



Master Class

Circular Supply Chain Management

MRDH LLO project 'Let's change the face of food waste'
Gerwin Zomer, Lorna James

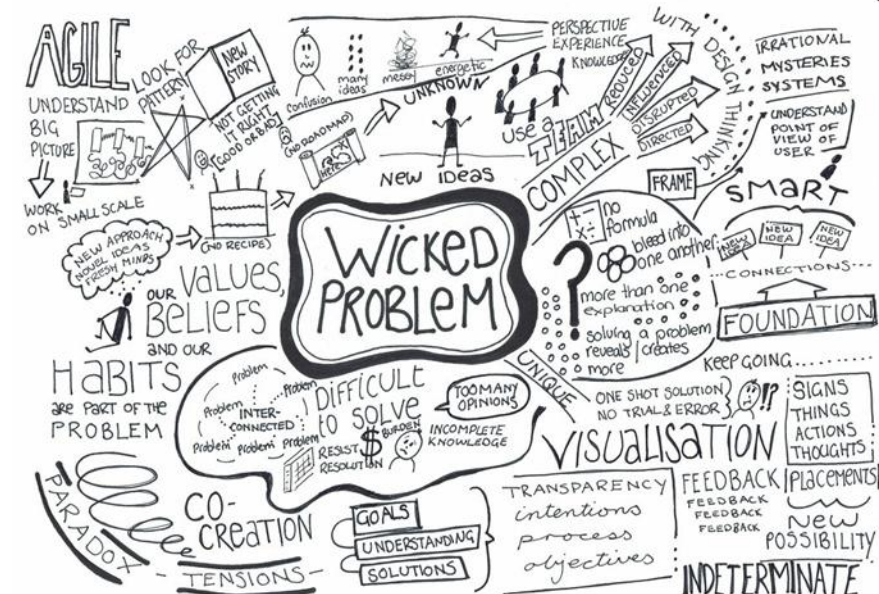
Who is Gerwin?

- BISCI Ecosystem Director Logistics & Agrifood (since May 2022)
- 49 Years, married, 2 kids: Wilco (13) en Carlijn (9), Bodegraven
- MSc Industrial Engineering & Management (UTwente)
- Professional Career
 - INFOR (Enterprise software)
 - ECORYS Consulting (Transport & Logistics)
 - TNO (Applied Science, Digital transformation and data driven logistics)
 - BISCI (Logistics and Agrifood Innovation)
- Multiple Advisory Boards
- Smart Agrifood Logistics
 - IoT4AGRI
 - Digital Transformation Strategy Greenport West-Holland
 - Topcorridors Fresh Corridor Digitization
 - RFH: Global flower trade optimization (CASSANDRA, CORE, PLATO)
- Passion: Create impact by connecting people, knowledge and technology
- Hobbies: Singing (pop choir), swimming, gardening



What is BISC?

- BISC: Brightlands Institute for Supply Chain Innovations (2019)
 - Develop and apply knowledge of supply chain management, digital technologies and collaboration to make supply chains sustainable, agile, resilient, circular and efficient.
 - Collaboration of Maastricht University, Fontys University of Applied Sciences, and TNO
 - UM MSc Global Supply Chain Management and Change (Venlo)
 - UM MSc Int'l Business & Supply Chain Management (Maastricht)
 - Fontys MSc International Logistics and SCM (Venlo)
 - Fontys MSc International Procurement and SCM (Venlo)
 - TNO: Unit Traffic and Transport, BU Sustainable Transport and Logistics (Den Haag)
- BISC Ecosystems
 - Business Ecosystem 'Logistics' & 'Agrifood'
 - Business Ecosystem 'Chemical SCM'
 - Business Ecosystem 'Healthcare SCM'
 - Horizontals: 'Sustainability & GHG', 'Circularity' & 'Digital Transformation'
- Ecosystem Innovation
 - Wicked Problems - Mission Driven Innovation
 - SDG goals: climate change, poverty, education
 - Multi-helix collaboration: business, knowledge, government, society
 - Open innovation: Learning communities, Fieldlabs / living Labs
 - Collaboration and sharing insights



Agenda

1. Introduction – Wake up call
2. Intro in Circular Economy
3. Circular SCM – part 1
4. Break and break-out assignment
5. Circular SCM - part 2
6. Some BISCI examples
7. Wrap up & main take away



Brightlands - BISCI

Nature is speaking



<https://www.youtube.com/watch?v=WmVLcj-XKnM>

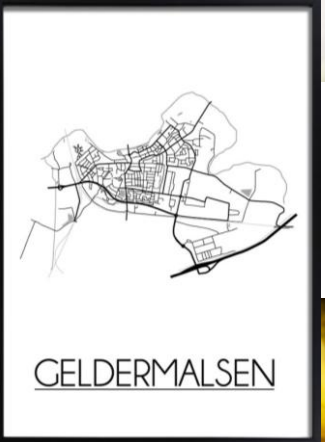
SUNT Banana Factory – All about supply chain management



COROOS



STOP FOOD WASTE 
26 April 2023 *Day*



GELDERMALSEN



**IMPORT
TARIFFS**

120.000 ton



Brightlands - BSCI

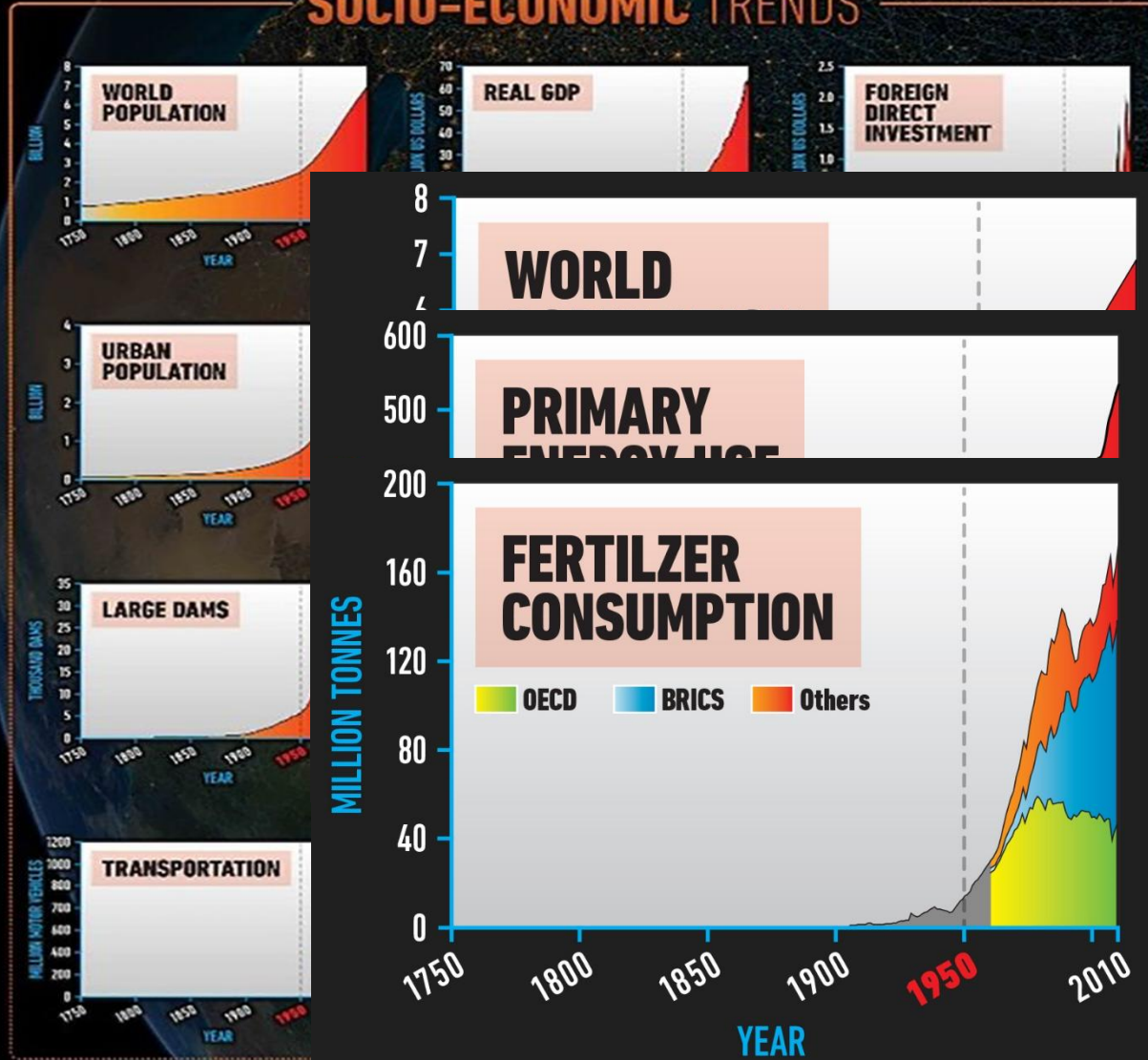
1 – Introduction – Wake up call

“Waste and residues are great raw materials for sustainable biofuels like renewable diesel. They can thus help decrease fossil fuel dependency and reduce emissions.”

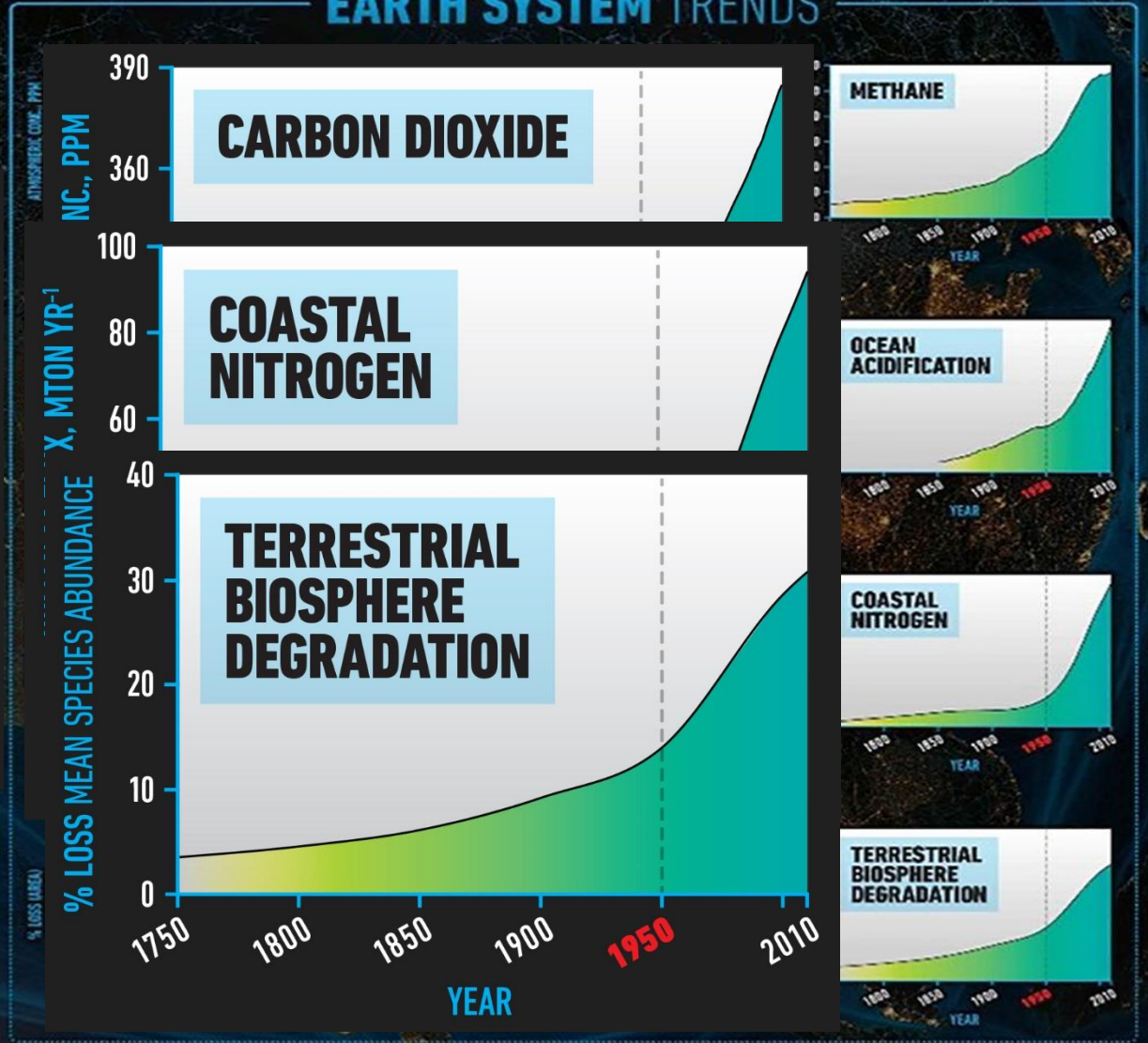
Interview with Mikael Ohlstrom (Neste) on the latest IPCC 2022 report on Climate Change, April 2022

THE GREAT ACCELERATION

SOCIO-ECONOMIC TRENDS



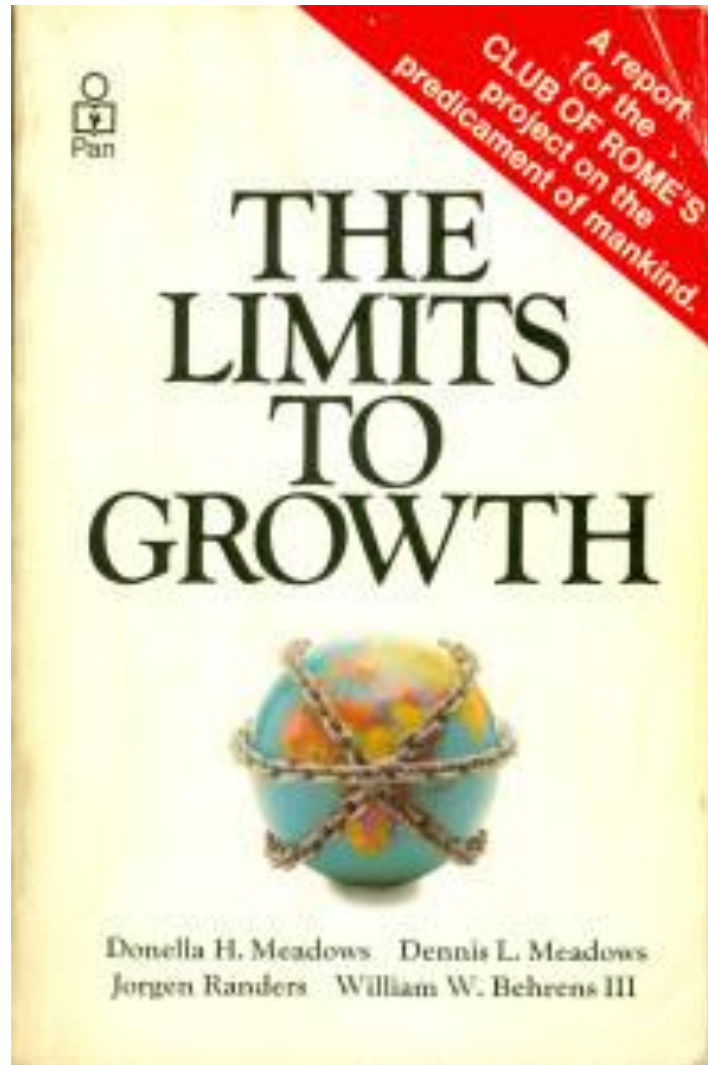
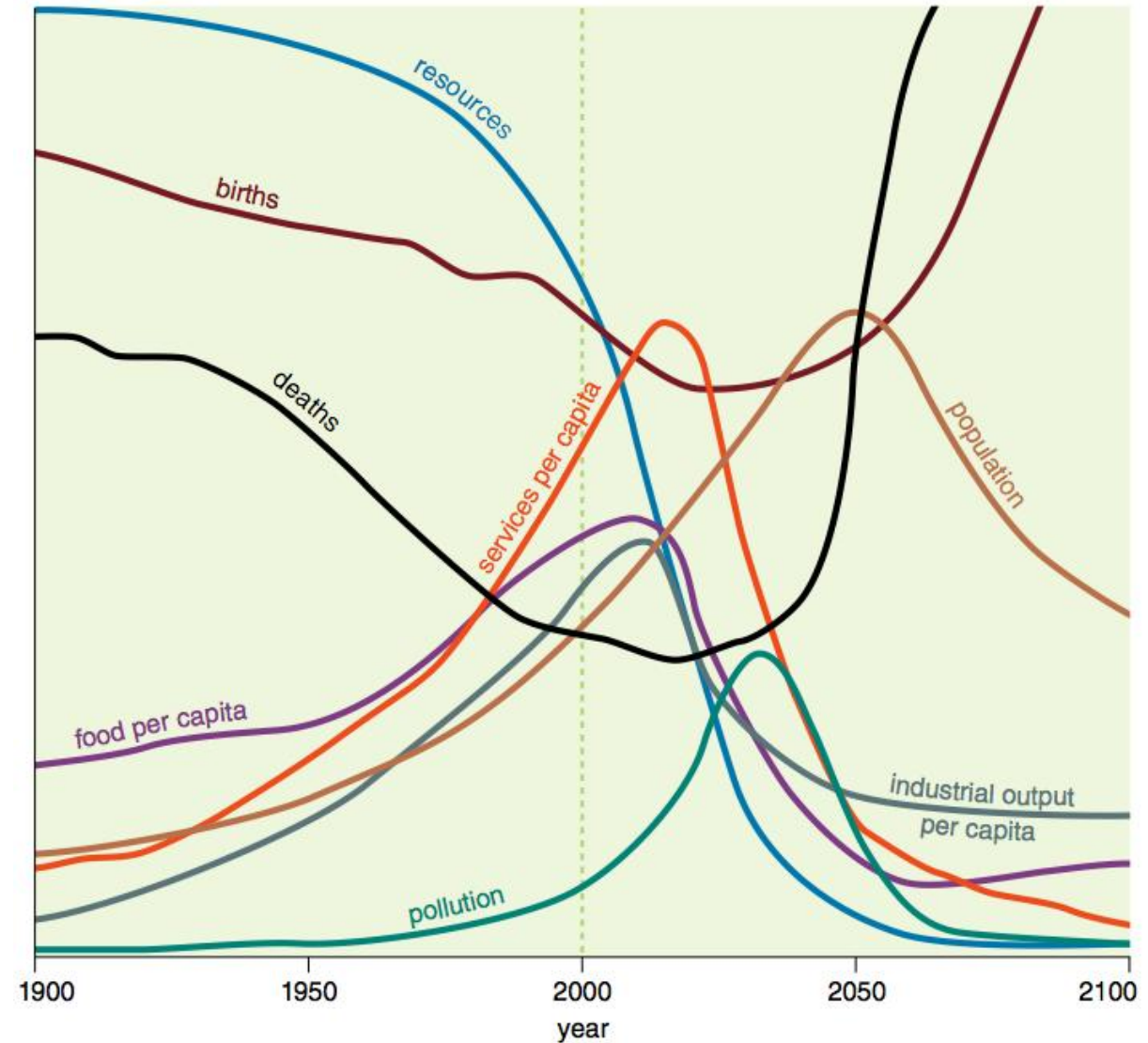
EARTH SYSTEM TRENDS



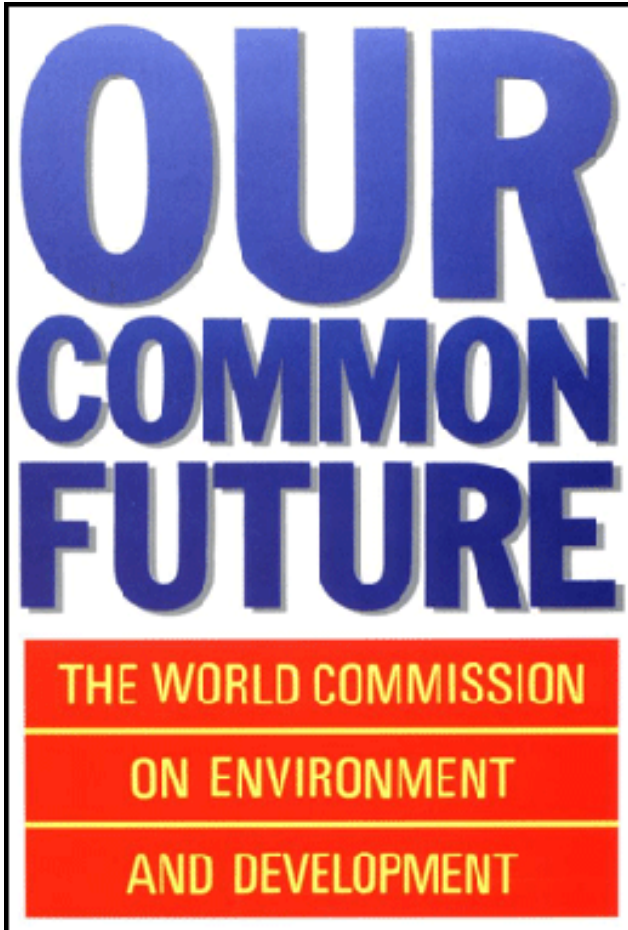
REFERENCE: Steffen, W., W. Broadgate, L. Deutsch, O. Gaffney and C. Ludwig, The Trajectory of the Anthropocene: the Great Acceleration, *The Anthropocene Review*, 16 January 2015.

MAP & DESIGN: Félix Pharand-Deschênes / Globaia

Club of Rome - Limits to growth (1972)



Brundtland Report: Sustainable Development (1987)



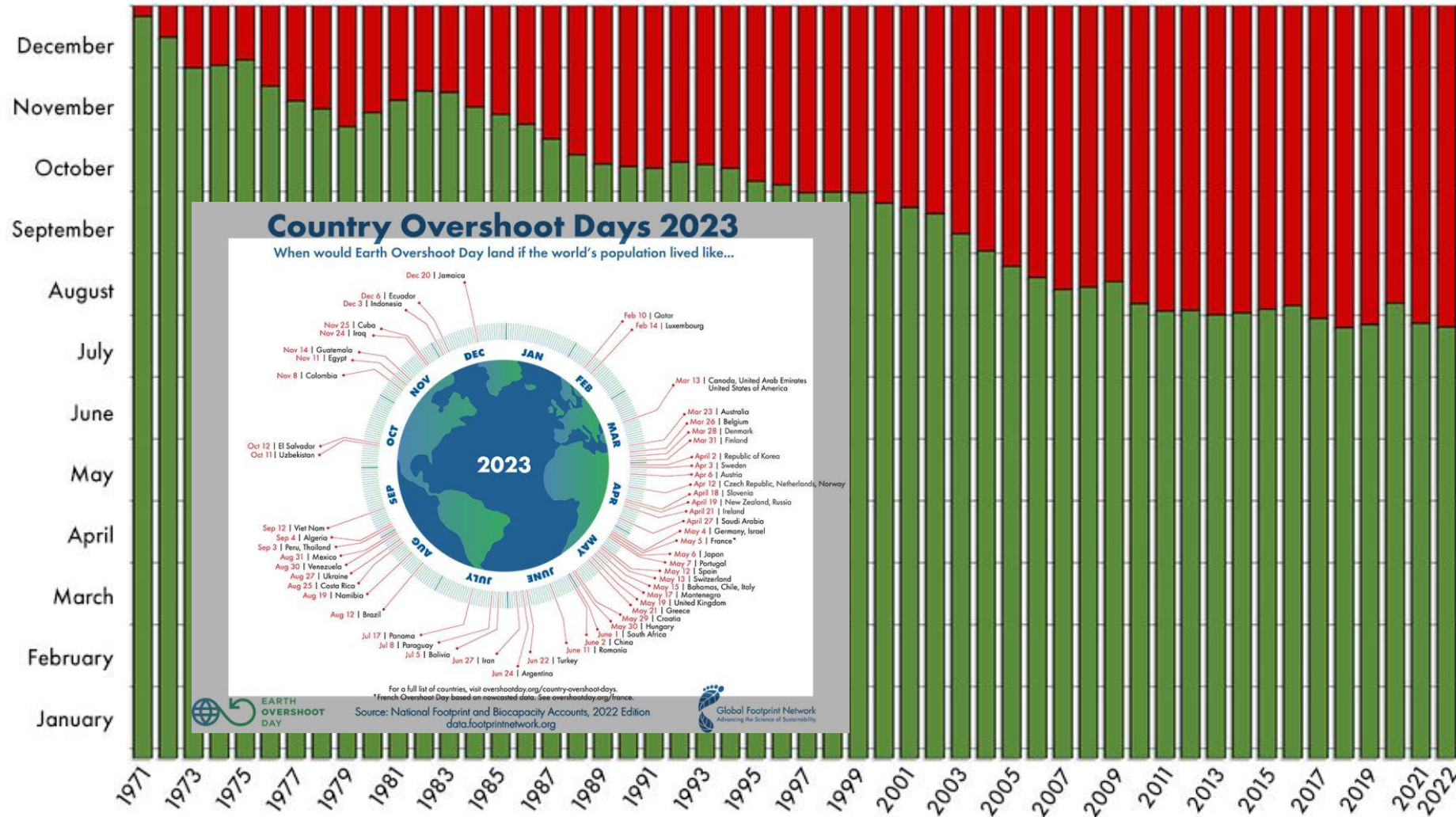
“ Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. ”

Earth Overshoot Day 1971 – 2022: July 28th !!!

We use 75% more resources in a given year than our Planet can regenerate.

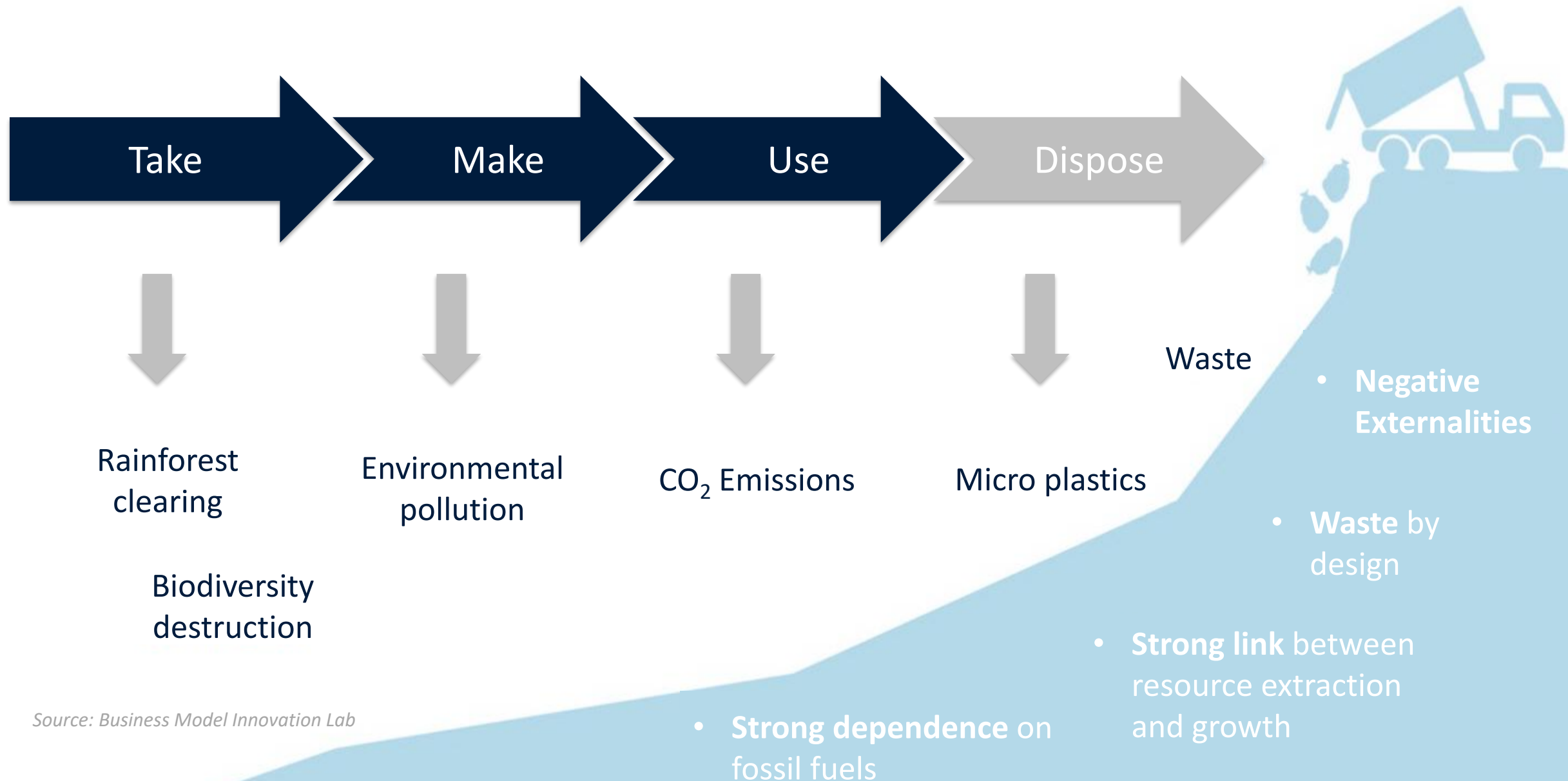


1 Earth



1.75 Earths

The linear economy and negative externalities



Summary section 1 – Wake up call

- **Our linear economic system lacks to valorise externalities and future damages**
- **As a consequence, we exploit our planet in a pace it cannot regenerate**
- **External impacts become unsustainable (climate change, environmental pollution, biodiversity, ...)**
- **Fundamental change is urgently needed**

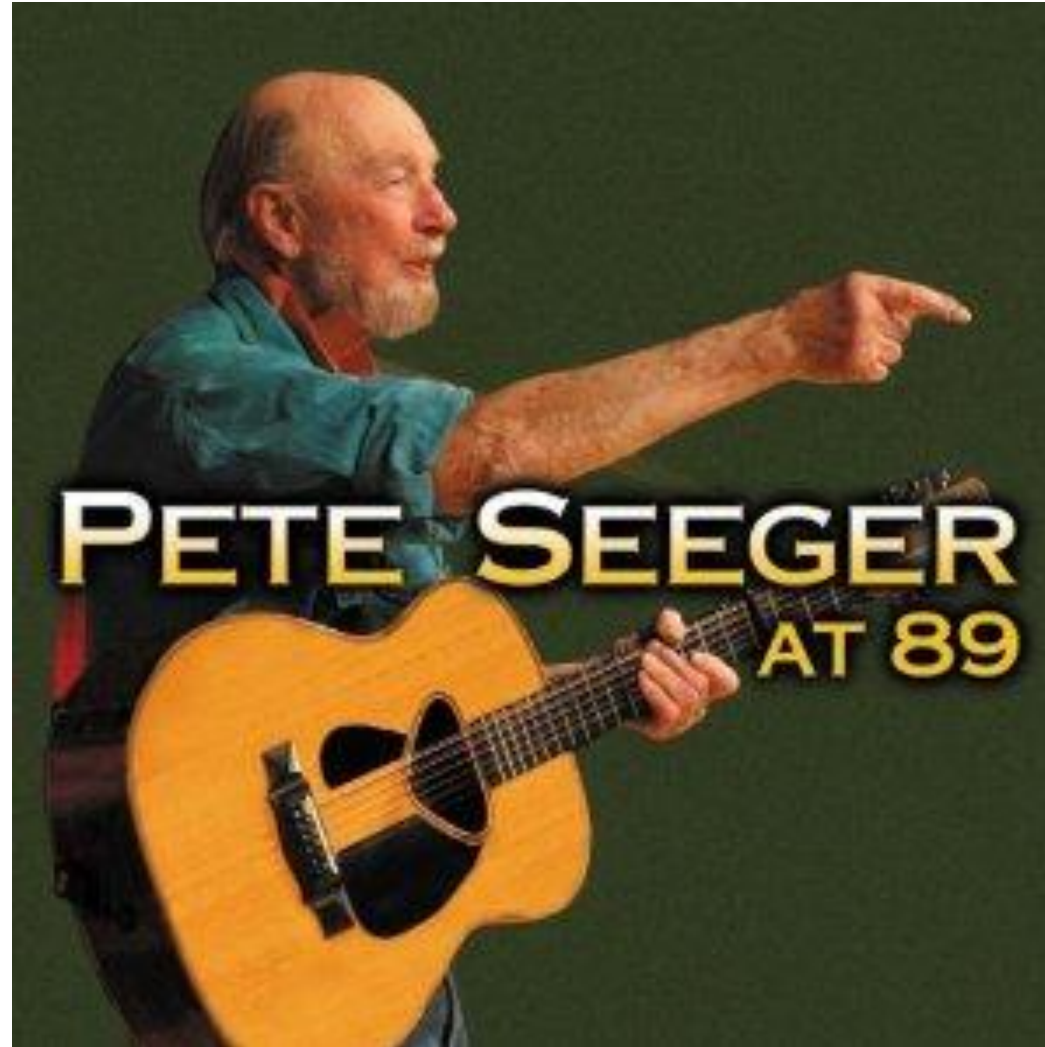


2 – Circular Economy – the basic principles

“If it can’t be reduced, reused, repaired, rebuilt, refurbished, refinished, resold, recycled, or composted, then it should be restricted, designed or removed from production.”

Pete Seeger, Sept 2008

Pete Seeger – If It Can't Be Reduced (2008)



<https://www.youtube.com/watch?v=ZhaXBcLmxiE>

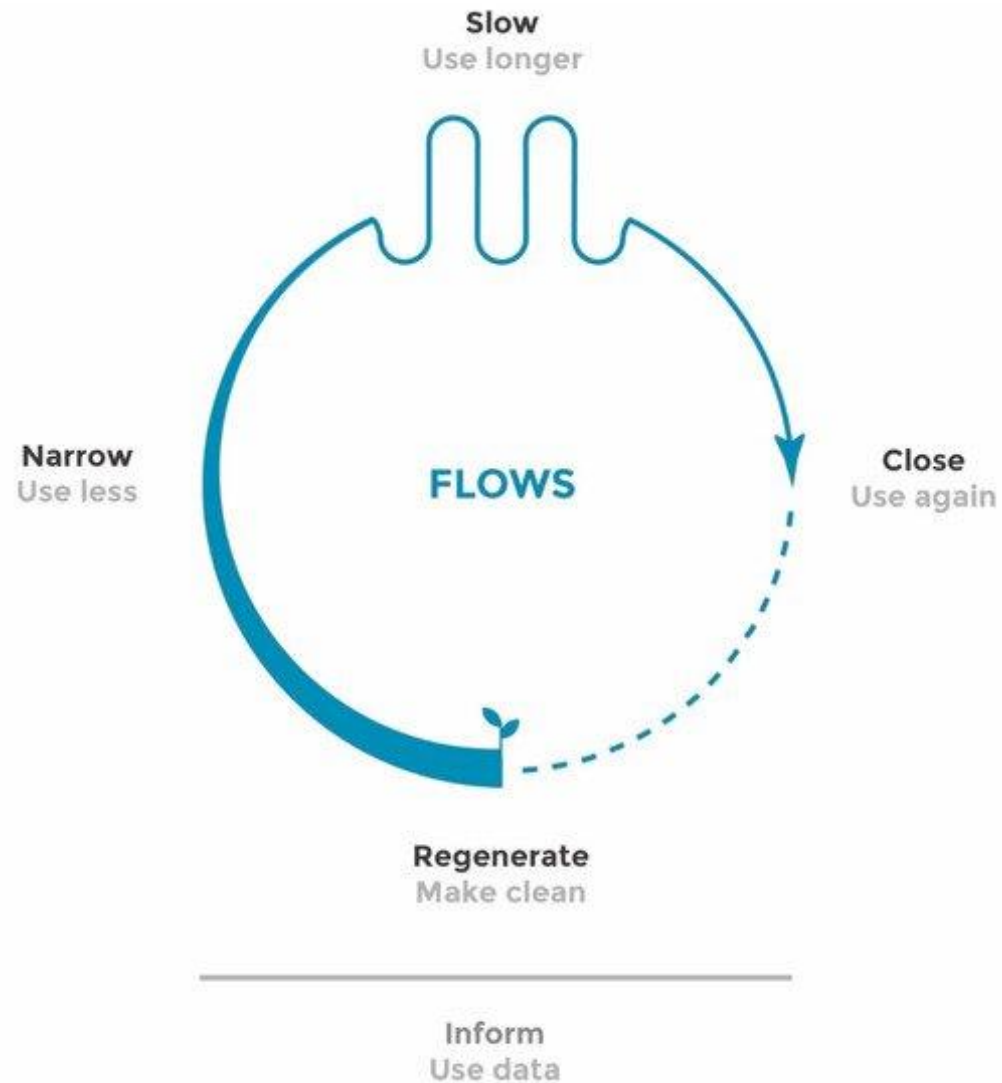
Definition of Circular Economy



*'The **circular economy** is based on three principles, driven by design:*

- ***Eliminate waste*** and pollution
- ***Circulate products*** and materials (at their highest value)
- ***Regenerate nature***'

Five strategies to create a circular economy



Hierarchy of '11 Rs' of the Circular Economy

Ease to change

Most difficult

Least difficult

- R0 Regenerate**
- R1 Refuse**
- R2 Reduce**
- R3 Rethink**
- R4 Re-use**
- R5 Repair**
- R6 Refurbish**
- R7 Remanufacture**
- R8 Re-purpose**
- R9 Recycle**
- R10 Recover**

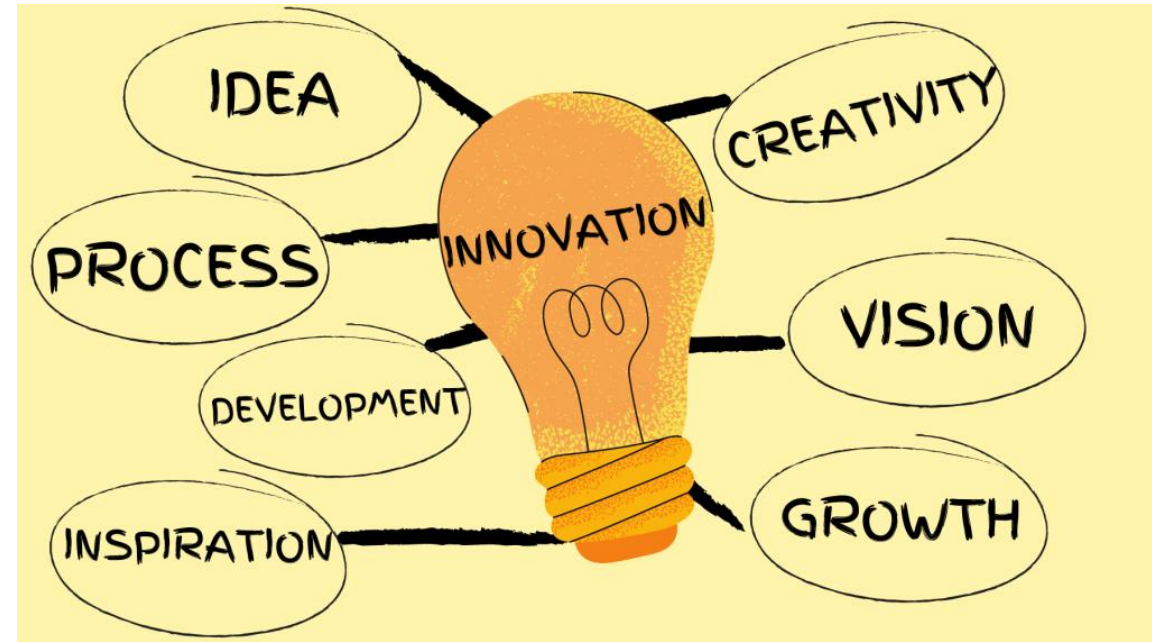
Value recovered

Greatest

Least

Different types of Circular Economy Innovation

- Circular Product Innovation
- Circular Business Model Innovation
- Circular Ecosystem Innovation



Teaser: Supply Chain Management is the key enabler and accelerator behind these innovations!

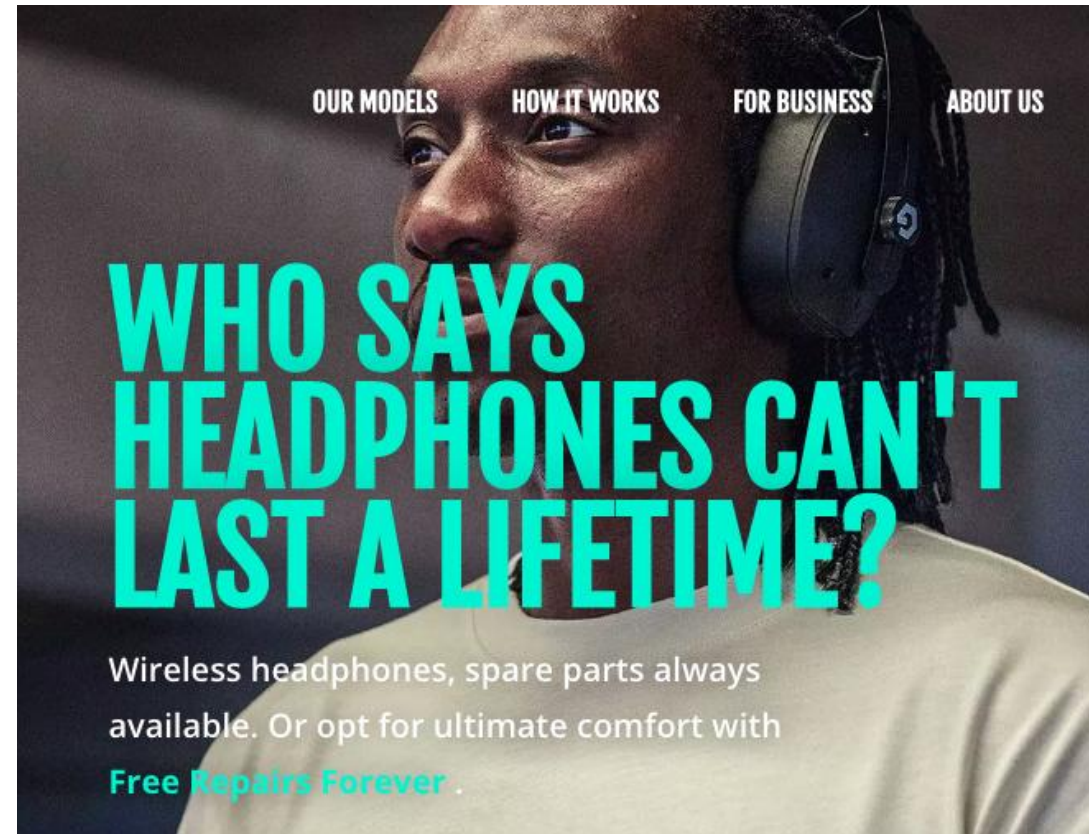
Product innovation – Gerrard Street



'Annually 50 million tons of electronics are discarded, full of reusable components.'

Gerrard Street offers fully **modular headphones**, designed for **repair**, and **refurbishment**: all defects are covered, and broken parts are retrieved and reused. Meaning no more waste. **In addition** to the product innovation, they combine this with a **business model innovation...**

Sound-as-a-service: headphones can be purchased via subscription, enabling flexibility to return or upgrade headphones whenever you want



Business model innovation – Signify



- Service-based is often used as new business model, selling a solution (rather than a product)
- Lighting company for the Internet of Things (IoT) - data collection helps tailor services and improve customer experience
- Carbon Neutral since 2020 – energy efficiency, renewable energy and carbon offsetting
- Avoid locking-in and capturing your customers by making them dependent on your company only



Light-as-a-service



Slowing and narrowing the loop



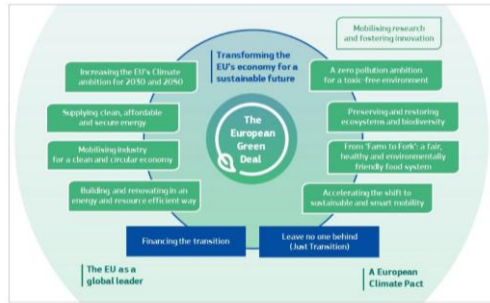
Internet of Things (IoT)

ZENROBOTICS

- Waste sorting often involves a relatively high manual labour cost, and sometimes a low material value in return
- Zenrobotics uses AI and robotics to automate waste sorting processes, enabling the cost-effective separation of waste, where otherwise it would not have been possible to sort, and therefore not recycled
- They perform an ecosystem enablement role to waste management companies to engage in the Circular Economy effectively
- Of course, a full LCA would need to be conducted, but the robotic innovation targets a circular economy principle



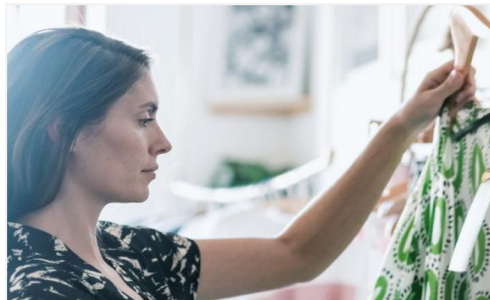
The increasing momentum & necessity for a CE



Governmental policies

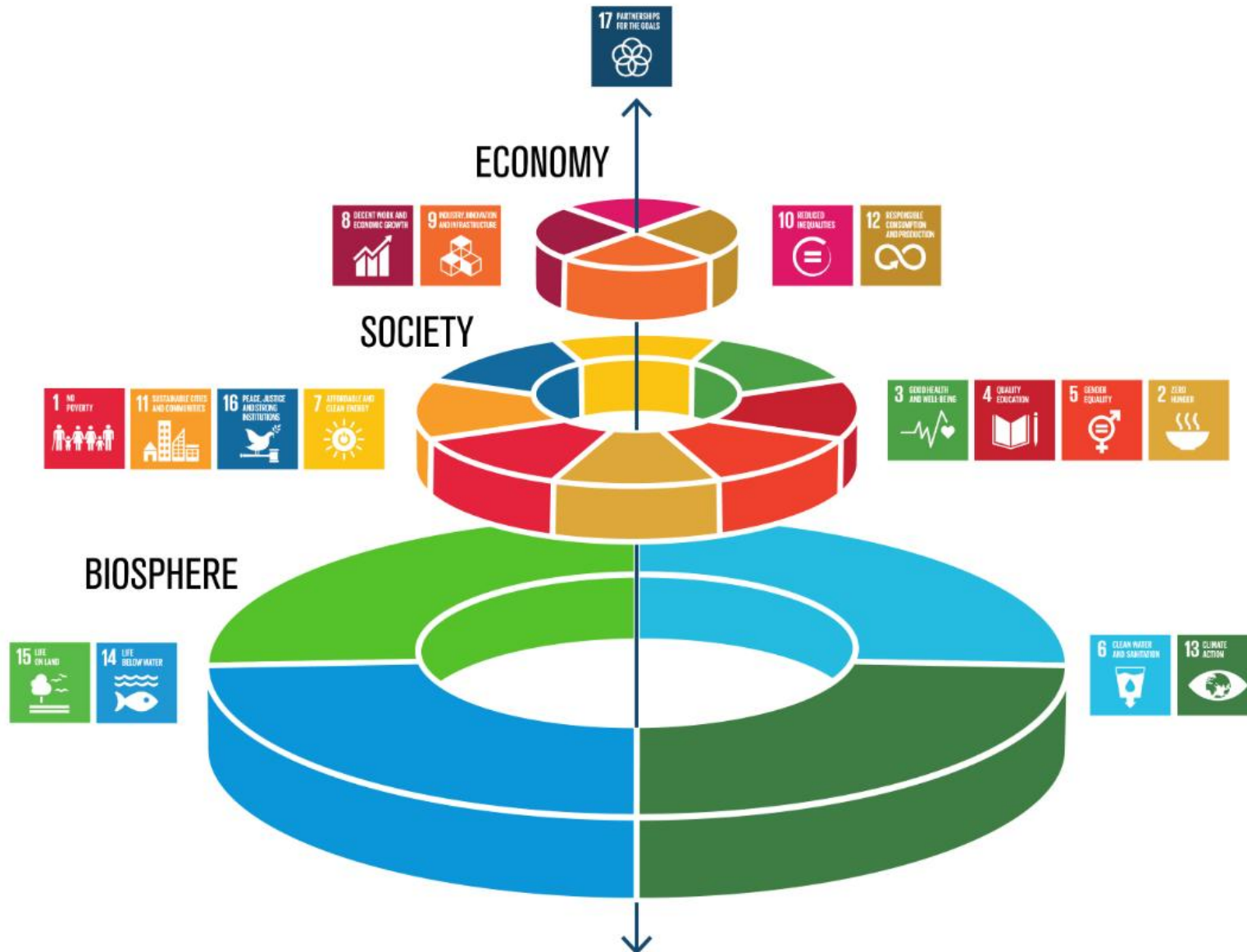


New business models and product designs emerge



Consumer preferences

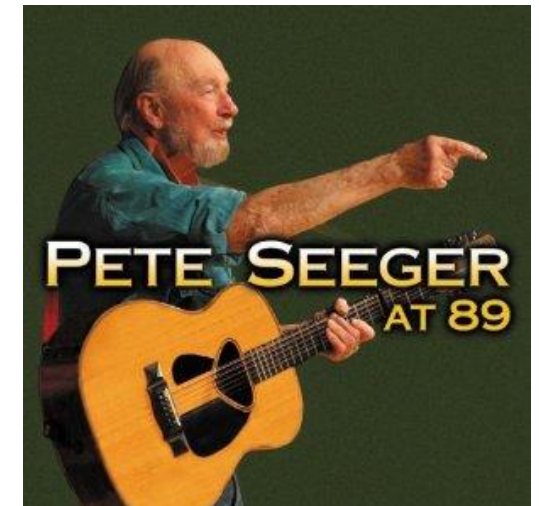
UN Sustainable Development Goals



Summary section 2

- Sustainable development was coined in 1987
- Balance people, planet, & profit
- The linear economy has accumulated, detrimental externalities
- Re-designing for the circular economy is more sustainable
- Eliminates waste, and reuses and regenerates natural resources
- Be careful of rebounds

R0 Regenerate
R1 Refuse
R2 Reduce
R3 Rethink
R4 Re-use
R5 Repair
R6 Refurbish
R7 Remanufacture
R8 Re-purpose
R9 Recycle
R10 Recover



3 – Circular Supply Chain Management – part 1

“In supply chain, we are the stewards of materials and the guardian angels of inventory”.

Deborah Dull, Author of Circular Supply Chain, European Commission, Dec 2019, The European Green Deal

Supply Chain Management defined

- Coined by Keith Oliver in 1982
 - Dutch invention
 - Integrated Inventory Management
 - Tear down functional silos
- “The process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible. Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption”.



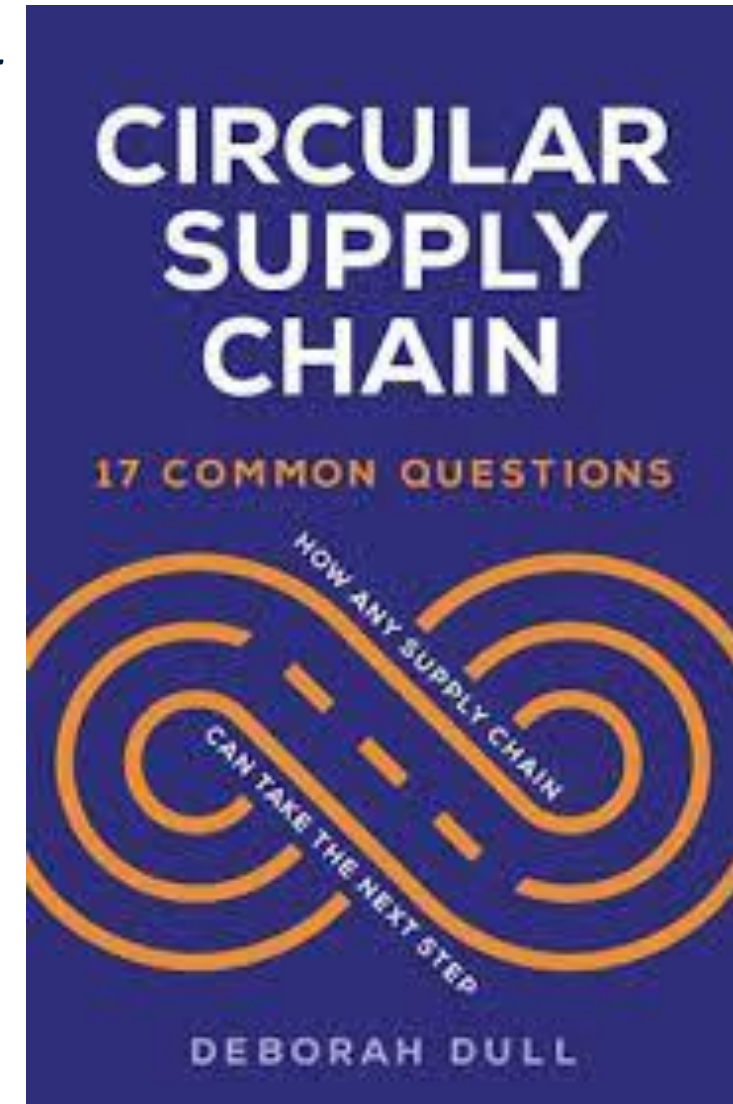
Circular Supply Chain Defined

"Circular Supply Chains are interconnected systems that use secondary and renewable inputs to generate value by reducing, then maximising, resource use."

- Deborah Dull -



- Interconnected
- Secondary and renewable inputs
- Value generation
- Reducing resource use
- Maximising resource use



Linear economy from Supply Chain perspective

Consequences of the linear economy:

1. We are **missing out on value** with one time use
Planned obsolescence → Linear economy goal is to get as many items consumed as possible

Circular economy output in 2030 could add \$4.5 trillion (Accenture)

2. We are **running out of materials**; We extract the materials from mines, oil drilling, or forests.

100 Billions tonnes of material enters economy annually

Only 8.5 tonnes is from other supply chains (circular)

Linear economy from Supply Chain perspective

Consequences of the linear economy:

3. **Supply chains are getting disrupted;** Long supply chains, bullwhip effect



Travels 24000km to the moon by the time it has reached the consumer (Humes, Door to Door)

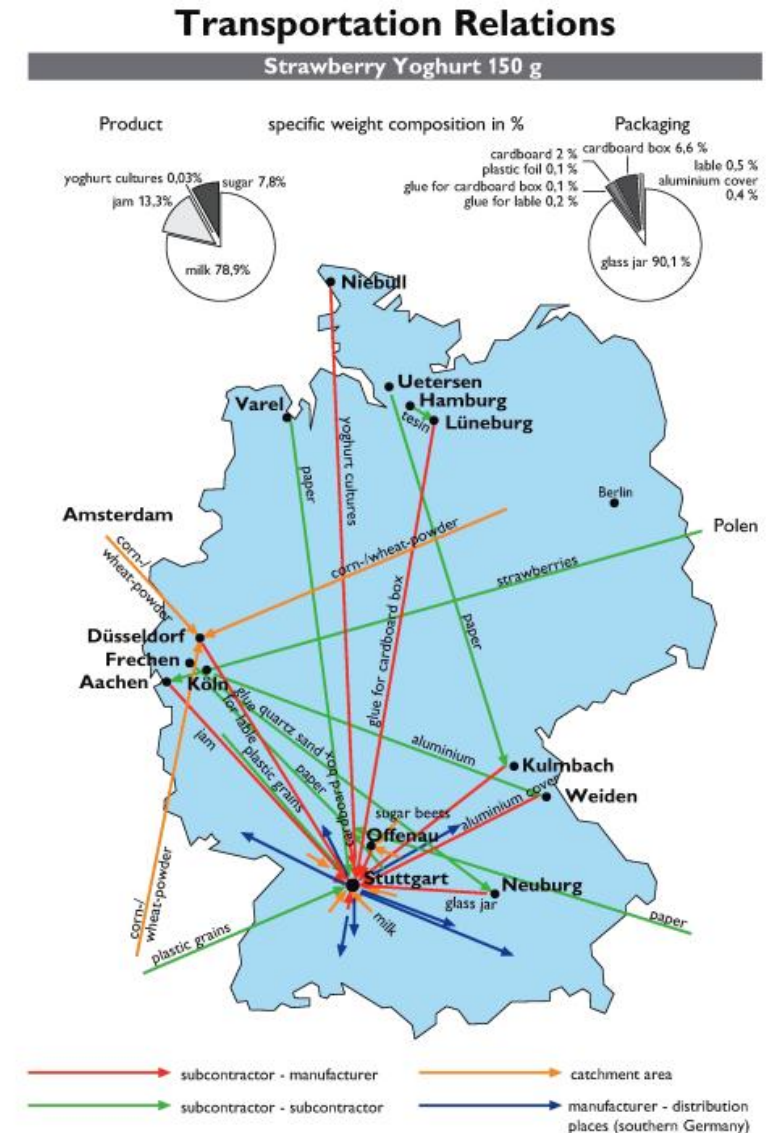
Travels 32000km from Vietnam to South Africa to Seattle

4. **We are emitting carbon;** most companies have 90% of their emissions in their Scope 3 (indirect) emissions. Climate change is the consequence.

Add carbon to the value chain in the same way material or financial value is tracked.

The Strawberry Yoghurt example (Stefanie Böge, 1993)

- Analysis of 150 g strawberry yoghurt in a recyclable glass jar, manufactured in Stuttgart
- Ingredients: milk, jam, sugar and the packaging:
 - the glass container, paper label, aluminium cover, cardboard box, cardboard sheets, glue and foil.
- Transport
 - Distribution from factory to supermarket DCs: > 1000 km per truckload end product
 - Each unit (150g pot) travels 9.2 meter by lorry
- Recommendations
 - Nearshoring, decentralized production, sustainable transportation, freight distribution centres



Summary section 3

- **Supply chain management definition**
 - Coined by Mr Oliver in 1982
- **Circular Supply chain definition**
- **Linear economy supply chain perspectives**
 - We are missing out on value
 - We are running out of materials
 - Long global supply chains are getting disrupted
 - We emit too much carbon
- **The Strawberry Yoghurt case**



4 – Break and break-out assignment

“Taking a break can lead you to breakthroughs.”

Russell Eric Dobda, Travel, Technology, and Meditation Expert,

Break-out assignment

- Make company – education couples
 - Each try to answer below questions
 - Help each other by asking clarification questions
 - 15 minutes total
- Company questions
 1. How far does our most popular product travel?
 2. What byproducts do we produce the most of, and what happens with it?
- Education questions
 1. How could these insights be incorporate in the teaching?
 2. What is needed to make that happen?

15 minute break



Break-out assignment - Recap

- Company questions
 1. How far does our most popular product travel?
 2. What byproducts do we produce the most of, and what happens with it?
- Education questions
 1. How could these insights be incorporate in the teaching?
 2. What is needed to make that happen?

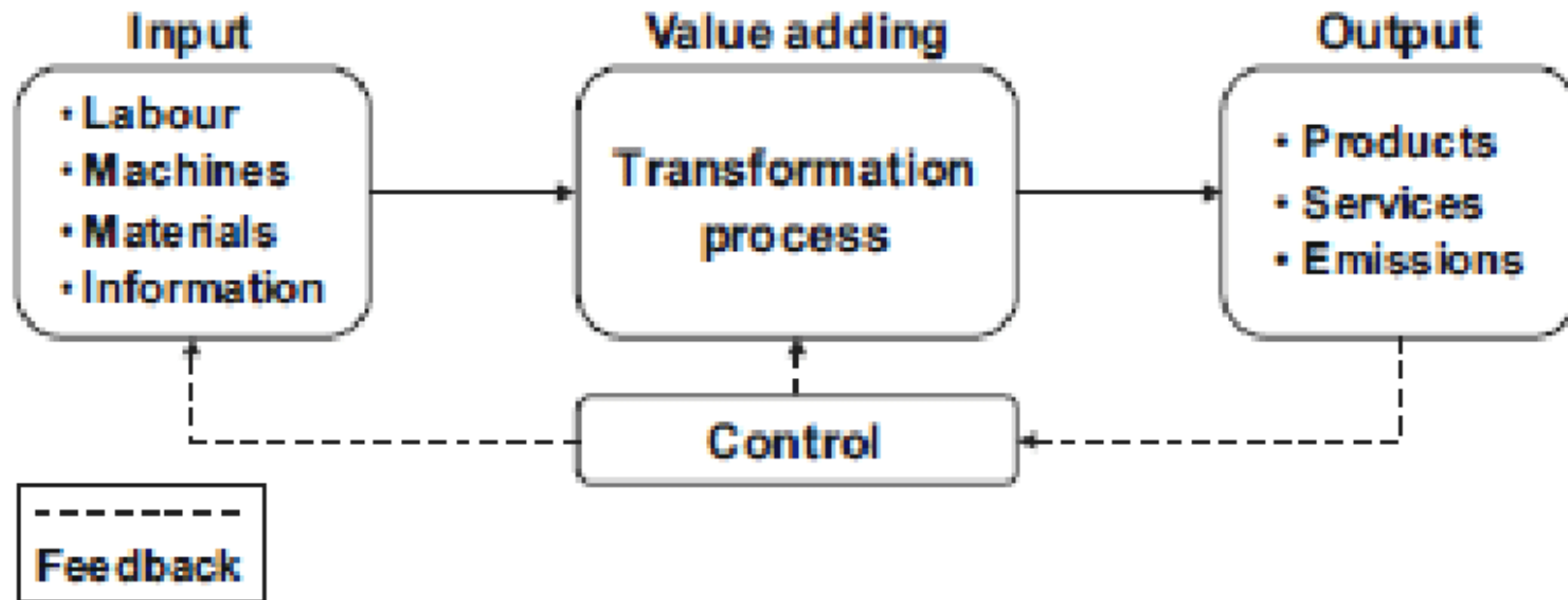
5 – Circular Supply Chain Management – part 2

“Some people tend to confuse recycling with the circular economy. Recycling is a component, but it's really the circle of last resort. So we want to have an item exchanged and used and repaired and remanufactured and refurbished. And then ultimately, if there's literally nothing else that can be done, we recycle it.”

Deborah Dull, Interview with Justin Kyngdon, March 2021

Modelling Circular Supply Chain Systems

- Input
- Process
- Output
- System



Source: Ivanov (2019), Basics of Supply Chain and Operations Management: A Decision-Oriented Introduction to the Creation of Value

Inputs: Circular materials

Reduce the materials we need and circulate for longer the materials we have.

Familiar terms for materials sources that are classed as 'circular':

- Refurbished
- Repaired
- MRO (Maintenance, repair, operations)
- Pre-owner
- Post-consumer
- Post-industrial

They are all **secondary sources**, i.e. not sourced directly from the planets natural resources (mines, oceans, forests, air).

Benefits are; added value to the economy, as one time value creation becomes multiple value creations, and the planets resources are not depleted



Examples of circular materials

Sources for Circular Materials

1. From your own supply chain (waste streams becoming minor value streams)
2. From other supply chains
3. From commodities markets
4. Out of the environment (e.g. ocean plastics or mining landfills)
5. From nature (e.g. solar/wind power, *bamboo?*)
6. From biology (e.g. agriculture byproducts or mushroom spores)



Brightlands - BSCI

Circular Supply Chain Processes – Linear assumptions

Can we make supply chains shorter? Yes, but we have to challenge the following assumptions

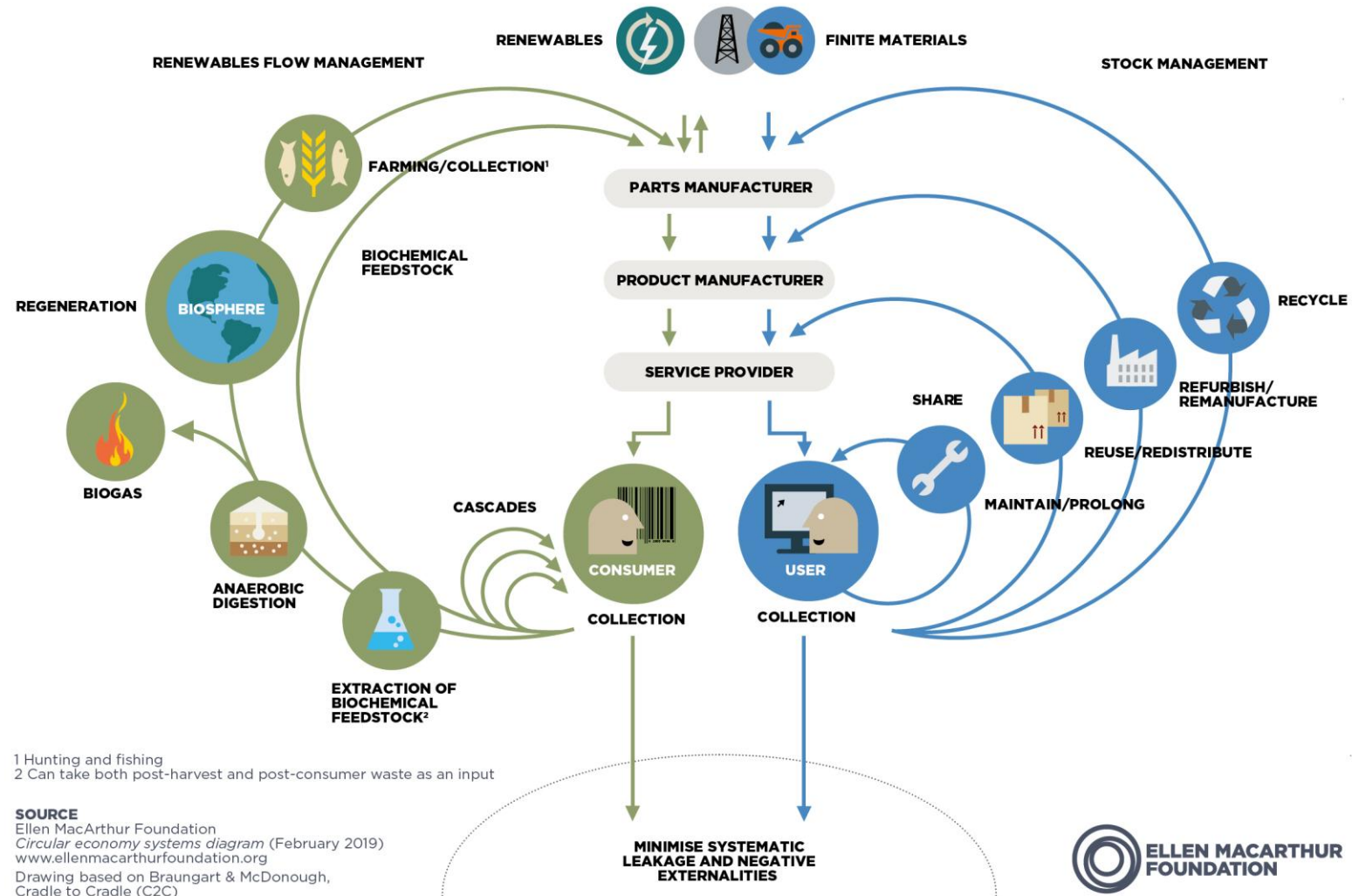
1. Centralized is optimized; Move to lowest cost production to minimize landed cost; Centralise warehousing (EDCs) to optimize logistics costs; But is this true?
2. Supply will continue; What about rare earth material and silicon chip scarcity?
3. Waster is thrown away; Where is '*away*'? can we simply dispose in landfills?
4. We are on our own; We've optimized our linear SCs, shift to circular SC infrastructures would imply 'sunk costs', but is it? Aren't contract manufacturers and governments willing to support the shift to e.g. flexible sourcing?



Effects of smaller circles on supply chains

- Point of sale (POS) is just the beginning
- Repair more than building new (avoid single use)
- Slower inventory turns (new KPI 'utilization')
- Shorter manufacturing / supply chain lead times (not starting from scratch)

Reuse is smaller than recycling!



Circular supply chain outputs: value!

- Major (linear) value streams and minor (circular) value streams
- How can other supply chains use our 'waste'?
 1. Next door;
 - Co-location, Industrial symbiosis;
 - E.g. Chemelot cluster
 2. Down the street;
 - E.g Heinz – Ford (bioplastics from tomato skins)
 - Finding material candidates for circulation ('Reststromen-hub')
 3. Circular brokerage;
 - Find brokers taking care of your process waste;
 - The US industrial waste (scrap metal, pulp etc) is valued at \$60 bio / yr!



Circular Supply Chain Systems Approach

1. Standards; Operate in supply chain networks
 - Recycle specs; etc
2. Measures, KPIs, metrics (e.g. time, cost, quality)
 - Circularity is a strategy not a goal, sustainability is the goal!
3. Modularity; Circularity will create many (outsource) options; Modularity helps:
 - (Re)manufacture closer to customers;
 - Balance new builds and repairs
 - Source a variety of circular materials from a variety of sources;
 - Increase utilization of the value chain assets;
 - Scale up and down with seasonality;
 - Shorten supply chains and reduce emissions
4. Interconnectivity
 - Data sharing infrastructures;
 - Digital Product Passports;



“Everything is inventory” (materials, consumables, assets, items)

1. Identify inventory (awareness)
 - Learn where your inputs come from
 - Where your outputs go
 - The gap in measurement
2. Intensify inventory (keep materials in use)
 - Redesign business models (e.g. product-as-a-service)
 - Redesign products to be modular
 - Redesign the process (shorten SCs and increase utilization)
3. Narrow inventory (eliminate waste: reduce, divert, sell)
4. Predict inventory
 - Machine use/wear/tear
 - Major/minor value streams: WIP, finished goods
5. Slow inventory (postpone lifetime → business model!)
6. Close inventory (closing the loop: refurbish, repair, remanufacture etc)
7. Capture inventory (oceans, landfills, environment)



Summary section 5

- **A Systems's approach to Circular Supply Chain Management**
 - Circular Inputs/materials
 - Circular SC Processes
 - Circular Outputs
 - Circular Systems Approach
- **Everything is Inventory**
 - Identify – Intensify – Narrow – Predict – Slow – Close – Capture



FATER Diaper recycling factory (IT)

6 – Some BISCI examples of Circular SCM innovation

“Dare to be Circular!”

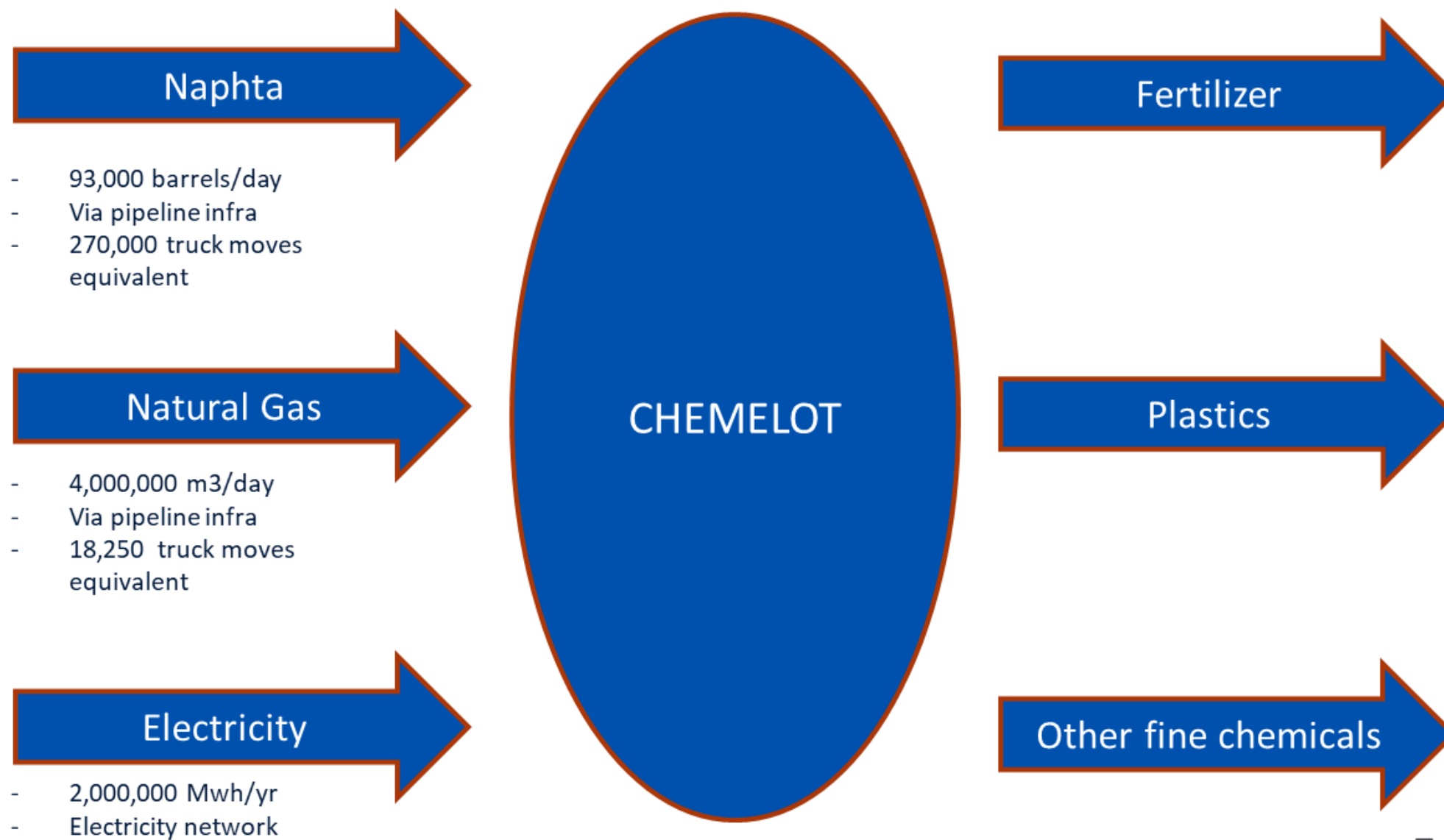
*Main theme of the 2023 BISCI conference on Circular Supply Chain Management,
March 2nd 2023 in MECC Maastricht*

Some BISCI examples

1. Circular Chemical Supply Chain Management
2. Circular Inland Ports
3. Circular Freight Forwarding Business Models



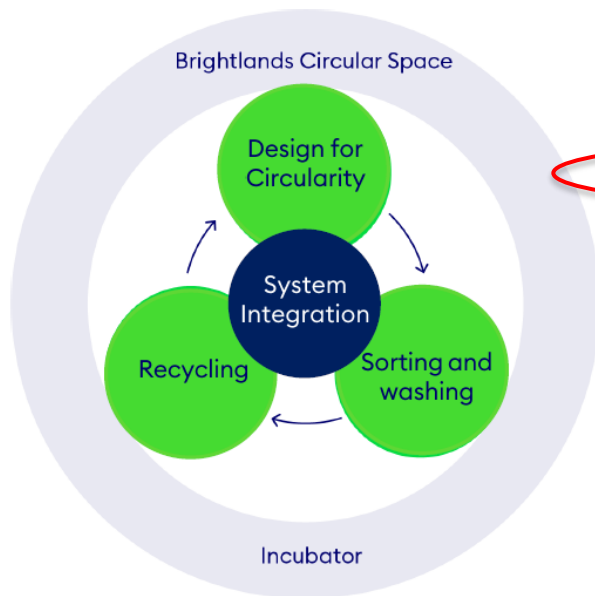
Circular Chemical Supply Chain Management



Circular Plastics NL

Today, we produce about 400 million tonnes of plastic waste every year. Only 10% of all plastics is being recycled, the rest ends up in landfills and oceans

Overview of the program



PROGRAMS

Show Case

P1a. System Integration

P1b. Design

P2. Characterization, sorting and washing

P3. Mechanical recycling of polyolefin packaging

(L)DPE, HDPE/PP

P4. Recycling of styrenics

PS, ABS, HIPS

P5. Chemical depolymerization

PET, Textile, PU, tyres

P6. Thermochemical recycling

From waste streams

P7. Brightlands Circular Space

P8. Incubator



Role of inland ports in circular economy transition



EUROPESE UNIE

BLUEPORTS

SDG'S

HAVENS

EVENTS

CEF1

CEF2

EU-FONDSEN

EVENTS

CIRCULAIR

Role of inland ports in circular economy in Limburg

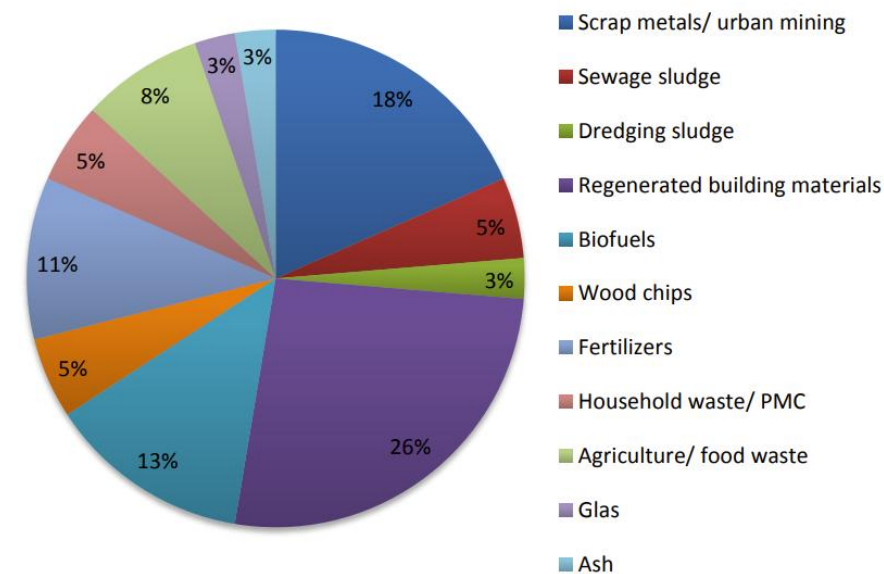
Gerwin Zomer, BISCI Programme Director Logistics, June 2022

Background context

Port areas are attractive for the recycling industry. The main reason for this is the proximity to cities, industries and the terminals. They are the providers of the supply for the recycling installations. The feedstock provided by big cities and the industry is generated locally. The terminal generates international feedstock. Inland ports provide crossing points between transport modes of waste streams with connections to hinterland and onsite industrial activities and a nearby urban setting. This means that inland ports, despite their limited areal footprint, have access to significant quantities of bio wastes, surrounding bioenergy resources, biomass from crossing supply chains and energy from intensive activities. It is an important trend for ports to attract these economies to locations along the network, along the inland waterways. Inland ports are therefore important crossroads of all kinds of waste and industrial streams and act as logistical hubs for the import/export of waste materials (EFIP, 2016).

Inland ports are typically faced with the following challenges:

Circular economy sectors - inland ports



Source: Output EFIP-survey on circular economy, 13 inland ports, 2015

Circular business opportunities for LSPs

WHITEPAPER

Circular Economy in Logistics

CIRCULAR SERVICE DESIGN FOR LOGISTICS
PROVIDER: AN ARVATO CASE STUDY



BISCI

arvato
BERTELSMANN
Supply Chain Solutions



Karoline Kowalik is a Logistics Engineer and PhD researcher at Arvato SCS and Maastricht University. She mainly focuses on innovation projects such as robotics and sustainability. Her research focuses on the interplay and evaluation of innovation, sustainability and green decision-making.

Wrap up and main take aways

- Mother nature will survive, but will we?
- Key Circular Economy principles
 - Design waste out of the system
 - Circulate products and materials
 - Regenerate natural systems
- Supply Chain Management is the key to the transition towards a Circular Economy
- Key Circular Supply Chain principles
 - Inventory is everything! No faster but slower inventory turns!
 - The Point Of Sale is just the beginning; From consumers to users
 - MRO and Reverse Logistics will be our Tomorrow Superheroes

