The Development of Circular Economy for Sustainable Development

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December 8th, 2021

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About me

- PhD from Linköping University, Sweden (2021)
- MSc Sustainable Development (2016)
- BSc Business Informatics

JOHANNES KEPLER UNIVERSITÄT LINZ · MYKOLAS ROMERIS UNIVERSITY · UNI GRAZ · Utrecht University · LINKÖPING UNIVERSITY

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Linköping Studies in Science and Technology
Dissertation No. 2119

Simulation Modelling of a Shift to Service-Based Offerings

Resource efficiency and operational implications in the context of the circular economy

Wasserbaur, Raphael, et al. "What if everyone becomes a sharer? A quantification of the environmental impact of access-based consumption for household laundry activities." *Resources, Conservation and Recycling* 158 (2020): 104780.
Sakao, Tomohiko, Raphael Wasserbaur, and Fabrice Mathieux. "A methodological approach for manufacturers to enhance value-in-use of service-based offerings considering three dimensions of sustainability." *CIRP annals* 68.1 (2019): 33-36.
Wasserbaur, Raphael, and Tomohiko Sakao. "Conceptualising Design Fixation and Design Limitation and Quantifying Their Impacts on Resource Use and Carbon Emissions." *Sustainability* 12.19 (2020): 8104.

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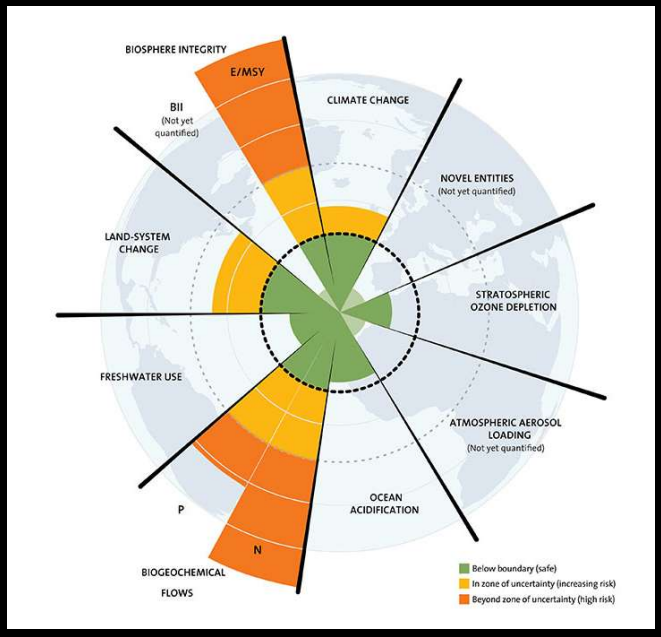

https://www.stockholmresilience.org/research/planetary-boundaries.html

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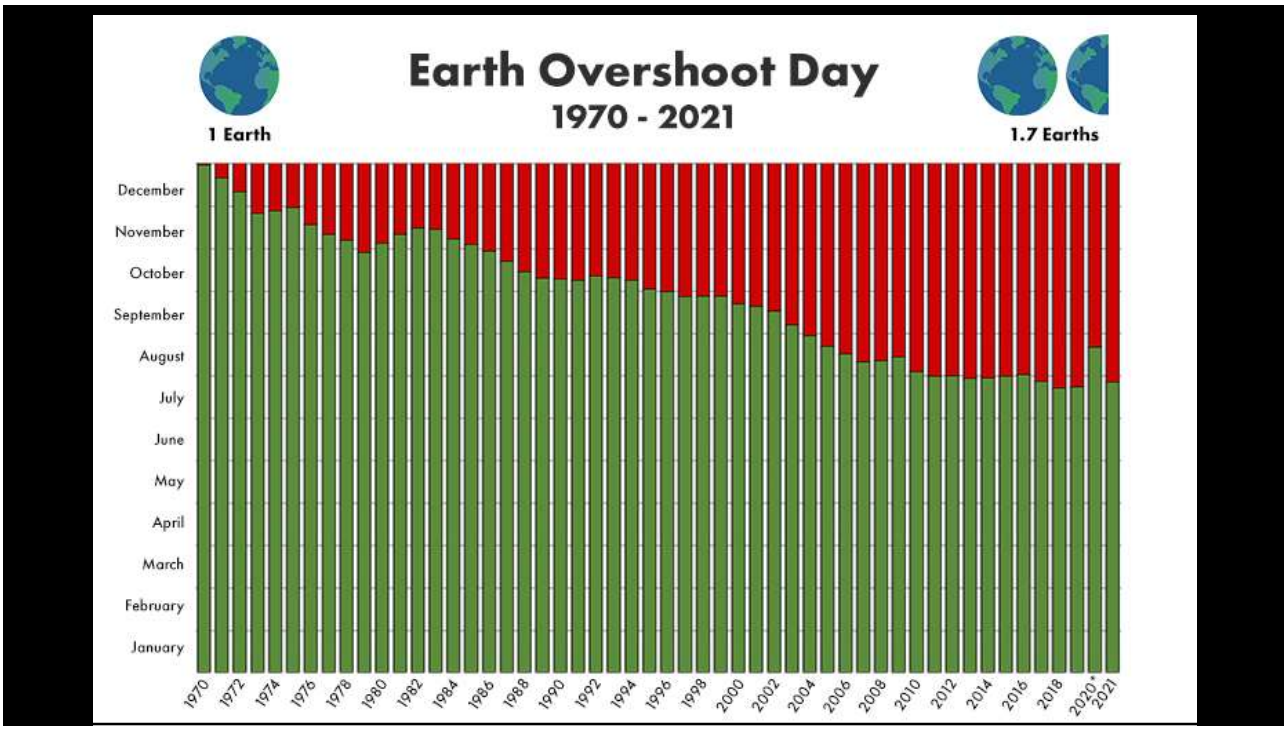
Earth Overshoot Day
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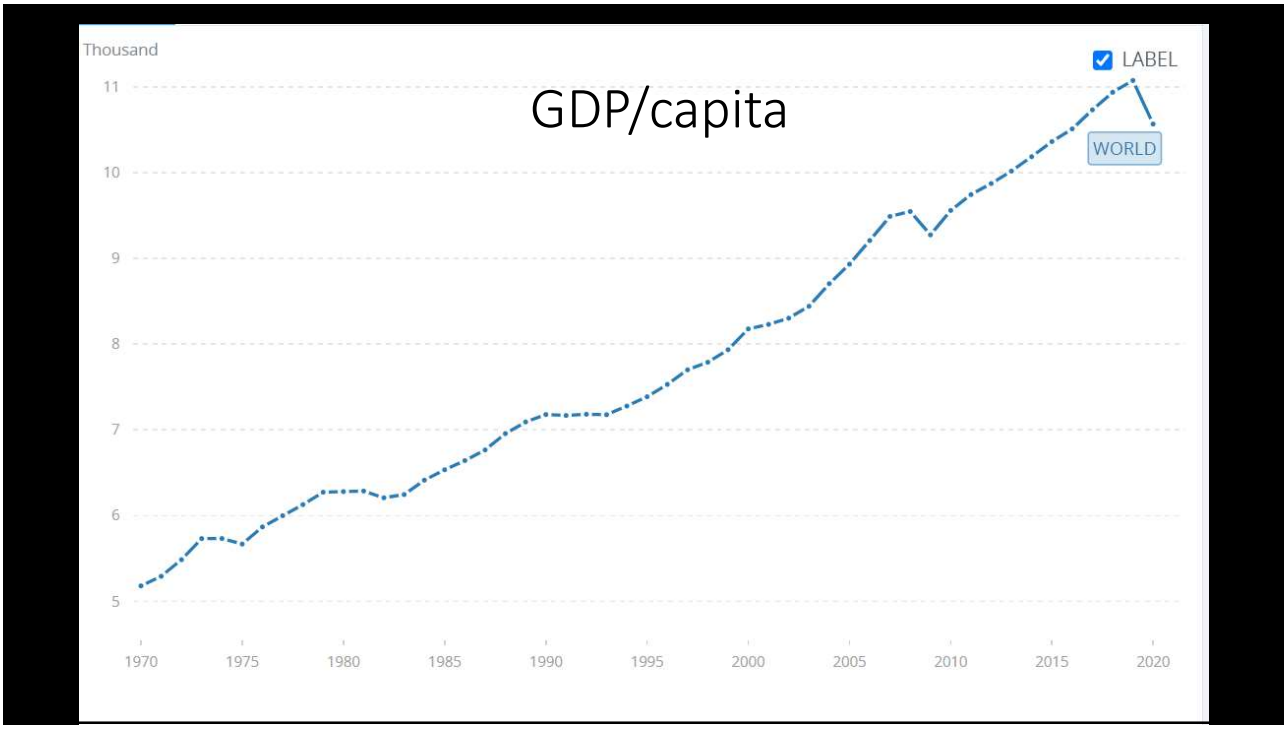
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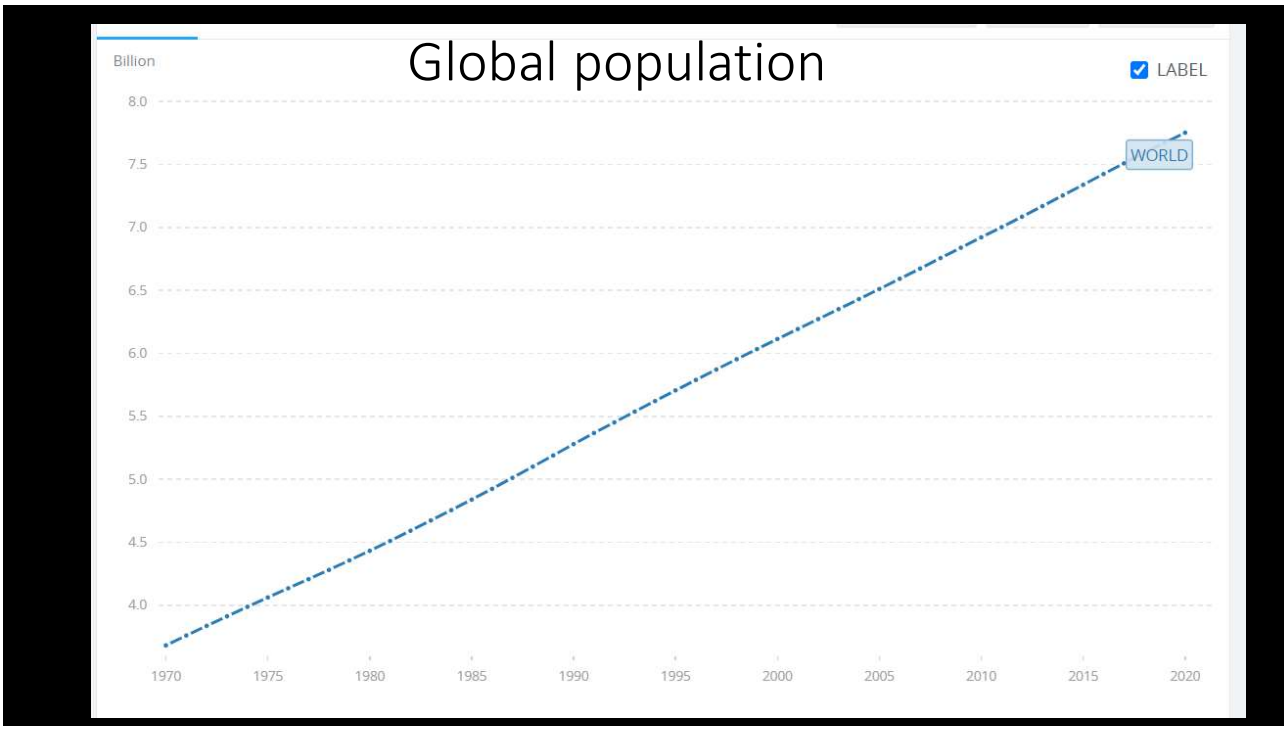

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$$I = P \times A \times T$$

emissions | # of people | $\frac{\text{consumption}}{\text{person}}$ | $\frac{\text{emissions}}{\text{consumption}}$

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Sustainable Development

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Report, 1987)

https://www.quora.com/What-are-sustainable-development-goals

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Sustainable Development Goals

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Sustainable Development Controversies

- Global North – Global South (Developing – Developed countries)
- Current generations – future generations
- Scientific knowledge
- Eco-centrism - anthropocentrism

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What is an economy?

An economy is **the large set of inter-related production and consumption activities that aid in determining how scarce resources are allocated**. In an economy, the production and consumption of goods and services are used to fulfill the needs of those living and operating within it.

https://www.investopedia.com/terms/e/economy.asp

A system that makes value/utility

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What is a Circular Economy?

A regenerative industrial system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops, in order to keep products, components and materials at their highest utility at all times.

(Geissdoerfer, Savaget, Bocken, et al., 2017) .

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What is a Circular Economy?

A system that makes and retains value/utility.

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1970-1990: Output focus

- Focus on output pollution prevention:
- Spaceship earth (1966), Limits to growth (1972)
- Pearce and Turner (1990) „Circular economy“
- 3R concept
- Cleaner production, polluter pays, end-of-pipe
- Landfill bans

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1990-2010: Connecting input and output

- Rio de Janeiro: UNFCCC 1992
- Germany passed laws for closed-loop recycling in 1996,
- Japan implemented policies for a sound material-cycle society in 2000,
- CE used in five-year plans in China in 2002,
- Extended producer responsibility, waste hierarchy, a clear definition of waste
- Planetary boundaries, Ecological footprint
- Efficiency gains = reputation gains = business gains
- Design for environment

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2010 – now

- Ellen MacArthur Foundation
- Industrial ecology, environmental economics
- Renewable resources, bio-mimicry, cradle2cradle
- Lifecycle thinking, systems thinking
- CE an operationalisation of sustainable development for business (WEF, 2014).
- CE main component for the European Green Deal (2019)
- CE 3.0 economic growth friendly narrative,
- win-win for business and environment
- Supertrends

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Life cycle thinking

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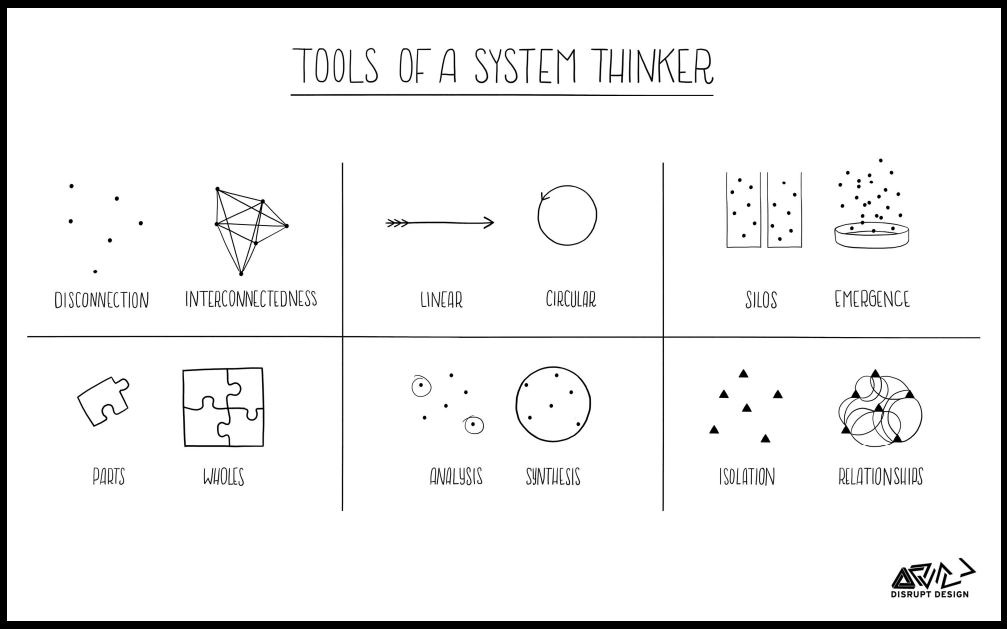

https://medium.com/disruptive-design/tools-for-systems-thinkers-the-6-fundamental-concepts-of-systems-thinking-379cdac3dc6a

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What circles?

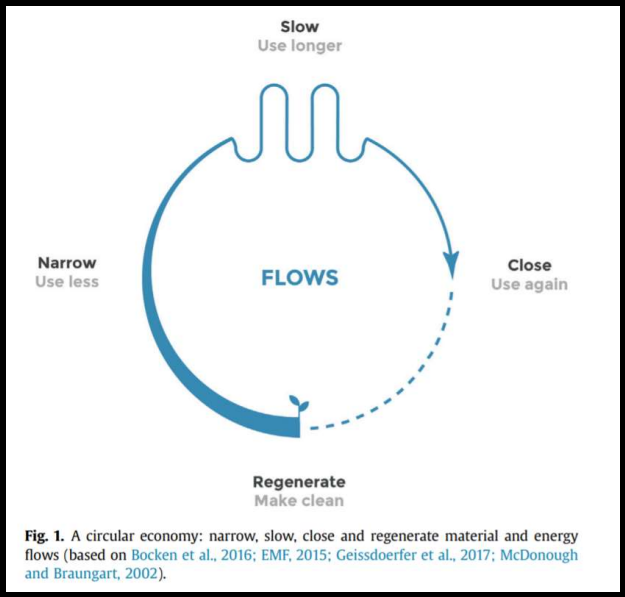

Fig. 1. A circular economy: narrow, slow, close and regenerate material and energy flows (based on Bocken et al., 2016; EMF, 2015; Geissdoerfer et al., 2017; McDonough and Braungart, 2002).

Konietzko, Jan, Nancy Bocken, and Erik Jan Hultink. "A tool to analyze, ideate and develop circular innovation ecosystems." *Sustainability* 12.1 (2020): 417.

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Value retention options

R0: Refuse: choice to buy less, use less

R1: Reduce: during use phase
https://www.youtube.com/watch?v=xxMxRTaF8R4

R2: Resell/Re-use: bring product back to market
https://www.youtube.com/watch?v=arA_fGLh74g

R3: Repair: bring back to order, extend life time

R4: Refurbish: components replaced, upgrade

R5: Remanufacture: as good as new or better

R6: Repurpose: art and more

R7: Recycle: destroy products, secondary materials,
https://www.youtube.com/watch?v=8COUfBNRaDk

https://www.youtube.com/watch?v=BMOAZ4ZEgng

R8: Recover: incineration

R9: Re-mine

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Please draw ☺

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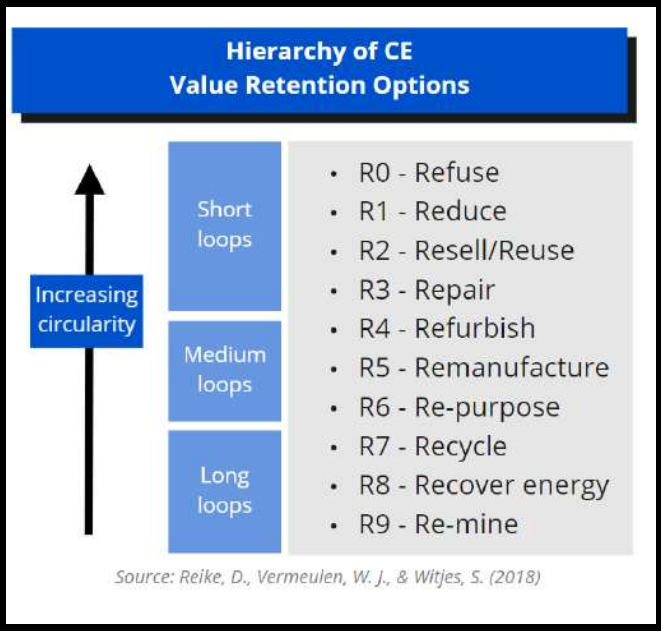

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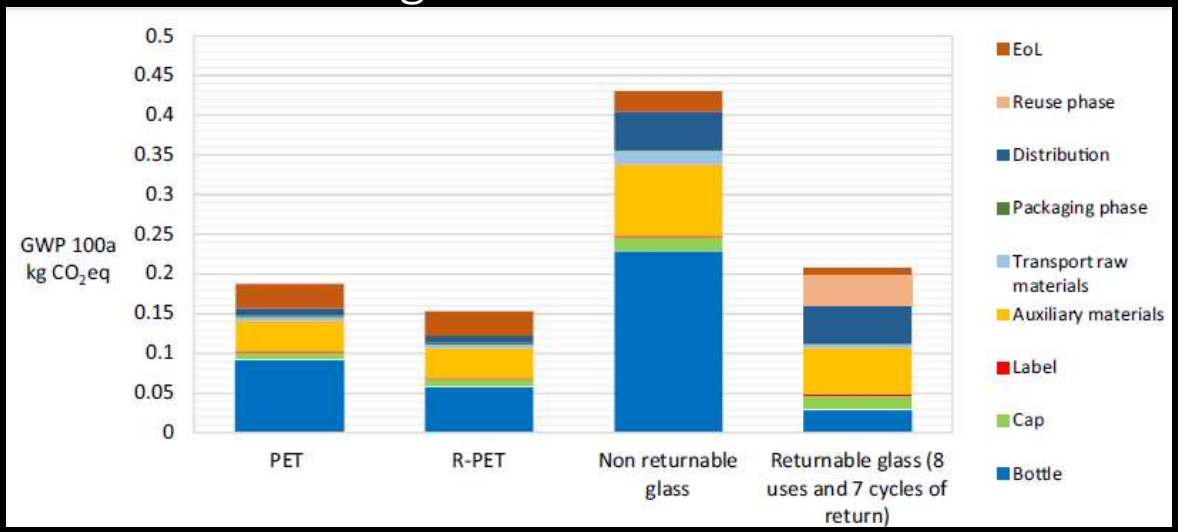
GWP of beverage bottles



Stefanini, Roberta, et al. "Plastic or glass: a new environmental assessment with a marine litter indicator for the comparison of pasteurized milk bottles." *The International Journal of Life Cycle Assessment* 26.4 (2021): 767-784.

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Circular economy according to EMF

A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature.

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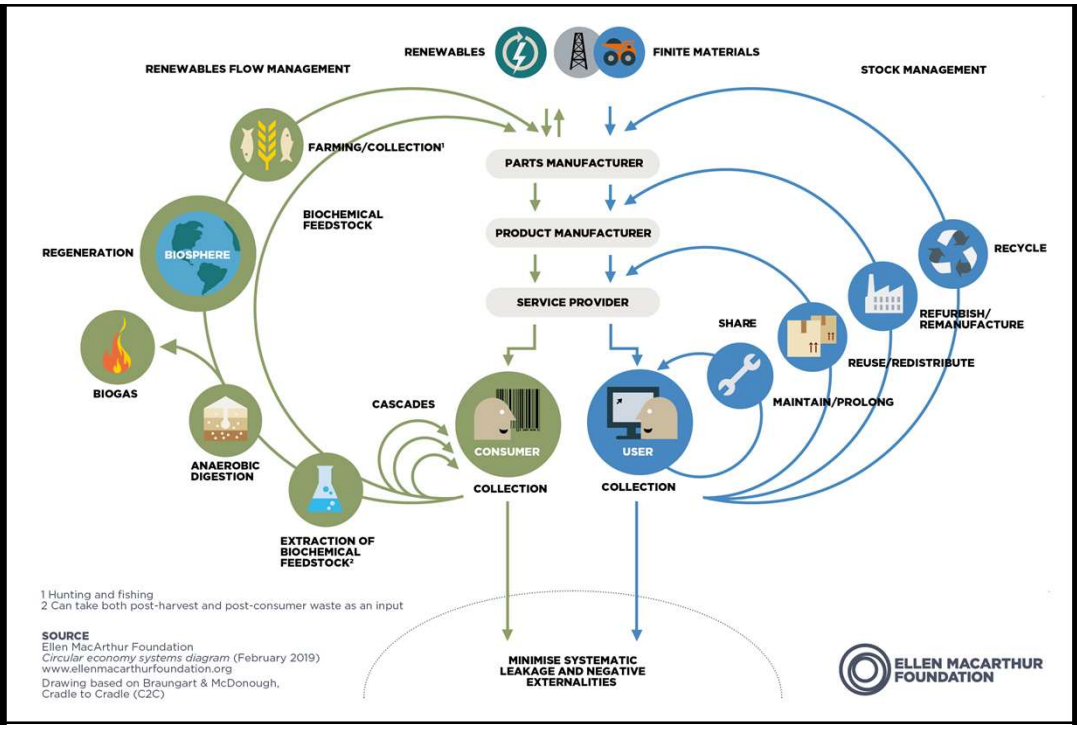

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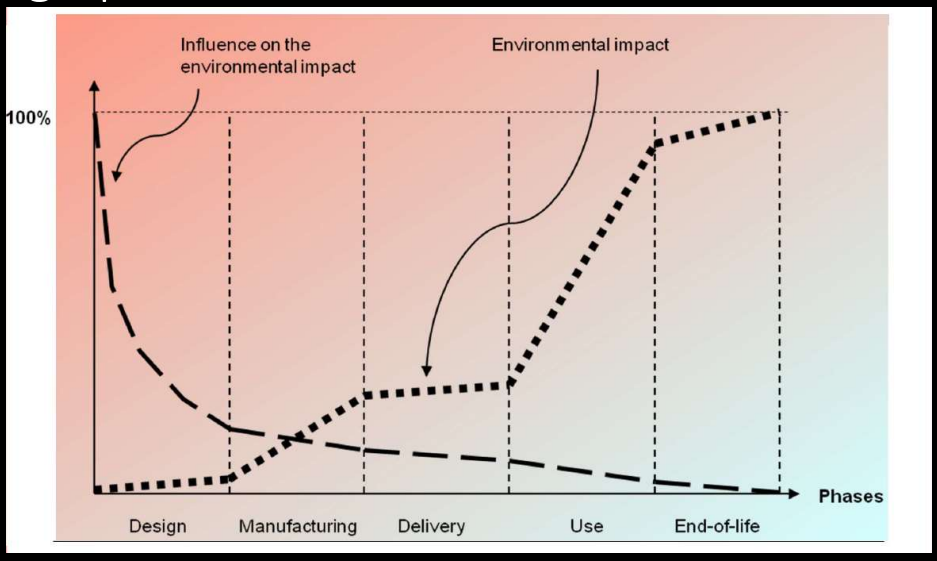
Design paradox



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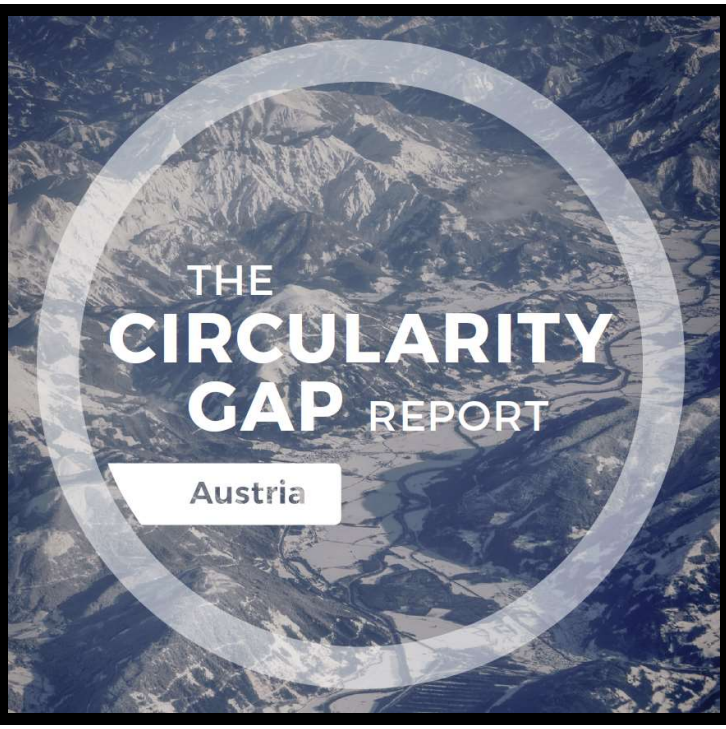

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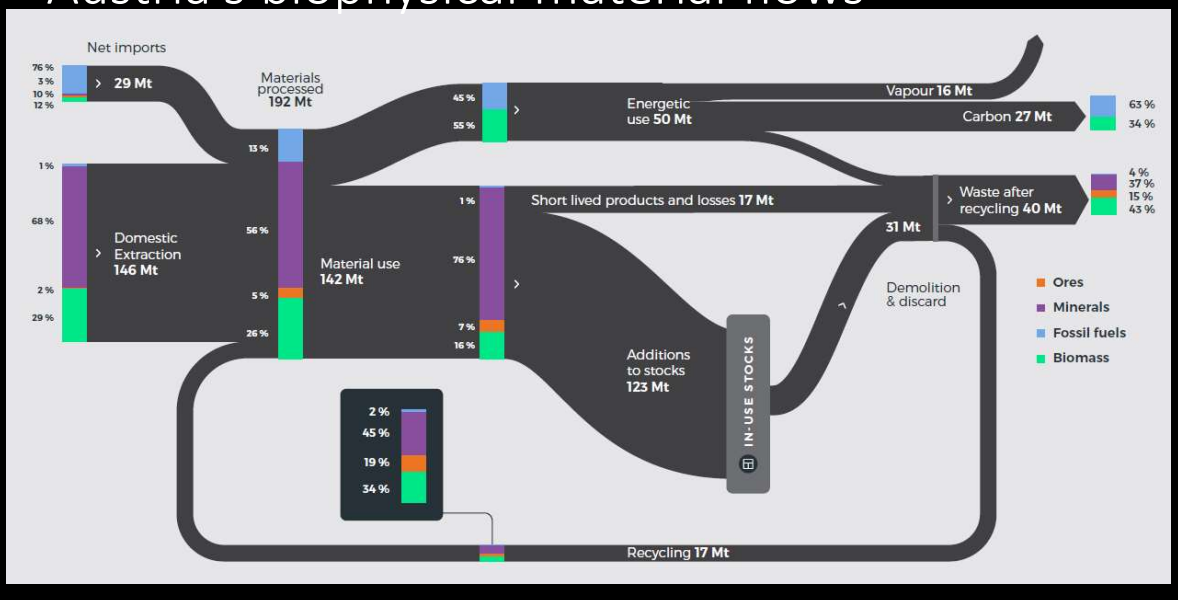
Austria‘s biophysical material flows



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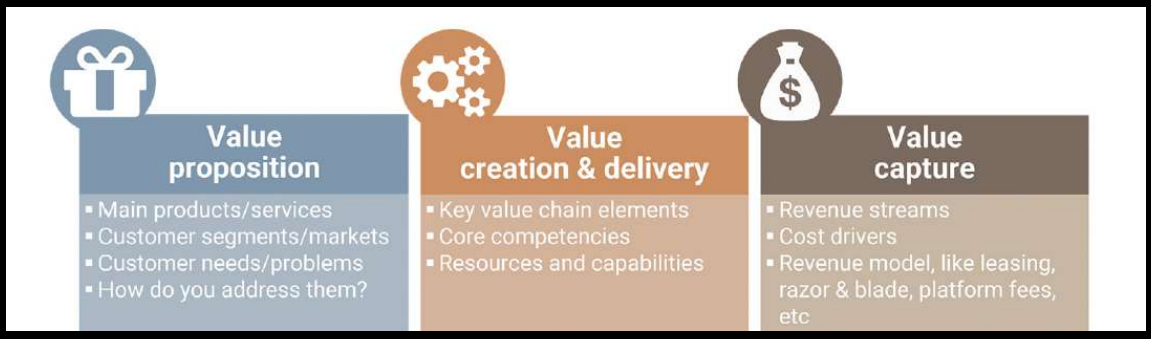
Business model



Geissdoerfer, Martin, et al. "Circular business models: A review." *Journal of Cleaner Production* (2020): 123741.

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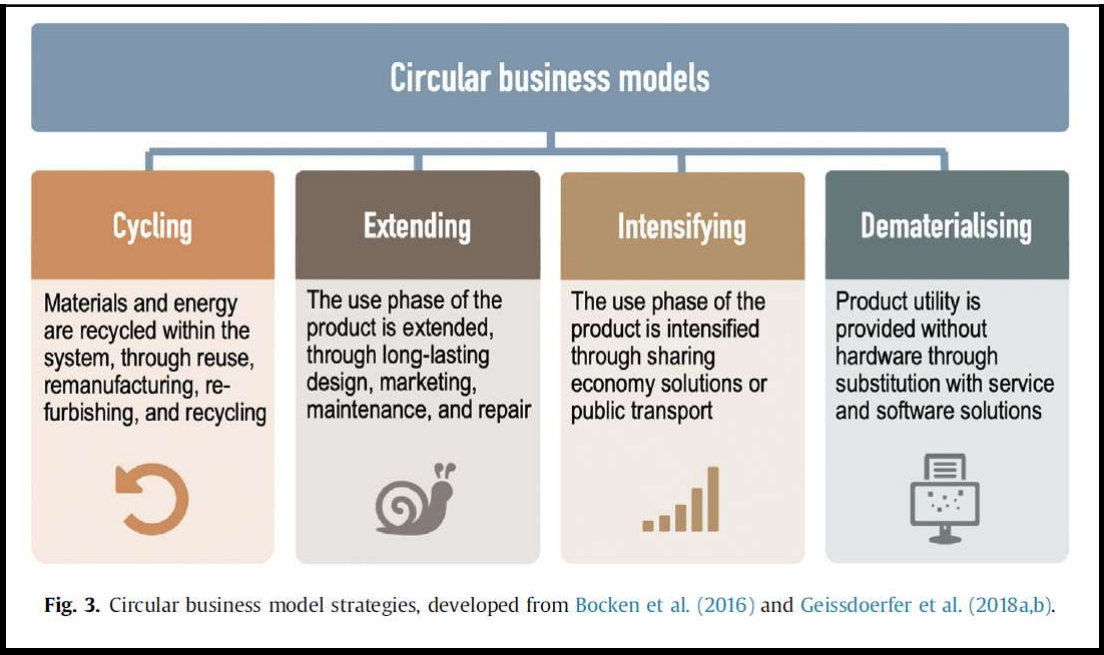

Fig. 3. Circular business model strategies, developed from Bocken et al. (2016) and Geissdoerfer et al. (2018a,b).

Geissdoerfer, Martin, et al. "Circular business models: A review." *Journal of Cleaner Production* (2020): 123741.

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Q & A

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