



# Circular Economy



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# Lecture Outline

- Why circular economy?
- Key concepts and definitions
- Areas of application
- Interactive discussion

# Definition of Circular Economy

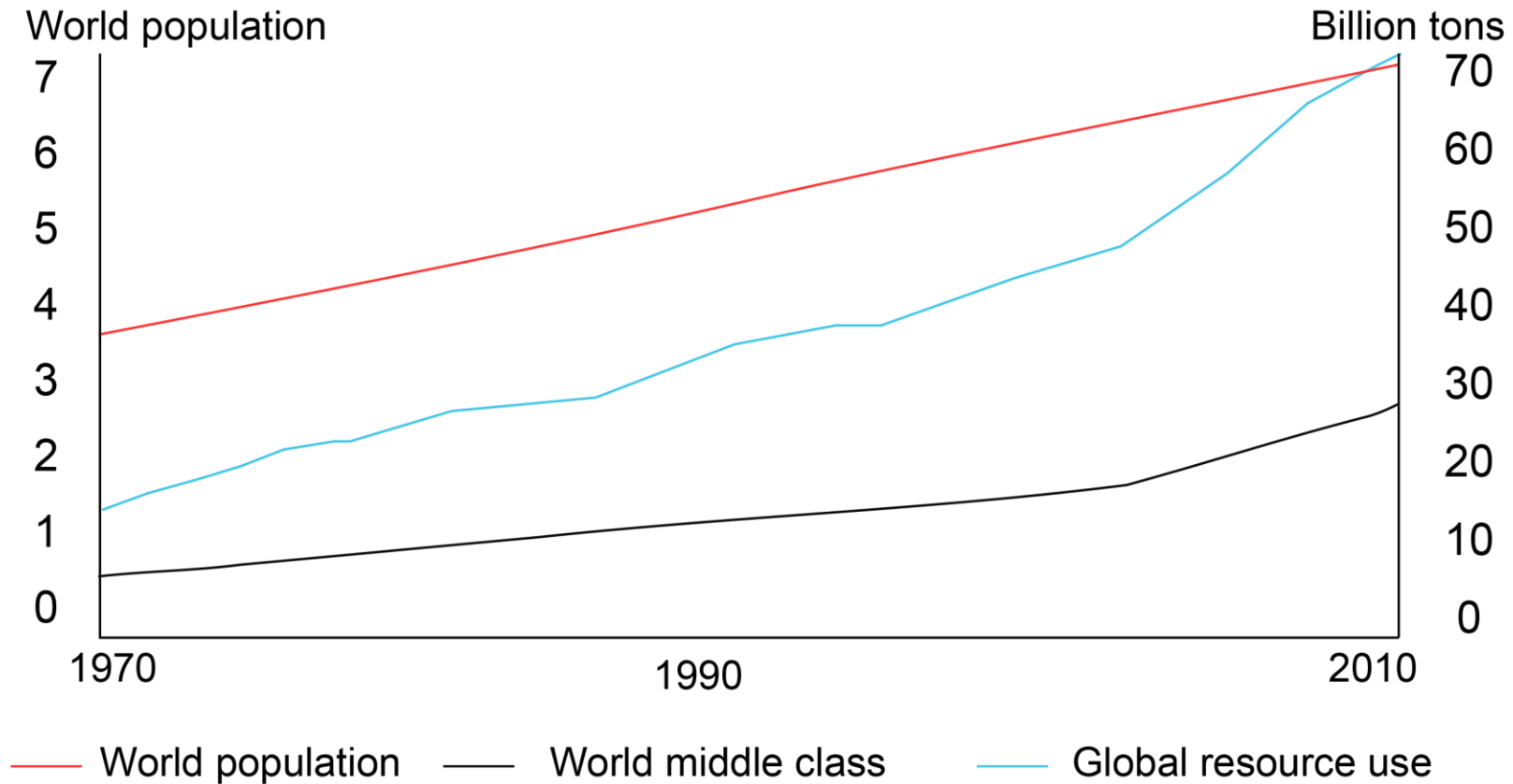
- A circular economy is an economic system where products and services are traded in closed loops or 'cycles'. A circular economy is characterized as an economy which is regenerative by design, with the aim to retain as much value as possible of products, parts and materials. This means that the aim should be to create a system that allows for the long life, optimal reuse, refurbishment, remanufacturing and recycling of products and materials.

*(Ellen MacArthur Foundation, 2016)*

# Did you know?

- We are currently consuming 1.7 Earth.
- If nothing changes, we will need 3 by 2050
- In 2018 yearly sustainable resources were consumed by 1st of August
- You need 3781 liters of water to produce a pair of Levi Strauss 501®

# World population vs. resource use



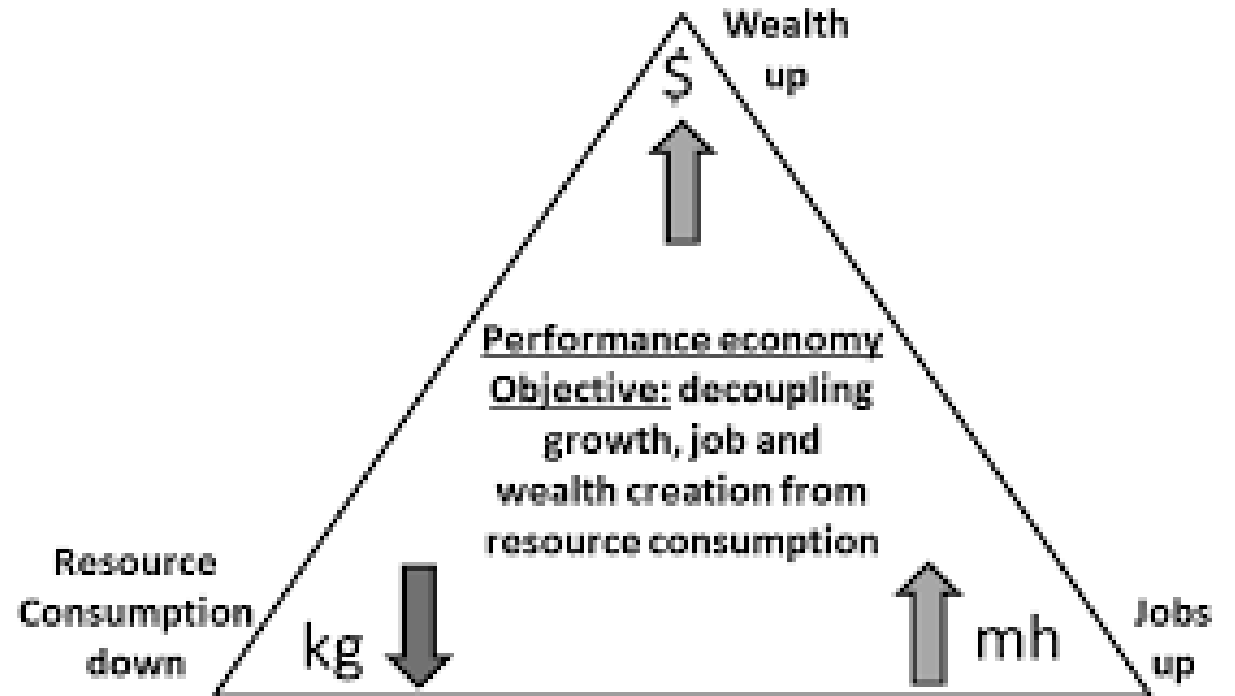


# What we leave behind?

- This consumption leave a footprint on:
  - Carbon
    - Leads to climate change
  - Water
    - Leads to shortage and drought
  - Natural resources
    - Depletion, shortage, price increase, impact on nature etc.

# What are the choices?

- Further increase in wealth cannot be achieved without changes in resource consumption.
- To create more jobs we need to be more efficient in resource consumption

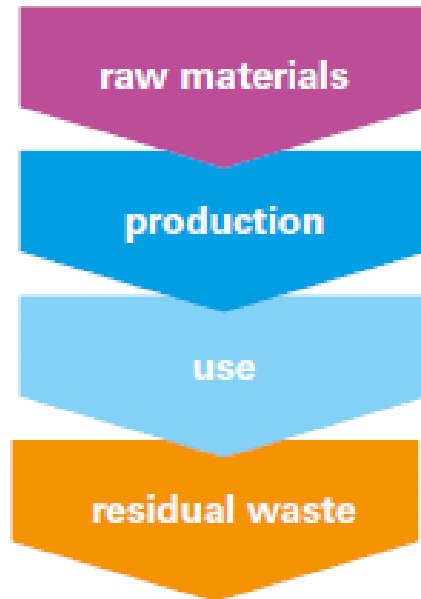


# Linear vs circular economy?

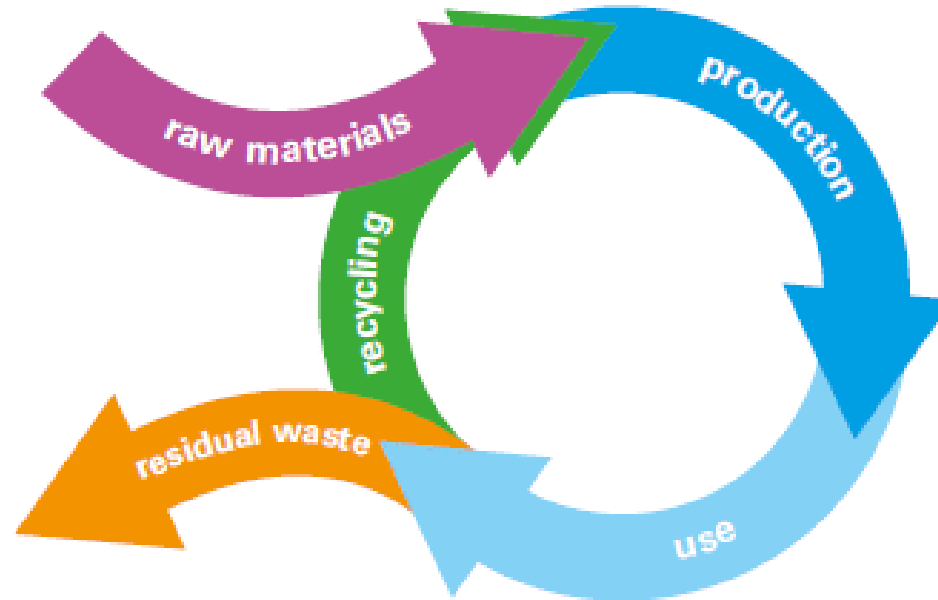
- Linear economy is based on linear process focused on high efficiency and low production cost.
- It is dependent on cheap and easily available natural resources
- Circular economy focuses on low environmental impact, minimizing waste and excessive resource use by turning goods at the end of their lifespan into new resources for others

# Linear vs circular economy

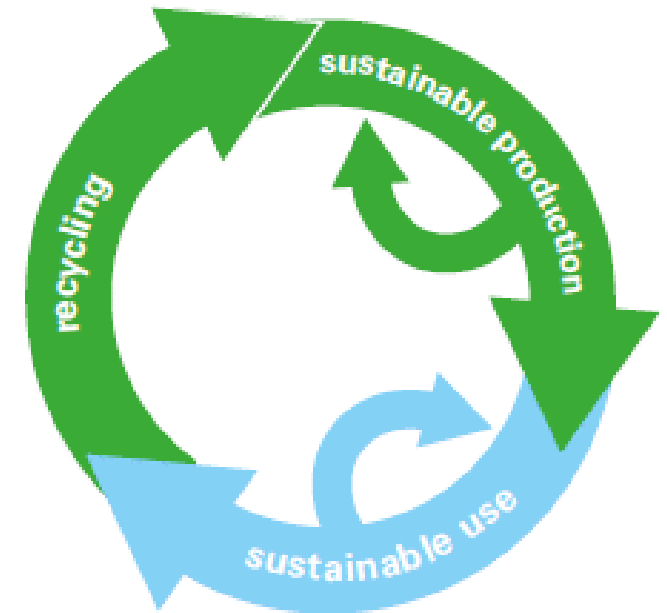
LINEAR ECONOMY



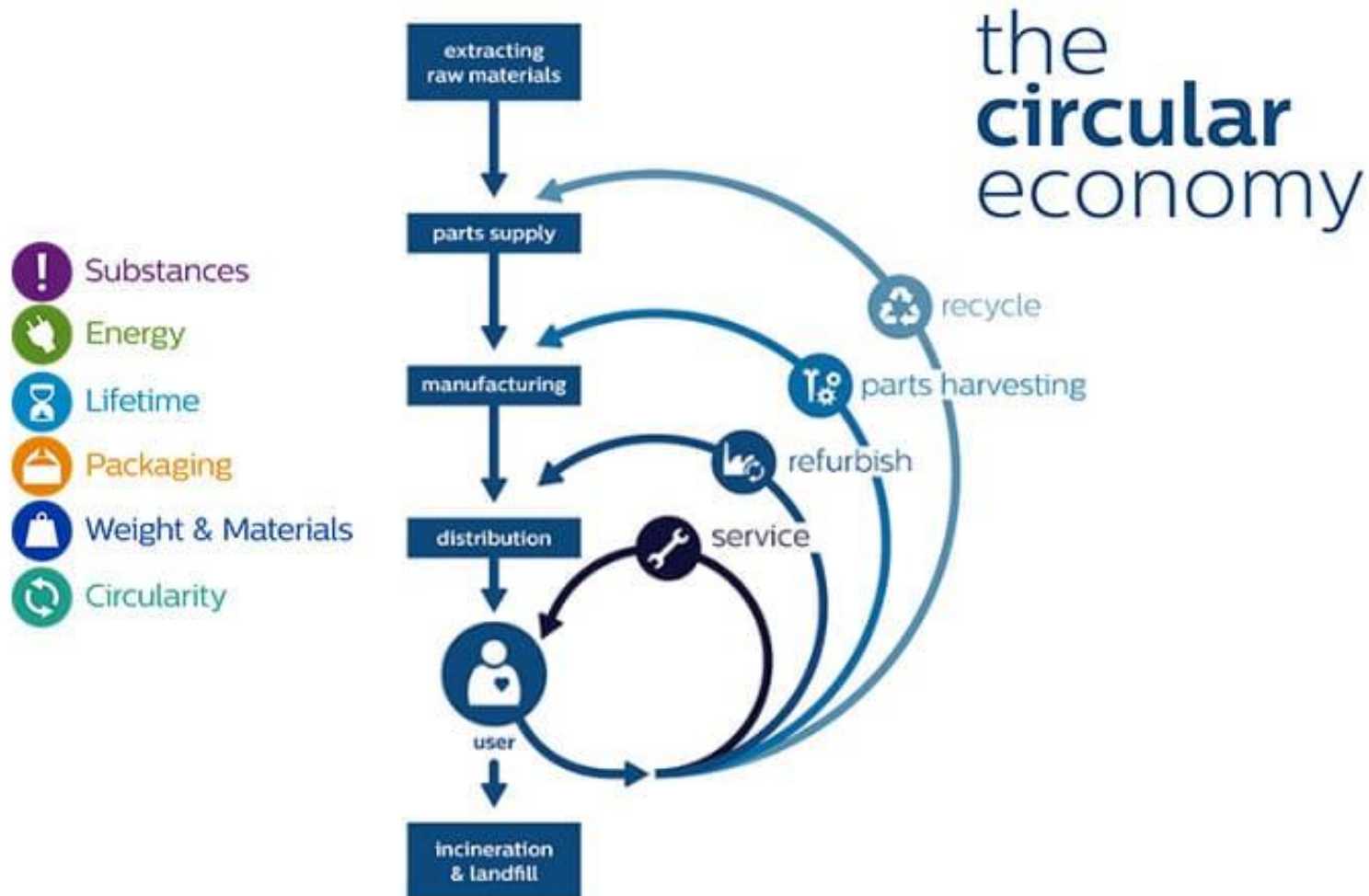
ECONOMY WITH FEEDBACK LOOPS



CIRCULAR ECONOMY



# The structure of circular economy



# Innovation and circular economy



Growth in demand should not lead to degradation of living systems, resource availability and cost.



The inspiration can be taken from the nature where waste from one specie becomes another's food and the energy is taken from the sun.

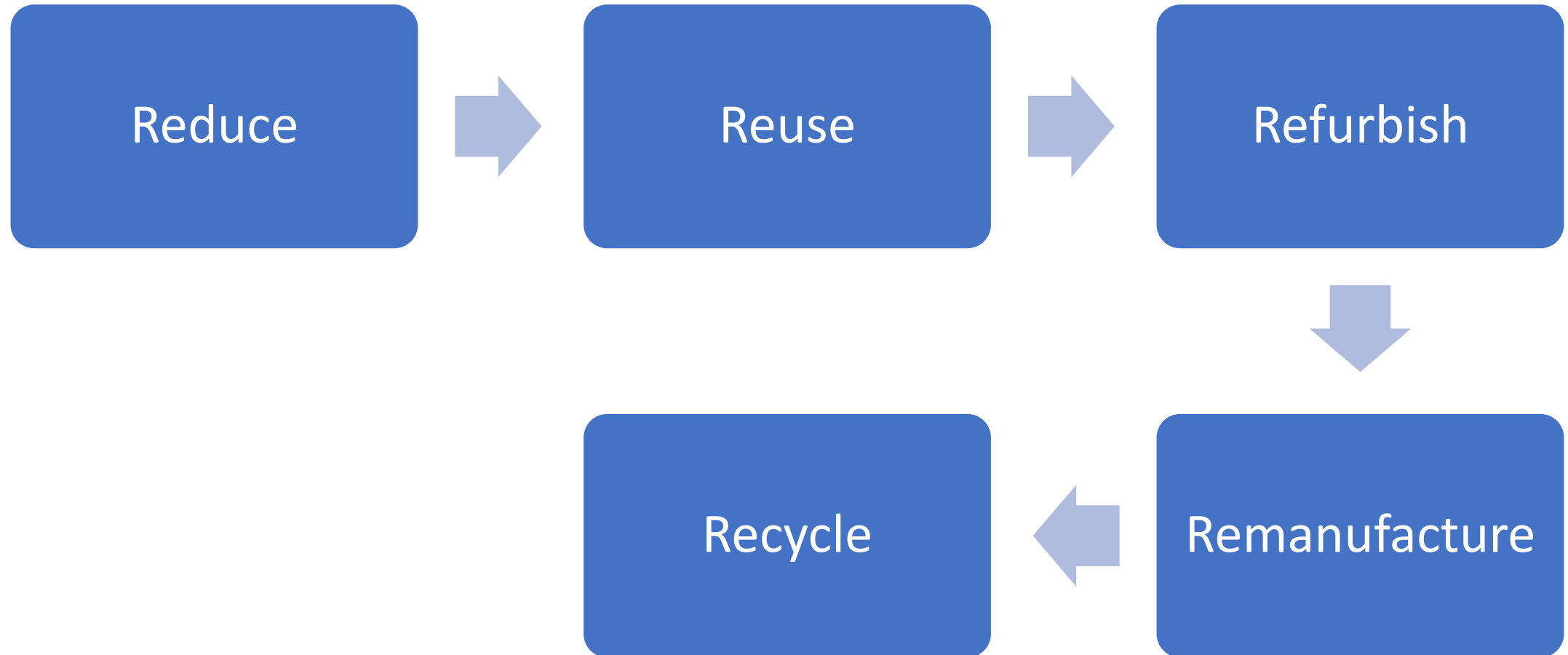


In circular economy valuable materials and products are produced cycled and transported in a sustainable way.



The circular economy need a different innovative approach to the product and system design.

# The main pillars of circular economy



# Areas of application



# Circular economy building blocks



Science and technology



Market demand and competitiveness



Finance and organization



Sustainability of operations



Governmental regulations and incentives



Human and societal development

# Strategic aspects of CE



Prices for resources are increasing and becoming more volatile



Globalization affects both economy and environment



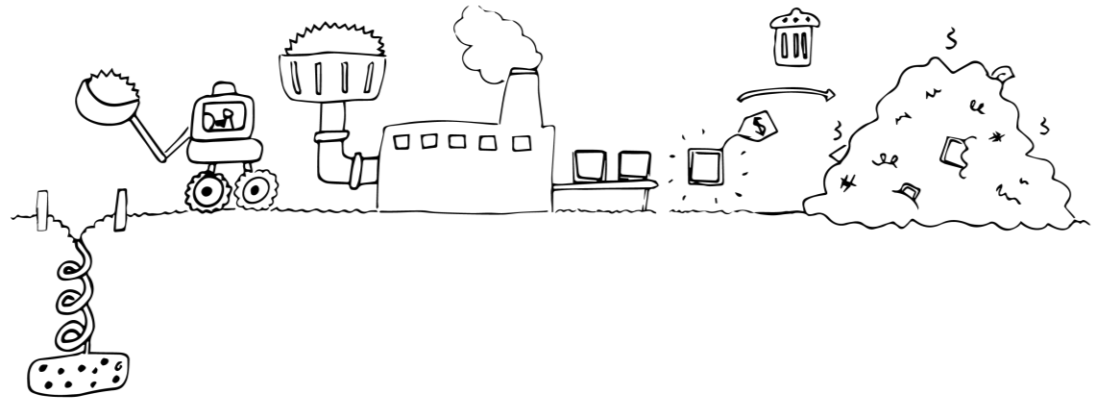
The environmental rules are becoming more strict and more governmental restrictions are expected



The consumers mindset is changing at more increasing pace

# Today's Take-Make-Dispose Economy

- New products = new raw materials
- Recycling at “end-of-pipe”
- Waste is chronically high



# A combination of risks and opportunities

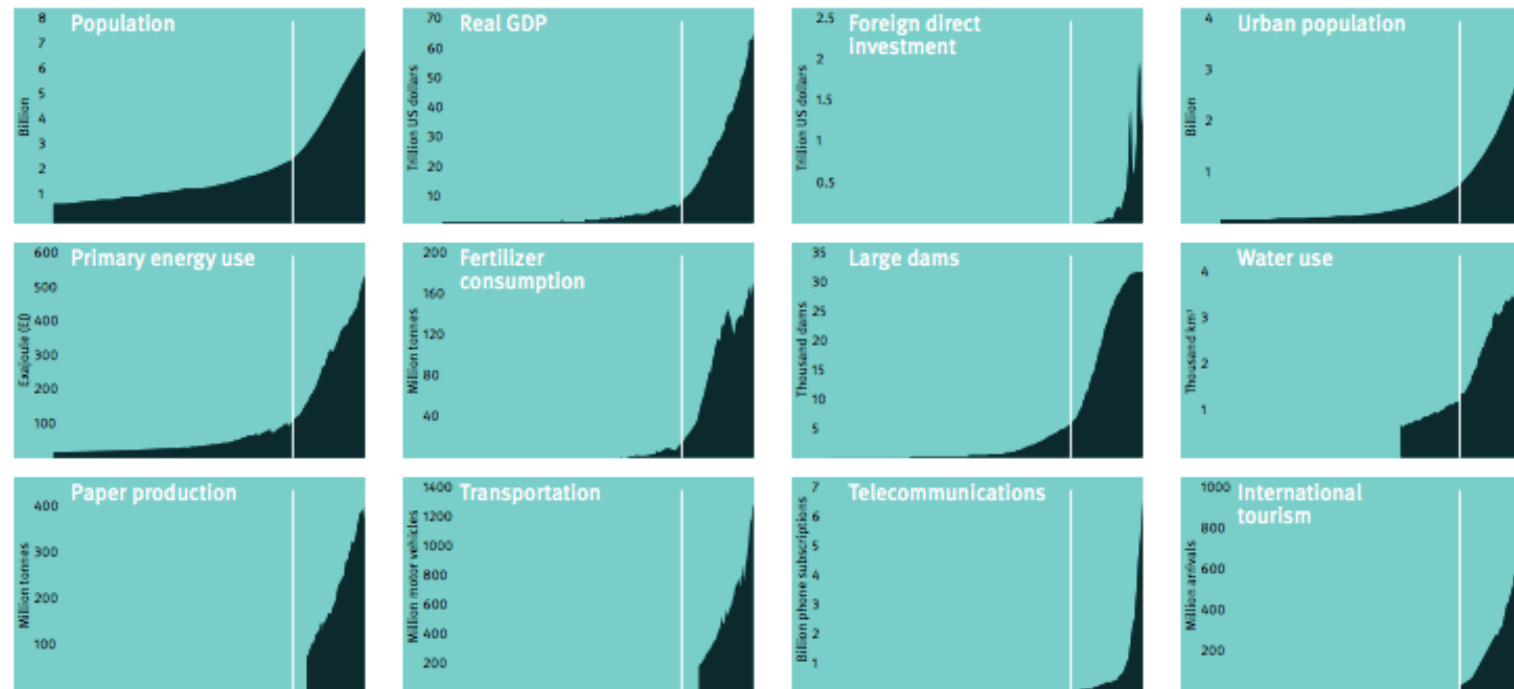
A further 3 billion middle-class consumers will enter the market by 2030 fuelling demand ...



# A combination of risks and opportunities

## Socioeconomic development

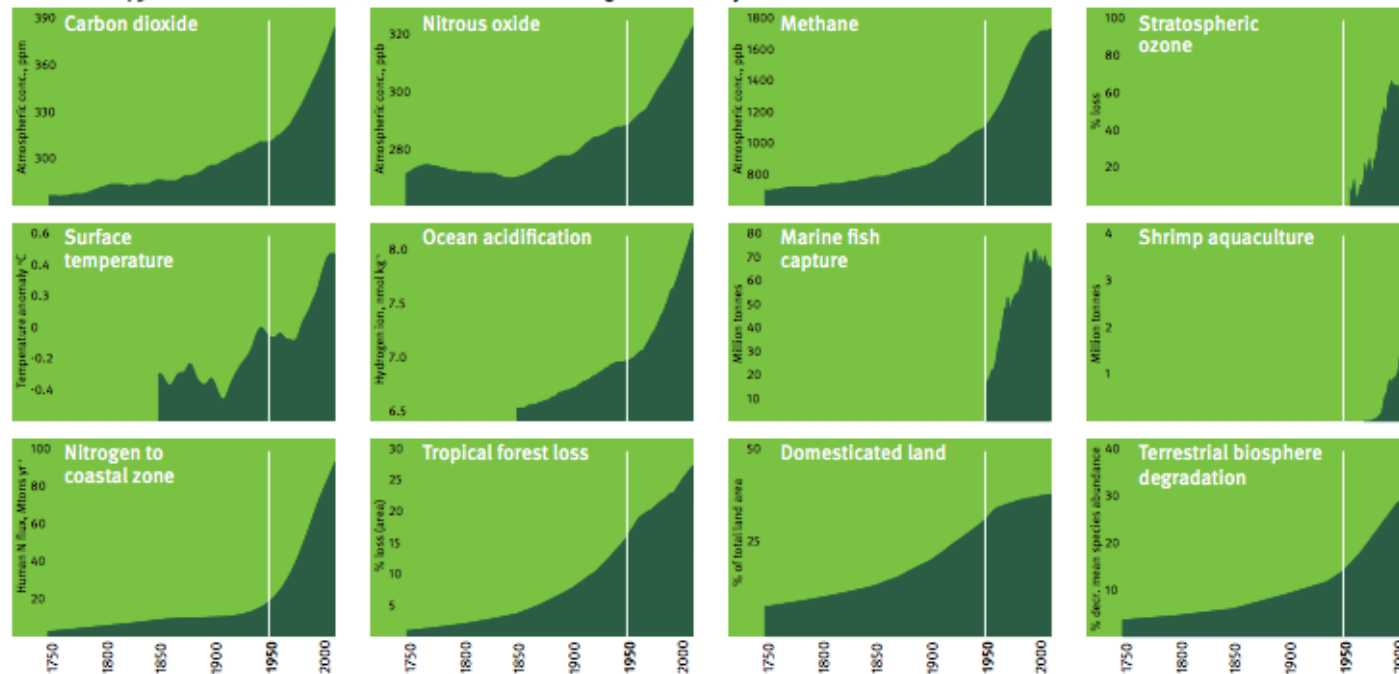
Trends from 1750 to 2010 in globally aggregated indicators for socioeconomic development



# A combination of risks and opportunities

## Living Systems

Trends from 1750 to 2010 in indicators for the structure and functioning of the Earth System



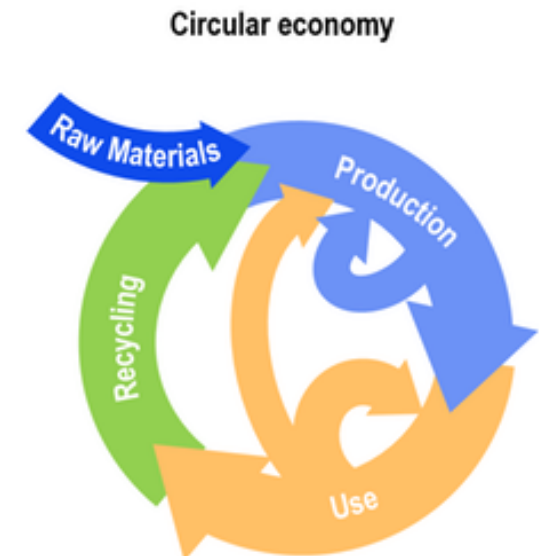
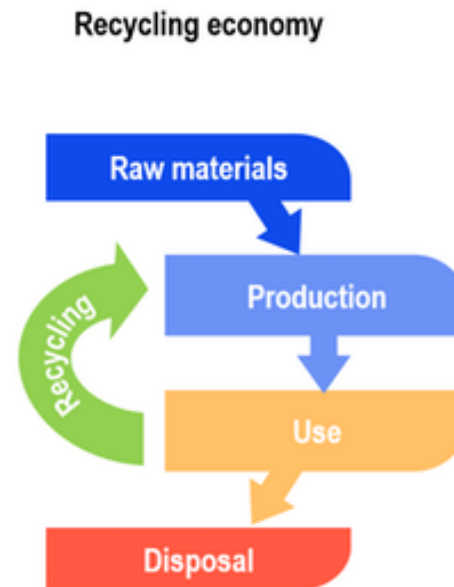
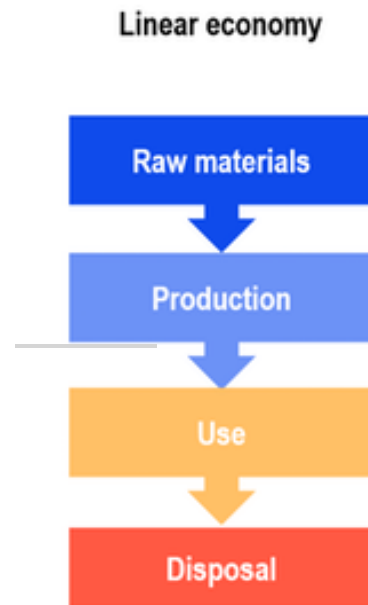
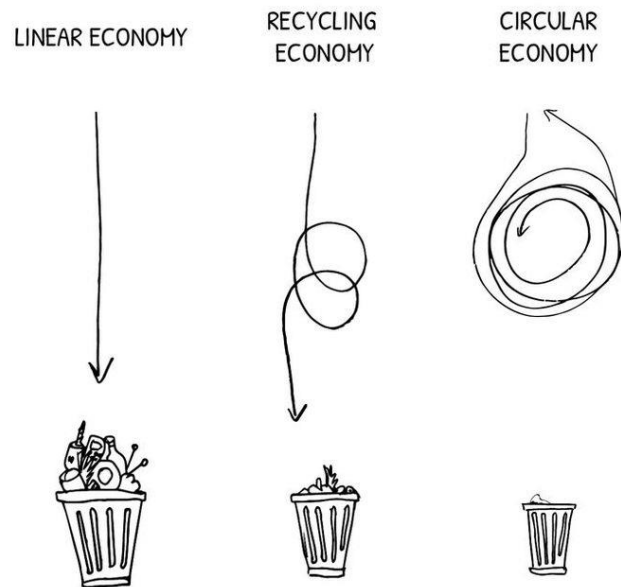
Images source: *The Anthropocene Review*, 2015

Faults in the linear model means great economic losses and negative externalities

|  MOBILITY                                                                                                                                                                                        |  BUILT ENVIRONMENT                                                                                                                                                                                                |  FOOD                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Cars remain parked <b>92%</b> of the time</li><li>• When moving, they usually carry <b>1,5</b> people at a time</li><li>• <b>30.000</b> lives are lost in accidents and, 1 out of 4 times, this results in irreversible lesions</li></ul> | <ul style="list-style-type: none"><li>• <b>30%</b> of waste sent to landfill in Europe originates from construction (in Brasil, approximately <b>50%</b>)</li><li>• Offices are occupied only <b>40-50%</b> of the day on a working day</li><li>• <b>11 million</b> empty homes in Europe</li></ul> | <ul style="list-style-type: none"><li>• <b>&gt;100Mi tonnes</b> of food lost annually in Europe</li><li>• <b>50%</b> lost along the production chain</li><li>• <b>97%</b> of global food residue is sent to landfill or <b>~USD 300 bn</b></li><li>• Soil degradation is around <b>30-80%</b> in Europe</li></ul> |

## A model with embedded structural losses

# Different economic models



**The New Plastics Economy is an ambitious, three-year initiative to build momentum towards a plastics system that works.**

Applying the principles of the circular economy, the initiative brings together key stakeholders to re-think and re-design the future of plastics, starting with packaging.

With the aim to create an effective after-use plastics economy; drastically reduce leakage of plastics into natural systems and other negative externalities and decouple plastics from fossil feedstocks, the New Plastics Economy works with five interconnected blocks to create the necessary conditions for redesigning the system:

1

## DIALOGUE MECHANISM

Cross-value chain collaboration is at the heart of the New Plastics Economy.

2

## GLOBAL PLASTICS PROTOCOL

A common target state to innovate towards, to overcome existing fragmentation and enable the creation of effective markets.

3

## INNOVATION MOONSHOTS

Mobilising innovations that can scale across the system, to re-define what's possible and create the conditions for a new economy.

4

## EVIDENCE BASE

A robust evidence base to guide improvement and inform the global debate.

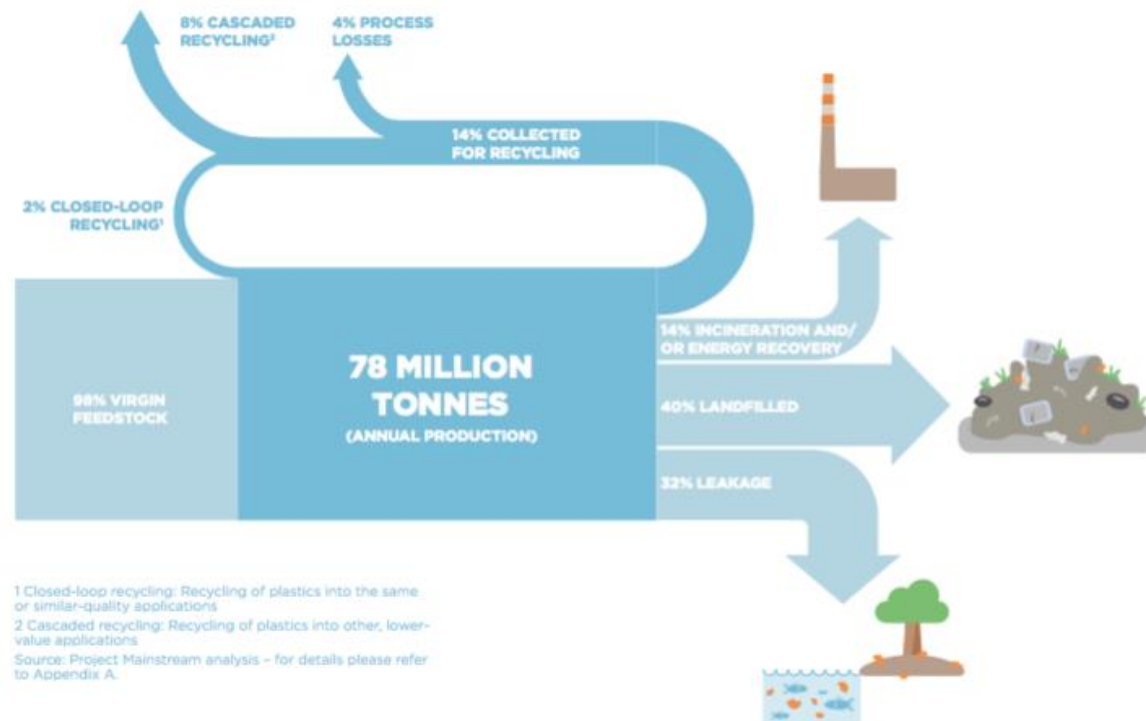
5

## OUTREACH

Engaging stakeholders to learn, to inform, and to amplify what works.

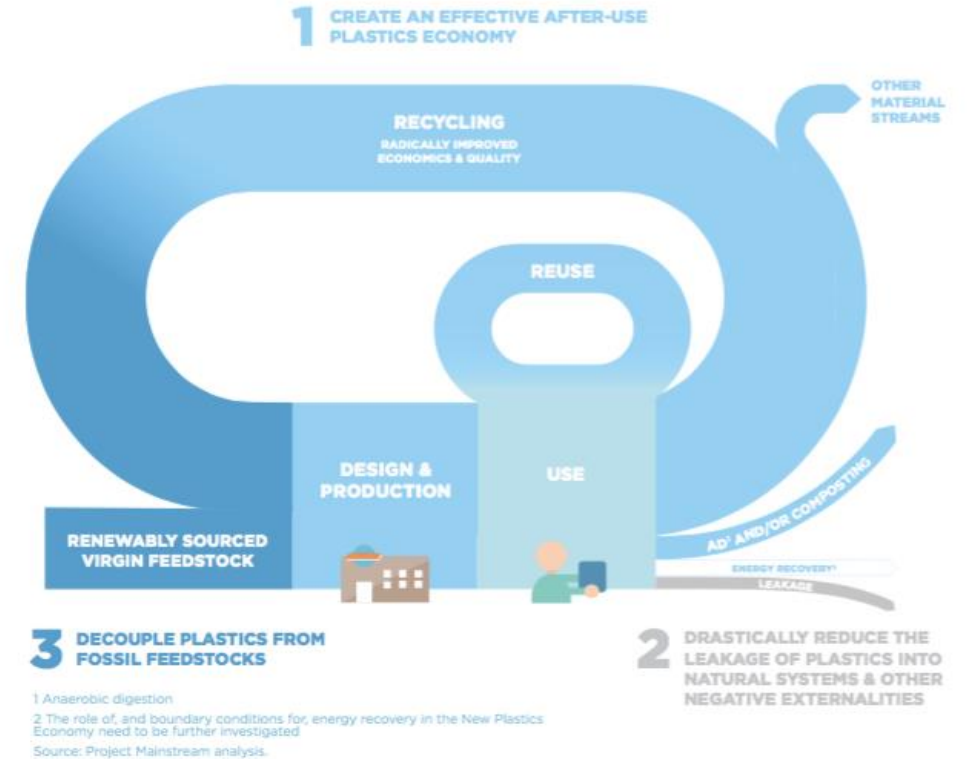
# The new plastics economy

FIGURE 4: GLOBAL FLOWS OF PLASTIC PACKAGING MATERIALS IN 2013



# The new plastics economy

FIGURE 6: AMBITIONS OF THE NEW PLASTICS ECONOMY



# Drivers for change

Various factors challenge the linear model



**URBANISATION**



**ACCEPTANCE OF  
NEW BUSINESS  
MODELS**



**TECHNOLOGICAL  
ADVANCES**



**ECONOMIC AND  
STRUCTURAL  
LOSSES**



**PRICE  
VOLATILITY**



**DEMOGRAPHIC  
TRENDS**

# The circular solution

An aerial, circular fisheye view of a city, likely Dubai, showing a dense urban landscape with numerous skyscrapers and buildings. The city is arranged in a circular pattern, with a prominent green, tree-filled area in the center. The city is surrounded by the blue ocean, and the Earth's horizon is visible at the very edge of the circular frame.

Introduction to circular economy 4 mins

# — Making Sense of the Circular Economy —

## The 7 Key Elements



[Examples of the key elements](#)

# A regenerative economy by design

1

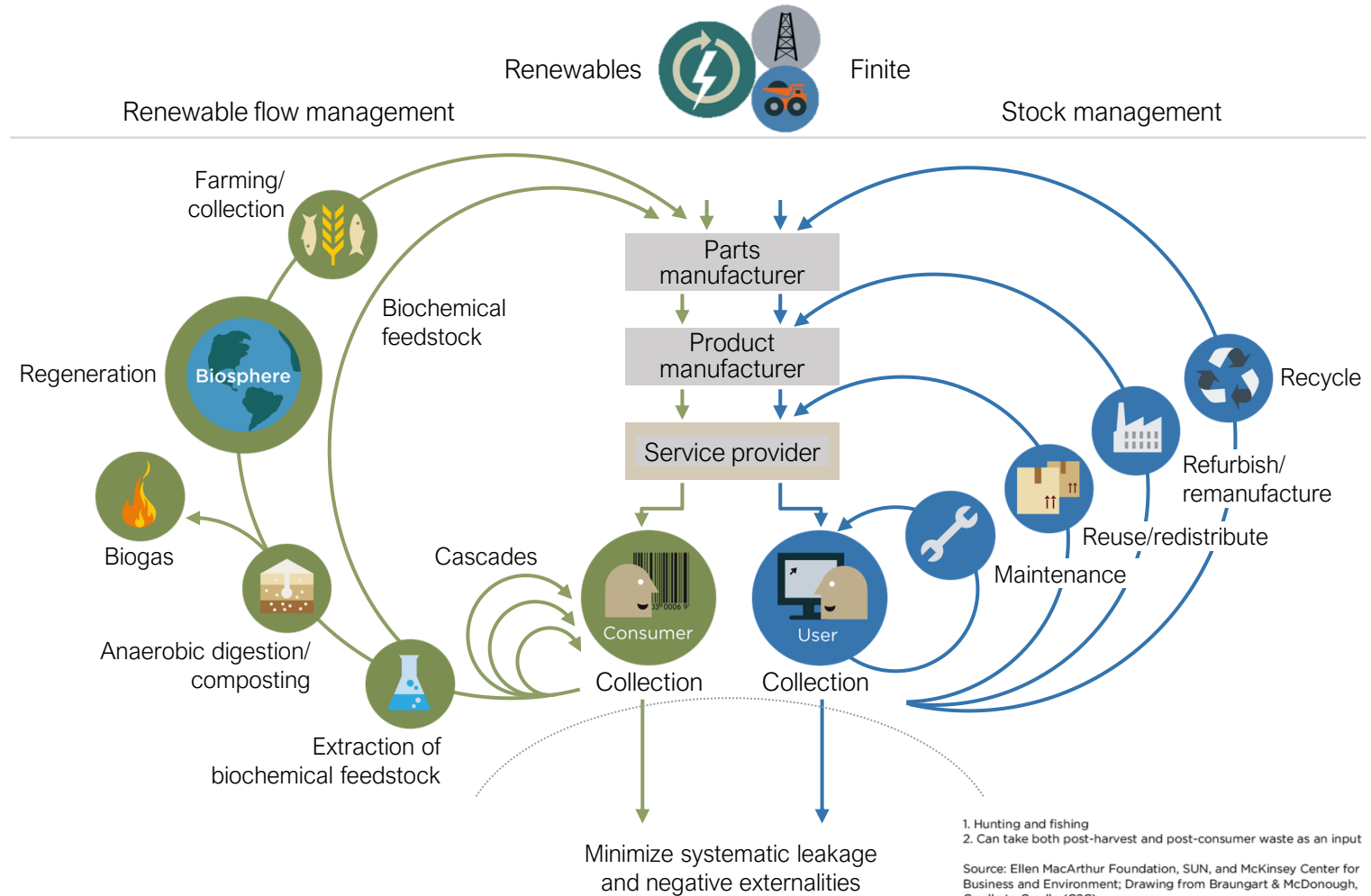
Serve and enhance natural capital by controlling finite stocks and balancing renewable resource flows

2

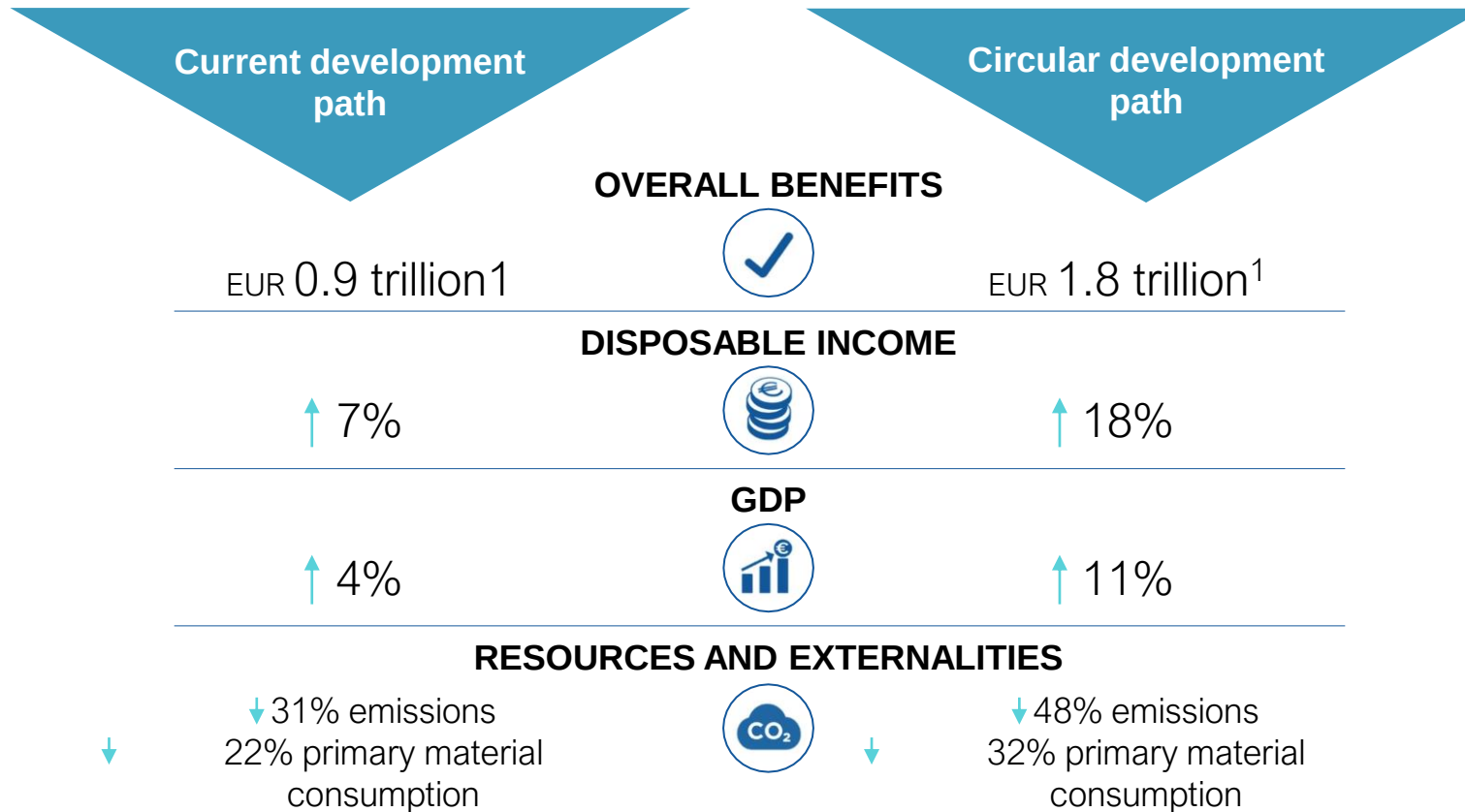
Optimise resource yields by circulating products and materials at the highest utility at all times in both the technical and biological cycles.

3

Foster system effectiveness by revealing and designing out negative externalities.



# The Compelling Business Rationale



€1.8 tri in benefits for Europe by 2030 in mobility, food and the built environment in a circular economy development path

<sup>1</sup> Reduction in resource, non-resource and externality cost

SOURCE: "Growth Within: A Circular Economy Vision for a Competitive Europe", Ellen MacArthur Foundation, SUN (Stiftungsfonds für Umweltökonomie und Nachhaltigkeit) and McKinsey Center for Business and Environment, 2015

# The Compelling Business Rationale

Net material savings in billions of USD per year<sup>1</sup>

## Durable Goods

**\$ 630**

- \$145 Motor Vehicles
- \$ 98 Equip. and Machinery
- \$ 67 Electric Machinery
- \$ 39 Other Transport
- \$ 29 Furniture
- \$ 82 Others



## Fast Moving Consumer Goods

**\$ 706**

- \$194 Packaged Food
- \$ 111 Clothing
- \$ 87 Drinks
- \$ 70 Fresh Food
- \$ 45 Others

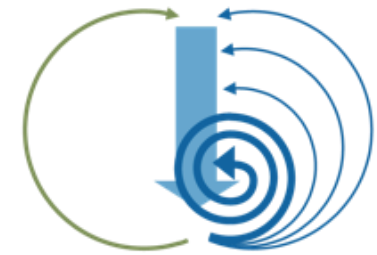


# Value in Loops

The power of the inner circle



The power of circling longer



The power of cascading



The power of pure inputs



# Building Blocks of a Circular Economy

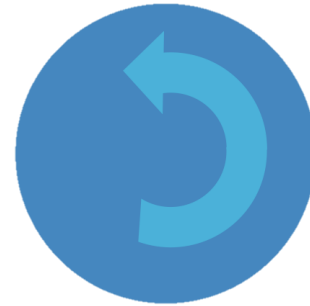
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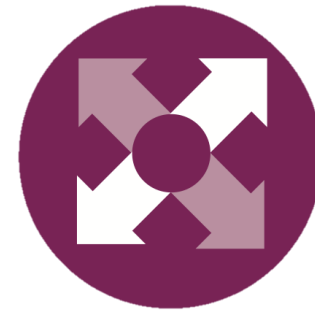
**Circular  
Economy  
Design**



**New Business  
Models**

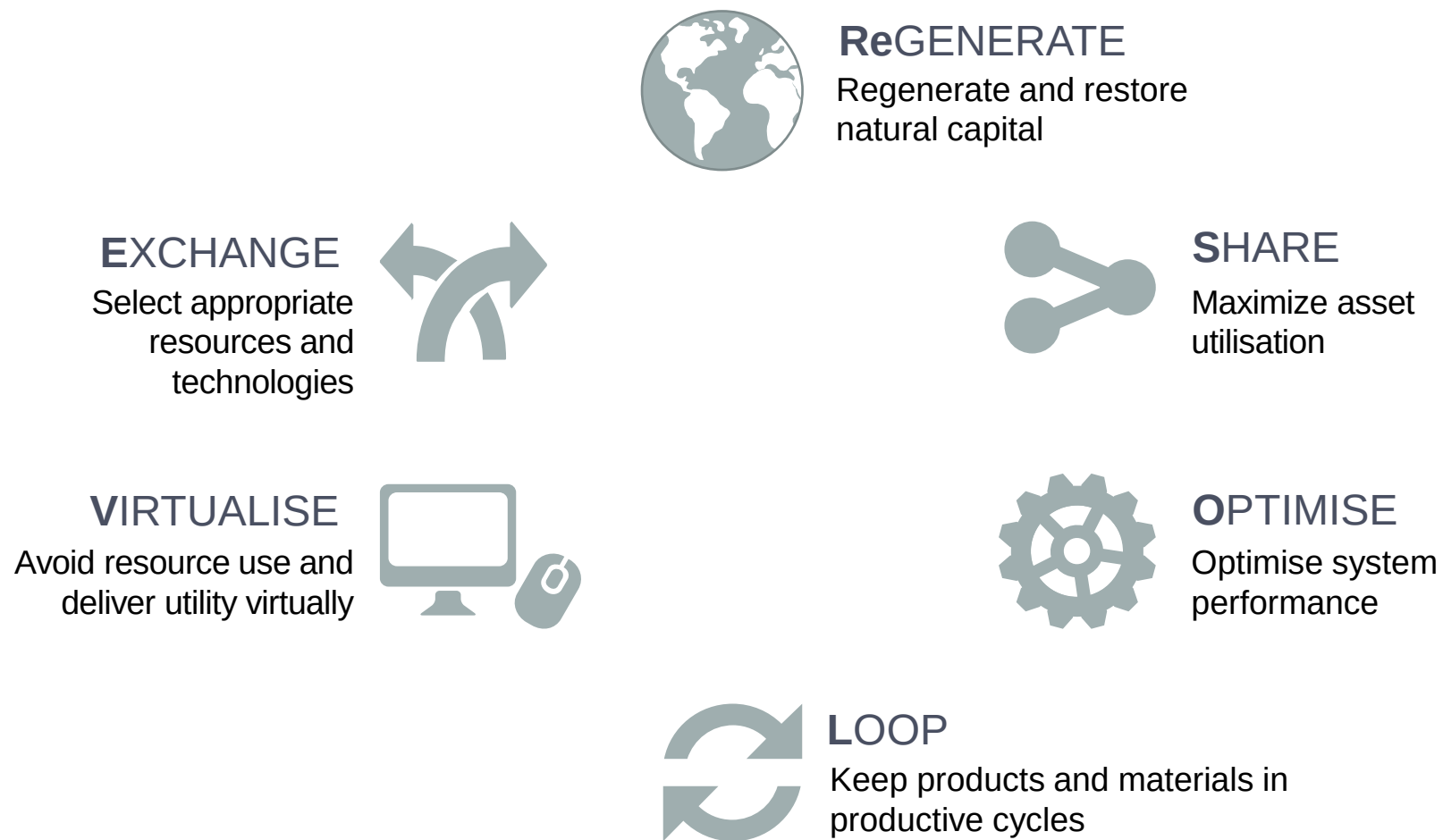


**Reverse Cycles**



**Enabling System  
Conditions**

# The ReSOLVE Framework



# The ReSOLVE Framework

## THE RESOLVE FRAMEWORK

### Examples

|                                                                                                      |                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>REGENERATE</b>   | <ul style="list-style-type: none"> <li>• Shift to renewable energy and materials</li> <li>• Reclaim, retain, and restore health of ecosystems</li> <li>• Return recovered biological resources to the biosphere</li> </ul>   |   <br>                                                                                                                                                                                                                                                              |
| <b>SHARE</b>        | <ul style="list-style-type: none"> <li>• Share assets (e.g. cars, rooms, appliances)</li> <li>• Reuse/secondhand</li> <li>• Prolong life through maintenance, design for durability, upgradability, etc.</li> </ul>          |   <br>                                                                                                                                                                                                                                                              |
| <b>OPTIMISE</b>     | <ul style="list-style-type: none"> <li>• Increase performance/efficiency of product</li> <li>• Remove waste in production and supply chain</li> <li>• Leverage big data, automation, remote sensing and steering</li> </ul>  |                                                                                                                                                                                                                                                                     |
| <b>LOOP</b>         | <ul style="list-style-type: none"> <li>• Remanufacture products or components</li> <li>• Recycle materials</li> <li>• Digest anaerobic</li> <li>• Extract biochemicals from organic waste</li> </ul>                         |    <br>    |
| <b>VIRTUALISE</b>  | <ul style="list-style-type: none"> <li>• Dematerialise directly, e.g., books, CDs, DVDs, travel</li> <li>• Dematerialise indirectly, e.g., online shopping, autonomous vehicles</li> </ul>                                   |    <br>                                                                             |
| <b>EXPLORE</b>    | <ul style="list-style-type: none"> <li>• Replace old with advanced non-renewable materials</li> <li>• Apply new technologies (e.g. 3D printing)</li> <li>• Choose new product/service (e.g. multimodal transport)</li> </ul> |    <br>                                                                                                                                                                                                                                                   |

**Reduce  
Environmental  
Footprint**

**Cleaner  
Production  
w/Less  
Resource Use**

**Green  
Products  
w/out Toxics,  
Long-life,  
Recyclable**

**Generate  
Increased  
Wealth**

# **Circular Economy**

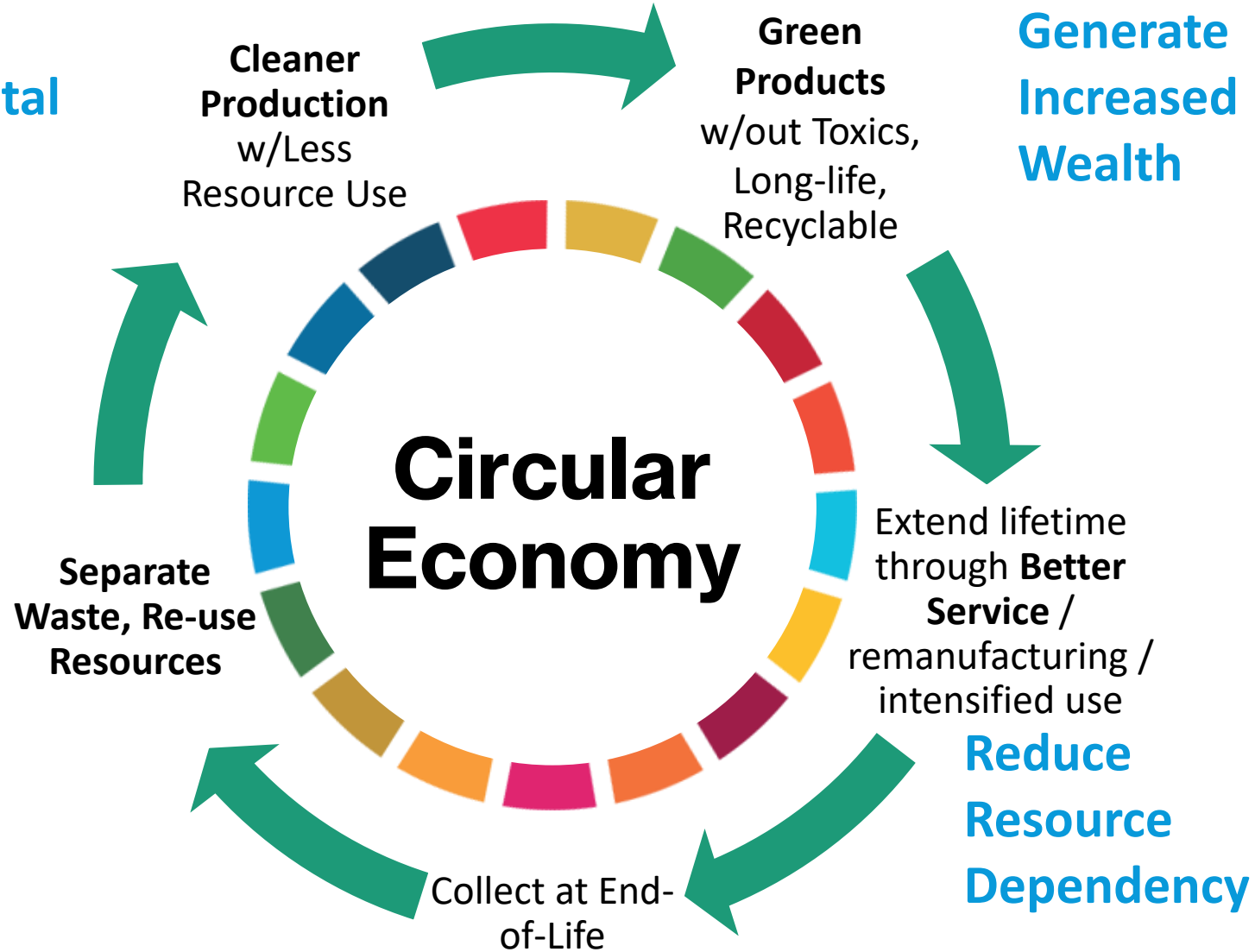
**Extend lifetime  
through Better  
Service /  
remanufacturing /  
intensified use**

**Reduce  
Resource  
Dependency**

**Collect at End-  
of-Life**

**Separate  
Waste, Re-use  
Resources**

**Minimise  
Waste**



# Assumptions .... Challenged

- Environmental pollution can be solved end-of-pipe
  - We believe this is neither fully effective nor very efficient. Circular Economy prevents pollution
- Circular Economy is about waste treatment
  - Recycling is today's starting point. Potential for industrial development clearly demonstrated
  - Innovations for better use of resources during useful product lifetime will be increasingly important
  - There will be much waste reduction from better use, probably more than from recycling
- Increasing demand for products has only a moderate impact on global resource costs
  - Several resources are bound to get scarce and costly. Rapid change likely once tipping point reached
- If major consuming economies change their internal business model, it has only limited repercussions on developing countries
  - Delivery into a circular economy market changes requirements, value, volume
  - Secondary raw materials are an (emerging) circular economy market
  - Given current market sizes, developing countries will mostly procure products designed for circular economy. Why not use their benefits?
  - Developing countries are inherently better in resource efficiency. Leapfrog!