

# Towards a more resilient, circular agriculture

## Agribusiness and Economic Recovery

An international seminar on Agribusiness

IPB University

19 10 2021, by dr.Emiel F.M.Wubben



# contents

- Intro dr Emiel F.M. Wubben
- The need to change
- What is Circular Economy?
- Relating C.E. to Agriculture?
- How does it help food system resilience?

# Who is dr Emiel F.M. Wubben?



Born in Westland, NL  
(horticultural area)

Living in  
Gouda

BSc, MSc, and PhD in Economics  
at Erasmus UR (Rotterdam)

Associate professor strategic mngt  
at Wageningen UR





# WUR: Lots on renewing agrifood systems

## Videos about a circular agrifood system



Martin Scholten about the challenge to create a circular agrifood system



Marin Scholten explains the principles of a circular agrifood system



Wijnand Sukkel explains how important circular agriculture is for a healthy soil.



Pieter de Wolf on collaborations between arable and livestock farmers.



Anne van Doorn talks about nature-inclusive agriculture



Dennis Ooninx grows insects on manure, to use as chicken feed





# Action is needed!



- From 1970 to 2017, the annual global extraction of materials **tripled** and it continues to grow.

Source: The International Resource Panel, [Global Resources Outlook](#), 2019



- More than **90%** of biodiversity loss and water stress come from resource extraction and processing.

Source: The International Resource Panel, [Global Resources Outlook](#), 2019



- EU's industry accounts for **20%** of the EU's emissions.

Source: European Commission, [EU Climate Action Progress Report 2019](#)



- Only **12%** of the materials used by EU industry come from recycling.

Source: Eurostat, 2016 figures

# Drivers for impactful change

- Economic losses and structural waste
  - Car in use average 8% ; 1/3 food wasted; office use?
- Price risks of inputs; price volatility
- Supply risks
  - Global supply chain dependencies, border problems
  - EU imports of materials and nat resources 6x exports
- Natural system degradation
  - Depletion of reserves, degradation of natural capital
- Regulatory trends e.g. landfill taxes, CO-pricing, etc
- Technology advances. Alternatives and downscaling
- Urbanisation, and ongoing population growth



INTERVIEW

# Discarded fishing nets given a new life as carpets

“

'We came up with the idea during a brainstorming session. At that time, we did not just procure yarn, we also provided our suppliers with recycled yarn. A successful example of a circular value chain. Eventually, market demand for recycled yarn exceeded our supply. This made us wonder whether fishing nets, made from high-grade nylon, could be used as an alternative source for the yarn in our carpet tiles.'

'In the coastal areas of development countries, large sections of the population fish for their living. Discarded fishing nets seriously affect the eco systems of these areas. Through the *Net-Works* project, set up in collaboration with the Zoological Society of London (ZSL) and yarn manufacturer Aquafil, local fishermen are trained to select and clean discarded nets. The coast and the ocean are cleaned, thereby restoring biodiversity. The local population makes some money and *interface* re-uses valuable resources for the production of carpet tiles.'

Ton van Keken

Vice President of Operations, *interface*

'Increasing the appeal of using end-of-life products as an alternative source of scarce and expensive resources requires a new balance in the tax system. Under the current system, labour is heavily taxed, whereas hardly any tax is paid on energy and resources. The current system thus encourages exactly the opposite of what a circular economy aims to achieve, viz., more work, a reduction in energy consumption, and a more efficient use of existing and old materials.'

'... hardly any tax is paid on energy and resources.'

'With *Mission Zero*, *interface* aims to eliminate any negative impact on the environment by 2020. In addition, with our new *Climate Take Back* mission we aim to make a restorative contribution to the environment and combat climate change.'

”



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UNIVERSITY & RESEARCH



## “It’s the ultimate Right to Repair laptop.”

- [Gordon Ung, PCWorld](#)

- The Framework Laptop was first delivered in the week that FTC unanimously voted to enforce the Right to Repair (21 Juli 2021)!
- Repair and upgrade: the Expansion Card system, CPU performance, keyboard feel, webcam quality, and more.

🔧 framework

**Fix Consumer  
Electronics**

(Thanks to Wietse van der Munt)



# Some upscale to realise large steps ..

## Endlessly Refreshing: Coca-Cola North America Rolls Out Bottles Made from 100% Recycled PET Plastic

🕒 4 MIN READ | 02/09/2021



**Coca-Cola investeert in Nederlandse plasticrecycler – de techniek van CuRe Technology is energiezuiniger dan bestaande methodes**

BUSINESS INSIDER NEDERLAND  
Business Insider Nederland  
🕒 16 jul 2020

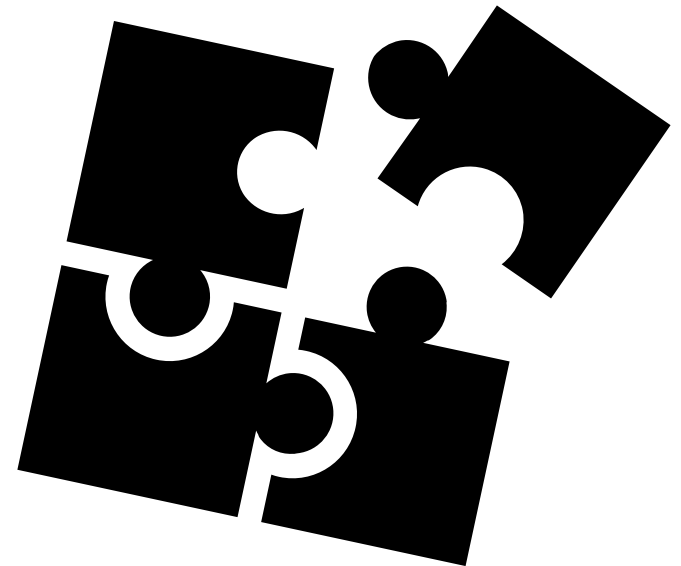




# The problem of conceptual vagueness

...we live today in an age of 'sustainababble', a cacophonous profusion of uses of .. the world 'sustainable [development]' to mean anything from environmentally better to cool".

Aaih, ..there is no commonly accepted definition on Circular Economy as well.

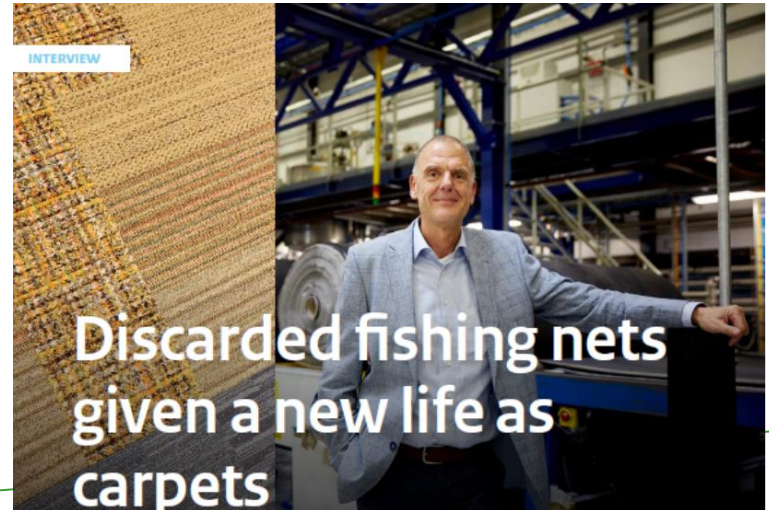


Is circularity bringing the entire story?

No? But... what are we talking about?

**What is Circular Economy?**

**And Circular Agriculture?**





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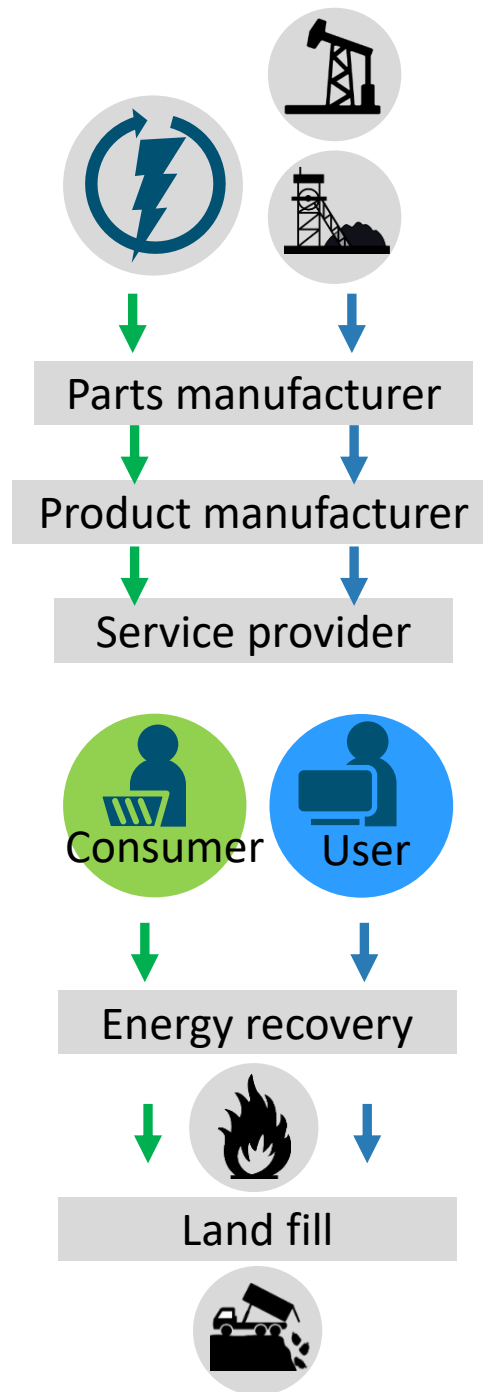
- Intro dr Emiel F.M. Wubben,
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From:  
We Take

We Make

We Consume

We Dispose



To:  
We Redesign  
(renewables)

We Reduce  
(inputs)

We Retain  
(maintain)

We Recover  
(recycle Value)





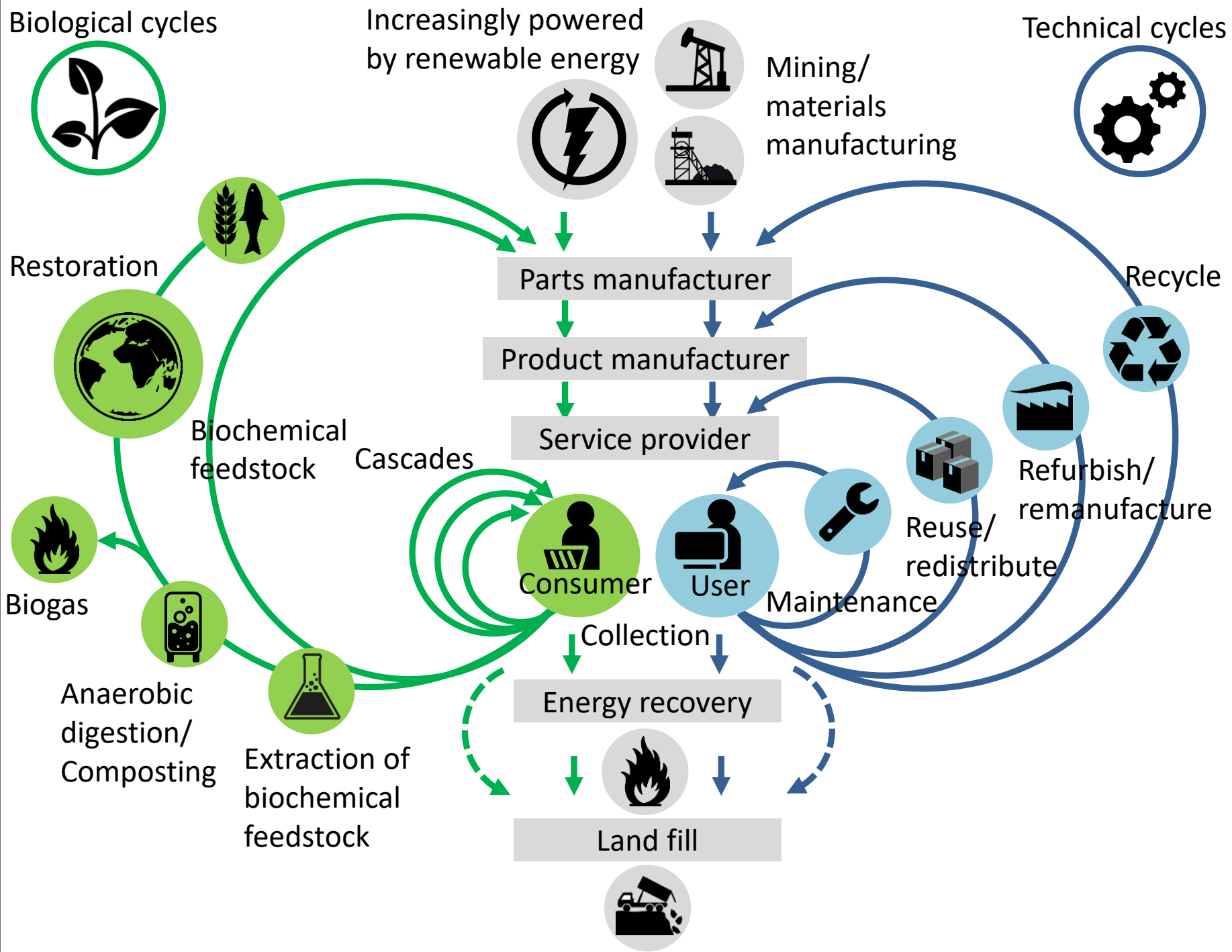
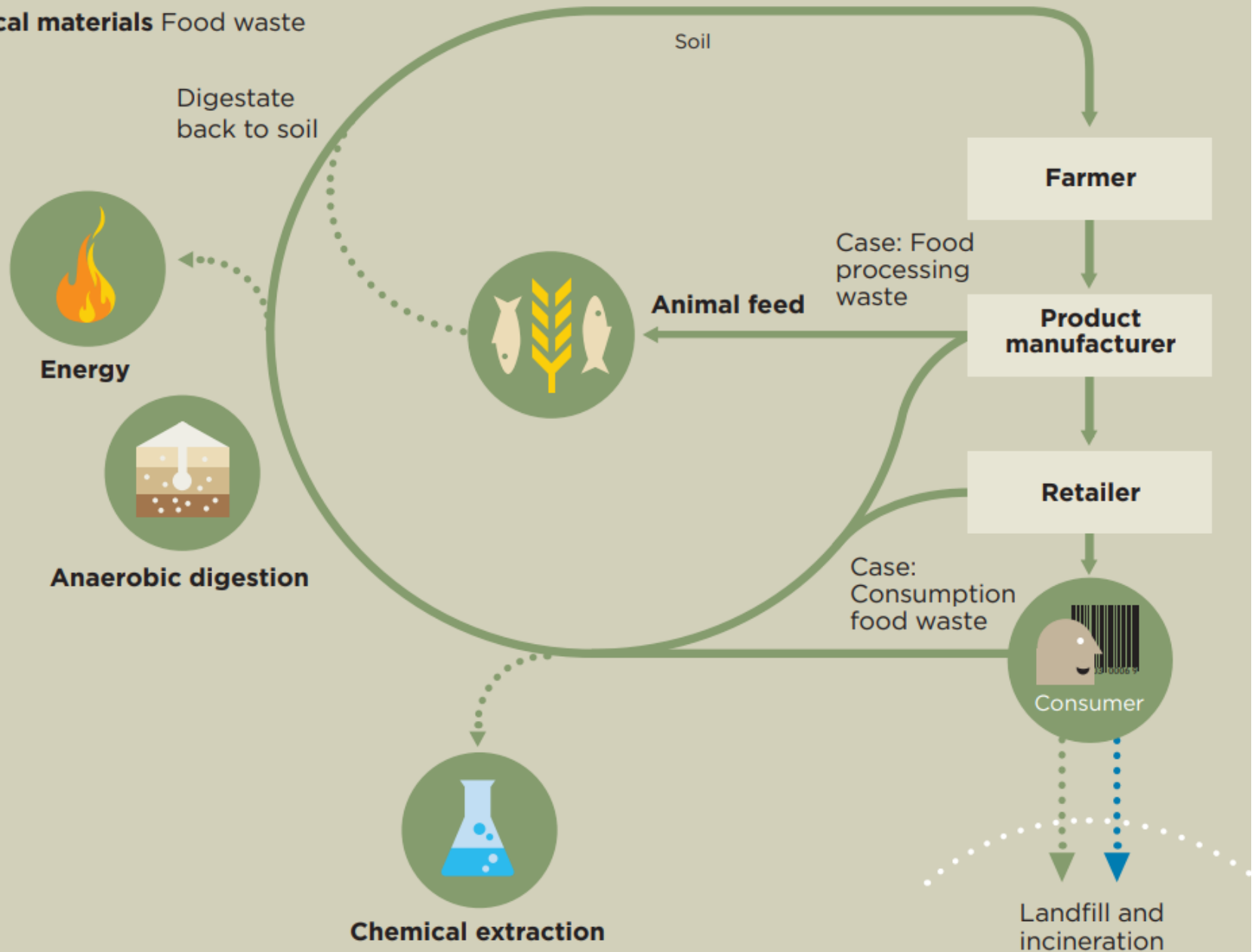


FIGURE 8 Food and beverage – retail, household, and production material flows

**Biological materials** Food waste



SOURCE: Ellen MacArthur Foundation circular economy team

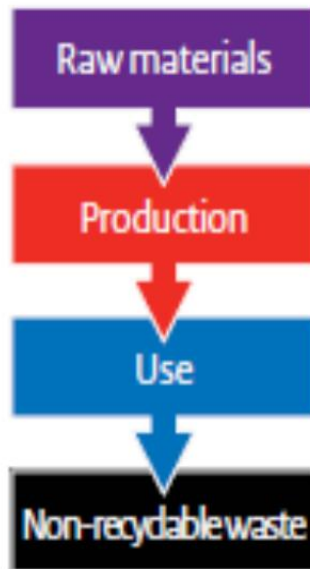


# What is Circular Economy?

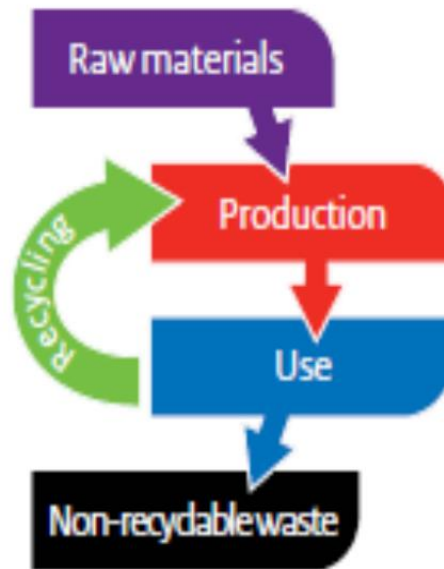
The basic idea is simple!

From a linear to a circular economy

Linear economy



Reuse economy



Circular economy



# Circular Economy is...? (I)

## (Ellen MacArthur Foundation)

- “The circular economy is an economic system that is **waste-free and resilient by design**, ...
- **mimicking natural ecosystems** in the way we organize our society and businesses. ...
- by following circular strategies and principles, **companies** can ensure the **highest** level of economic and societal **value** is attained, while **minimizing** planetary **impacts.**”



# Circular Economy is..? (II)

We define the **Circular Economy** as a **regenerative system** in which resource input and waste, emission, and energy leakage are **minimised** by slowing, closing, and narrowing material and energy **loops**.

- This can be **achieved through** long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.

We define **sustainability** as the **balanced integration** of economic performance, social inclusiveness, and environmental resilience, to the benefit of current and future **generations**.

Geissdoerfer et al. (2017) *Journal of Cleaner Production*, 143





# Circular Economy is...? (III)

- ...an **economic system** that is based on **business models** which **replace end-of-life-concept**..
- with reducing, reusing, recycling, and recovering **materials**
- in production, distribution and consumption **processes**,
- .. operating at micro, meso and macro **levels**,
- with the aim **to accomplish sustainable development**, which implies creating environmental quality, economic prosperity, and social equity,
- to the benefit of current and future **generations**.

Ref: Kirchherr et al (2017), in *Resources, Conservation and Recycling*, 221-232



# Circular economy, to minimize footprint

'Ladder of Moerman'  
= utilization of waste



# More key terms

**Bio-economy:** “The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to **produce food, materials and energy.**”

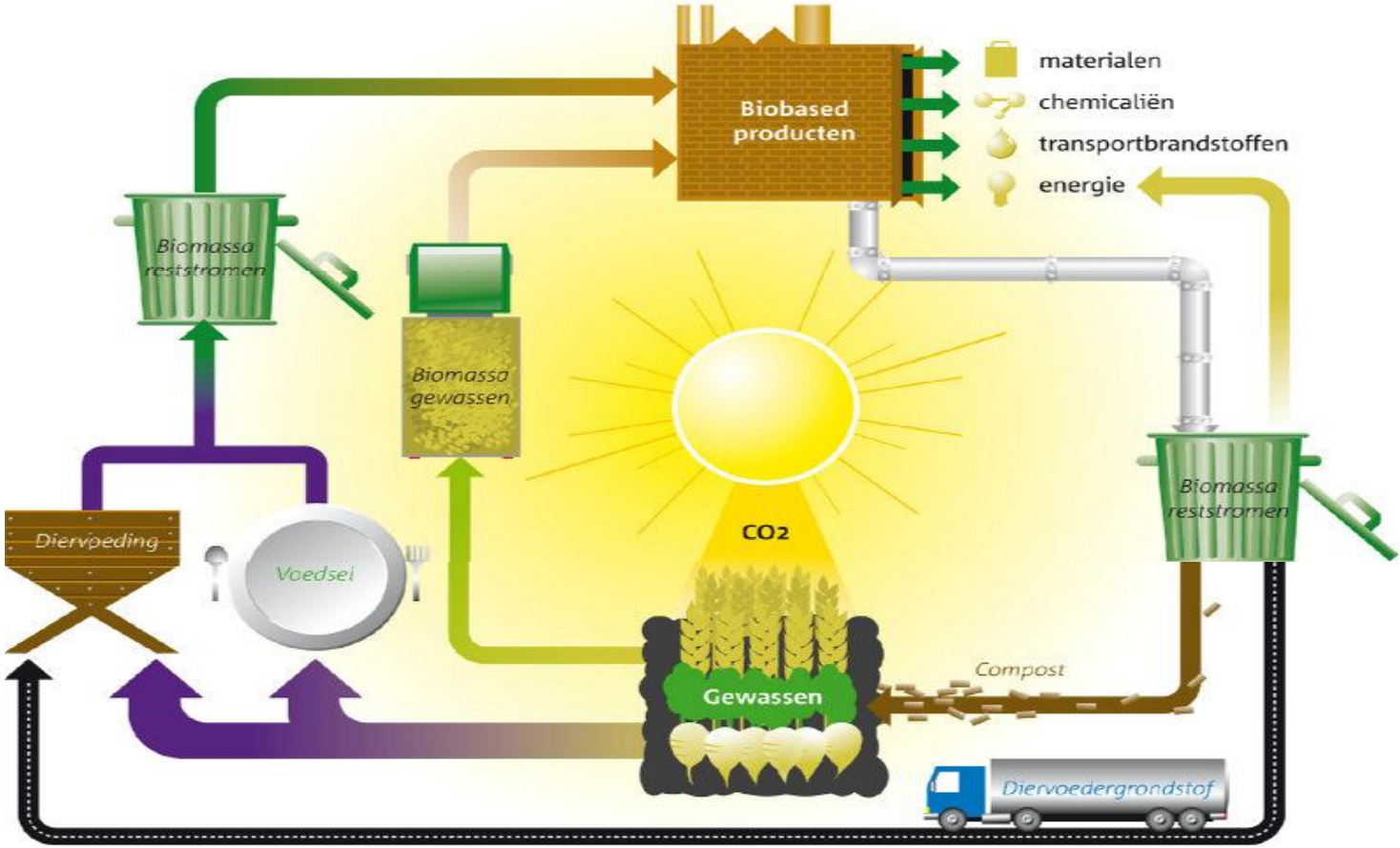
“<https://ec.europa.eu/research/bioeconomy/index.cfm>”

“A **biobased economy** is an economy which for a large proportion draws its **resources from living nature** (biomass, ‘green resources’), as an integral part of a **green or sustainable economy.**” <http://www.biobasedpress.eu/>

- Often on substituting fossils and scarce materials.

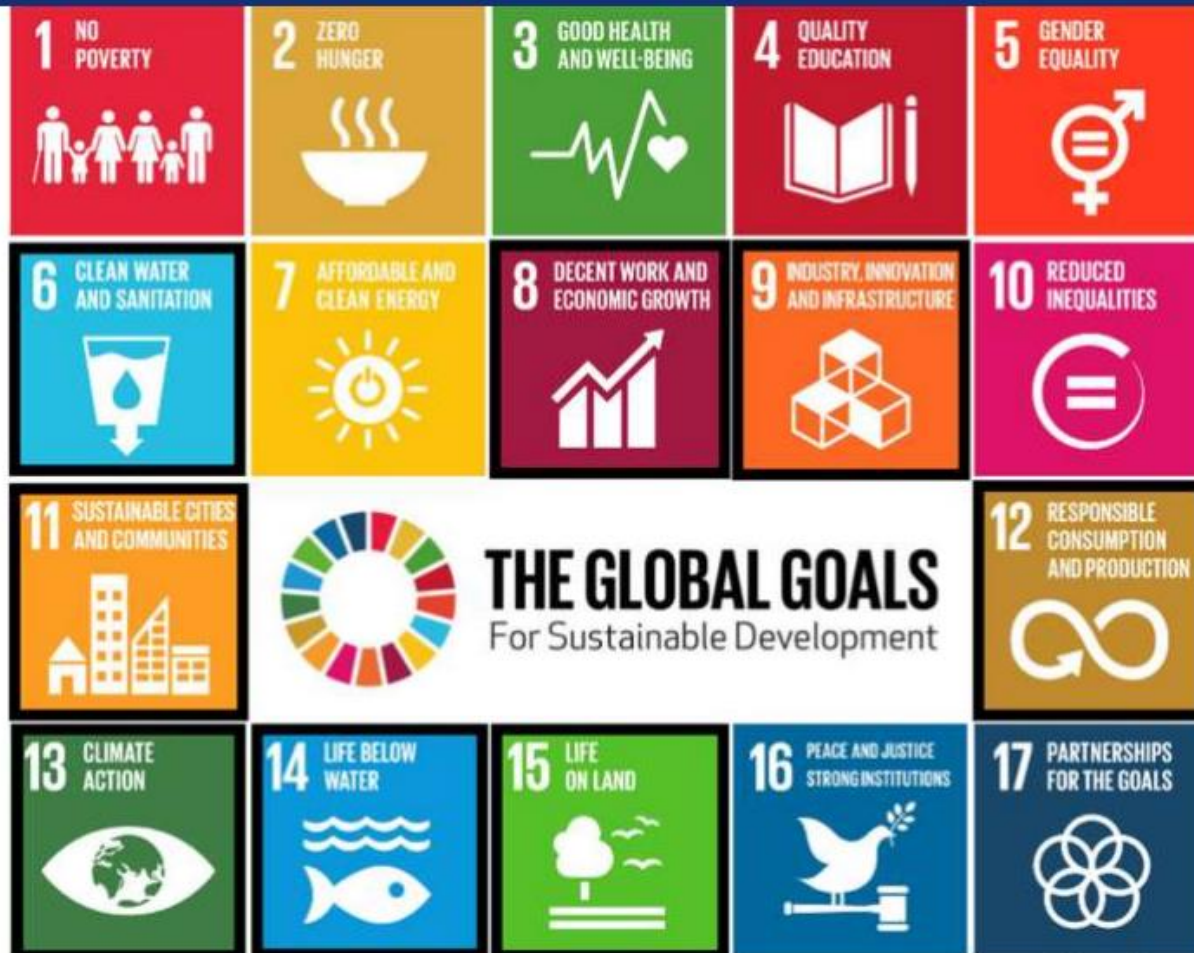


# Scheme of a Biobased Economy





# Circular economy & the SDGs



## Next: 3 principles of the Circular Economy

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

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

Foster system effectiveness by revealing and designing out negative externalities.



# Next: Roughly 3 levels of biomass usage

- **Biomass as it is, e.g. use of bamboo by mr Eek for Ikea**
- Biomass components, e.g. fibers for building materials
- Molecules as building blocks, e.g. creating biobased PLA for plastics.





PIET HEIN EEK



## Afvalstapelkruk

90x45x48

Product code: 3805H



- Designed for IKEA



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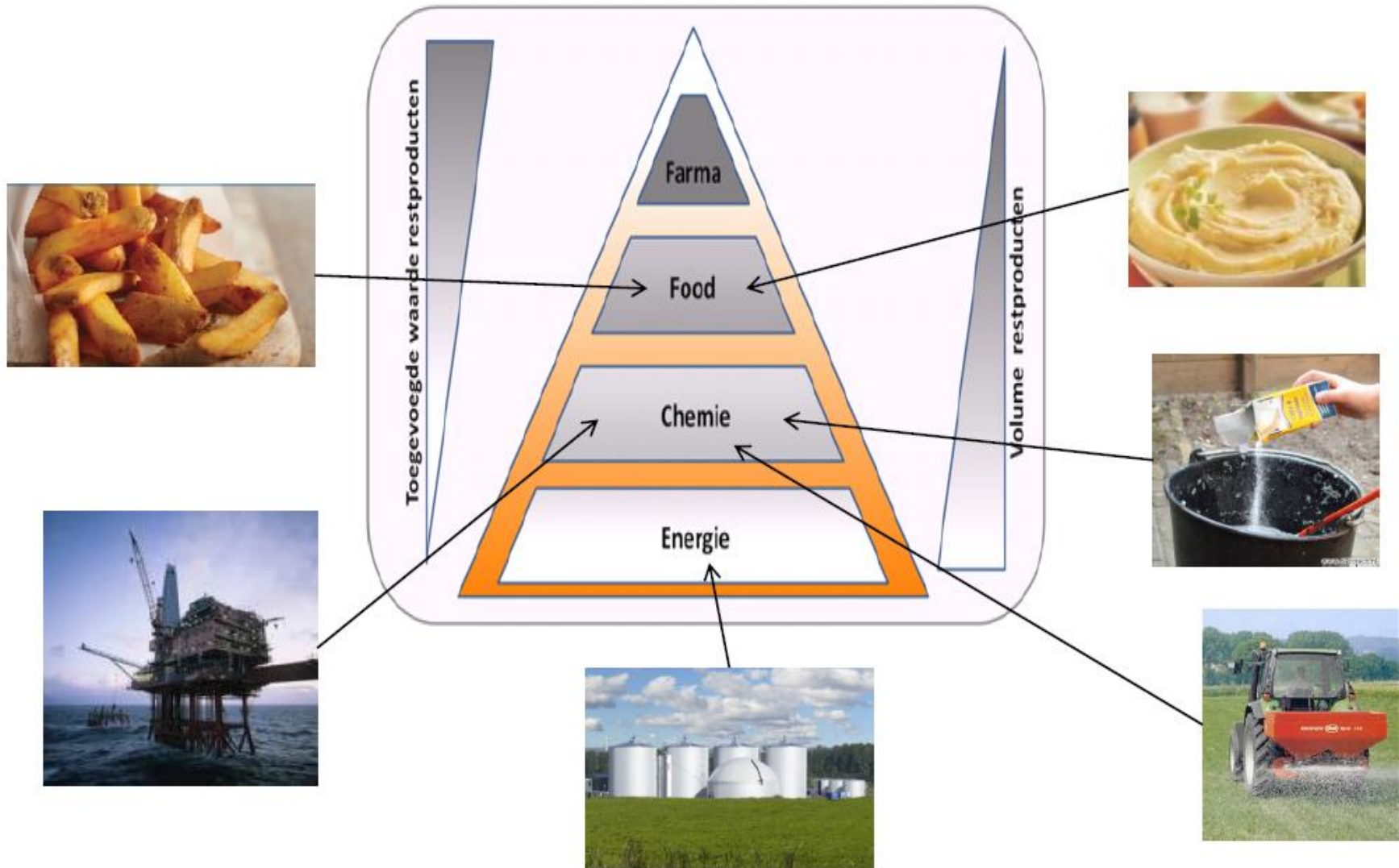
# Roughly 3 levels of biomass usage

- Biomass as it is, e.g. use of bamboo by mr Eek for Ikea
- **Biomass components, e.g. hemp fibers for building materials and cars**
- Molecules as building blocks, e.g. creating biobased PLA for plastics.



# Aviko en Duynie: Bioraffinage van aardappel

Aviko and Duynie (both part of Cosun): Potato Biorefinery actually exists.



# Roughly 3 levels of biomass usage

- Biomass as it is, e.g. use of bamboo by mr Eek for Ikea
- Biomass components, e.g. fibers for building materials
- **Molecules as building blocks, e.g. creating biobased PLA for plastics.**







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WAGENINGEN UR

Oke, so we have definitions, 3 principles and 3 product levels.

Next, what are the viewpoints on

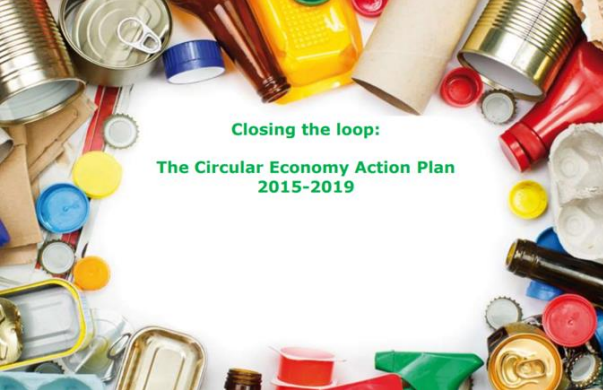
C.E. and Agriculture



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Closing the loop:

The Circular Economy Action Plan  
2015-2019



# A circular economy in the Netherlands by 2050

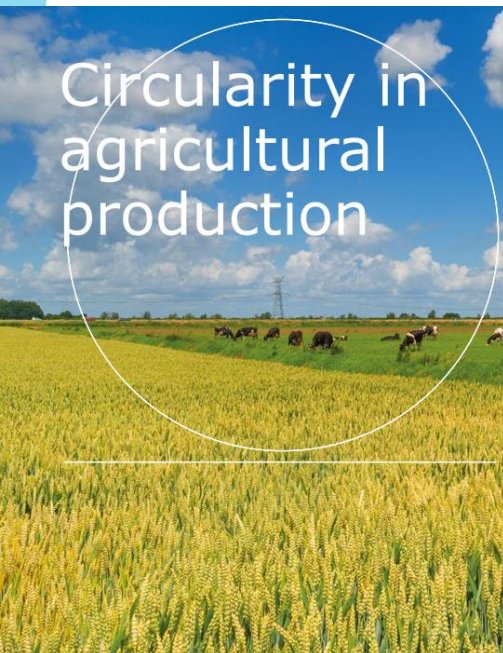


## Agriculture, nature and food: valuable and connected

The Netherlands as a leader in circular agriculture

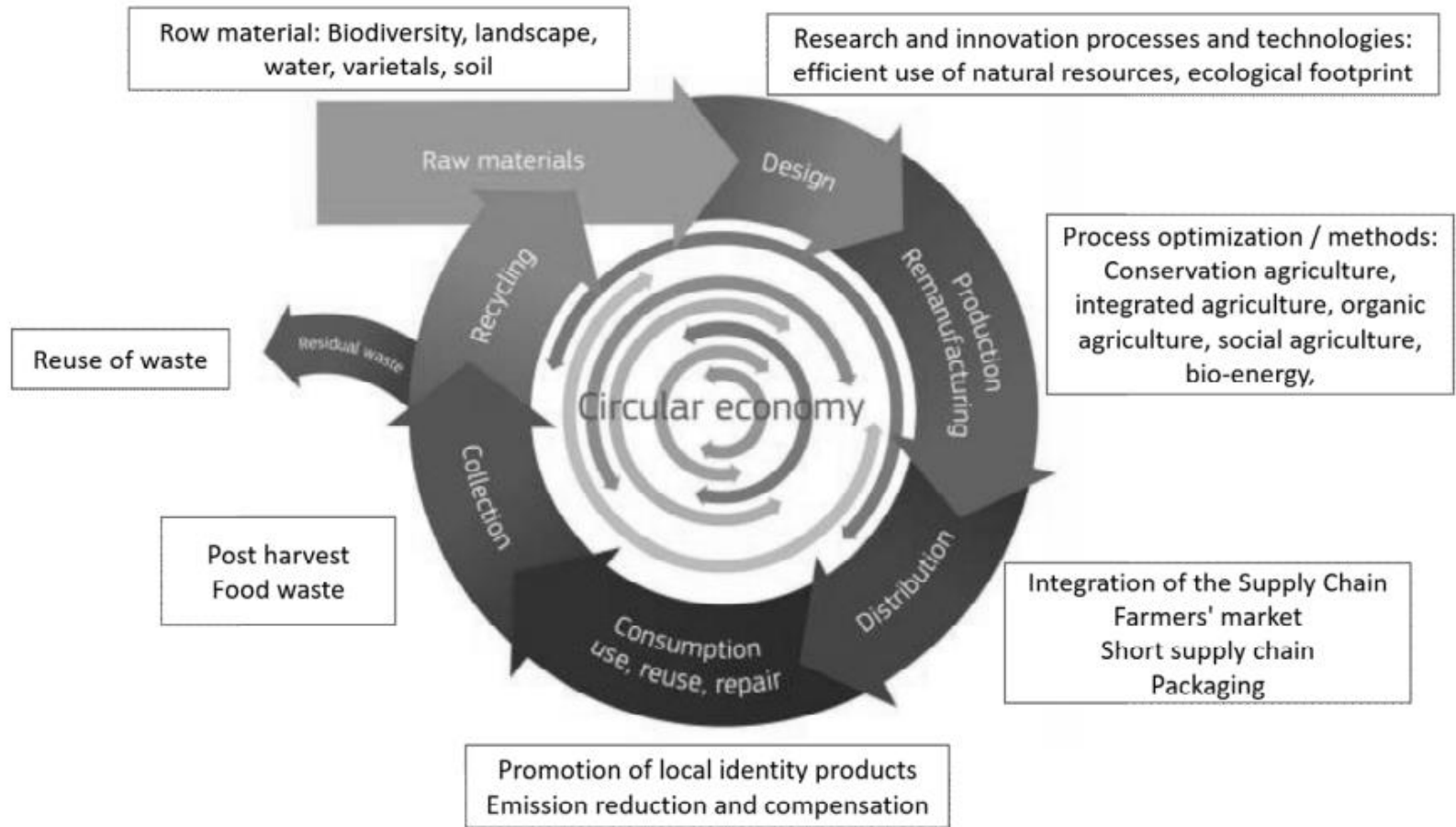


### Circularity in agricultural production





# Agriculture and the CE



(Source: Cristiano, 2016)



# EU Circular Economy Action Plan 2015-'19

## Specific on Food, water and nutrients

- Ensuring the sustainability of renewable bio-based materials.
- Propose a target on food waste reduction.
- Substitute single-use packaging, tableware and cutlery by reusable products in food services.
- Facilitate water reuse and efficiency, including in industrial processes.
- Reviewing directives on wastewater treatment and sewage sludge and will assess natural means of nutrient removal such as algae.





# Agriculture, nature and food: valuable and connected

The Netherlands as a leader  
in circular agriculture



Farming, horticulture and fisheries are essential sectors. Farmers, growers and fishermen feed the people. How this is done - globally - today, is not sustainable.



Things need to change. Instead of constantly reducing the cost of products, we need to focus on constantly reducing the use of raw materials through a more efficient use within cycles. This shift is possible.

In a circular agriculture system, arable farming, livestock farming and horticulture primarily use raw materials from each other's supply chains and waste flows from the food industry and food supply chains.

Agriculture holds an important key to further improvement of natural value in the Netherlands, but the sector can only achieve this if the entire system and all its participants cooperate.

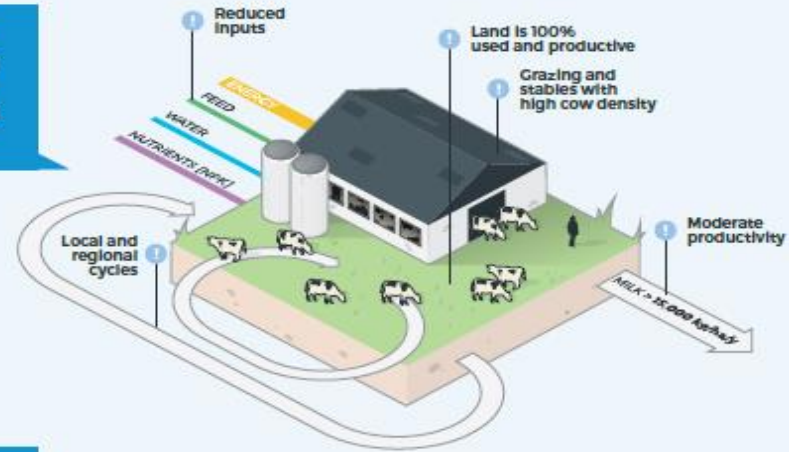


# THE CIRCULAR DAIRY ECONOMY

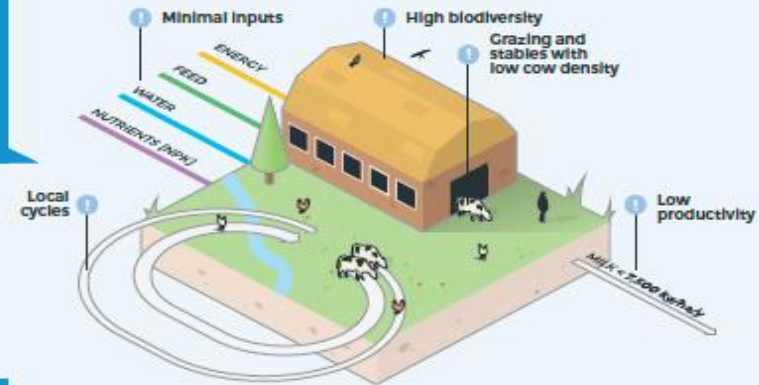
Exploring the business case for a farmer led, "net-positive" circular dairy sector



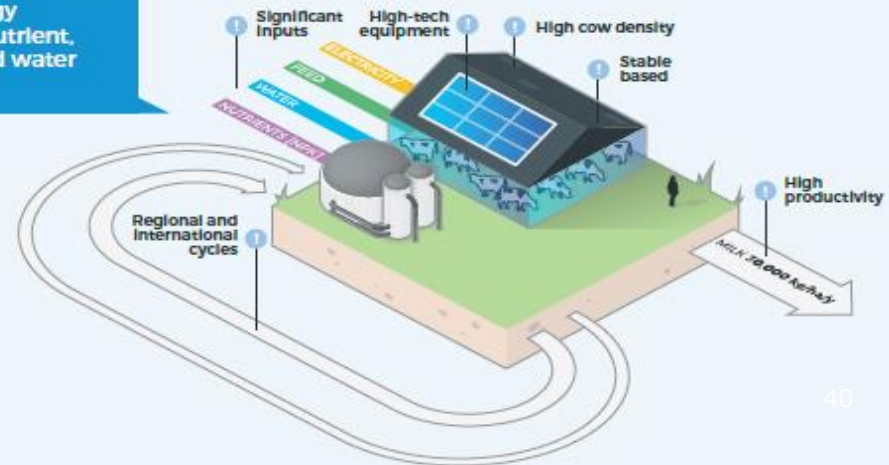
**OPTIMISED GRAZING** maximises land productivity while leveraging biological and technological processes to achieve circularity.



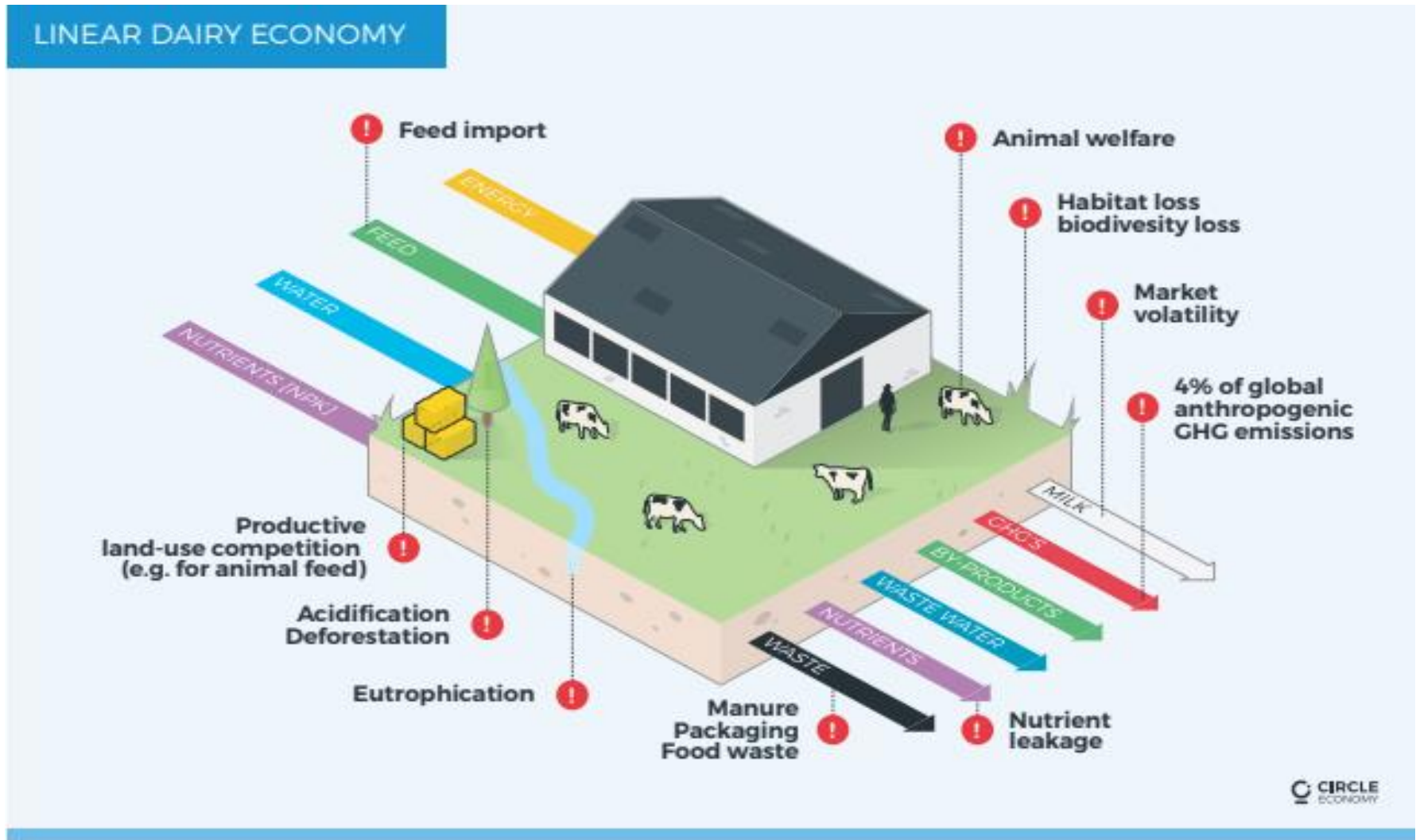
**EXTENSIVE GRAZING** is inspired by biological processes and organic farming to close the soil-plant-animal-manure cycle locally.



**INTENSIVE HIGH-TECH** leverages technology solutions to close nutrient, greenhouse gas and water cycles.



# Characteristics of the Dutch dairy sector




















# Transition pathways

Biological & technological

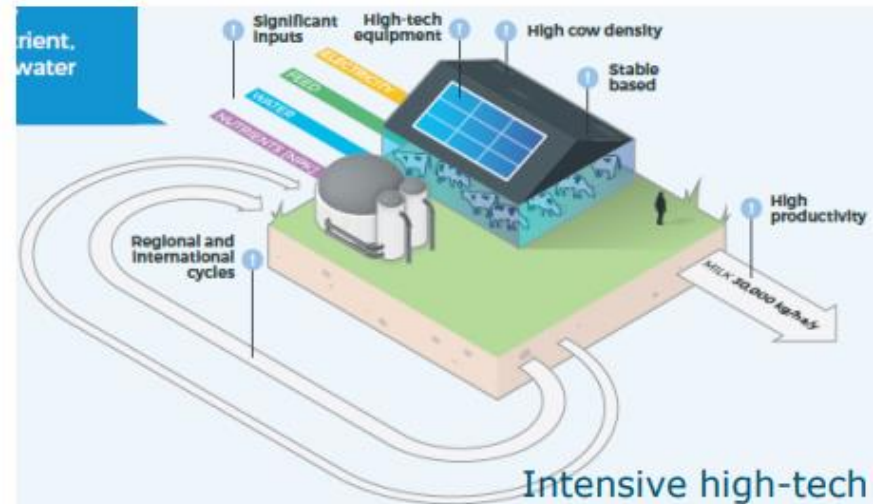
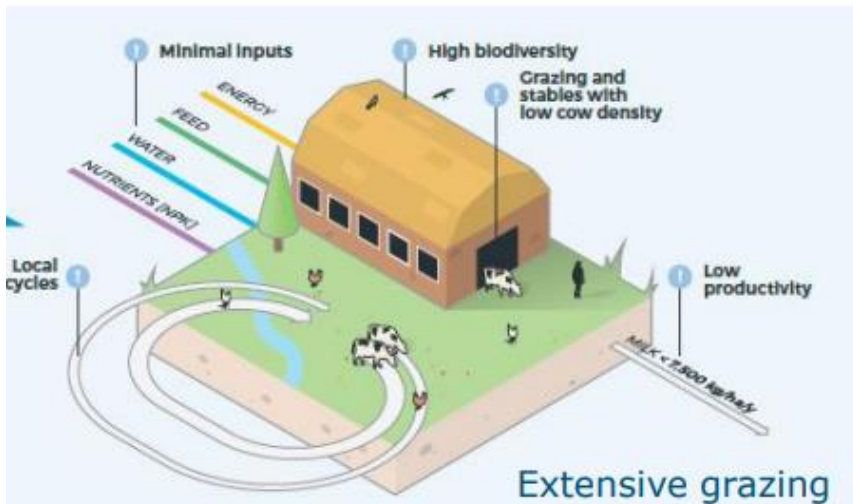
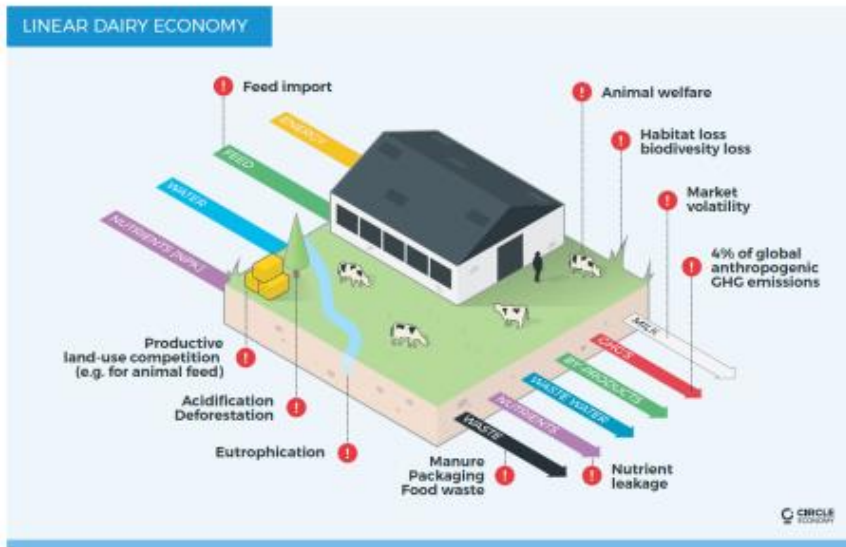
Biological

Technological

Circularity indicators		Optimised grazing	Extensive grazing	Intensive high-tech
Circularity potential	Nutrient cycle			
	GHG cycle			
	Biodiversity			
Productivity & business	Best practice productivity	 > 15,000 kg/ha/y	 < 7,500 kg/ha/y	 30,000 kg/ha/y
	Capital intensity	 Low	 Moderate	 High
	Key levers	Farm economics Technology	Regulation Consumer marketing	Technology Regulation
Farmers & value chain	Farmer profiles	'Virtue' farmers	'Rights' farmers	'Utility' farmers
	Value chain	Preserved role Regional	Smaller role Local	Greater role International



# Linear versus circular dairy farming



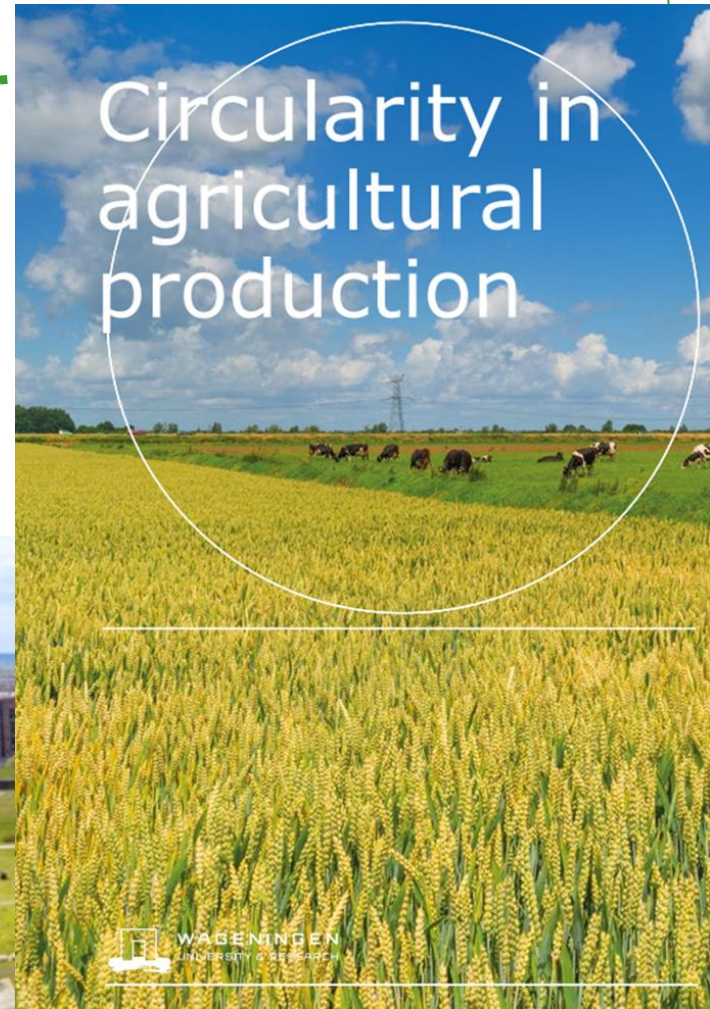
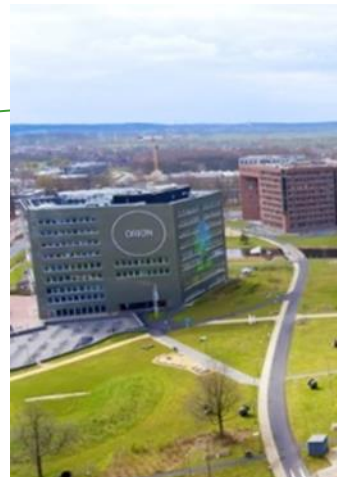


Oke, so we have definitions, 3 principles and 3 product levels.

Next, what is the viewpoint from..

Wageningen UR?

Circularity in  
agricultural  
production

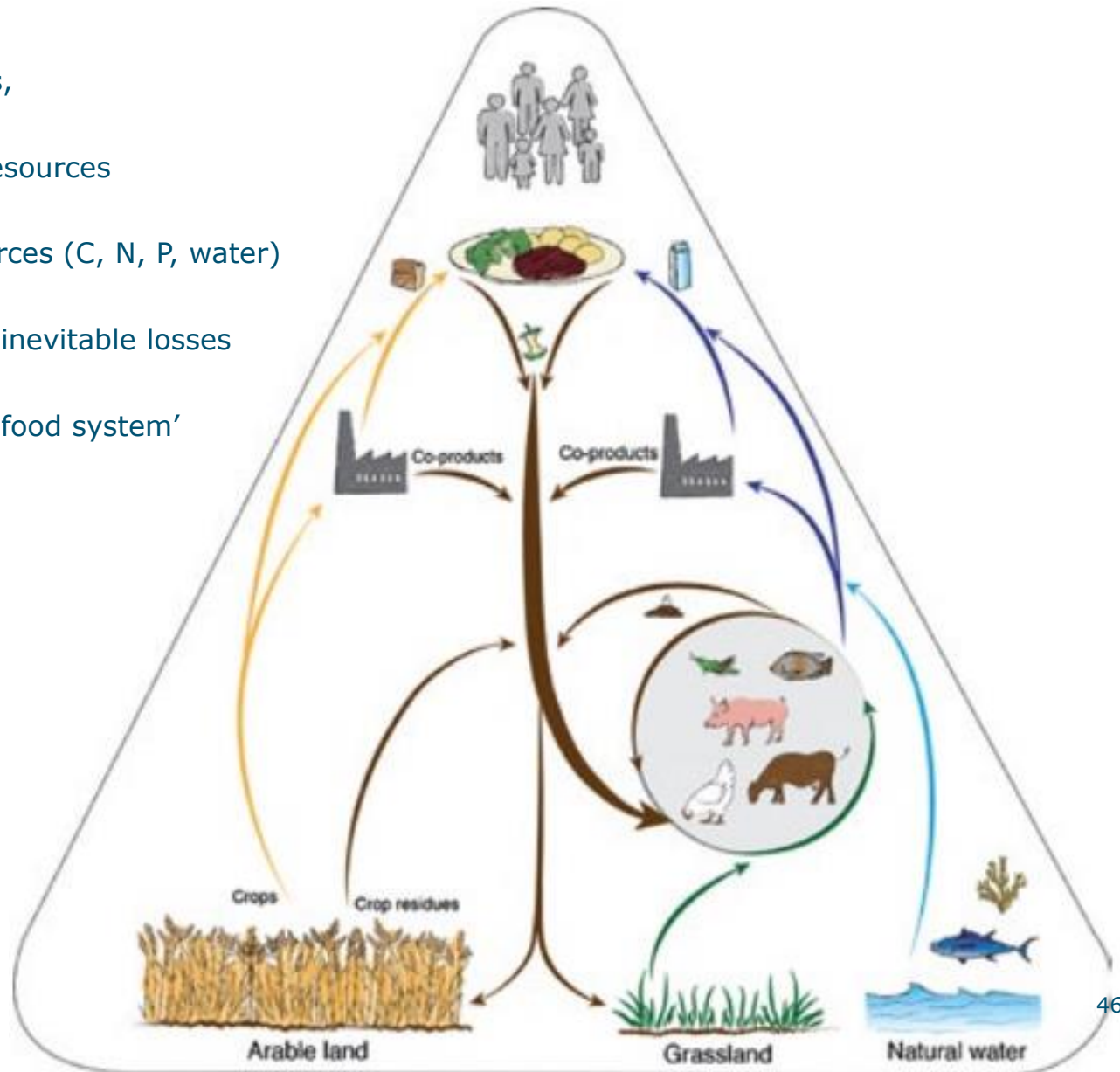


# Towards a circular agriculture and food system in Europe, Mansholt lecture (2018)

- EU CAP: never shortages + decent farmer income  
⇒ high volumes, low prices; diverse; safe food; export
- Unintended consequences
  - soil degradation; inputs dependency; poor animal welfare; pollution; GHG emissions; reputation loss
- Paradigm reset needed: optimisation above productivity!
  - Starting point is the carrying capacity of soils
  - Optimise a food system, not a farm or cow.
  - Integrate animals and plant production

# A more circular food system implies:

- Minimize input finite resources,
- Encourage use regenerative resources
- Prevent leakage natural resources (C, N, P, water)
- Stimulate reuse and recycling inevitable losses
- ‘...to add highest value to the food system’

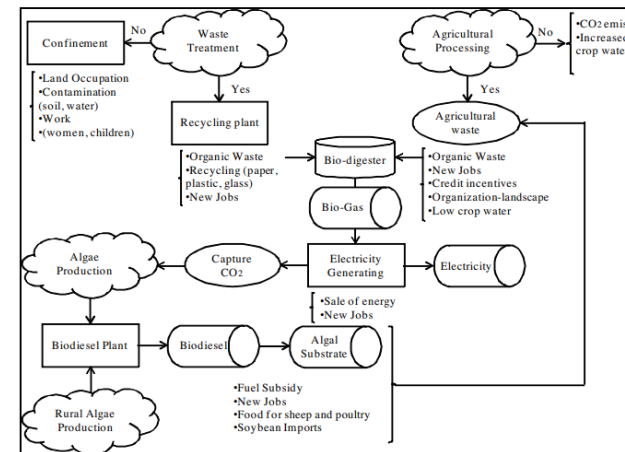


# Circularity in agricultural production

## 3 Principles:

1. Plant biomass is basic building block, for humans first
2. Recycle by-products, co-products, and food losses back into the food system.
3. Use animals to transfer remains. Manure and excreta may enrich soil and crops.

Broader applications (biochem., pharma, energy) and seafood (fish) and algae largely excluded.





# Sub 1 Plant biomass basic building block.

- Most crops not optimised for entire crop yield
- Intercropping 22% higher yields than av. sole crops
  - Esp cereals + legumes, for nitrogen fixation
  - (+crop rotation) lower pests, weeds, and diseases
- 20-50% yield differences for organic vs mainstream
- Integrated crops-livestock-forests systems (ICLF)

**Agro-ecosysteem**  
integratie van agroecologische bouwstenen



Example: Open cultivation in Circular agriculture



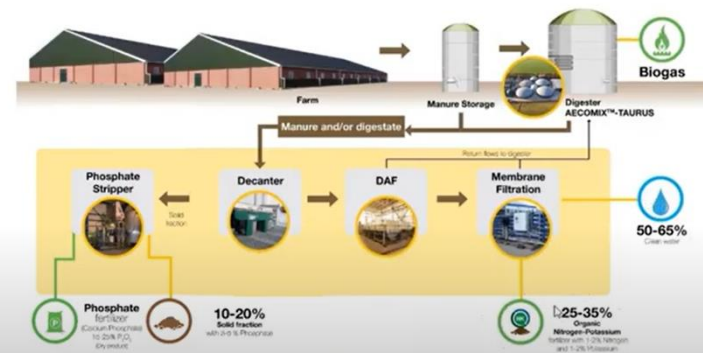
# Sub 2: Recycle by-products, co-products, and food losses back into the food system.

Suited soil organic matter (SOM) location-specific.

Addition suited till 1,5-3,5% SOM-level.

- Thereafter, max 2 tonnes p.ha p.a. organic matter.
- C-sequestration effective in peatlands and cold areas.
- Manure for nutrients & digestate for fertilisers
- Processing into manure fractions

Demonstration plant Groot Zevent Digestion (NL)





# A paradigm shift needed

## The role of animals in a Circular agrofood system

In 2050, the global population will have risen to 9.5 billion people. In a circular food system we can use the current available agricultural land to provide the growing world population with food, without causing any extra burden to the earth. An essential part of this system is in establishing smart connections between plant-based and animal products, in order to create an integral agrofood system.

[www.wur.eu/circularfood](http://www.wur.eu/circularfood)

### LAND

Manure from the animals contributes to a fertile healthy soil and **improves crop yields**.

### CROPS

Only 30% of the crops are suitable for human consumption. We can use the other parts and **residual flows** from agriculture and the food industry to produce **animal feed**.

### CATTLE

Cattle and sheep can consume grass and herbs in pastures that are unsuitable for growing food, such as the peat **grasslands** in the Netherlands.

### MANURE

Manure is also a valuable source of organic material that **replenishes the soil** and completes the circular agrofood system.



## Sub 3: Use animals to transfer remains. Manure and excreta may enrich soil and crops.

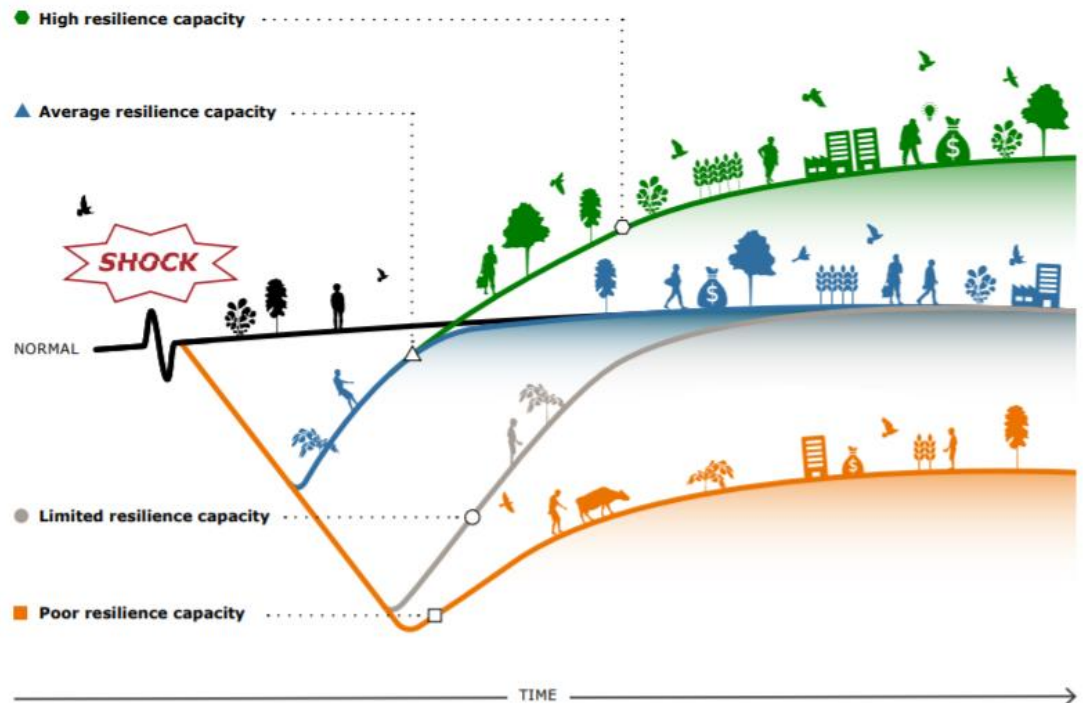
- Convert low-opportunity—cost feeds into valuable food, manure and other products.
- Frees up ¼ global arable land. Better than vegan and current diets.
- Provides max. 25gr p.p.p.day (Europe).
- Dual purpose food-feed crops
  - soybean oil & meal; maize as grain & green stover
- Sequestration by grass lower than GHG of ruminants



So we have definitions, and viewpoints.

Now how does it help

food system resilience



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# Food system resilience is:

Capacity of food systems to deliver desired outcomes in the face of *shocks* (Covid19) and *stressors* (climate change).

- Based on inherently stable ecosystems
- Multiple types of resilience
  - Agricultural, ecological, economic, political, social
  - => Hand in hand with sustainable development



# Stagnating SGD-outcomes (WEcR, 2021)

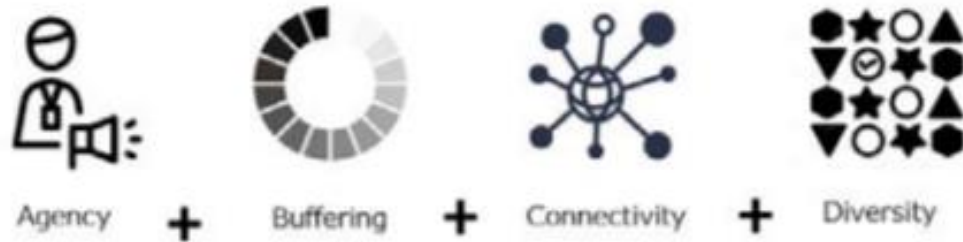
<b>Stagnating outcome 1: Food and nutrition security</b> (SDG 2, 3, 6)	<b>Stagnating outcome 2: Equitable livelihoods</b> (SDG 1, 5, 8, 10, 11)	<b>Stagnating outcome 3: Sustainability</b> (SDG 6, 13, 15)
<p>Despite the global commitment to end hunger by 2030 (SDG 2) and decades of decline in world hunger, the most recent estimates show that if recent rates of increase persist, the global number of undernourished people in 2030 would exceed 850 million (UN FAO et al., 2020).</p>	<p>Action Track 4 of the Food System Summit emphasises how inequality and power imbalances constrain the ability of food systems to deliver poverty reduction and equitable livelihoods. For the first time in over 20 years, global extreme poverty levels rose in 2020 as COVID-19 compounded the impacts of conflict and climate change (World Bank, 2020).</p>	<p>Climate change is threatening all aspects of the food system. Although global ambitions to tackle climate change were set in the Paris Agreement, the global community is a long way off track meeting either the 1.5 or 2 degrees targets. As a result of this, the frequency and severity of natural disasters is expected to increase, exacerbating food insecurity and poverty (UN, 2020).</p>



# 5 resilience capacities (WEcR, 2021)

- **Anticipation:** Capacity to manage risks and plan strategies to deal with shocks when they occur.
- **Prevention:** Preventive actions to mitigate the effects of expected shocks or stressors.
- **Absorption:** The ability to cope immediately with the effects of shocks and stressors.
- **Adaptation:** The capacity to adapt strategies and actions while maintaining stable functioning of the system.
- **Transformation:** The capacity to transform the entire system.

# The ABCD of food system resilience building



- Agency > Understanding individual behaviour, as well as community responses
- Buffering > An economic asset, to be preserved or strengthened at the appropriate level
- Connectivity > At different levels (community, firms, country) with different means (infrastructure, communication, relationships)
- Diversity > Not just in nature, but in the entire food system

# Resilience and the Circular Economy (Circle Economy)

- In cycling resources, C.E. raises resilience by increasing the diversity of feedstocks;
- In sharing resources, C.E. increases resilience through localised management and participation of stakeholders;
- Decentralised activities and infrastructure increase resilience by bringing governance bodies closer to communities, raising participation and lowering hyperspecialisation





Thank you for participating.  
By  
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