

Emerging Technologies for the Circular Economy

Lecture 2: Circular Economy I

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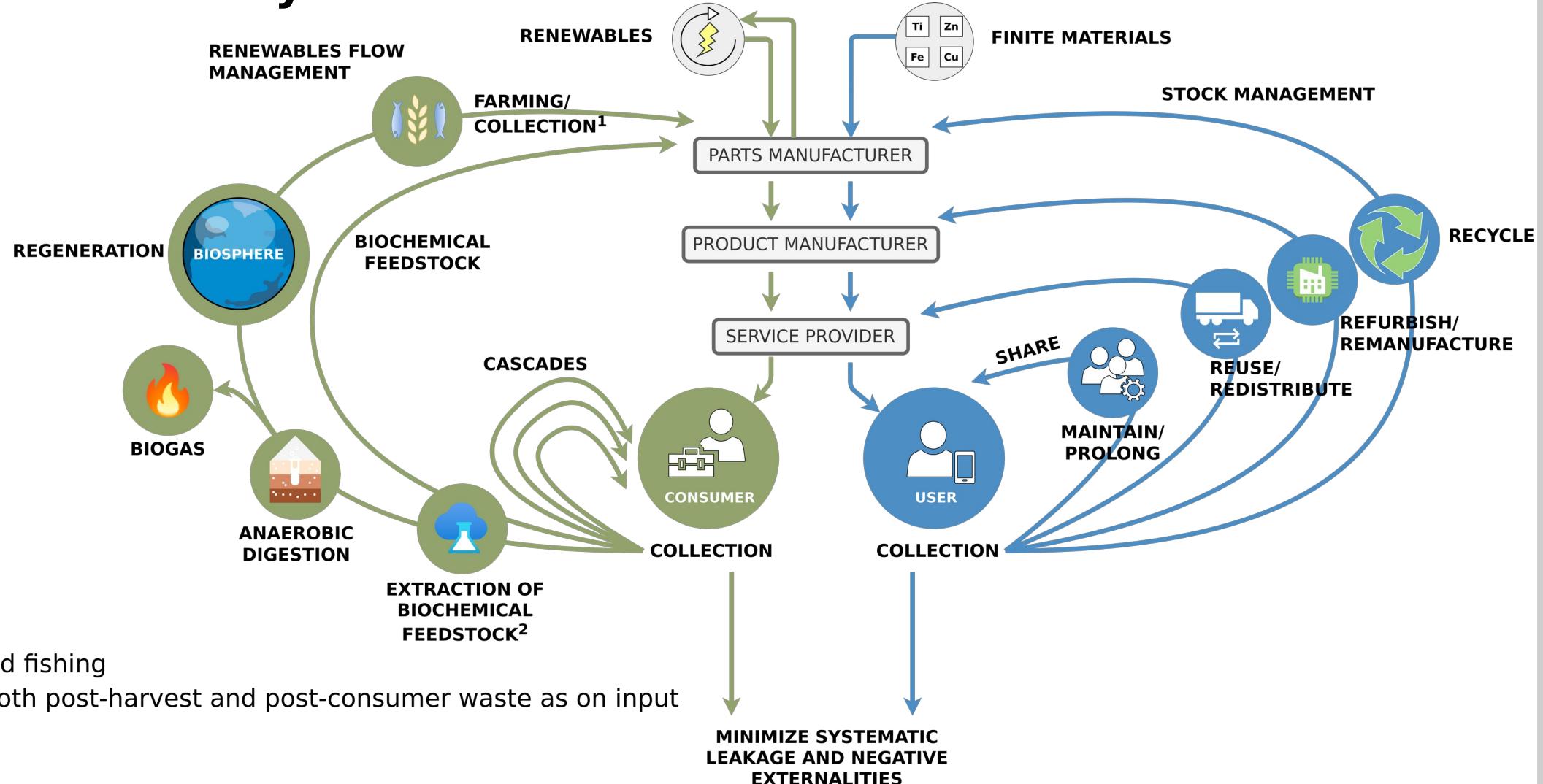
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The Linear (Industrial) Economy

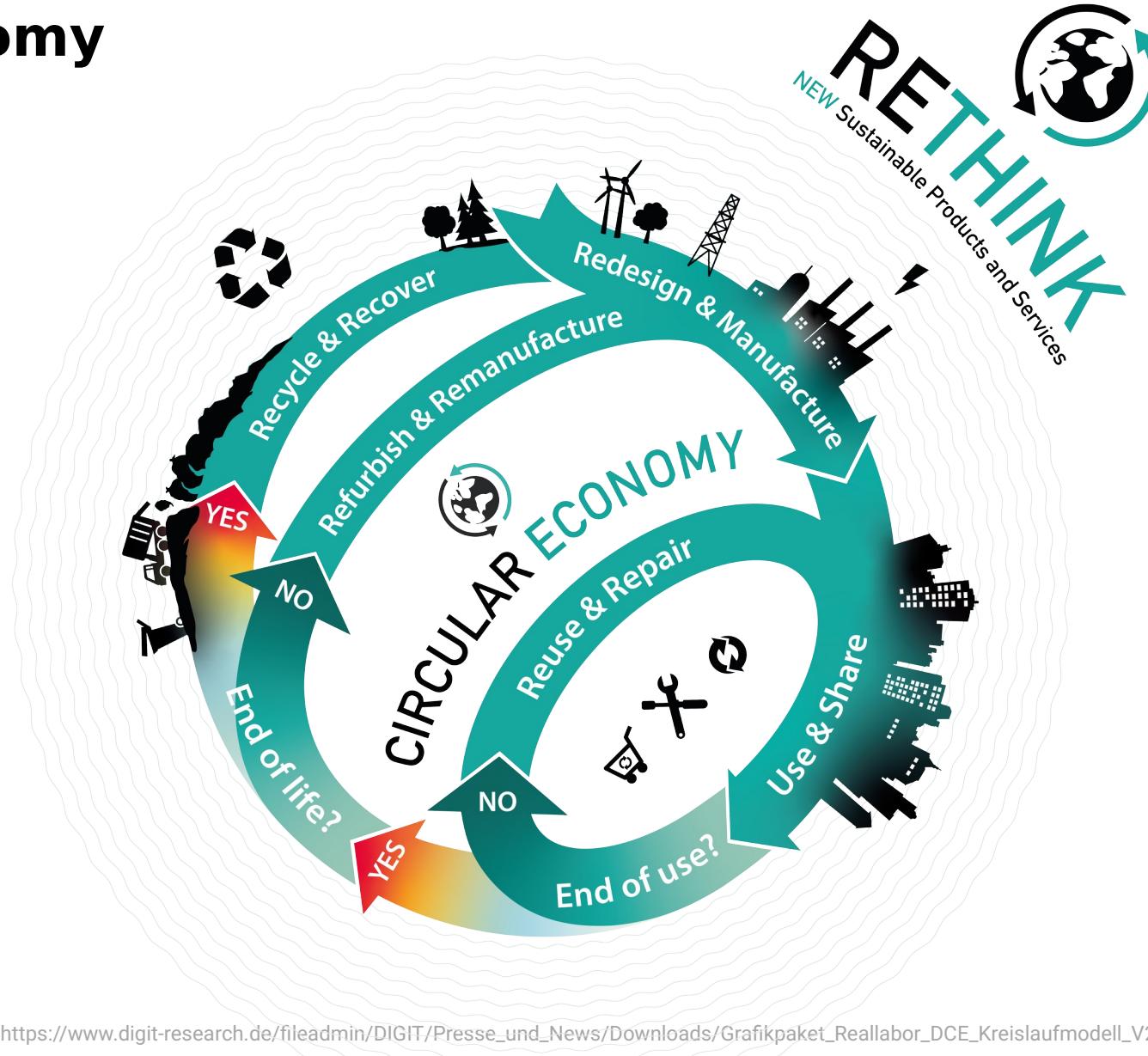


THE CIRCULAR ECONOMY

Circular Economy



Circular Economy



Circular Economy - Definitions

“Conceptualizing the circular economy: An analysis of 114 definitions.”

Kirchherr, Julian, Denise Reike and Marko P. Hekkert. Resources Conservation and Recycling 127 (2017): 221-232.

<https://doi.org/10.1016/J.RESCONREC.2017.09.005>

Circular Economy - Definitions

“A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.”

– Ellen MacArthur Foundation

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“The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.”

– European Parliament

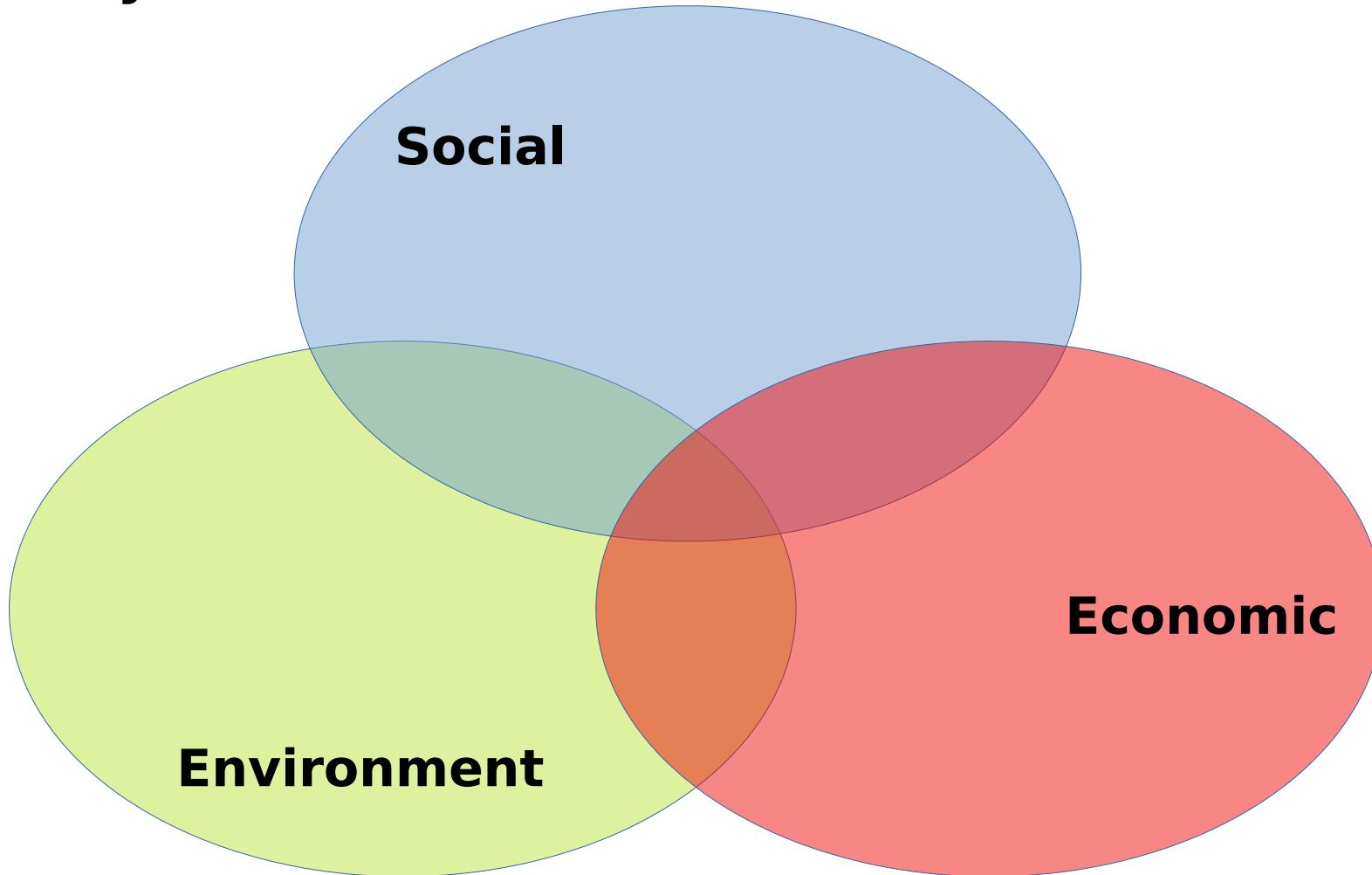
Circular Industrial Economy - Definitions

“The circular industrial economy manages stocks of manufactured assets, such as infrastructure, buildings, vehicles, equipment and consumer goods, to maintain their value and utility as high as possible for as long as possible; and stocks of resources at their highest purity and value.”

Sustainability - Definition

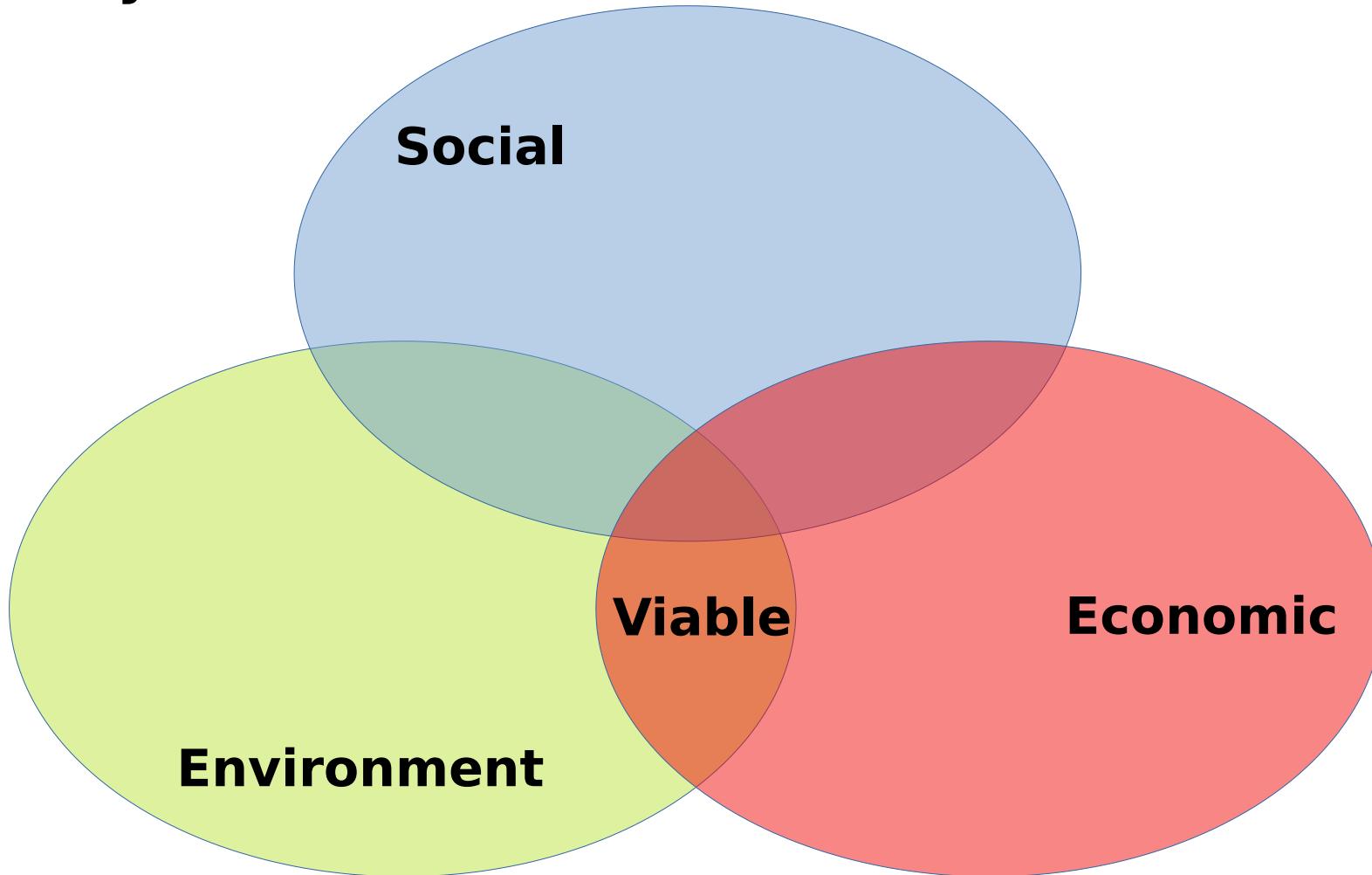
„Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.“

Sustainability - Definition



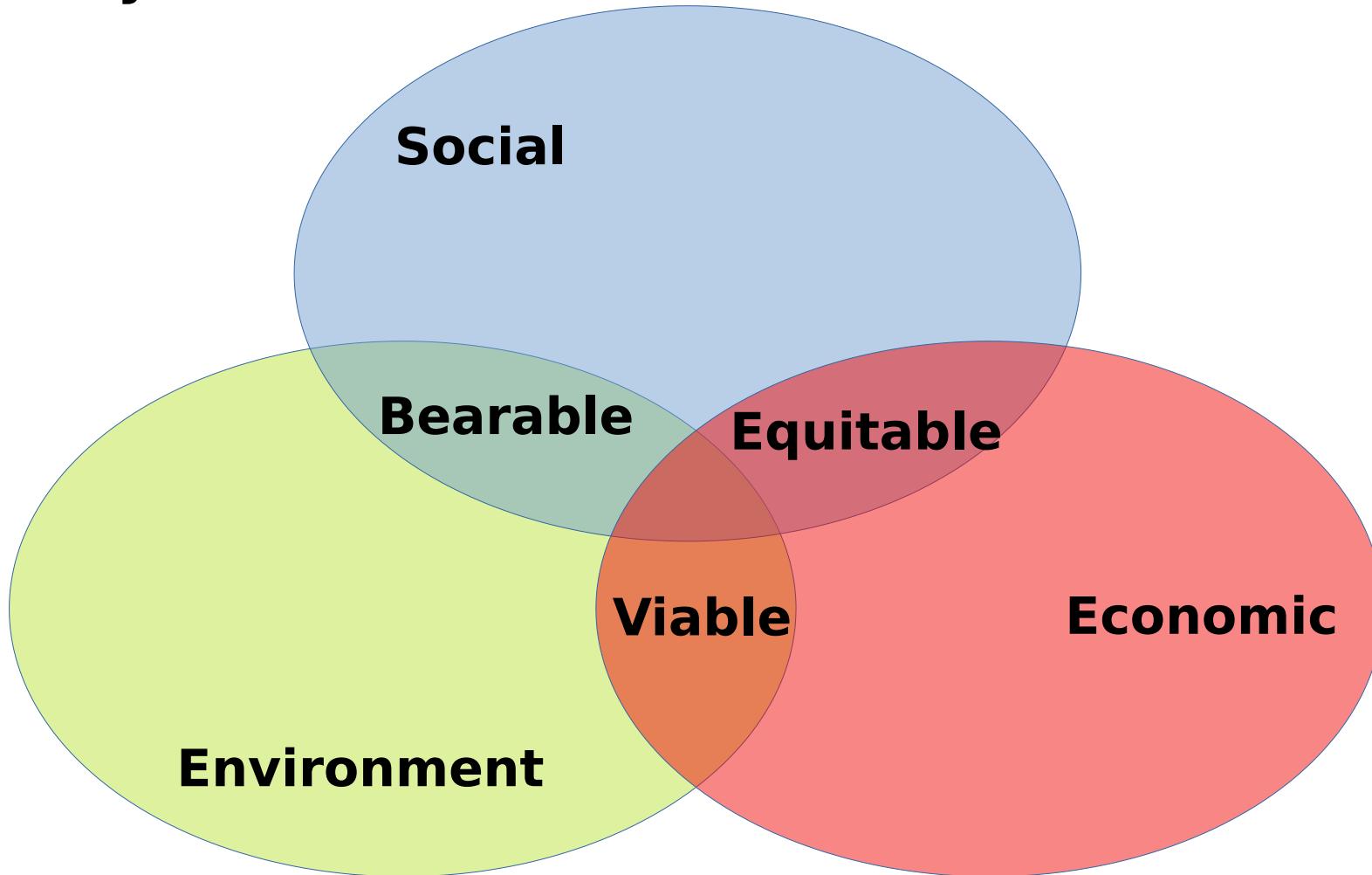
Based on: Thomsen C. (2013) Sustainability (World Commission on Environment and Development Definition). In: Idowu S.O., Capaldi N., Zu L., Gupta A.D. (eds) Encyclopedia of Corporate Social Responsibility. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-28036-8_531

Sustainability - Definition



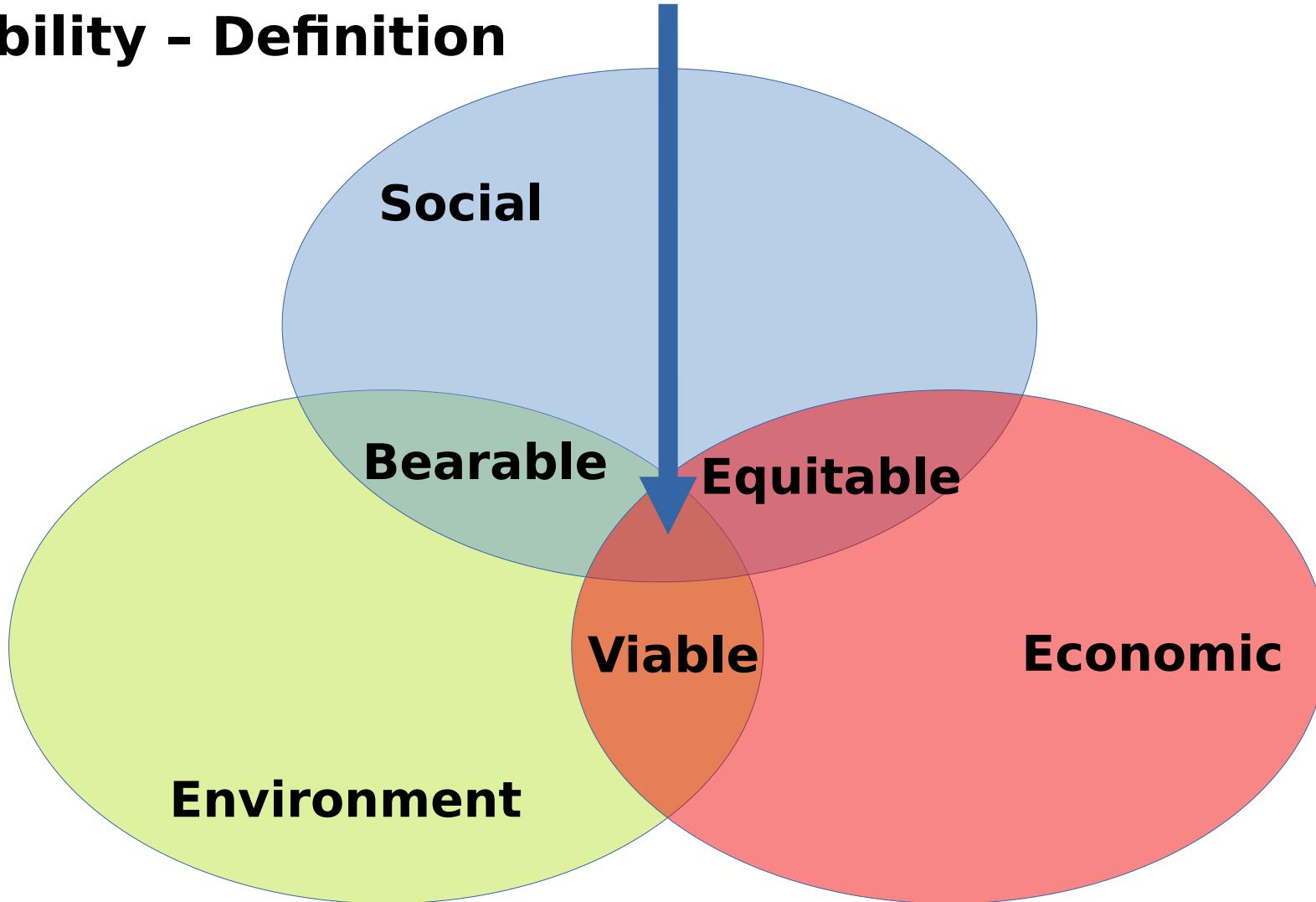
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Sustainability - Implications

Sustainability → Consume less

Circular Economy - Characteristics

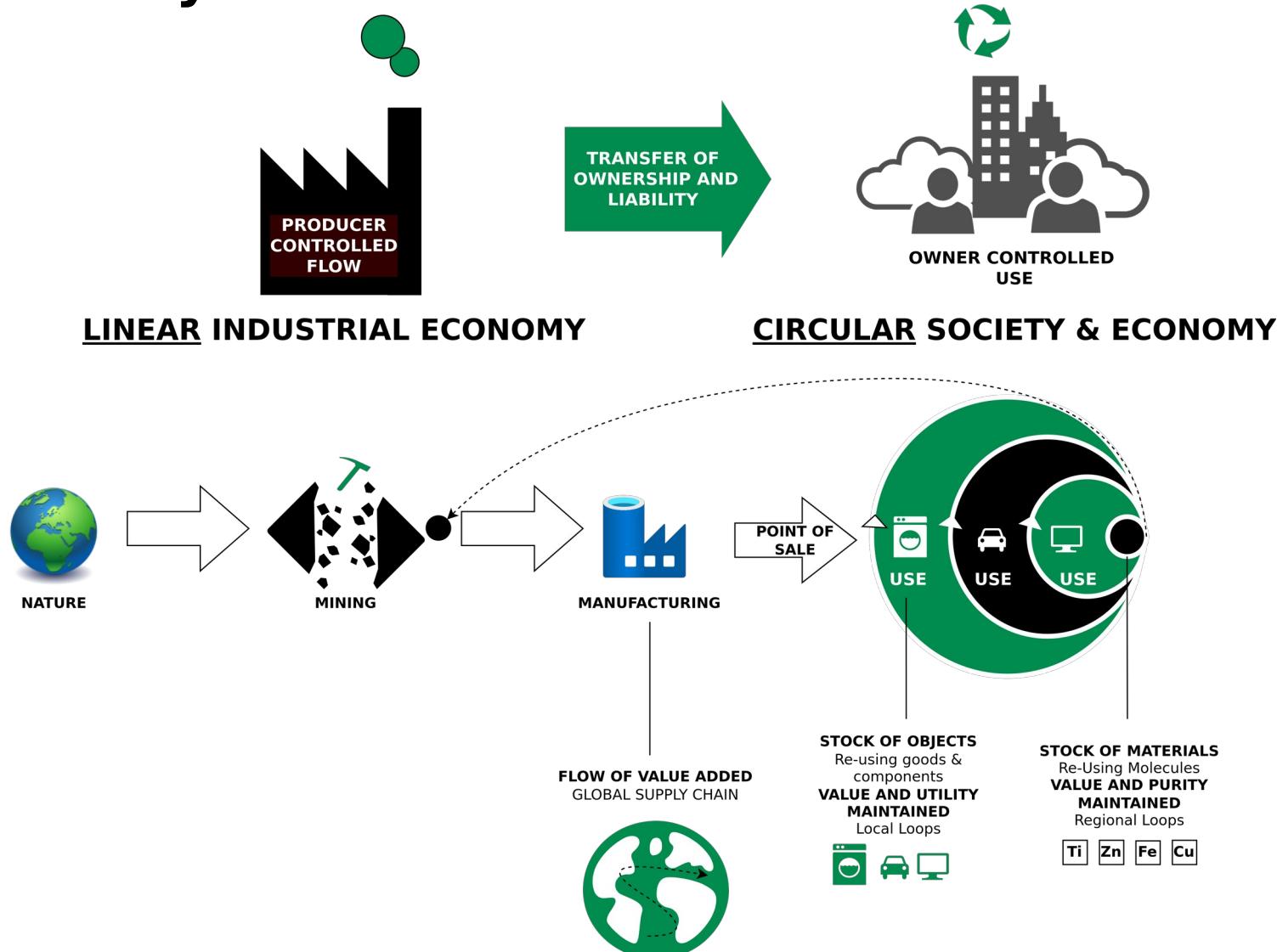


Image adapted from: Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

The Era of R

Techno-commercial strategies to keep goods and components at highest value level through:

- **Reuse**
- **Repair**
- **Remarket**
- **Remanufacture**
- **Re-refine**
- **Reprogramme goods**

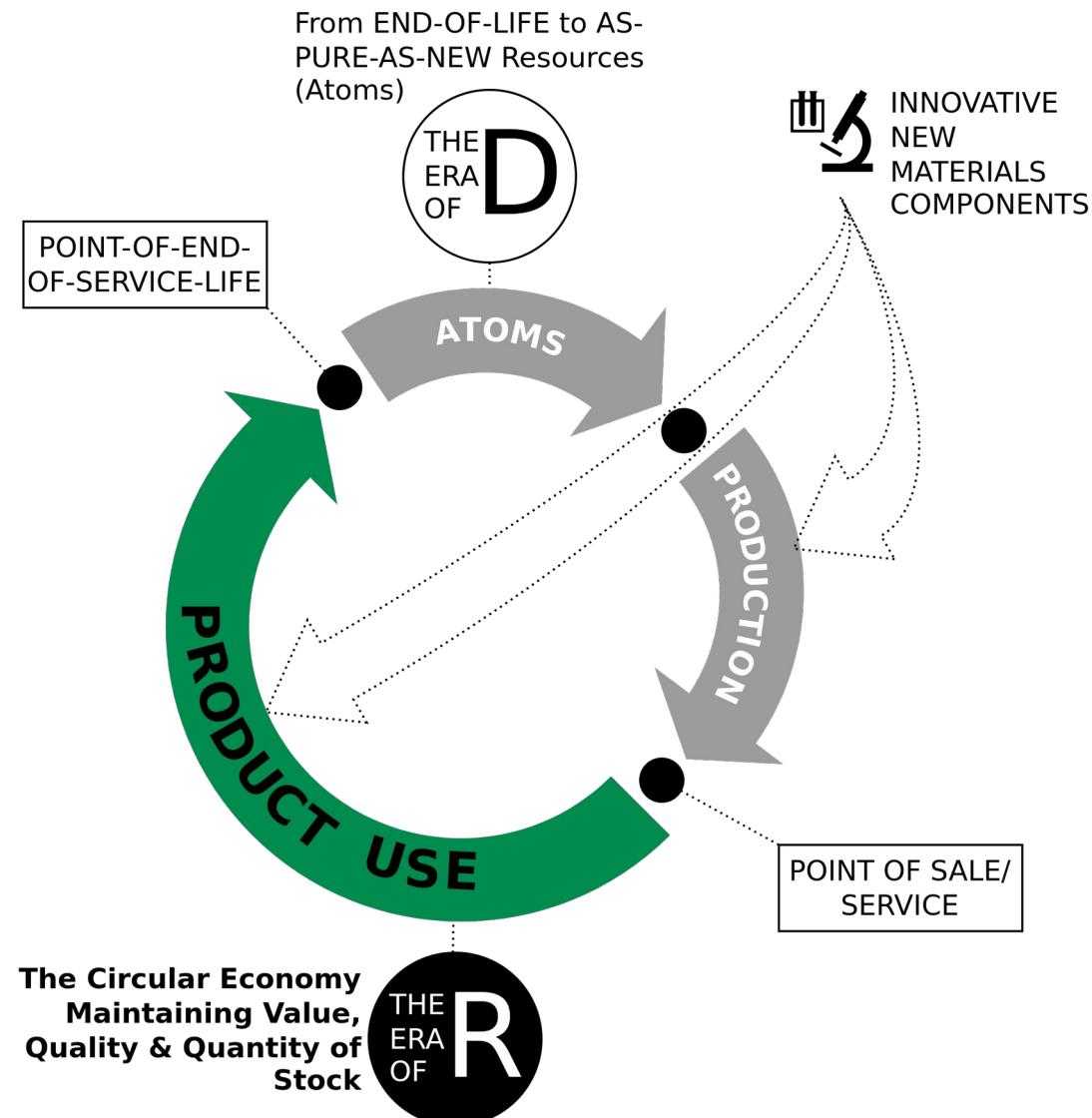
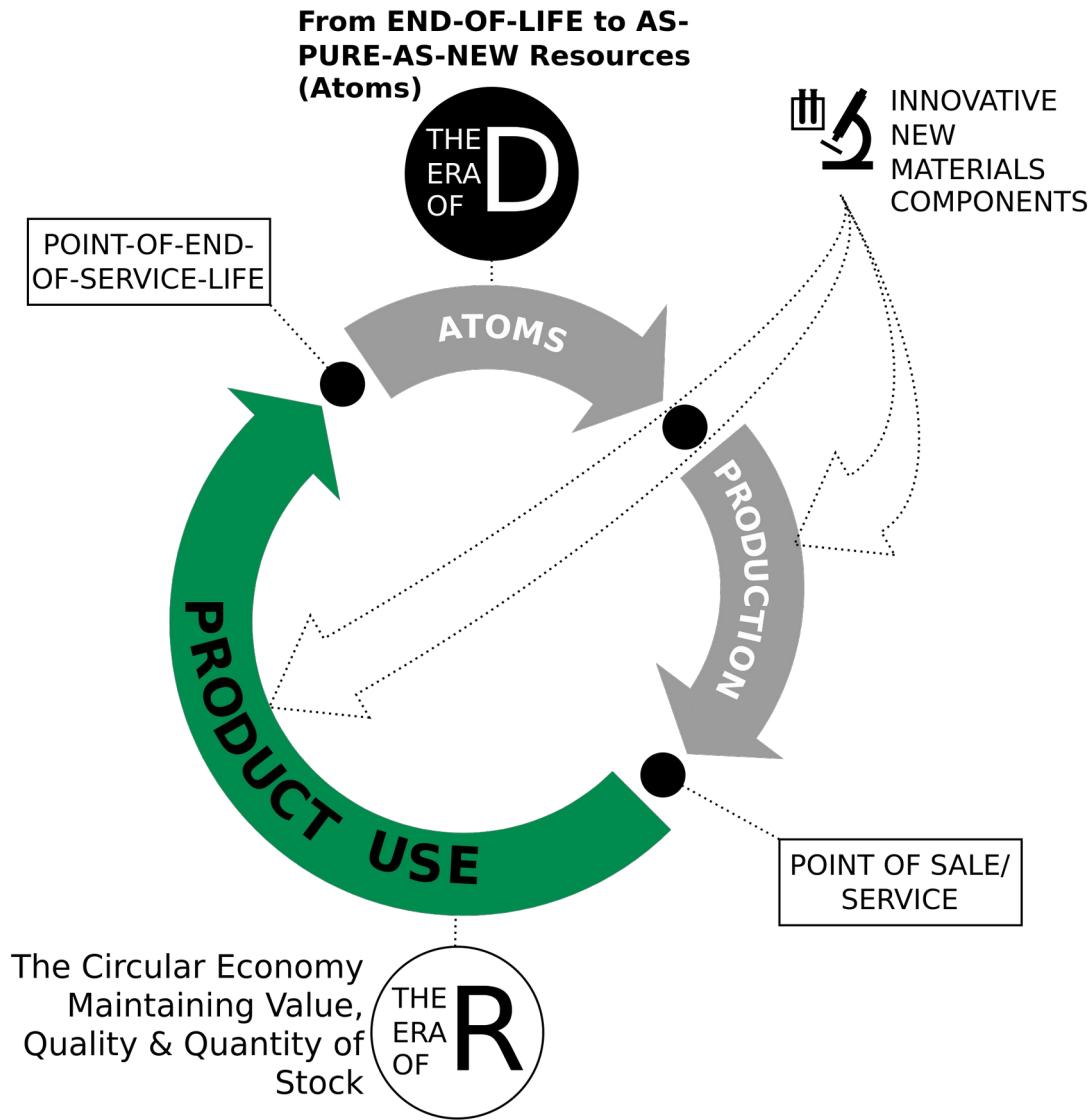


Image adapted from Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

The Era of D

Technologies and actions to recover atoms and molecules at highest quality (purity and value) level as pure as virgin:

- **D**e-polymerise
- **D**e-alloy
- **D**e-laminate
- **D**e-vulcanise
- **D**e-coat materials
- **D**e-construct high-rise buildings and major infrastructure



End-of-service-life business opportunities for value preservation: Reuse or Recycle?

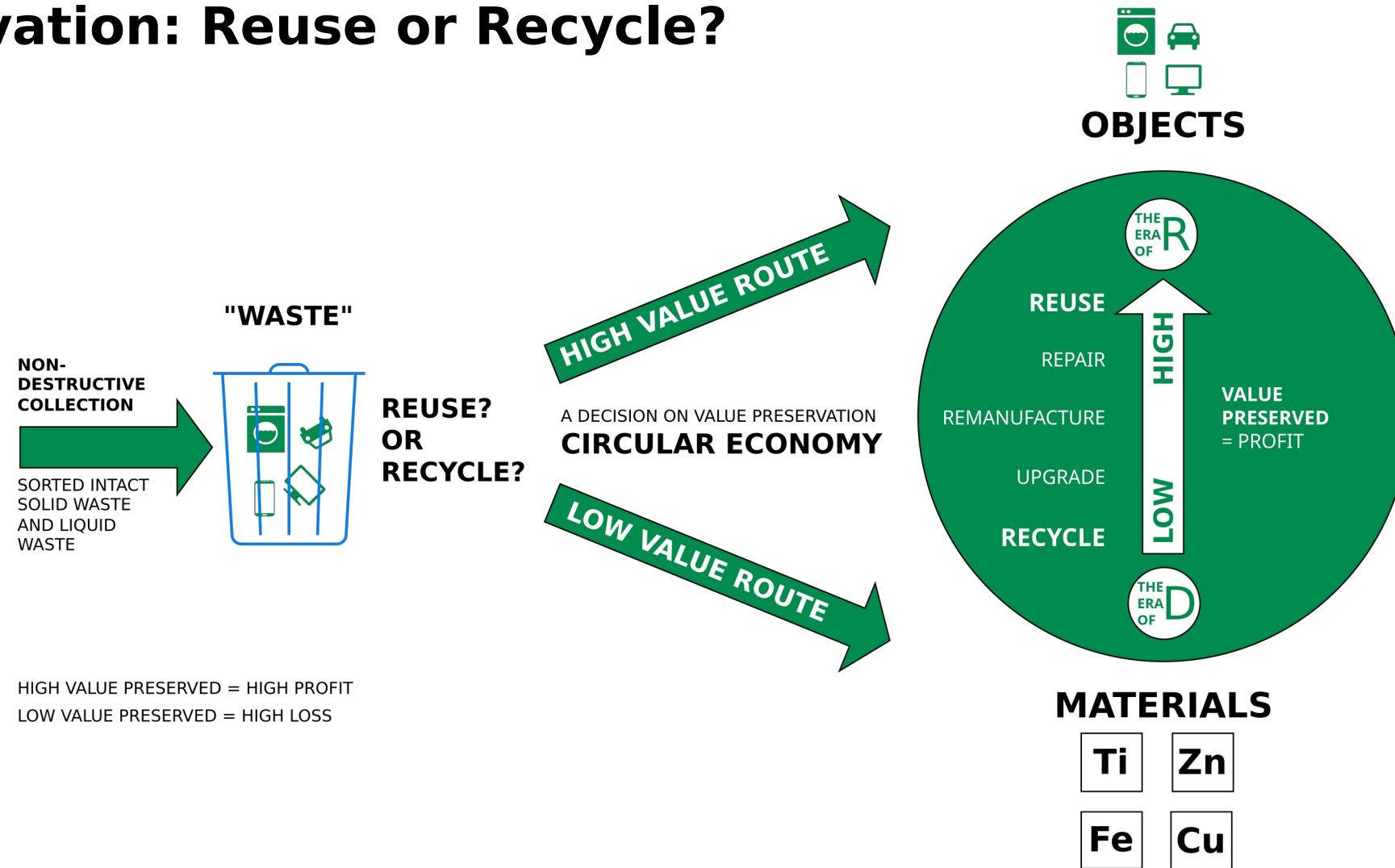


Image adapted from Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

The two absolute decoupling indicators of the CIE monitoring more wealth and jobs from less resource consumption

- **Linear Economy:** Low hr/kg (labor input per weight) ratios, coherent with mass production in highly mechanized processes, and low to medium €/kg (value per weight) ratios, in a range from basic materials like cement to smart goods like USB memory sticks

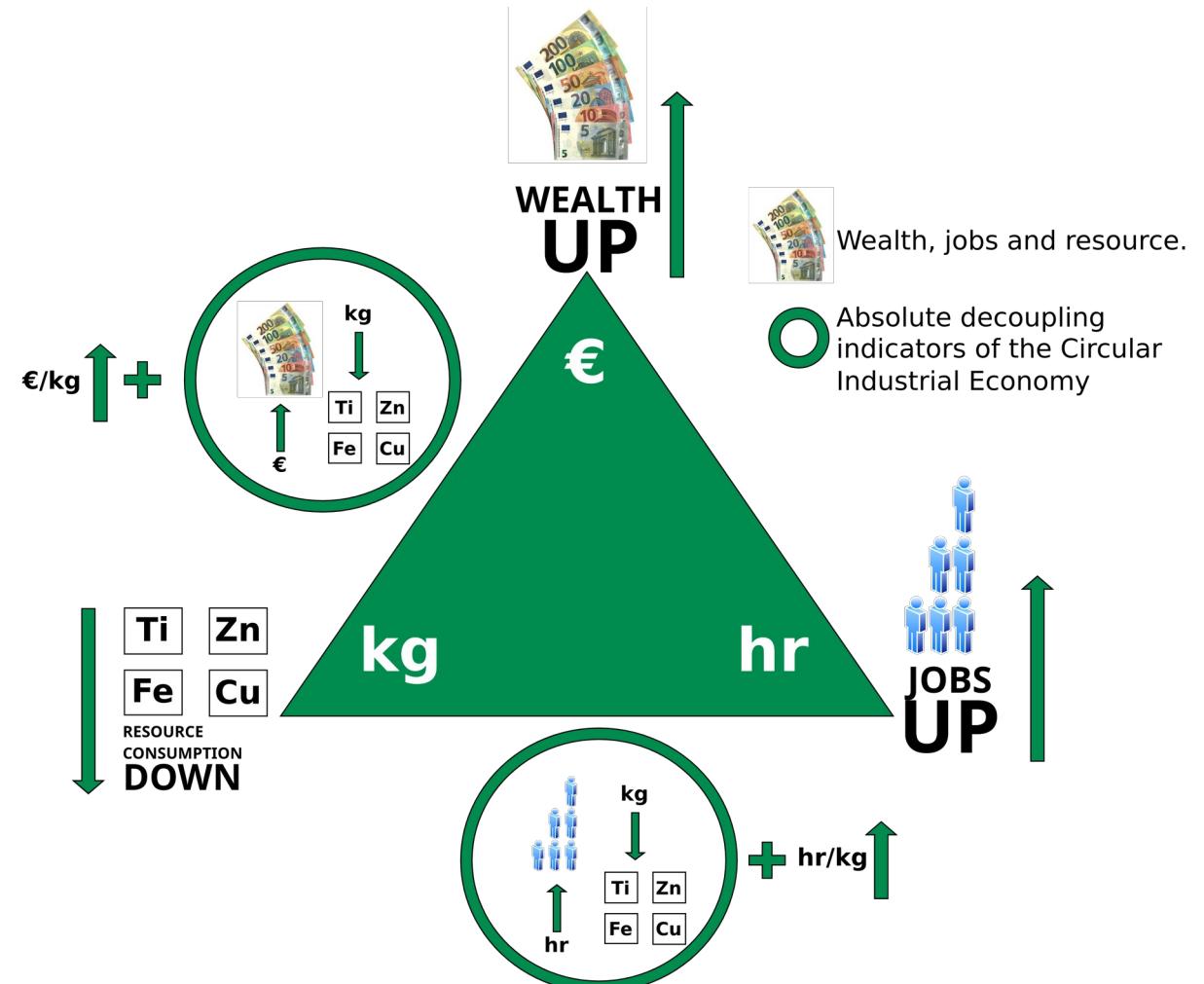
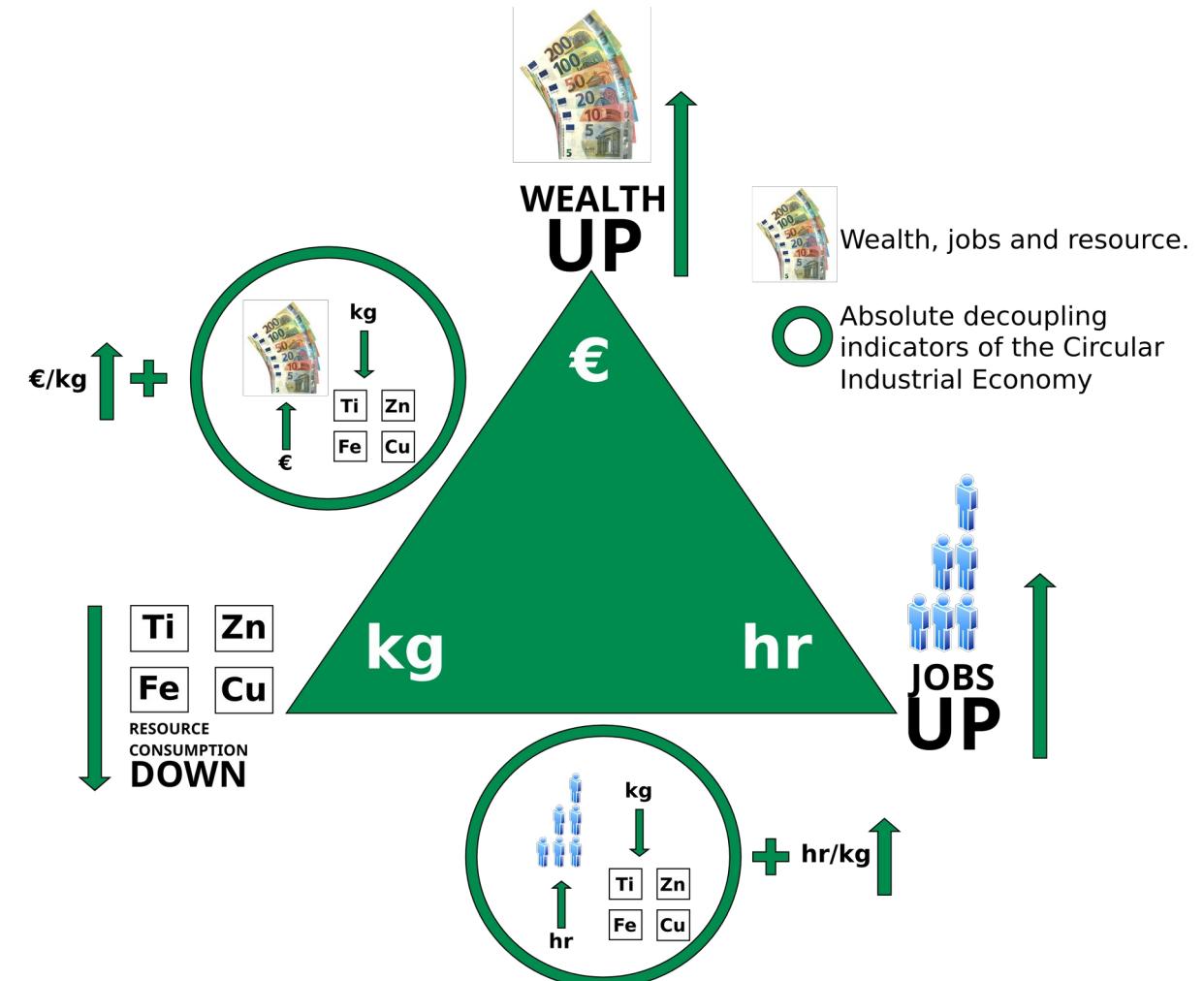


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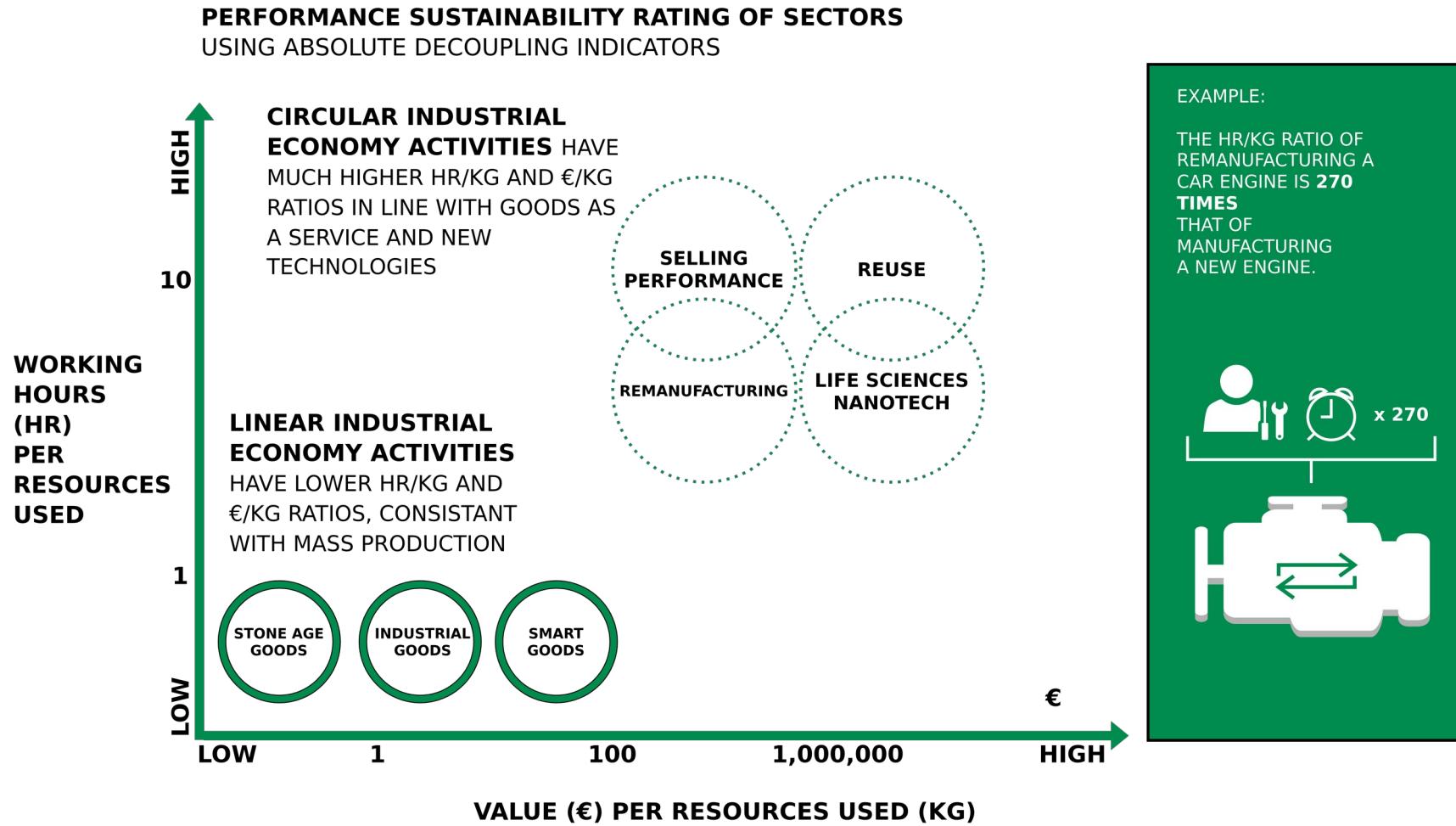
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- **Linear Economy:** Low hr/kg (labor input per weight) ratios, coherent with mass production in highly mechanized processes, and low to medium €/kg (value per weight) ratios, in a range from basic materials like cement to smart goods like USB memory sticks
 - **Circular Economy:** Higher hr/kg and €/kg ratios for reuse, remanufacture and selling performance (goods as a service), in a group with new technologies, such as life sciences and nanotechnologies, which by nature produce dematerialized objects.



[Image adapted from Walter R. Stahel (2019) – The Circular Economy: A User’s Guide]

Absolute decoupling indicators make the difference between the LIE and the CIE visible



PERFORMANCE ECONOMY

Performance Economy

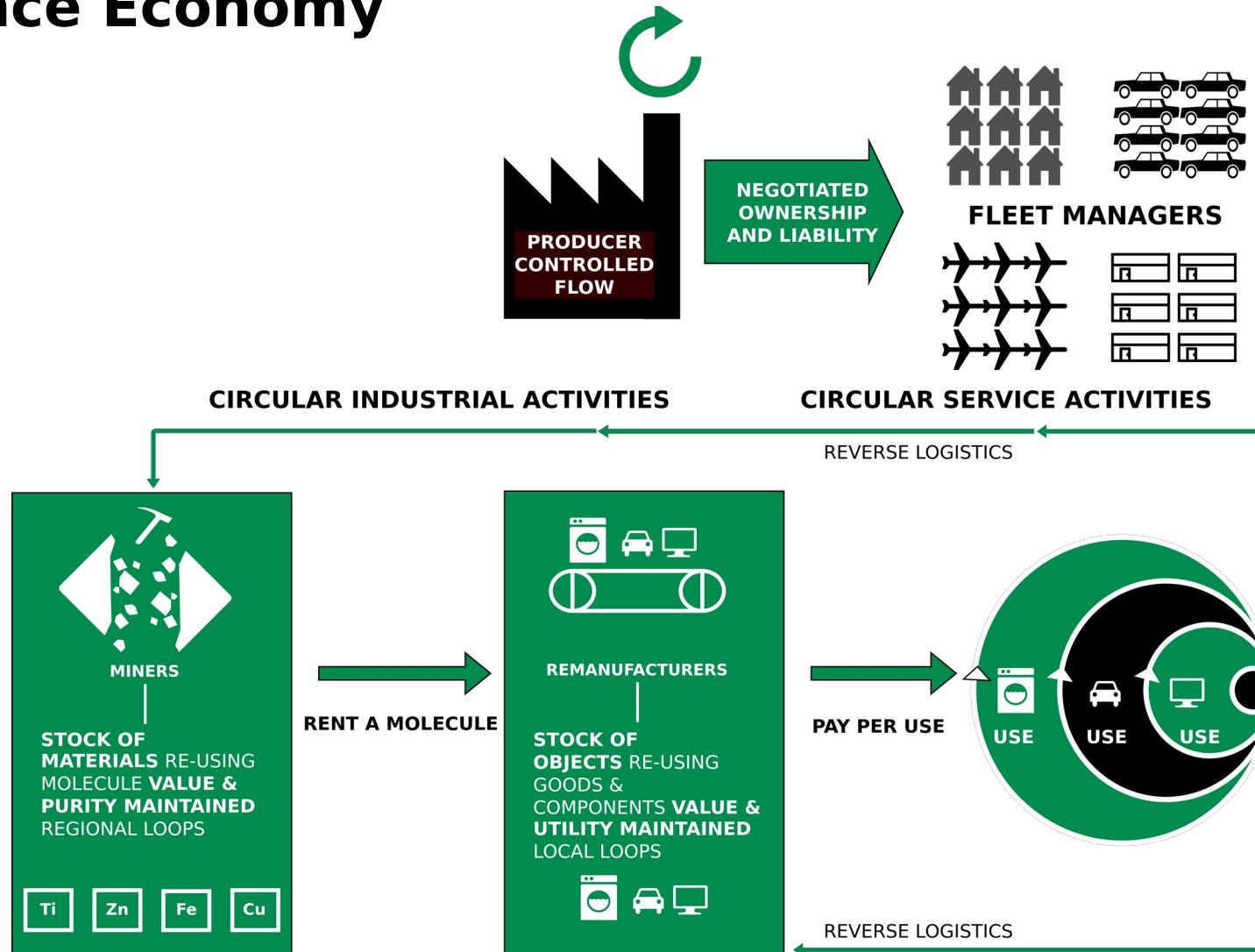


Image adapted from Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

Performance Economy - Definition

„The Performance Economy sells results instead of objects. Its economic actors may be manufacturers of durable objects or fleet managers operating them. In both cases, they sell the use of these objects as a service over the longest possible period of time and maximize their profits by exploiting both efficiency and sufficiency solutions. “

Performance Economy - Most sustainable CE business model?

- Stahel argues:
 - “The Performance Economy of selling goods and molecules as a service, function guarantees or results and performance, is the most sustainable business model of the circular industrial economy because by internalising the costs of product liability, of risk and waste, it offers manufacturers a strong financial incentive to prevent losses and waste.”

Performance Economy - Most sustainable CE business model?

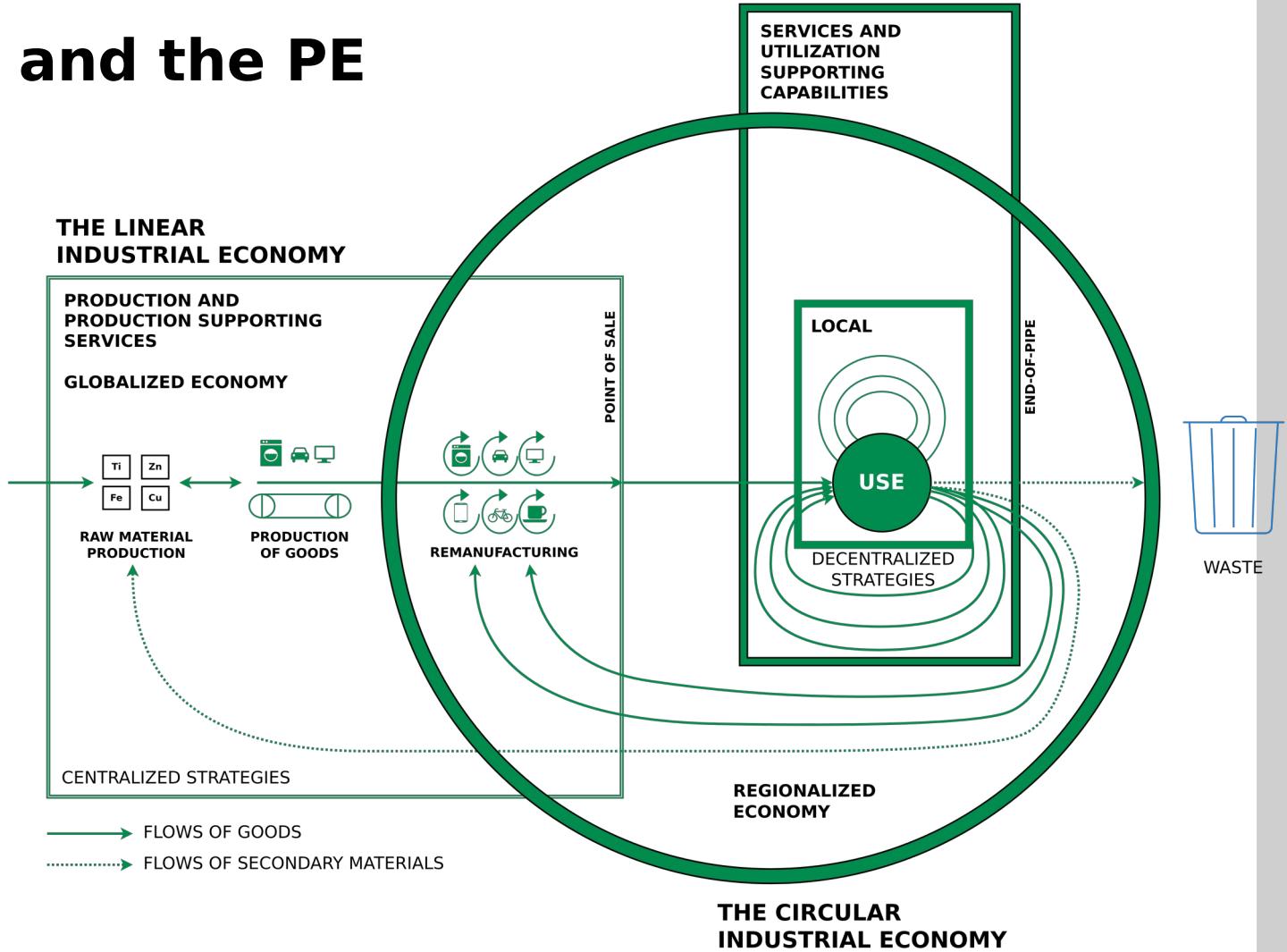
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 - “It maximises the profit potential by exploiting sufficiency, efficiency and systems solutions.”
 - “In addition, by maintaining the ownership of objects and embodied resources, it creates long-term corporate and national resource security at low cost.”

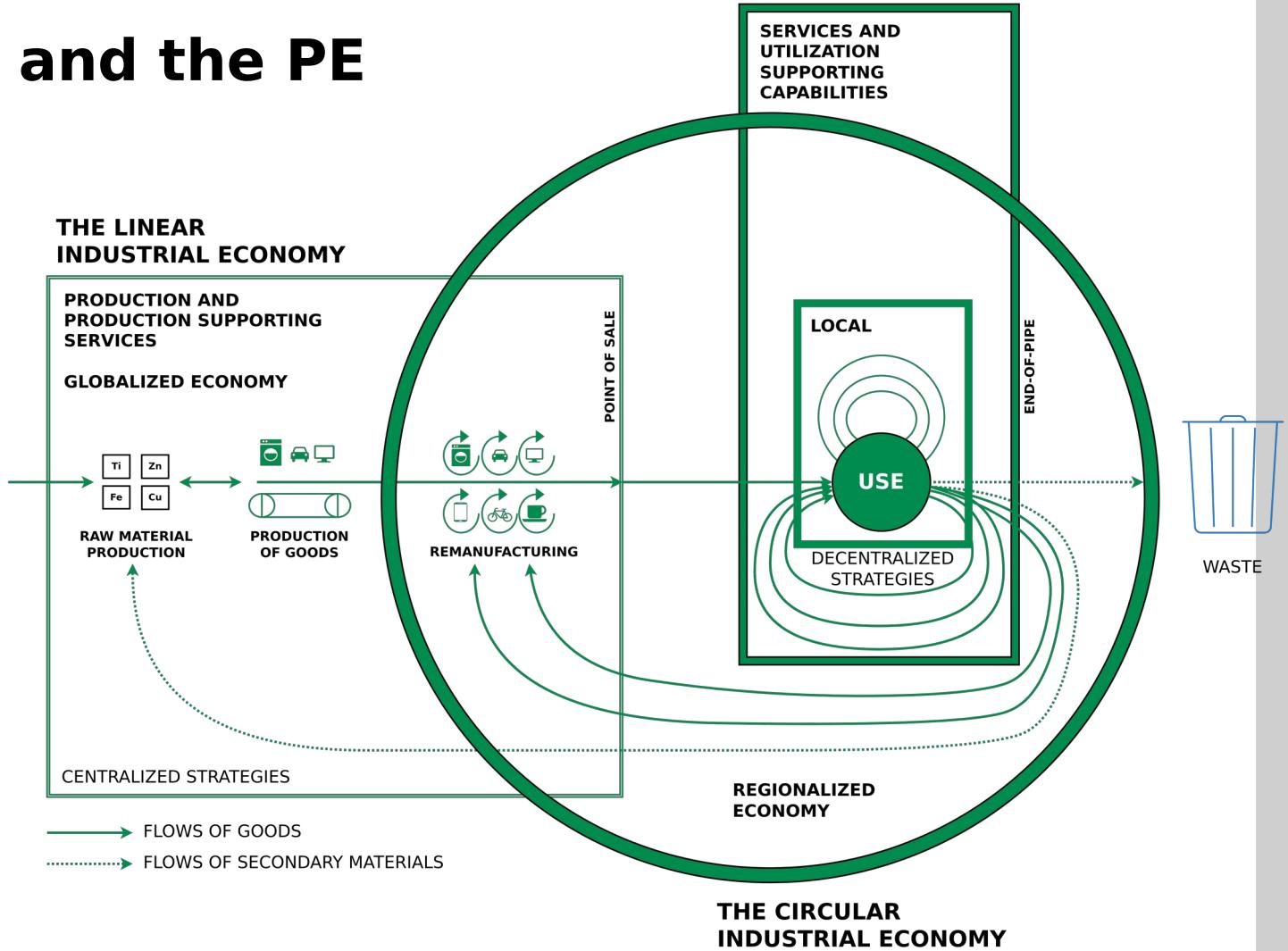
Situating the LIE, the CIE and the PE

- **Circle:** Managing the utilisation or use phase of stocks of manufactured objects and their components, by maintaining the value and quality of infrastructure, buildings, investment goods, equipment and durable consumer goods in a local or regional economy



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- **Small square:** Local use-focused PE

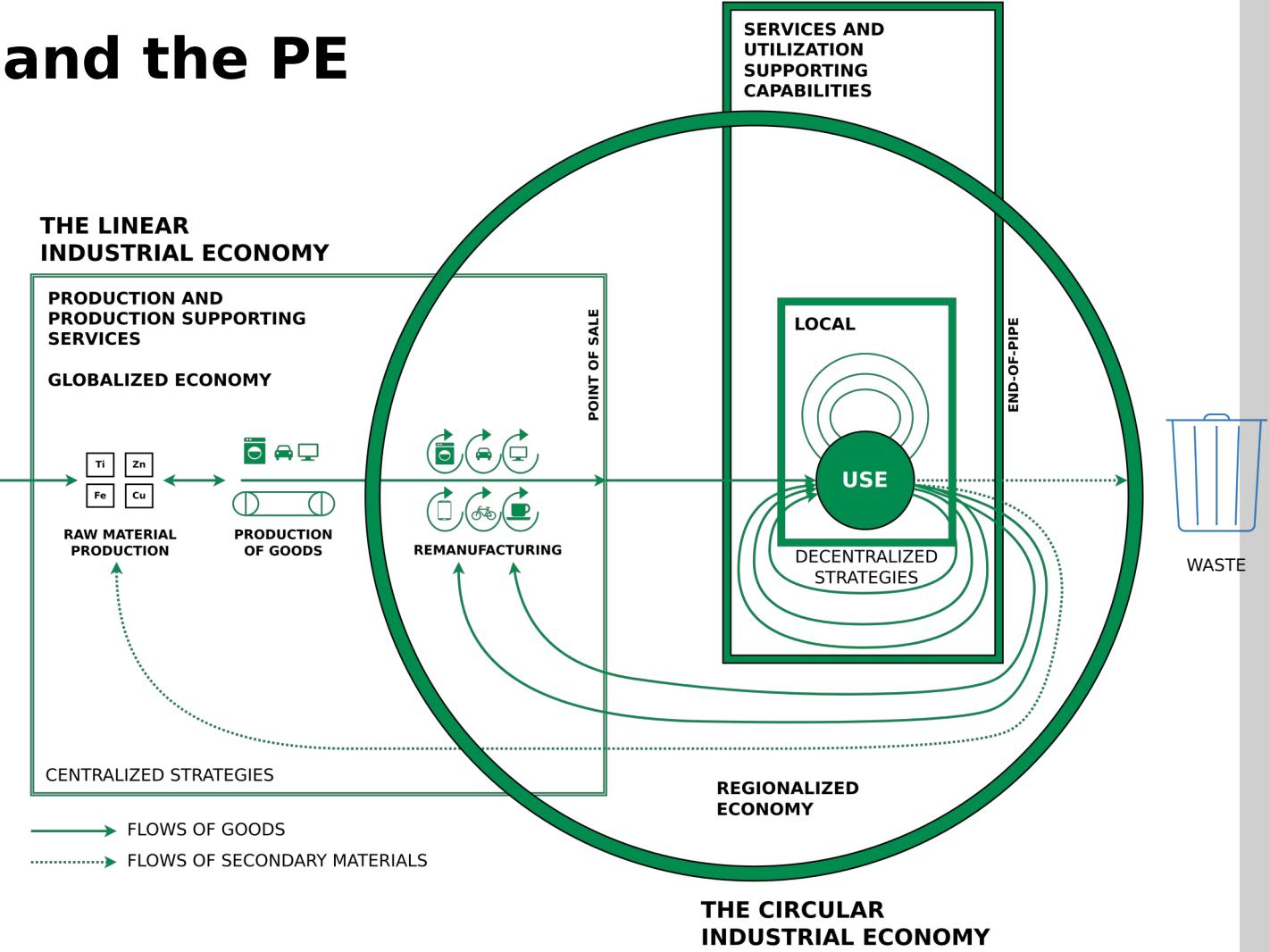


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- **Small square:** Local use-focused PE
- **Big square:** Flows of used materials returning to the raw material producer to recover molecules and atoms in a globalised economy



EXAMPLE 1 - FOODSHARING

The Problem

Food Waste - Overview (2015)

- 1.3 billion tons of the world's food ends up in the trash every year.

Question 1

- What percentage of the food you purchase is ending up in your trash bin?
 - A: 0% - 10%
 - B: 10% - 25%
 - C: 25% - 40%
 - D: 40% - 50%

The Problem

Food Waste - Overview (2015)

- 1.3 billion tons of the world's food ends up in the trash every year.
- In Germany alone, 12 million tons of food are wasted every year → per capita: 75kg/year
 - Private households → 6.7 million tons (52%)
 - Processing → 2.2 million tons (18%)
 - Out-of-home-consumption → 1.7 million tons (14%)
 - Primary production → 1.4 million tons (12%)
 - Retail → 0.5 million tons (4%)

1.) BMEL (2021) – Lebensmittelabfälle in Deutschland: Aktuelle Studie über Höhe der Lebensmittelabfälle nach Sektoren – <https://www.bmel.de/DE/themen/ernaehrung/lebensmittelverschwendungen/studie-lebensmittelabfaelle-deutschland.html>

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The Problem

Food Waste – Retail in more detail (2015)

- Total food waste → **696,484 tons**
 - Fruit and vegetables → 328,245 tons
 - Bread and baked goods → 206,399 tons
 - Dairy products → 60,255 tons
 - Meat-like/based products → 53,307 tons
 - Others → 48,279 tons

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Where is the difference between the 0.5 million tons on the previous slide and the 696,484 tons on this slide coming from?

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Where is the difference between the 0.5 million tons on the previous slide and the 696,484 tons on this slide coming from? → donated food (Tafel Deutschland e.V.)

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Solution?

General

- Make it illegal to throw food away → In February 2016, France adopted a law on fighting food waste that meant supermarkets were forbidden to destroy unsold food products and were compelled to donate it instead.
 - Has been later adopted in the gastronomy and related sectors

Alternative Solutions?

Foodsharing Platform

- [Click Me](#)
- Platform launched in 2012
 - Decentralized and self-organized
 - 450,000 registered user (all volunteers)
 - Cooperates with more than 11,000 businesses
 - More than 65 million tons of food saved

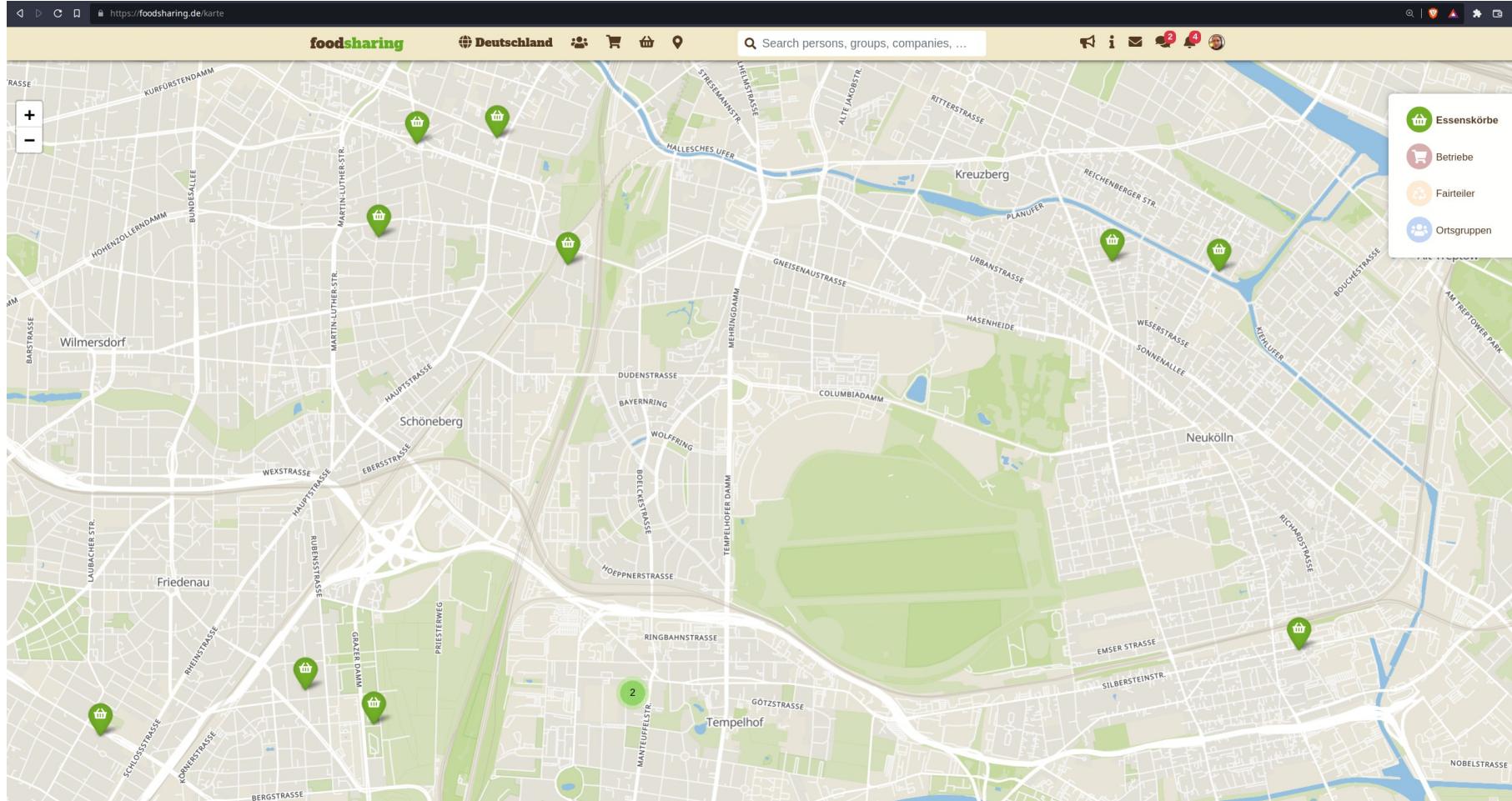
Alternative Solutions?

Foodsharing Platform – How does it work?

- Register (free – no charges, no subscriptions)
- Types of users:
 - 1. User
 - „ Share your own leftovers or collect food from others (offers visible on the Foodsharing map)
 - 2. Foodsavers
 - „ Pass a quiz (quite some effort) and become a Foodsaver.
 - „ Allowed to collect (“save”) leftovers from businesses that cooperate with Foodsharing
 - „ Redistribute saved food among friends and within the Foodsharing community
 - 3. Operations manager (Betriebsverantwortlicher = abbr. “BV”)
 - „ Manage cooperation with business, manage your team of Foodsavers and organize a collection schedule

Alternative Solutions?

Foodsharing Platform - How does it work?



<https://foodsharing.de/>

Alternative Solutions?

Foodsharing Platform – How does it work?

- Just keep/take what you can consume, redistribute everything else
- Most businesses don't want to be publicly mentioned
 - Bad image if you throw away huge amounts of food every day
 - People are supposed to buy their food at your place instead of picking it up for free ;)
- Strict:
 - Food collection schedule (pre-defined time slots, each foodsaver only once every week or every two weeks, etc.)
 - Hygiene rules
 - Pre-defined procedures for collection of food

Alternative Solutions?

Foodsharing Platform - How much food is saved every day?



The screenshot shows a user profile for 'Benjamin' on the foodsharing.de website. At the top, there's a navigation bar with 'foodsharing', 'Deutschland', and a search bar. Below the navigation is a banner with 'Neues Update | FAQ zu Corona und foodsharing'. The main profile area features a photo of Benjamin, a status message 'Benjamin is online.', and a summary of his activity: 3 Posts, 3 Food baskets, 30 x picked up, and 550 kg saved.

Benjamin is a foodsaver in:
Deutschland, Braunschweig, Niedersachsen, Europa

home district of Benjamin:
Braunschweig



<https://foodsharing.de/>

Further Resources

- Baccini et al. (2012) – Metabolism of the Anthroposphere: Analysis, Evaluation, Design
- Deutscher Bundestag (1994): Bericht der Enquete-Kommission „Schutz des Menschen und der Umwelt – Bewertungskriterien und Perspektiven für umweltverträgliche Stoffkreisläufe in der Industriegesellschaft“ ([Link](#))
- Meadows (1972) – The Limits to Growth
- Meadows, Randers und Meadows (2004) – Limits to Growth – The 30-Year Update
- Polestar (2020) – Life Cycle Assessment – Carbon Footprint of Polestar 2 ([Link](#))
- Walter R. Stahel (2019) – The Circular Economy: A User's Guide
- Website of the Ellen MacArthur Foundation – [Link](#)

Questions?