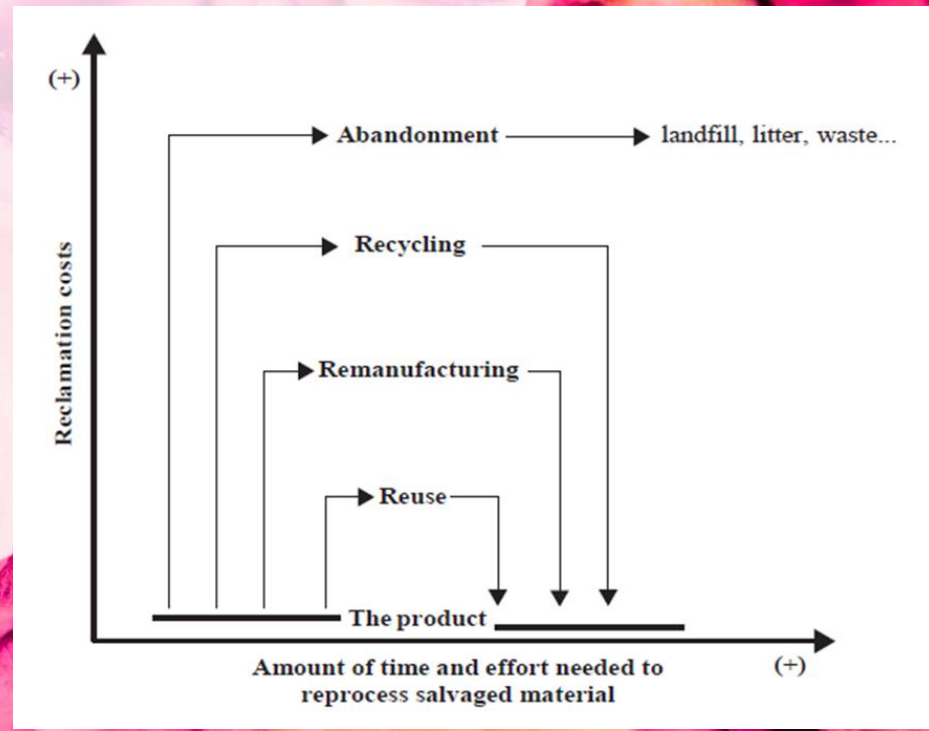


# Visions for improving circular economy in the food system in Finland

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Bioeconomy and Environment,  
Sustainability Science and Indicators

# Circular Economy in the food system

- Nutrient recycling in agriculture
- Food waste minimization in the food chain and resource efficient concepts
- Sustainability assessment of the food system

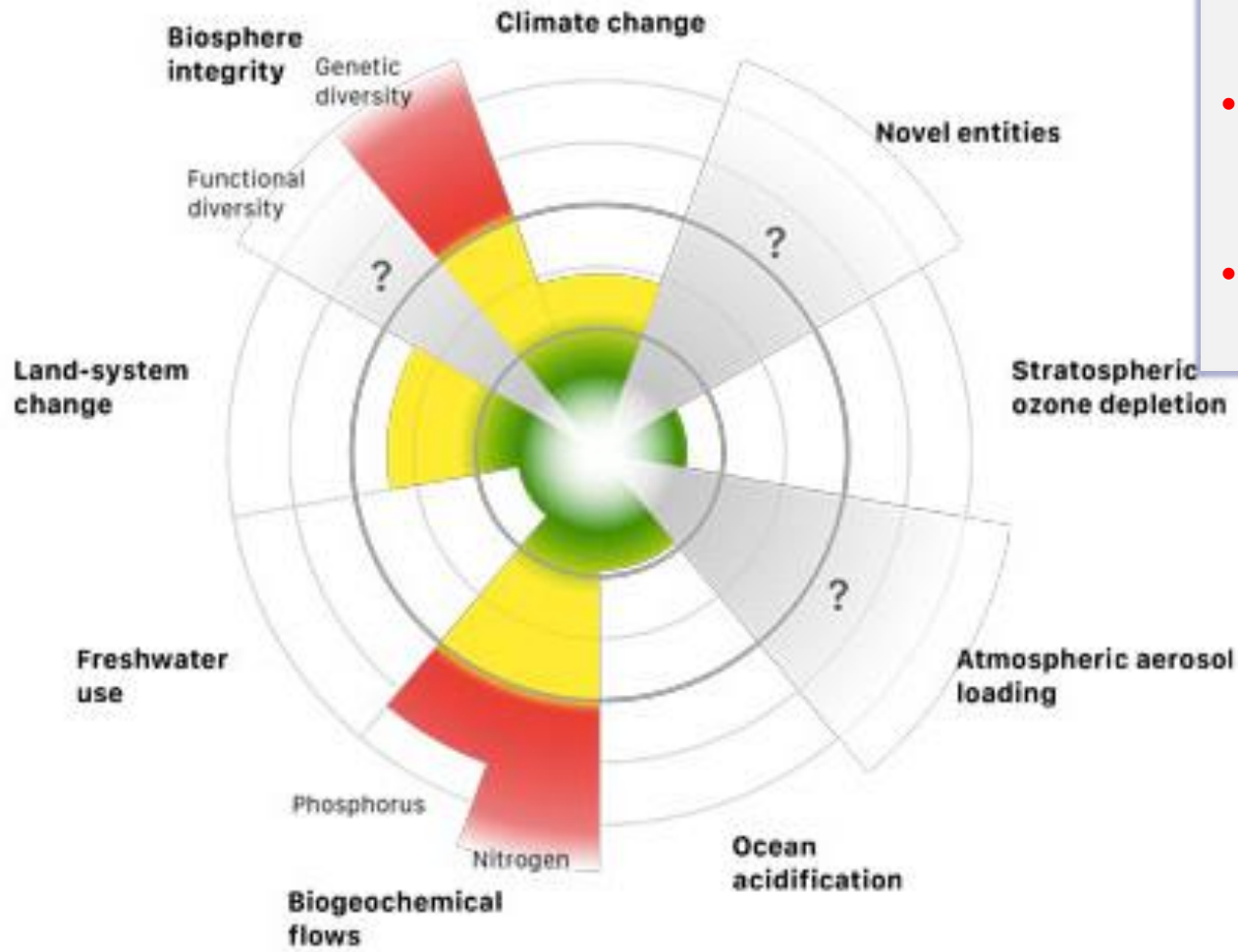




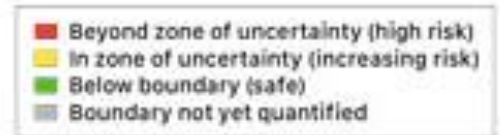
# Circular agriculture – circular food economy

- *“I want to have my products near by.”*
- *Food crises*
- *Protein crises*

# Planetaarinen järjestelmä



- 814 million hungry
- 2 billion living in hidden hunger
- 1.2 billion living in scarcity of water

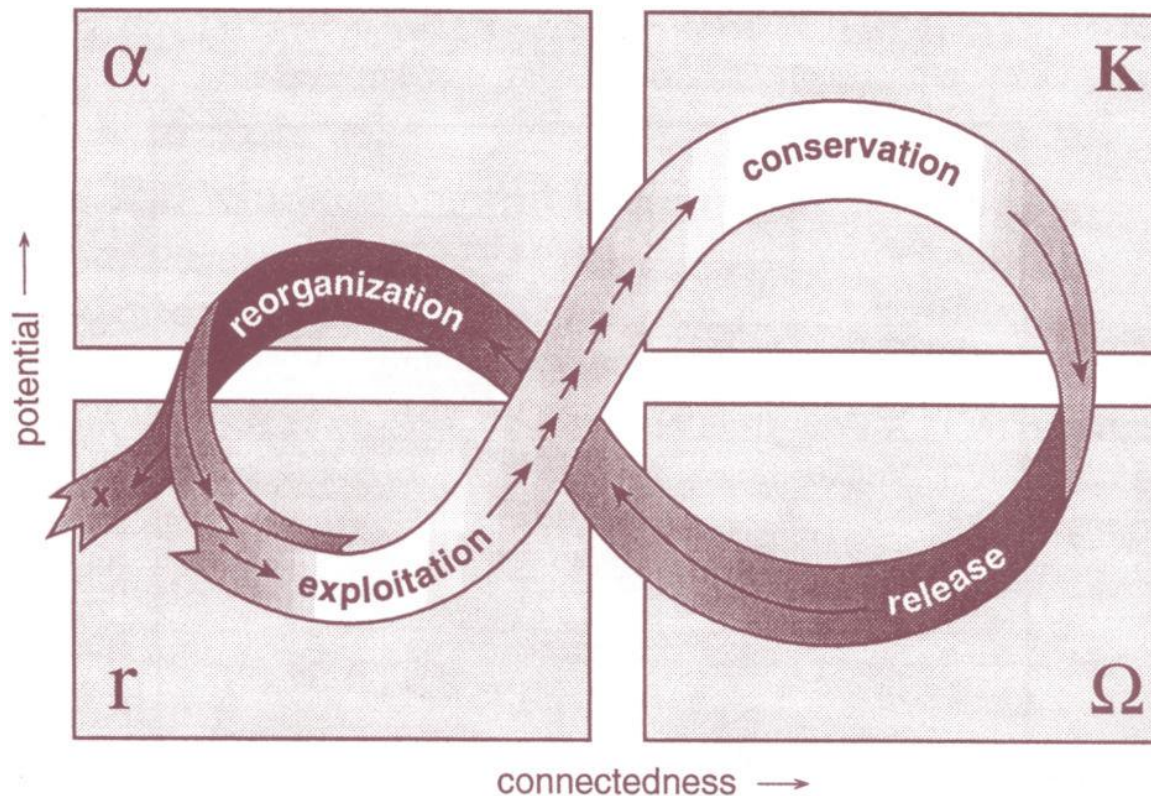




# Hypothesis

- Raw materials will be utilised more efficiently, as new processing and bioprocessing methods and their cascades are wisely used in food and feed production.
- These processes bring about research-supported ingredients and products, which are healthy, tasty, high-quality and sustainable.





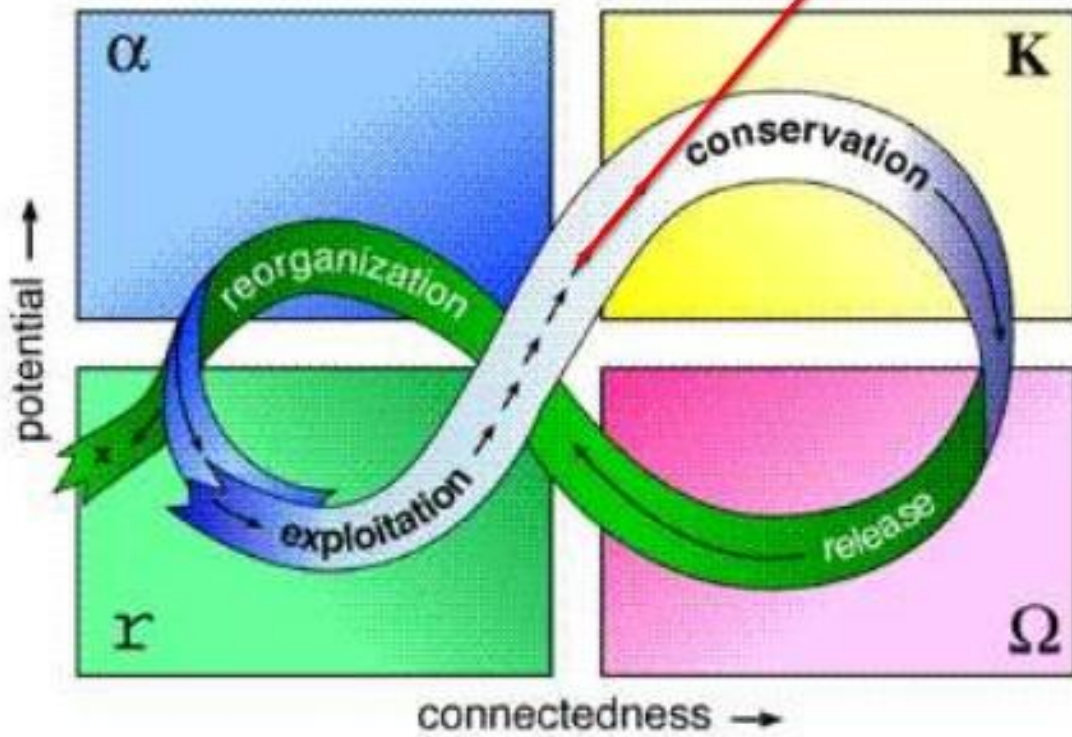
The trajectory alternates between long periods of slow accumulation and transformation of resources (from exploitation to conservation, or  $r$  to  $K$ ), with shorter periods that create opportunities for innovation (from release to reorganization, or  $\Omega$  to  $\alpha$ ).

Figure 4. A stylized representation of the four ecosystem functions ( $r$ ,  $K$ ,  $f_1$ ,  $x$ ) and the flow of events among them. The arrows show the speed of the flow in the cycle. Short, closely spaced arrows indicate a slowly changing situation; long arrows indicate a rapidly changing situation. The cycle reflects changes in two properties: the y axis (the potential that is inherent in the accumulated resources of biomass and nutrients) and the x axis (the degree of connectedness among controlling variable). The exit from the cycle indicated at the left of the figure suggests, in a stylized way, the stage where the potential can leak away and where a flip into a less productive and less organized system is most likely (Holling 1986). (Re- printed from Gunderson and Holling 2001 with permission of Island Press) and



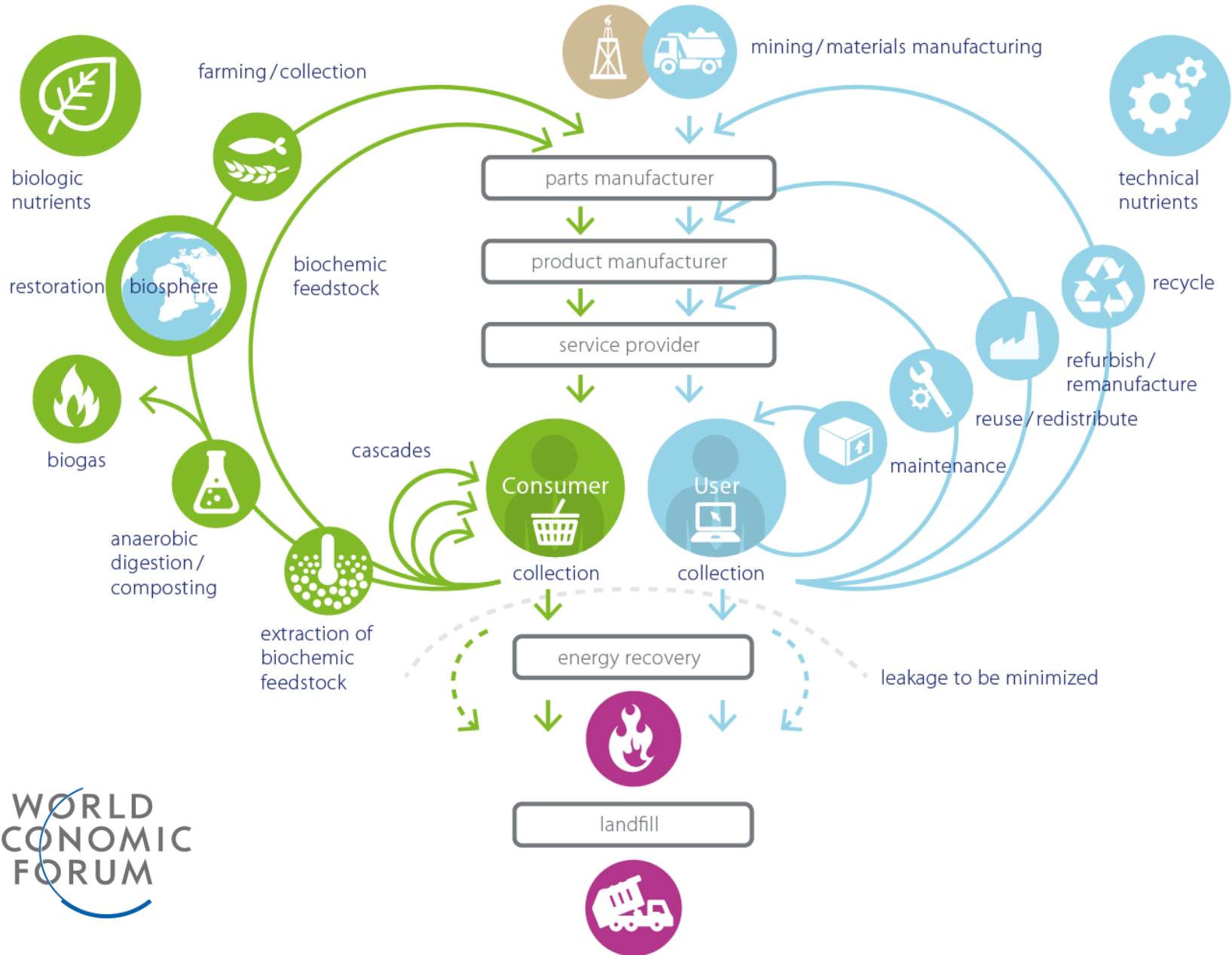
# Adaptive Cycles of Complex Adaptive Systems

We are stuck here in accumulative self-reinforcing self-multiplying feedback loops (r to K) with little renewal of the system



There is no Invisible Hand (Adam Smith)  
 There is no Creative Destruction (Schumpeter)  
 The system accumulates risk and fragility  
 Release is increasingly violent and long to get over

Panarchy - Gunderson & Holling 2002





# An EU Action Plan for the Circular Economy

**Funding** of over **€650 million** under Horizon 2020 and **€5.5 billion** under the structural funds;

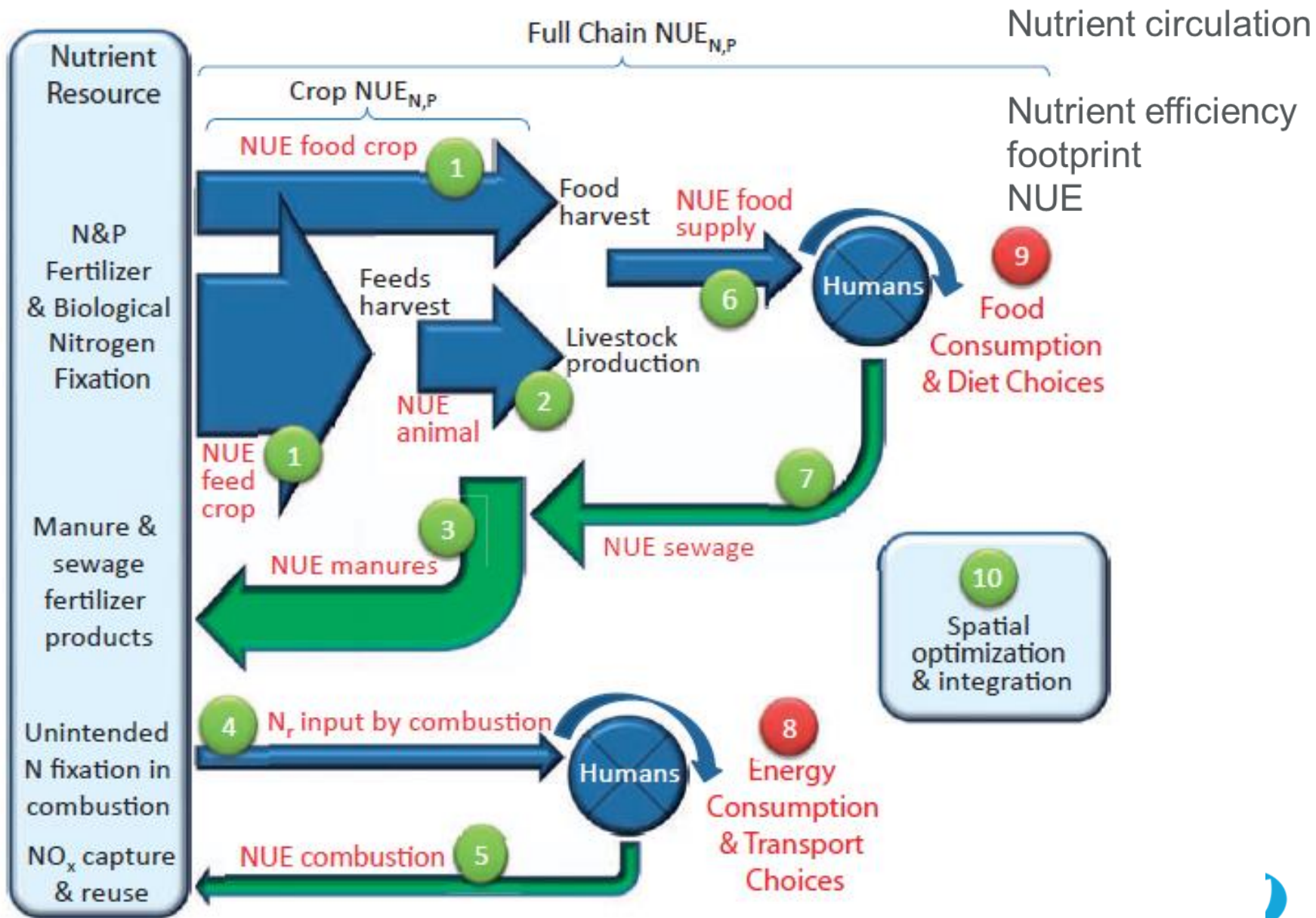
- **Actions to reduce food waste** including a common measurement methodology, improved date marking, and tools to meet the global Sustainable Development Goal to **halve food waste by 2030**;
- Development of **quality standards for secondary raw materials** to increase the confidence of operators in the single market;
- Measures in the **Ecodesign working plan for 2015-2017** to promote reparability, durability and recyclability of products, in addition to energy efficiency;

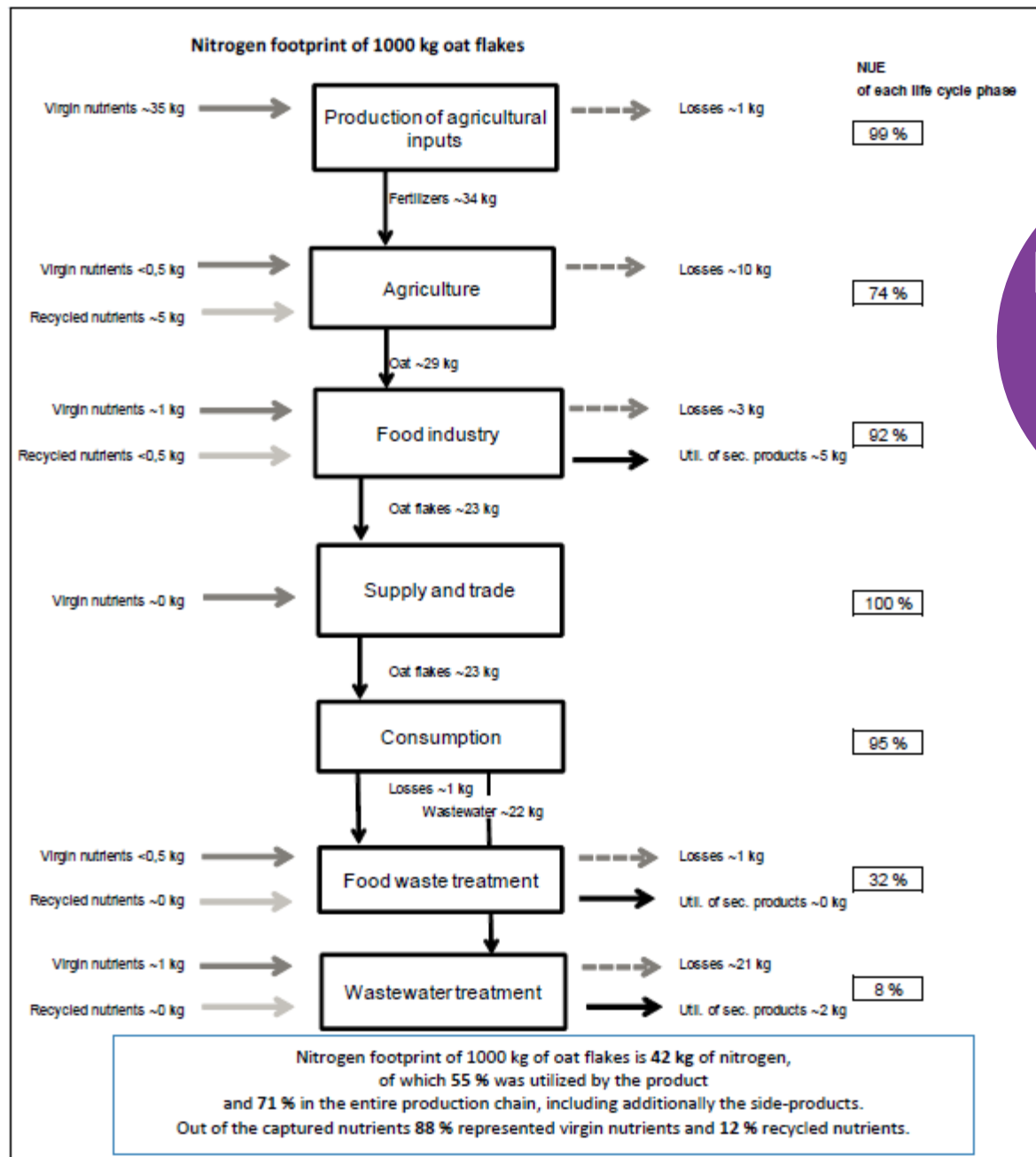
# An EU Action Plan for the Circular Economy

- A **revised Regulation on fertilisers**, to facilitate the recognition of organic and waste-based fertilisers in the single market and support the role of bio-nutrients;
- A **strategy on plastics in the circular economy**, addressing issues of recyclability, biodegradability, the presence of hazardous substances in plastics, and the Sustainable Development Goals **target for significantly reducing marine litter**;
- A series of **actions on water reuse** including a legislative proposal on minimum requirements for the reuse of wastewater.



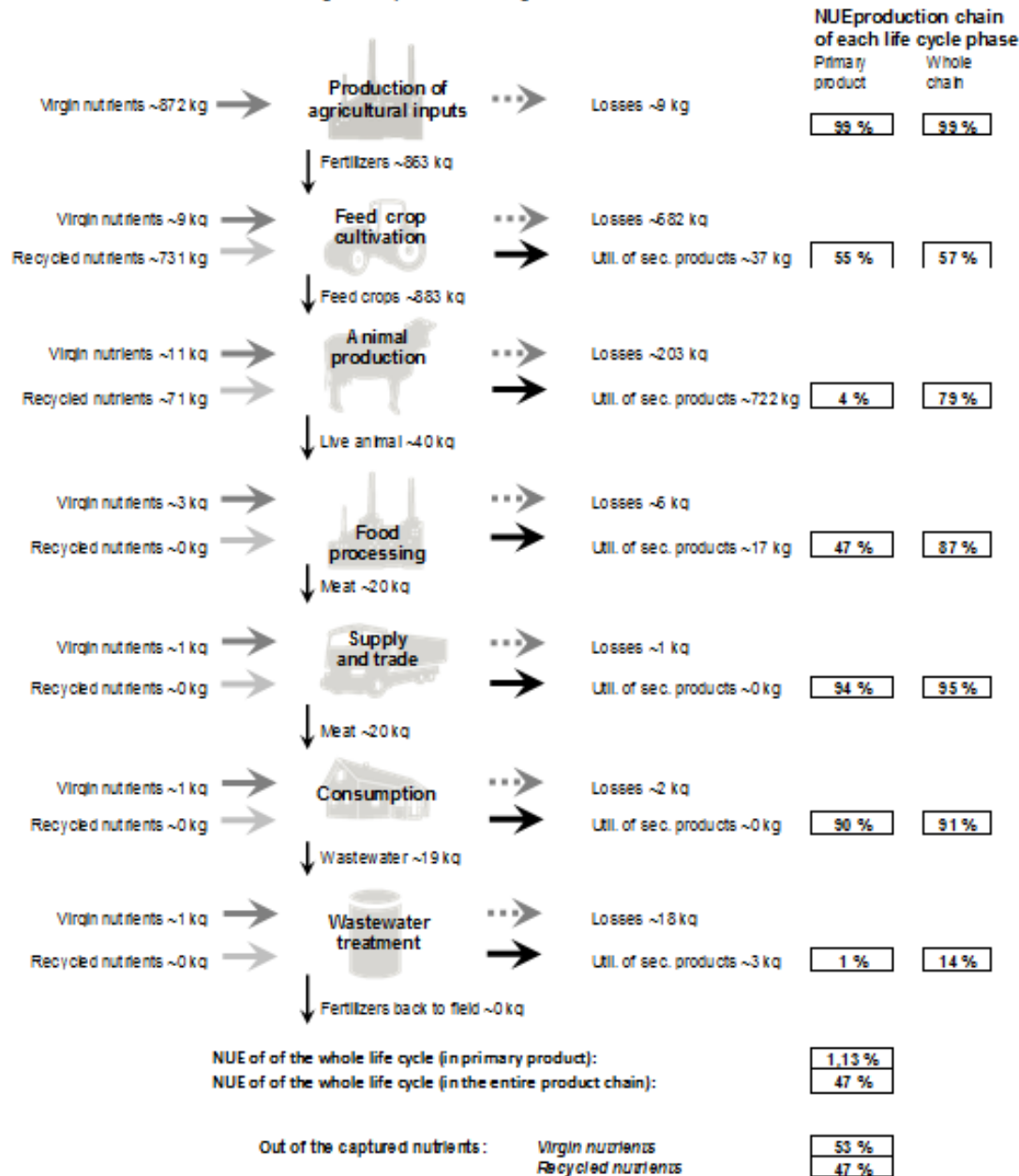






Nutrient efficiency footprint  
NUE

Nitrogen footprint of 1000 kg beef

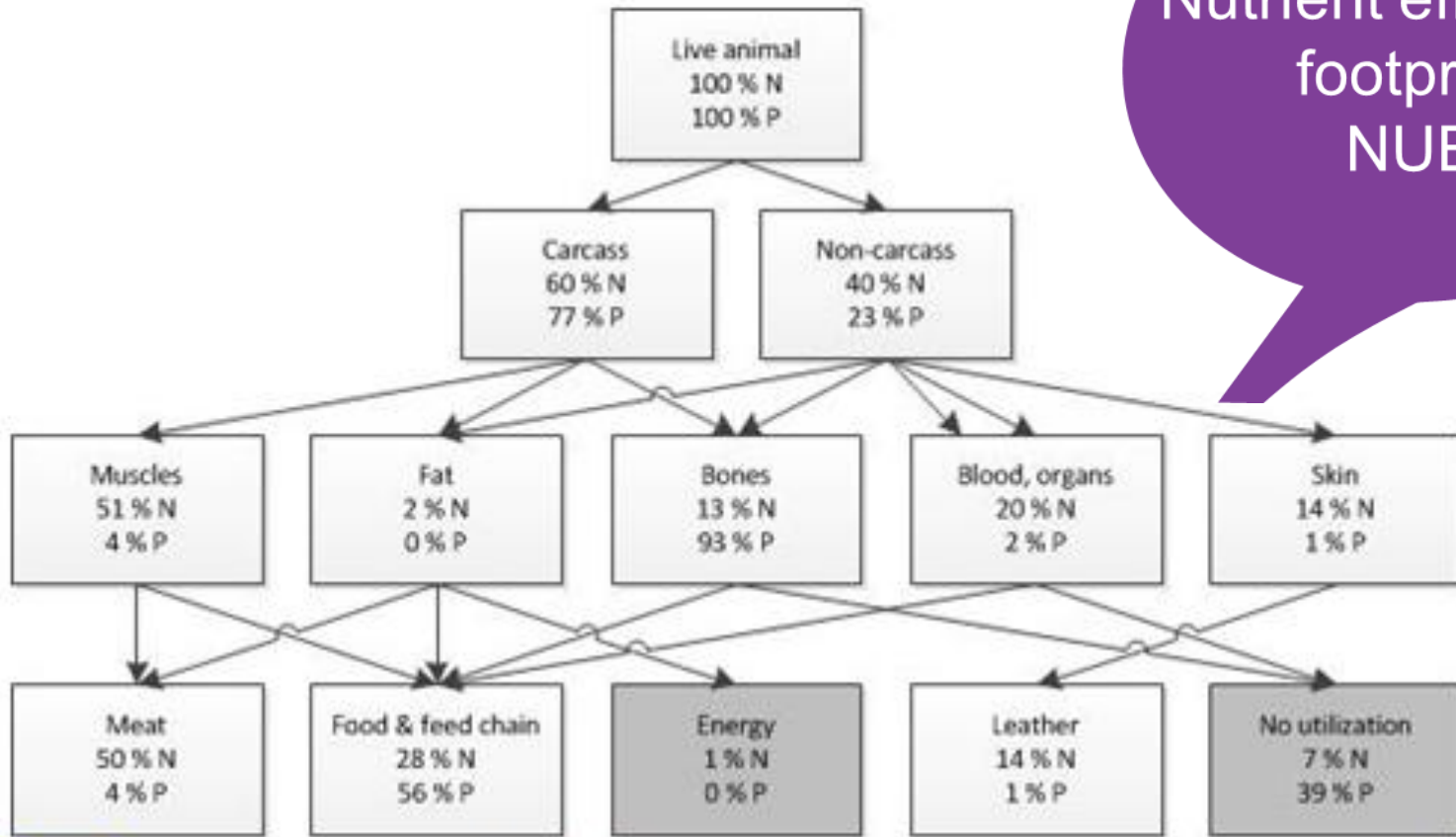


Confidential draft

Nutrient efficiency footprint NUE



Nutrient efficiency  
footprint  
NUE



Flow of animal N and P from slaughter to retail. Grey boxes: the nutrients are not utilized after this step.

# Re- concepts for circular food economy

- **Reduce** - food waste
- **Reuse** – excessive food
- **Revive** – re-process
- **Recycle** – carbon and nutrients
- **Regenerate** - carbon regeneration
  
- **Redefine** – resource needs
- **Re-imagine** – potential uses
- **Redesign** – new products
- **Replace** - substitutes
- **Rebuild** – supplements
- **Reassess** – LCA
  
- **Reform** – new formulations
- **Reorganize** - holistic change of a food chain
  
- **Resilient:** adaptability, transformability, persistence, preparedness

# Food revolution/Protein revolution reorganisation - reform

Side flows from  
conventional raw  
materials

- Slaughtereries
- Fish processing

Novel raw materials

- Sea weed
- Single cell  
protein



All combinations between these



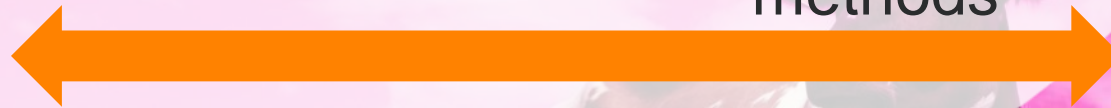
# Circular economy redesign, rebuild, replace, reassess

Sophisticated, long value chain, national/global approach

- Functional ingredients

Nature close, short value chain, local/regional circular approach

- Natural component preserving methods



All combinations between these



# Circular economy

## reduce, reuse, revive,

- Food efficiency
- Feed efficiency
- Supplements
- Additives
- Synthesis of new compounds
- Naturalness
- Robust animals
- Nature based functional impacts
- Nature derived bioprocessing



All combinations between these



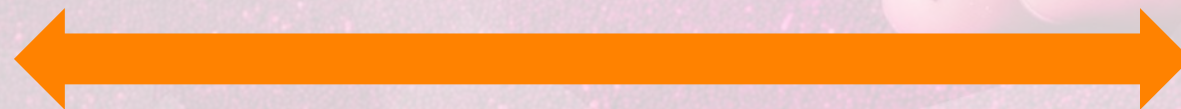
# Circular economy

## Risks

- Heavy metal accumulation
- Other toxic compounds

## Benefits

- Suppressive bioactive compounds
- Biodegradation of organic contaminants
- Primary metabolites
- Phytochemicals



All combinations between these

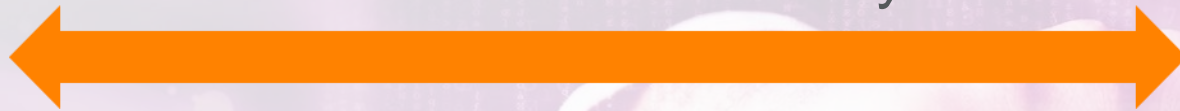
# Circular economy - redefine, reimagine

Building up new ideas

- at present excessive

Escaping from old ideas

- PAP
- Recycled fertilisers



**Circular economy – transformation**

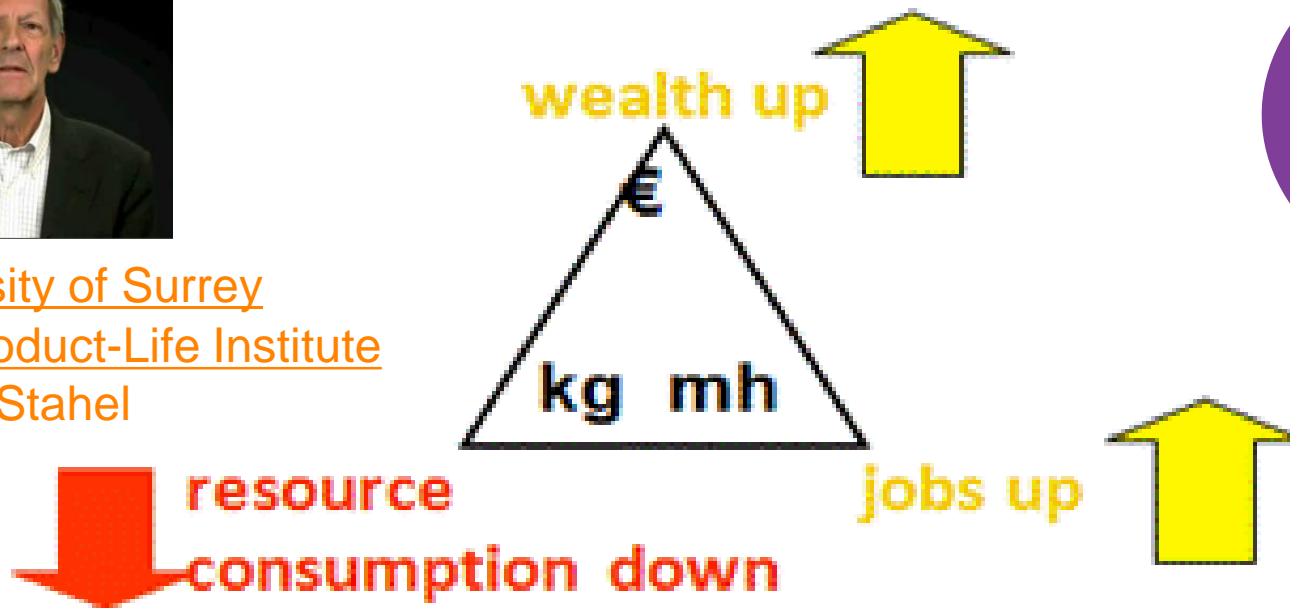
**Resilience**



The objectives of the Performance Economy:  
decoupling growth, as well as job and wealth creation,  
from resource consumption : **higher sustainability** ....



University of Surrey  
The Product-Life Institute  
Walter Stahel



28/01/2013

The Performance Economy

7

## Producing Performance

- **Circular economy**: reduce, reuse, remanufacture, recycle
- new metric of the value-per-weight ratio (€-per-kg) to measure **wealth creation in relation to resource consumption**
- **resource efficiency (rebound impact managed)**
- strategies how to significantly boost this ratio up

## Managing Performance over Time

- the new metric of the labour input-per-weight ratio (man hour-per-kg) **to measure job creation in relation to resource consumption** and highlights ways to radically increase this ratio by preserving value
- business models used focus on **extending the service-life of goods and components through reuse, remanufacturing and technological updating**
- Legitimacy from **EU waste directive and development of circular economy**

## Useful tool for tomorrow's functional service economy?

- introduces the business models that turn knowledge into **better performance**, more jobs and greater wealth,
- describes how to improve the processing, product **service sales and performance over time**,
- shows how innovations in traditional sectors can **preserve embodied resources** and create both manual and skilled jobs, resulting in **lower unemployment, lower energy consumption, less waste and greatly reduced resource throughput** – major ingredients for economic growth.
- Introduces new **decoupling metrics** to measure the **relation between value, jobs and resource consumption**



## Selling Performance

- business models that enable entrepreneurs to achieve synergies by profitably exploiting the three objectives of **more value, more jobs and considerably less resource consumption**
- procurement strategy of **buying performance** instead of goods
- selling performance has a strong environmental component because it **internalises the costs of risk and of waste and rewards sufficiency solutions and systemic solutions**

## The Performance Economy

- At policy level: bridges the gap between the 2010 Lisbon Objectives of the European Union - **higher growth and more jobs** - and the **sustainability objective** to greatly reduce the resource consumption - energy and materials - especially of industrialised countries
- At practical level: **exploits sufficiency and prevention as profit strategies**



Global  
Innovation

Local - Global Society  
Local - Global Market



Structural change of enterprises, entrepreneurship and regions

Requirements of overall sustainability

Global Society Markets

Natural resources use



Global Society  
Market

Climate, energy and  
natural resources  
policies

Market functionality  
and Competitiveness  
of Finnish  
Bioeconomy

**Global  
innovations**

# Food System



**Circular economy  
in food system**

**Innovative primary  
production**

**Smart  
agriculture**

**Healthy and  
sustainable food and  
feed**



Consumers and  
markets

Innovative  
Food System



# Consumers and markets

- Understanding the customer
- Consumer-oriented creation of business value
- Development of product and service chains

# Stakeholders who need information

- Farming sector
- Food business companies developing products to the domestic and export markets – SMEs and larger companies
- Retailing sector
- NGOs such as consumer organizations, producer organizations, animal welfare or environmental groups
- Government authorities



## Topical questions in this focus area

- Consumer future needs – How to identify and respond to them?
- Consumers are heterogeneous - How products and services can be tailored to meet individual needs?
- Valuing attributes and trade offs - How to extract market price premium for quality characteristics?
- How to pass the premium along the supply chain?
- Can novel operational business models add value to the business (e.g. Reko)?
- How to measure preferences and choices made by the consumers and producers in a robust manner?

# Circulate Food System

## Genomics and breeding

- Genetic diversity
- Genomic (incl. microbiome) understanding of key traits (animal, plants)
- Development of breeding methodologies (genomic selection, genome editing)

## Sustainable and competitive plant production

- Sustainable intensification in presents systems
- Organic production and diversity in cropping systems
- Novel production concepts (urban, greenhouse)
- Soil structure, microbiome and nutrient balance
- Smart farming – sensors, optimization

## Sustainable and competitive animal chain, aquabiomass entomobiomass products

- Manure management
- Nutrient recycling
- Animal feed and nutrigenomics
- Gut microbiome
- Novel product and production concepts
- Precision livestock farming

## Value-added food and

- Food waste accounting and prevention
- Utilisation of raw materials and side-streams in food and feed
- Processing technologies (proteinaceous raw materials, gentle processing, microbes)
- High quality products and functional ingredients
- Sustainability assessment
- Economic modelling of animal chain

Thank you!





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