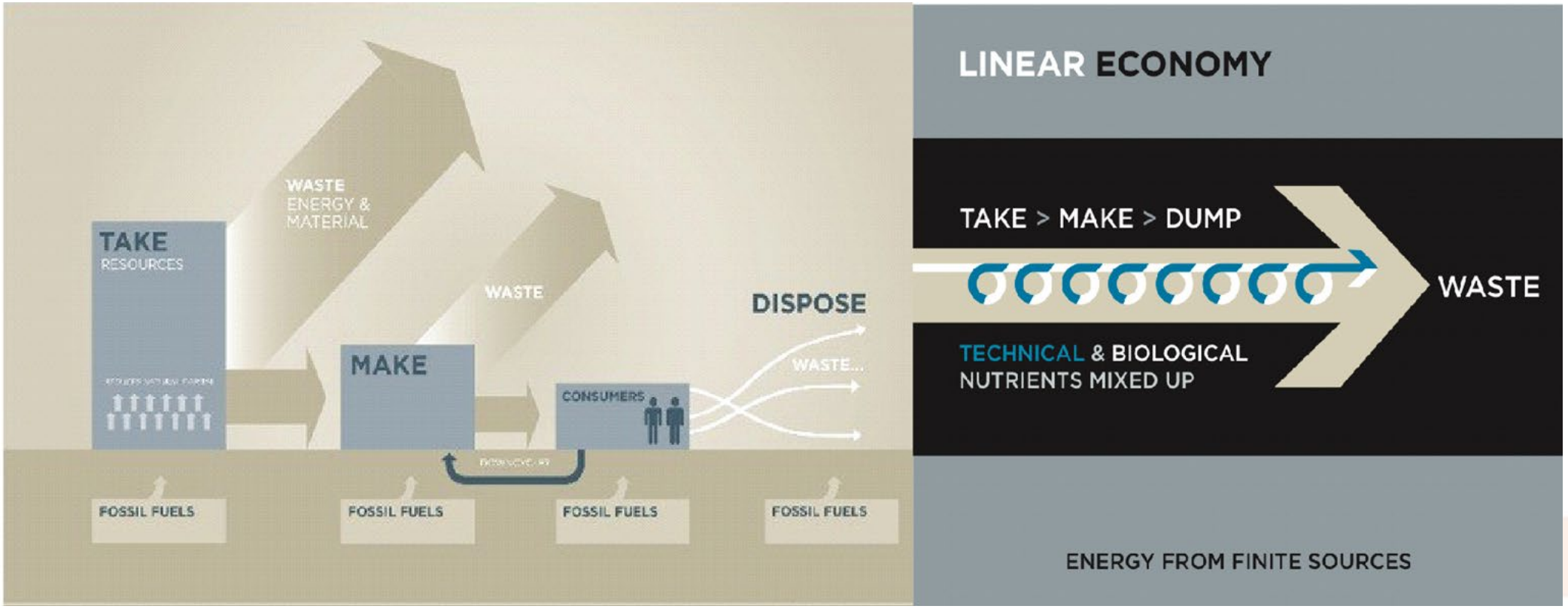
# Collective reflection on Circularity vs Sustainability

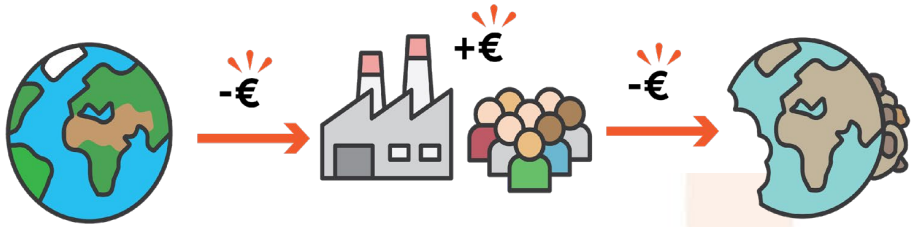
## Single-use plastics: to prohibit or not to prohibit?

Credit: Dr. Alejandro Gallego Schmid

- “Circularity” vs “sustainability”
  - Life Cicle Assessment
  - Single-use plastic containers
- Final reflections

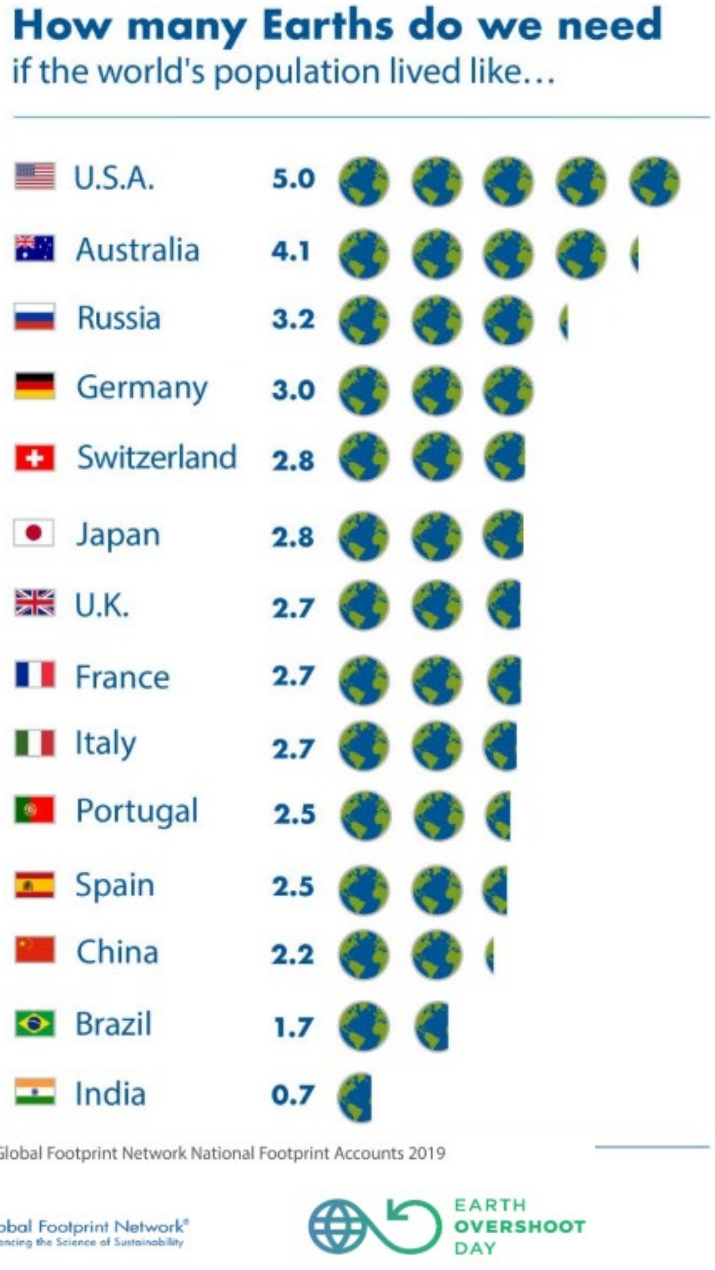



The current linear economy (based on take-make-use-dispose) is inefficient, vulnerable and wasteful.




- More than 90% of extracted non-renewable materials are wasted during the production process→ they do not end up as part of the product sold.
- > 80% of marketed products are discarded after a single use and a large portion becomes waste within six weeks after sale!
- ≈ 80% of the environmental impacts of products and services are determined at the design stage.

# Lineal Economy

- The circular economy represents an alternative to the linear model

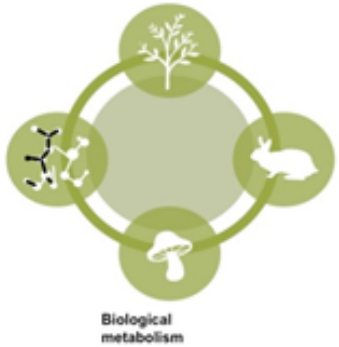
**Principle 1**

*Preserve and enhance natural capital*

... through less use of finite and fossil resources and more use of renewable resources.

**Principle 2**

*Optimise resource yields by circulating materials*





... keeping products, components and materials in use for as long as possible in technical and biological cycles.

**Principle 3**

*Minimise and avoid negative externalities*

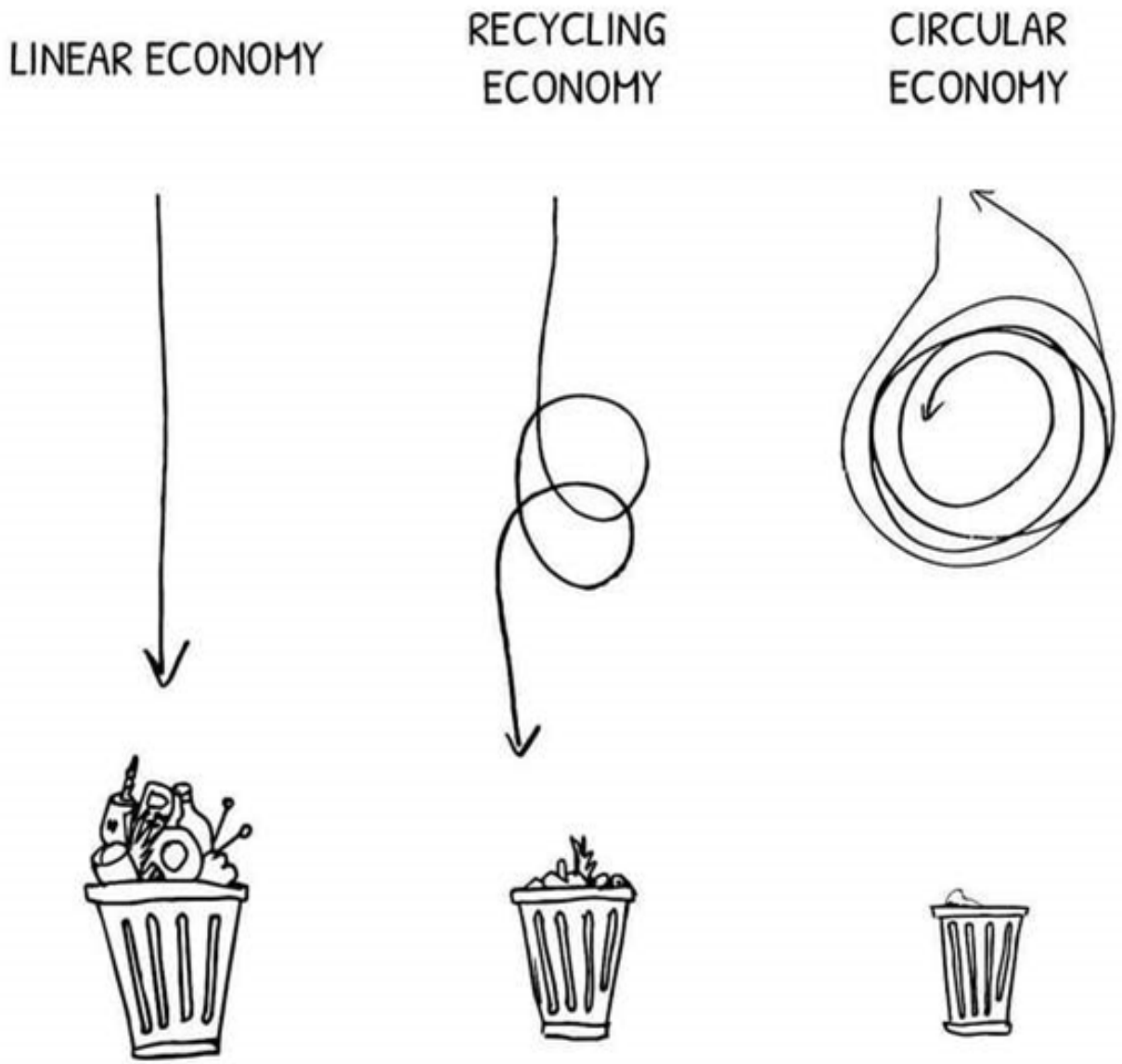
... to design products, technologies and systems free of waste, polluting emissions and negative impacts (social, environmental).

# Circular economy benefits

- Improved economic growth and profits
- Savings in material, energy and potentially environmental impacts.
- Creation of employment opportunities (new jobs)
- Reduced price volatility, risks and negative externalities
- Increased security of supply and business resilience
- Improved customer relations and loyalty
- Opening of new markets to access new customers

# Circular economy benefits

- The circular economy can increase resource productivity in the European Union by 3% per year.
- Annual benefits of around €1.8 trillion in 2030
- GDP>7% → compared to current scenarios.
- Raw material consumption ↓ 32% by 2030 and 50% by 2050.
- In 2030, 1.2 million jobs created and unemployment reduced by 250,000!

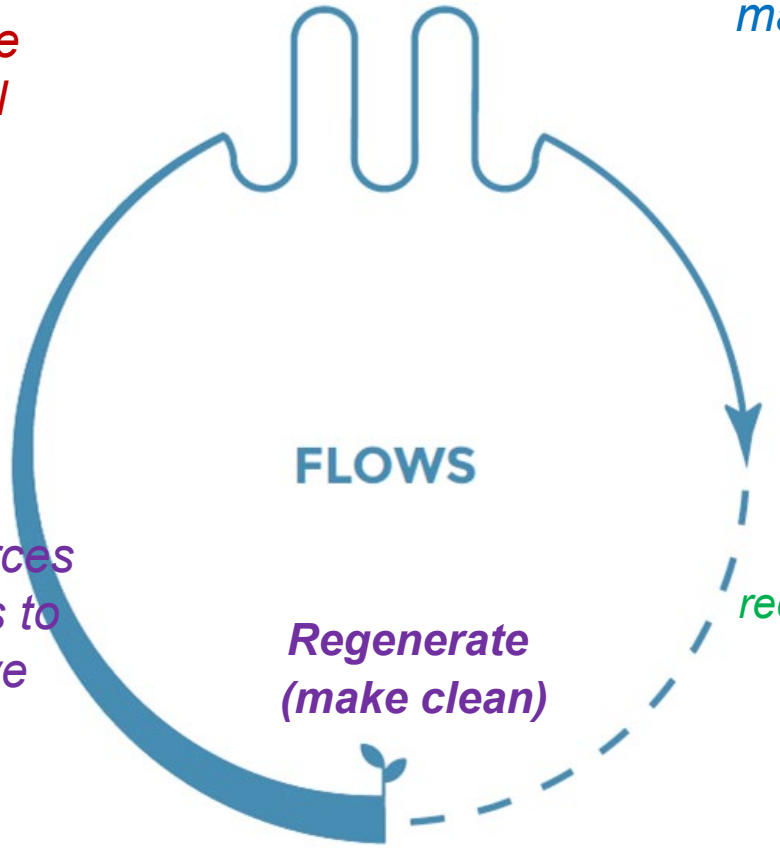

LINEAR ECONOMY
RECYCLING ECONOMY
CIRCULAR ECONOMY

# Circular strategies

***Slow down (use more time)***

*Prolong and intensify the use of products and materials to maintain their value over time.*

*Progressively reduce the intensity of resource use and environmental impacts per functional unit.*




***Optimize (use less)***

*Using renewable resources and toxic-free materials to conserve and preserve natural ecosystems*

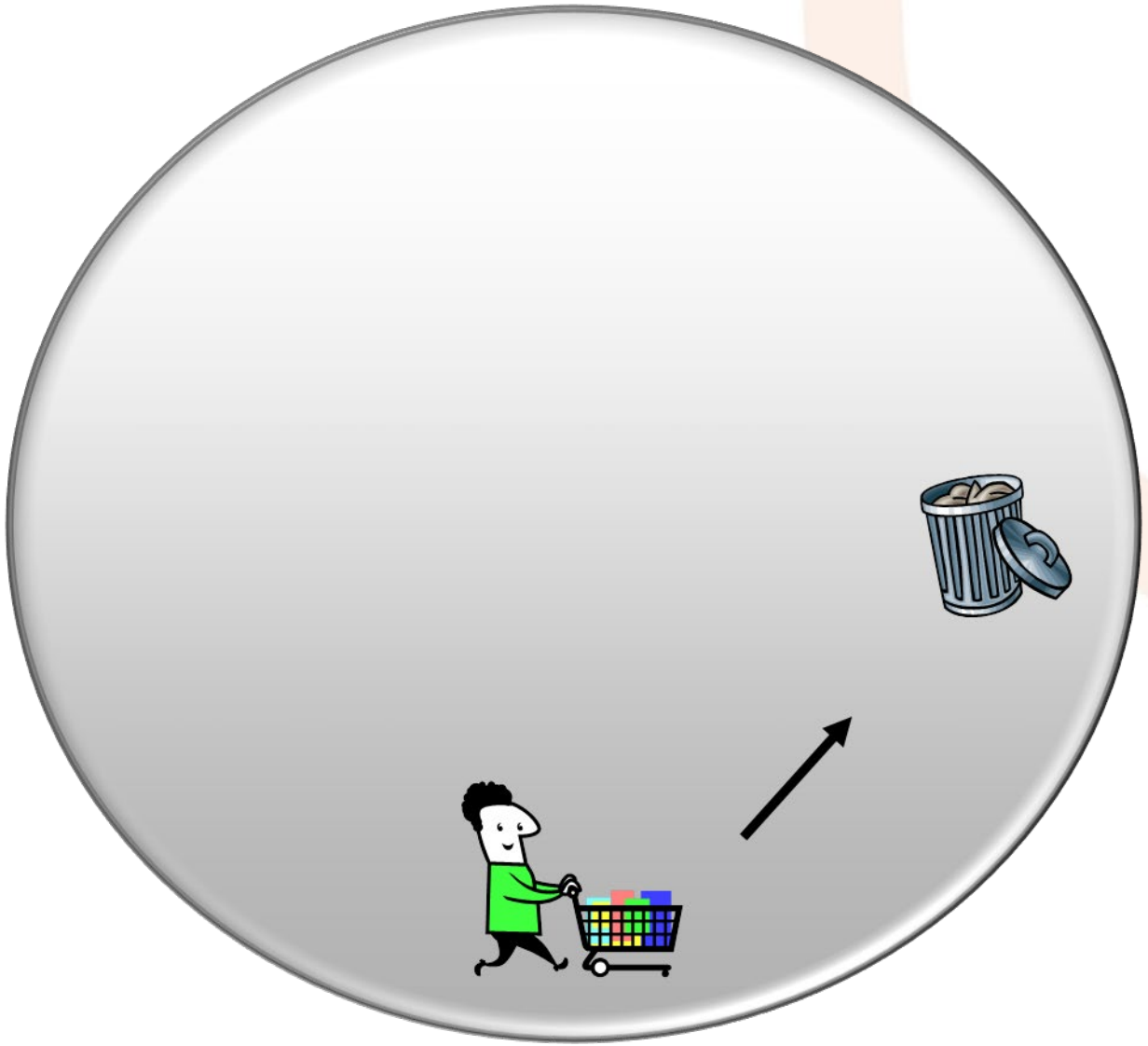
***Close (use again)***

*Closed-loop materials recycling (upcycling) to restore or create new value from spent materials or waste.*

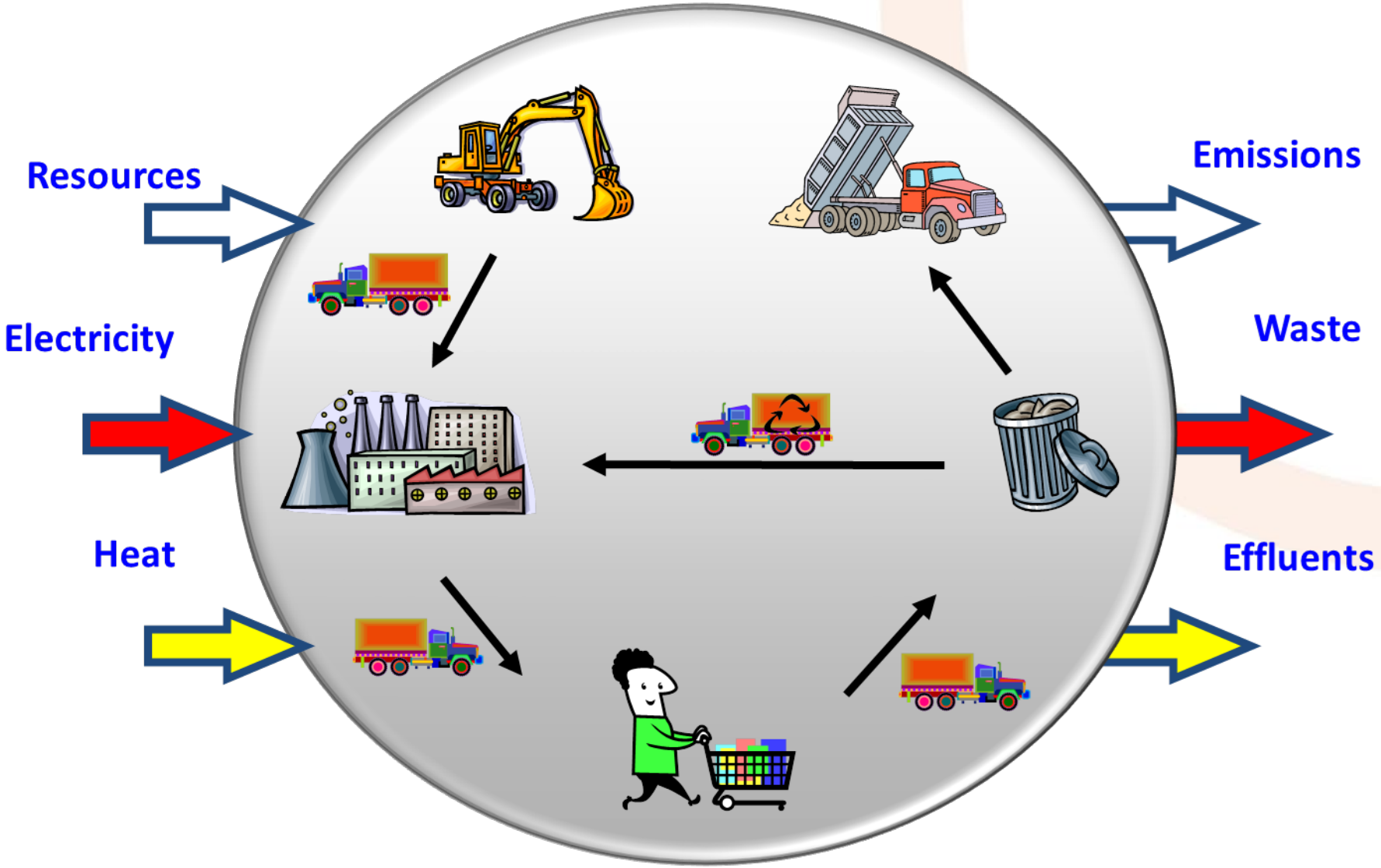
***Regenerate (make clean)***

Konietzko et al., 2019.

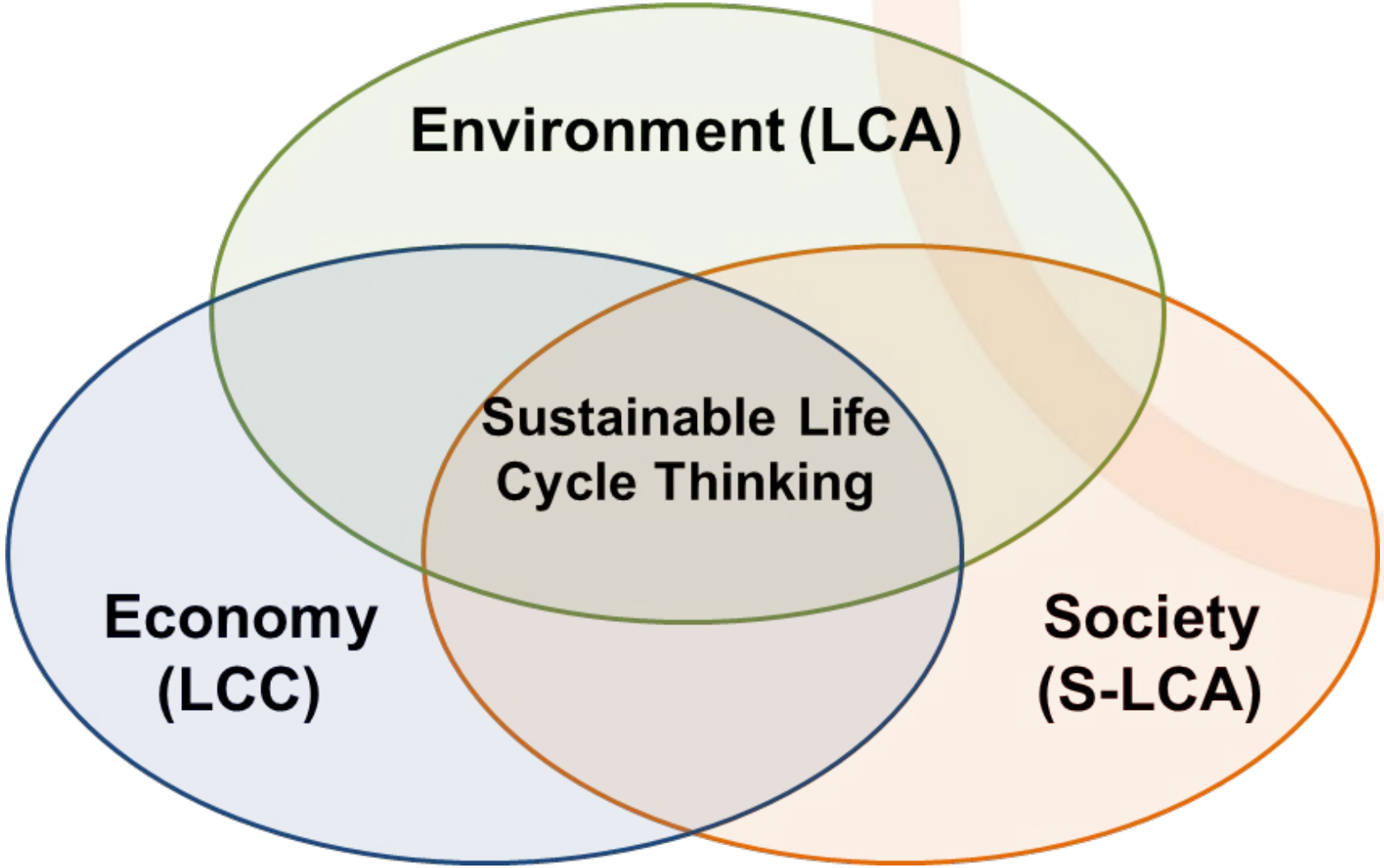
# Life Cycle thinking



# Life cycle thinking



# Life cycle analysis



# ENVIRONMENTAL IMPACTS

18 impact categories:

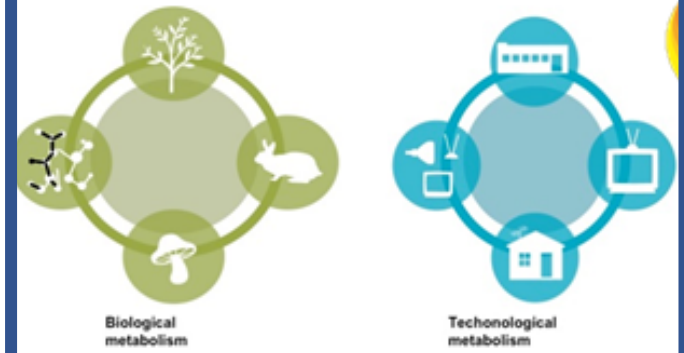
- Climate change (carbon footprint)
- Water consumption (water footprint)
- Land use changes
- Eutrophication
- Resource consumption
- Eco-toxicity
- Human toxicity
- Acidification
- Destruction of the ozone layer

# Circularity vs. sustainability

**Principle 1:**
**Preserve and regenerate natural capital.**

... through less use of finite and fossil resources and more use of renewable resources.

**Principle 2:**
**Optimize efficiency in the use of resources.**




... keeping products, components and materials in use for as long as possible in technical and biological cycles.

**Principle 3:**
**Waste and pollution free design**

... to design products, technologies and systems free of waste, polluting emissions and negative impacts (social, environmental).

# Single-use plastics

## To prohibit or not to prohibit?

# Food containers: single use vs. reusable

500-850 million used and discarded units in the EU

Gallego-Schmid et al., *J. Cleaner Prod.* (2019) 211 417-427

# End of life (EU28)

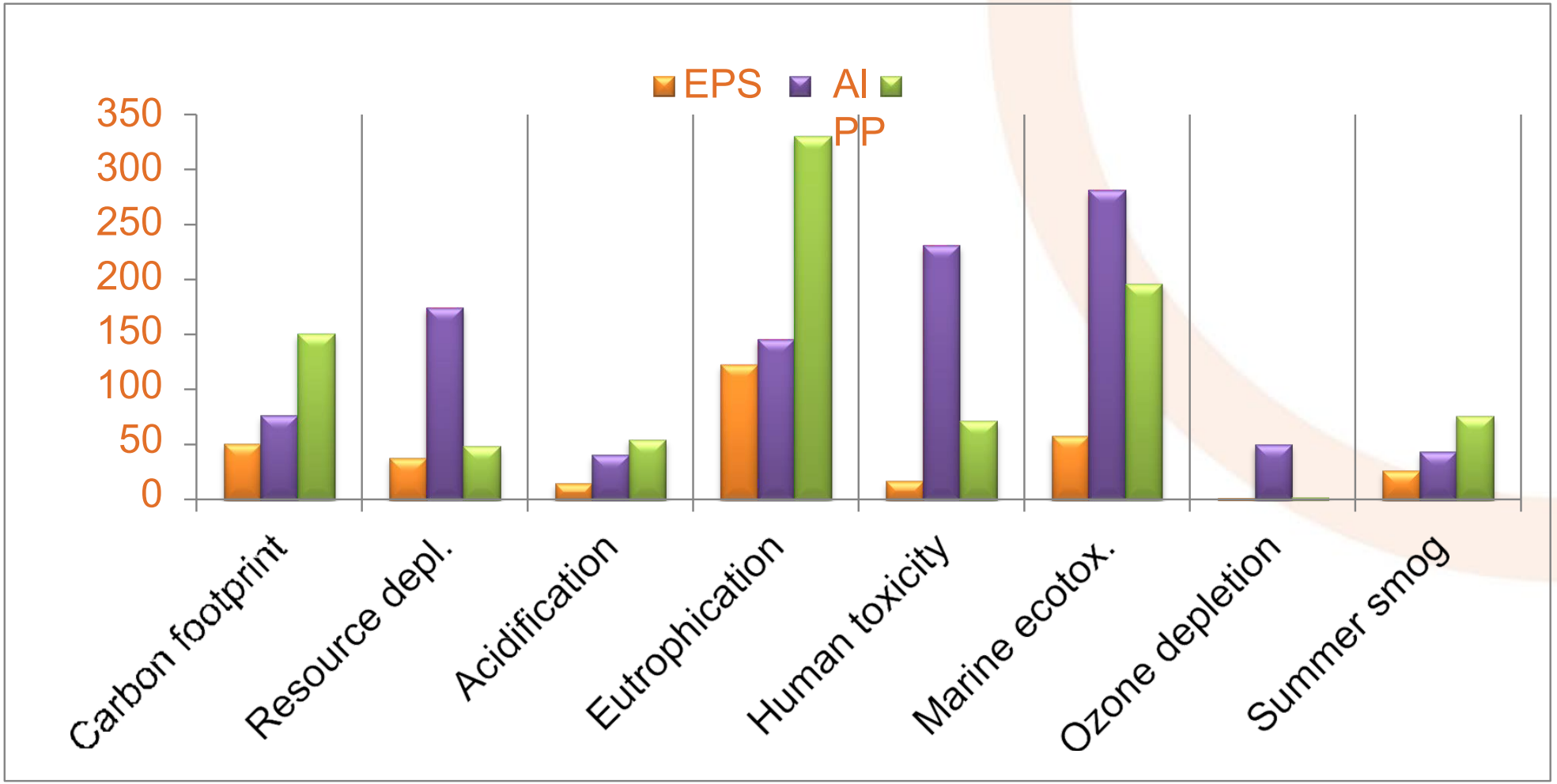
- Polypropylene
  11% recycled, 44% incinerated, 45% landfilled

- Aluminum
  54% recycled and 46% landfilled

- Extruded polystyrene
  50% landfill and 50% incinerated

Gallego-Schmid et al., *J. Cleaner Prod.* (2019) 211 417-427

# LCA of single-use containers




Not to scale

Gallego-Schmid et al., *J. Cleaner Prod.* (2019) 211 417-427

# LCA of single-use containers

- EPS
  - 7% up to 28 times less impact than aluminum
  - 25% up to 6 times less than polypropylene

- Less EPS needed than PP and less energy than Al

Gallego-Schmid et al., *J. Cleaner Prod.* (2019) 211 417-427

# Single-use vs. reusable containers

**Number of times the reusable PP container has to be used to equal the impact of a single-use container**

| Impact |  |  |  |  |
|---|---|---|---|---|
| Climatic Change | 18 | | 11 | |
| Abiotic Resources | 208 | | 3 | |
| Eutrophication | 29 | | 8 | |
| Eutrofización | 18 | | 14 | |
| Human toxicity | 37 | | 2 | |
| Marine Ecotox. | 24 | | 4 | |
| Ozone layer | 27 | | 1 | |
| Smog | 16 | | 9 | |
| Terrestrial Ecotox. | - | | 2 | |

Gallego-Schmid et al., *J. Cleaner Prod.* (2019) 211 417-427

# Final Reflections

- EPS single-use container → has the lowest impacts.
- Single-use PP container → highest impact in several categories.
- The reusable version of the PP container has to be used 16-208 times to equal the impact of the single-use EPS containers
- Recycling EPS is technically possible but costly
- In this case, “circular” does not translate into more “sustainable”.

Gallego-Schmid et al., *J. Cleaner Prod.* (2019) 211 417-427; Peña et al., *Int J LCA* (2021) 26 215–220.

# Citations


- Gallego-Schmid A., J. M. F. Mendoza and A. Azapagic (2019). Environmental impacts of takeaway food containers. *Journal of Cleaner Production* 211 417- 427.
- Peña, C., B. Civit, A. Gallego-Schmid, A. Druckman, A. Caldeira- Pires, B. Weidema, E. Mieras, F. Wang, J. Fava, L. Milà i Canals, M. Cordella, P. Arbuckle, S. Valdivia, S. Fallaha and W. Motta (2021). Using life cycle assessment to achieve a circular economy. *International Journal of Life Cycle Assessment* 26, 215–220.