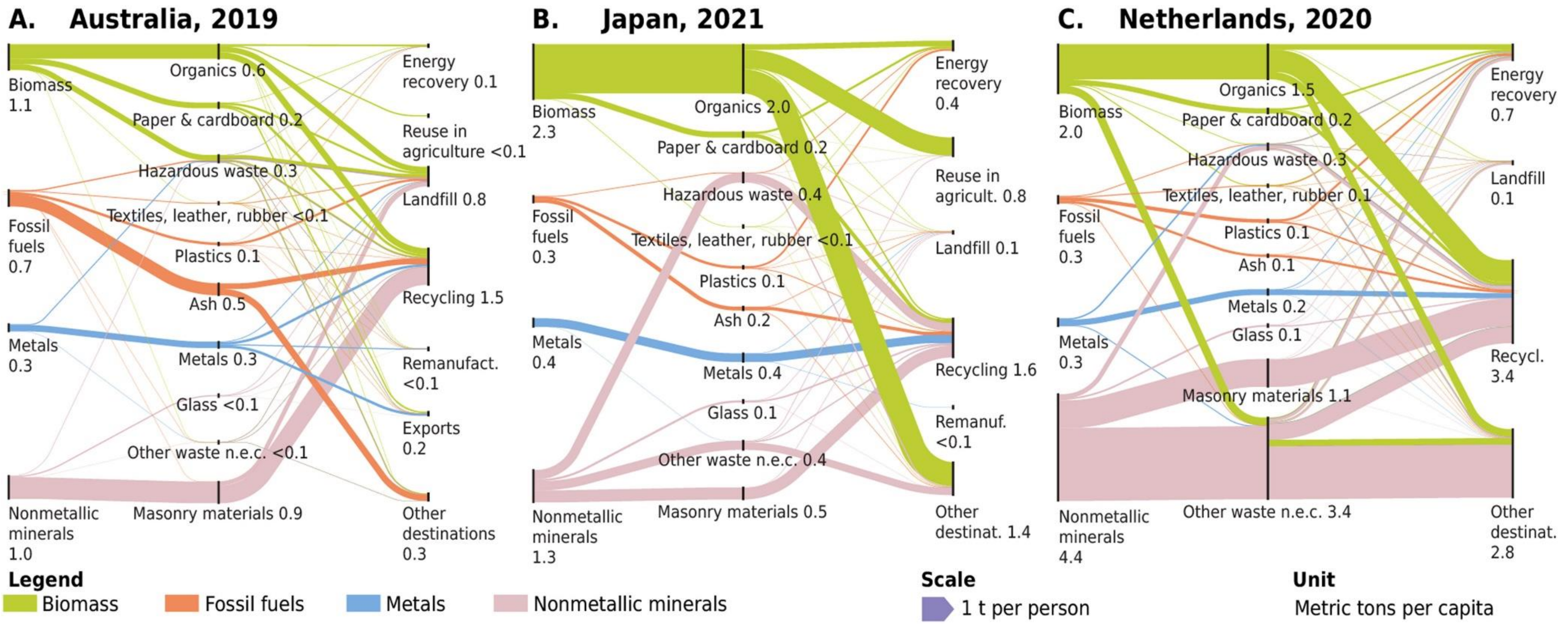
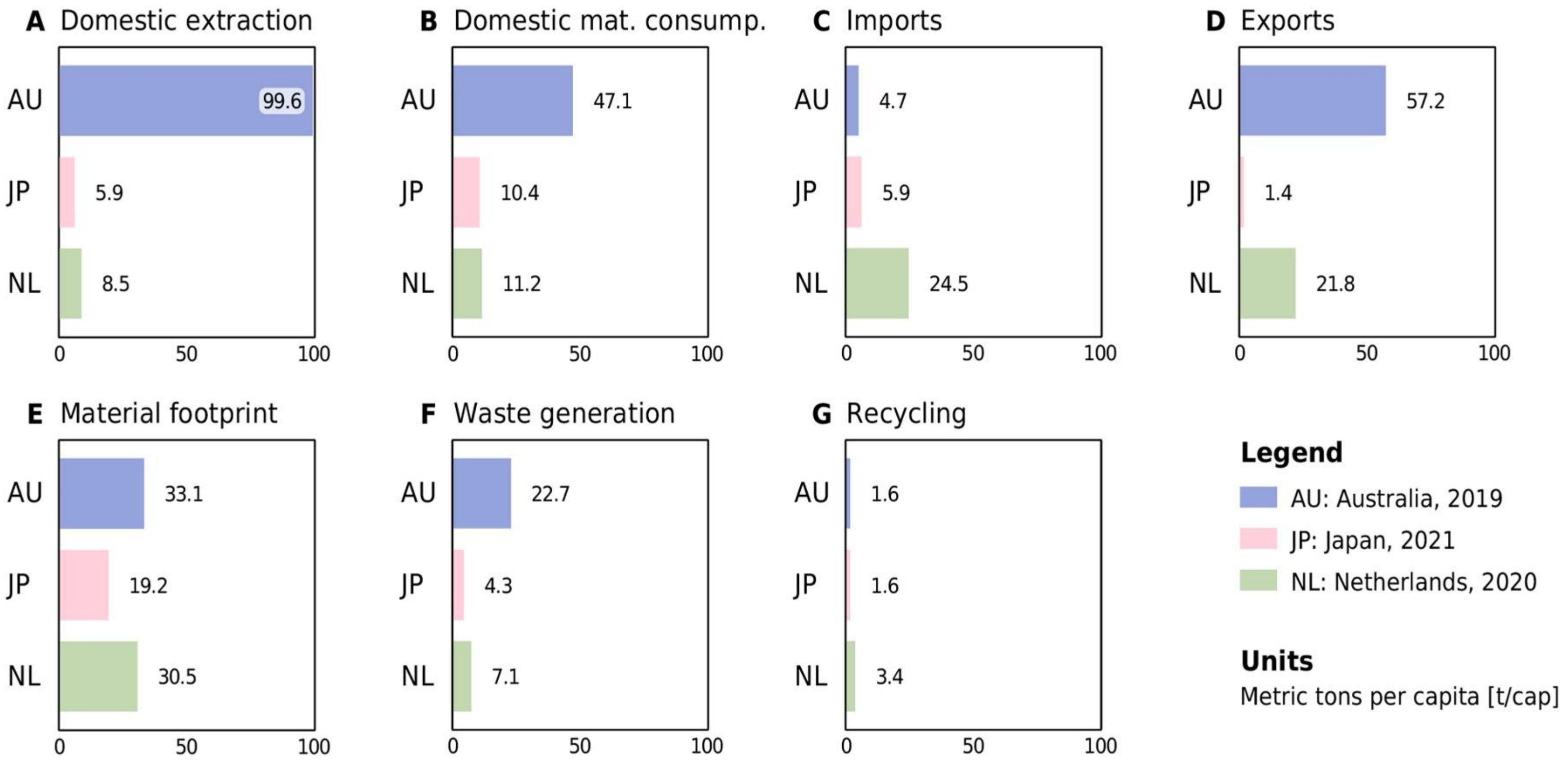
[d] Institute of Environmental Sciences (CML), Leiden University, the Netherlands

Core waste generation and fate



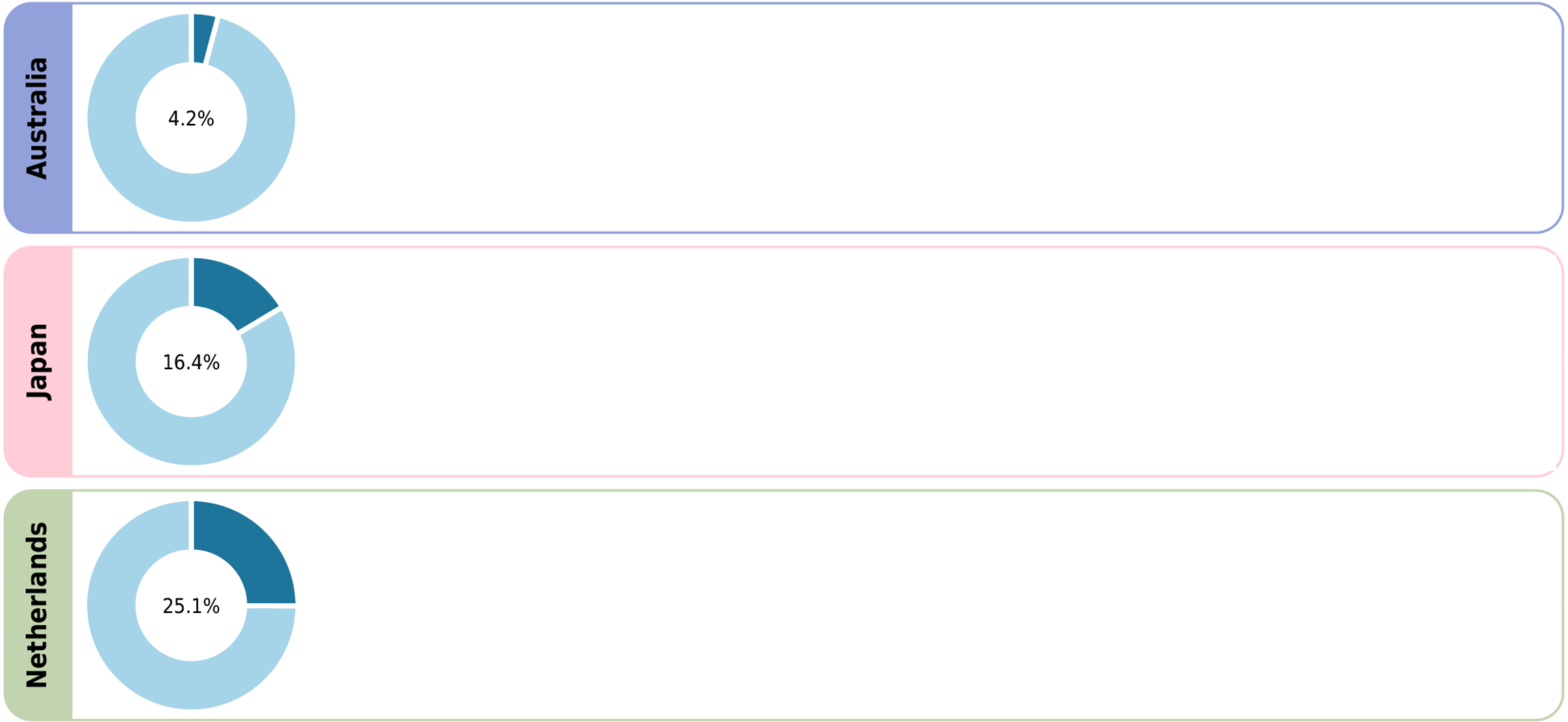
Miatto et al. 2025. Detailed Waste Flows and Circularity Rates Reveal the Limits of the Circularity Gap Concept. Resources, Conservation and Recycling

Key Material Flow Indicators: Australia, Japan, the Netherlands



Comparison of Circularity and Potential

Current circularity



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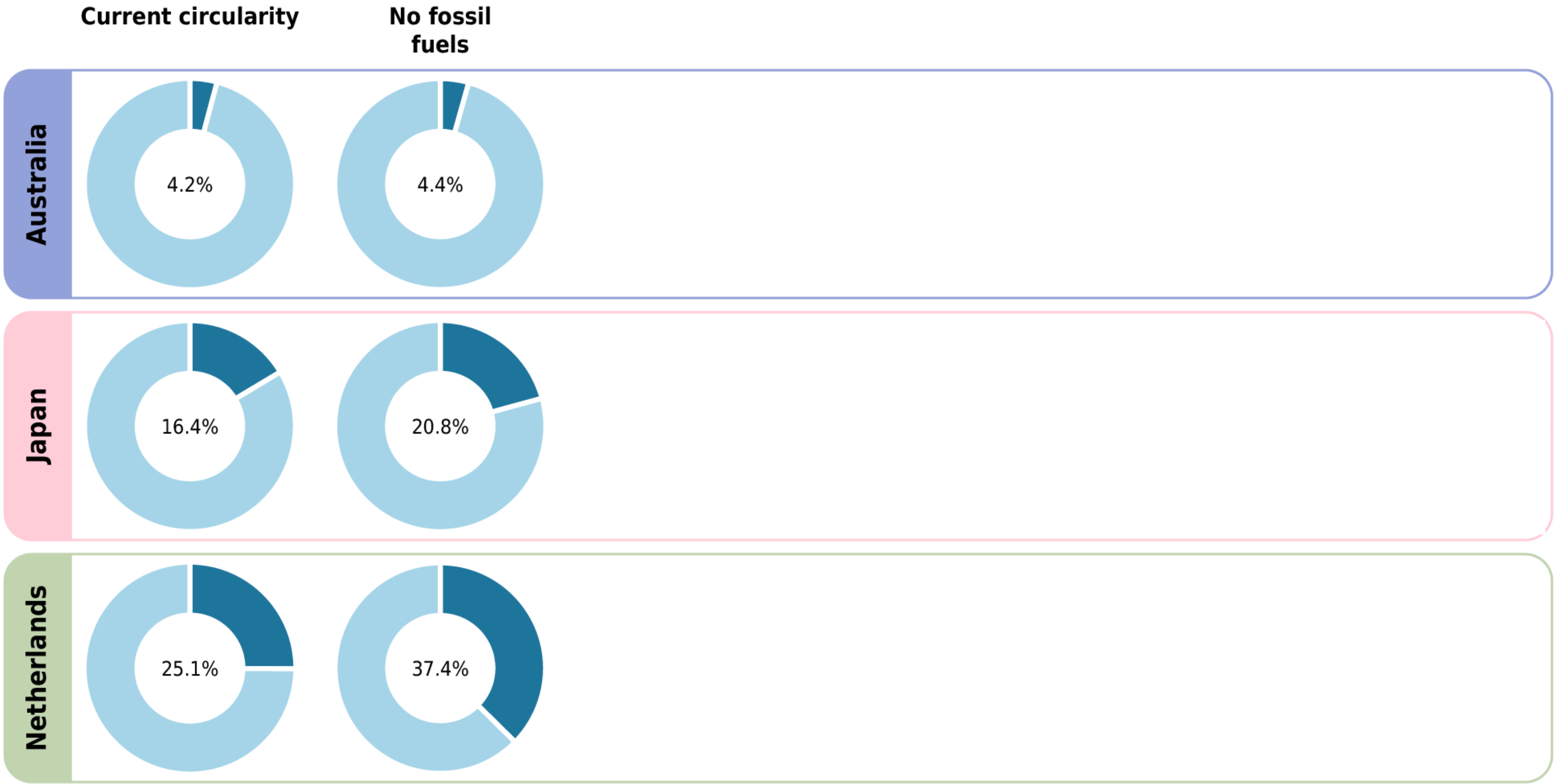

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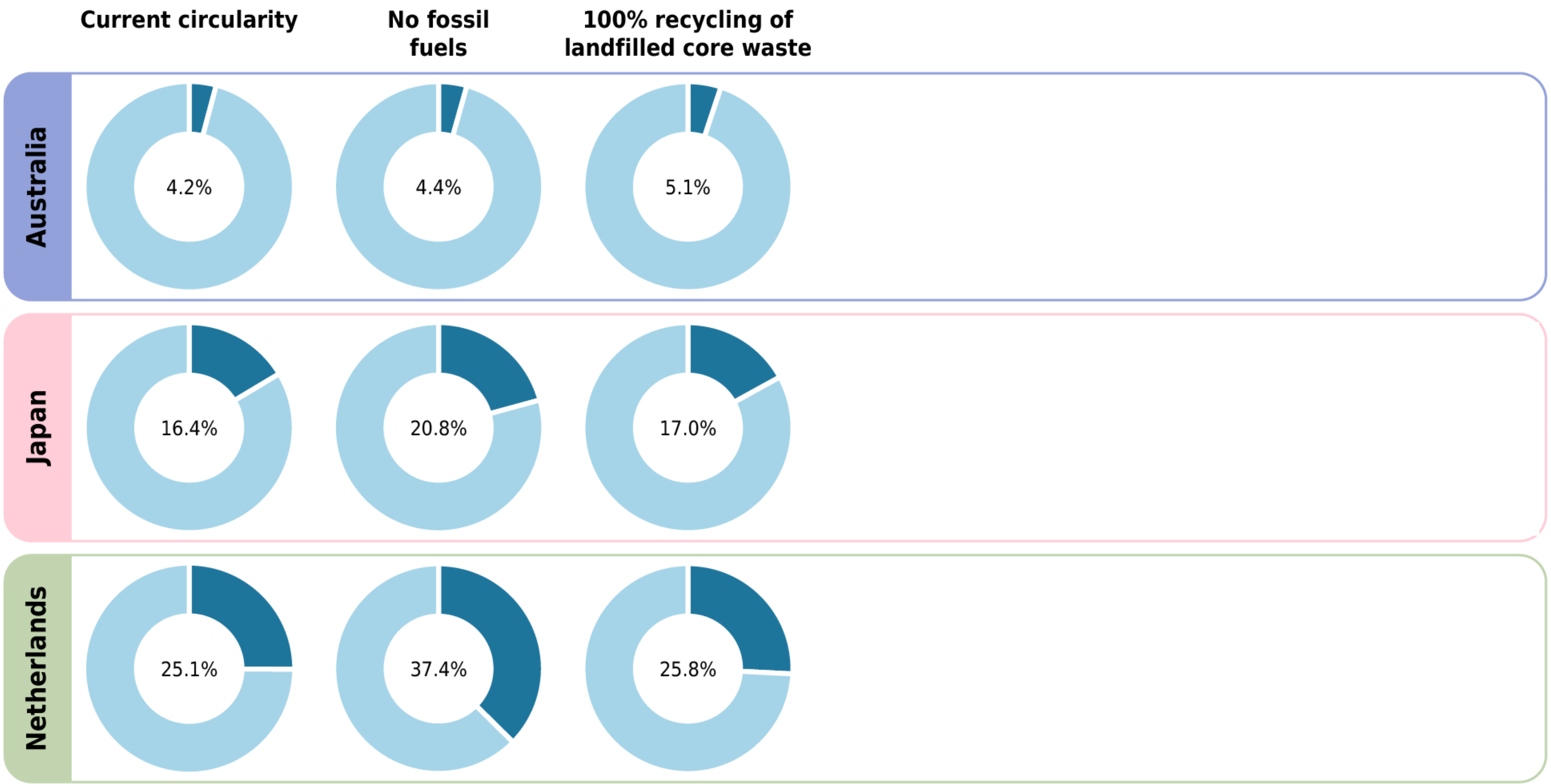

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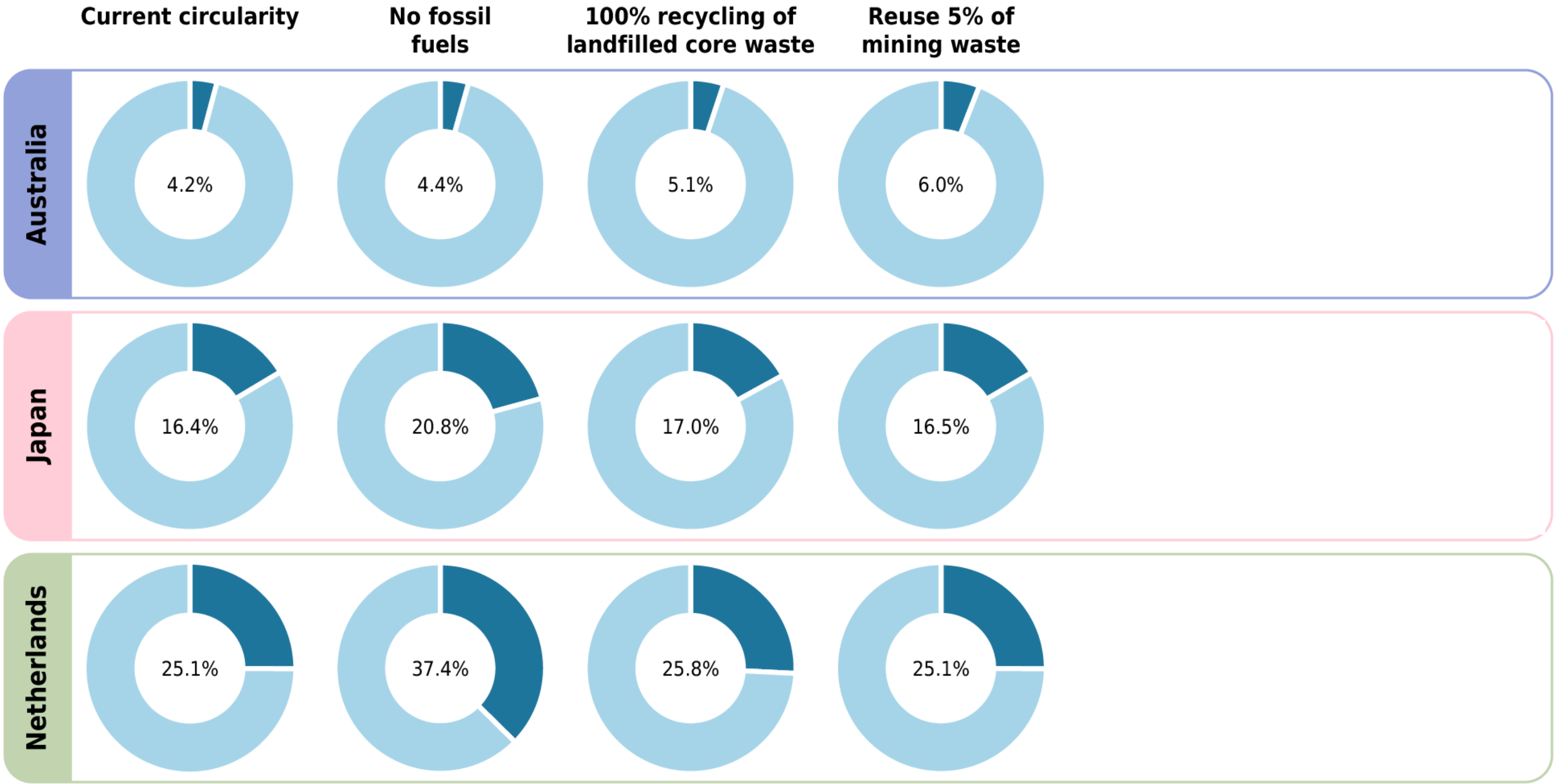

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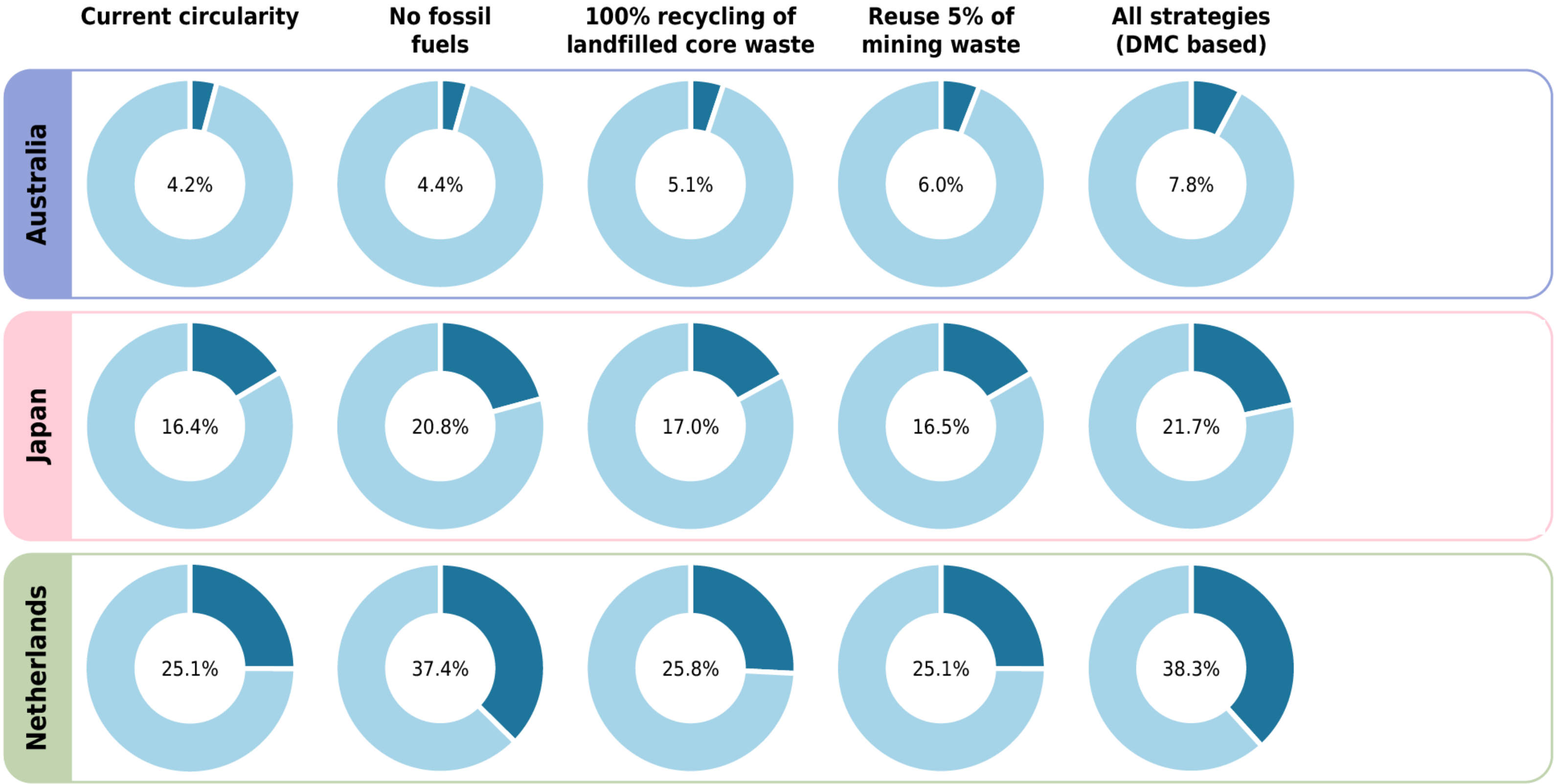

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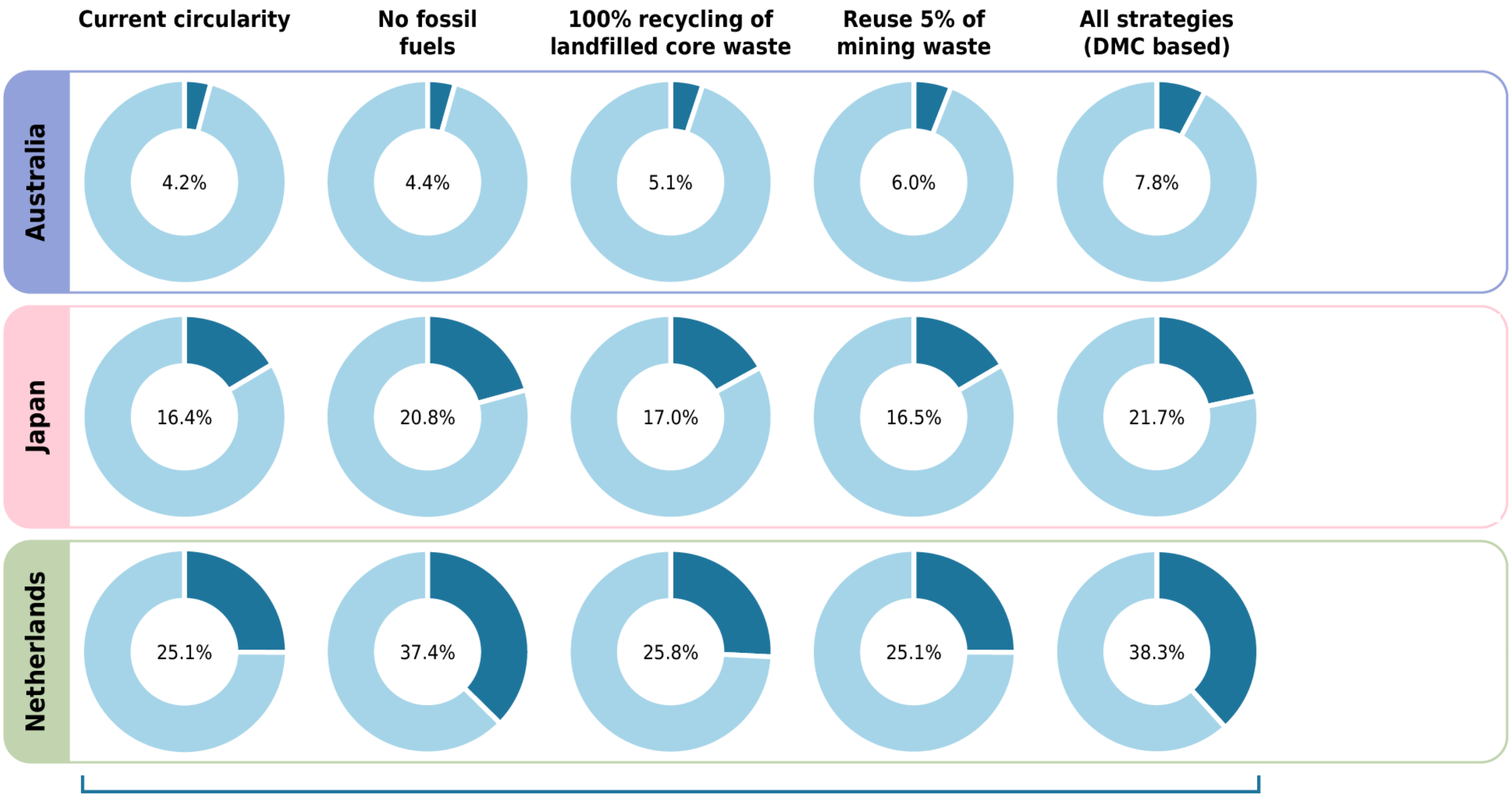
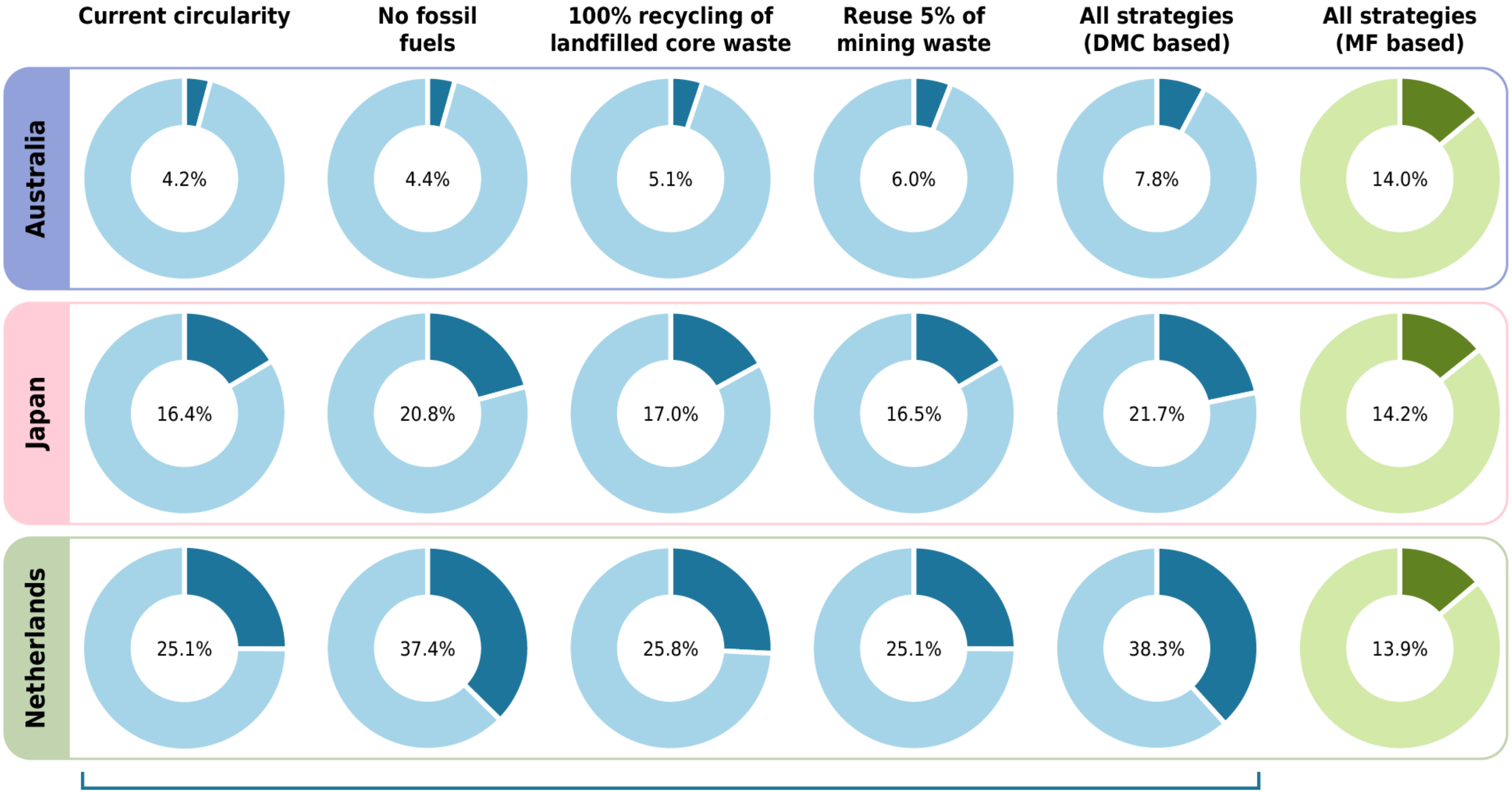


Circularity = % of secondary materials in the domestic material consumption

Comparison of Circularity and Potential



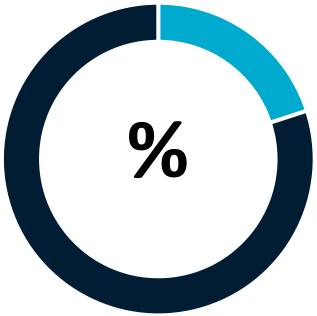
Circularity = % of secondary materials in the domestic material consumption

Circular Economy: overall objective

The circular economy as an economic strategy

- Minimise resource extraction
- Create local jobs and resilience

Circularity rate

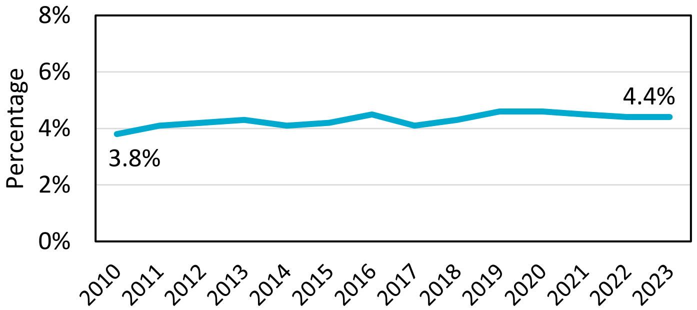


To track progress	Three Rs	Ten Rs
Material footprint	Reduce	R0 Refuse R1 Rethink R2 Reduce
Material productivity	Reuse	R3 Reuse R4 Repair R5 Refurbish R6 Remanufacture R7 Repurpose
Recycling rate	Recycle	R8 Recycle R9 Recover

Measuring What Matters ‘Circular Economy’

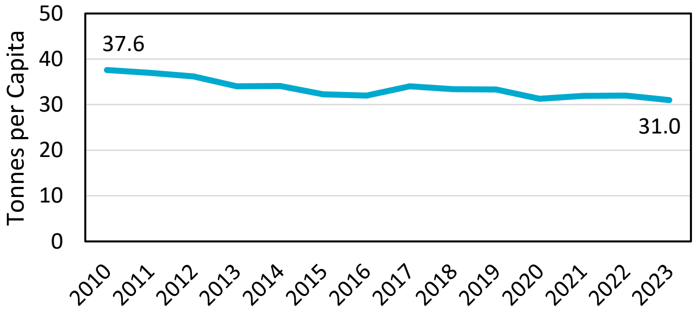
Circularity Rate

Share of secondary materials in overall material use



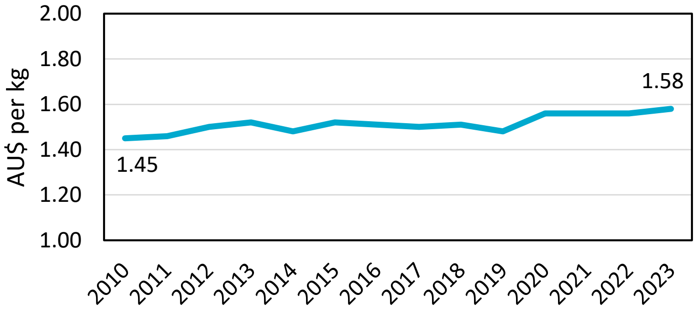
Material Footprint (Reduce)

Primary materials required for domestic final demand



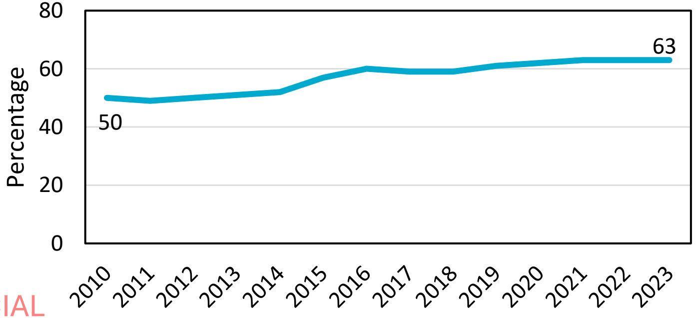
Material Productivity (Reuse)

Economic output per kg of material use



Waste Recovered (Recycle)

End-of-life materials returned to a next use



Imports: Consumer Goods and Embedded Resource Use

Challenge and potential

Heavy reliance on imported manufactured goods

- Embodied materials and energy occur offshore
- Limited domestic remanufacturing opportunities
- Value creation leaks to producer countries
- Opportunity to extend circularity upstream

Economic implications

Constraints on capturing circular economy dividends

- Need for reverse logistics infrastructure
- Right-to-repair laws essential
- Build local repair and refurbishment capability
- Circular procurement can re-localise value

Imports: Policy Priorities

Product Standards and Design

Mandate circular design and labelling in imported products
- Extended producer responsibility for electronics, textiles, vehicles
- Prefer remanufactured, modular, recyclable, repairable goods
- Set design standards through procurement policy

Trade and Capability

Negotiate trade arrangements rewarding circular practices
- Ensure transparency of embodied materials and carbon
- Strengthen domestic repair and refurbishment capability
- Reduce dependency on linear imports

CSIRO

Domestic Economy: Resource Systems

Challenge and potential

Extractive structure with low value capture

- Raw materials exported, waste underutilised
- Enormous potential in construction, infrastructure, and manufacturing
- Close loops within domestic material systems
- Reduce material intensity and environmental pressure

Economic implications

Shift from volume-based to value-based productivity

- Turn waste into secondary resources
- Service-based models: leasing, maintenance, reuse
- Transition costs: retooling, infrastructure, retraining
- Rebalance from extraction to circular manufacturing

Domestic Economy: Policy Priorities

Targets and Integration

- Material efficiency and productivity targets
- Integrate circularity into industrial policy
- Regional development supporting diversification
- Move away from resource extraction dependency
- Public procurement as a market pull for circular materials

Innovation and Infrastructure

- Support industrial symbiosis clusters
- Establish repair hubs and networks
- Design for disassembly standards
- Innovation ecosystems for circular solutions
- Regional employment in circular services

Exports: Raw Materials and Value Chains

Targets and Integration

Dominated by unprocessed/semi-processed materials

- Iron ore, coal, gas, bauxite, and lithium exports
- Vulnerability to volatile commodity markets
- Risk of stranded assets in incumbent sectors
- Opportunity to upgrade value chains

Innovation and Infrastructure

Moving up the value chain increases domestic income

- Improve resilience against market volatility
- Reposition as a circular materials hub for Indo-Pacific
- Investment in secondary materials infrastructure
- Transition to knowledge-intensive jobs

Exports: Policy Priorities

Strategic Positioning

Align trade and industry policy with circular export capacity

- Critical materials recovery and processing
- Renewable-powered refining infrastructure
- Green materials: low-carbon steel, recycled aluminium
- Battery precursors and advanced manufacturing

Support Mechanisms

Export finance for circular industries

- Innovation policy supporting new sectors
- Embed circularity metrics in export reporting
- Measure resource productivity per tonne
- Not just volume, but value and efficiency

The Strategic Vision

Imports

Address consumption and product design standards to avoid importing linearity

Domestic Economy

Industrial transformation, innovation, and jobs in value retention

Exports

Move up the value chain: export circular materials and services, not raw extraction

A Dual Strategy

Industrial Diversification and **Economic Sovereignty**

Reduce dependence on imports for manufactured goods AND on exports of raw commodities, while strengthening local circular value creation

Creating a Level Playing Field

- Secondary materials remain at a cost disadvantage – **market prices ignore environmental externalities**
- A **levy on virgin materials** can internalise true costs and reward material efficiency
- Applied bluntly, this risks raising input costs and reducing industrial competitiveness
- **A sequenced and balanced approach** can manage the transition:
  - Start with high-impact materials and phase in gradually
  - Recycle revenues to support innovation, tax reliefs, and circular infrastructure
  - Use procurement and standards to grow markets for secondary materials
- Outcome: Align price signals with sustainability, making waste costly and circular innovation profitable

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https://doi.org/10.1007/s43615-024-00460-9

SHORT COMMUNICATION

Mission-Oriented Research and Theory of Change: Driving Australia's Transition to a Circular Economy

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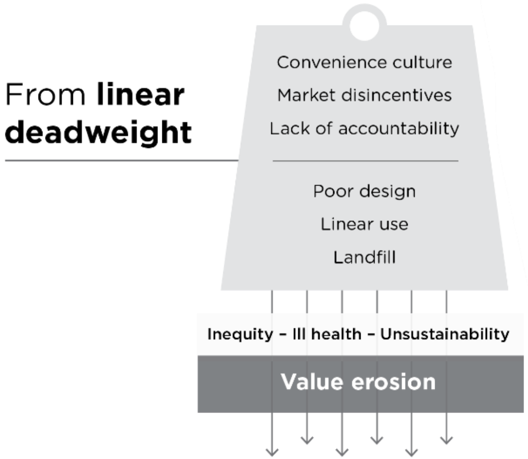
Circular Economy Theory of Change



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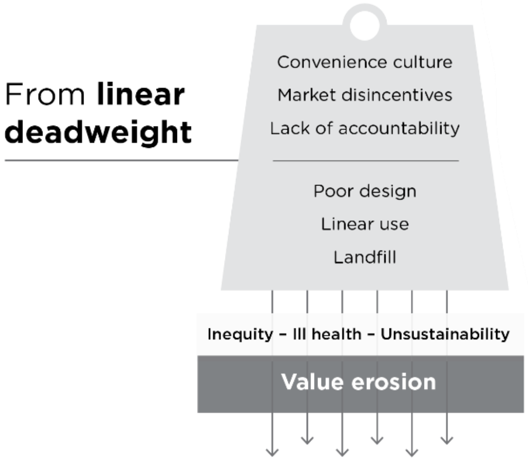

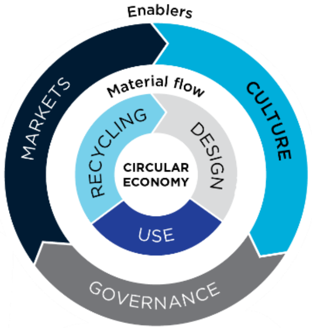

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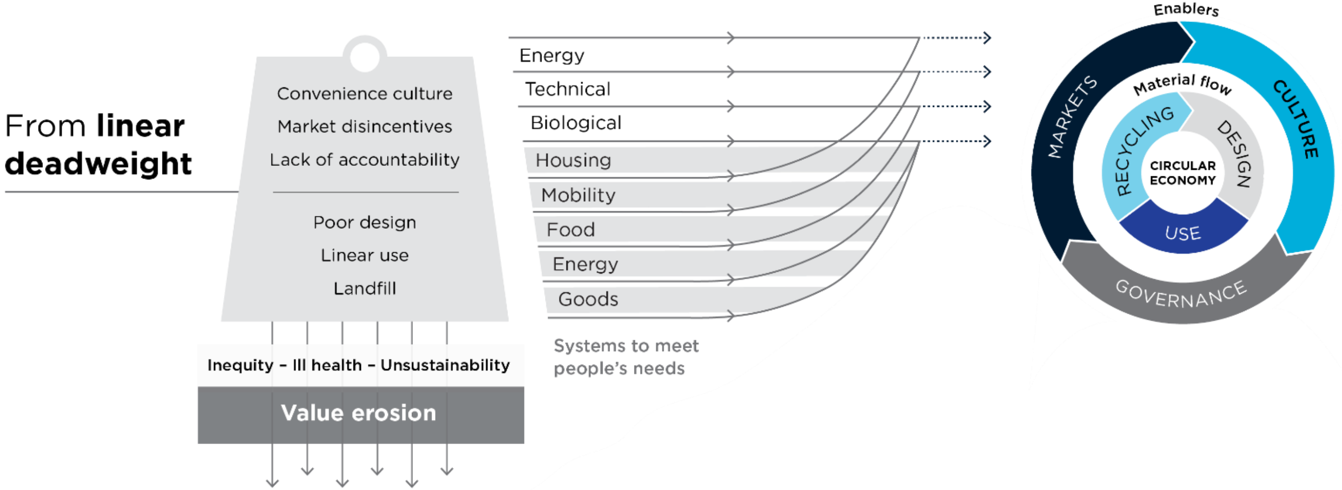

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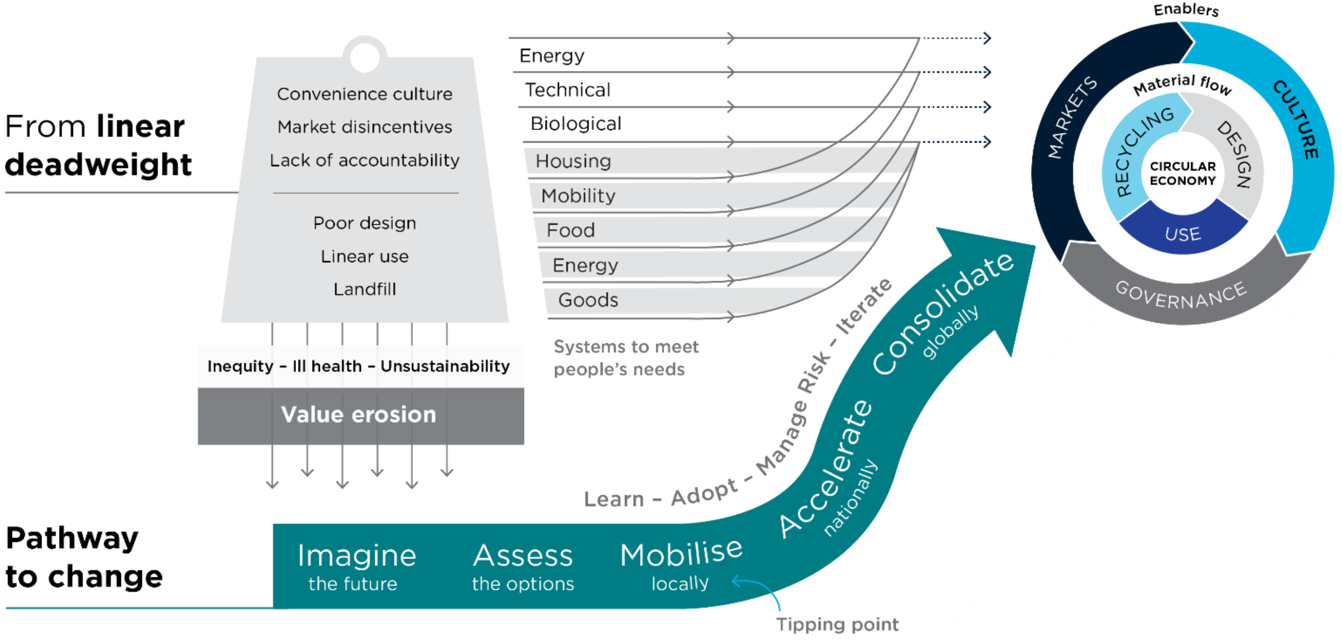

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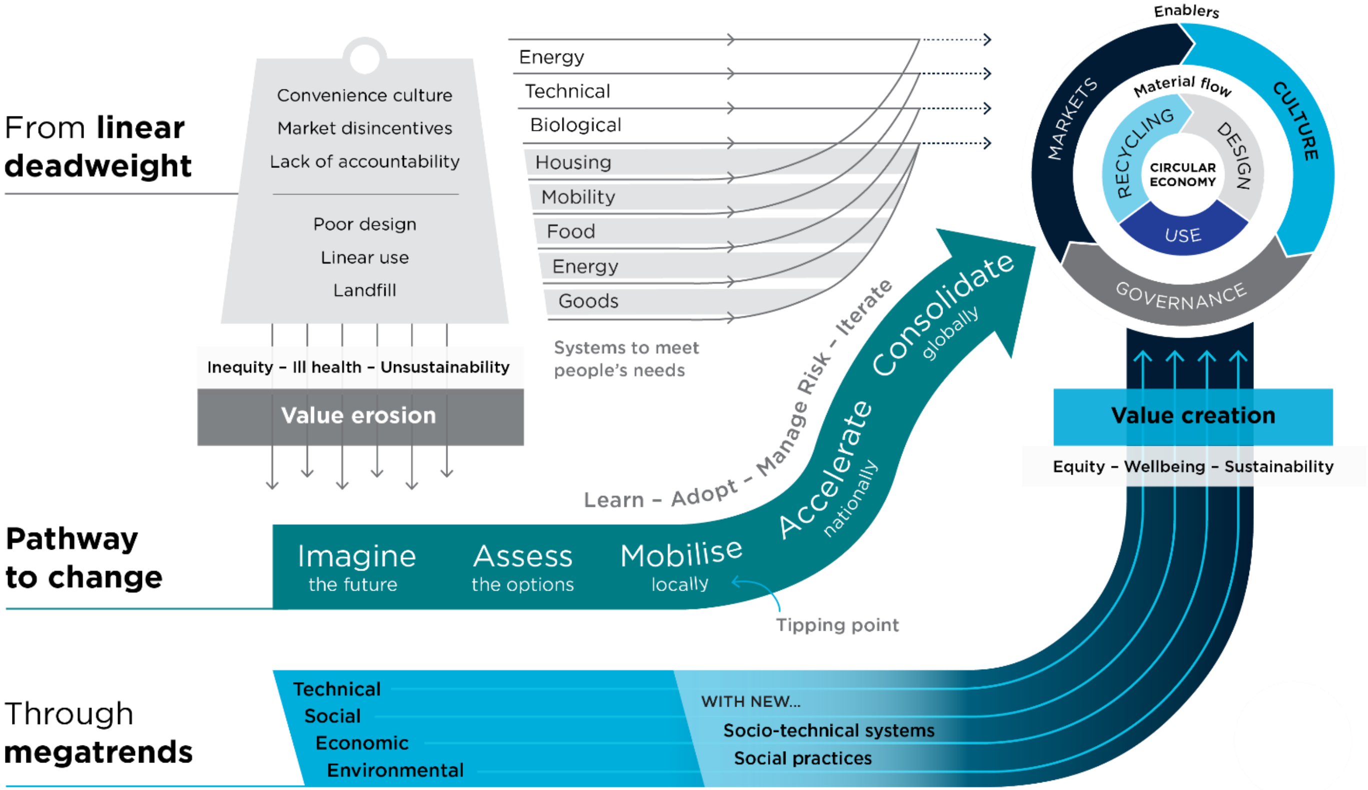
Circular Economy Theory of Change

How can we meet Australia's needs for a **circular economy**



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Circular Economy as Mission-Oriented Research

Bold, inspirational, and with wide societal relevance	Addresses key challenges: climate, nature, equity, and sustainable prosperity
A clear direction: targeted, measurable and time-bound	Metrics anchor policy frameworks with milestones, thresholds, and targets
Ambitious but realistic research and innovation actions	Science drives systems innovation, linking knowledge to experimentation, pilots and large-scale transitions

Circular Economy as Mission-Oriented Research

Cross-disciplinary, cross-sectoral and cross-actor innovation

Innovation bridges disciplines, sectors, and stakeholders to drive systemic change

Multiple bottom-up solutions

Diverse place–based solutions can converge and scale to drive regional and national transition

Thank you

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