CIRCULAR ECONOMY

Malou van der Vegt

19th of September 2022

INTRODUCTION:
MALOU VAN DER VEGT

BACKGROUND

- Industrial Design Engineering
- Sustainable Packaging Design

LECTURER

- Industrial Engineering and Management

RESEARCHER

- Centre of expertise Smart Sustainable Cities

INTRODUCTION: MALOU VAN DER VEGT

Interreg North-West Europe TRANSFORM-CE
EUROPEAN UNION
European Regional Development Fund

1

Workshops
barriers & enablers
for recycled plastic

2

Case studies
good practices
circular economy
business models

3

Case studies
business support
redesigning products
with recycled plastic

4

CE roadmap
plastic roadmap for
IEM and AM

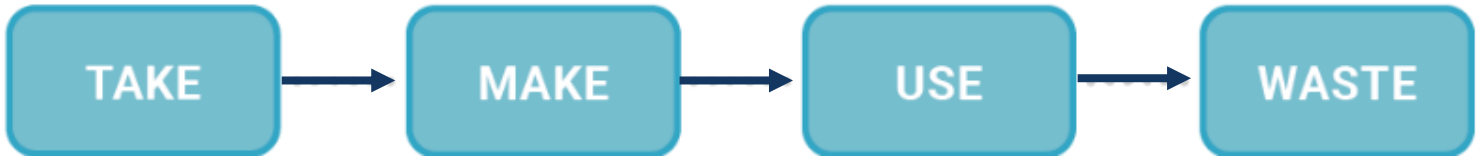
CONTENT

- Linear economy
- What is the issue?
- Circular Economy
- Added value
- Circular strategies
- Material and value flows
- Examples

WHAT IS ECONOMY?

*“The state of a country or region in terms of the **production and consumption** of **goods and services** and the **supply of money**.”*

LINEAR ECONOMY



Source: Velzing et al., 2021

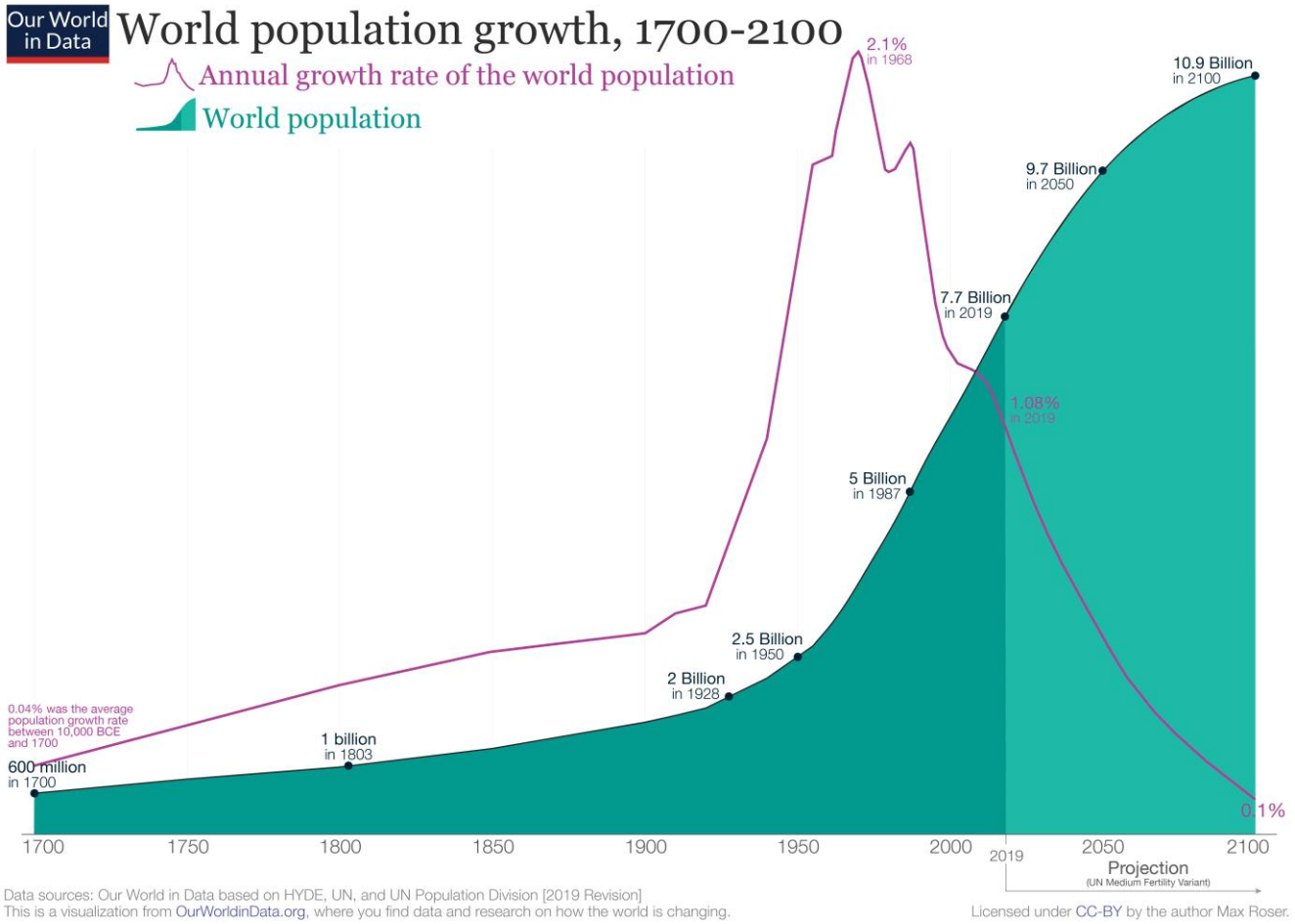
WHAT IS THE ISSUE?

GLOBAL MATERIAL USE WILL DOUBLE IN THE NEXT 40 YEARS

Source: OECD, 2019

WHAT IS THE ISSUE?

GROWING WORLD POPULATION



WHAT IS THE ISSUE?

URBANISATION

WHAT IS THE ISSUE?

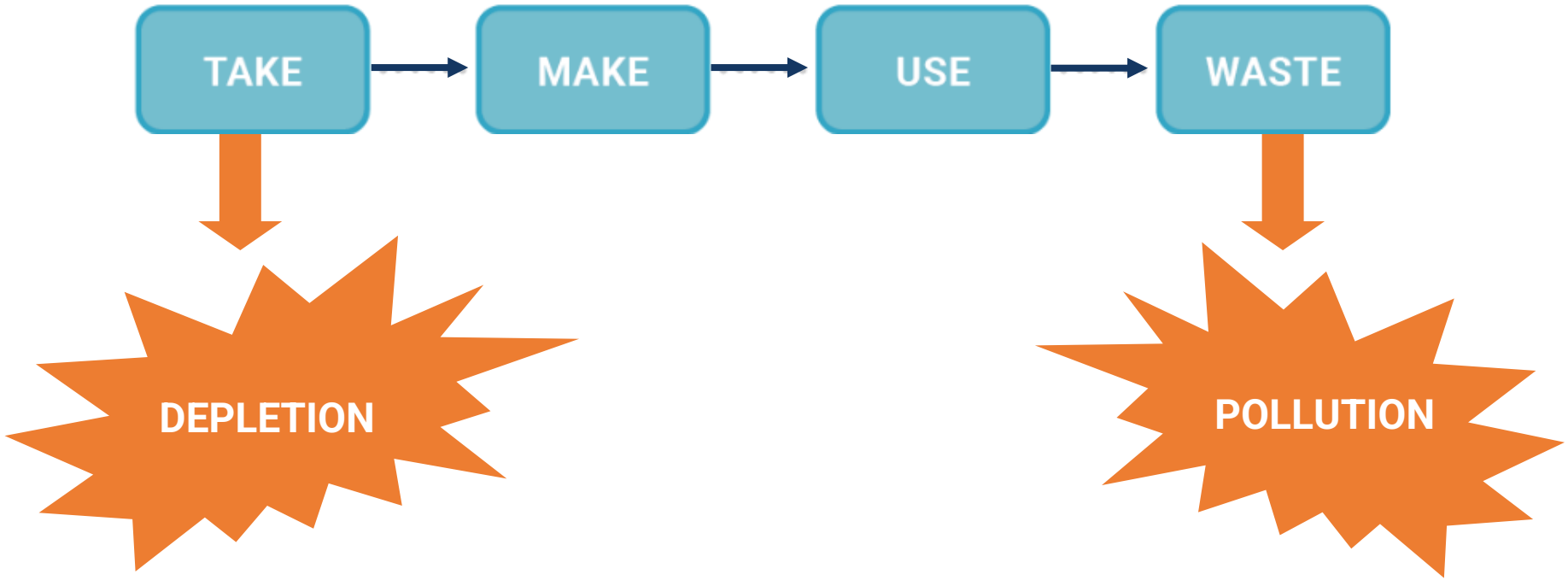
INCREASED CONSUMPTION LEVELS

Every second, the equivalent of one garbage truck of textiles is landfilled or burned.

IMPACT OF PRODUCTION & CONSUMPTION

EXAMPLE: BOTTLING OF WATER

RESULT



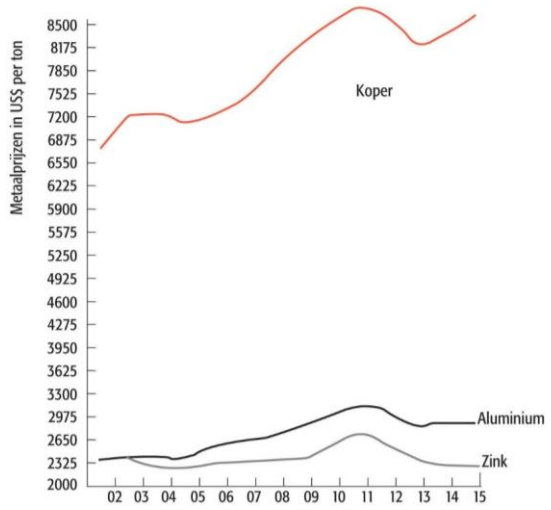
Source: Velzing et al., 2021

WHAT IS THE ISSUE?

Earth Overshoot Day 2021 fell on July 29.

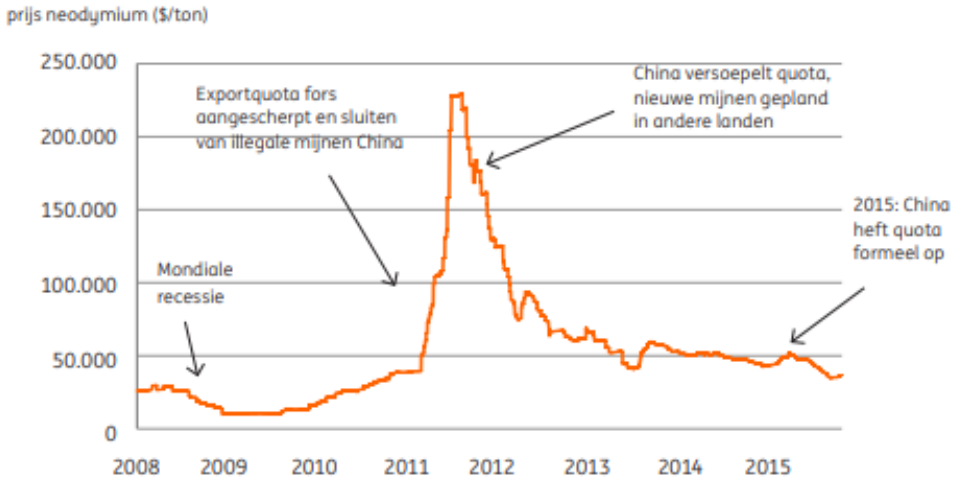
WHAT IS THE ISSUE?

INCREASED RESOURCE PRICES



LME over a period of 14 weeks

Source: Van de Put, 2020



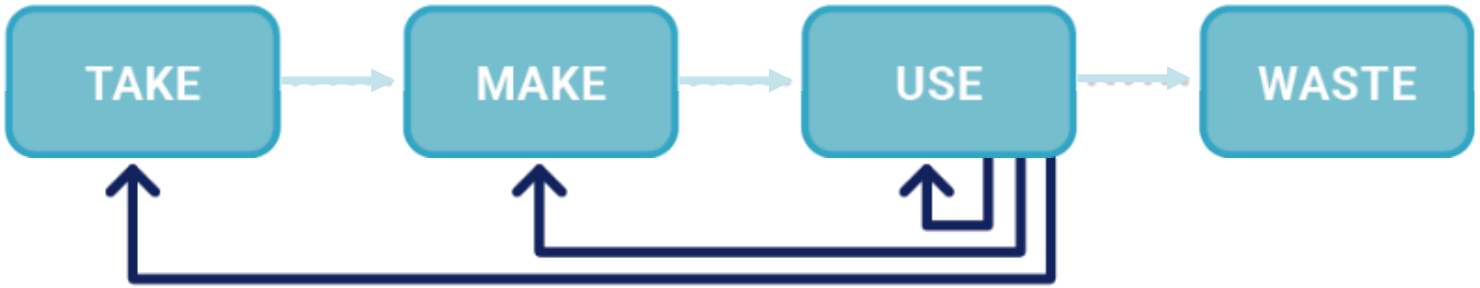
Neodymium

Source: ING

HOW TO SOLVE? → SUSTAINABLE DEVELOPMENT

- Some stress to produce in different manners
- Others accentuate the urgency to consume differently or less;
- And several consider the way the economy is organised:
  - Pricing nature
  - Government regulation
  - Taxing consumption
- Part of society assumes it is *im*possible for a capitalist economy to become sustainable
- Jet others do see possibilities for a transformation

CIRCULAR ECONOMY



Source: Velzing et al., 2021

WHAT IS CIRCULAR ECONOMY?

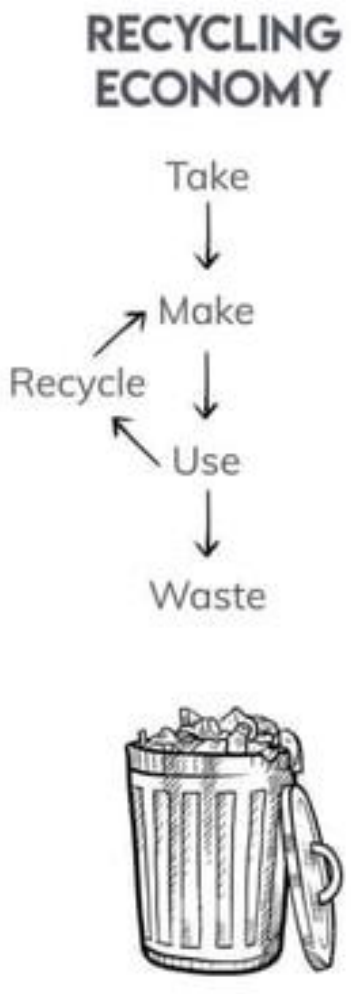
- Keep resources in the loop

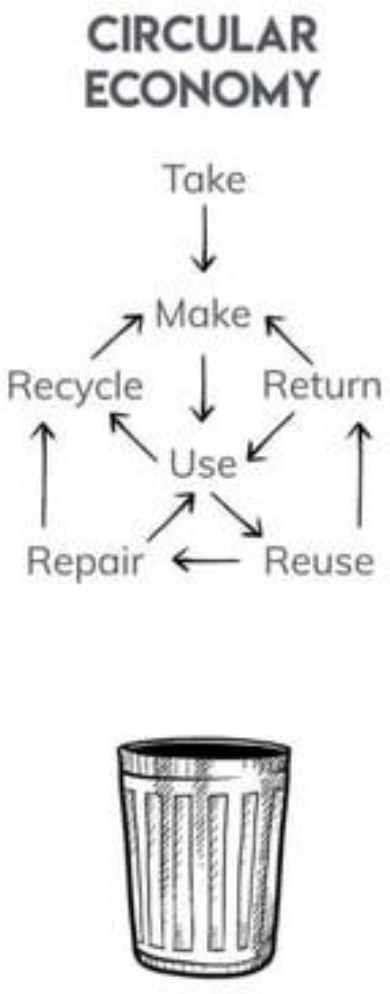
Ellen McArthur Foundation:

1. Design out waste and pollution
2. Keep products and materials in use
3. Regenerate natural systems

EXAMPLE: BOTTLING OF WATER

LINEAR VS. RECYCLING VS CIRCULAR ECONOMY





LINEAR ECONOMY

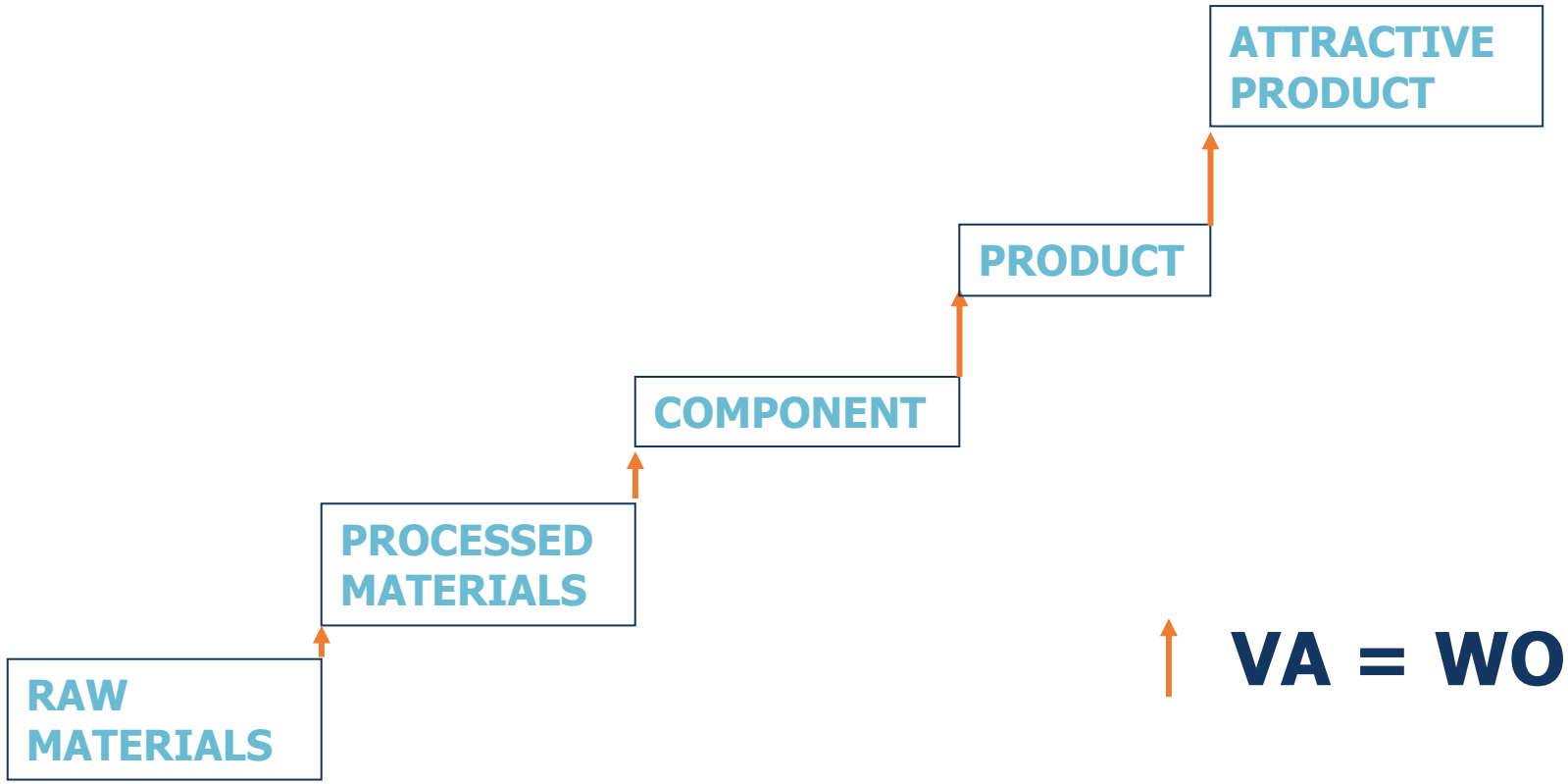
REPRESENTS A MISSED ECONOMIC OPPORTUNITY, AS MANY MATERIALS, COMPONENTS AND PRODUCTS RETAIN VALUE

Source: Velzing et al., 2021

WHAT IS ADDED VALUE?

The difference between the **market value of production** and the **resources paid for**

WHAT IS ADDED VALUE?

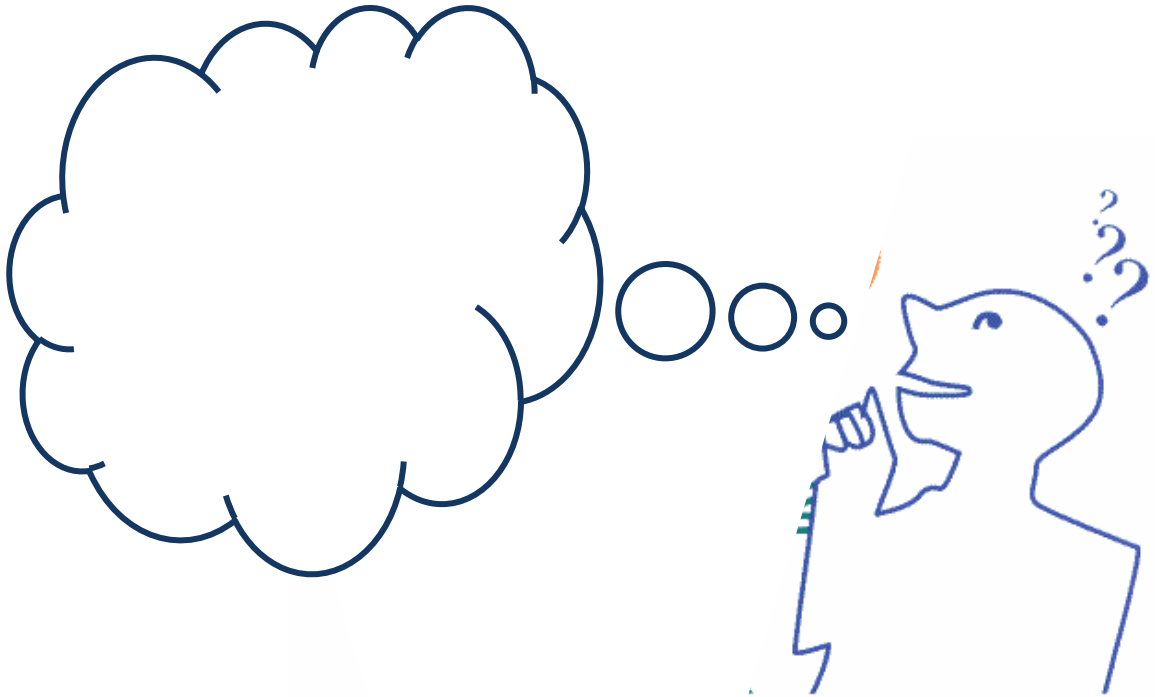


↑ **VA = WORK**

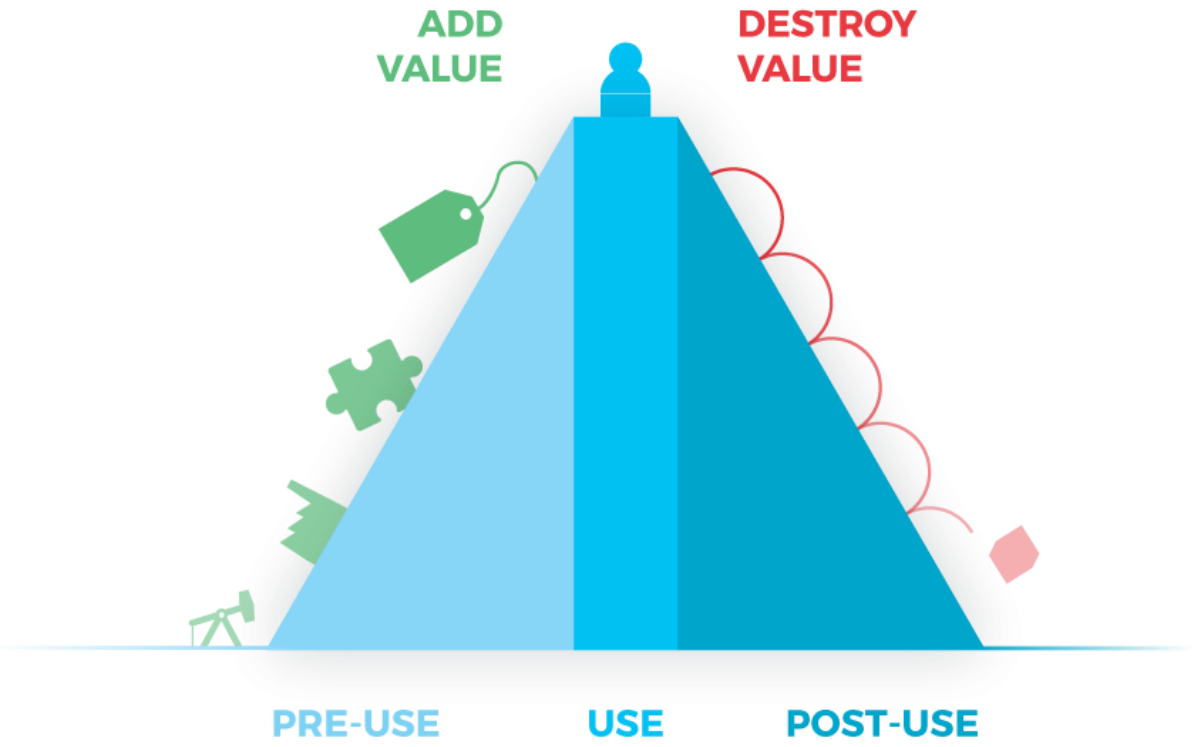
Source: Jacobs, 2010

WHAT IS ADDED VALUE?

- Functioning
- Design, style
- Healthy
- Sustainable
- Image
- Sentiment
- Durable



VALUE HILL



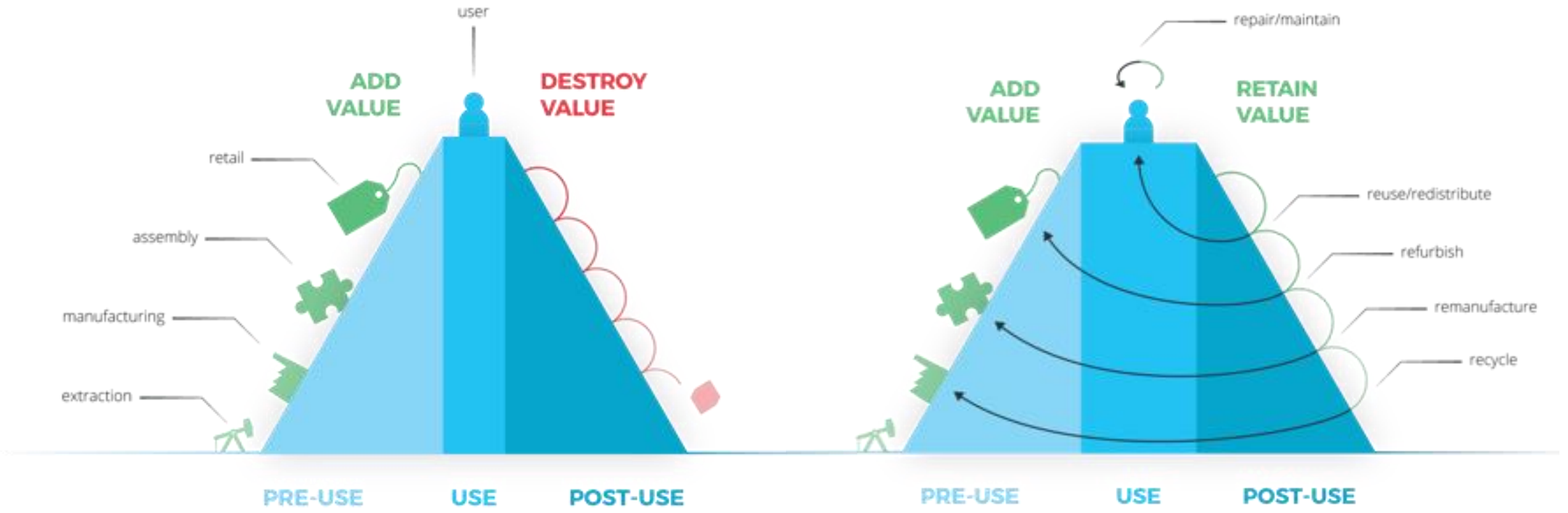
Source: Achterberg, Hinfelaar & Bocken, 2016

ADDED VALUE IN A CIRCULAR ECONOMY

- Closing loops
- Transition from ownership to services
- More intensive use of product functionality
- (Durability of products)

Source: Jonker, Stegeman & Faber

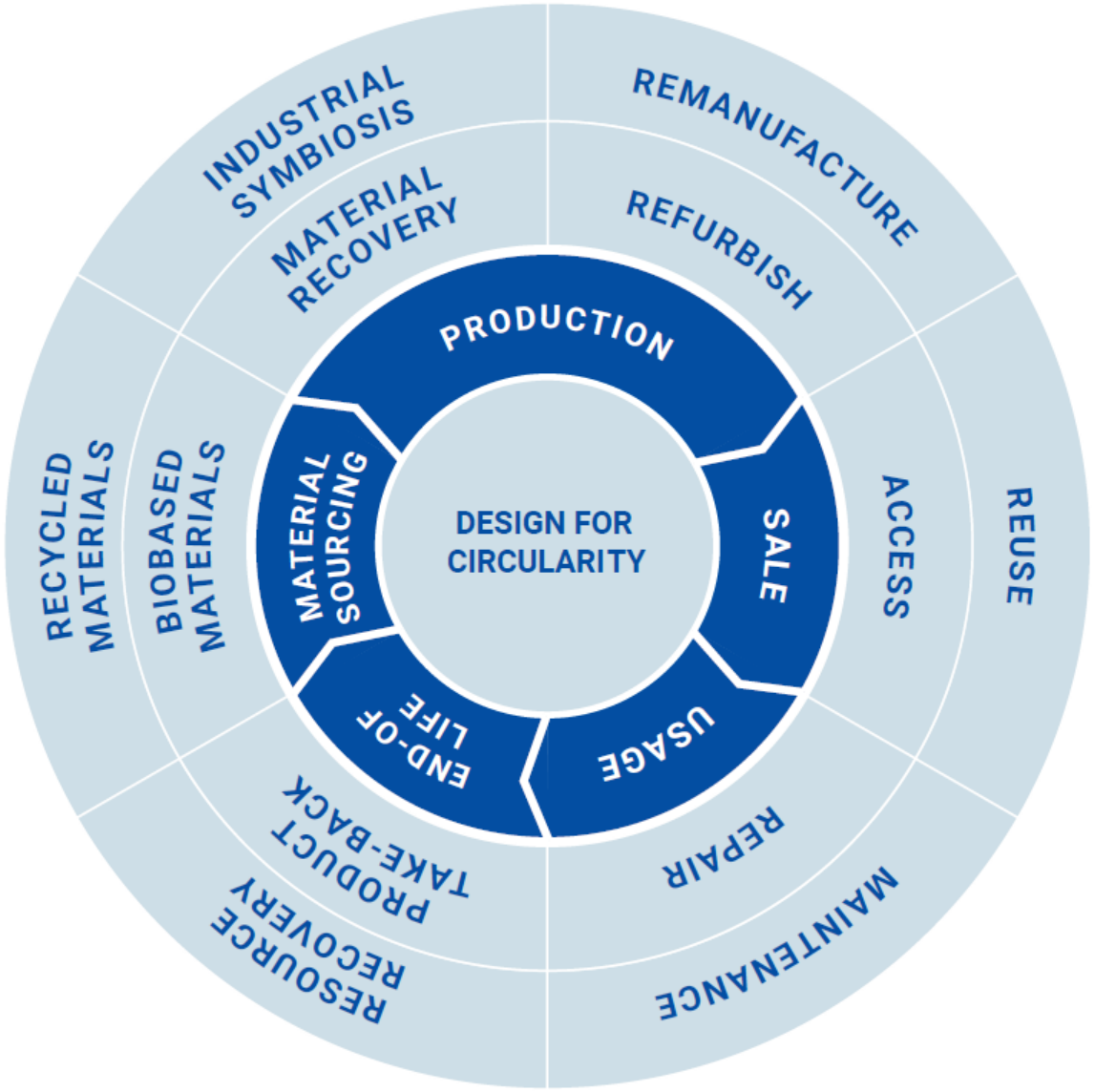
VALUE HILL IN A CIRCULAR ECONOMY



LINEAR ECONOMY **CIRCULAR ECONOMY**

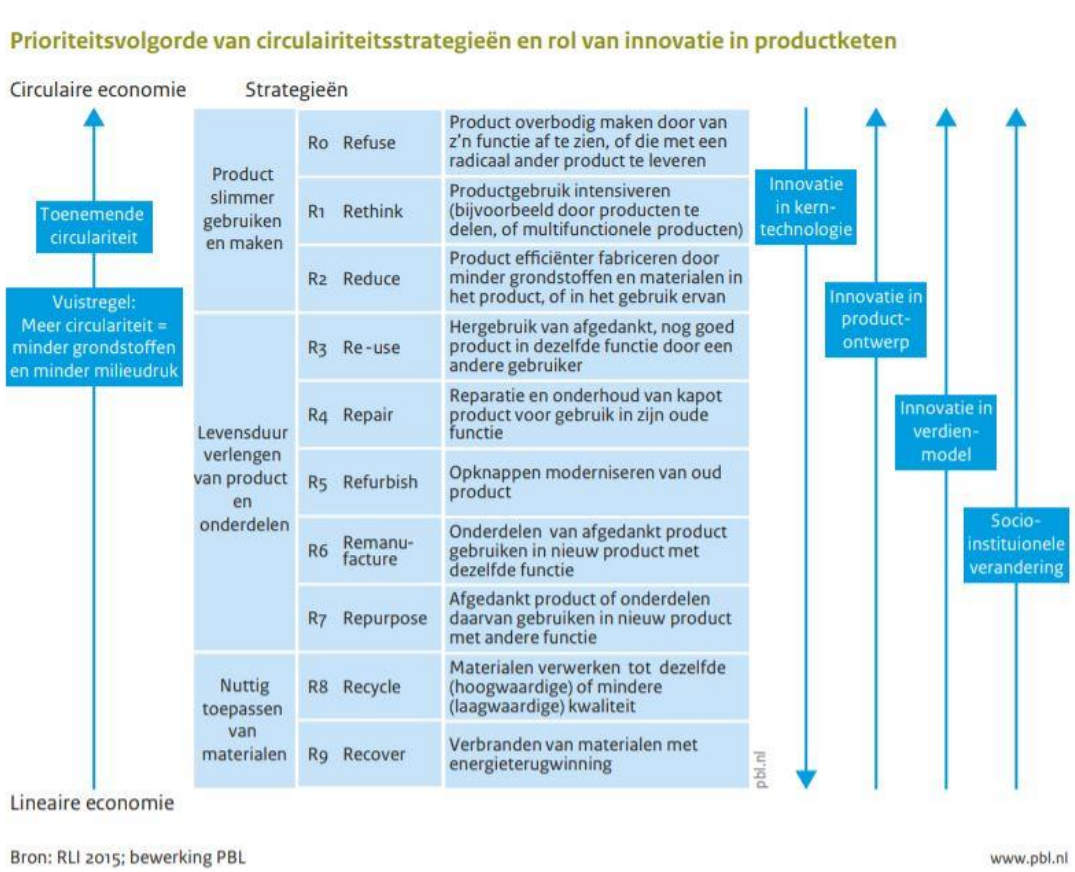
Source: Achterberg, Hinfelaar & Bocken, 2016

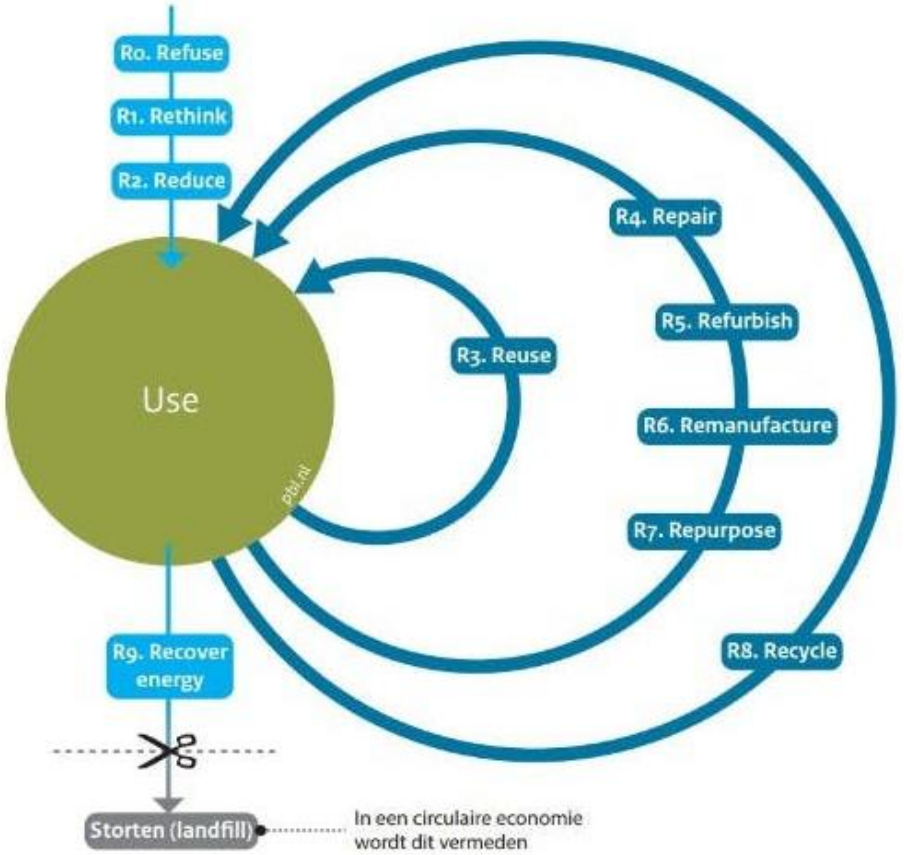
CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

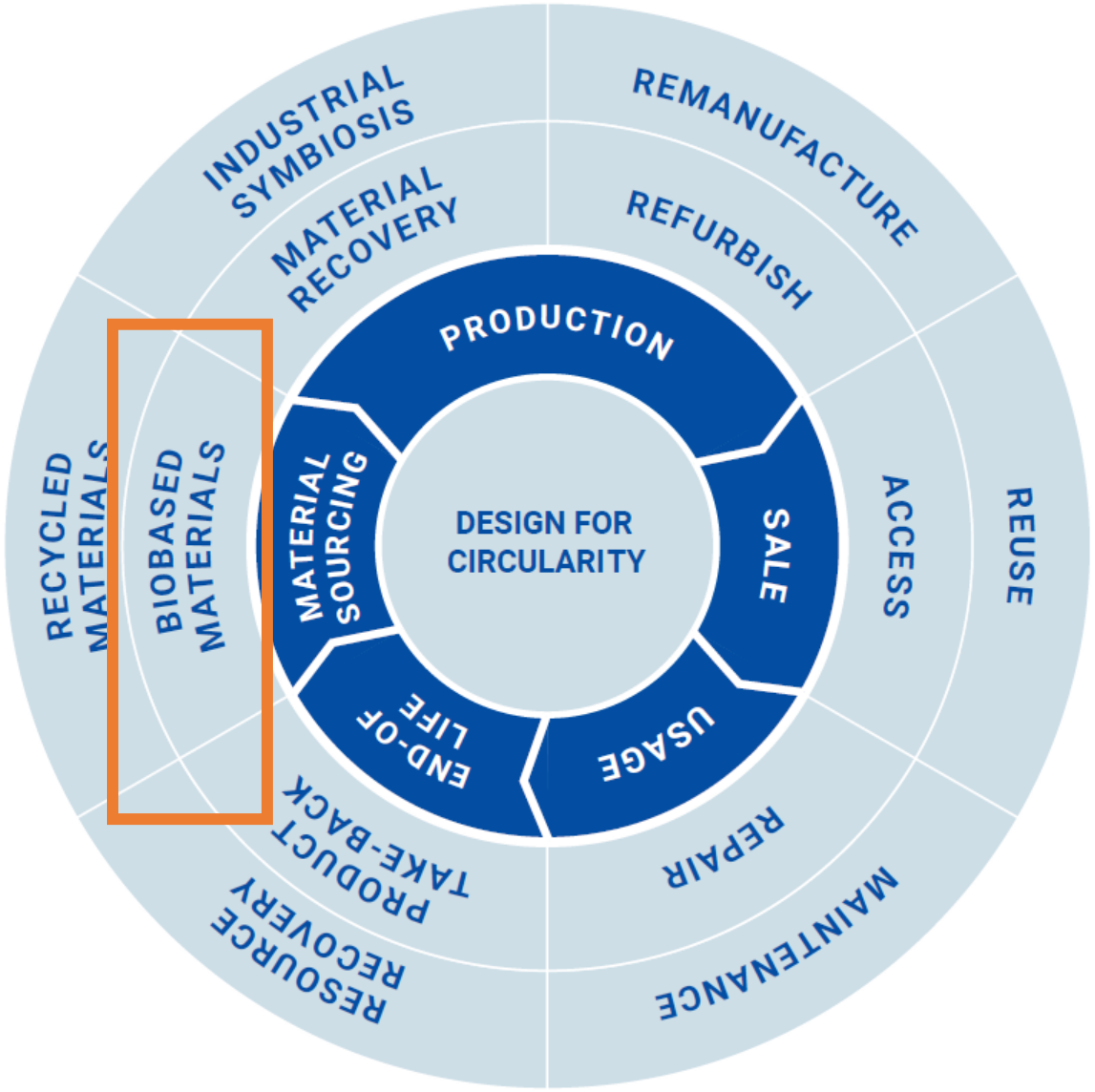
CIRCULAR STRATEGIES: R-LADDER





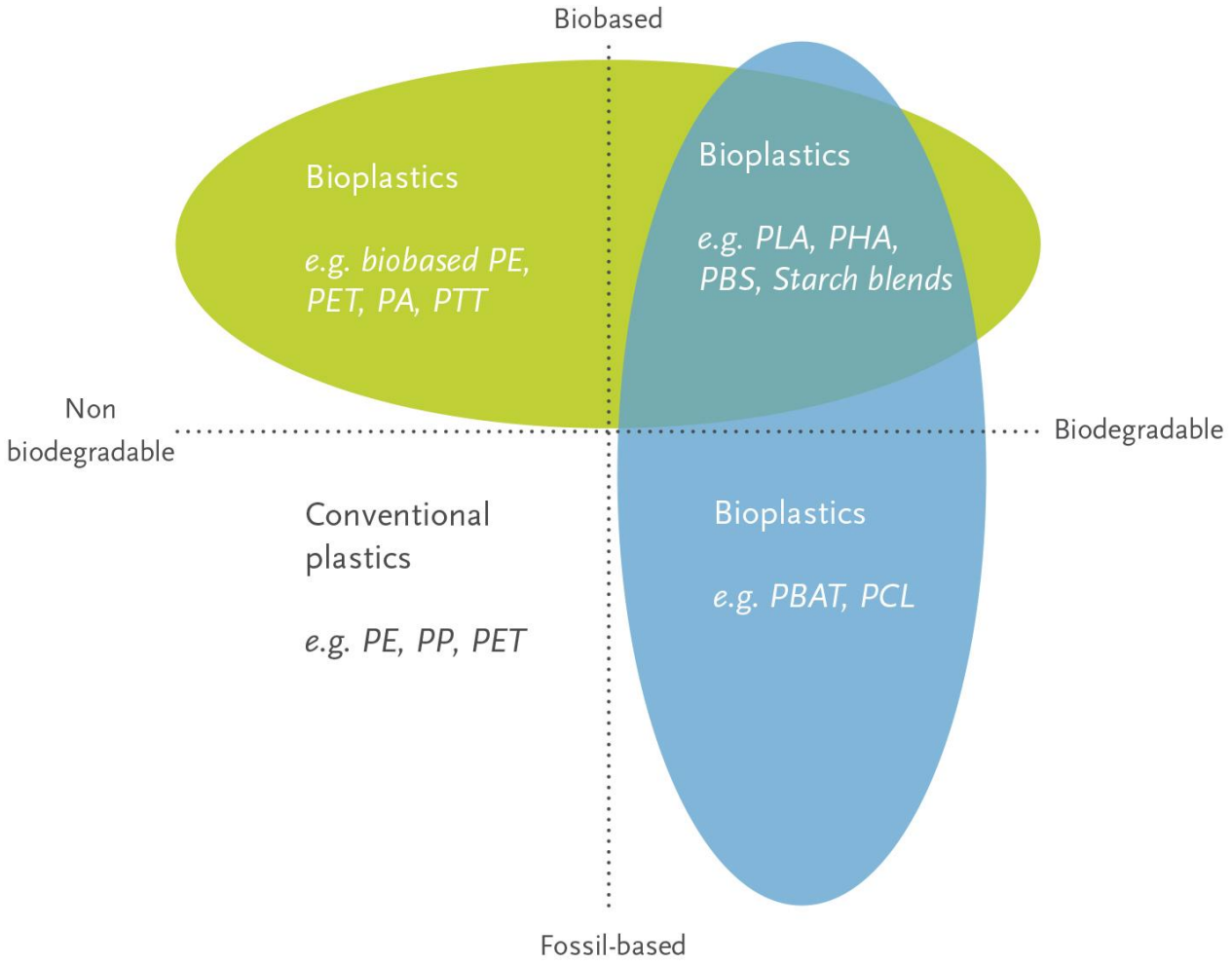
Source: PBL, 2015

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

BIOPLASTICS – BIOBASED VS. BIODEGRADABLE



Biobased: the material is obtained from biomass (plants, e.g. sugar cane, maize, starch). This is about the **origin** of the material.

Biodegradable: the material breaks down under specific conditions. This is about what happens to the material at **end-of-life**.

Biobased ≠ Biodegradable

European Bioplastics

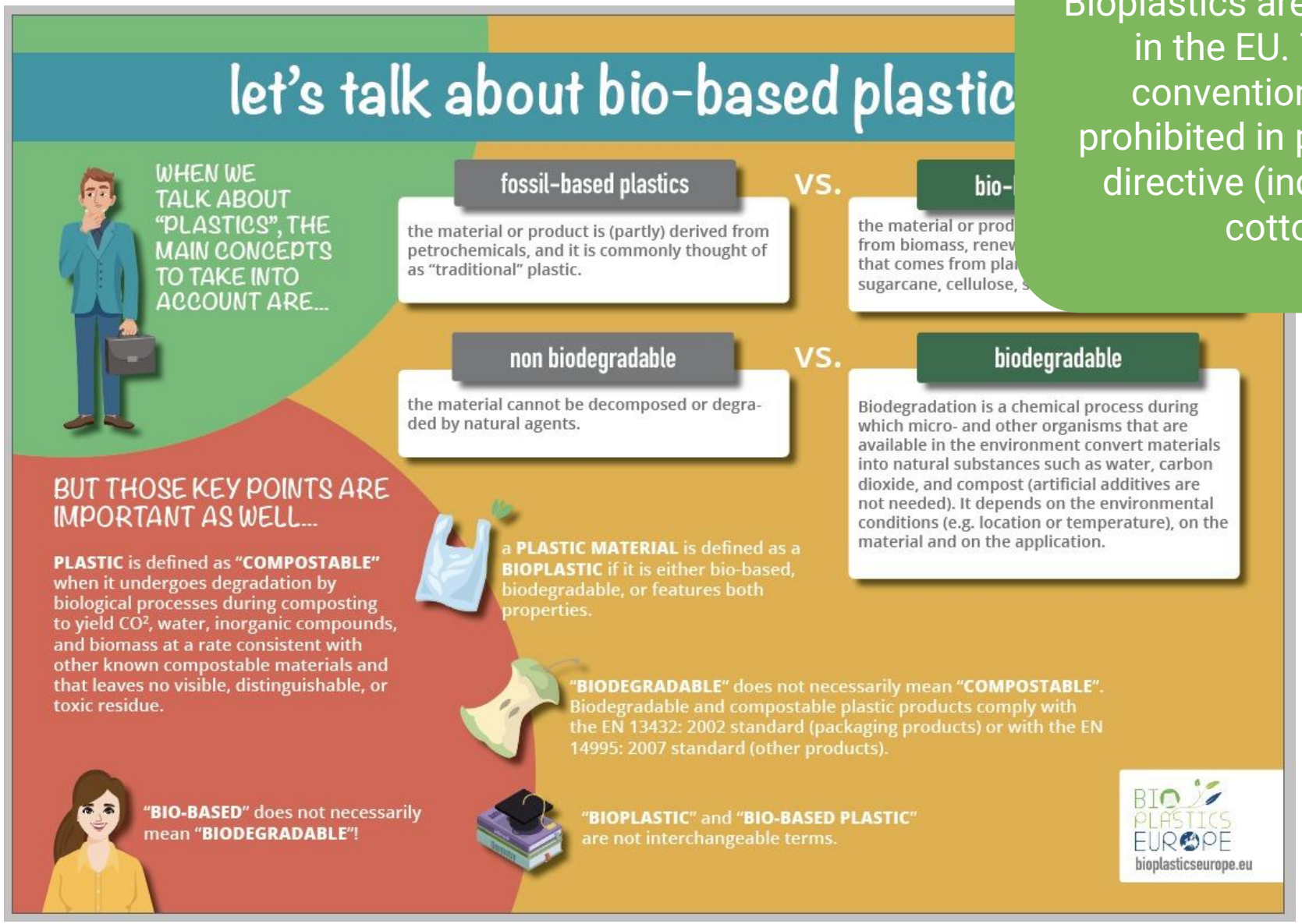
BIOPLASTICS

Problems with biodegradable packagi

- Degradation under specific condition
- No solution for polution
- Converted into CO_2, water en methane
  - Little biomass
  - Material disappears from the value chain
- Recycling or incineration yield more energy
- Degradation time is too long for composters (3-4 weeks vs. 12 weeks)
- Labels confuse consumers
- Misunderstandings regarding plastic, biobased, biodegradable
- Problems for plastic recycling process
  - Possible rejection of whole batch

There are options for using biodegradable plastics if the packaging still contains organic material (e.g. coffee capsules, tea bags, organic waste bags) or, for example, on a product (sticker on banana peel). Other options are, for example, catering or airplane meals, where the packaging can be thrown away together with the food residues.

BIOPLASTICS



Bioplastics are also considered plastic in the EU. That is why, just like conventional plastic, these are prohibited in products under the SUP directive (including cutlery, plates, cotton swabs, etc.)

Bioplastics Europe

BIOPLASTICS – BIOCOMPOSITES

Only ‘recyclable’ if:

- Separate stream
- Or large enough volumes

Biocomposieten: composite of two materials, often plastic is mixed with a fiber (e.g. wood, hemp), of which one or both are biobased.

BIOBASED MATERIALS

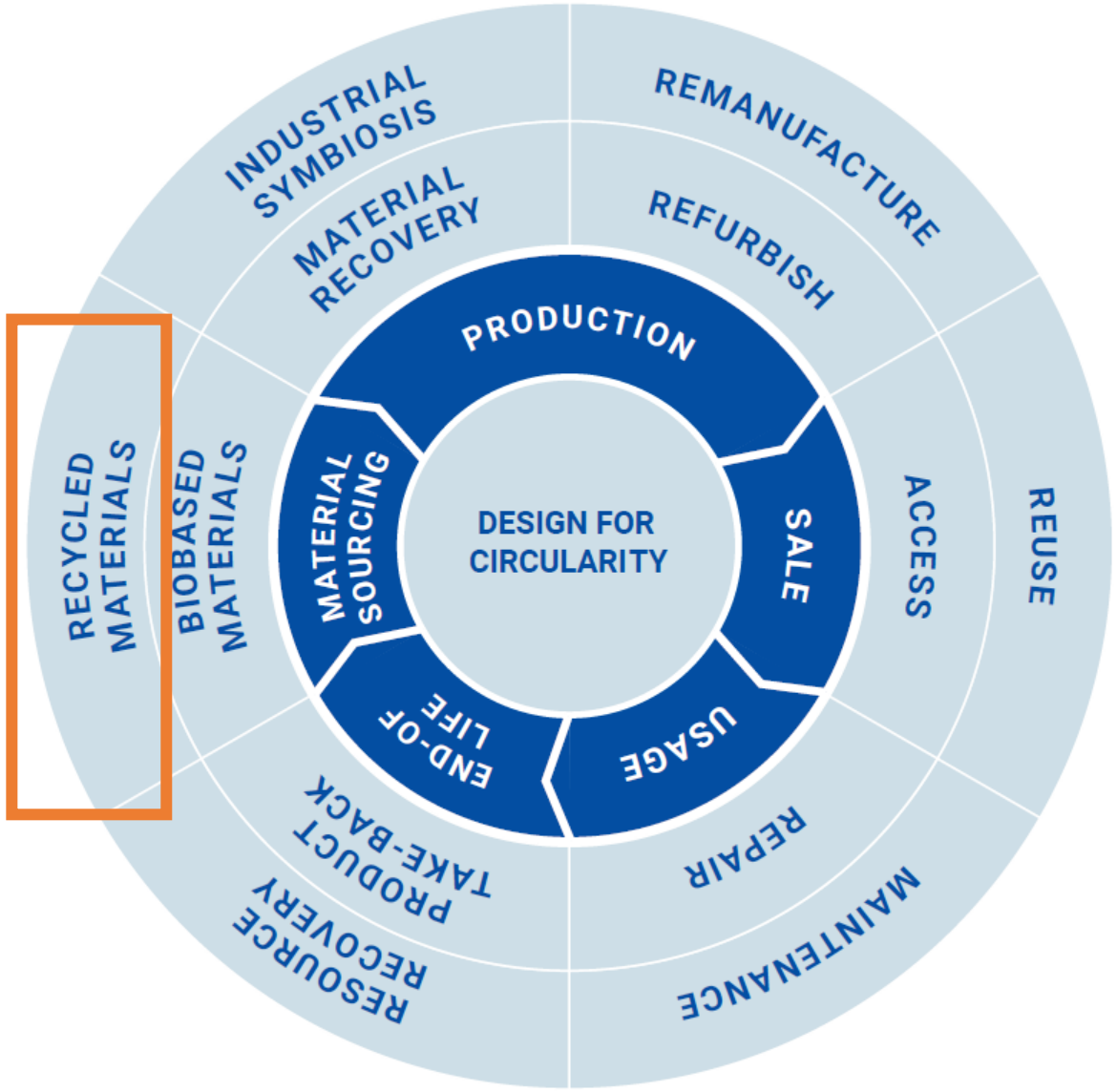
member of the Pont Europe Group

BIO-BASED HDPE

An eco-friendly option as it is entirely recyclable within the actual sorting/recycling process and it comes from renewable resources which do not affect food production. Bio-based HDPE offers great performance and is ideal when used with a hinge guard cap. Pont can offer a wide variety of packaging solutions in this material. However, it's a relatively new production process with more production sites currently being built to increase the overall availability of raw material in the coming years. Currently, the material is readily available, but the demand is increasing continuously which could result in raw material tensions on the market.

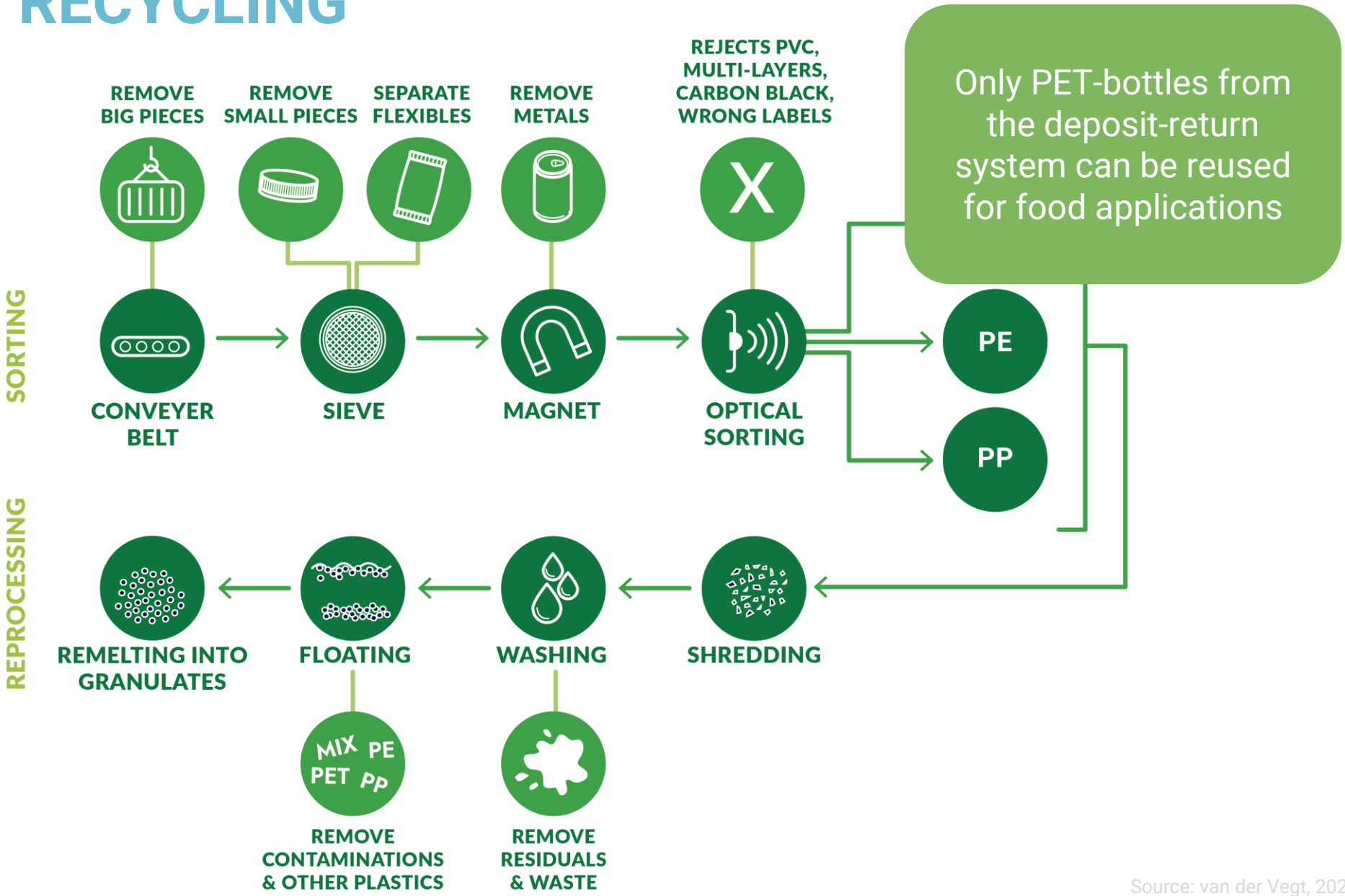
More about material

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

PLASTIC RECYCLING



Source: van der Vegt, 2020

PLASTIC RECYCLING

Limited recyclability (contaminations): 24%

Not recyclable: 1%

The term recyclable does not necessarily mean that the material is also recycled in industry. It must also be correctly collected, sorted and reprocessed.

- A seperate stream is needed (**enough volume**)
- Correct sorting should be possible (**technologies**)
- There should be application possibilities (**market**)
- There must be an economic value (**good quality**).

PLASTIC WASTE

Poor sortability (design) :13%

Limited recyclability (technologies): 19%

Low quality (mix plastics): 17%

PLASTIC RECYCLING

RECYCLING

DOWNCYCLING

UPCYCLING

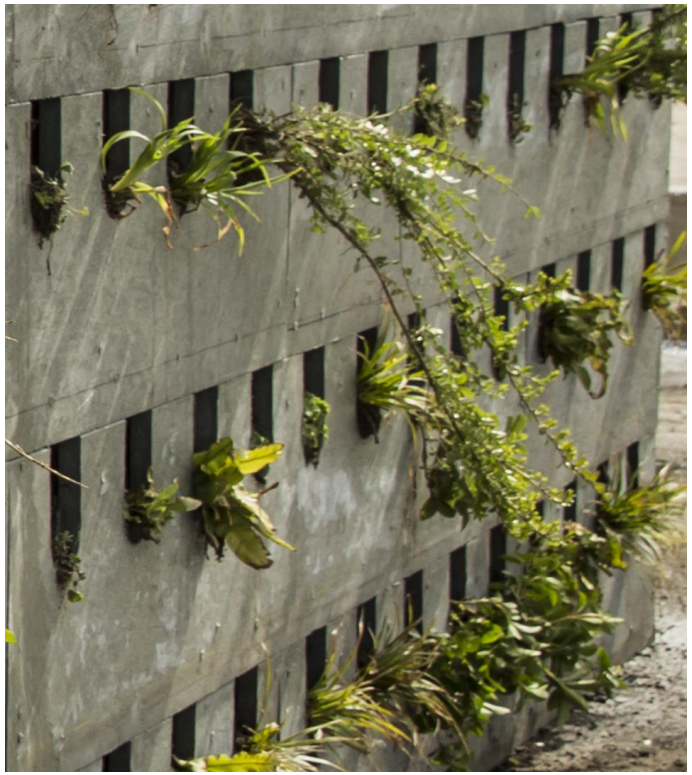
PLASTIC RECYCLING – NEW TECHNOLOGIES

- Barcode scanning
- Chemical recycling
- Plastic scanner
- Material passport

Toepassen van barcode scanning in recycle proces

Plastic scanner 'scant' materiaal van product

RECYCLED MATERIALS

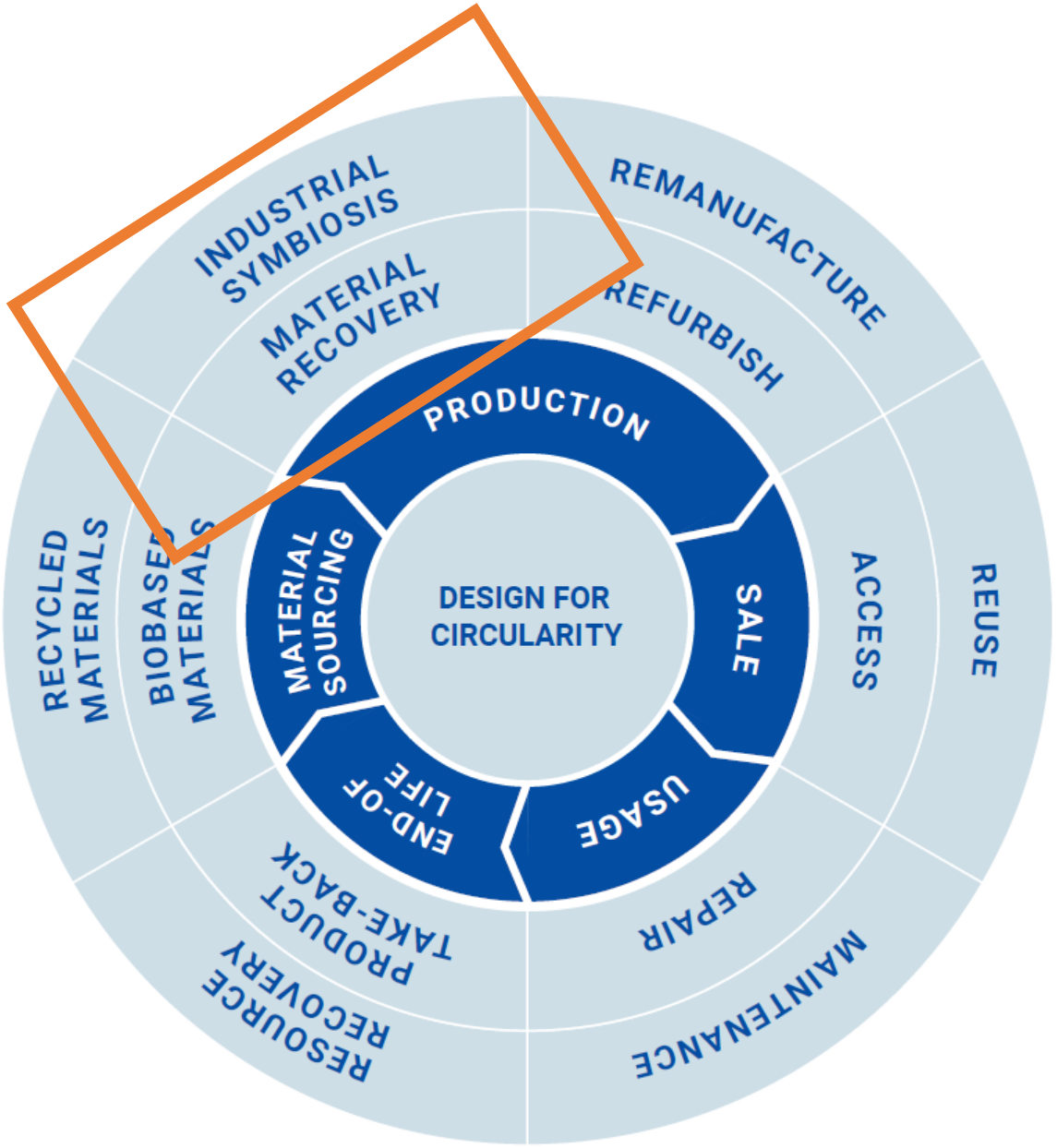


Laagwaardig plastic gebruiken voor een planten muur (Save Plastics)

Gerecycled materiaal toepassen voor 3D-printen van container tuintjes (10XL)

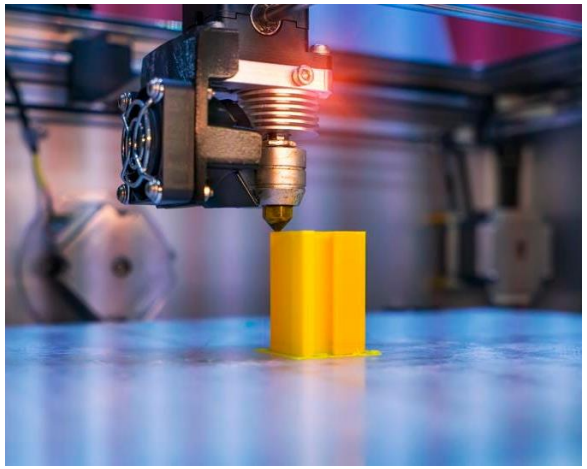
Gerecycled materiaal in tuinmeubelen toepassen (Keter)

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

MATERIAL RECOVERY



3D-print afval – granulaat – recyclaat printen

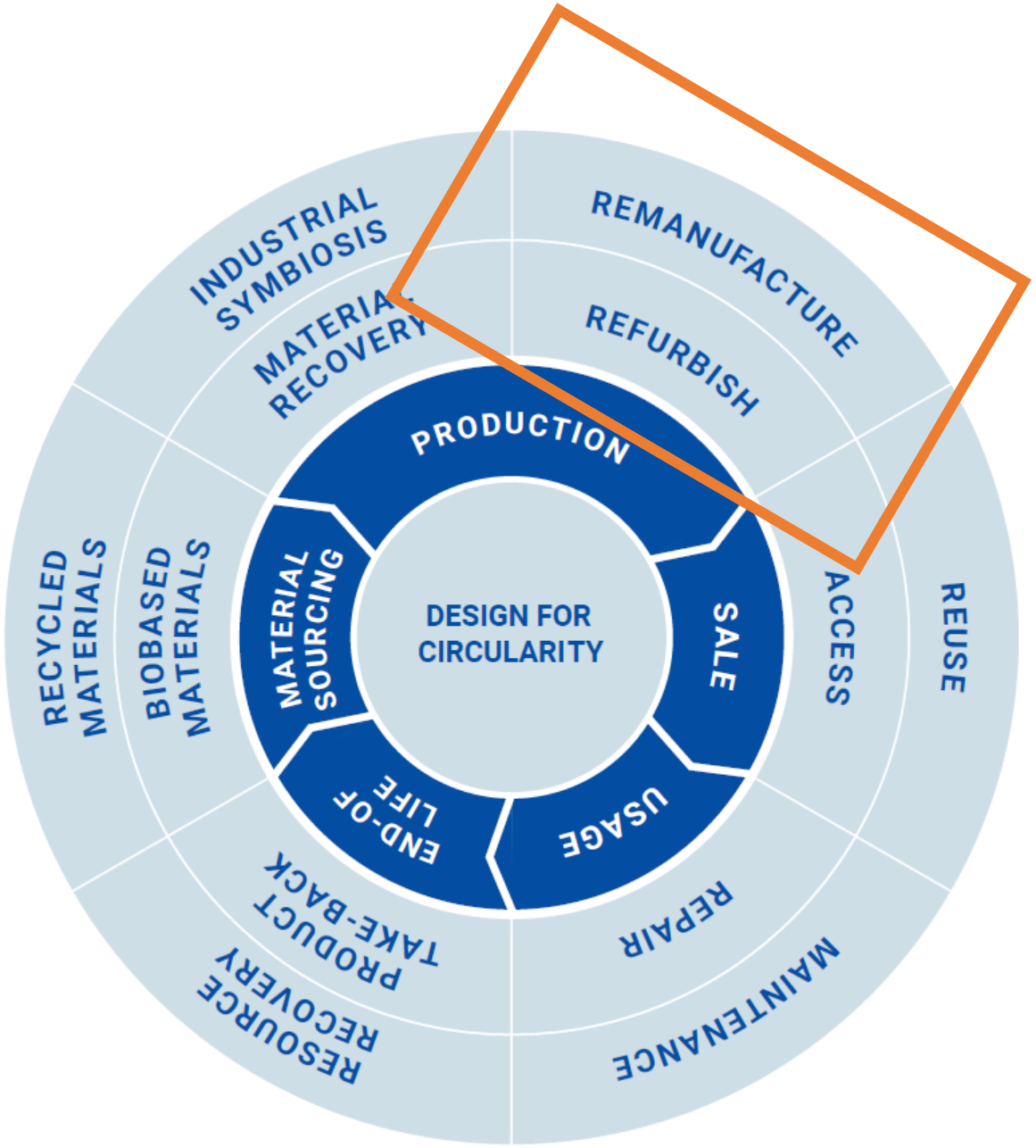
INDUSTRIAL SYMBIOSIS

Van fruitpuree (1500 kilo) naar leer (10m2)

Van koffiedik (31 ton) naar oesterzwammen (6201 kilo)

Van koolstofdioxide (Brouwerij, Rotterzwam) naar spirulina, algen

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

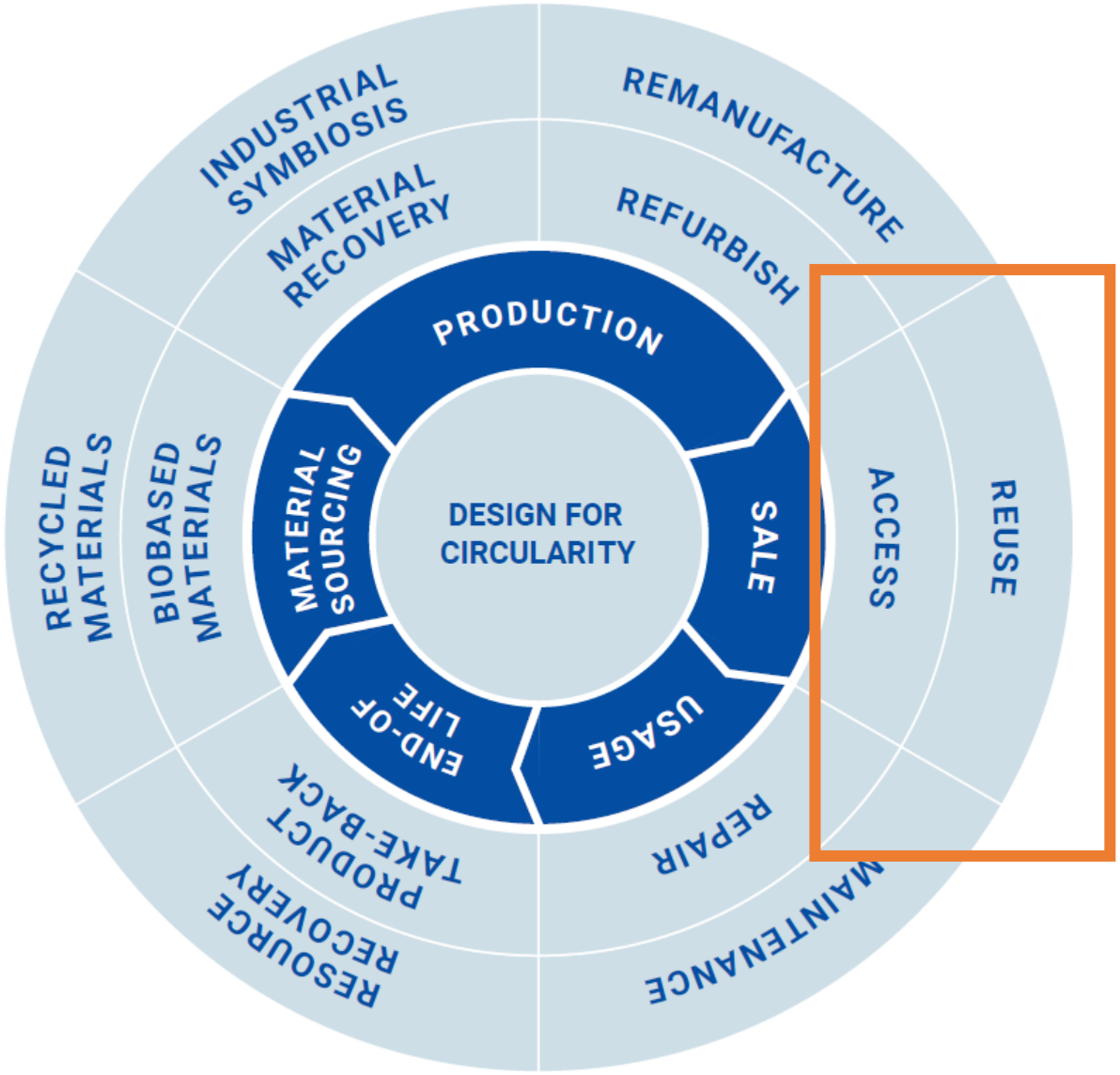
REMANUFACTURE/REFURBISH

Remanufacture van printers van Canon

Refurbished bureaustoelen (Opnieuw)

Refurbished macbook, klaar voor volgend gebruik

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

REUSE

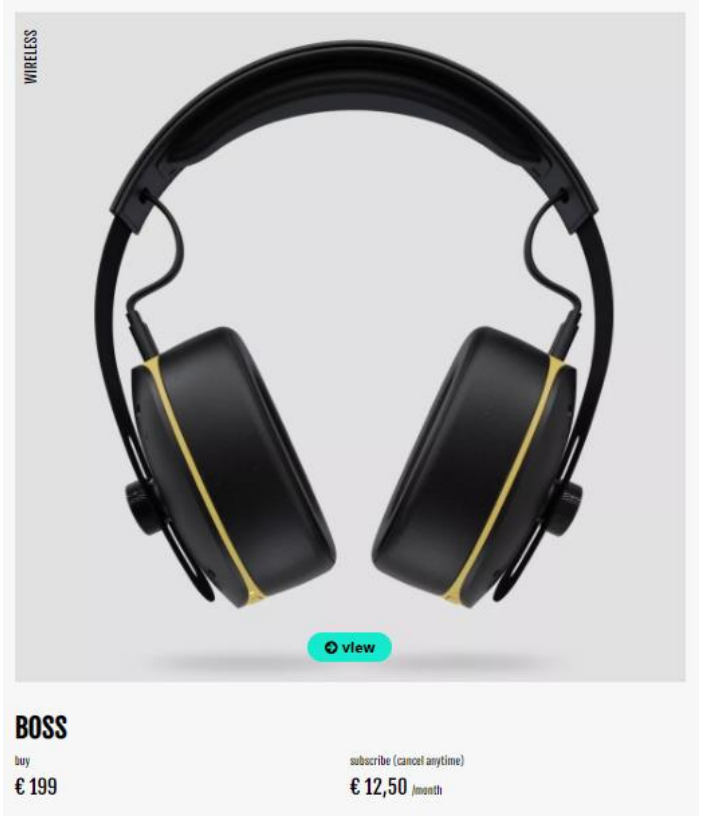
Refill van bierflesje

Reuse van bierkratje

Eten dat wordt besteld via DeliverZero komt in een herbruikbare verpakking (Ozarka)

ACCESS (PRODUCT AS-A-SERVICE)

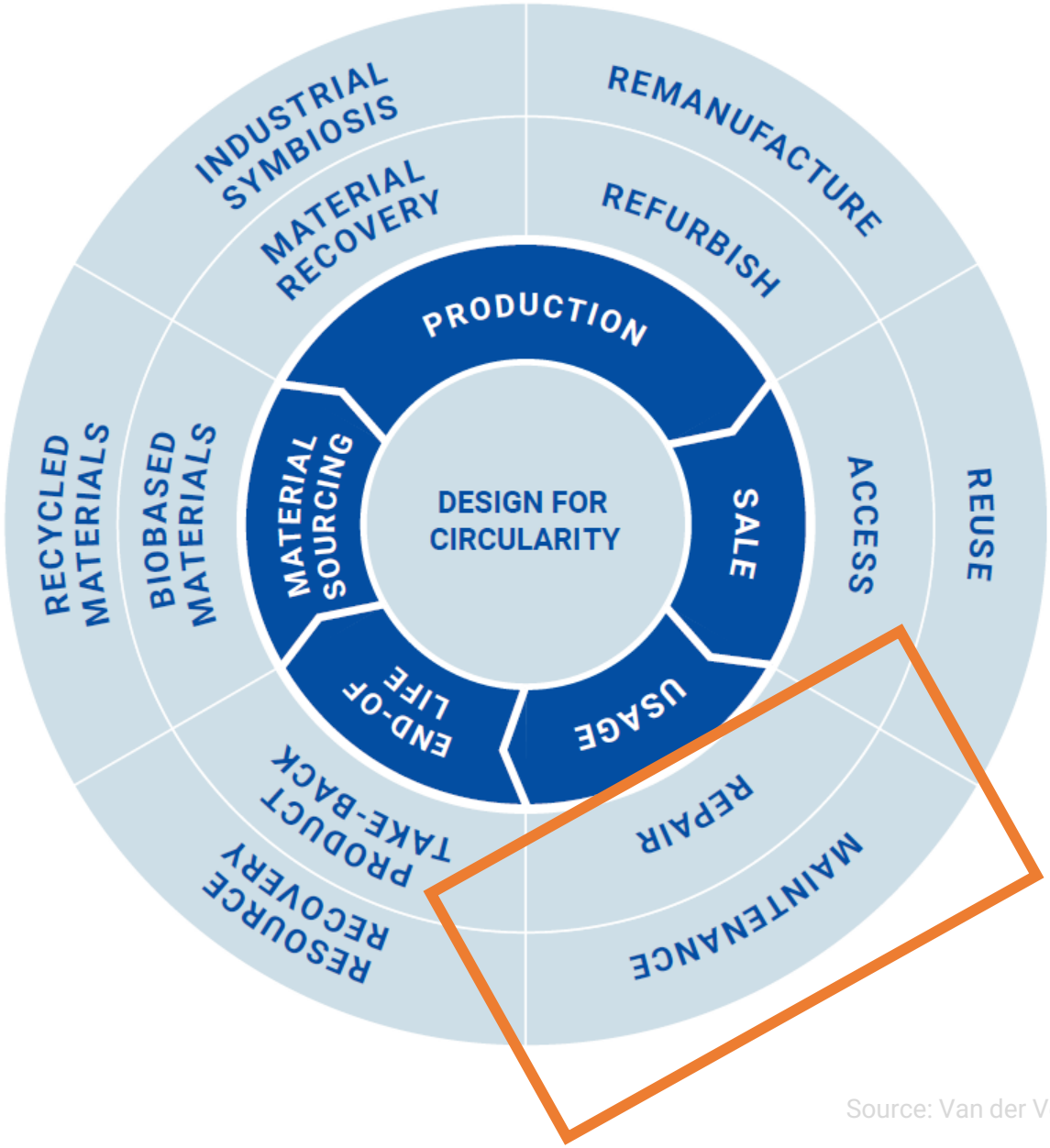
Huren van wasmachine



Huren van koptelefoon

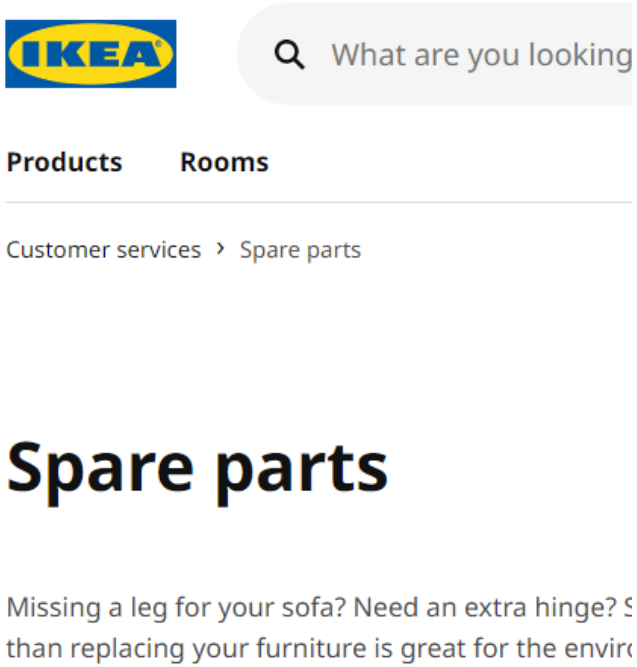
Abonnement op kunstbloemen

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

MAINTENANCE/REPAIR

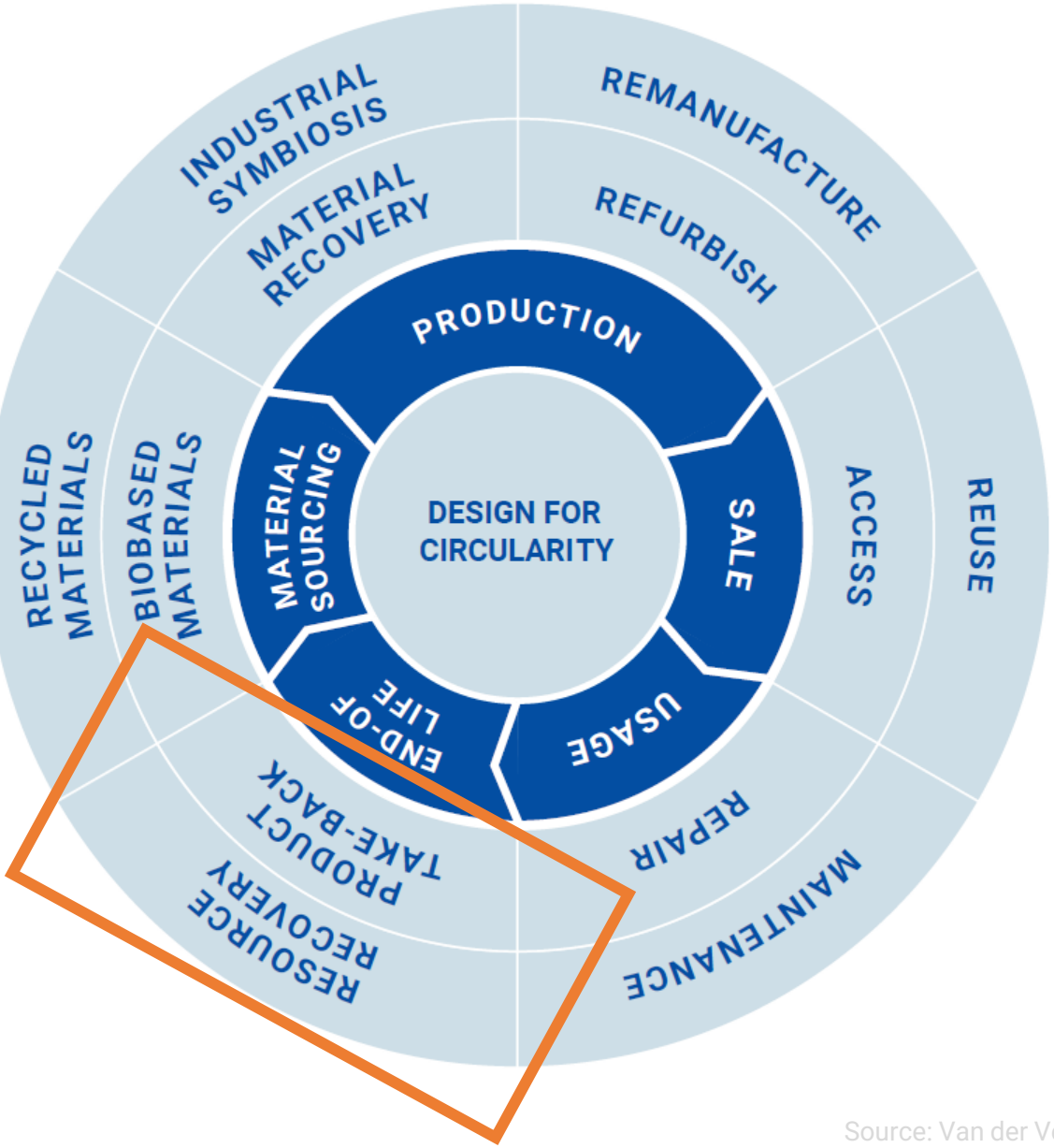


Losse items (her)bestellen via Ikea

Reparatie van telefoonscherm

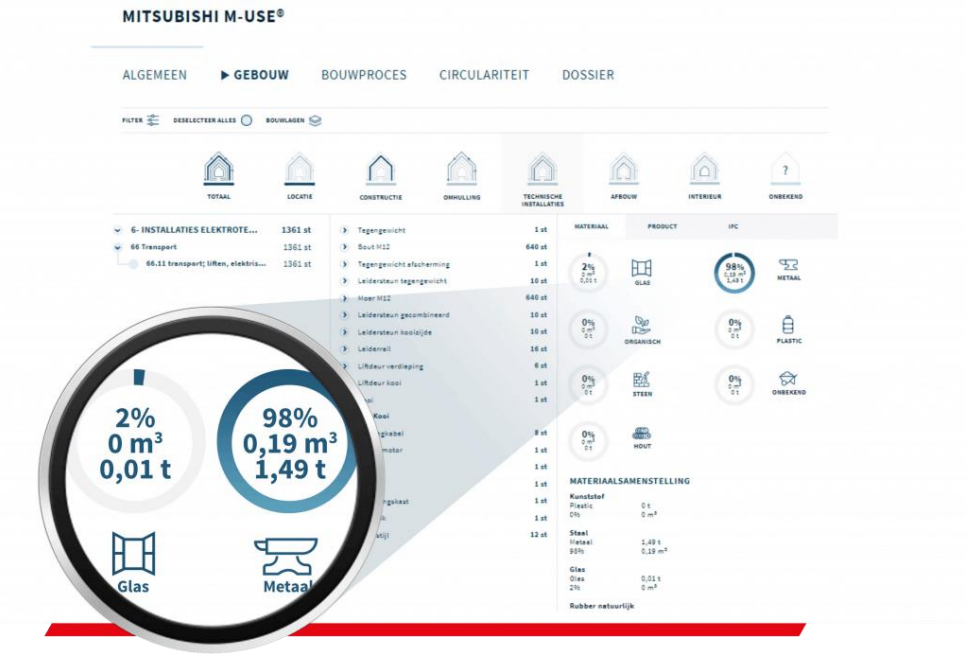
Onderhoudsbeurt van een auto

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

RESOURCE RECOVERY



Mitsubishi liften worden geleverd met een materialen paspoort

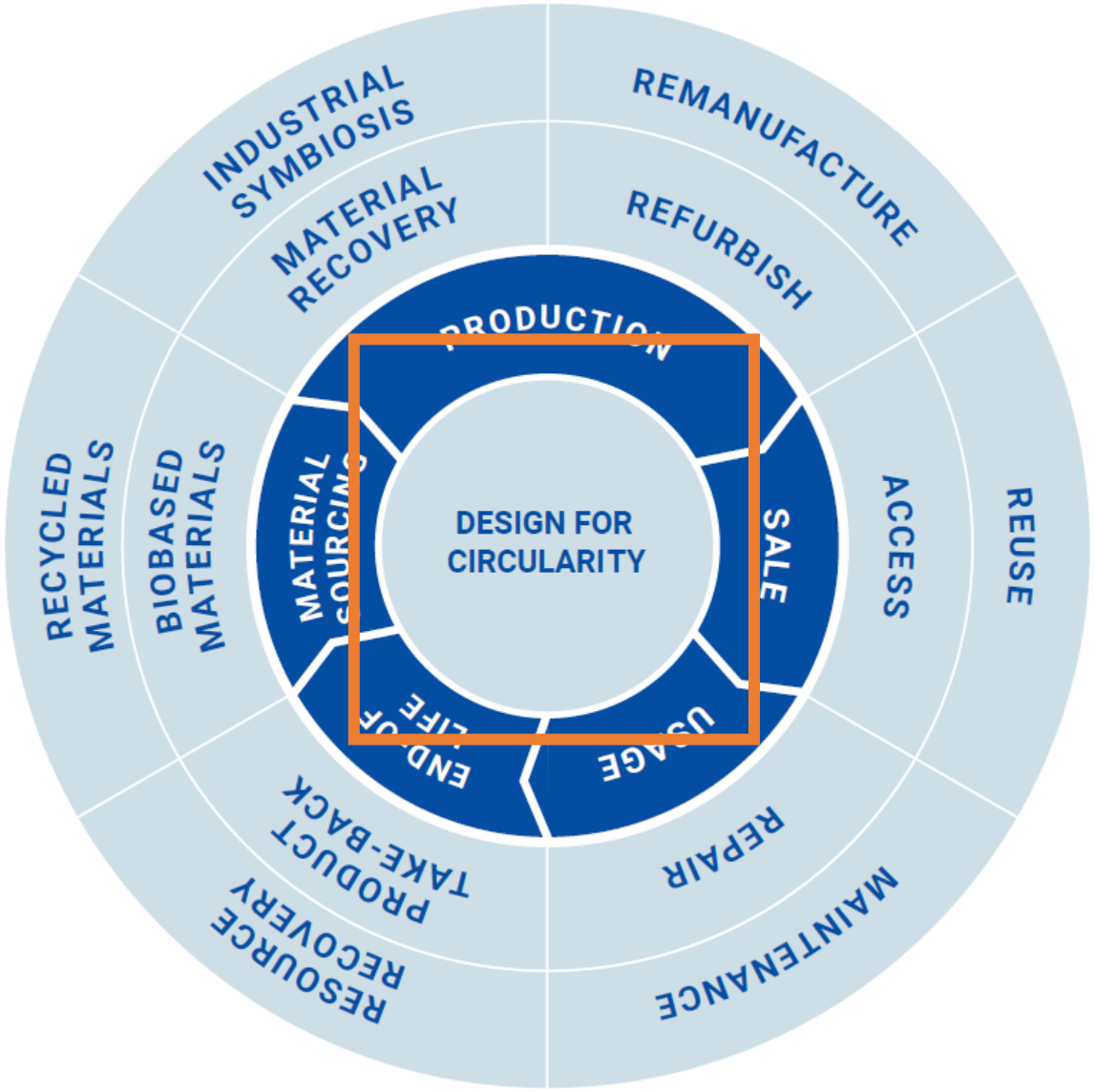
Producten van 10XL worden geleverd met een materialen paspoort

PRODUCT TAKE-BACK

Het aanbieden van ‘inzameldagen’ om producten terug te nemen (Keter)

Retourneren van je oude telefoon in ruil voor een giftcard (Fairphone)

CIRCULAR STRATEGIES



Source: Van der Vegt et al., 2021

DESIGN FOR CIRCULARITY

- Design for disassembly
- Design for recycling
- Design for durability and performance
- Design for standardisation
- Less material usage

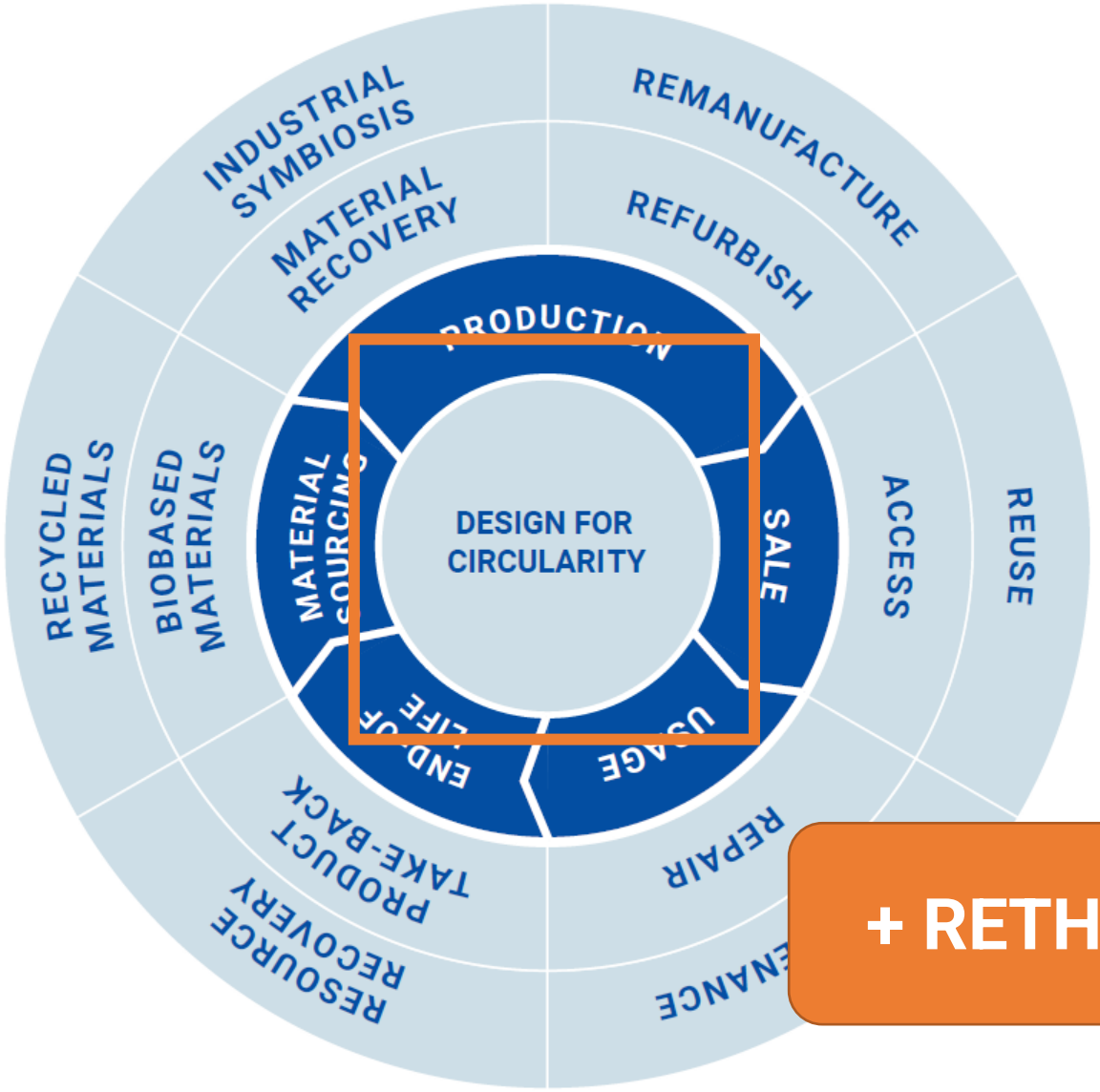
Verwisselbare batterij in telefoon

Producten met detecteerbaar zwart voor recycling

Standaardisering van oplaadkabels: USB-C

Verminderen van materiaal: Smile tandpasta

CIRCULAR STRATEGIES

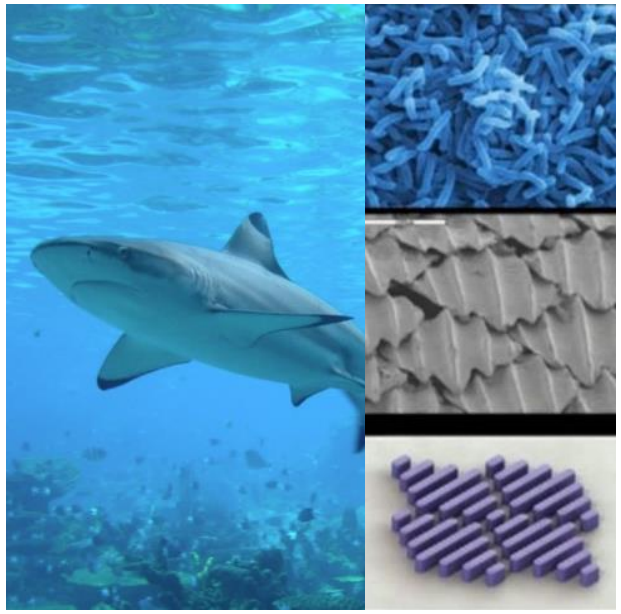


+ RETHINK

Source: Van der Vegt et al., 2021

RETHINK - BIOMIMICRY

Smeerolie op basis van giraffenkeel



Minder water weerstand en algengroei voor boten op basis van haaienhuis

Minder plastic op basis van lichtgewicht skeletstructuur zee-micro-organismen

RETHINK – SUSTAINABLE BEHAVIOUR

Veilig Rijden? Zo werkt het!

Veilig auto rijden met korting op je verzekering (ANWB)

Auto die aan geeft wanneer je moet schakelen (minder verbruik)

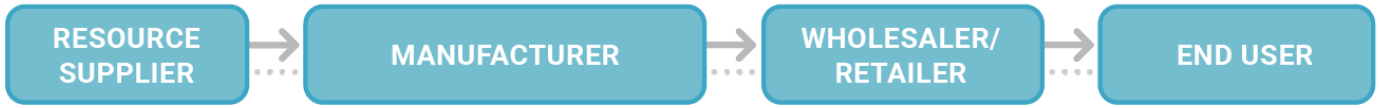
Advertentie van Coca Cola om recycle gedrag te stimuleren

MATERIAL AND VALUE FLOWS

- Lifecycle of resources, materials and components
  - From where to where?
  - How much?
  - What activities?

- Added value
  - What value is added for customers?

MATERIAL & VALUE FLOW MAP



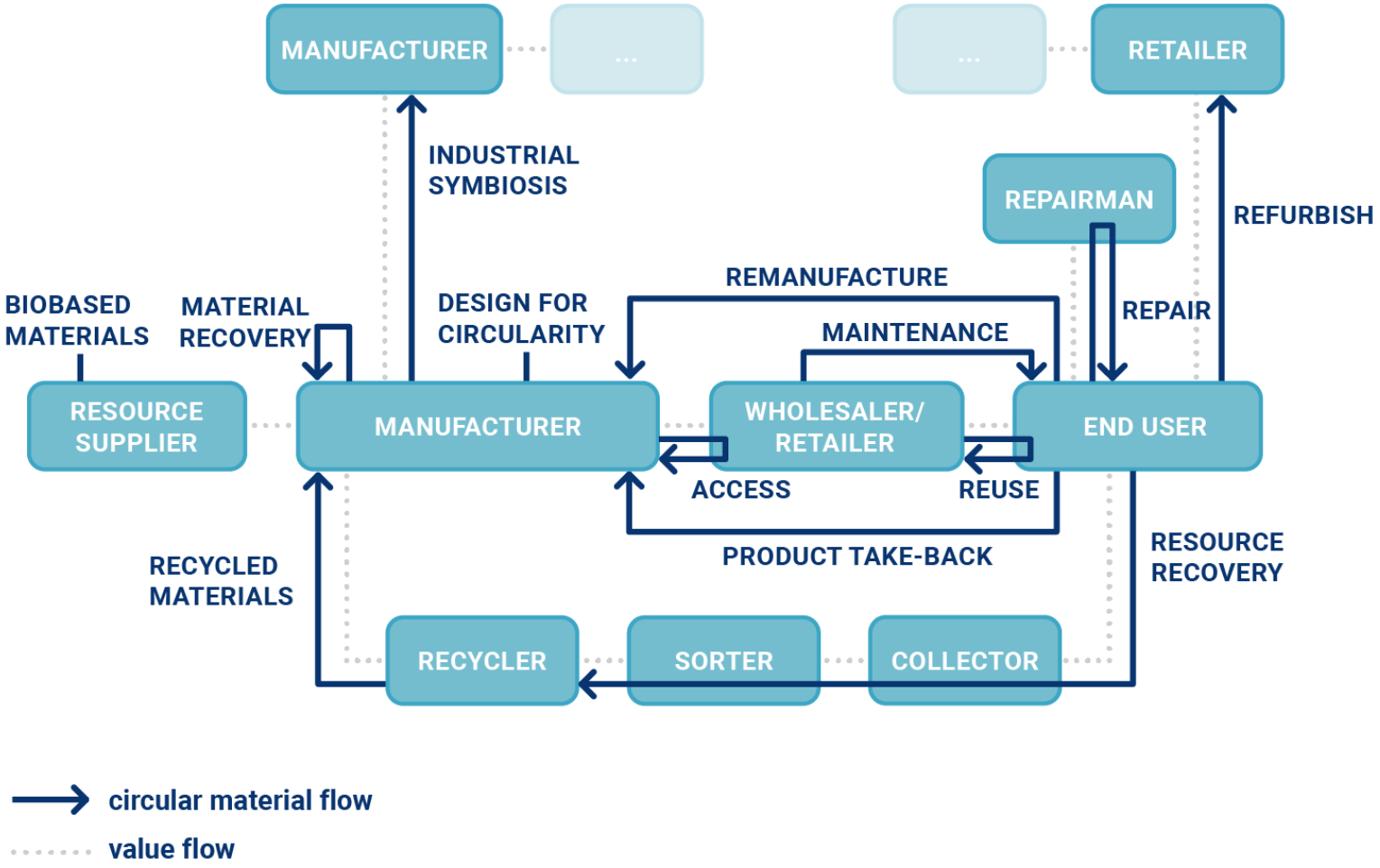
linear material flow

value flow

MATERIAL AND VALUE FLOWS IN A CIRCULAR ECONOMY

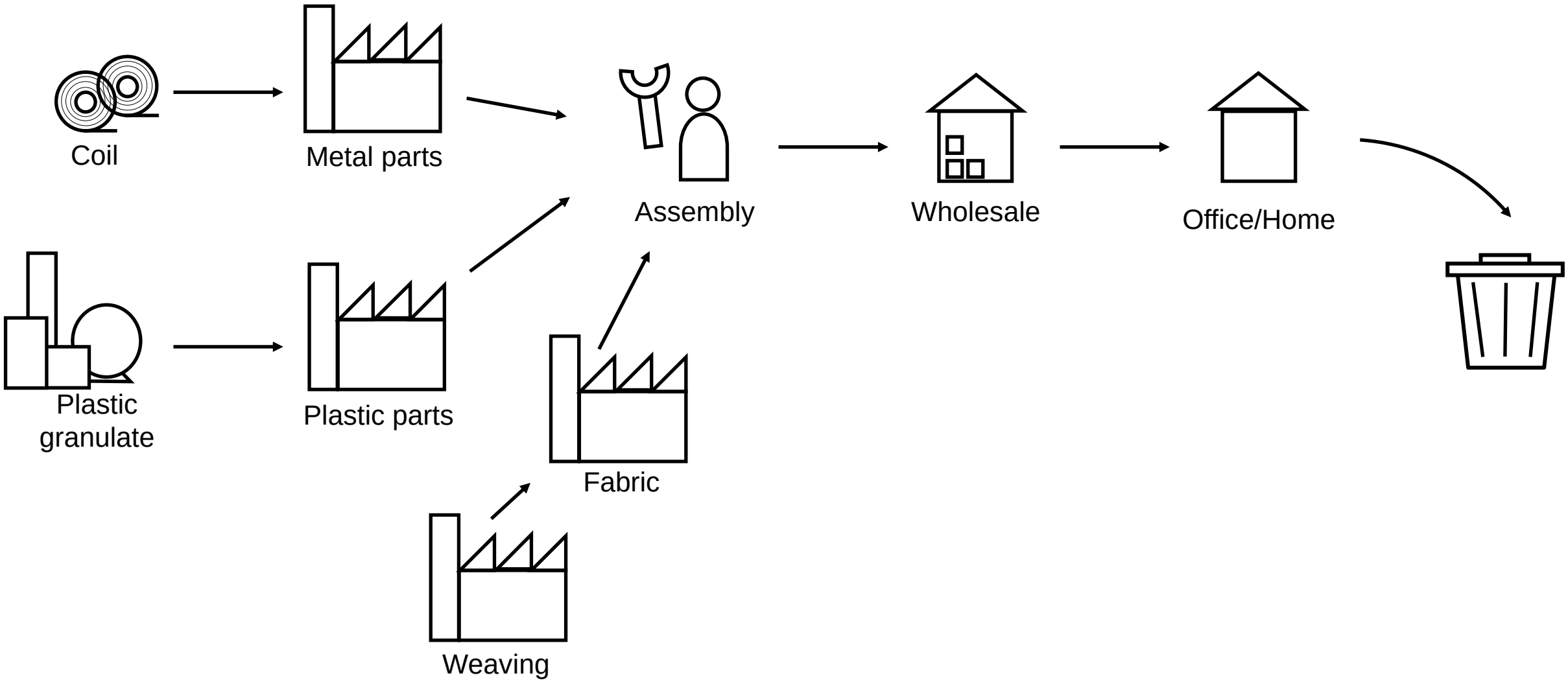
- Lifecycle of resources, materials and components
  - From where to where?
  - How much?
  - What activities
- Added value
  - What value is added for customers?
- Reverse flows may also add value!

CIRCULAR MATERIAL & VALUE FLOW MAP

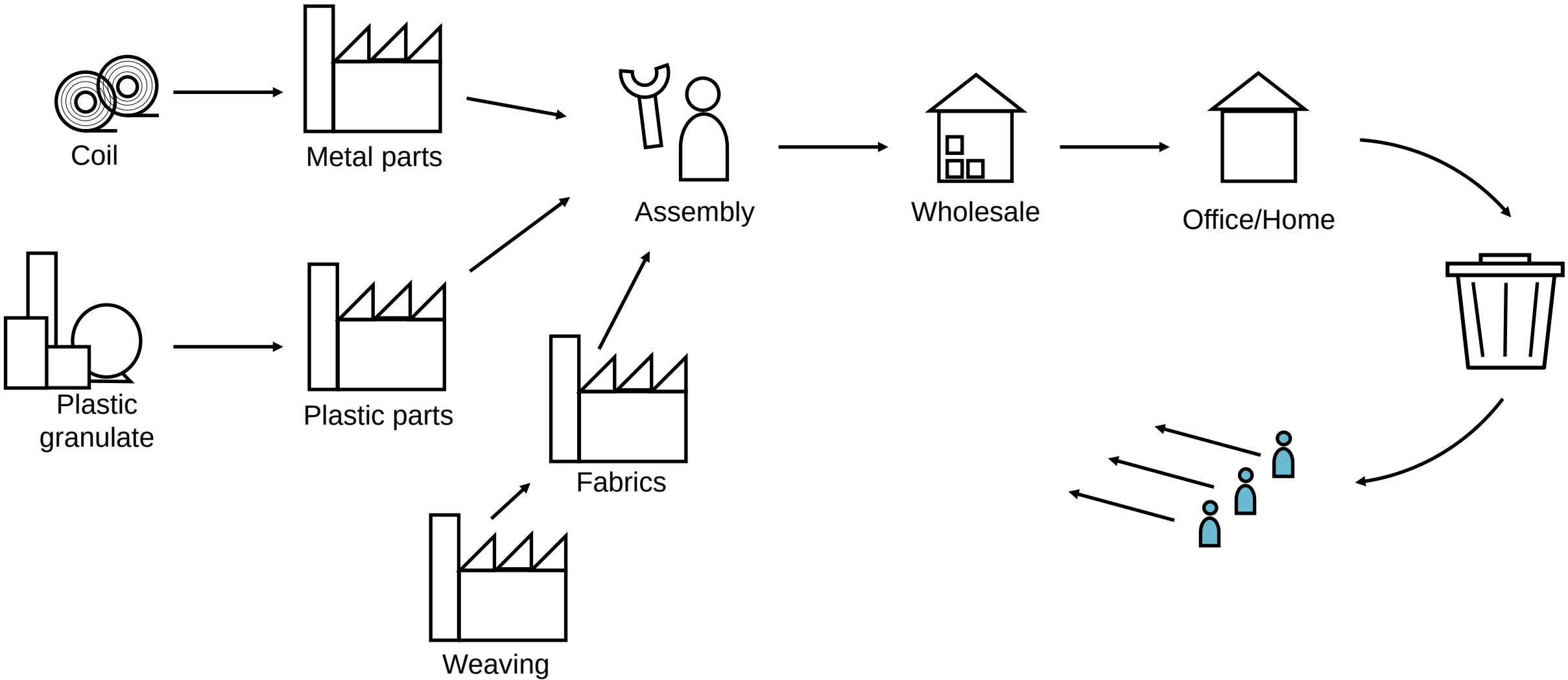


Source: Van der Vegt et al., 2021

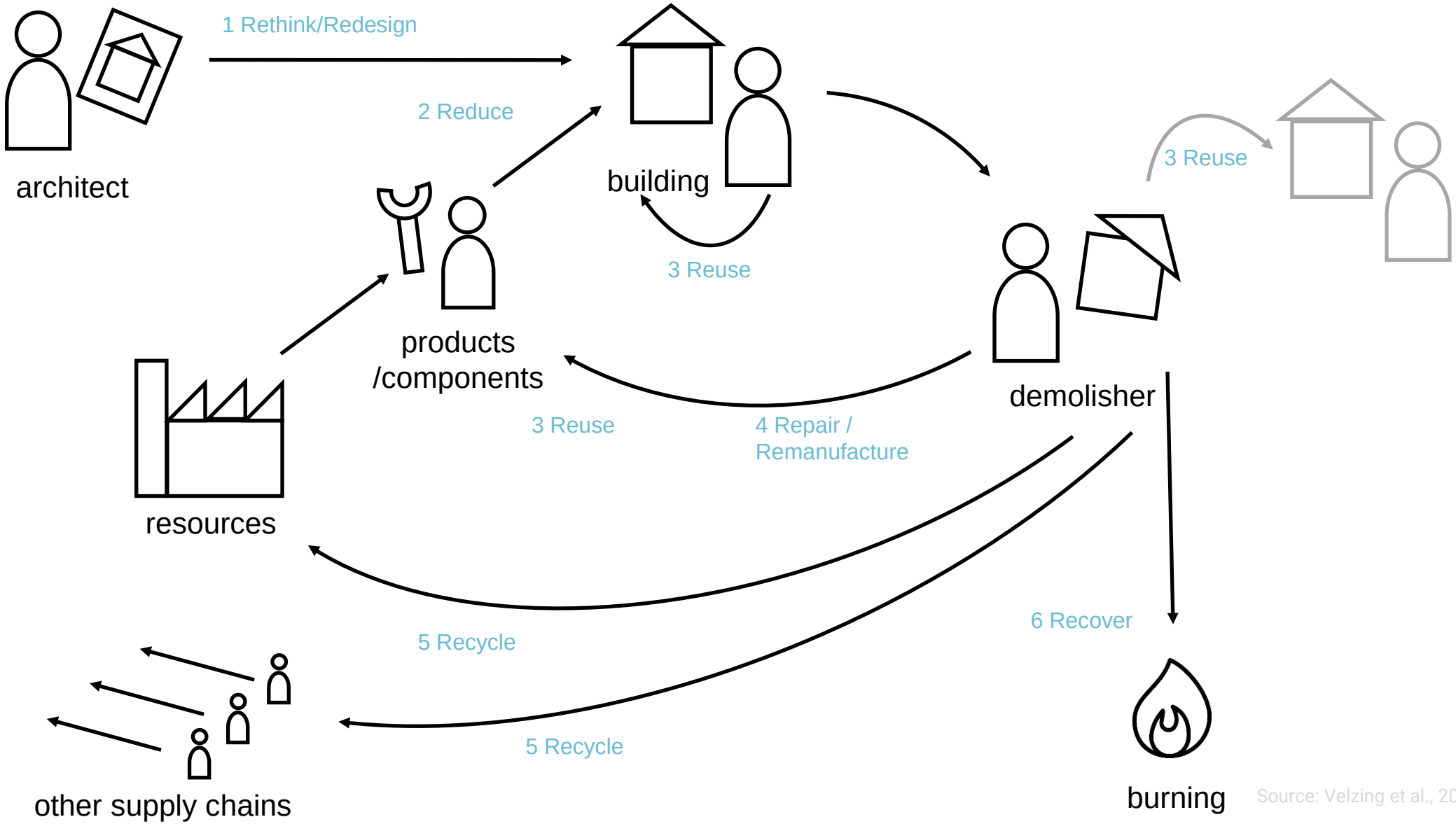
EXAMPLE: OFFICE CHAIR



EXAMPLE: CIRCULAR (?) OFFICE CHAIR



EXAMPLE: CIRCULAR CONSTRUCTION



Source: Velzing et al., 2021

10XL

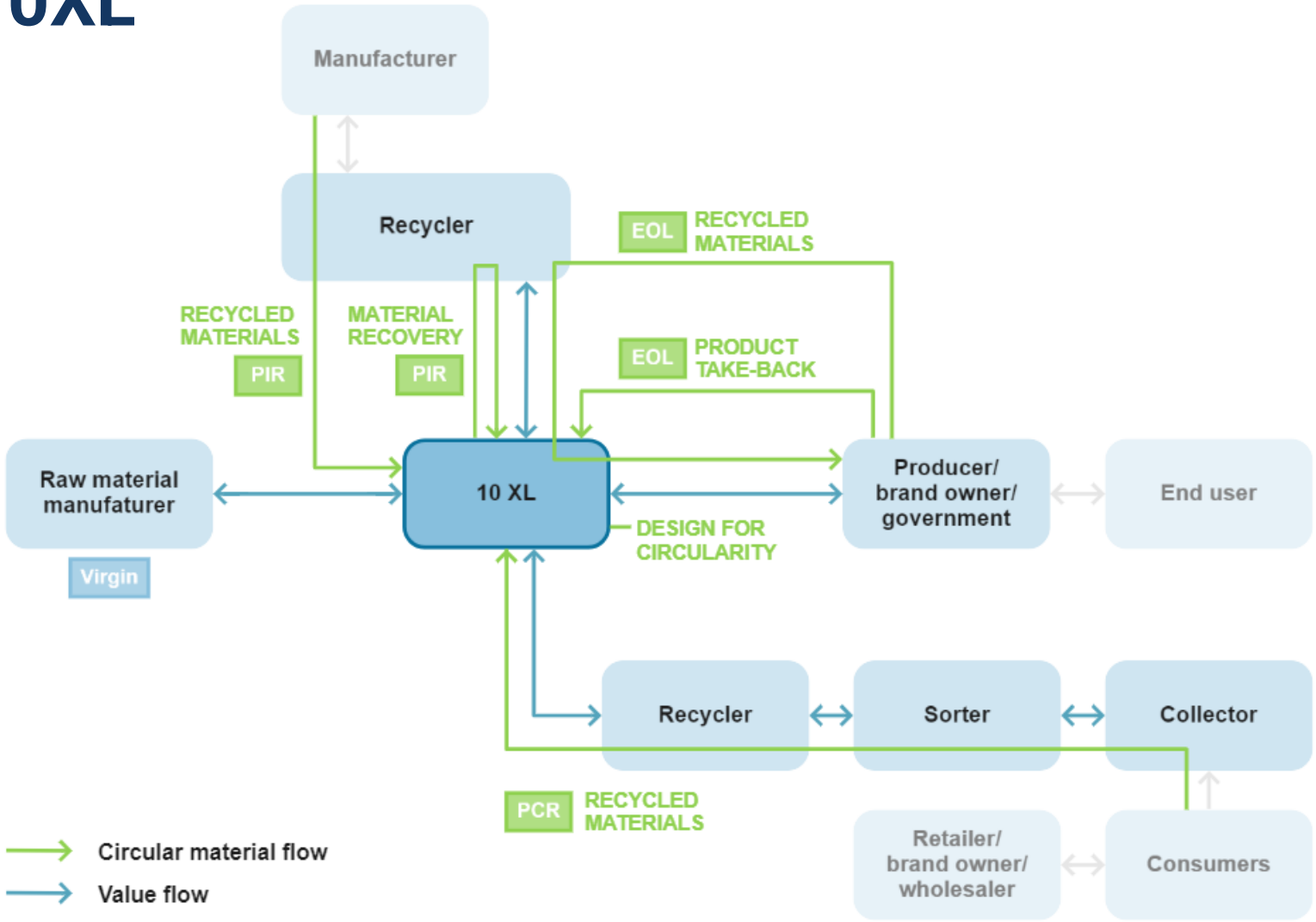
Large products (up to 12m)

Finding the right material stream

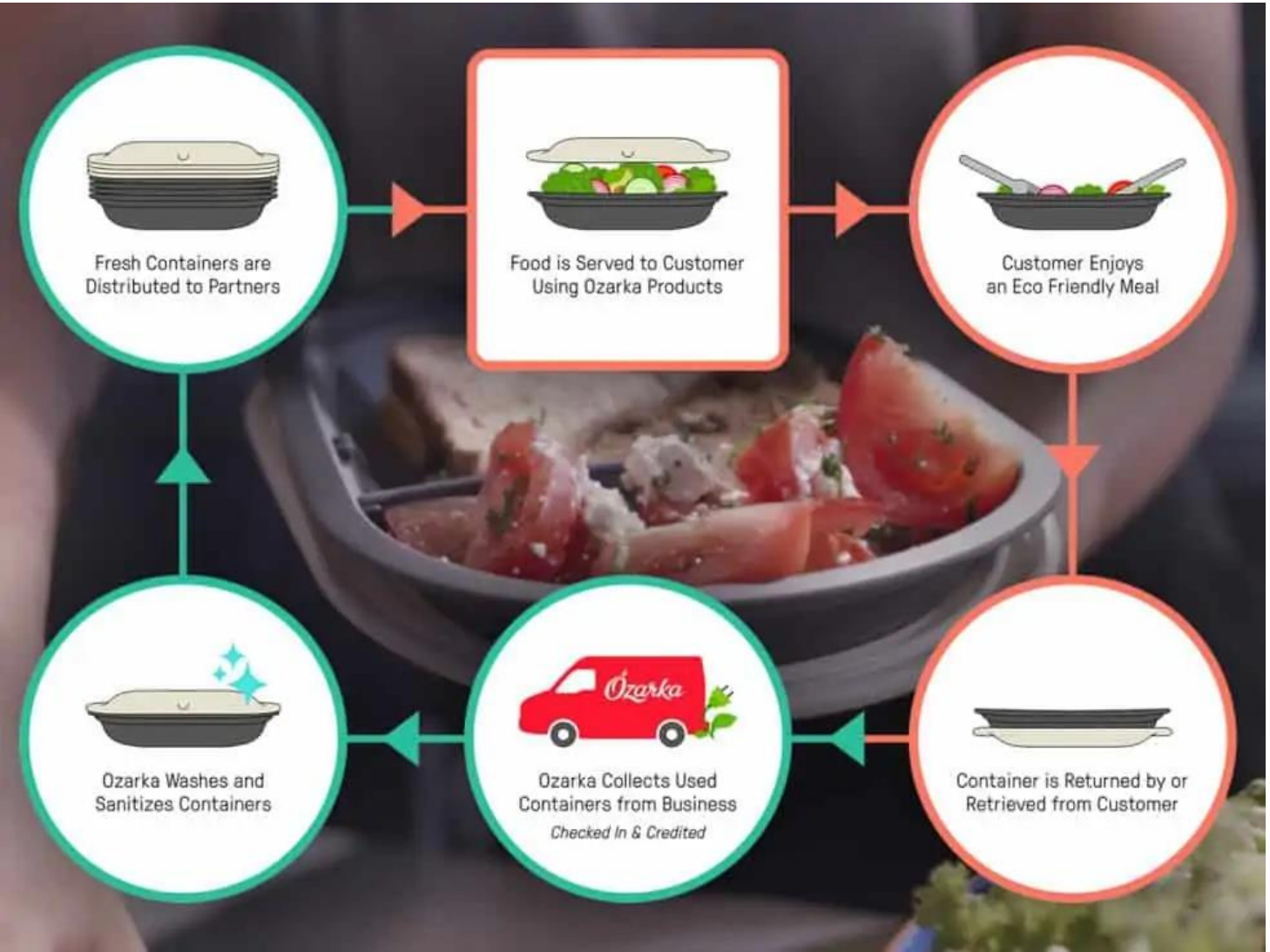
Material passports

3D-printing settings

EXAMPLE: 10XL



EXAMPLE: OZARKA



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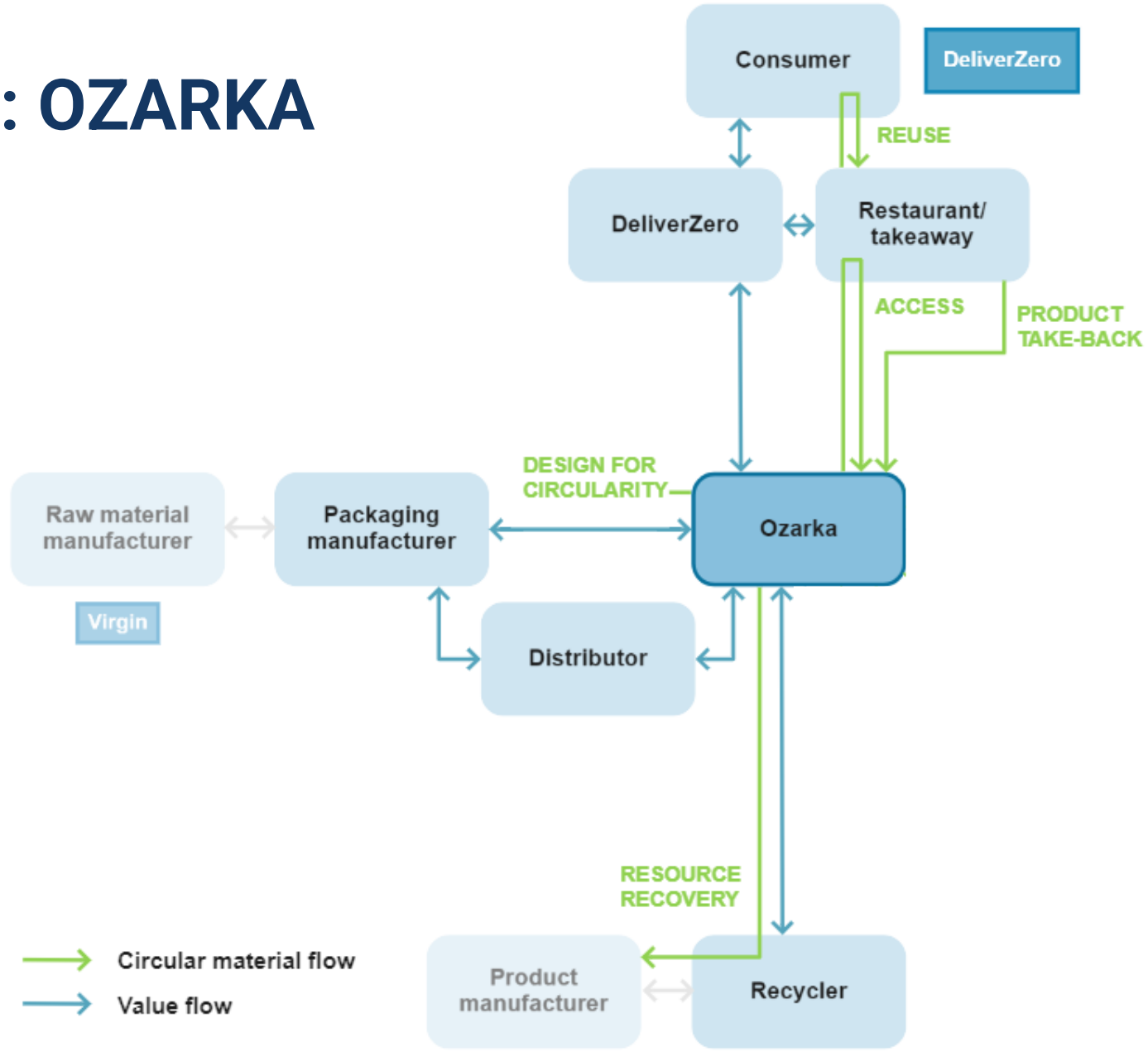
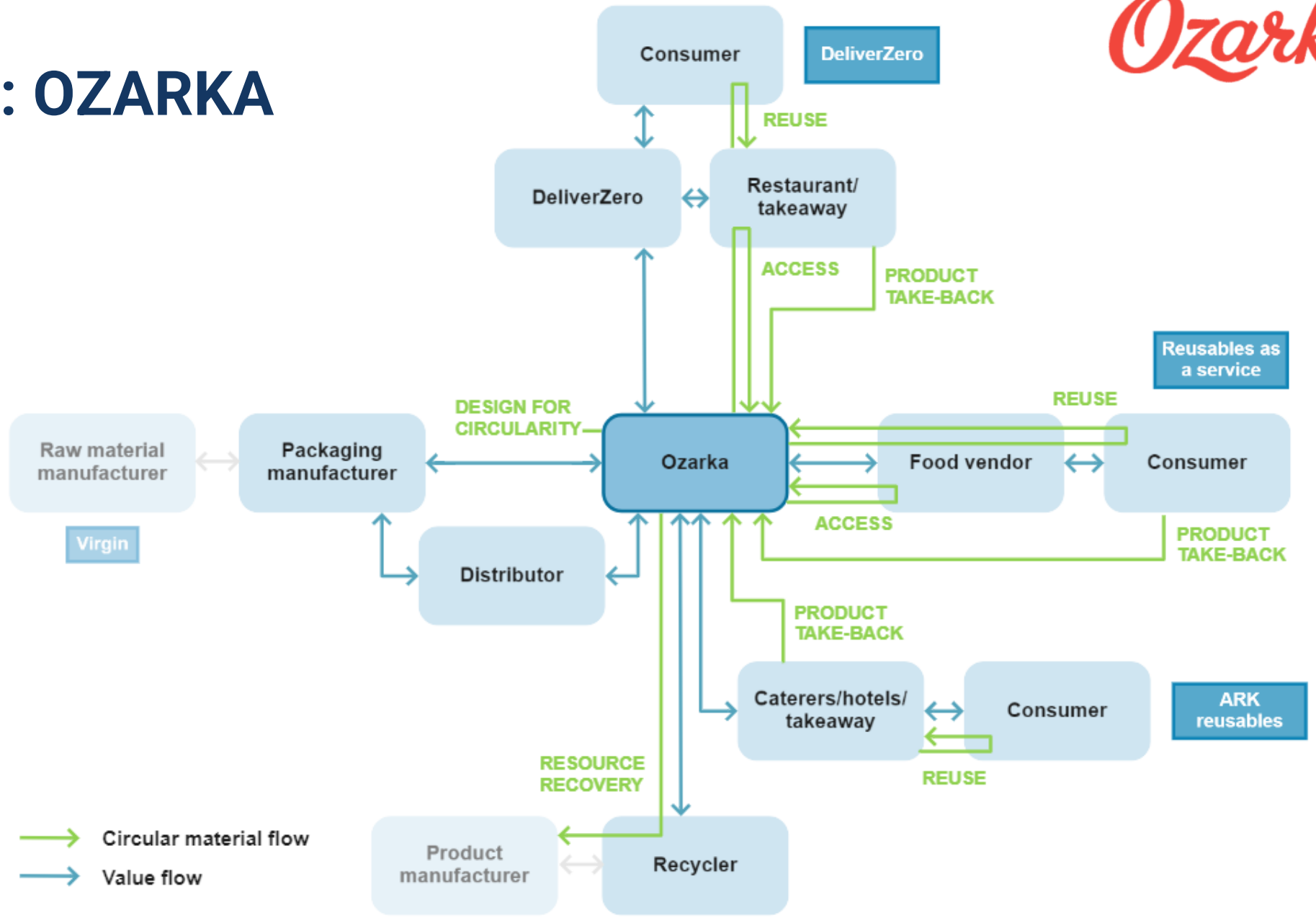


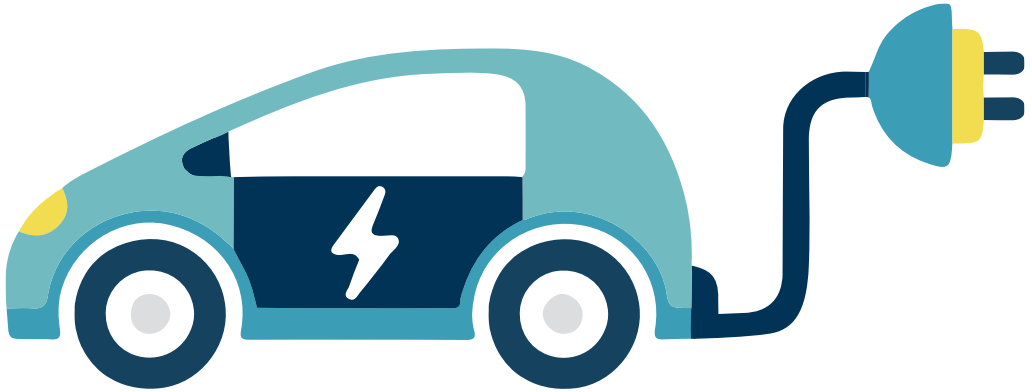
EXAMPLE: OZARKA



WHY USE MATERIAL VALUE FLOW MAPPING?

Example: The city of Zwolle has decided that in the next 3 years all cars should be electric

- Would this be a sustainable solution for **the city**?
- Would this be sustainable solution for **every city in the Netherlands**?
- Would this be sustainable solution for **the value chain**?



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Is this a sustainable solution for **every city in the Netherlands**?

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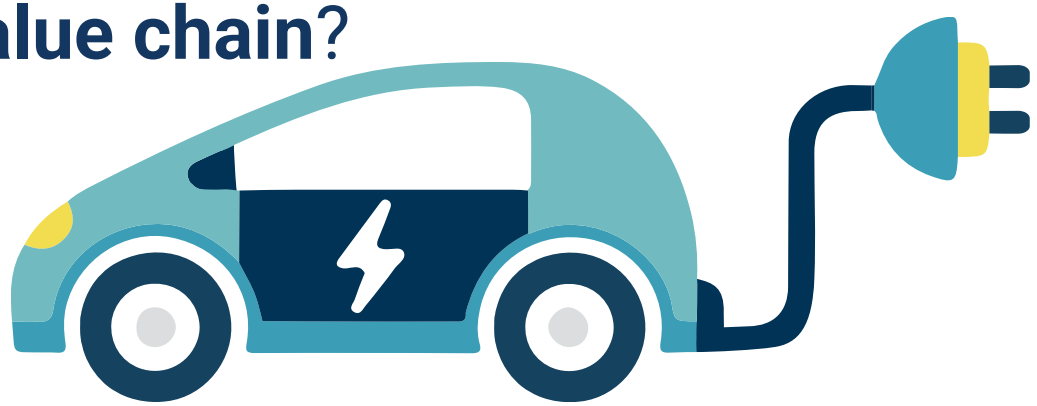

WHY USE MATERIAL VALUE FLOW MAPPING?

- Provides an **overview of the complete value chain**
  - Not just a focus on ‘visible impact’: materials, or usage
- A way to **explore opportunities for circularity** with other stakeholders
  - Not just focus on circularity within company
- Shows **where in the chain problems** may aris
  - To check whether a certain change also (negatively) affects other parts of the chain

TODAY

- Excercises 1-5, chapter 10

ASSIGNMENT

Assignment for Tuesday

- Draw a material flow map of one of the products:
  - Road surface
  - Pipes / sewages
  - Street furniture
  - Bricks or concrete for residential buildings
  - ? free category
- Investigate which concepts, materials or new strategies exists for making these products / materials more circular for a future new town in Zeist
- Update (or renew) the material flow map (fig 10.2) and include the new concepts, materials or strategies for circularity