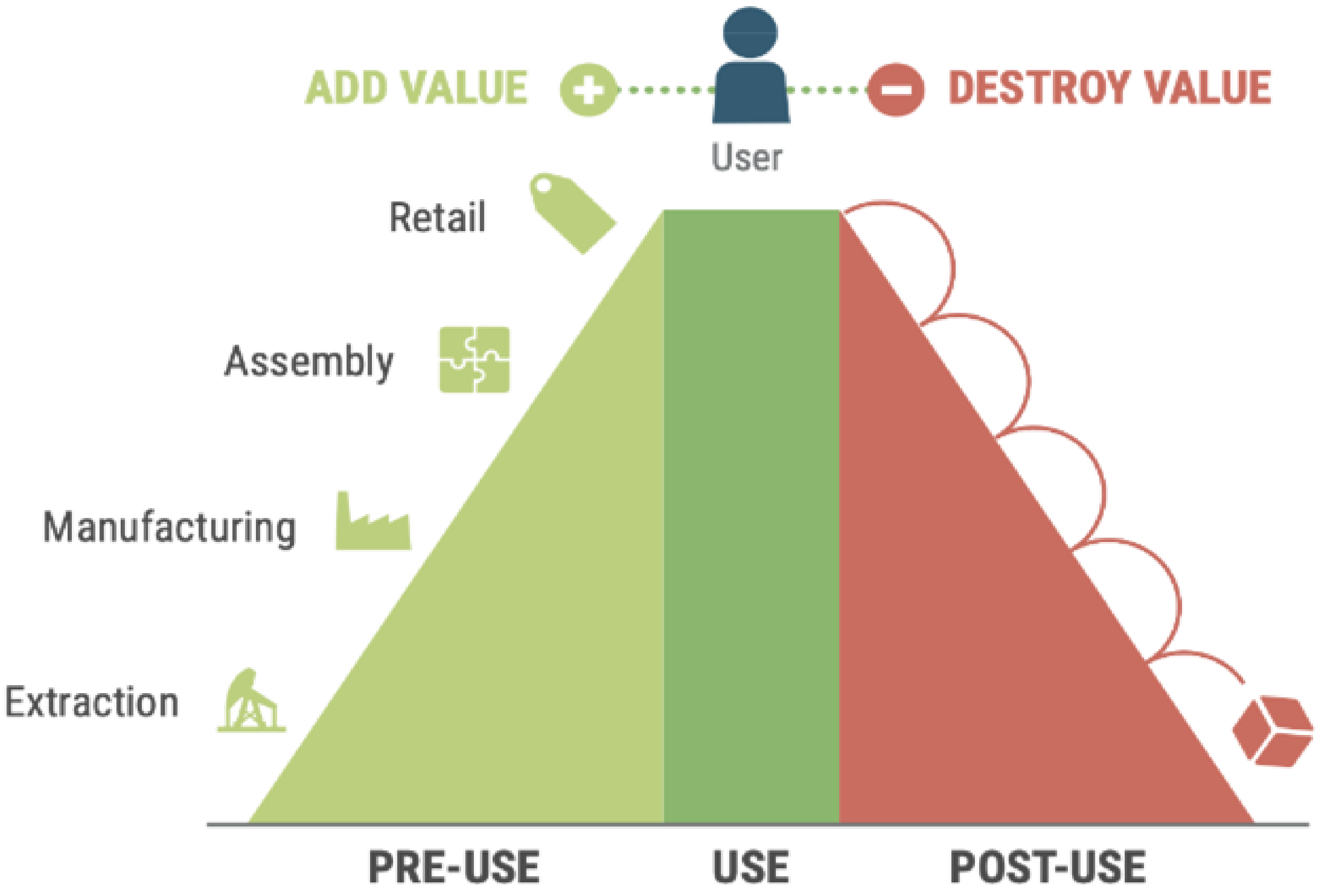
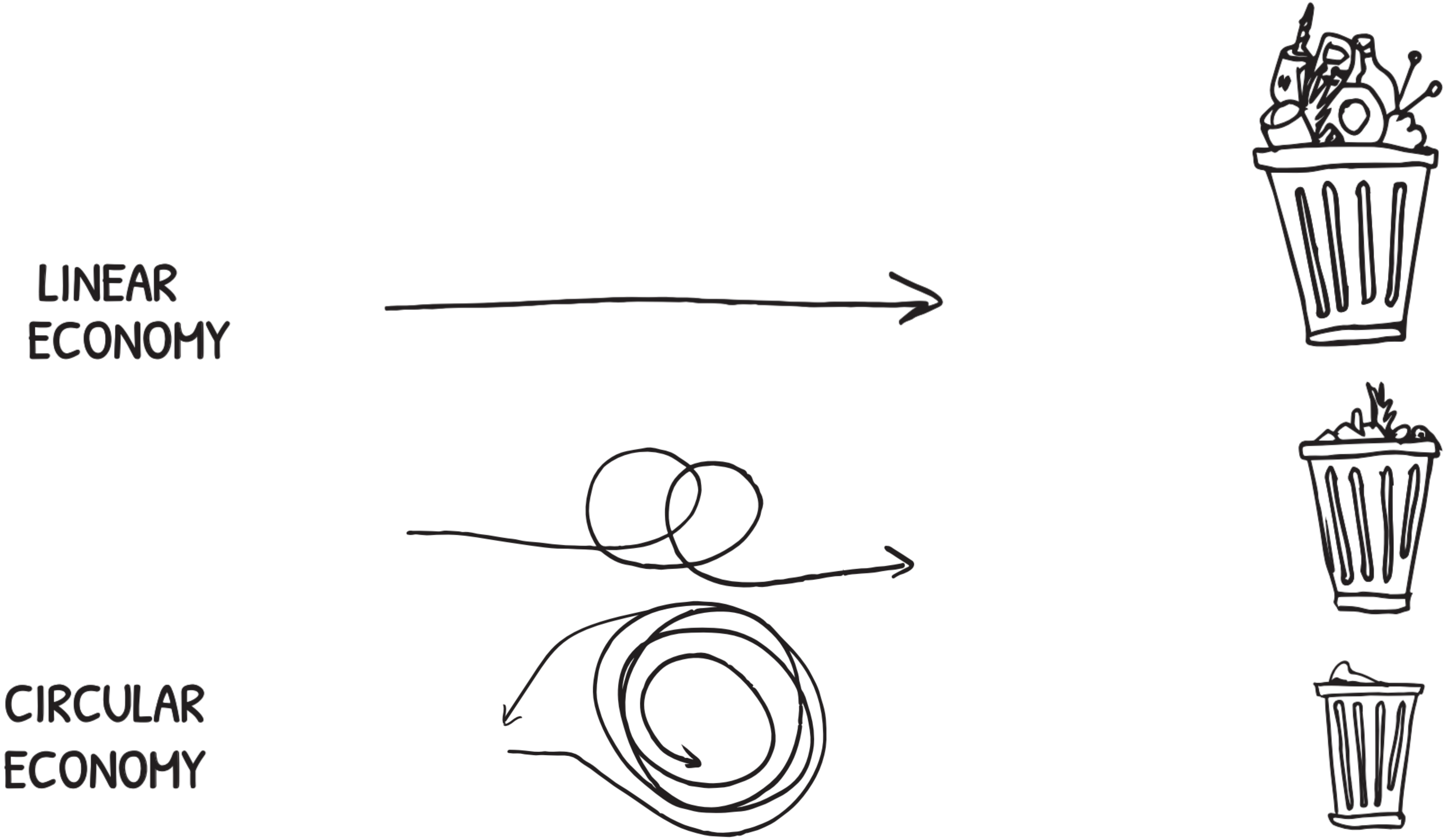
DESHEALTH

AUTUMN SCHOOL

TU DELFT

Value Hill – We destroy at highest value





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So, what do we mean by circular economy?

"In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting." *– Ellen MacArthur Foundation*

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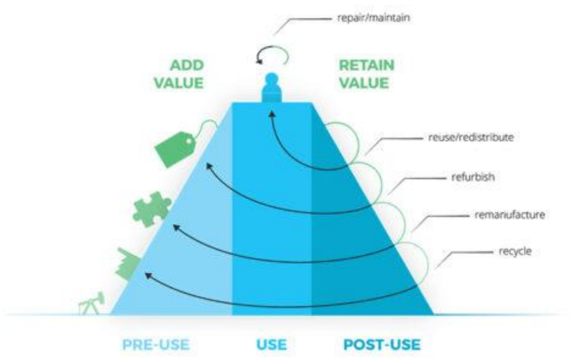
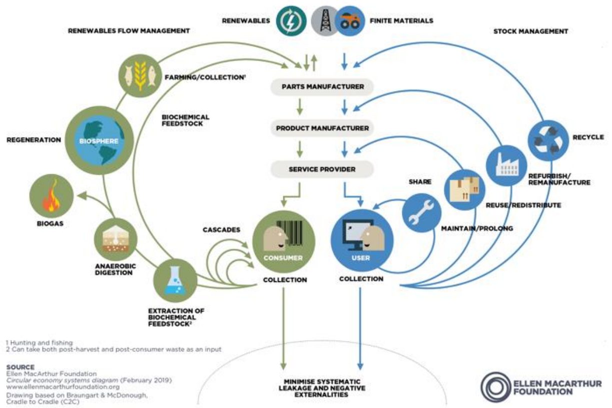
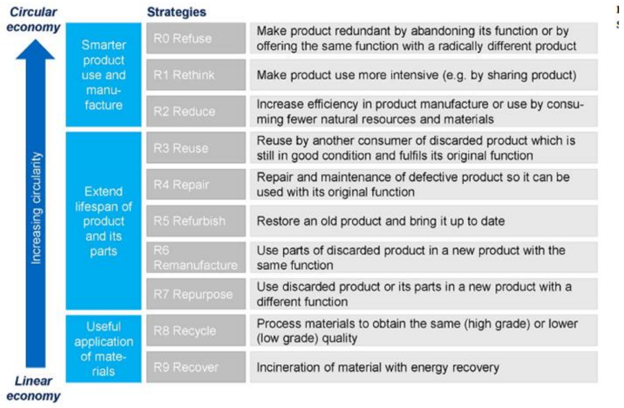


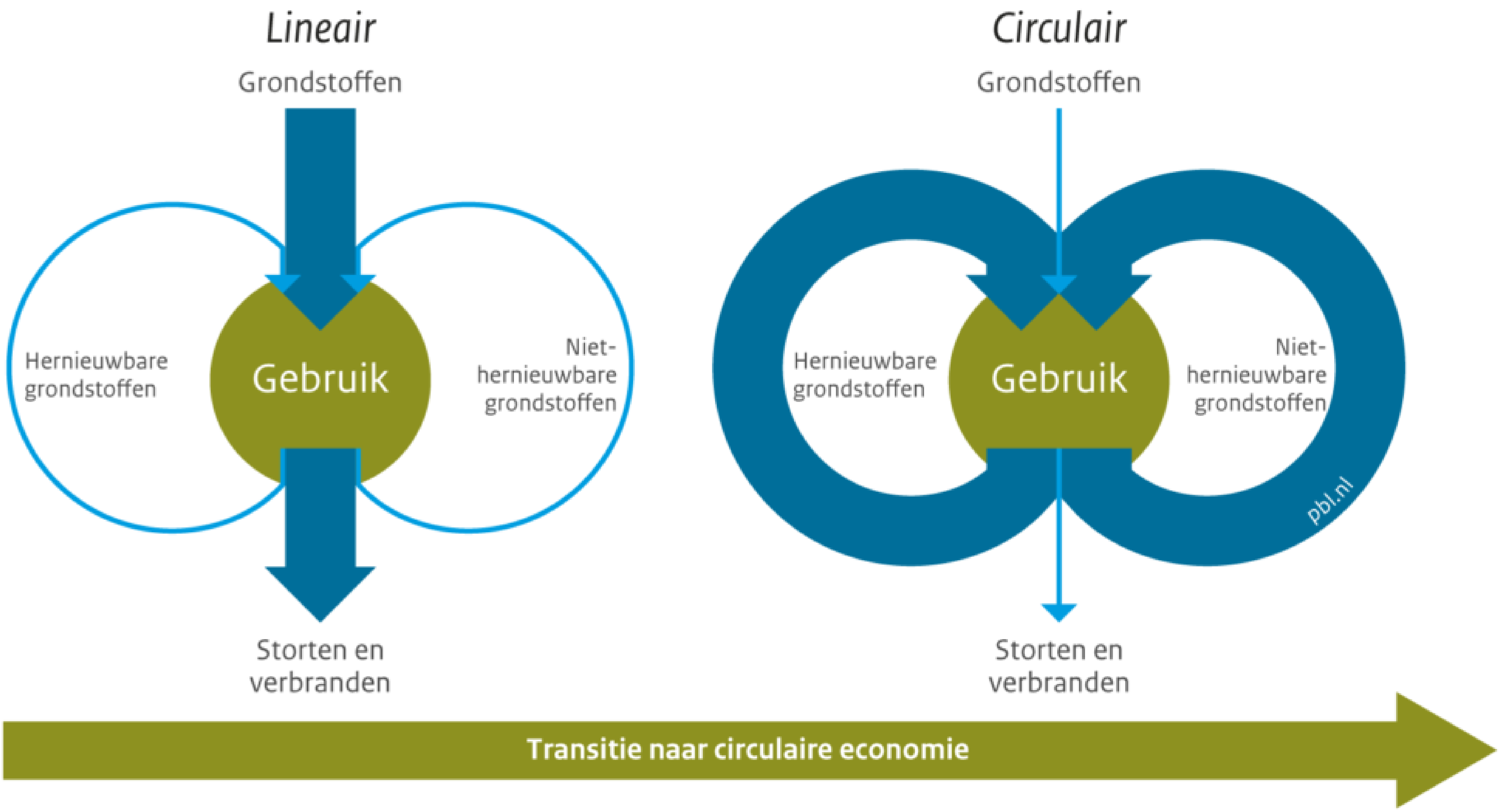




Circular economy ↑ Increasing circularity ↓ Linear economy	Strategies	
Smarter product use and manu-facture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1 Rethink	Make product use more intensive (e.g. by sharing product)
	R2 Reduce	Increase efficiency in product manufacture or use by consu-ming fewer natural resources and materials
Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
	R4 Repair	Repair and maintenance of defective product so it can be used with its original function
	R5 Refurbish	Restore an old product and bring it up to date
	R6 Remanufacture	Use parts of discarded product in a new product with the same function
	R7 Repurpose	Use discarded product or its parts in a new product with a different function
Useful application of mate-rials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9 Recover	Incineration of material with energy recovery

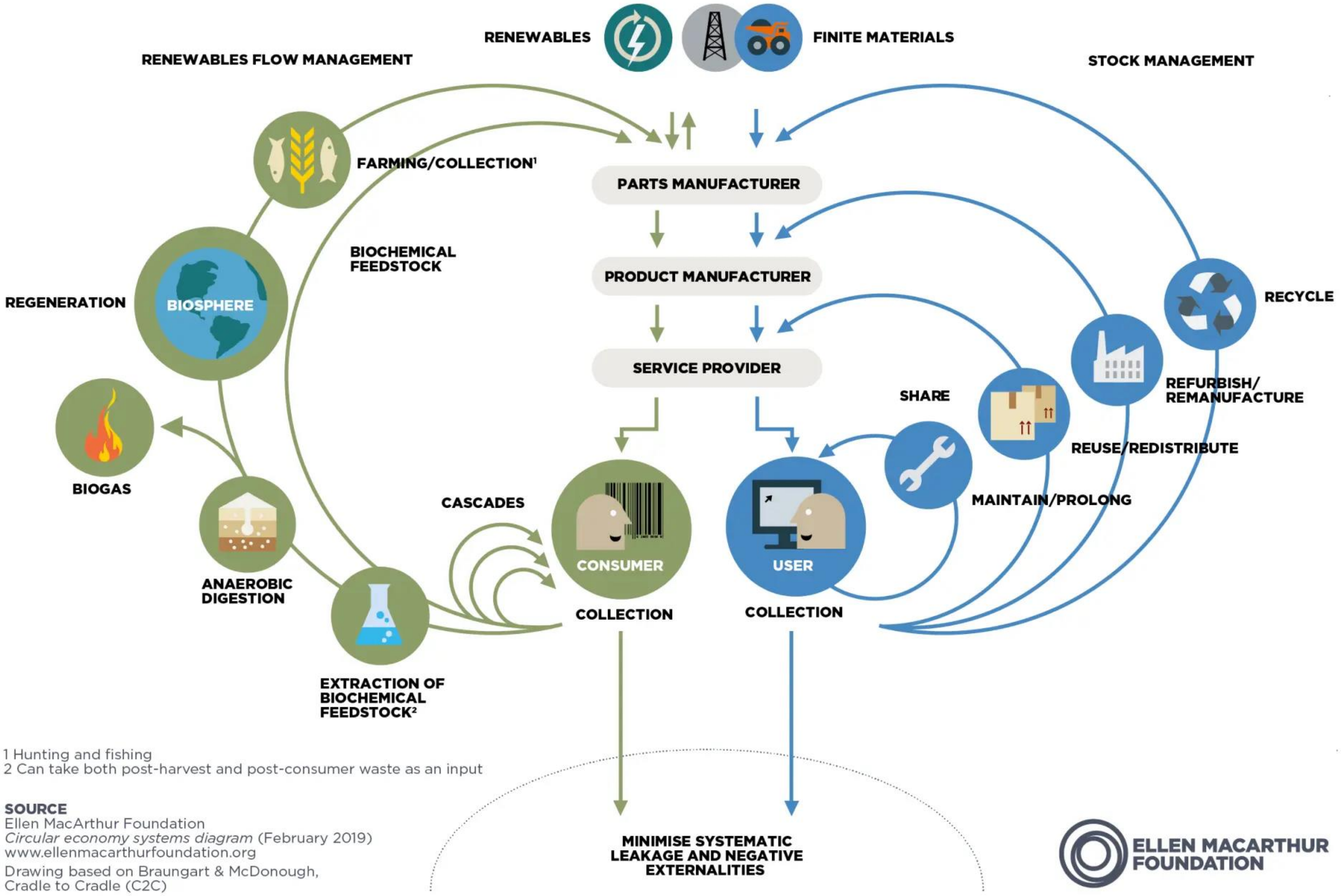
So, what do we mean by circular economy?

Van een lineaire naar een circulaire economie



Bron: PBL 2016

www.pbl.nl

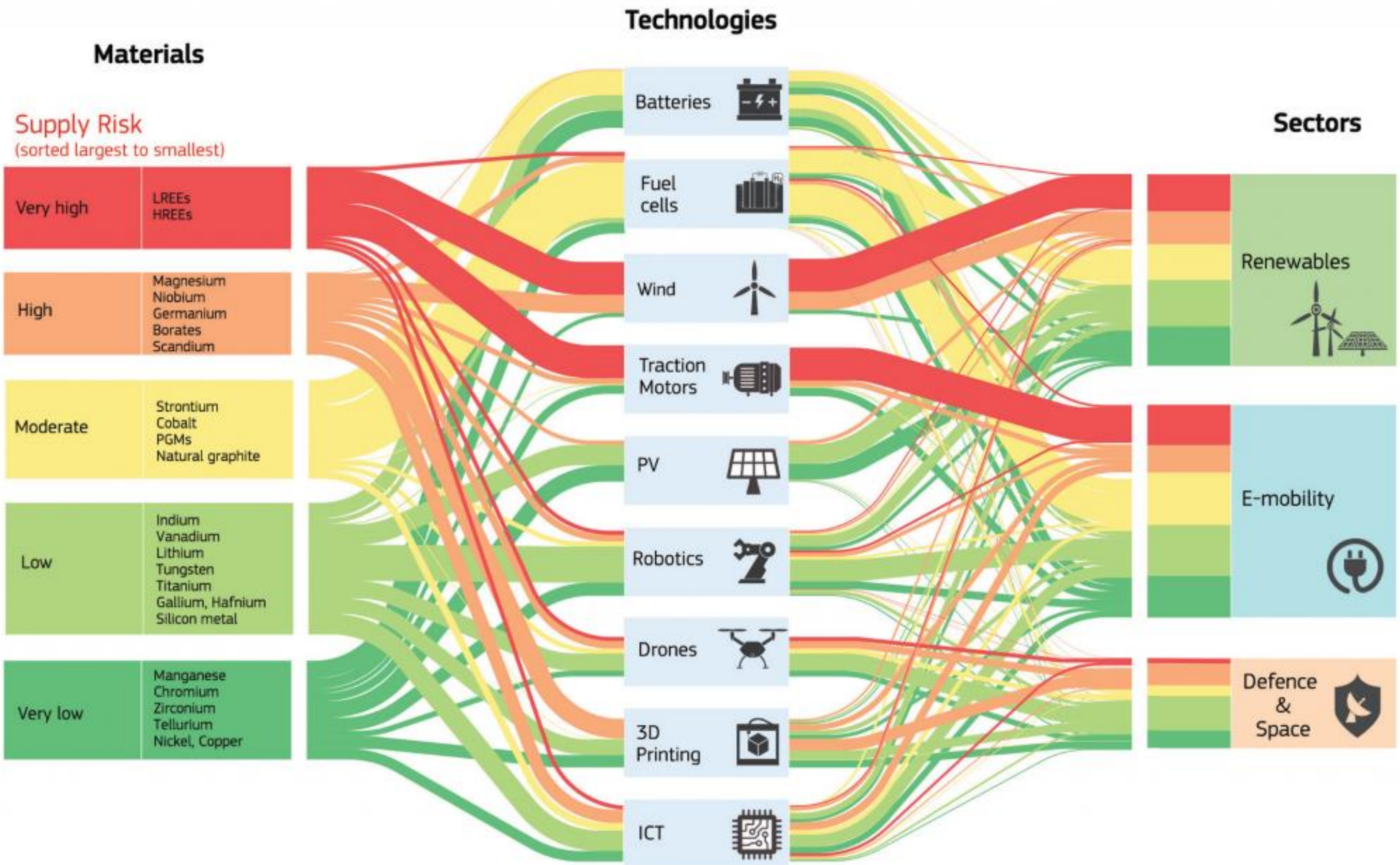


1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input

SOURCE
Ellen MacArthur Foundation
Circular economy systems diagram (February 2019)
www.ellenmacarthurfoundation.org
Drawing based on Braungart & McDonough, Cradle to Cradle (C2C)

ELLEN MACARTHUR FOUNDATION

Why do we (EU) work on circular economy?



Materials
Technologies
Sectors
Supply Risk
(sorted largest to smallest)
Very high
LREEs
HREEs
High
Magnesium
Niobium
Germanium
Borates
Scandium
Moderate
Strontium
Cobalt
PGMs
Natural graphite
Low
Indium
Vanadium
Lithium
Tungsten
Titanium
Gallium, Hafnium
Silicon metal
Very low
Manganese
Chromium
Zirconium
Tellurium
Nickel, Copper
Batteries
Fuel cells
Wind
Traction Motors
PV
Robotics
Drones
3D Printing
ICT
Renewables
E-mobility
Defence & Space

Ladder van Lansink 1979

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Strategies in a circular economy

Circular economy	Smarter product use and manufacture	R0 Refuse	Make a product redundant: abandon function or use different product
		R1 Rethink	Make product use more intensive: sharing or multi-functional products
		R2 Reduce	Consume less through efficient manufacturing or use
	Extend lifespan of products and its parts	R3 Re-use	Re-use of functioning discarded products by another use
		R4 Repair	Repair and maintenance of defects to keep original function
		R5 Refurbish	Restore and update
		R6 Remanufacture	Use parts in a new product with the same function
		R7 Repurpose	Use products or parts in a new product with a different function
	Useful application of materials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
Linear economy		R9 Recover	Incineration of materials with energy recovery

Table 3: Proposed conceptual framework. Healthcare specific definitions are the authors' own, inspired by all examined established definitions and definitions derived from the review of review results.

<table>
<tr><th></th><th>TERMS</th><th>HEALTHCARE-SPECIFIC DEFINITIONS</th></tr>
<tr><td></td><td>Refuse</td><td>Rejecting the use of a medical product or procedure by abandoning its function or specific added value compared to more environmentally sustainable, existing alternatives, thus avoiding unnecessary interventions.</td></tr>
<tr><td></td><td>Replace</td><td>Substituting a medical product or procedure with an alternative that serves the same purpose but significantly reduces environmental impact.</td></tr>
<tr><td></td><td>Rethink</td><td>Systemically enhancing the procedures surrounding product use to drive environmentally sustainable practices, such as through rethinking patient transport and telemedicine, sharing products or introducing multifunctionality.</td></tr>
<tr><td></td><td>Reduce</td><td>Increasing sustainability in healthcare delivery and medical product manufacturing by consuming fewer resources, optimizing energy and water use, and carefully minimizing (unnecessary) procedures to meet healthcare needs.</td></tr>
<tr><td rowspan="5">Reprocessing</td><td>Reuse</td><td>The repeated use of a medical device on multiple patients for the same intended purpose, after decontamination when needed, and without significant modification.</td></tr>
<tr><td>Maintain</td><td>Preserving the quality, function, and safety of medical products and clinical environments to ensure reliable performance, extend their lifespan, and reduce the risk of malfunctions that could lead to potential treatment failures.</td></tr>
<tr><td>Repair</td><td>Restoring a faulty or broken product or component to a usable state to fulfil its intended use, which typically involves corrective maintenance, ensuring that safety and performance specifications are met for an extended period of time.</td></tr>
<tr><td>Refurbish</td><td>Restoring a product to good working condition through decontamination, repairs, upgrades, cosmetic changes, performance checks, reinstallation, warranty assurance, and parts replacement.</td></tr>
<tr><td>Remanufacture</td><td>Re-engineering products and components, often utilizing parts from discarded products for the same function, to achieve as-new condition through decontamination, quality control, certification, repackaging, and redistribution.</td></tr>
<tr><td></td><td>Repurpose</td><td>Using discarded products or parts for different purposes than originally intended, such as in varied contexts (e.g. veterinary care procedures), purposes (e.g. different human procedures) and locations (e.g. developing countries).</td></tr>
<tr><td></td><td>Recycle</td><td>Through e.g. decontamination, shredding, and moulding, transforming waste materials from used products or resources into new raw materials, either of the same or lower quality.</td></tr>
<tr><td></td><td>Renew</td><td>Replenishing waste materials, energy sources, and other substances into basic elements like carbon dioxide, water, biomass, or human tissue (for regenerative medicine) through natural processes.</td></tr>
<tr><td></td><td>Recover energy</td><td>Incineration (or medical incineration) of waste materials with energy recovery.</td></tr>
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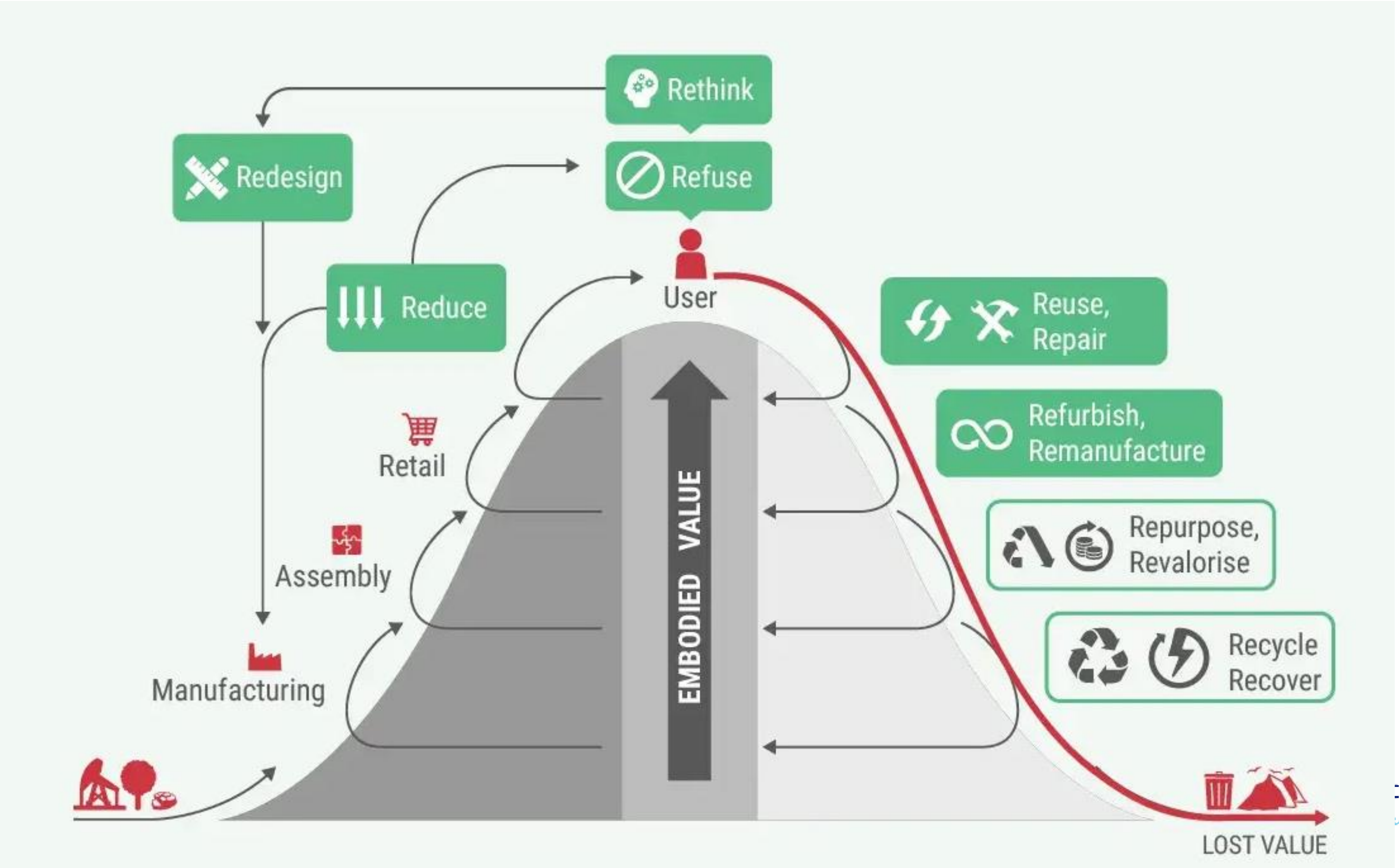
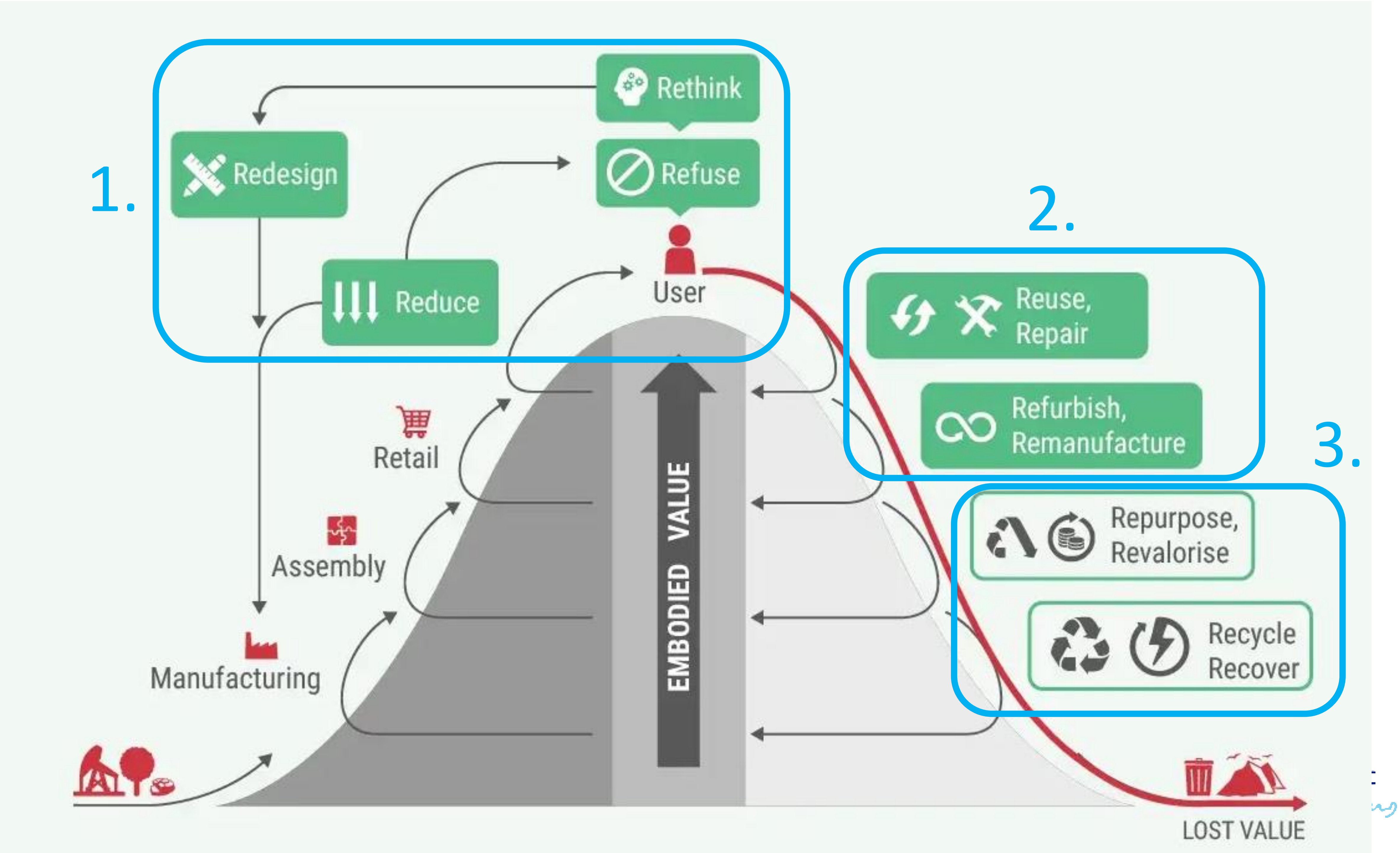

Rethink
Redesign
Refuse
Reduce
User
Reuse,
Repair
Refurbish,
Remanufacture
Repurpose,
Revalorise
Recycle
Recover
Retail
Assembly
Manufacturing
EMBODIED VALUE
LOST VALUE


1.
Rethink
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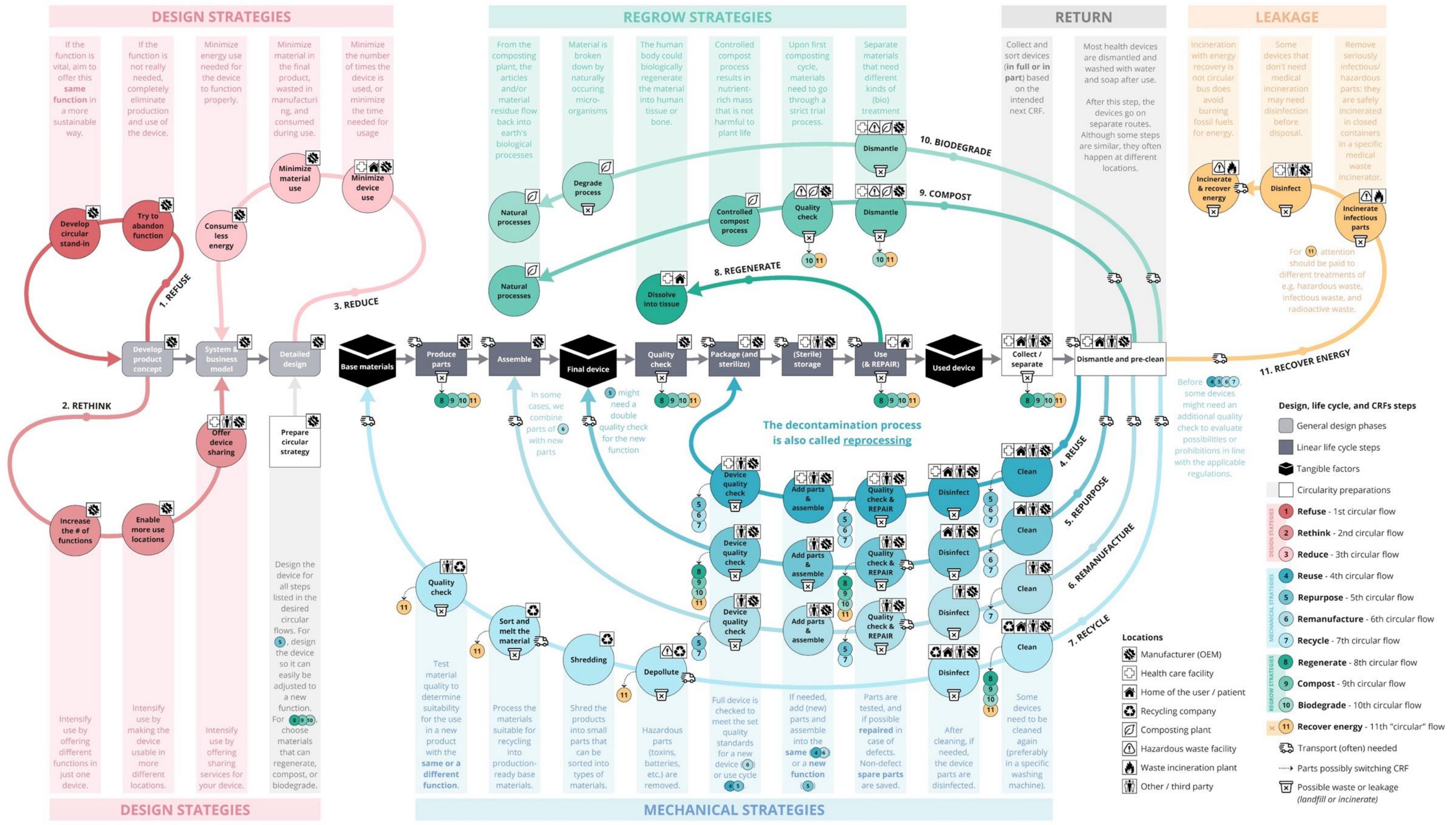
Circular R-Strategies in Healthcare



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Examples of Healthcare specific nuances

Safety protocols

Patient data

Contamination risks

Standards and regulations

Practitioner workload

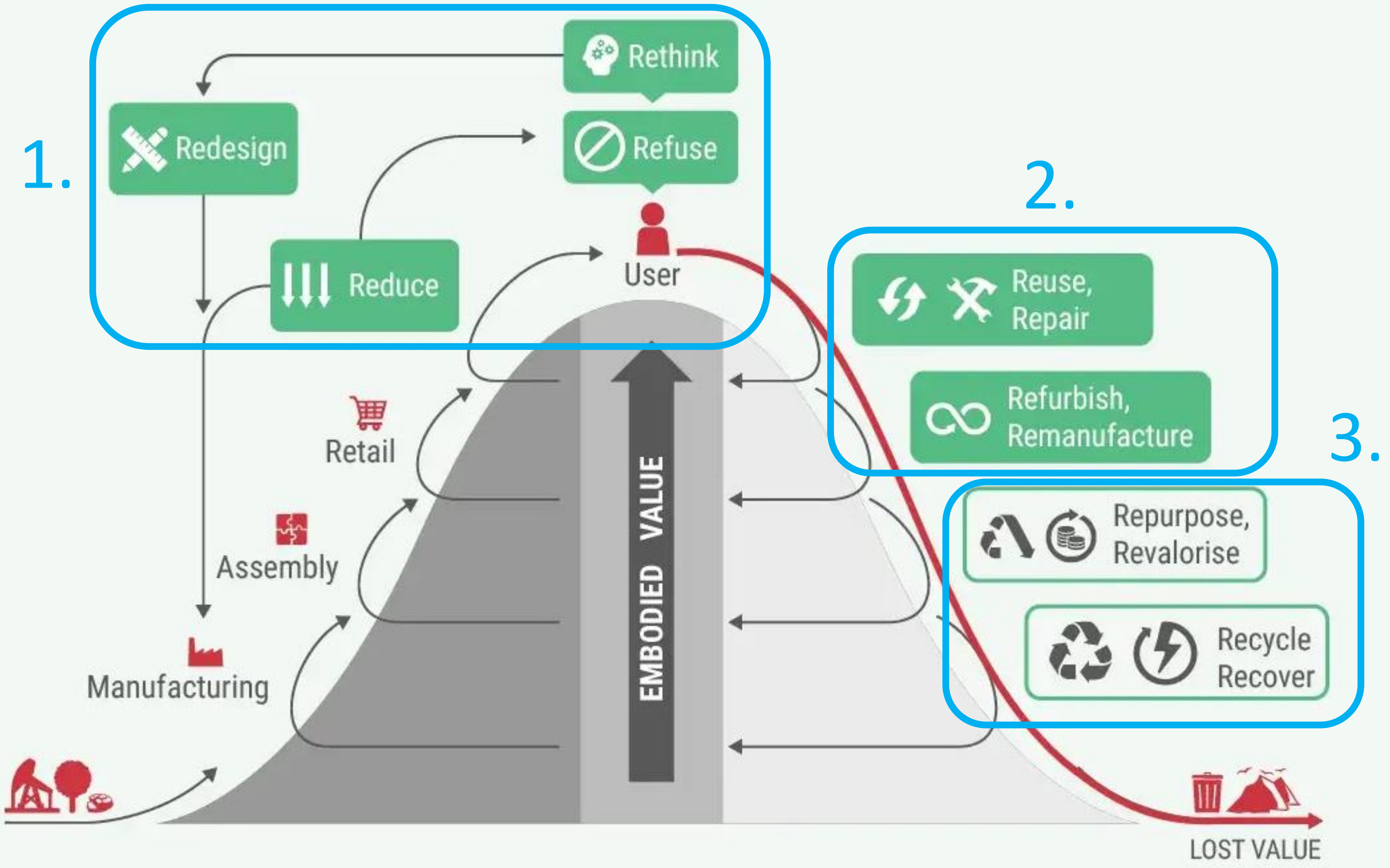
What **barriers** to circularizing active medical devices can be defined and how can we potentially **overcome** them?

BARRIERS TO CIRCULARITY IN HEALTHCARE

Read the article

- Literature review of 94 articles
- 21 expert interviews

Examples of barriers	Occurence	Example quote
Safety, infection, and contamination risks	**171**	“. . . it can be dangerous . . . if you come into contact with certain pharmaceutical substances, sharps, lots of types of things, they can be contaminated with viruses from other persons”.
Practical difficulties related to collection and separation logistics	**145**	“There are unlimited logistic issues. There is no return flow in place”.
Regulations that complicate the process	**125**	“Brazilian legislation prohibits the reuse and reprocessing of CIED, such as pacemakers, defibrillators, and CRT devices”.
Financial constraints of different stakeholders	**108**	“You need economies of scale to be economically successful in something”.
Unsuitable device/material characteristics for circular strategies	**81**	“The design team strictly adhered to the glued solution, as that was the only way to create a completely watertight devices that are still hygienic”.
Unawareness about and complexity of the circular economy	**78**	“People are often not aware of the impact of everything we use. Locally, but also in the supply chain”.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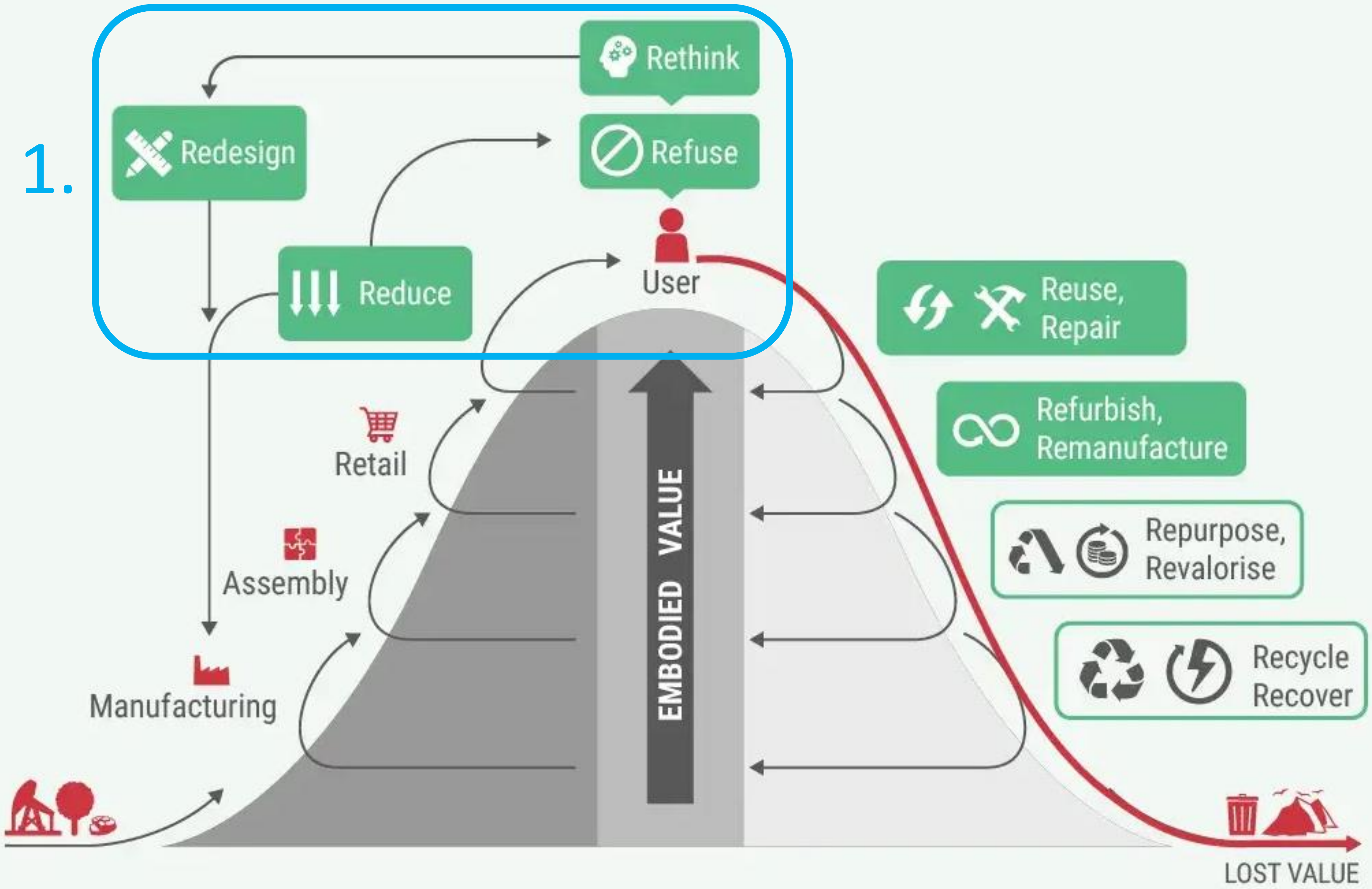
1.



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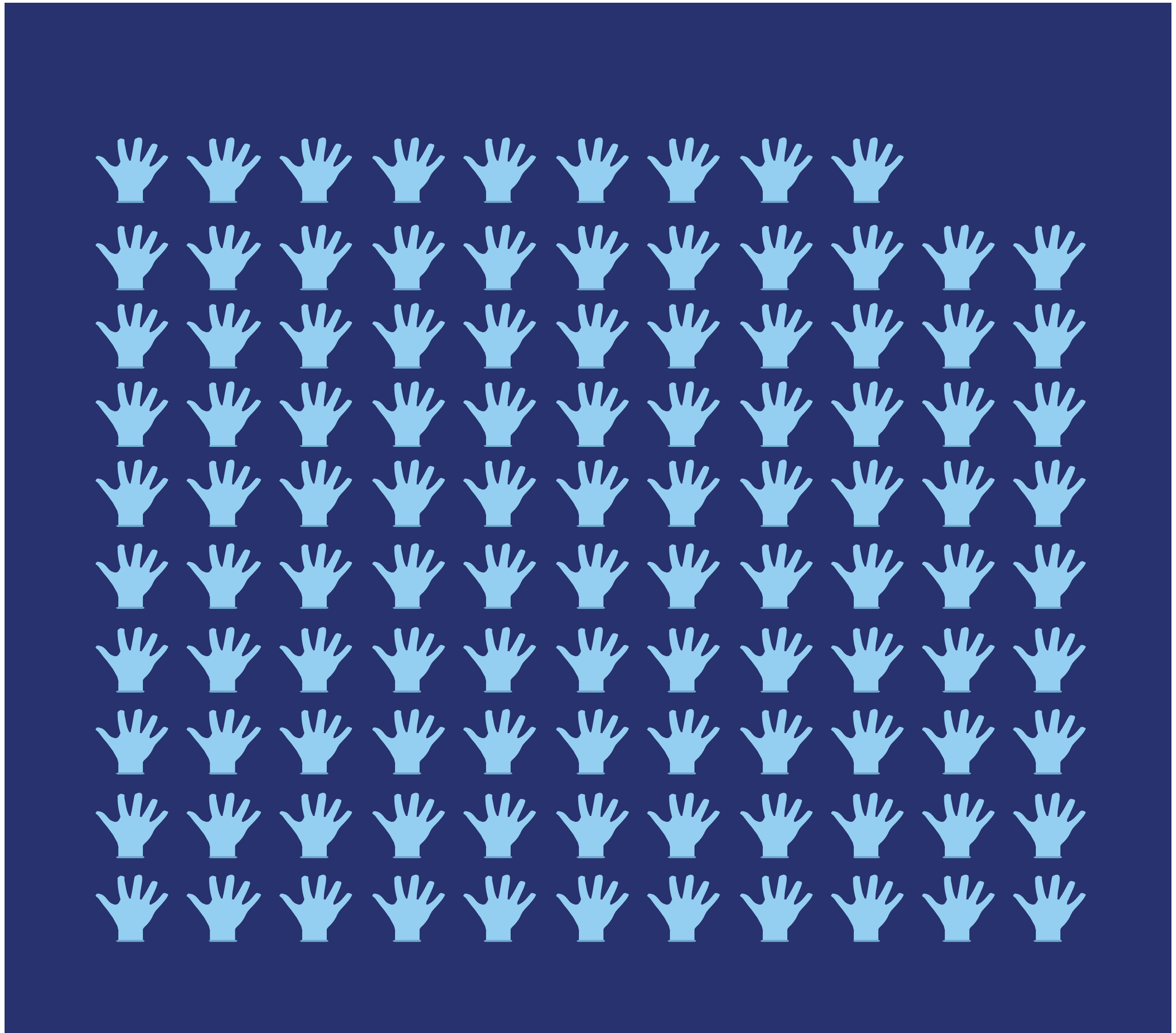
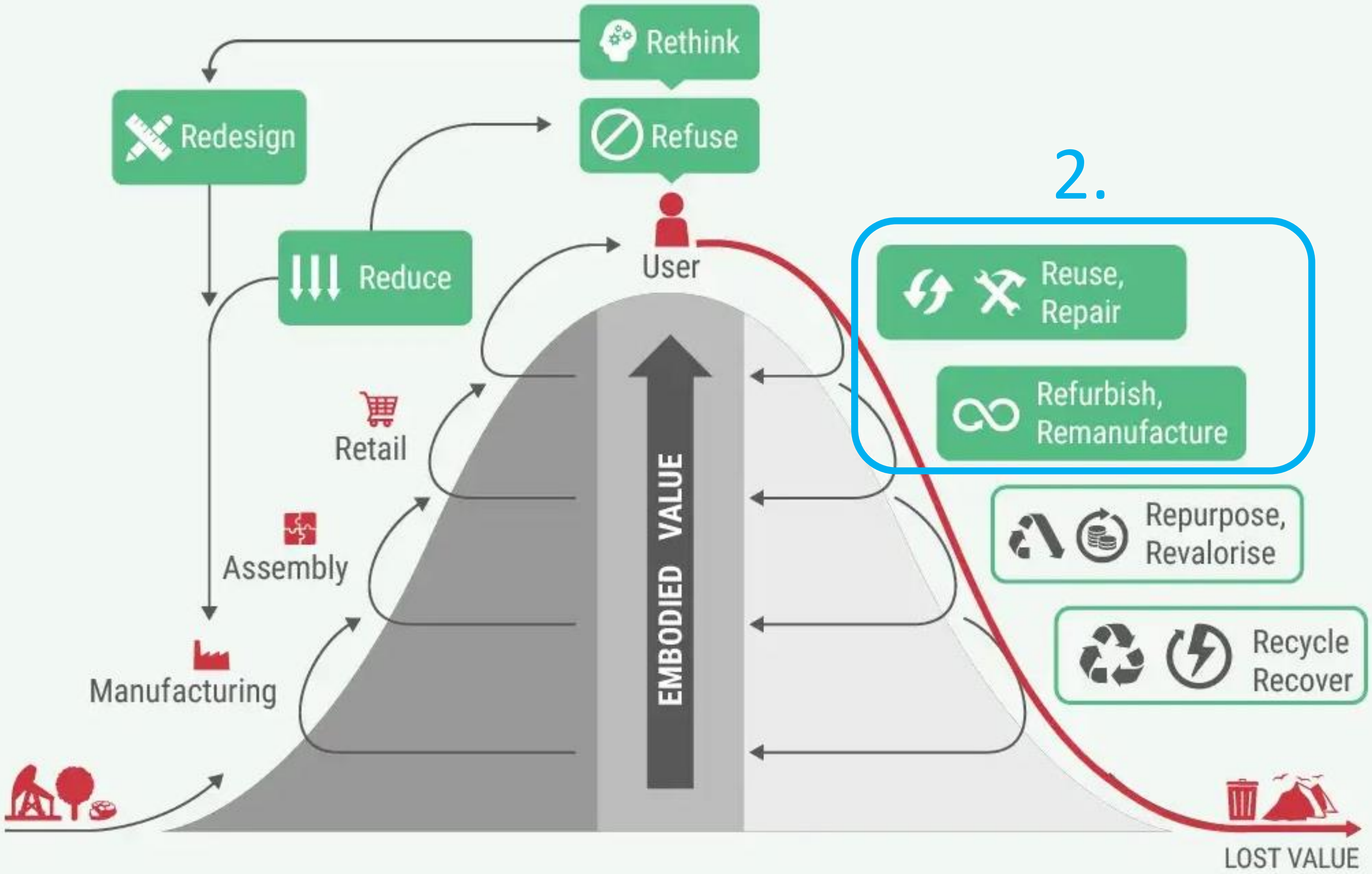
Dispoable Gloves - 108 per patient per day





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LOST VALUE

Case 4: Endocutter

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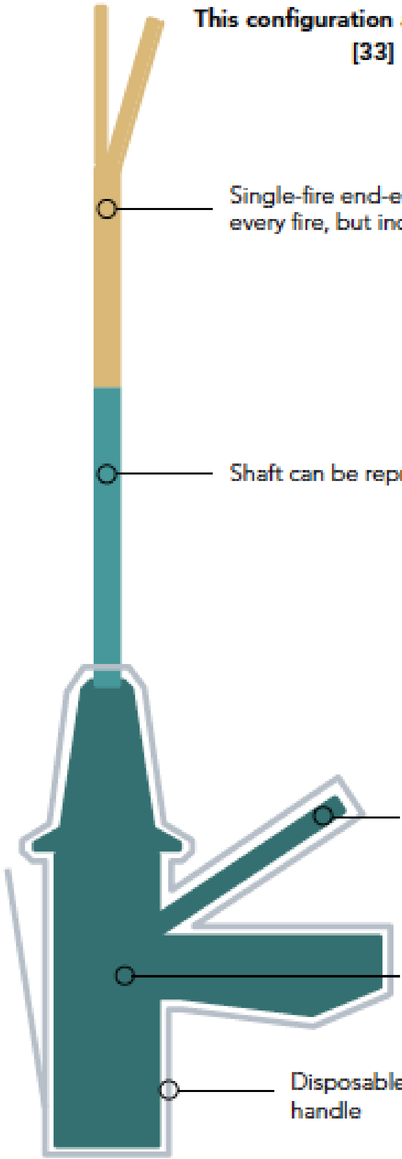
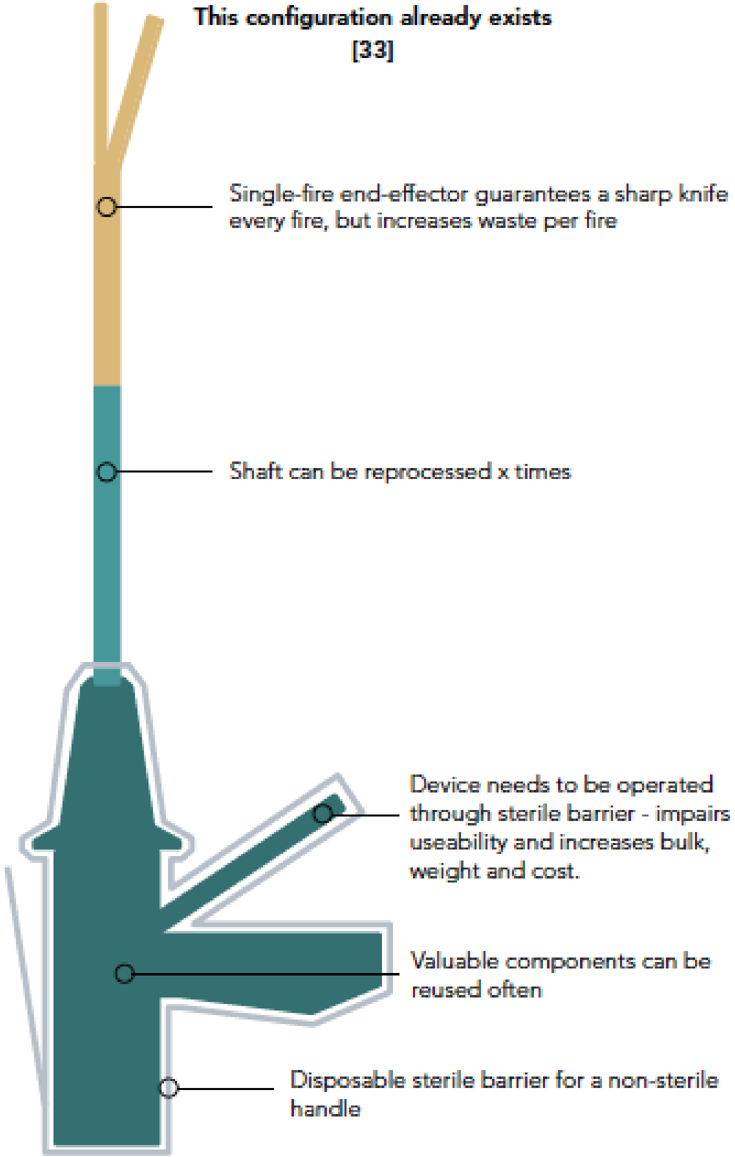
Re-use or Remanufacture



Re-use or Remanufacture



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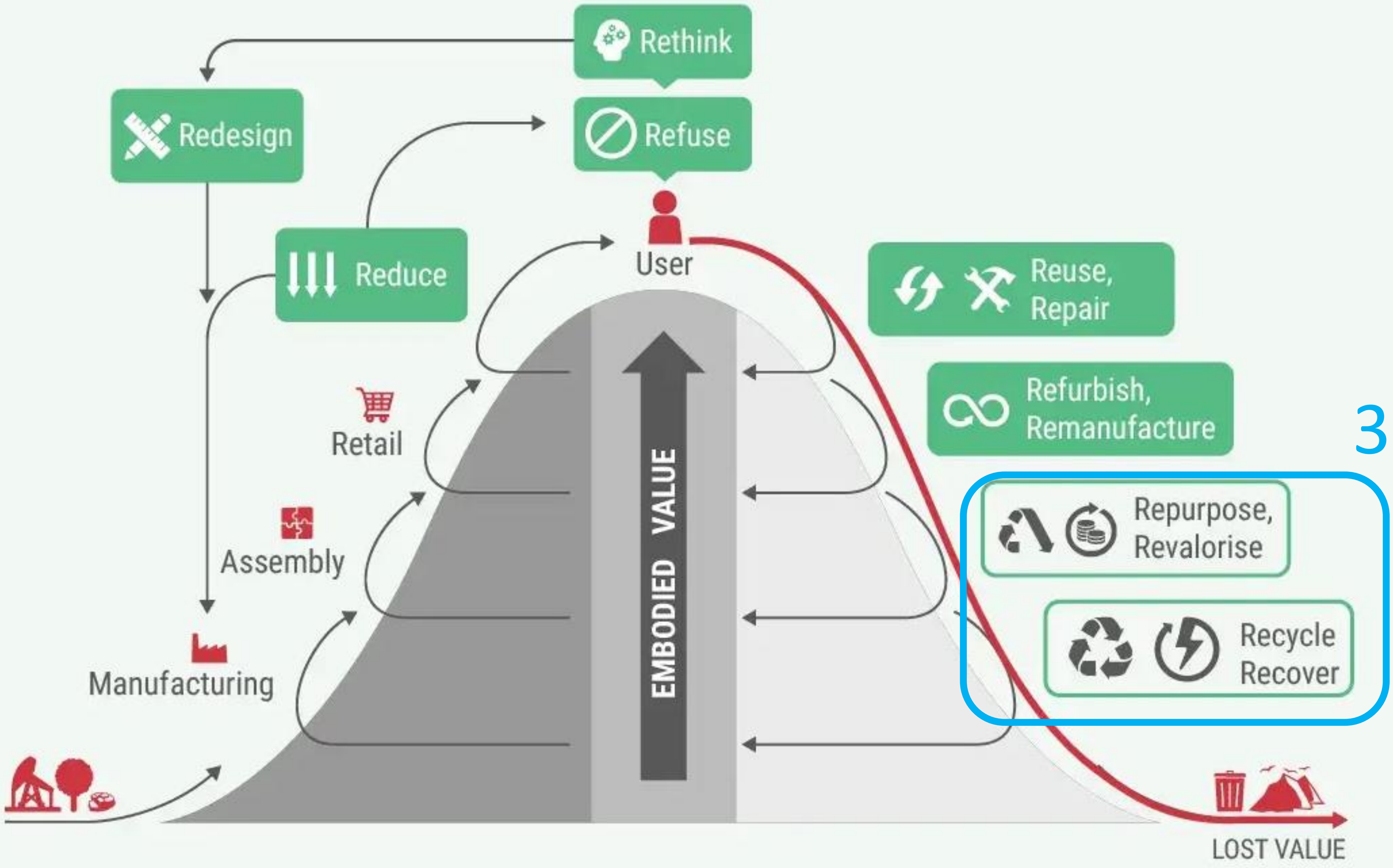
Product Service Systems & New Business Models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Repurpose,
Revalorise
Recycle
Recover
LOST VALUE

3.

Dialysis bags at ICU

4500 kg

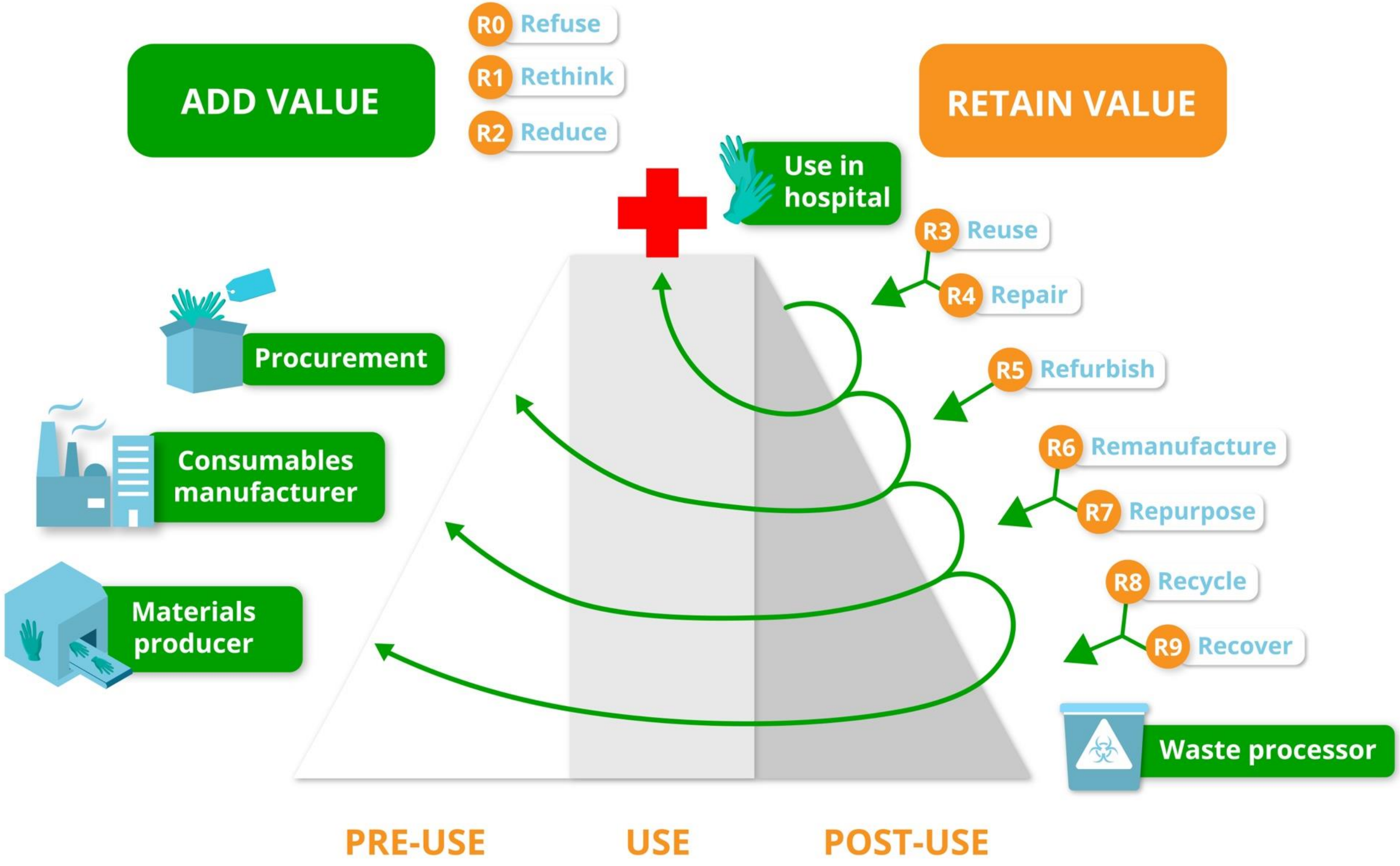
+

4500 kg

Recycle


+ Dialysaat zakken
zonder "tuutjes"
alle overige plastics
alle

"R" STRATEGIES CIRCULAR ECONOMY



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Erafung

Two cases

Which two R-Strategies do fit with your case and vision?

First ideas how to make your case suitable for those R-Strategies

- Product
- Circular system
- Business model
- Organizational change
- Behaviour cahnge

Questions