

The Limits to Growth: Sustainability and the Circular Economy

Lecture 7: Circular Economy

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- Updated versions of these slides will be available in our [Github repository](#).

NEWS/UPDATES



Course Evaluation

- Link: [Click Me](#)



We are hiring!

- Topic:
 - Automated gourmet mushroom farming system
 - Detect whether gourmet mushrooms are ready to be harvested (camera)
 - Harvest mushrooms with a robot arm
- Duration → August 2022 until June 2023
- Why should I work with you → free mushrooms!
- Positions:
 - HiWi
 - Later: Research assistant (50-60% E13)
- Application:
 - CV
 - Motivation
 - Study records
 - Send all the relevant documents to: etce-ltg@tu-clausthal.de

Bonus Task Updates

- Please prepare your bonus task submission until 04.07.2022 – 2 pm
- Submit a 60-120s video that covers the following:
 - Explain the problem you want to solve
 - Describe your solution
 - Present what you achieved so far and what you would like to do next.

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- Submit a 60-120s video that covers the following:
 - Explain the problem you want to solve
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 - Present what you achieved so far and what you would like to do next.
- Submission procedure:
 - Upload the video to *cryptshare.tu-clausthal.de*
 - Send the link to etce-ltg@tu-clausthal.de
 - Incl. your team/project name and the team members

EXERCISE E04

Exercise E04

Feeback

- General feedback:
 - Some submissions did not bother to use OpenLCA and just resubmitted E03
 - Other worked on a LCA without OpenLCA
 - Some inconclusive results for OpenLCA
 - **BUT → Some real good results for OpenLCA**



Exercise E04

Feeback

- Some confusion

Exercise E04

Feeback

- Some confusion → “Chicken” is neither a fruit, nor a vegetable!

Exercise E04

Feeback

- Some confusion → “Chicken” is neither a fruit, nor a vegetable!
- So why did we receive submissions for:
 - “*Chicken microni*”
 - “*Chicken curry*”
 - “*Chicken Biryani*”
 - “*Chicken karrahi*”

Exercise E04

Feeback

- How easy difficult was it to use/understand openLCA?
 - a) easy
 - b) okay
 - c) difficult
 - d) impossible

INTRODUCTION

Introduction

Sustainability - Definition

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

Introduction

Sustainability - Implications

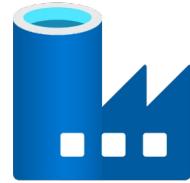
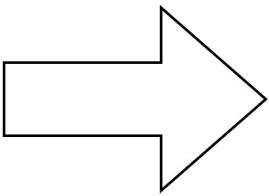
Sustainability → Consume less

Introduction

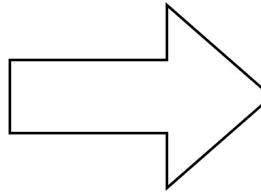
Linear (Industrial) Economy



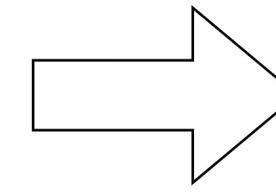
RESOURCES



MANUFACTURING



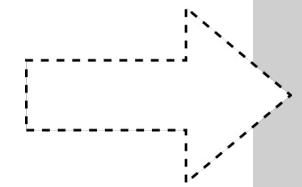
DISTRIBUTION



POINT OF SALE

GLOBALIZED INDUSTRIALIZED PROCESSES

NATURAL RESOURCES (Water, Energy, Materials) and Human Resources (Labor and Skills) are used to produce manufactured **objects** (infrastructure, buildings, equipment, durable projects).



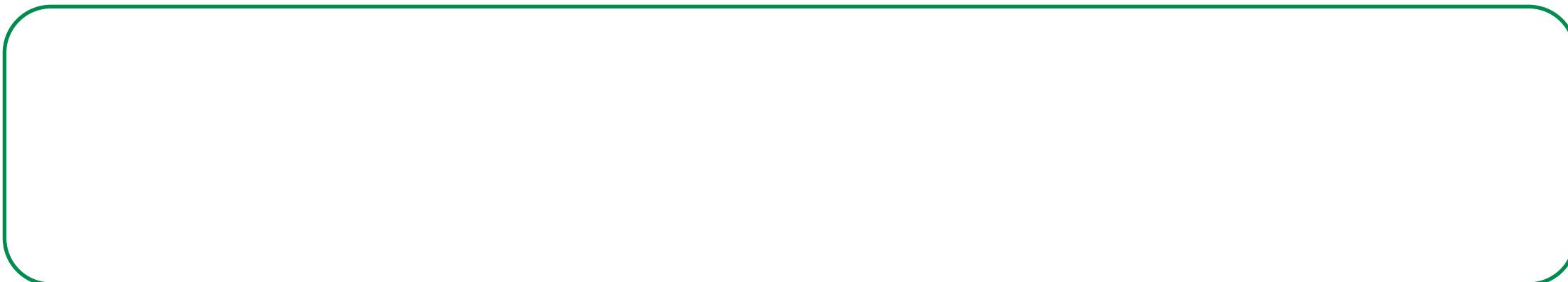
GLOBALIZED DISTRIBUTION LOGISTICS

COMMERCIALIZATION at the factory gate or at point of sale these objects are put to use (sold, leased, rented, sold as service)...



Introduction

Linear Economy



Introduction

Linear Economy

“Take – Make – Dispose”

Introduction

Linear (Industrial) Economy – Definition

“Its objectives are to **maintain value** (not to create value added), to **optimise stock** management (not flows) and to **increase the efficiency of using goods** (not of producing goods)”

Introduction

Linear (Industrial) Economy - Waste Management as last Step

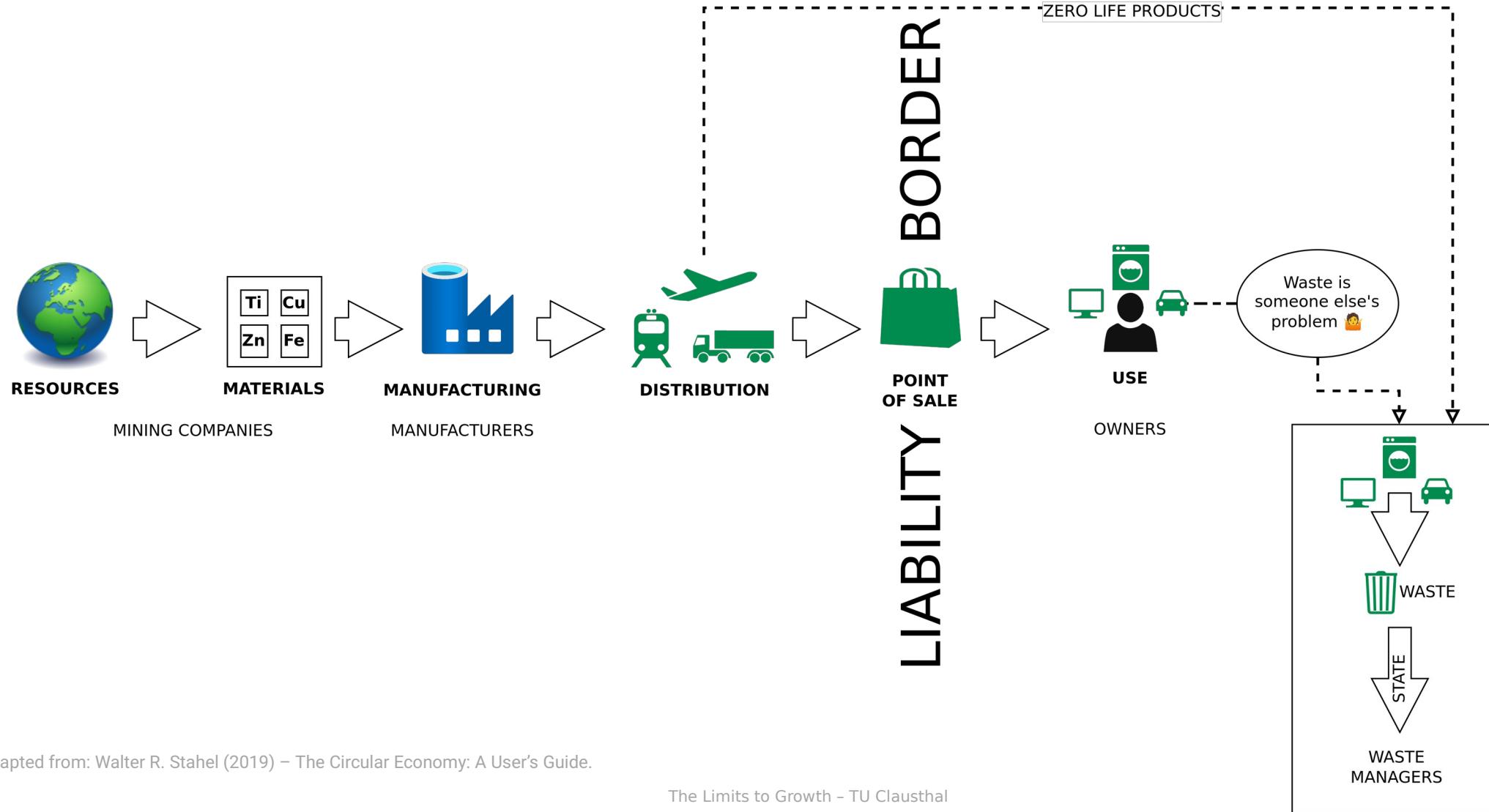


Image adapted from: Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

Introduction

Horrible Waste Management



1. "Landfill at Upernivik" by ulalume – <https://www.flickr.com/photos/96649248@N00/43867280734> – CC BY-NC-ND 2.0

2. Christian Hüpfer – <https://flic.kr/p/aKXw2F> – CC BY-SA 2.0

Introduction

Horrible Waste Management - Nuclear Waste



Introduction

Horrible Waste Management - Nuclear Waste

- → 2 generations profited from cheap nuclear energy
- → 40,000 generation will have to live with the waste

Introduction

Horrible Waste Management - Plastic



"Pollution Plastique" by Mouenthias is licensed with CC BY-SA 4.0. To view a copy of this license, visit <https://creativecommons.org/licenses/by-sa/4.0/>

Introduction

The Limits to Recycling

- Recycling often requires a lot of energy
- Some materials cannot be recycled at all (yet)
- Impurities are challenging
- Often requires a lot of manual labor
- Recycled material often with lower quality than input material
- False sense of safety!

I am not saying you should stop recycling!

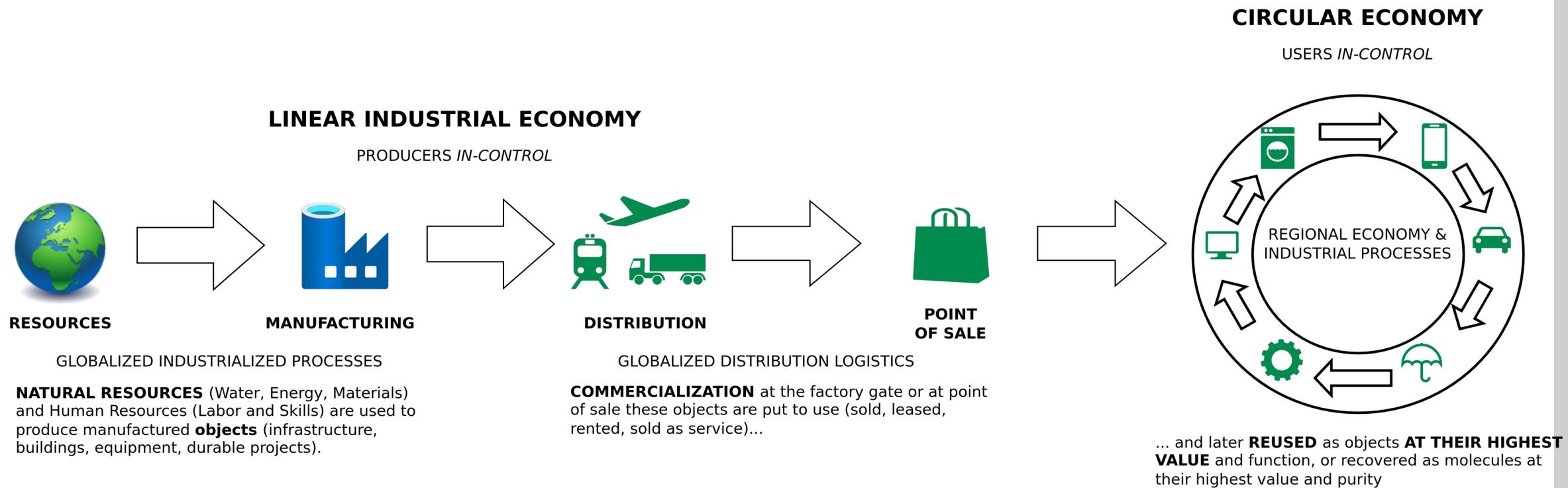
→ Recycling is great but it is better to make sure that we do not have to recycle anything.
→ Buying less (e.g., only the essentials) is way more effective.

*"We buy things we don't need, to impress people we don't like." -
Tyler Durden / Chuck Palahniuk*

Waste = Inefficiency

Introduction

From Linear to Circular



Introduction

Linear Economy - Main Challenges

- Environmental pollution / waste
- Waste of resources
 - → Just recycling is not gonna do it

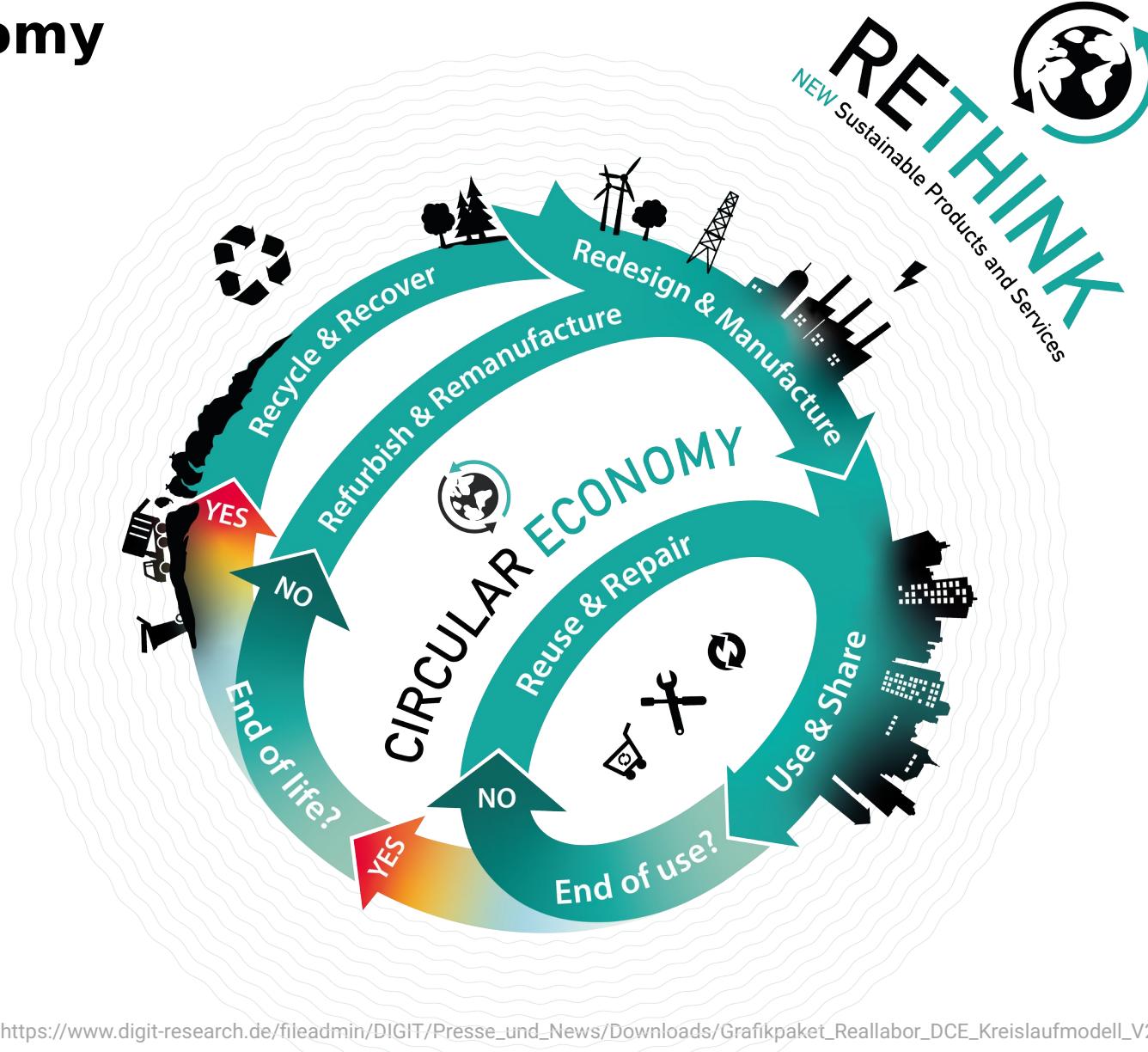
Introduction

Linear Economy - Main Challenges

- Environmental pollution / waste
- Waste of resources
 - → Just recycling is not gonna do it
- Therefore:
 - Consume less
 - Make stuff last longer
 - Maximize resource utilization

THE CIRCULAR ECONOMY

Circular Economy



Circular Economy

Definition

“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

Definition

“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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– Ellen MacArthur Foundation

“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

Definition

“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.**”

Circular Economy

Sustainability - Definition

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

Circular Economy

Characteristics

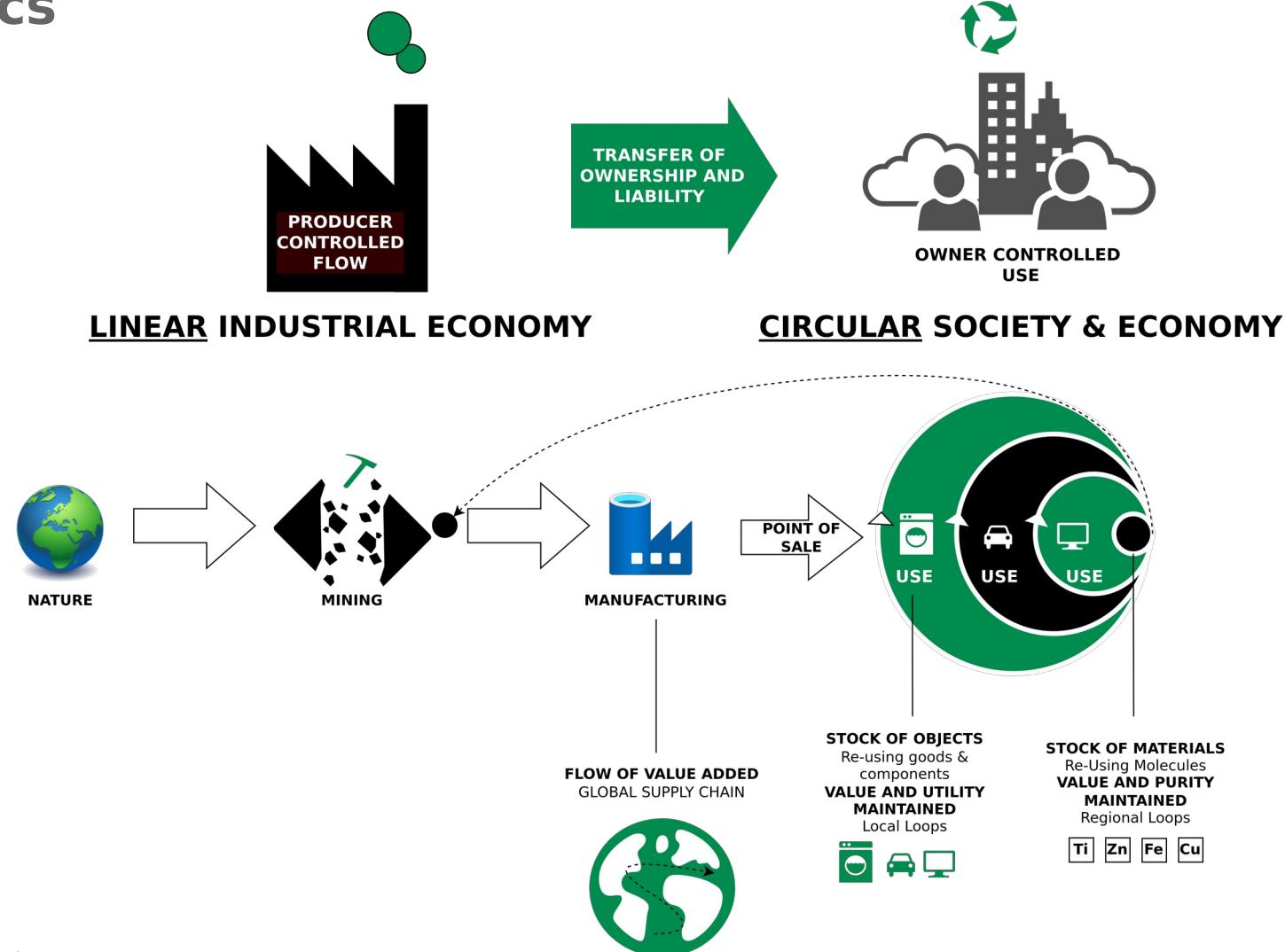


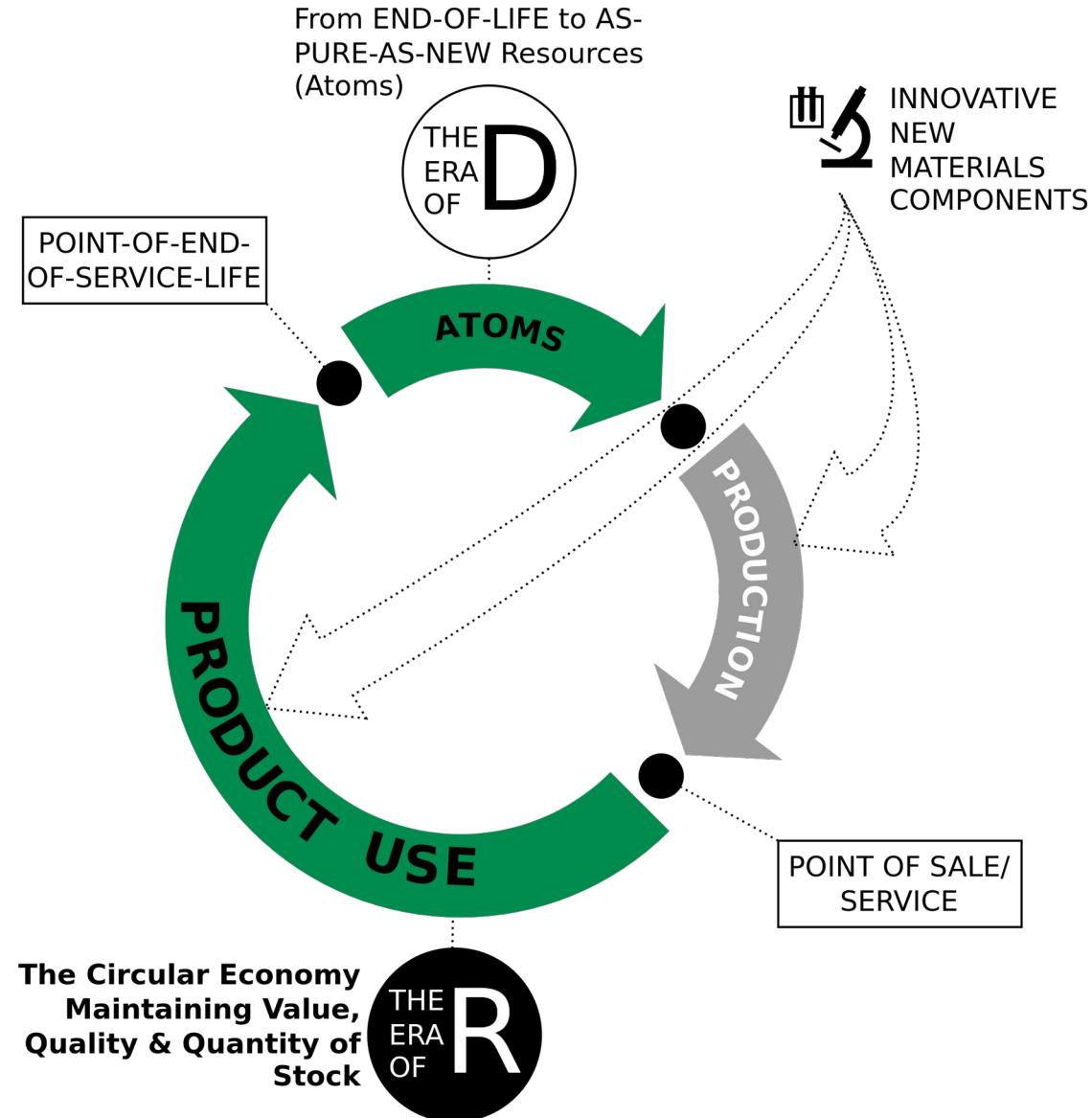
Image adapted from: Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

Circular Economy

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**

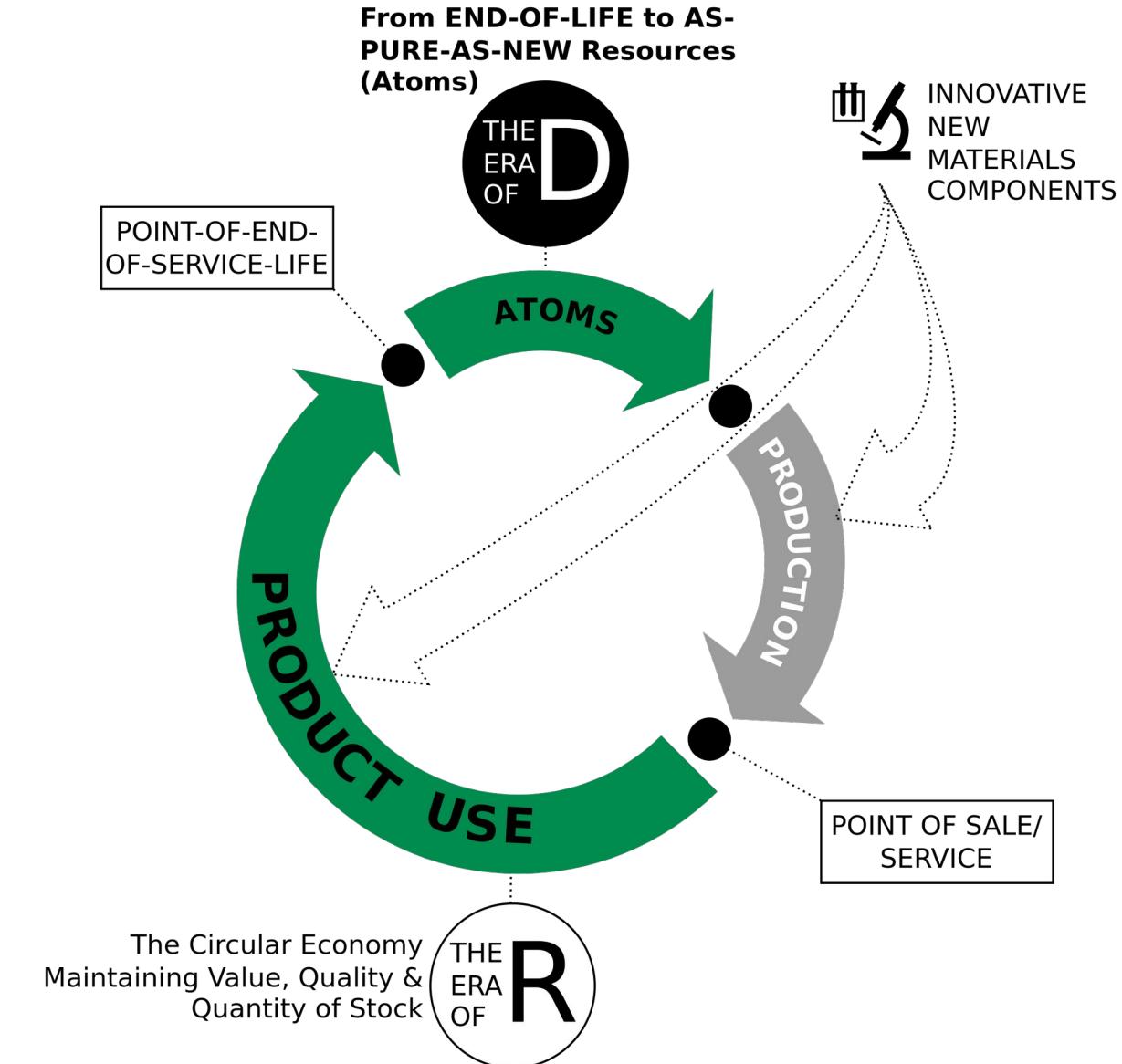


Circular Economy

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



Circular Economy

End-of-Life - Reuse or Recycle?

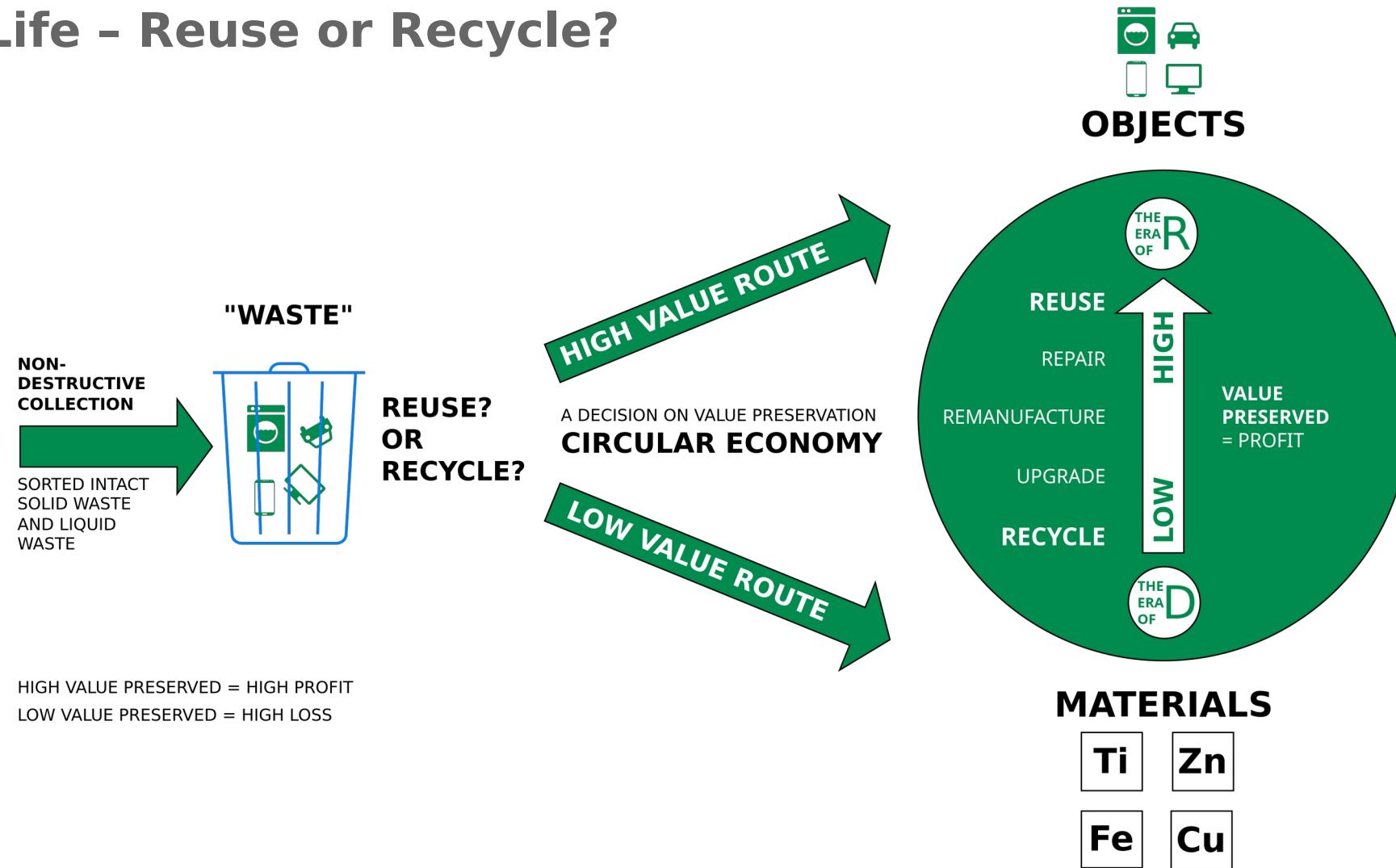


Image adapted from Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

Circular Economy

More Wealth/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

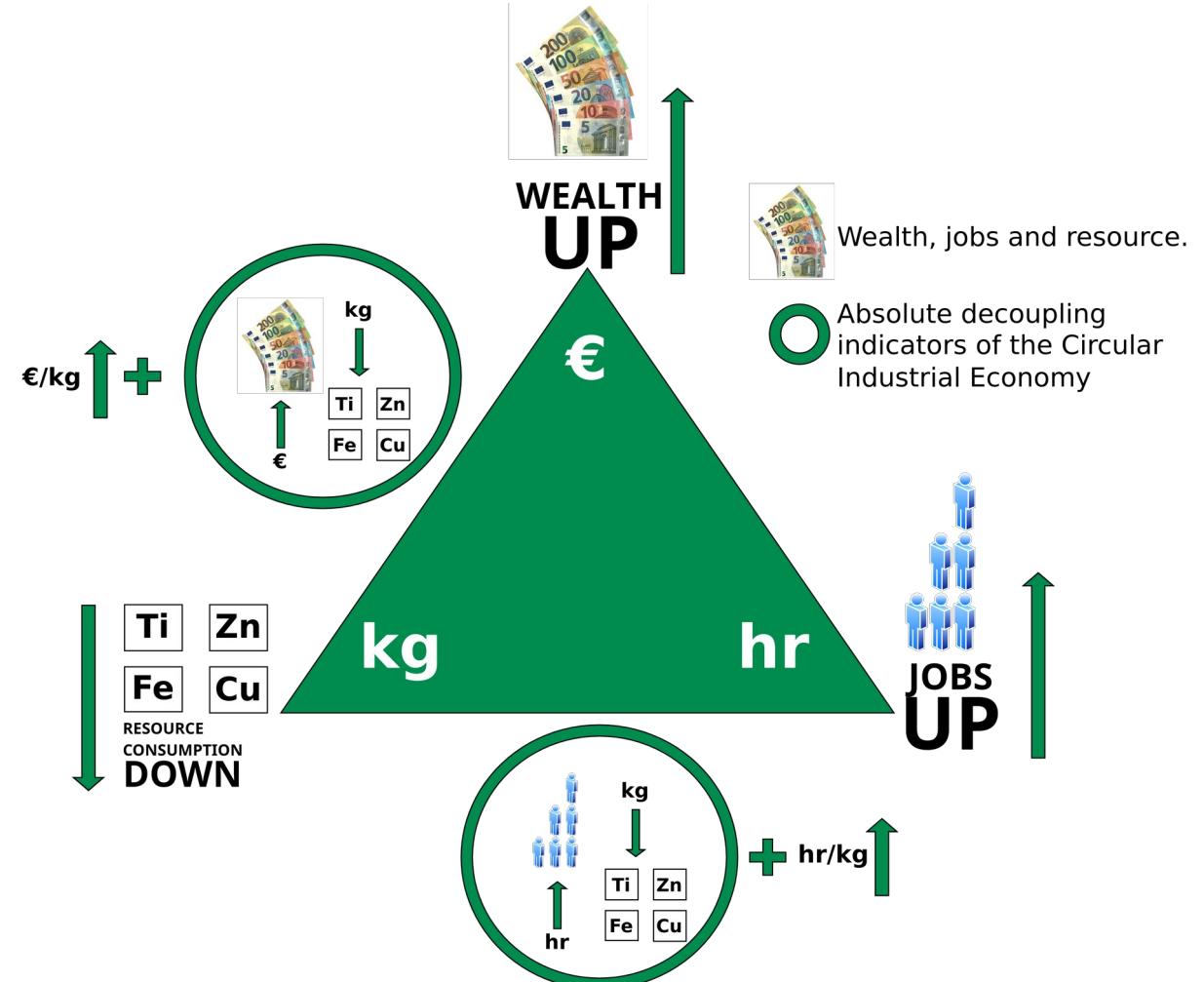


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Circular Economy

New Engine vs. Remanufacturing A Car Engine

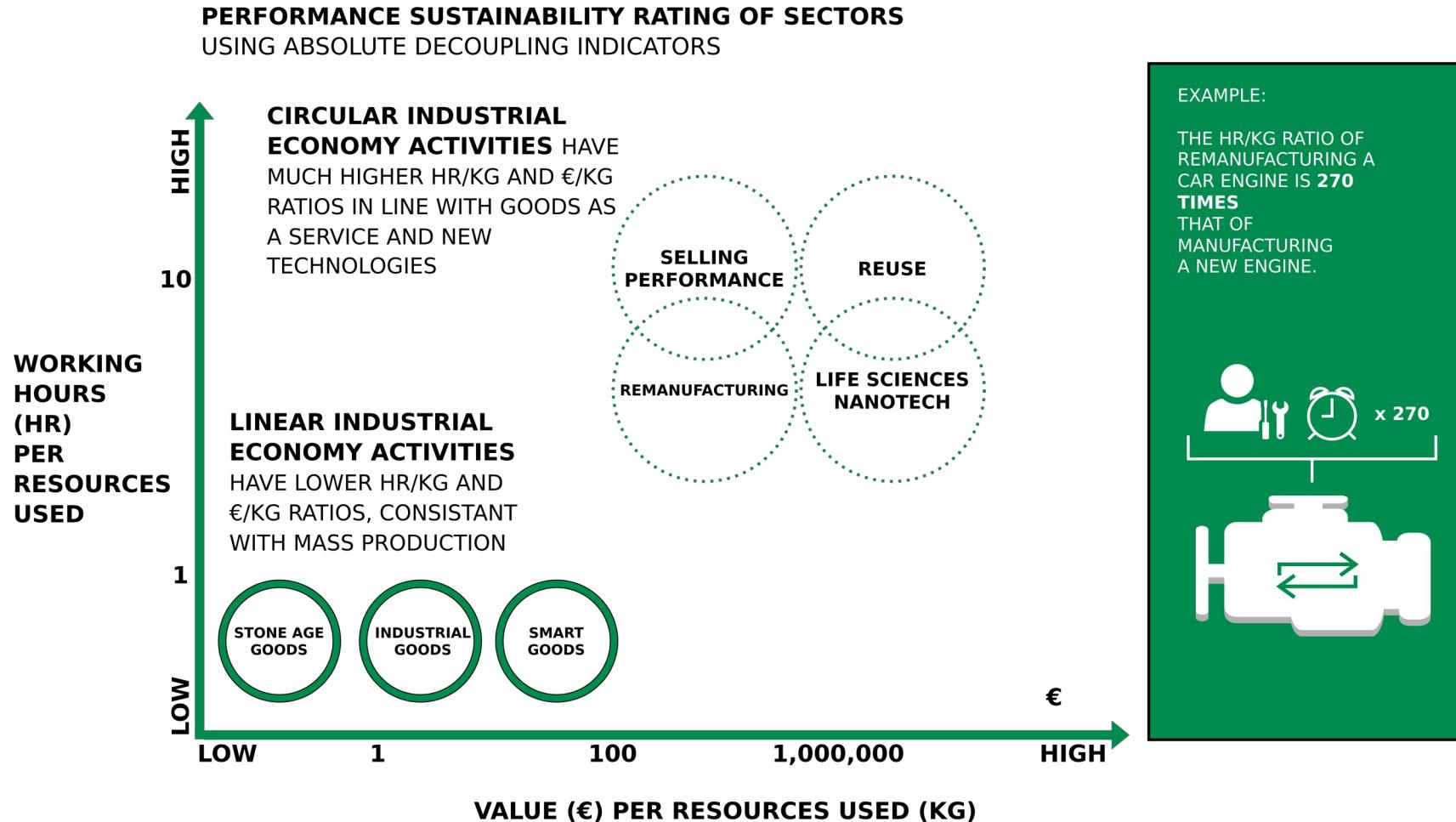
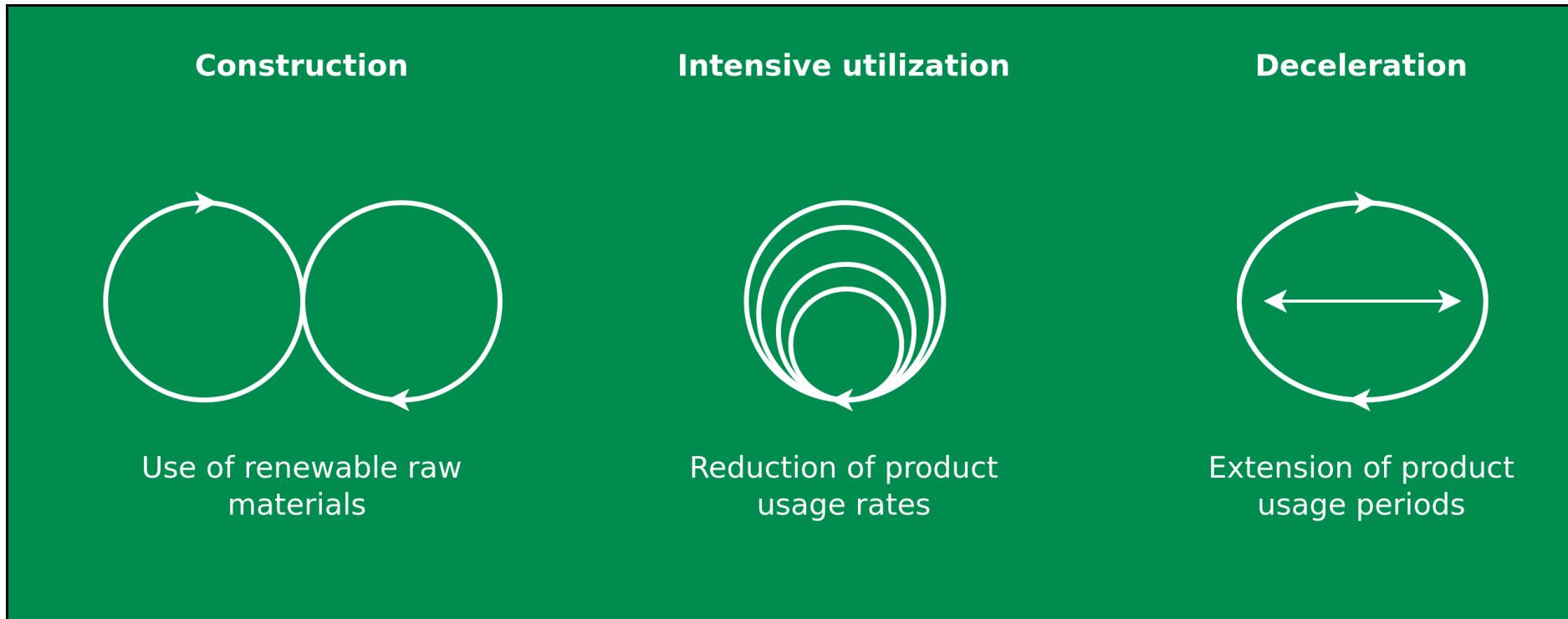


Image adapted from Walter R. Stahel (2019) – The Circular Economy: A User's Guide.

Circular Economy

Business Model Characteristics



Circular Economy

BUSINESS MODEL TOPOLOGY OF THE CIRCULAR ECONOMY

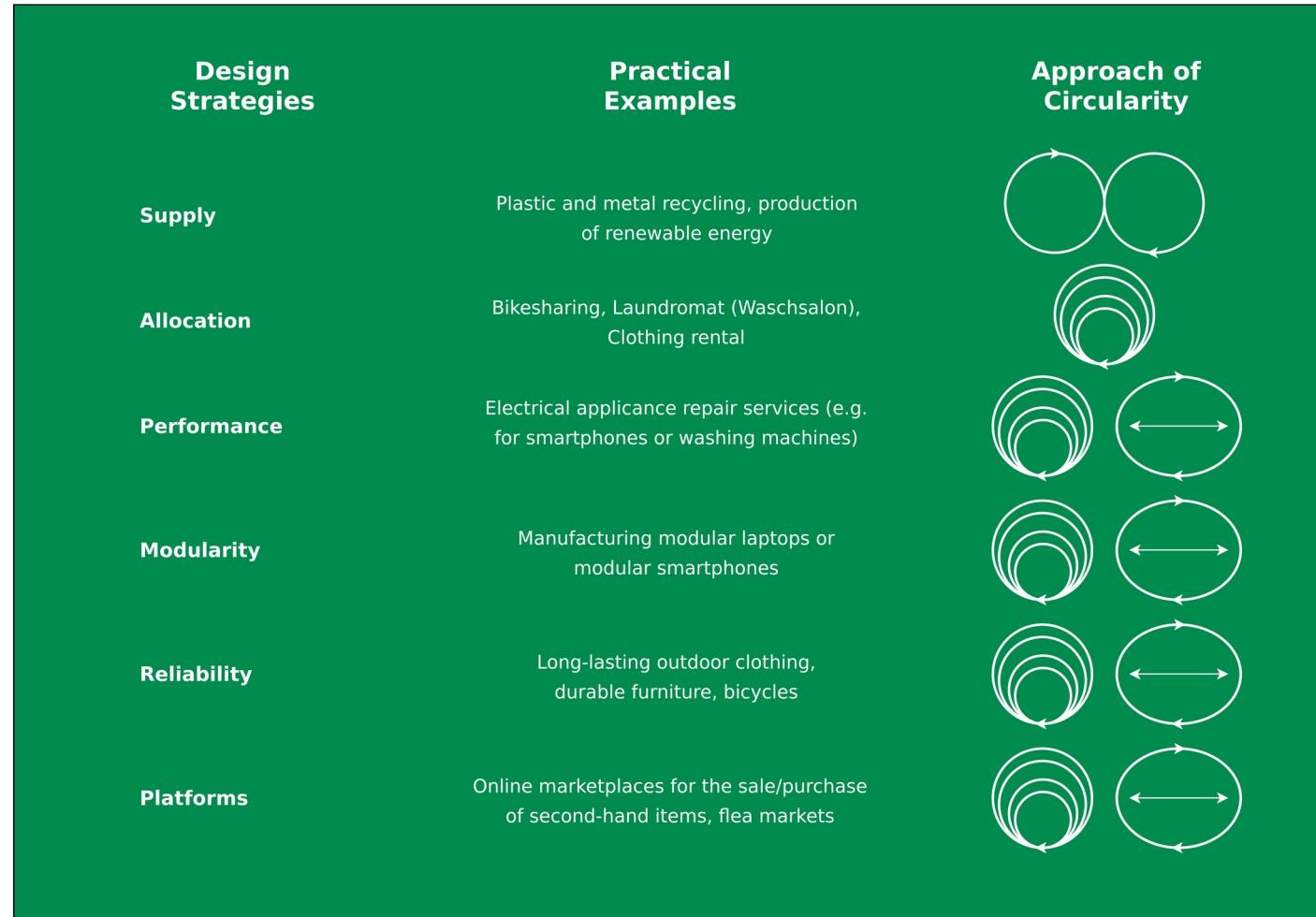


Image adapted from: M. Jaeger-Erben, F. Hofmann (2019) – Kreislaufwirtschaft - Ein Ausweg aus der sozial-ökologischen Krise? – [Link](#).

PERFORMANCE ECONOMY

Performance Economy

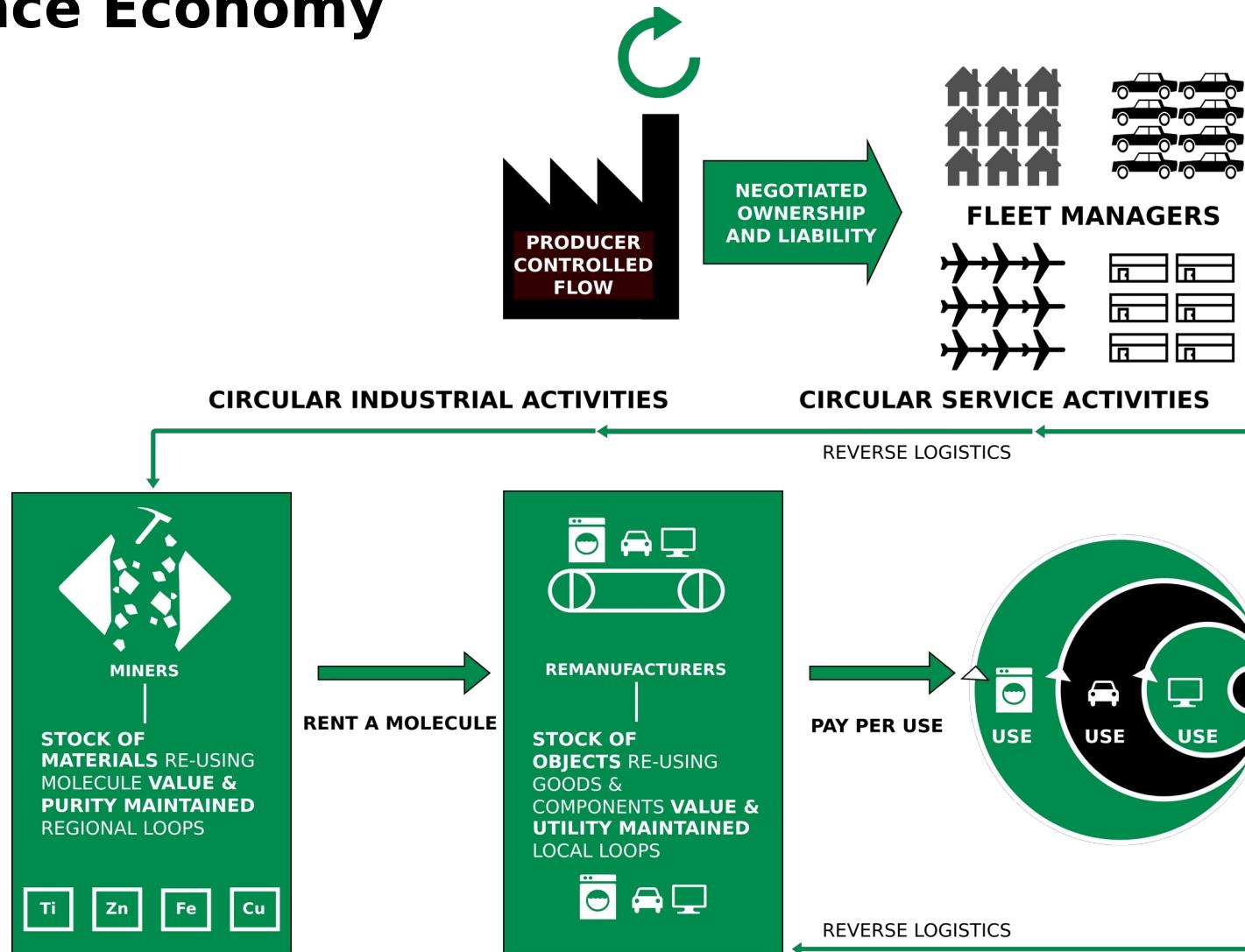


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Performance Economy - Definition

„**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?

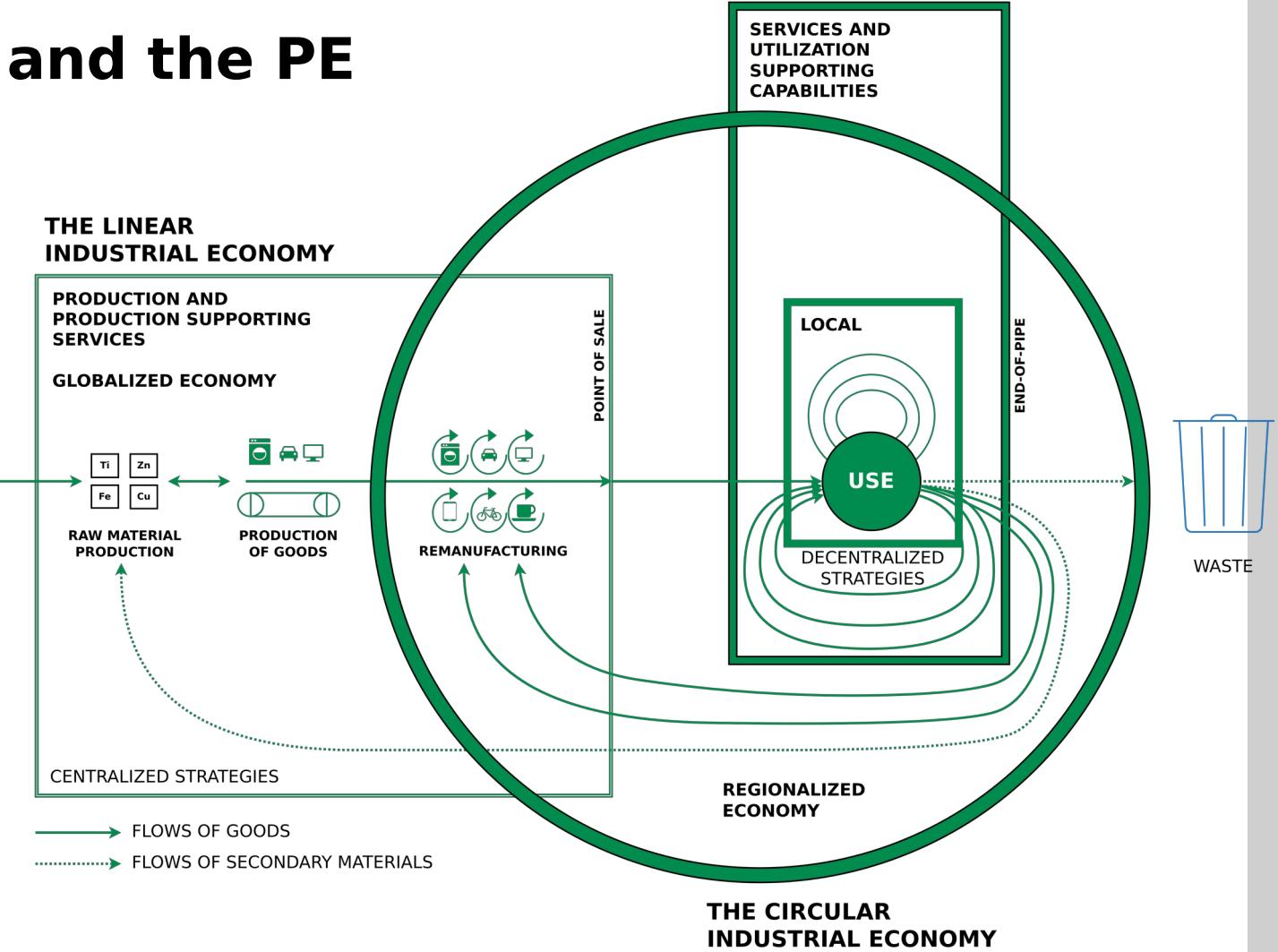
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 - “It maximises the profit potential by exploiting sufficiency, efficiency and systems solutions.”
 - “In addition, by maintaining the ownership of objects and embodied resources, it creates long-term corporate and national resource security at low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

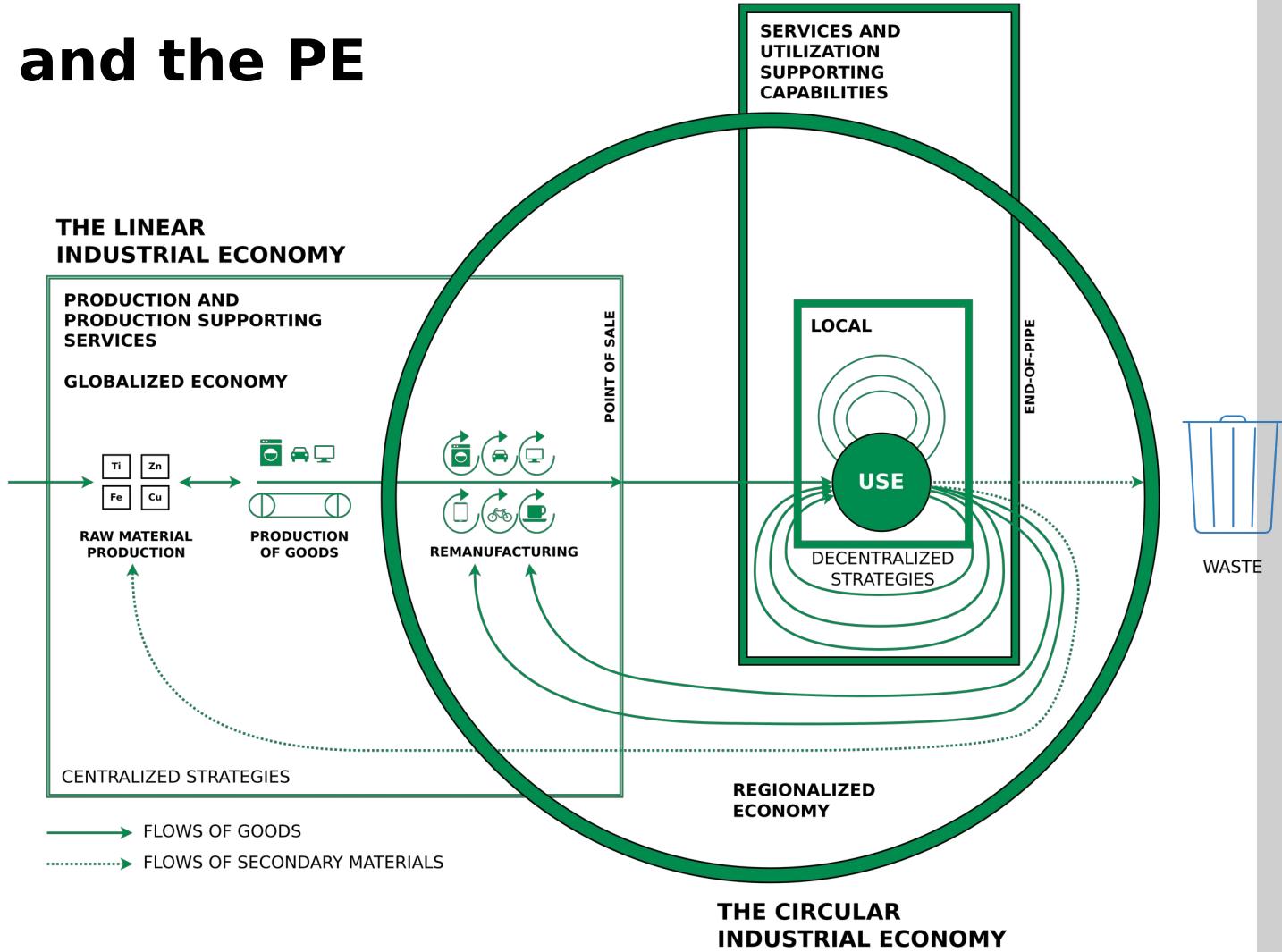
Situating the LIE, the CIE and the PE

- **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



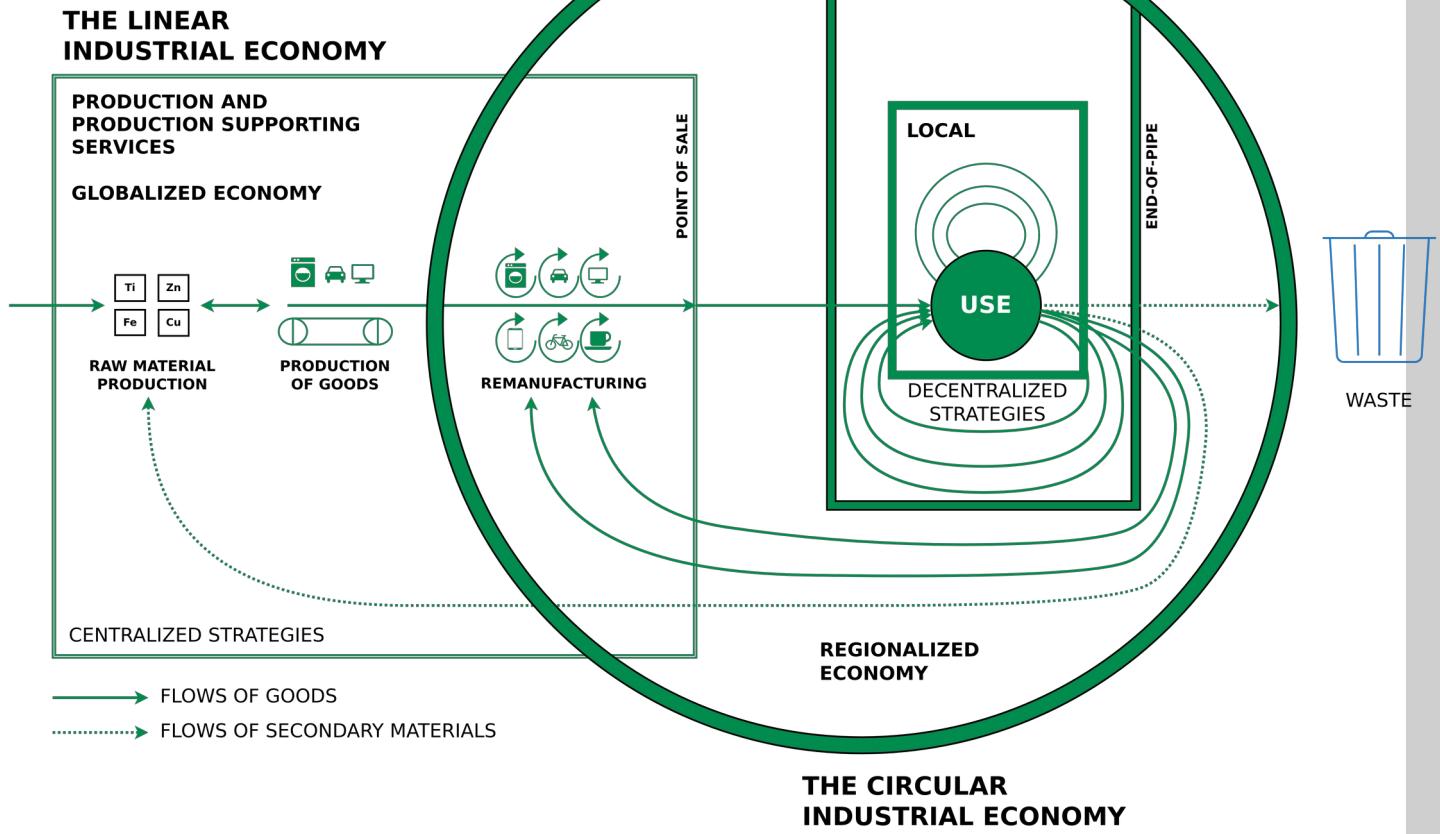
Situating the LIE, the CIE and the PE

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



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



CONCLUSION

Conclusion

- Linear Economy (LE) → “Take – make – dispose”
- Circular Economy (CE) → Maintain value and utility as high as possible for as long as possible
- Performance Economy → Sell results instead of objects

EXERCISE E06

Exercise E06

Performance Economy

- Identify **THREE** objects that you own which could be replaced by service provision within the Performance Economy (PE).
- Explain your choice for each of the objects in three sentences or more.
- Submit your submission according to the instructions in the [exercise sheet](#).

Additional Resources

- Walter R. Stahel (2019) – The Circular Economy: A User's Guide
- Website of the Ellen MacArthur Foundation – [Link](#)

Questions?