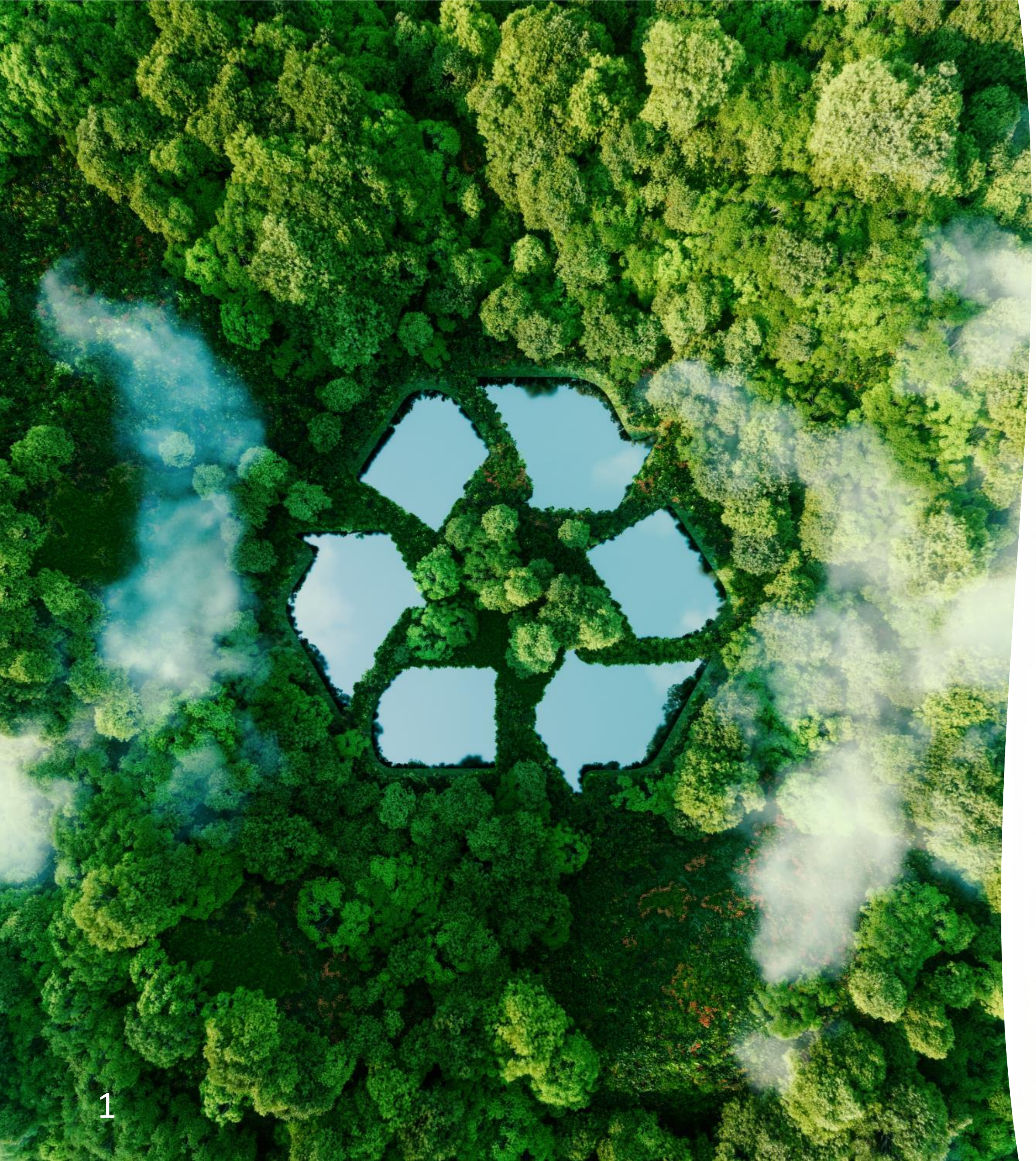


TREASoURcE

TREASoURcE webinar

Deep dive into European circular economy ecosystems

26.05.2023, 9.00-11.45 CET
Microsoft Teams

Funded by
the European Union


CLIC
Circular economy ecosystems create new value chains
TREASoURcE seminar 26.5.2023
CLIC Innovation/Tiina Laiho

CLIC Innovation – open innovation ecosystem powerhouse

We pick

We create additional value to our partners by building, coordinating and managing R&D&I collaboration to construct systemic solutions, which are beyond the resources of individual operators.

We mix

We work with cross-sectoral challenges in order to create new partnerships. We operate with open innovation ecosystem methods across different industrial sectors and scientific disciplines in quadruple helix model.

We CLIC

We are owned by leading international companies and Finnish research organizations committed to create sustainable solutions for the world.

We contribute to developing a more favourable innovation environment in Finland and EU.

We are part of TREASoURcE project

TREASoURcE

A four-year (2022-2026) project funded by the EU's Horizon Europe program.

The goal is to promote the circular economy through regional circular economy pilots. Three value chains are involved in the pilots: unused plastic waste, reuse of electric car batteries, and bio-based waste and side streams, especially in agriculture and forestry.

The pilots will be implemented in close cooperation with companies, communities and expert organizations. The goal is to significantly increase the circulation of products and materials as well as citizens' awareness of the circular economy in the Nordic countries and the Baltic Sea region with the help of pilots and their communication, especially through numerous workshops aimed at different target groups.

Funded by the European Union

WP2

Understanding key stakeholders' incentives and roles

Funded by the European Union

TREASoURcE

Objectives

- Achieve transparent decision-making processes and transitions to CE supported by relevant stakeholders.
- Strengthen the decision makers capability of enabling CE.
- Learn from stakeholders and understand their perspectives, perceptions and positions in the CE transition.
- Build knowledge and stakeholder capacity to ensure they understand the benefits of CE and can participate in implementing CE on different stakeholder levels.

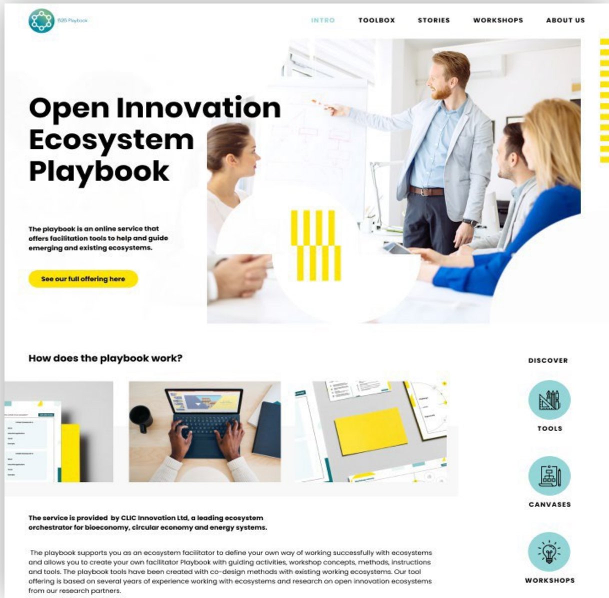
Main activities

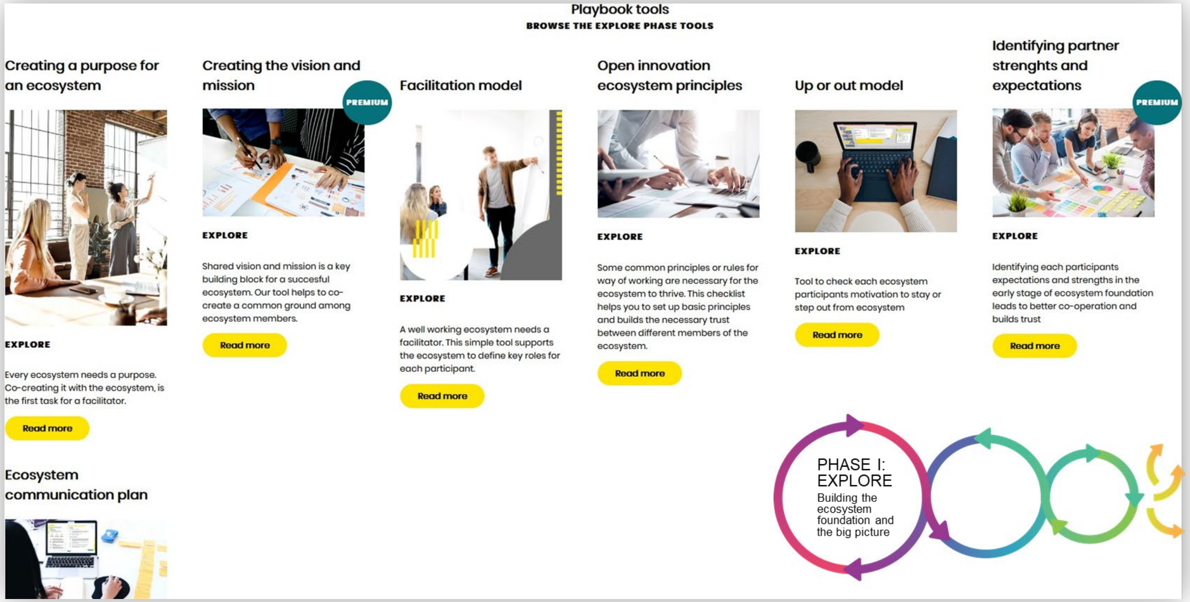
- The structures for stakeholder engagement will be established by setting up cross-sectorial task forces in 3-4 geographical areas. The aim is to cooperate with a broad range of stakeholders.
- Concrete cooperative actions will be carried out through five different demonstrations, including activities such as workshops for consumers and industry actors, hackathons, fixing workshops, seminars, procurement recipes, and larger cultural and sports events.

Open innovation Playbook

training and tailored workshops for ecosystem facilitators and tools for ecosystem management

B2B Playbook





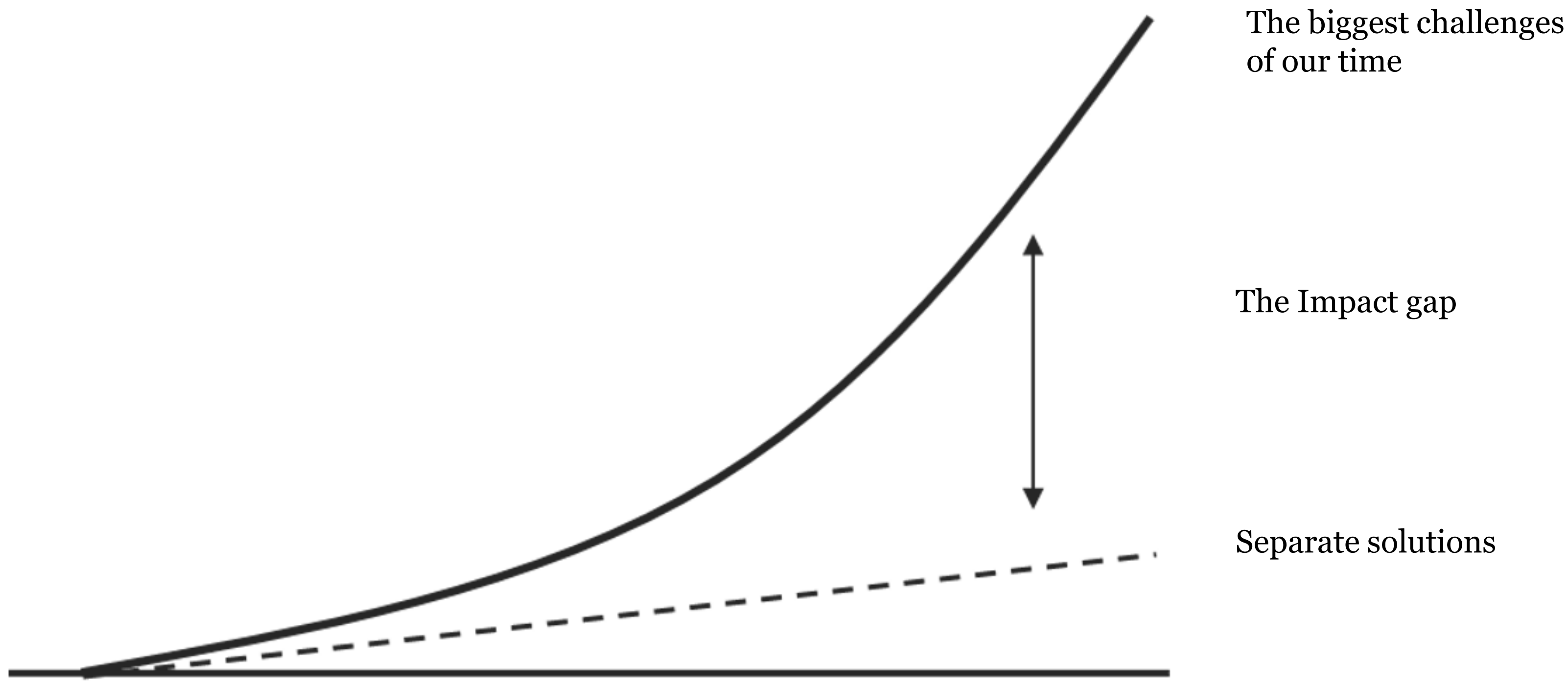

Why ecosystems?

Change is not easy

Image source:
Reuters/Mike Segar

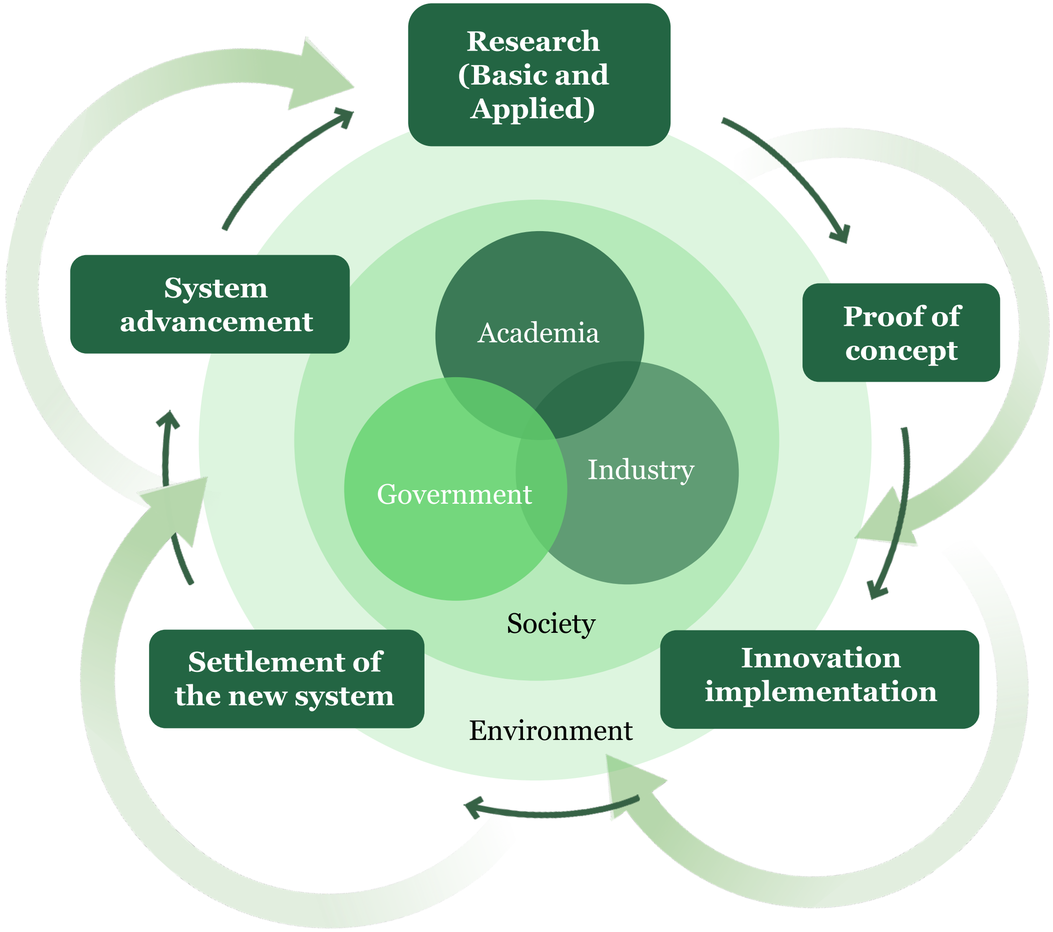
Why ecosystems?

The existing operating models do not work anymore



REFRAMED INNOVATION HELIX:

Process loop with the actors involved



Adapted from: González Fernández, S. et al. "Innovation Ecosystems in the EU: Policy Evolution and Horizon Europe Proposal Case Study (the Actors' Perspective)". Sustainability 2019.

Open innovation and ecosystem definitions

WHAT IS

Open innovation?

Open innovation is "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model".

Read more

WHAT IS

An ecosystem?

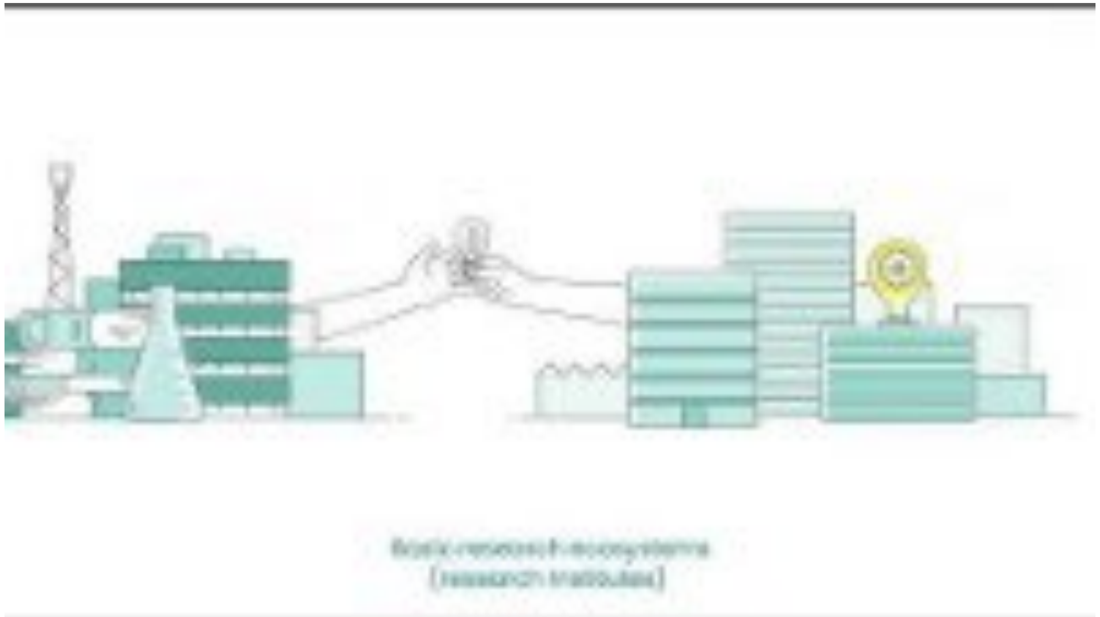
An ecosystem is a structure as well as a process for interaction through which the multilateral set of complementary actors that link to an aligned purpose co-create various forms of actor perceived value.

Read more

What is an ecosystem?

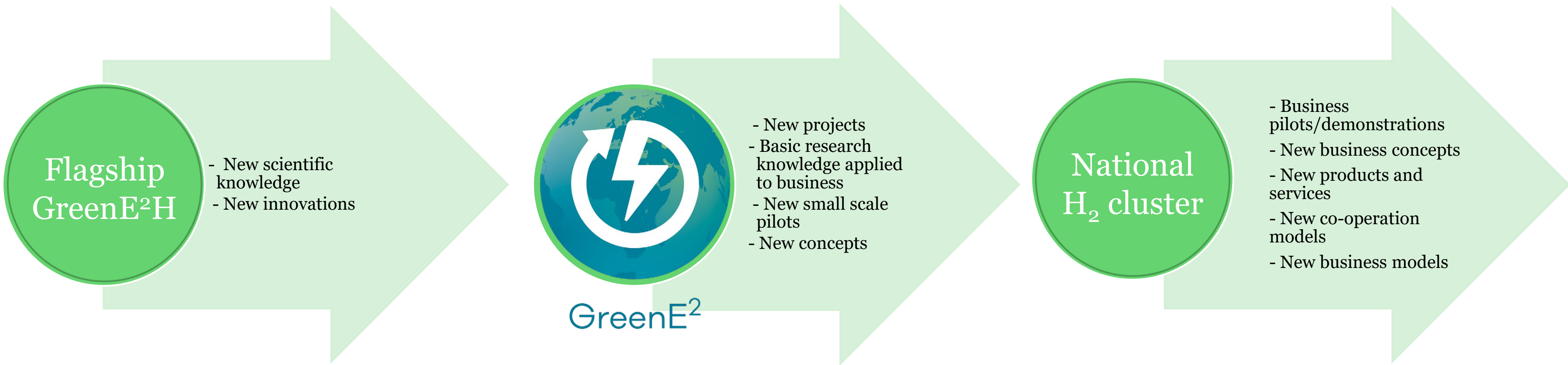
- **Knowledge ecosystem** → New research knowledge
- **Innovation ecosystem** → New solutions for systemic challenges
- **Business ecosystem** → New business solutions for systemic challenges
- **Business Networks** → Efficient development and implementation process

*Ref. VTT

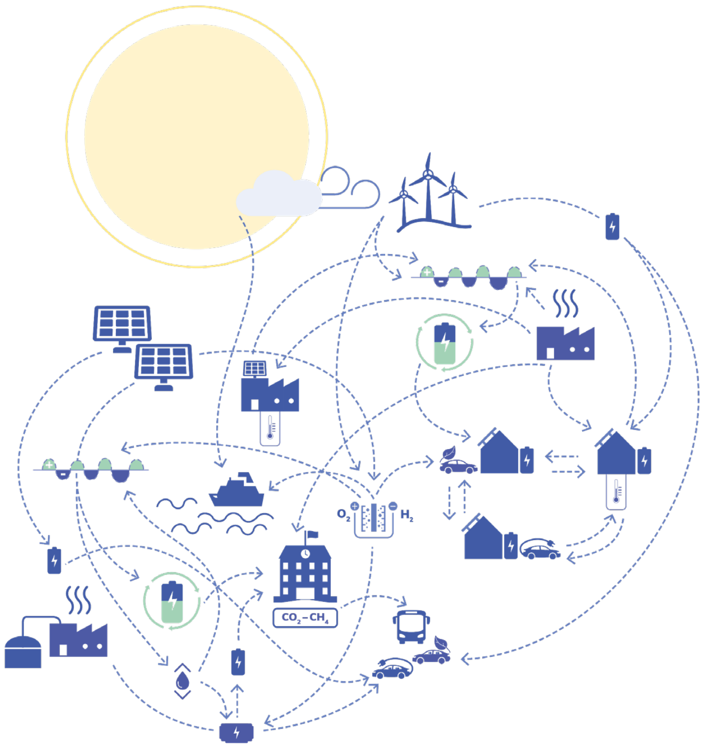


https://www.youtube.com/watch?v=ke5PXlu-n-w

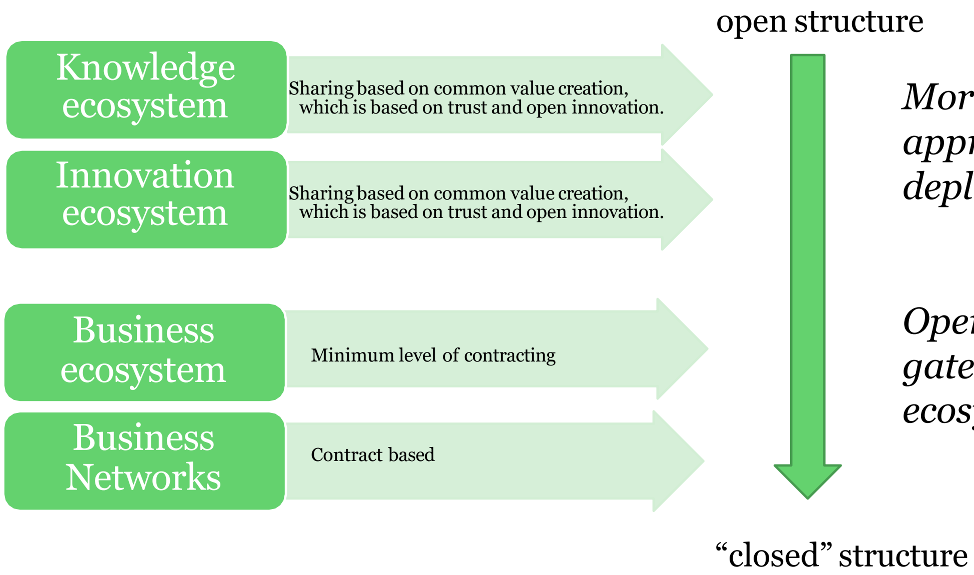
Example of different ecosystems in Finland
GreenE²: an open innovation ecosystem to create an industrial circular economy of H_2 and CO_2



What an ecosystem is not: supply chain, project organization



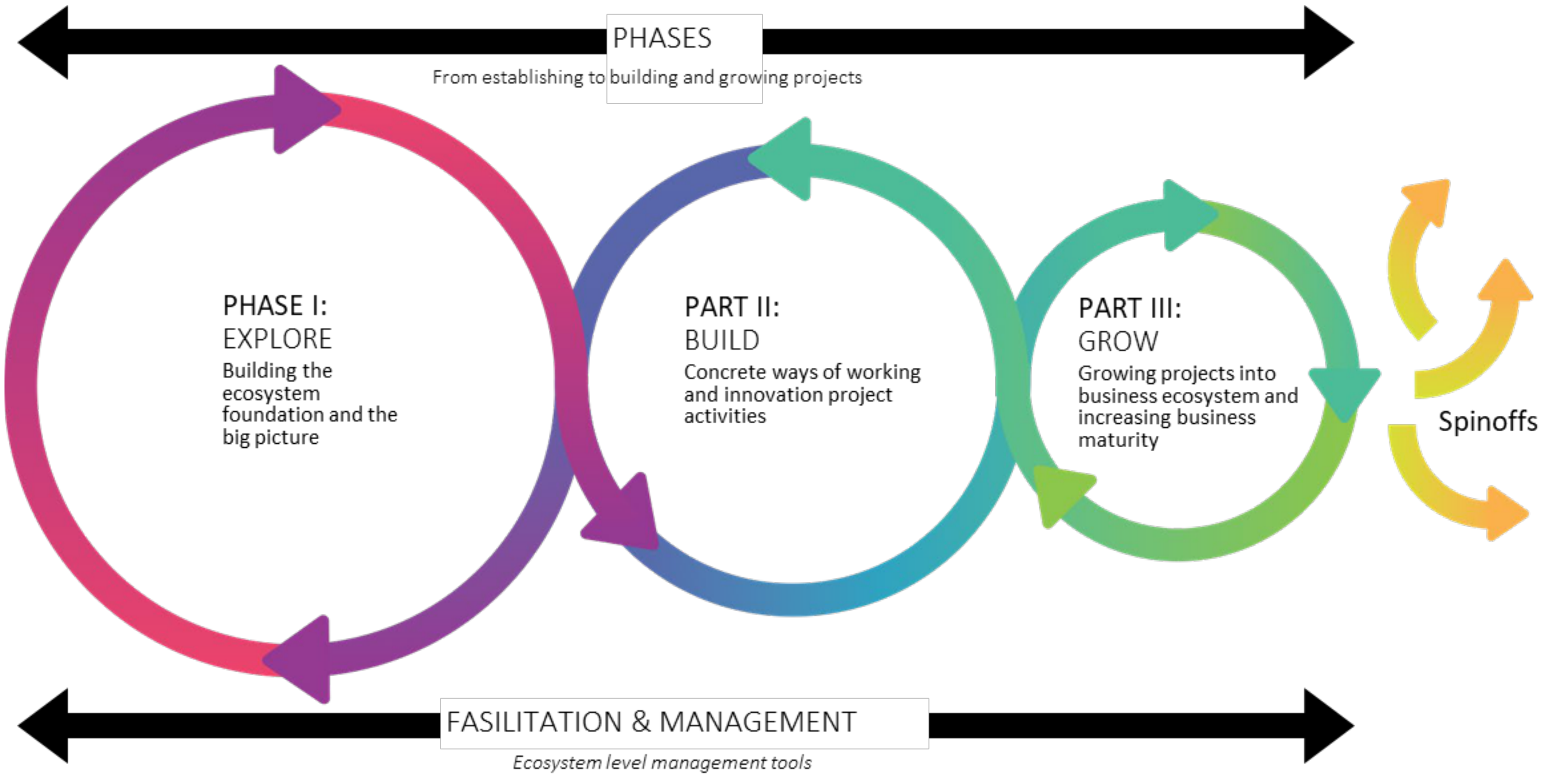
Ecosystem vs. network



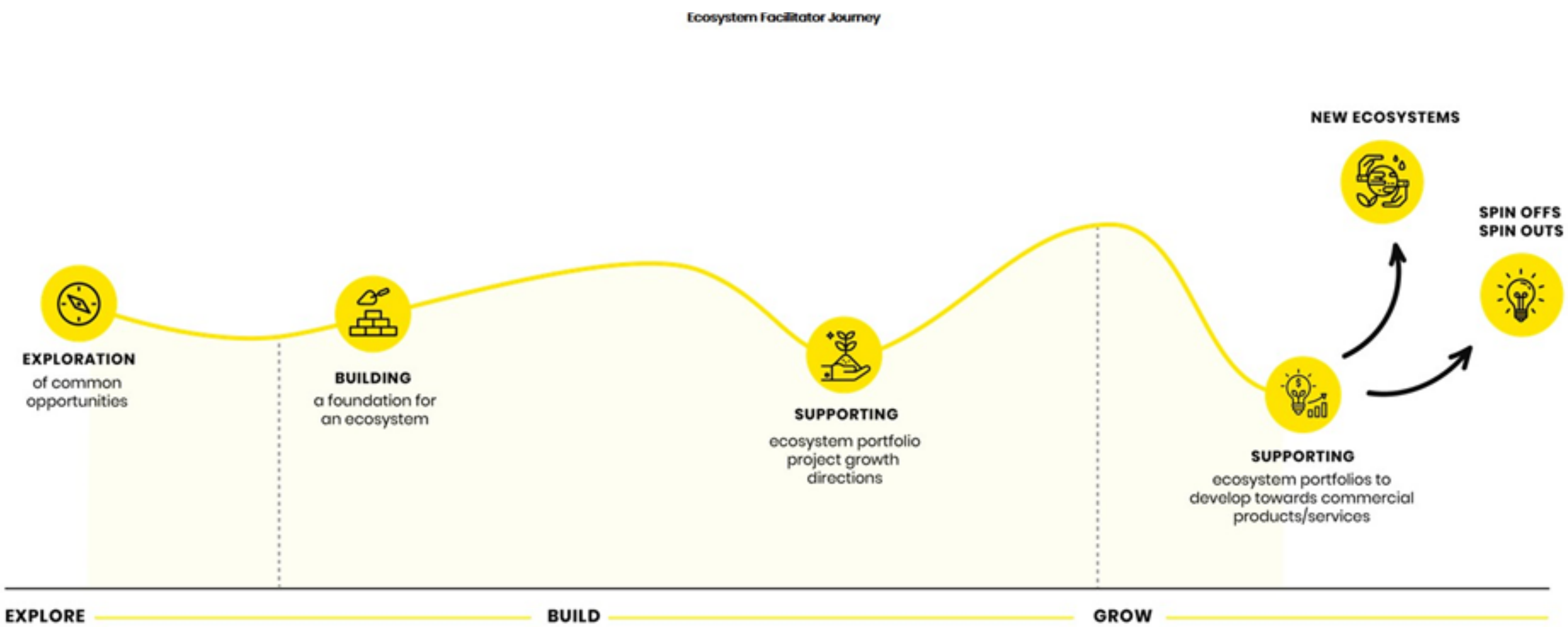
More structured model as ecosystems approach towards business deployment/commercialization

Open innovation usually ends at the ”project gateway” with knowledge innovation ecosystems

Ecosystem lifecycle



Ecosystem lifecycle



KEY FACILITATOR TASKS

EXPLORE

- Create a common purpose for the ecosystem
- Create a vision and mission for the ecosystem
- Develop and agree on the facilitation model

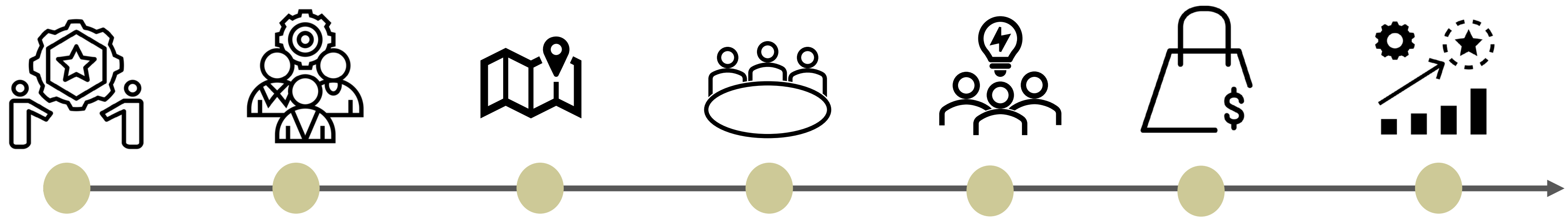
BUILD

- Identify and support analysis of necessary foresight data for portfolio projects
- Support mapping and analysis of ecosystem portfolio projects' strengths, weaknesses, opportunities, threats
- Support project portfolios resourcing planning with necessary tools

GROW

- Map growth opportunities for the ecosystem portfolio projects
- Create value propositions for the ecosystem portfolio projects
- Prototype and test your ecosystem

GreenE² ecosystem development process with Playbook tools: Explore and Build phase



Nov 2020
Define purpose, mission and vision

Dec 2020
Define member strengths and expectations

Jan 2021
Develop RDI roadmaps

Jan 2021
Define ecosystem principles

Feb 2021
Identify communication challenges

May 2022
Identify market shaping needs

June 2022
Update RDI roadmaps

Ecosystem checklist

	Science ecosystems	Innovation ecosystems	Business ecosystems	Business supply chains
Maturity of ideas and technologies	Science	Applied science	Demonstrations, pilots, business renewals	Sales
Communications	Public	Public & private	Public & private	Private
Financing	Public (SA, STN, foundations)	Public (BF, EU/Horizon2020) & private (companies)	Public (BF, EU/IPCEI, Ilmastorahasto) & private (companies)	Private (customers)
Central actors	Research institutions	Research institutions and companies	”Veturit”, demonstration platforms like Smart Otaniemi, Flexens	Companies

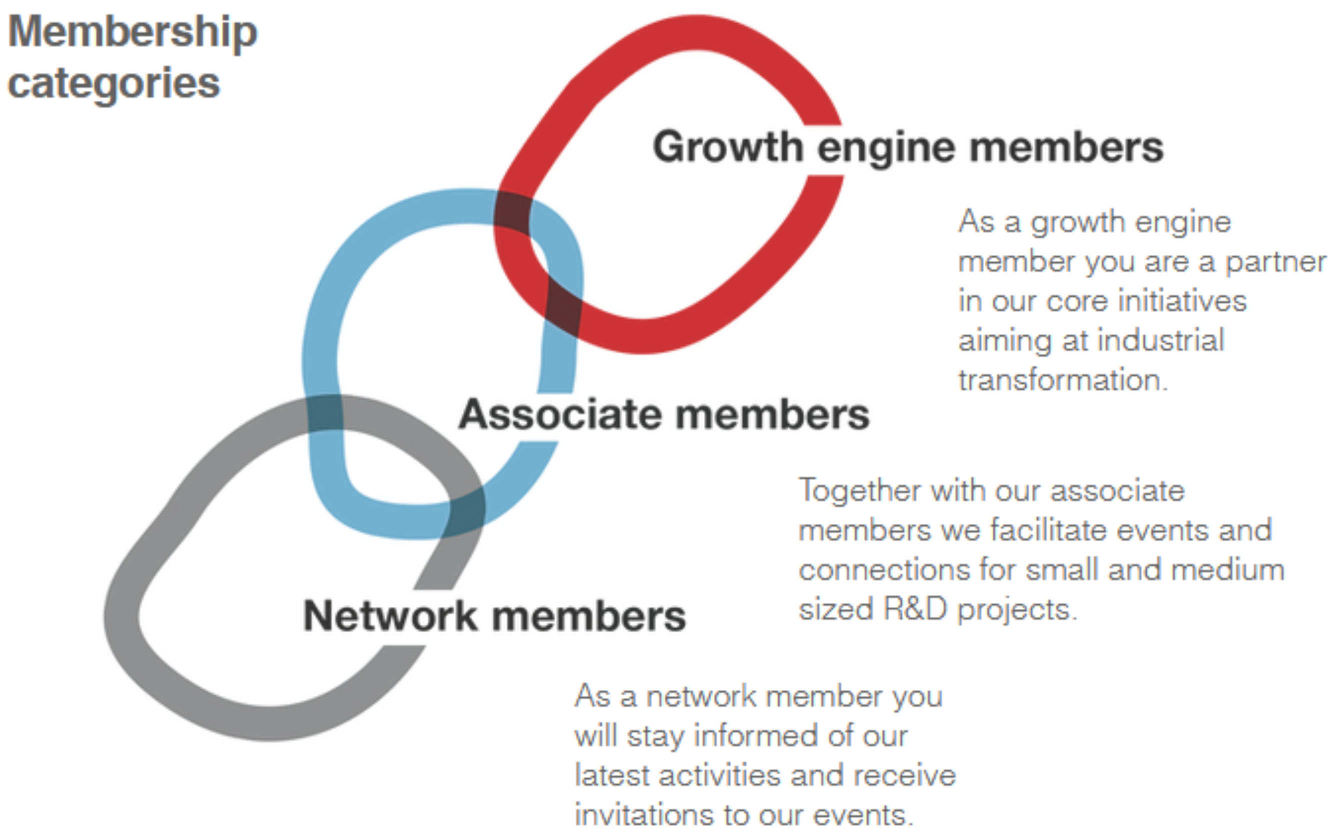
Ecosystem vs. clusters

What is a cluster?

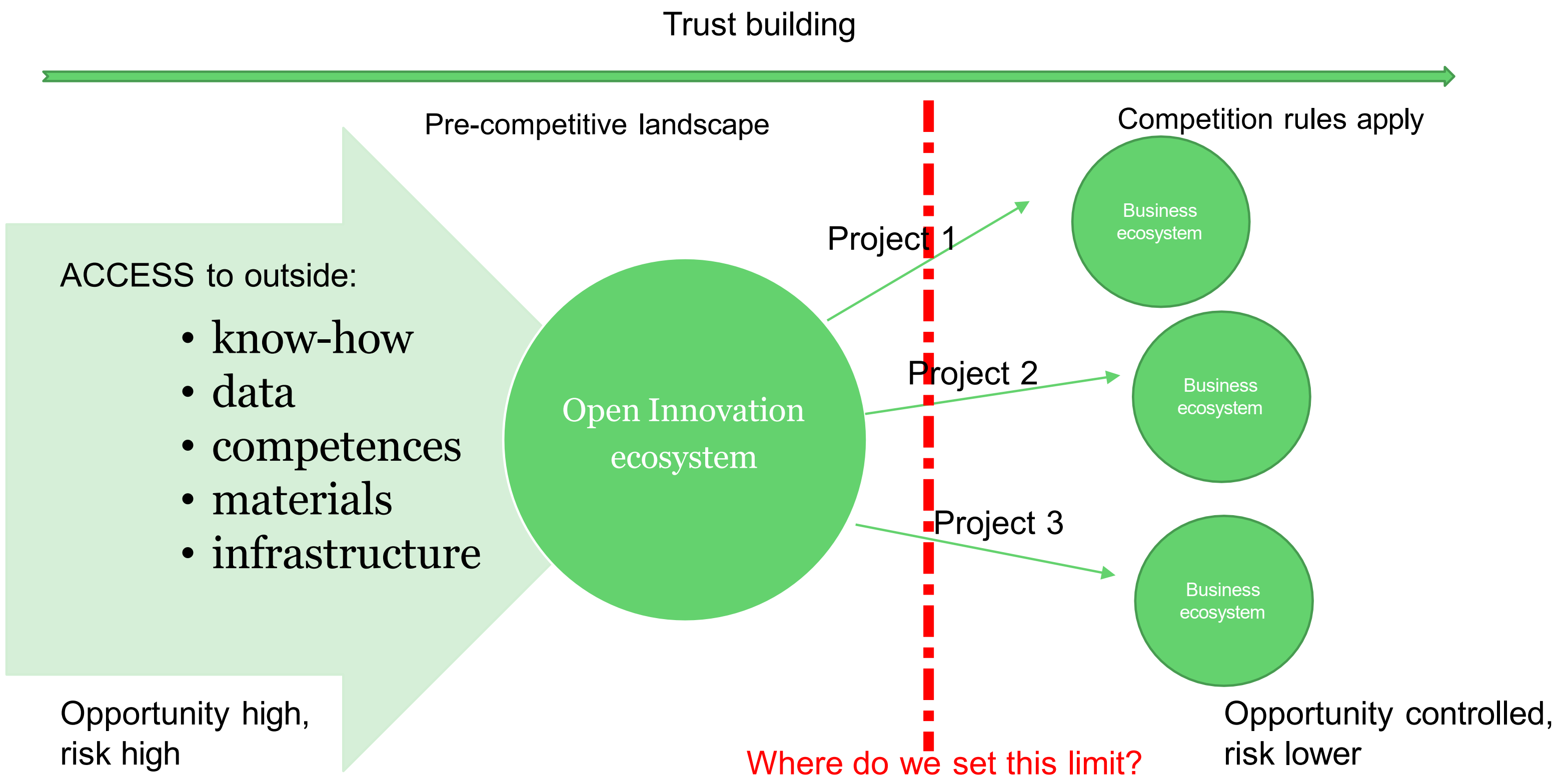
Clusters should be considered as regional ecosystems of related industries and competences featuring a broad array of inter-industry interdependencies[1].

They are defined as groups of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills. Clusters are referred to both as a concept and a real economic phenomenon, such as the Silicon Valley, the effects of which, such as employment concentration, can be measured.

Different kinds of ecosystem members (one approach)



Value creation in open innovation ecosystems



What is Open innovation?

Open innovation is “a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model“

https://www.youtube.com/watch?v=VMAZ-CwDUIg

What is Open innovation?

- ***Collaboration*** refers to the joint development of knowledge through relationships with external partners to achieve the value proposition – Shared innovation process

- **Commitment** to a common mission, such as the joint development of new products and innovations

- Open innovation dependent on successful **design and management** of the ecosystem

- Ensuring **open and free mobility of knowledge and competences** between various partners and collaborators emphasized

Innovation ecosystems benefits

Our R&D is only one

vs.

The world is our R&D department

Open Innovation ecosystems benefits

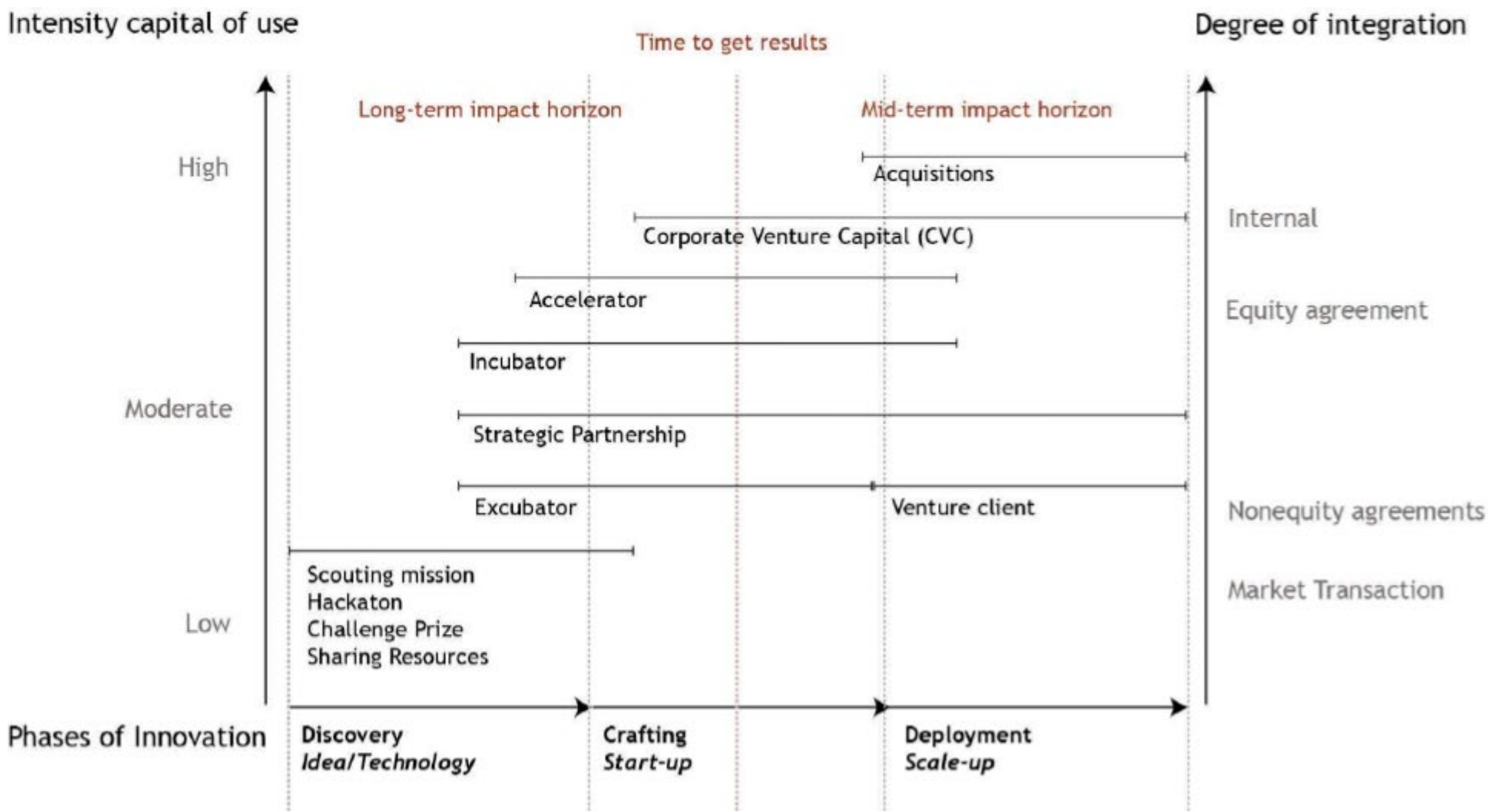
Access to new

- Resources/skills
- Knowledge
- Platforms
- Infrastructure
- Shared risk
- Technology
- Research
- Multidisciplinary know-how
- Data
- Reduced cost
- New talent
- Reduced innovation creation cycle
- New partners

Open innovation process approaches

Outside in process:
The firm seeks to enhance its own knowledge base through the integration of external knowledge

Inside out process:
Earning profits by bringing ideas to market, selling IP and multiplying technology by transferring ideas to the outside environment


Intensity capital of use
Time to get results
Degree of integration
Long-term impact horizon
Mid-term impact horizon
High
Acquisitions
Internal
Corporate Venture Capital (CVC)
Accelerator
Equity agreement
Incubator
Moderate
Strategic Partnership
Excubator
Venture client
Nonequity agreements
Scouting mission
Hackaton
Challenge Prize
Sharing Resources
Market Transaction
Low
Phases of Innovation
Discovery
Idea/Technology
Crafting
Start-up
Deployment
Scale-up

Change management is necessary in organizations

Ecosystem 2.0: Climbing to the next level

To participate successfully in ecosystems, traditional companies must often change the way they think about customers.

Introduction of the TREASoURcE co-creation workshop methodology (Playbook) to map value chains along new key value chains

Introduction to Circular Economy

Strategies in a circular economy

Circular economy ↑ (from Linear 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
	R0 Reduce	Consume less through efficient manufacturing or use
Extend lifespan of products and its parts	R0 Re-use	Re-use of functioning discarded products by another use
	R0 Repair	Repair and maintenance of defects to keep original function
	R0 Refurbish	Restore and update
	R0 Remanufacture	Use parts in a new product with the same function
	R0 Repurpose	Use products or parts in a new product with a different function
Useful application of materials	R0 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R0 Recover	Incineration of materials with Energy recovery

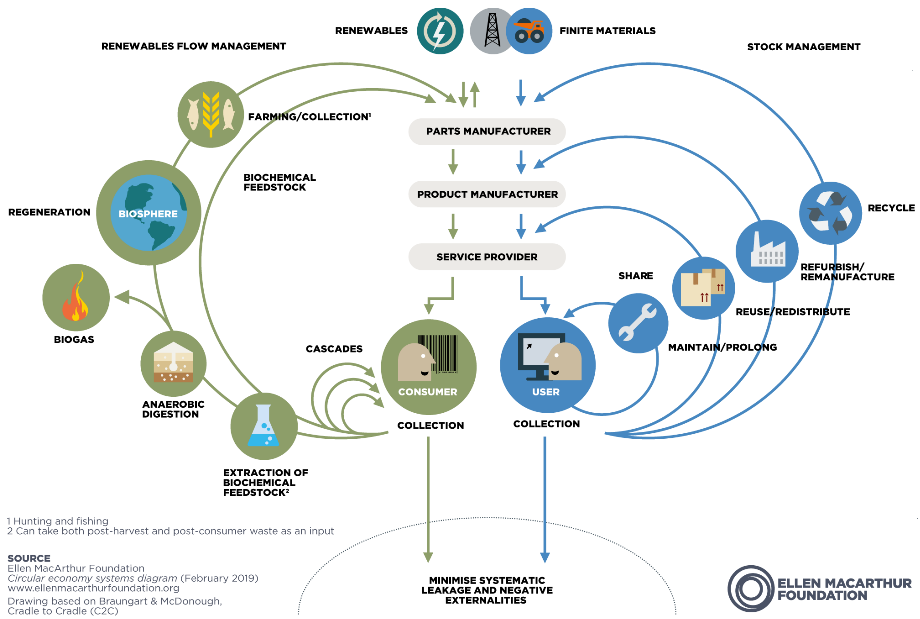
Linear economy

Source: Circular economy strategies. Source: PBL (2017). Circular economy: measuring innovation in the product chain, J.Potting, M. Hekkert, E. Worrell et al.

Circular Design Principles

Circular design **allows us to keep materials in circulation and move towards a regenerative future with practical, innovative, long-lasting and environmentally friendly principles in mind**.

1. Design with a purpose
2. Design for longevity
3. Design for resource efficiency
4. Design for biodegradability
5. Design for recyclability
6. Source/produce more locally
7. Source/produce more without toxicity
8. Source/produce with efficiency
9. Source/produce with renewables
10. Source/produce with good ethics
11. Provide services to support long life
12. Reuse, recycle and compost all remains
13. Collaborate well and widely
14. Use, maintain and reuse with care
15. Consider rent, loan, swap, secondhand or redesign
16. Buy quality as opposed to quantity



Source: Circular Fashion Framework, Dr. Brismar; Ellen MacArthur Foundation; Weavabel

Real world Examples Coffee Machine

Circular Design Considerations

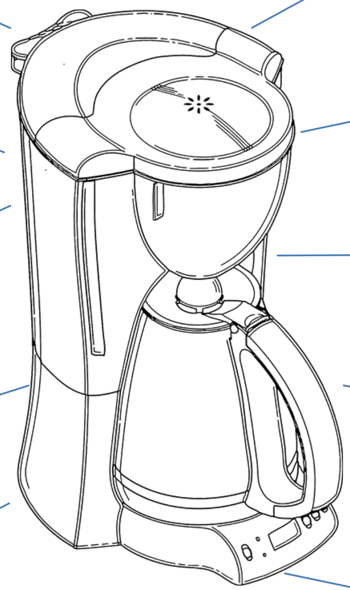
Packaging:
Utilize only recycled carton for packaging an avoid plastic wrapping

Business Model:
Offer rental model or incentivize return of used end-of-life products

Production:
Optimize recovery and re-use of material side streams / used material and optimize use of e.g. energy, and water

Logistics:
Optimize weight and stackability of product / packaging to ease transport.

Reuse / Refurbish:
Use standard parts and plan for re-use of components at end-of-life.



Material:
Use recycled, recyclable or bio-based material, e.g. recycled plastic for body and metal for can

Resource usage:
Minimize material usage by optimizing form and function, e.g. remove unnecessary parts

Durability:
Enforce main areas of defect and increase durability e.g. hinges, buttons.

Repair:
Provide required spare parts and enable repair either directly or through partner network

Recycle:
Enable easy recovery of material for recycling and use only recyclable material.

Circular Design Canvas

METHOD DESCRIPTION

The purpose of the workshop

Introduce participants to circular design thinking with the help of a concrete example and guided by the focus areas of the Circular Design Canvas.
After the workshop participants should understand key design considerations in the development of circular products and services.

Workshop duration:
4 hours

Who should be involved?
Key ecosystem actors

Participants:
15-18 (optimum)
divided into 3 teams

Suggestions for preparatory assignments
Familiarize yourself with key circular design principles and approaches. Reading recommendations:

- Ellen MacArthur Foundation Design Guide
- 10 Principles of Circular Design (Nike Circular Design)
- Design and the Circular Economy (Ellen MacArthur Foundation)

Recommended workshop setup
Face-to-face workshop recommended; online workshop possible

Assets needed
Printed canvas for a face-to-face workshop (size's A0 on the wall and printed A1 & A3 worksheets for teams) OR online canvases (e.g. Miro or Padlet)

Other hints and tips
The Circular Design Canvas and workshop will provide participants with a basic understanding of key design considerations in the development of circular products and services.

Instructions

How to prepare for the exercise

- Send a calendar invitation to a 3,5 -hour workshop
- Send an e-mail to participants with pre-reading recommendations approx. 1-2 weeks before the workshop
- Familiarize yourself with key circular design principles and approaches
- Select product(s) for the workshop either general example products or products selected by participants. Each team can have another product.
- Pre-work hand-out material, posters and presentation.

How to run the workshop

- Introduce / recap key circular design principles and introduce exercise
- **Exercise 1: Background**
Review the selected product, fill in the product specific information and consider / document focus areas of the "Produce" phase.
Exercise 2: Produce Phase
Review the selected product and consider it in the context of the current customer and organizational needs and impacts.
Exercise 3: Use Phase
Imagine using the product for its intended purpose and consider / document focus areas of the "use" phase.
Exercise 4: Sustainable Value Proposition
Considering the outcome of exercises 1 and 2, formulate a unique sustainable value proposition for the re-design product.
- Present results back to the group and discuss questions and additions from other teams.
- Reflect on the experience, challenges and new insights with the full group. Discuss how participants will apply the new techniques learned in their everyday work life.

Product Impact Canvas
Canvas

Product Service:

Description:

Customer Need

What customer need are we addressing?

Strategic Goals

What are our strategic goals that we aim to address with the product / service?

Product Impact

What are the negative / positive environmental impacts our product has today across its full life-cycle?

Circular Design Canvas
Canvas

Sustainable Value Proposition

What customer need does the product meet or problems does the product solve?"

Product Service:

Description:

Produce

Use

Material & Resource Use
How can we minimize resource usage?
What recycled/ recyclable/ biodegradable materials can we use?

Packaging
How can we reduce / minimize packaging?
What recycled/ recyclable/ biodegradable materials can we use?

Reduce / Extend
How can we increase durability?
How can we reduce resource usage in the use phase?

Ecosystem:
What capabilities / partner do we need?

Reuse / Refurbish
Are we considering re-use / re-furbish of components / the product at end-of-life?

Ecosystem:
What capabilities / partner do we need?

Recycle (End-of-life)
How can we ensure easy recycling of the product and its components to maximize resource reuse?

Ecosystem:
What capabilities / partner do we need?

Production
How can we minimize material loss and resource usage during production (e.g. support material, energy, water, residue)?

Business Model
How can we encourage circular behavior?
How can we provide the product as a service?
Can we offer services around maintenance, repair and refurbishment?

Repair
How can we enable easy repair of the product?

Ecosystem:
What capabilities / partner do we need?

Logistics
How do we minimize impact from transportation?

Ecosystem:
What capabilities / partner do we need?

Circular Value Chain Builder

METHOD DESCRIPTION

The purpose of the toolbox

To enable circular economy and sustainability, the end-to-end value chain of products and services needs to be understood. Optimization potential, bottlenecks and challenges need to be identified and solutions co-created.

The Circular Value Chain Builder will provide practitioners with a hands-on toolset to jointly draft relevant value chain models and to develop concrete actions plans to enable circularity and sustainability.

After the workshop participants should be able to master key value chain design & optimization principles and techniques.

Workshop duration: 2x4 hours

Who should be involved? Key ecosystem actors

Participants: 15-18 (optimum) divided into 3 teams

Suggestions for preparatory assignments
Familiarize yourself with key circular design principles and approaches. Reading recommendations:
- Circular Economy Playbook (SITRA)
- Towards the Circular Economy: Accelerating the scale-up across global supply chains (World Economic Forum)
- Circular Supply Chains Are More Sustainable. Why Are They So Rare? (Harvard Business Review: Soufani / Loch)

Recommended workshop setup
Face-to-face workshop recommended; online workshop possible

Assets needed
Printed canvas for a face-to-face workshop (size's A0 on the wall and printed A1 & A3 worksheets for teams) OR online canvases (e.g. Miro or Padlet)

Instructions

How to prepare for the exercise

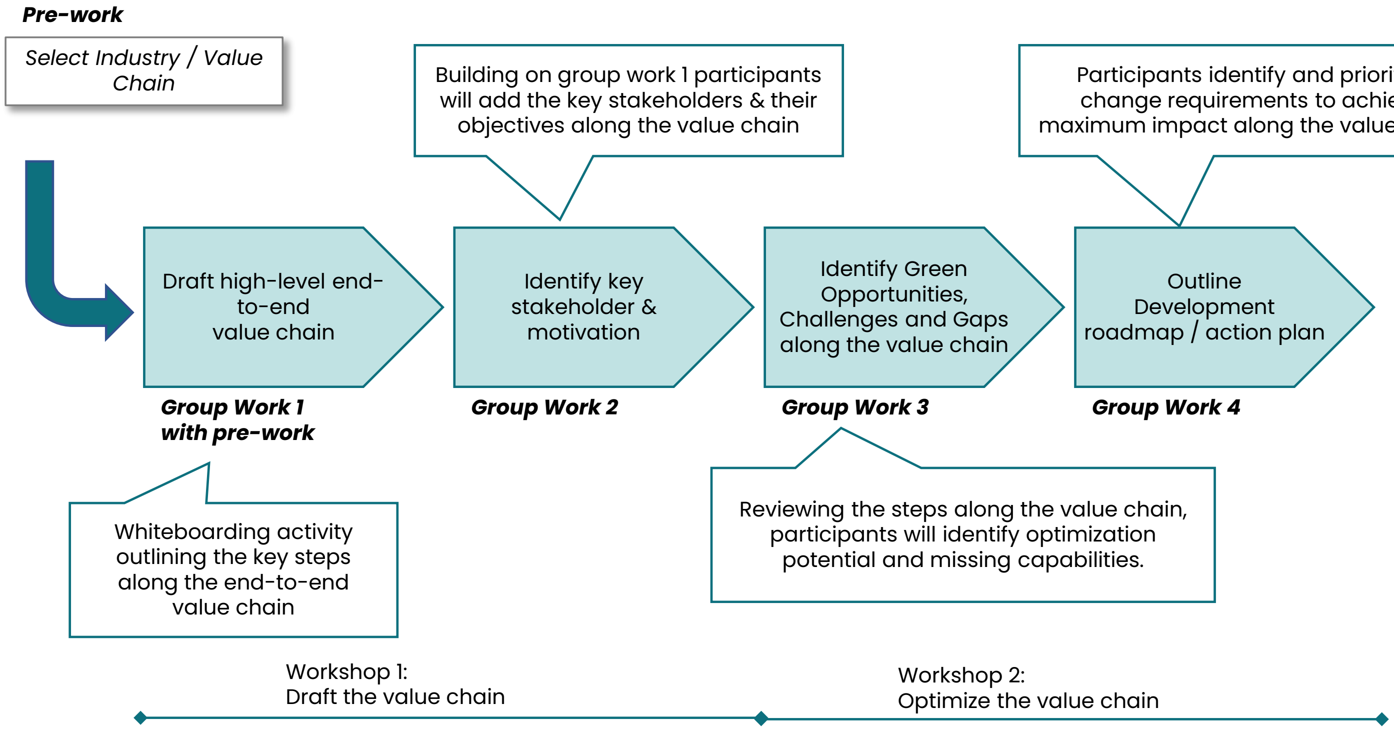
- Send a calendar invitation for two 4 -hour workshops
- Send an e-mail to participants with pre-reading recommendations approx. 1-2 weeks before the workshop
- Familiarize yourself with key circular / sustainable value chain principles and approaches
- Select product / value chain for the workshops either as an example or selected by participants.
- Prepare hand-out material, posters and presentation.

How to run the workshop

- Introduce workshop objectives, the circular value chain toolbox and key circular value chain principles
- **Exercise 1: High-level end-to-end value chain (WS 1)**
  Outline the end-to-end value chain under consideration of each major process step from raw material, production, use to end-of-life incl. logistics and life extension.
  Exercise 2: Key stakeholder & motivation (WS 1)
  Identify key stakeholders per process step along the value chain as well as their objective and motivation.
  Exercise 3: Opportunities, Challenges and Gaps (WS 2)
  Identify opportunities, challenges and capability gaps along the drafted value chain as it relates to achieving circularity and sustainability.
  Exercise 4: Roadmap / action plan (WS 2)
  Draft a concrete roadmap and action plans derived from the identified opportunities, challenges and capability gaps outlining short-, mid- and long-term actions.
- Between exercises present results back to the group and discuss questions and additions from other teams.
- Consolidate findings into a single value chain model for the selected product / value chain.

Circular Value Chain Builder – Toolbox Overview

Participants:	Representatives from companies along the value chain.
Duration:	2 x 4h workshops



GROW PHASE

Group-Work 2

STAKEHOLDER CANVAS

Value chain stage / step:

Name of the stage / step in the value chain.

Stakeholder Group:

Name of the stakeholder group.

Description:

Who are the stakeholders? What is their role in the value chain and what are their key characteristics?

Motivation

What is the main motivation of the stakeholder group? Why are they contributing within the value chain?

Main Tasks

What are the main tasks of the stakeholder group? Do they have all required capabilities?

Input / Output

What is the main Input and Output the stakeholders required / are looking for?

Facilitating sustainable growth.

For more information
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Circular batteries - Opportunities and bottlenecks

Linda Rekosuo, Ekokumppanit

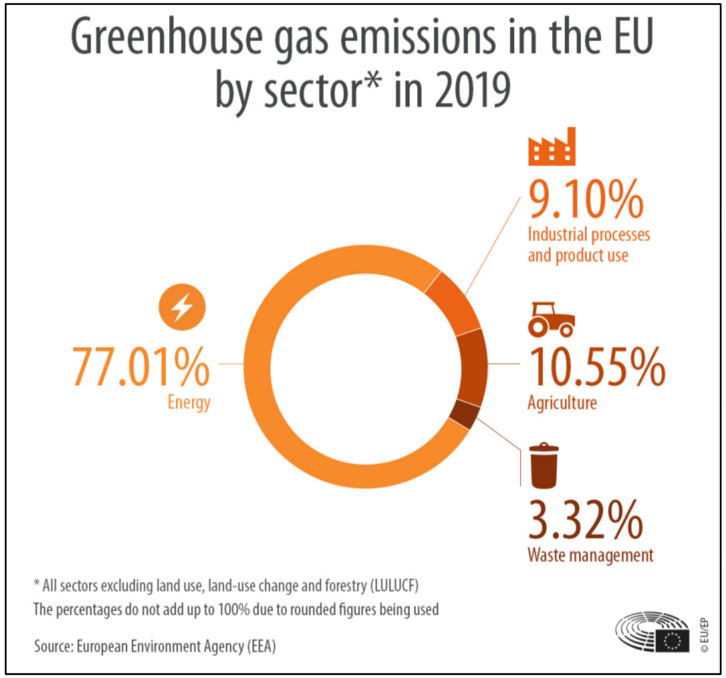
26.5.2023

Funded by the European Union

Background

Most of the global greenhouse gas emissions are caused by Energy sector

Transportation accounts ~1/3 of all energy sector emissions



Source: Greenhouse gas emissions by country and sector (infographic) | News | European Parliament (europa.eu)

Funded by the European Union

Electrification

Electrification is seen to have a key role of reducing emissions caused by energy sector.

Electrification includes two steps

- First, energy production is needed to become carbon free
- After that, all possible operations in society should be electrified

Role of batteries in electrification

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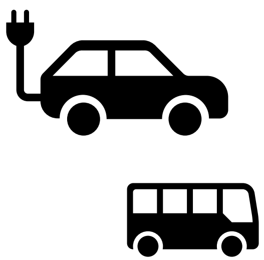
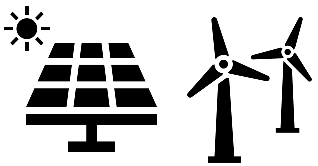
Electrification of transportation

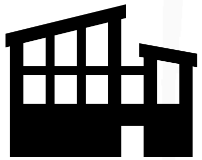


Balancing electricity grid

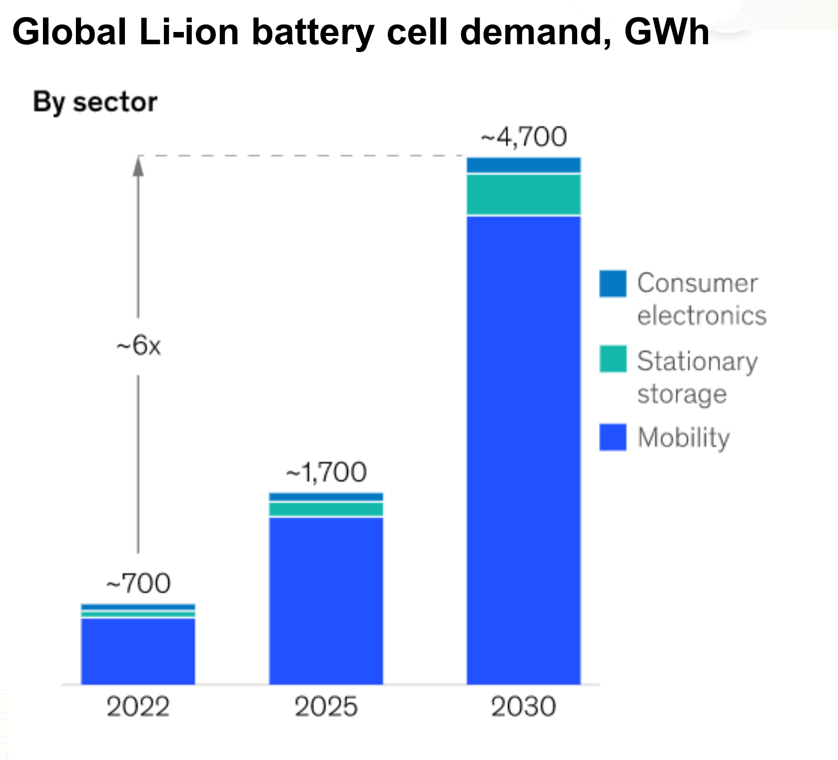


Renewables create new challenges for electricity grid frequency control. Batteries are good short term energy buffers that can respond to grid's changes fast.

Facilitating self-sufficiency



Societies that do not have access to electricity grid can use electricity with the help of batteries.



Source: McKinsey & Company 2023 Lithium-ion battery demand forecast for 2030 | McKinsey

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eko KUMPPANIT

Battery value chain

TREASoURcE

Batteries enable the green transition
BUT
increased demand puts pressure on the sufficiency of raw materials and sustainability of supply chain.

Raw material aquisition

Battery production

Application production

Use

EoL activities

According to some estimations 400 new mines need to be established by 2035.

Global supply chains have environmental and social sustainability challenges.

Upcoming EU legislation will tighten the recycling requirements.

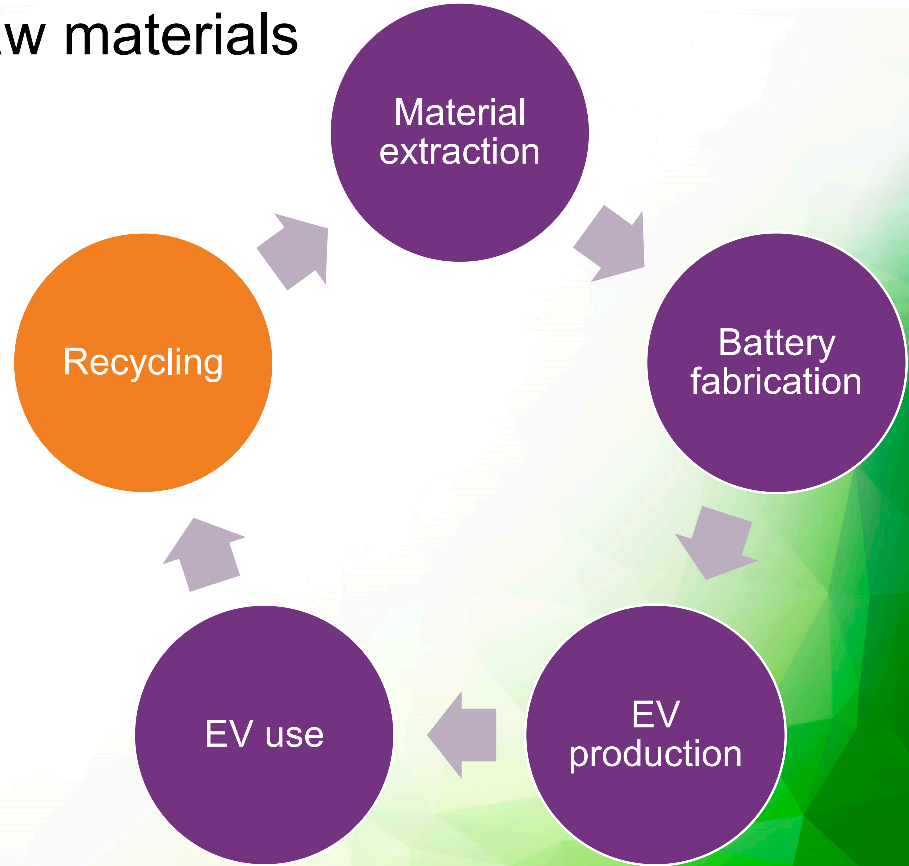
Funded by the European Union

eko KUMPPANIT

Circular economy opportunities Recycling

Recycling converts waste batteries into new raw materials and helps with the resource scarcity.

Battery recycling has some obstacles to overcome
- Collection and transportation of heavy and hazardous EV batteries
- Recovery rates of materials are low
- Profitability of recycling
- Limited number of recycling facilities
- Processes are energy intensive
- Lack of design for recyclability and fast innovation loops of batteries



Source: Oulu University, Battery recycling and ecosystems course

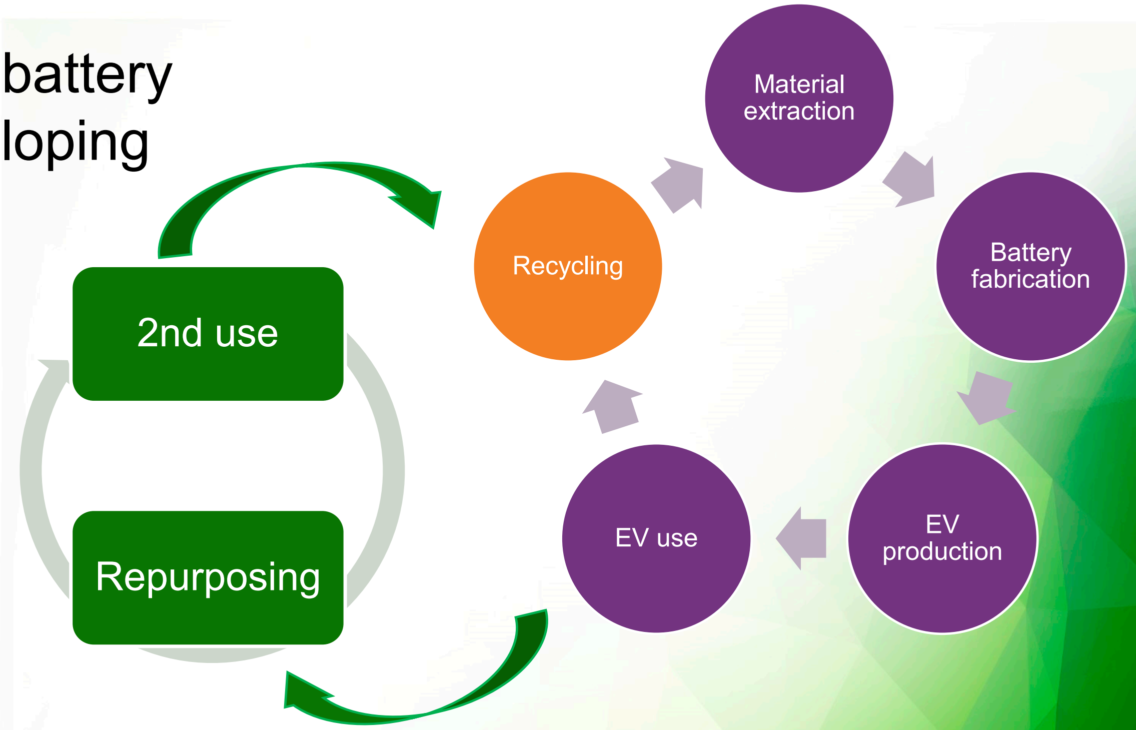
Funded by the European Union

Circular economy opportunities Repurposing

The second life of EV batteries increase battery life time and can give extra time for developing sustainable battery supply and recycling operations.

Repurposing have some challenges
- Lack of regulation and standardisation
- Economic feasibility
- Safety concerns
- EV battery design and fast innovation loops

Source: Nina McDougal, Master thesis 2023



When EV batteries have lost their capacity to 70-80 % from the initial they are not suitable for the original purpose anymore. Still, they might be suitable for lighter use.

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Nordic Li-ion batteries' reuse and recycling actors

Global competition is tight.

Business environment is in constant change.

What is the role of different actors, EV manufacturers, battery manufacturers and independent companies in the future?

Source: Innovation Norway, Business Finland, Business Sweden, and the Swedish Energy Agency, 2023
The Nordic Battery Value Chain , Companies webpages

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eko KUMPPANIT

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Thank you!
Questions?

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eko KUMPPANIT

Identifying challenges, technology & knowledge gaps related to plastics recycling in circular economy

VTT, Ugur Kaya
26.05.2023

MSc thesis findings of Mikko Myrä

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TREASoURcE

Content

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1. Complexity of circular economy of plastics

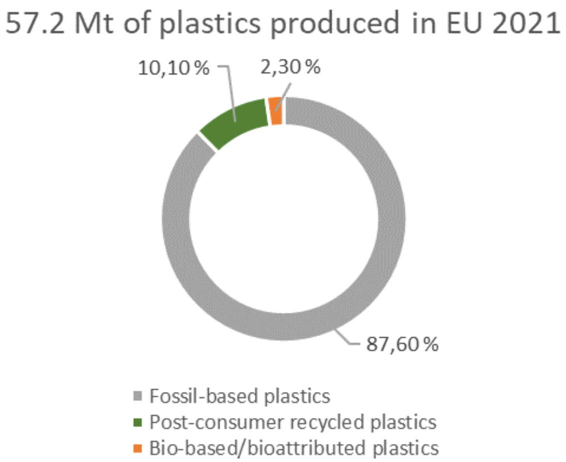
57.2 MT of plastics were produced in Europe in 2021.

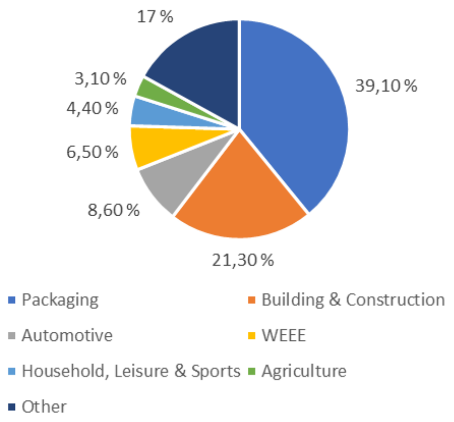
Over 6 different sectors are using plastic in their products

Within these sectors there are countless of applications for plastics

The challenge of transition to circular economy of plastics is diverse spectrum of applications

Circular economy of plastics is needed to reduce dependance on fossil based raw materials and to reduce the amount of plastic waste in the environment





*PlasticsEurope 2022

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2. Research methodology

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- Literature review
  - State-of-the-art review
  - Regulatory review
- Stakeholder interviews
  - Recyclers
  - Developers of recycling machines and systems
  - Organizations advancing circularity of plastics
- Questionnaire
  - Researchers

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3. Literature review key findings

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- Plastic waste streams are very heterogenous further complicating the situation
  - Different plastic types (e.g., PET, PE, PP)
  - Products from various sectors (e.g., Packaging, WEEE, Automotive)
  - Multi-layer/material packaging/composite materials
  - Hazardous substances (e.g., BFRs)
  - Different contamination levels
- Insufficient and fluctuating material properties
- Perception of recycled plastic as unattractive choice for product designers & consumers
- Advancements in technology development are needed to supply market

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4. Interviewee Background

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8 Interviewees from Europe

Finland (3), Austria (2), Netherlands (1), Italy (1), Belgium (1)

Organization sizes

<50 (3), 250-1000 (3), >1000 (2)

Sectors interviewed

Recyclers

- Waste from Electrical and Electronic Equipment (2), PET bottles (1), Post-consumer plastic packaging (1), Post-consumer plastic waste (1)

Organizations actively advancing circularity of plastics (2)

Developers of recycling machines and systems (1)

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4. Respondent Background

13 Respondents from Europe

Finland (8), Germany (2), Austria (1), Norway (1), Belgium (1).

Organization sizes

<50 (1), 50-249 (1), 250-1000 (3), >1000 (8).

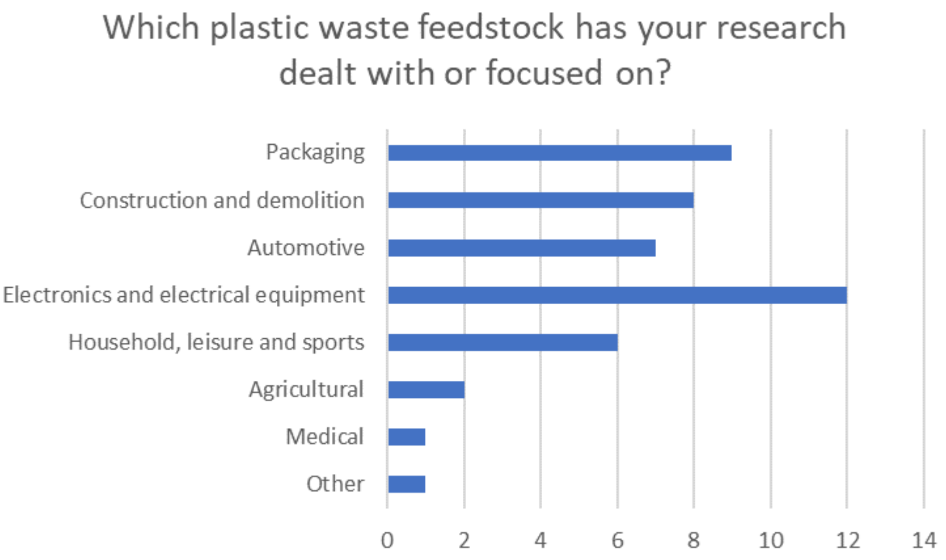
Professions

Researcher or scientist (4)

Senior researcher or scientist (6)

Professor or similar (2)

Civil servant (1)



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5. Challenges and gaps

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- **Collection & pretreatment**
  - Waste management and its diversity
  - Collection
- **Supply and trade of feedstock**
  - Feedstock acquisition
  - Exports
  - Ownership of the waste
  - Price of recycled plastic vs. virgin plastic
  - Acceptance of recycled plastic
- **Recycling types**
  - Mechanical recycling
  - Chemical recycling
  - Balance of mechanical and chemical recycling
  - Design for recycling
- **Production**
  - Lack of capacity
  - Unawareness or lack of investments by converters, original equipment manufacturers or brand owners
  - Rejects or currently non-recycled plastic
- **Regulation gaps & policies**

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5. Challenges and gaps

Collection and Pretreatment

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Fluctuations in feedstock quality and quantity

No mandatory separate collection of plastics for all households

Sorting by consumers and businesses

Contamination

Washing quality

Capability of sorting technology (Selectivity, speed, reliability, price, new equipments)

Lack of information on the origin and composition of the feedstock

Lack of knowledge on the final use of the recycled material

Lack of priority to plastic fraction originating from e-waste leads to its contamination

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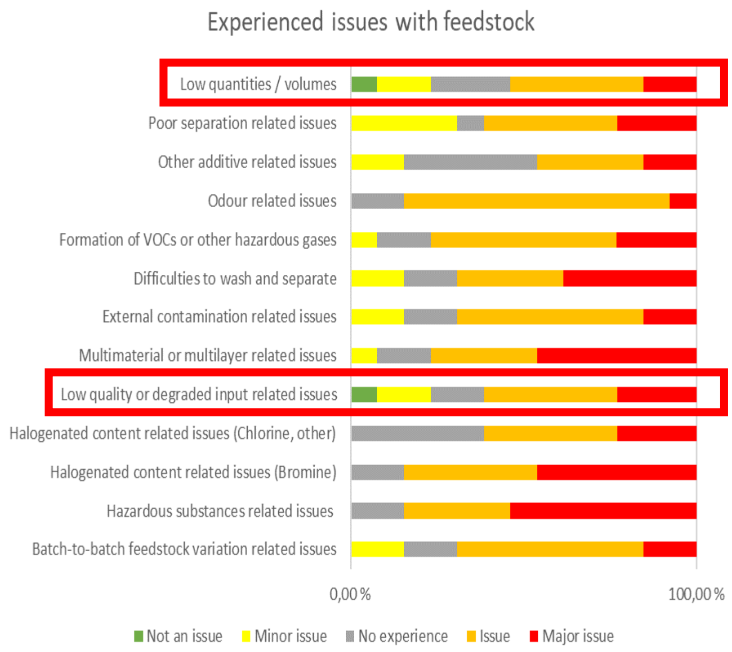
5. Challenges and gaps
Supply & trade of feedstock



Export management

Allocation of feedstock based on recycling plants' capacities.

Ownership of the waste

Uncertainties for the ownership (Municipal, private waste management and new investors).

Price of recycled plastic vs. virgin plastic

Lack of willingness to pay

Feedstock competition between materials and energy uses

Energy crisis

Acceptance & acquisition of recycled plastic

Demand for high quality recyclates for demanding uses.

Different views for policies for the acceptance of recycled plastics

Certification of clearance from hazardous substances.

Lack of documentation in technical specification of recyclates

Lack of communication with authorities especially in WEEE sector

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5. Challenges and gaps
Recycling types & Design for recyclability

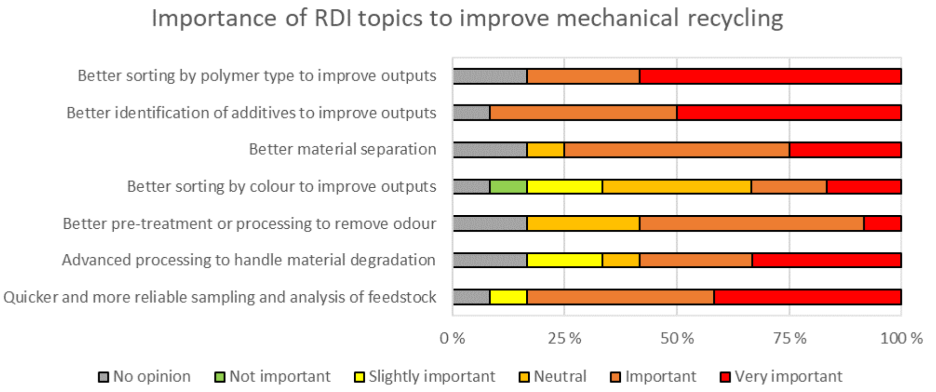
TREASoURcE

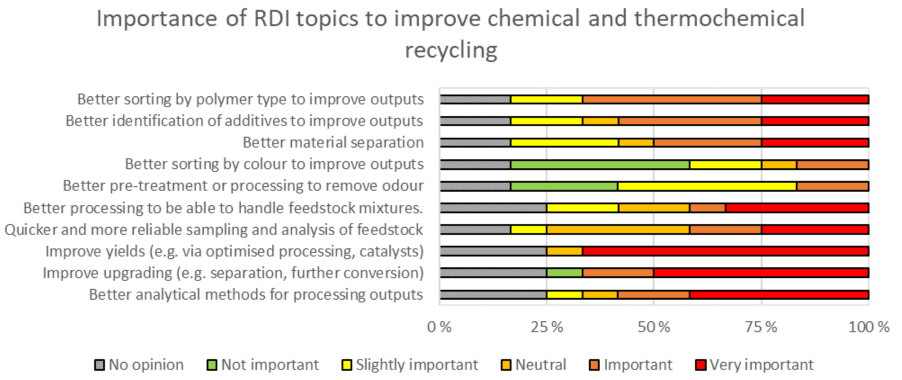
Mechanical recycling specific challenges
- Better sorting and pretreatment
- Loss of properties after several recycling steps

Chemical recycling specific challenges
- Highly energy intensive
- Material losses
- Higher environmental footprint
- High investment costs
- Often high capacity is required
- Complex process

Balance of different recycling technologies
- Mechanical and chemical recycling as complementary techs
- Guidelines for the usage of waste plastic for each tech.

Design for recyclability
- Improvements especially in packaging uses (food contact, WEEE)
- Multilayer packaging (layer separation, adhesives, metals, inks)
- Carbon black plastics can not be fragmented easily by sorting
- Flame retardants, other challenging additives for functionality





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5. Challenges and gaps
Production

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Lack of capacity

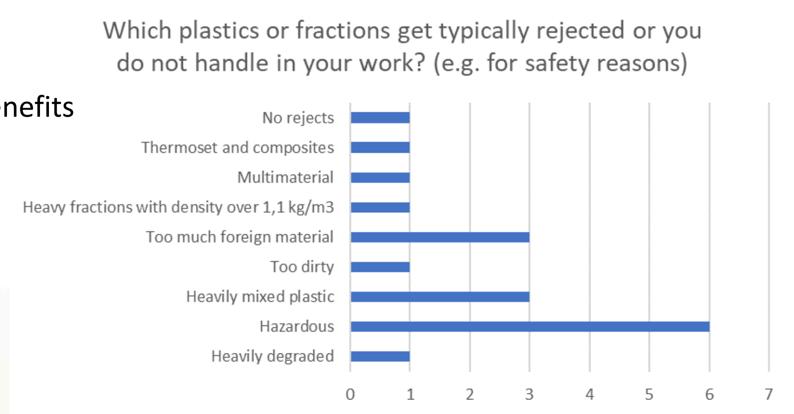
- Achieving European recycling target for 2025 is not likely to be achieved. (50% of plastic packaging waste)
- Optimization of densely populated areas is needed.
- Utilization of capacity optimization of existing recycling plants
- More sorting and recycling capacity need
- Different grades regarding the quality recycled plastics and addressing the needs of industry (converters, OEMs)

Unawareness or lack of investments by converters, original equipment manufacturers or brand owners

- Perception of recycled plastics' quality
- Modification needs of infrastructures to adapt to new feedstocks
- Better and trustworthy proofs and marketing showing environmental benefits

Rejects or currently non-recycled plastics

- Most problematic waste plastics



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5. Challenges and gaps
Regulation gaps & Policies

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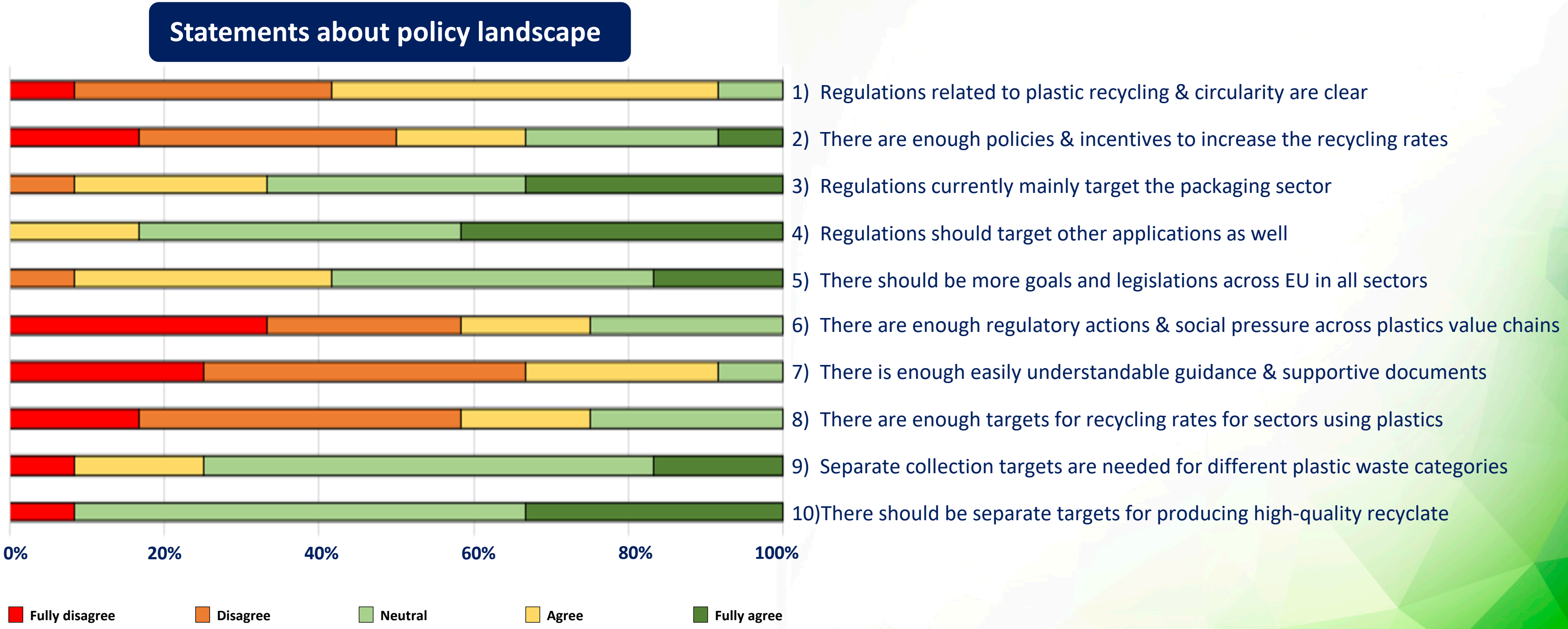

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6. Key takeaways

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- Challenges across plastic value chain have been identified, which depicts the scale and complexity of plastic value chains.
- Challenges and gaps can be categorized into
  - Feedstock acquisition and its quality
  - Recycled plastic and its uptake
  - Technology: sorting, identification and recycling
  - Regulations
- A key takeaway is that every stage of the life-cycle has impacts on the future stages.
  - There is no one major challenge, but multiple sometimes very application-dependent issues.
  - Effort across every stage of the plastics life-cycle is required

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Biocircular economy and Digitalisation
Findings from the challenges of building an ecosystem

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Projectmanager, WP-leader

MTK - The Central Union of Agricultural Producers and Forest Owners

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Circular Cities & Regions Initiative

CCRI Project

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Biobased side streams

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- Various waste materials are often generated in the manufacturing process of the main product
- Biobased side streams are valuable raw materials for use as such, e.g., biogasification, fertilization or soil improvement, and there is also a demand for further processing in industry
- The best benefit can be obtained from side streams when the raw materials are primarily used for products with a high degree of processing
  - First used, then reused or recycled and only finally used for final use, for example in energy production (called the cascade principle)

Powerpoint picture

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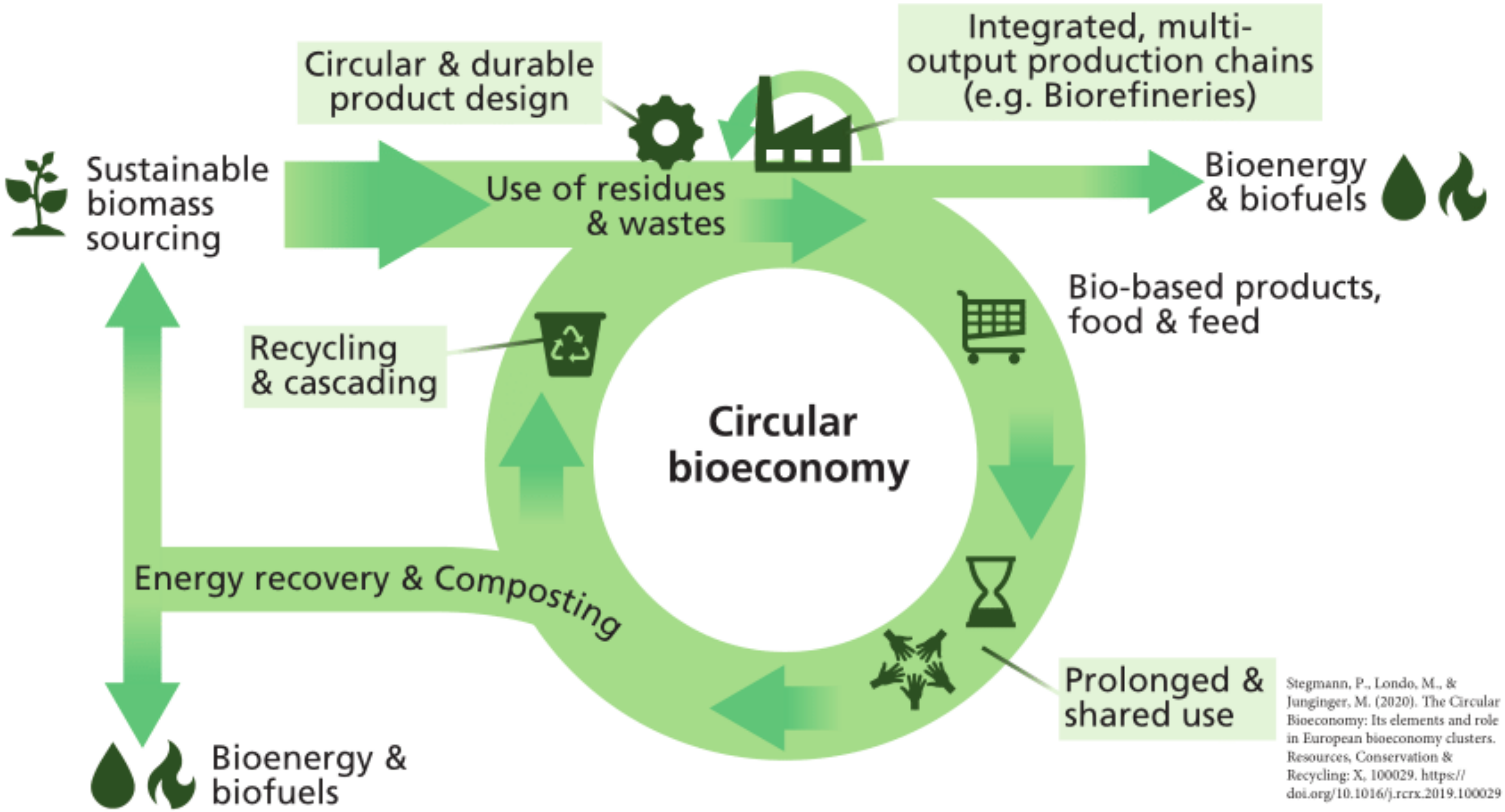
Overarching CBE principles

Resource-efficiency, Optimizing value of biomass over time, Sustainability



Stegmann, P., Londo, M., & Junginger, M. (2020). The Circular Bioeconomy: Its elements and role in European bioeconomy clusters. Resources, Conservation & Recycling: X, 100029. https://doi.org/10.1016/j.rcrx.2019.100029

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Biogas and Recycled fertilizers

TREASoURcE

- In order to guarantee as closed circularity cycle as possible, nutrients, material or energy should be returned to the farm, for example after biogasification, as processed compost or recycled fertilizers
- Biogas is a renewable energy source that replaces fossil energy and increases regional self-sufficiency

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Biogas and Recycled fertilizers

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- Recycled fertilizers replace synthetic fertilizers, and significantly reducing emissions from fertilizers
- Other benefits from utilizing side streams are for example
  - possibility to produce renewable energy and recycled fertilizers
  - economic benefits obtained through resource efficiency
  - ecological benefits obtained by e.g., using fewer virgin materials

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Digital marketplace for biobased side streams

TREASoURcE

- TREASoURcE -project develops a digital marketplace for biobased side streams: KiertoaSuomesta.fi /CircularFinland.fi
  - Piloting firstly in Finland and the model will be replicated in other regions
- On the following pages, findings from interviews and surveys and about needs and wishes for the marketplace for biobased side streams

KiertoaSuomesta.fi -logo

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Findings from the farmers interviews

5 interviews

- Farmers **do not have a clear understanding** of what biobased side streams mean
- A lot of side streams are **exploited internally** on farms and are also **disposed inappropriately**
- The problems of recycling of **agricultural plastic** has come up in almost every interview
- The KiertoaSuomesta.fi website has attracted a **lot of interest** but also **suspicion**
  - Is the side stream volume of our farm too low? Is the location of the farm too remote? Can logistics be organized in a sensible way? How to get enough users on the platform to generate sales?


Photo: Riina Kärki

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Questionnaire for matketplace development

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- User questionnaire was made to find development needs of the digital marketplace KiertoaSuomesta.fi
  - Background questionnaires were made earlier for farms and industry about biobased side streams
- Questionnaire was made in Webropol
- 15 respondents

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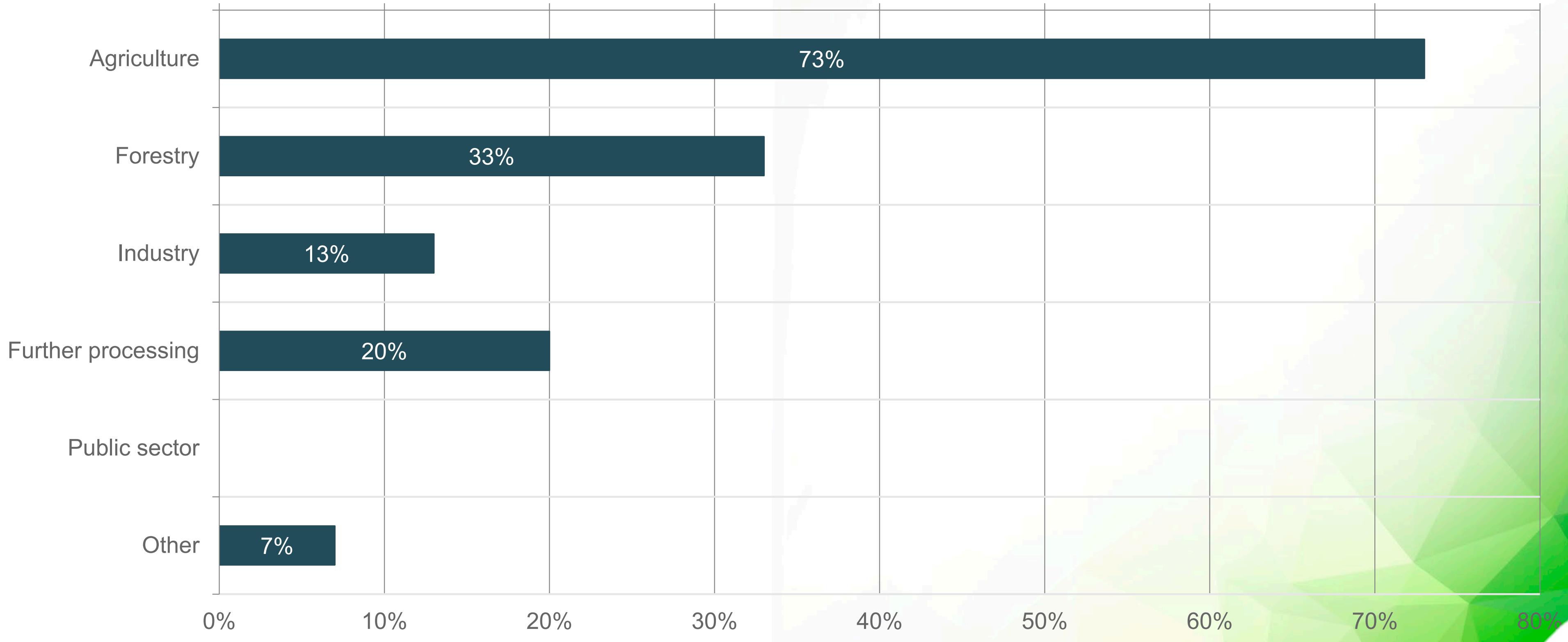
Industries of the user questionnaire respondents



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Interest in utilizing biobased side streams

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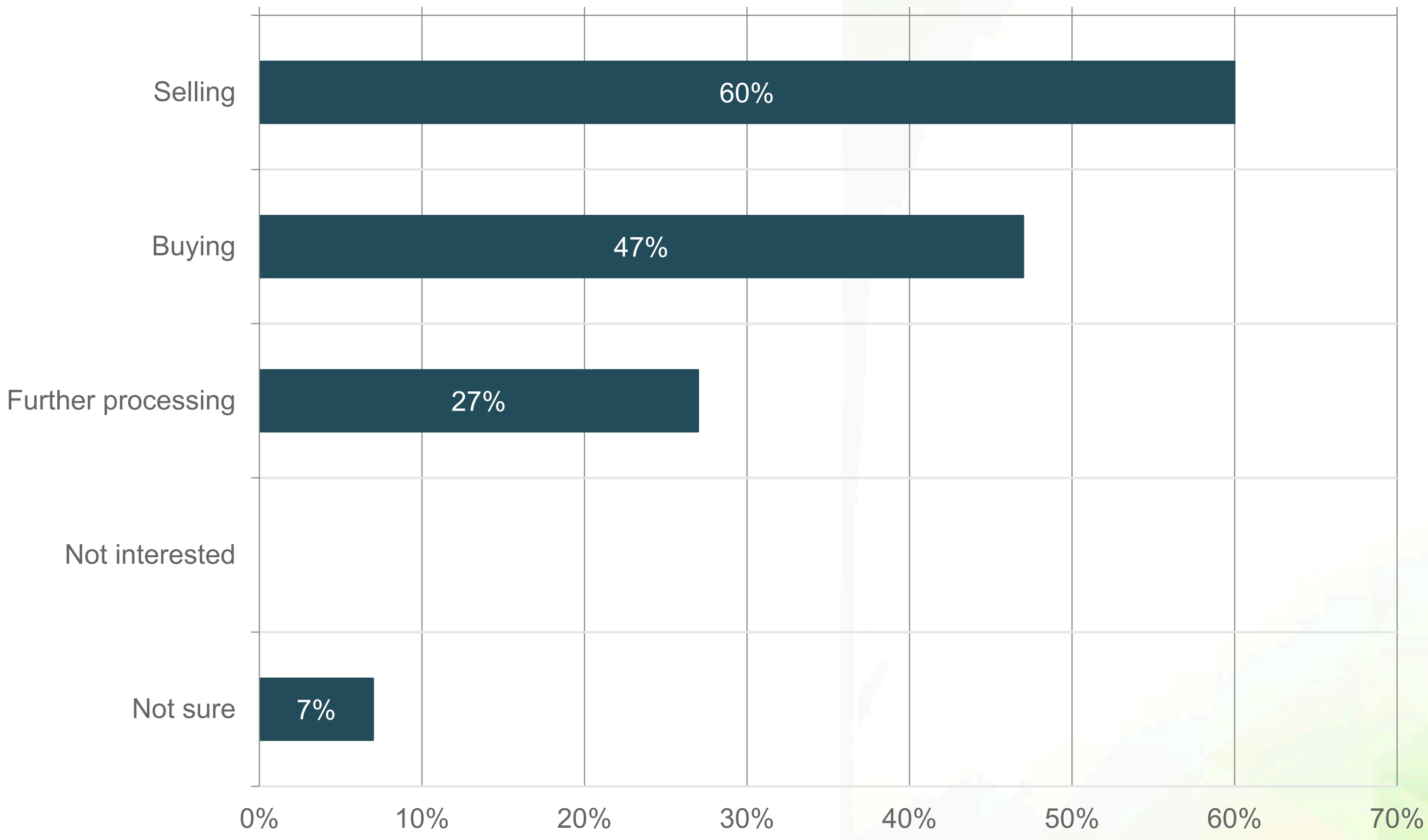

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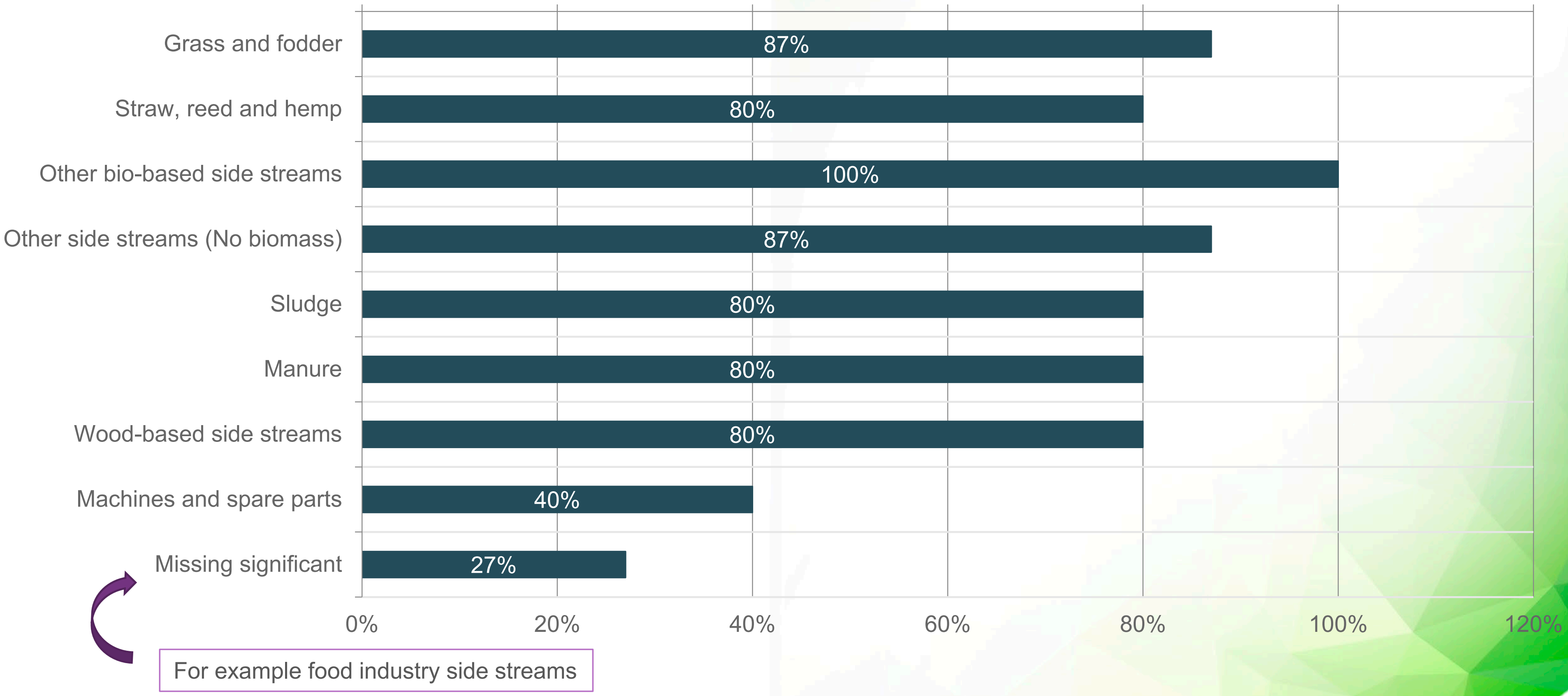
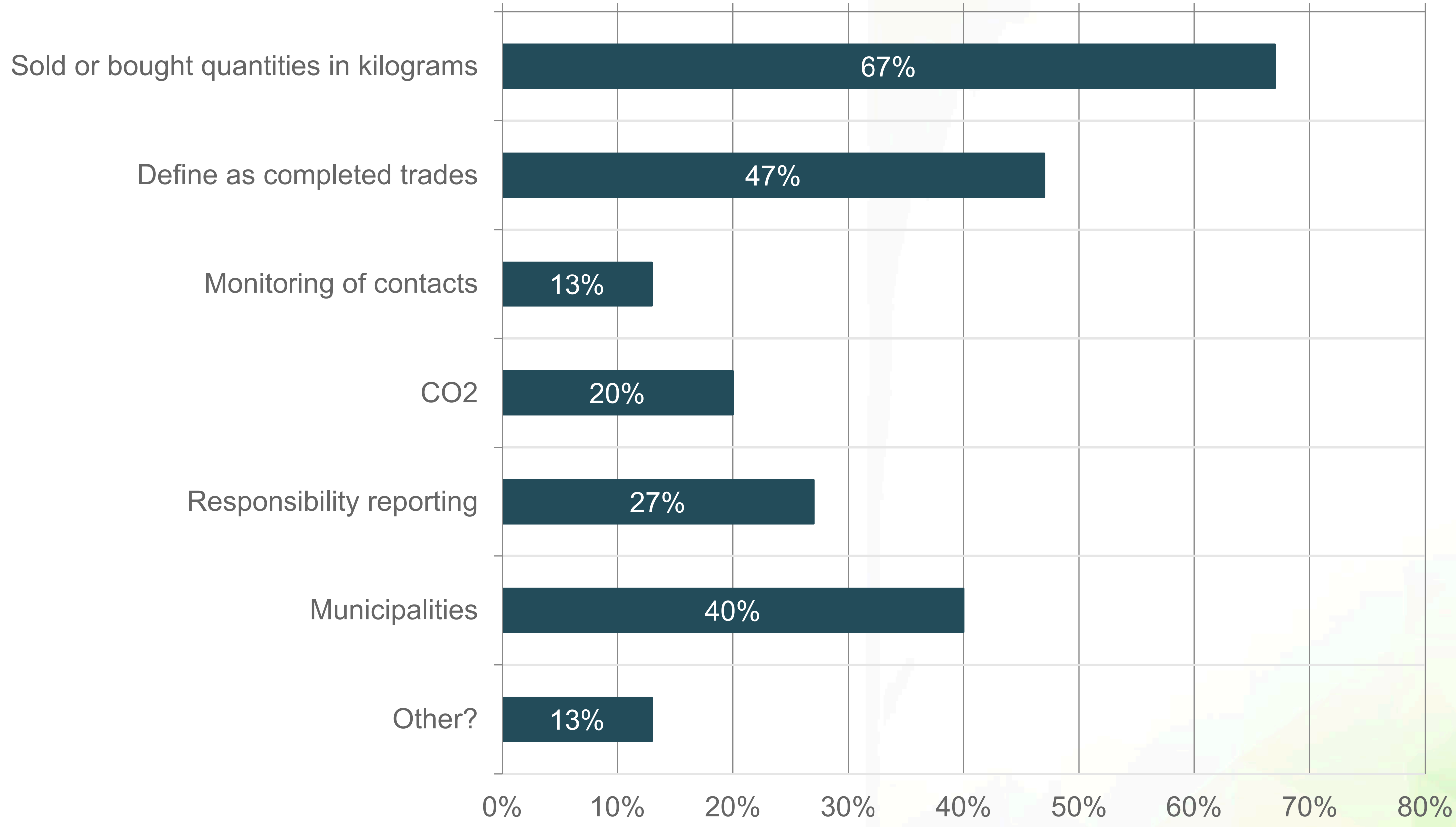
Interest to categories of selling



Interest to get help for reporting



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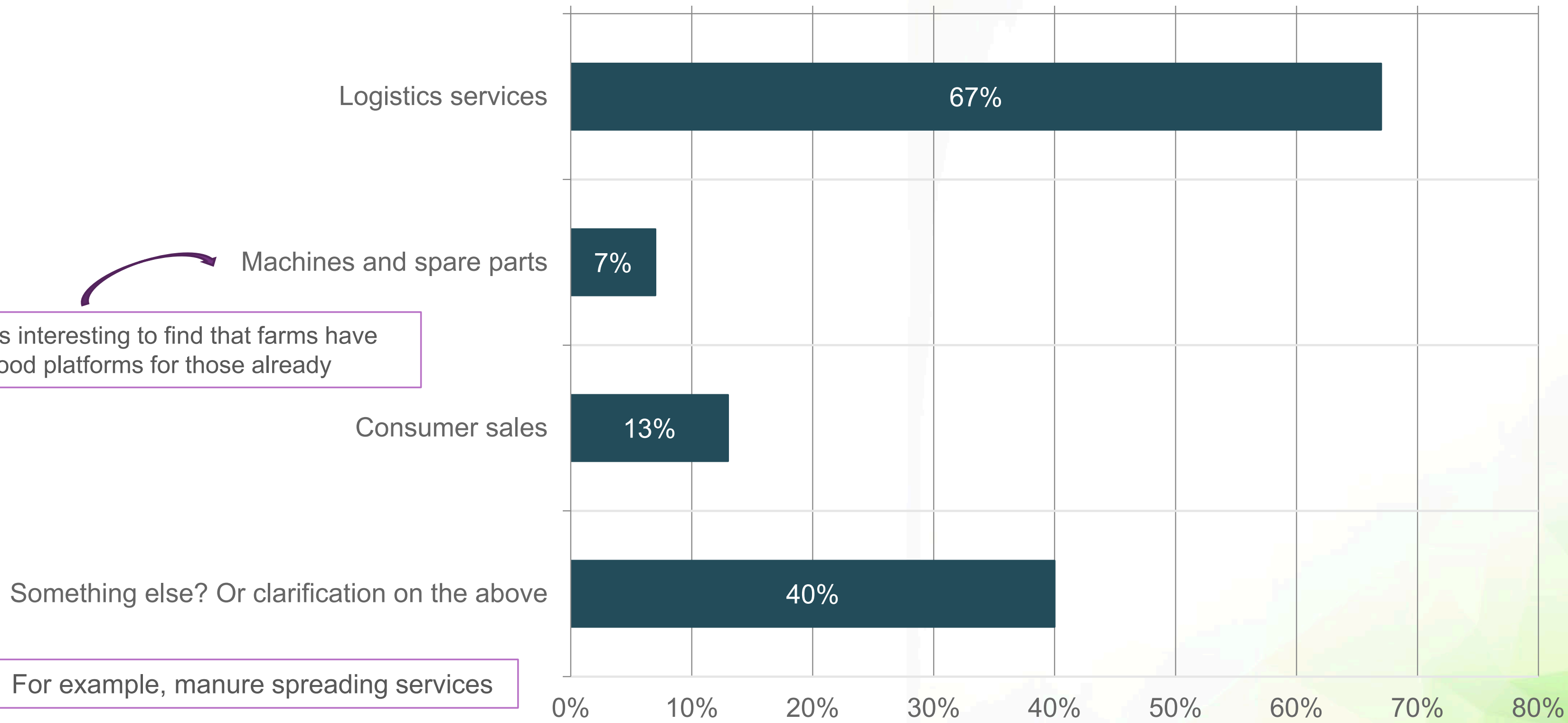
What else you like to have in marketplace?



This was interesting to find that farms have found good platforms for those already

For example, manure spreading services

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What was found in the research - why renewal is slow

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Understanding and knowledge

- What does circular economy and side streams even mean
- What resources I have
- Not easy to find clear and new information

Fear of new things and skepticism

- Fear of data (cybercrime, damage caused by incompetence)
- Distrust of the future
- Distrust of new technology

Limited time and budget

All resources are already stretched so tight that it is difficult to introduce even new beneficial measures, because it would always require learning, new technology, etc.

Logistics, transport and storage key factors in success

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In the circular economy only one sector cannot be looked at, it must be seen more broadly

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- The efficient utilization of side streams has been slowed down by challenges related to profitability and logistics
  - On one farm, the amounts of side streams may be small, seasonal and no suitable buyers have been found
- In the planning of circular economy entities, it is necessary to consider what kind of key players and regional characteristics are influencing the implemented solutions
- The cooperative form is also a viable option to build common structures, e.g., for biogas production
- Facilitated support is needed from the public sector on many levels

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SDU
Life cycle engineering

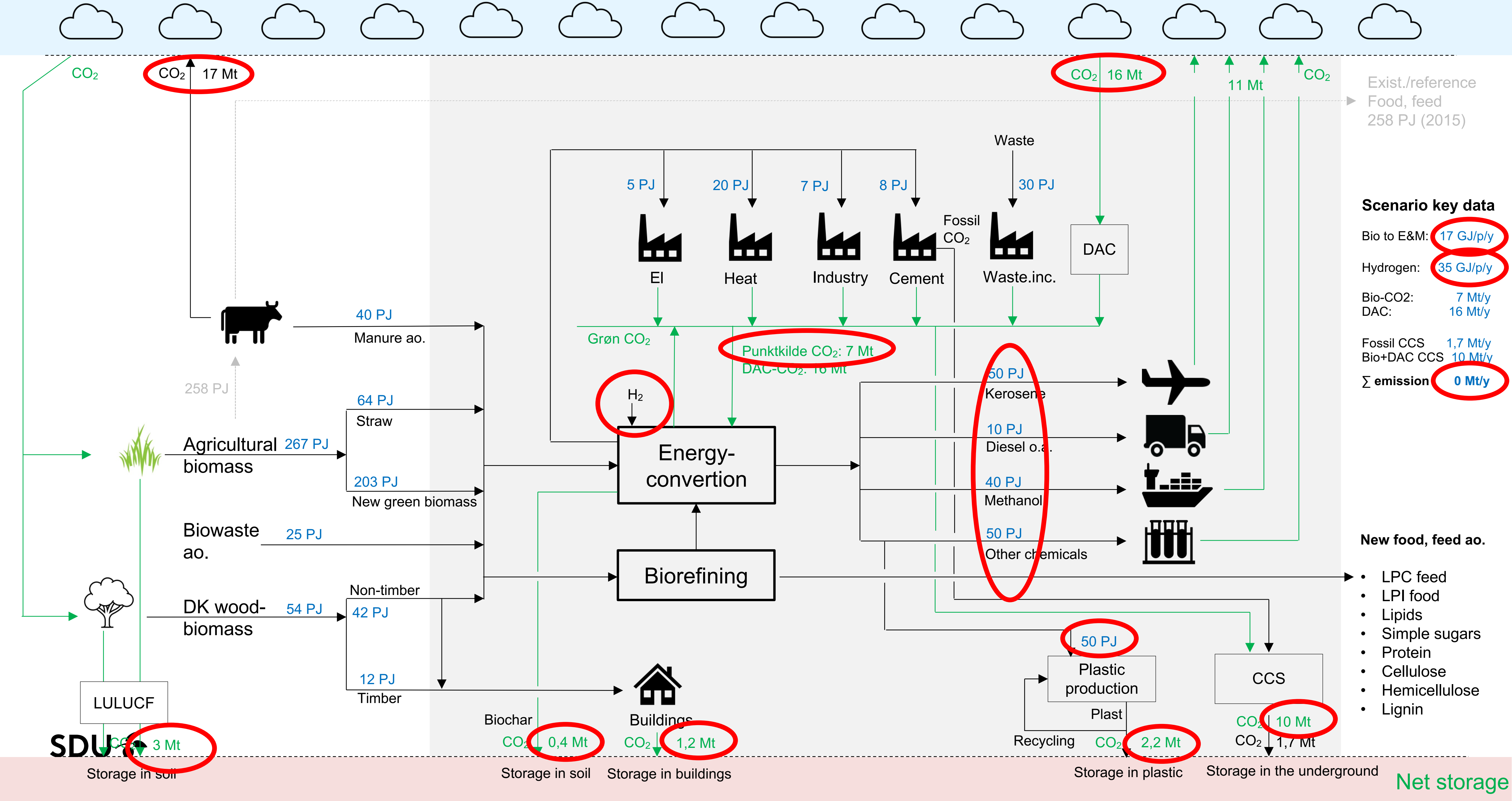
Biowaste ecosystems in Denmark

Henrik Wenzel, Professor SDU

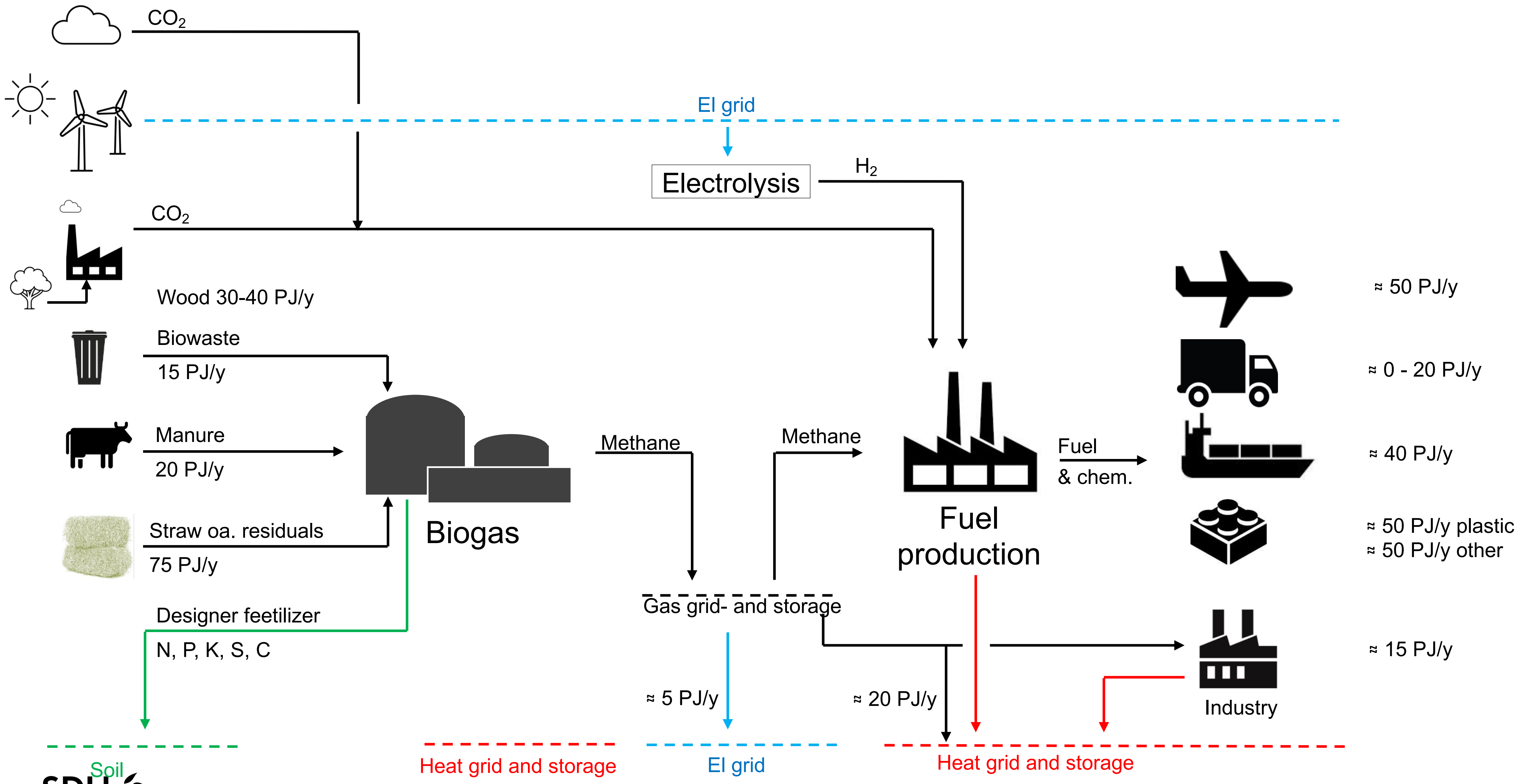
TREASoURcE

Webinar, May 26th, 2023

The Danish carbon balance 2050: incl. innovation in agriculture – scenario example

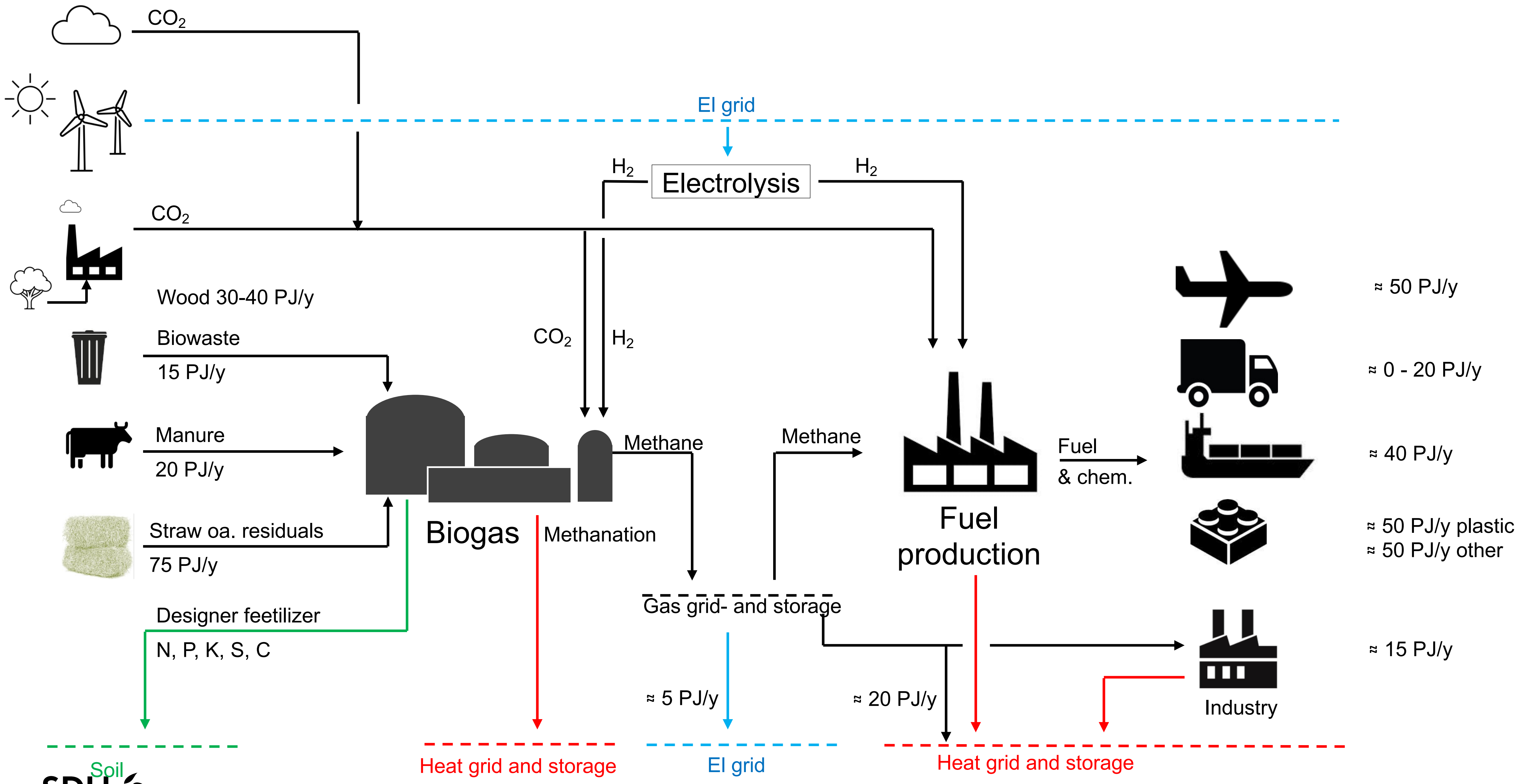


The system design: making the most of biowastes



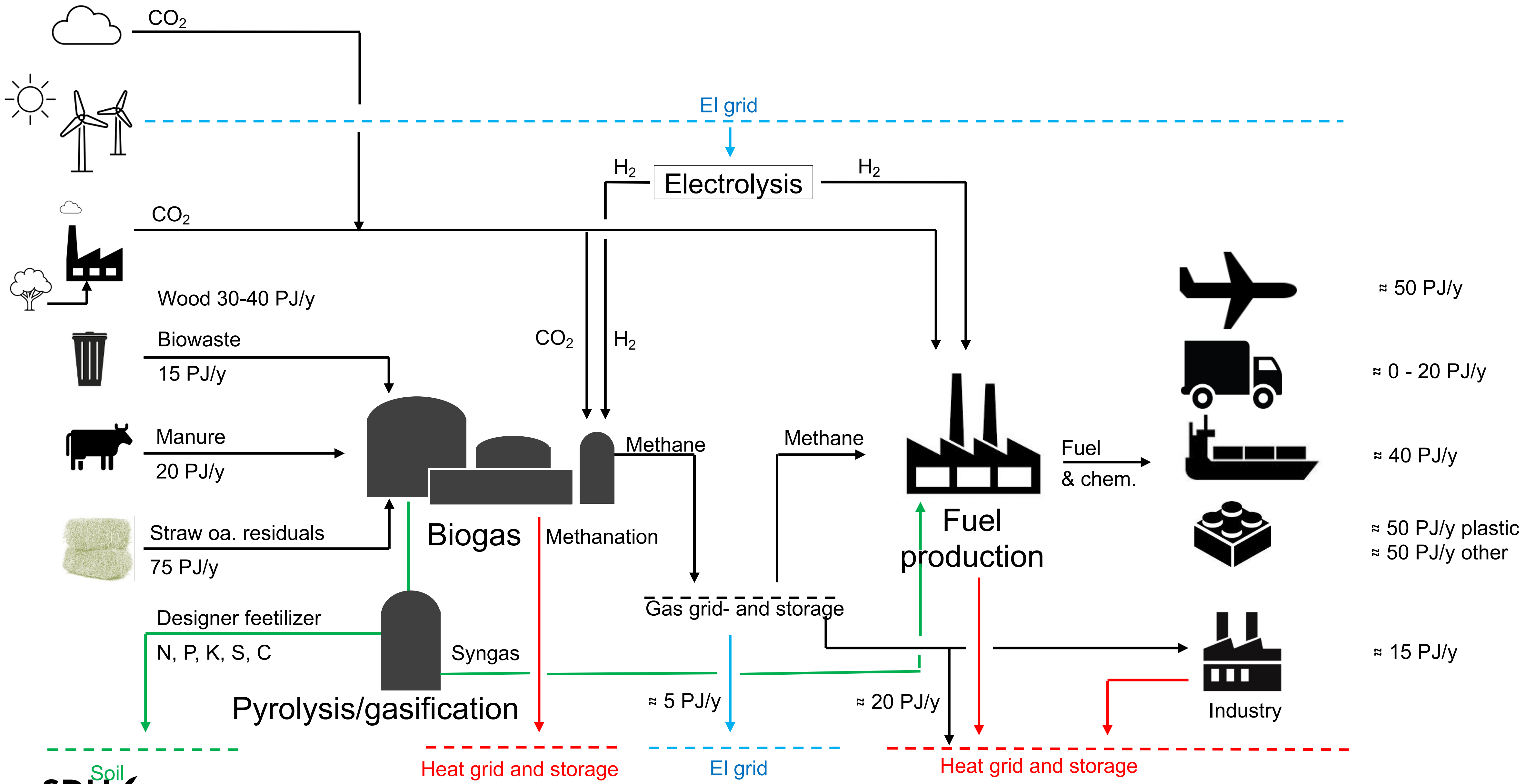
SDU

The system design: making the most of biowastes



SDU

The system design: making the most of biowastes



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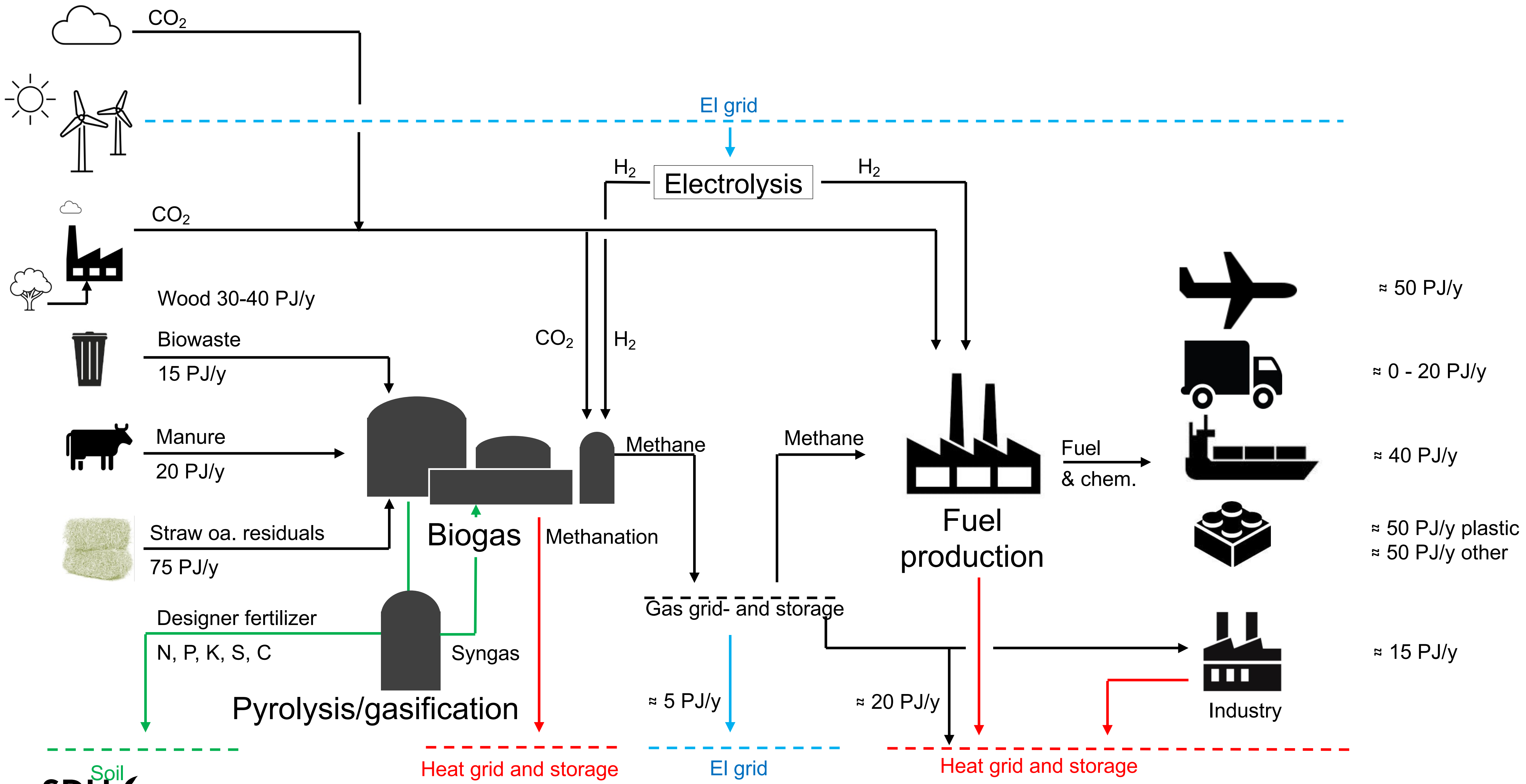

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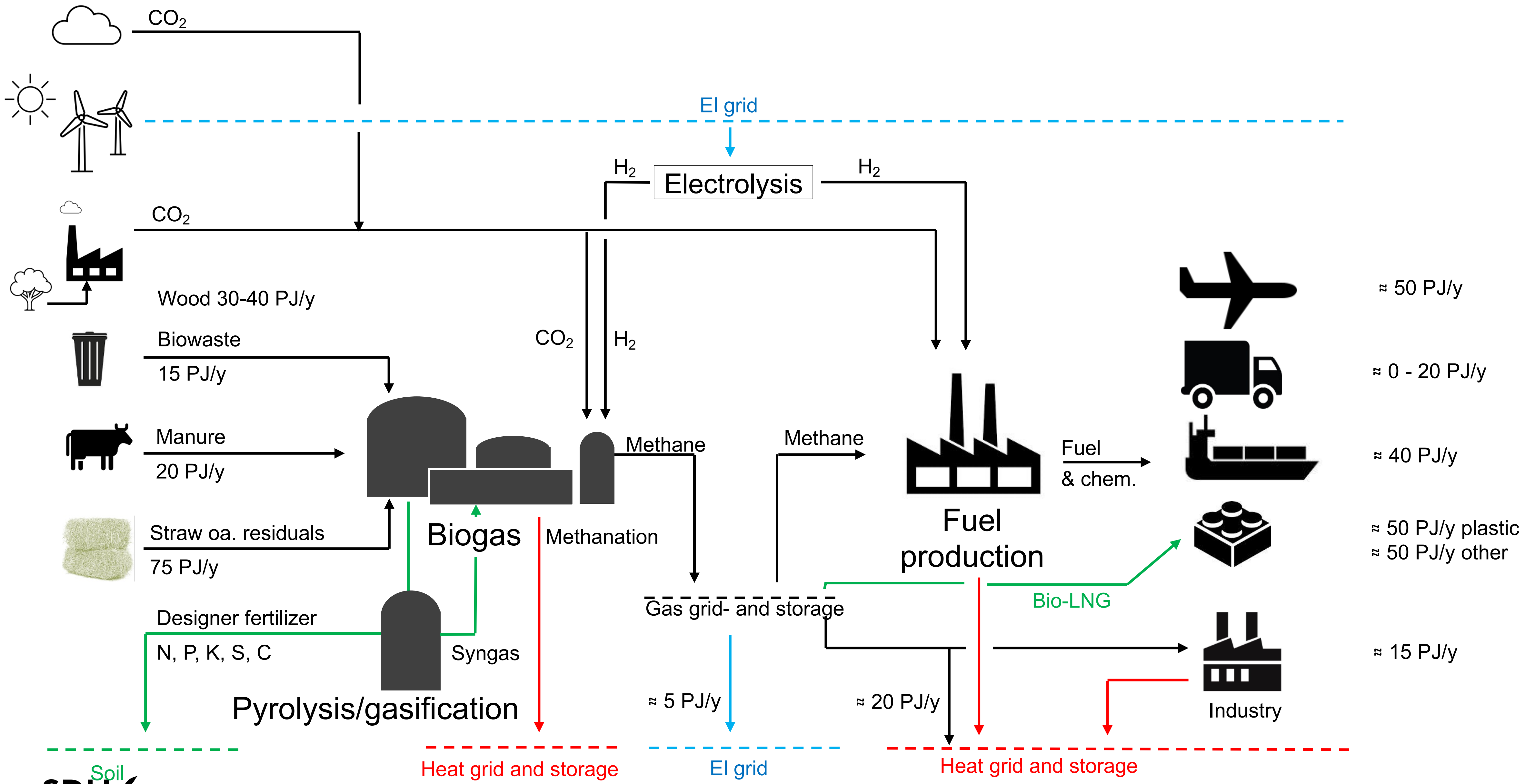

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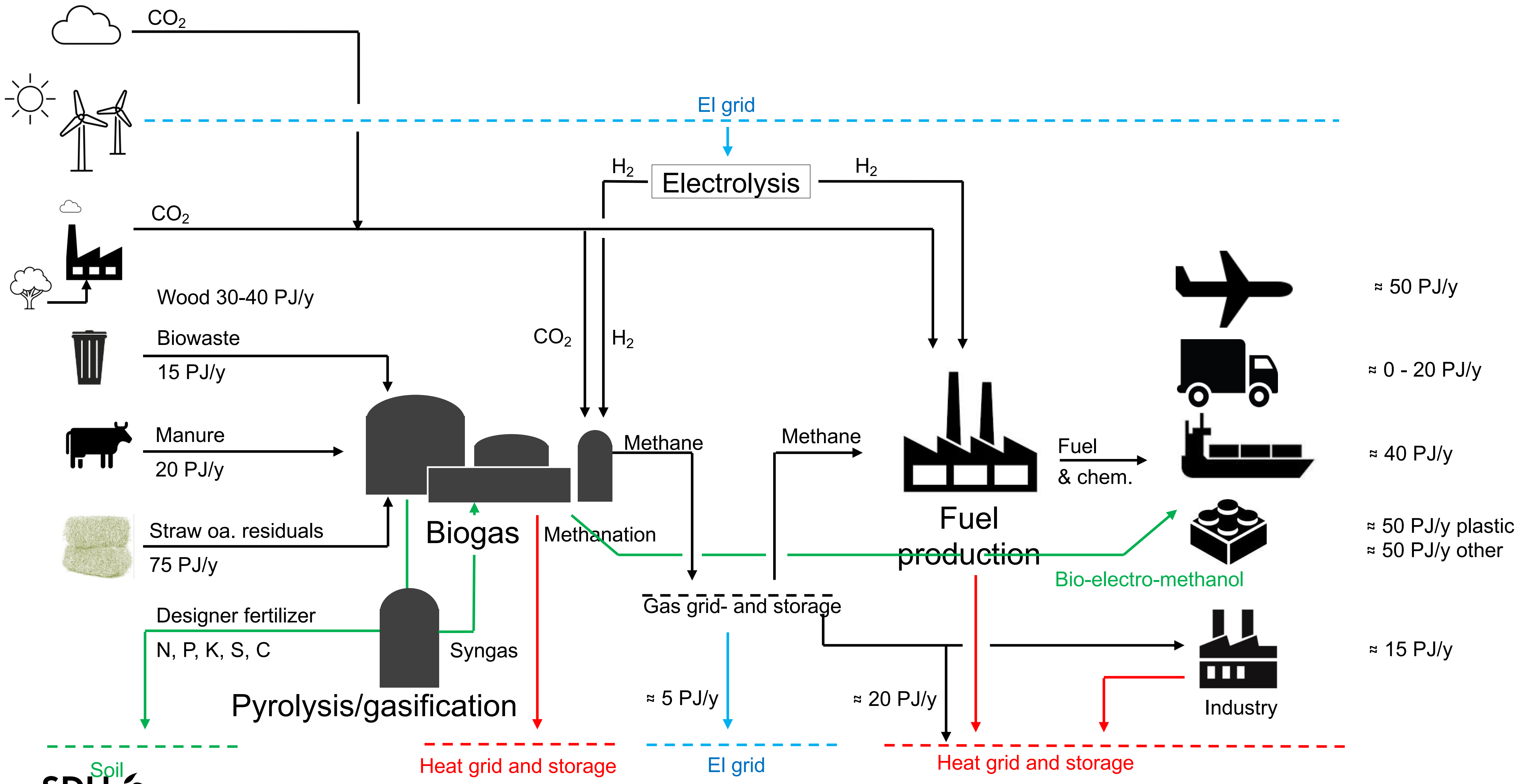

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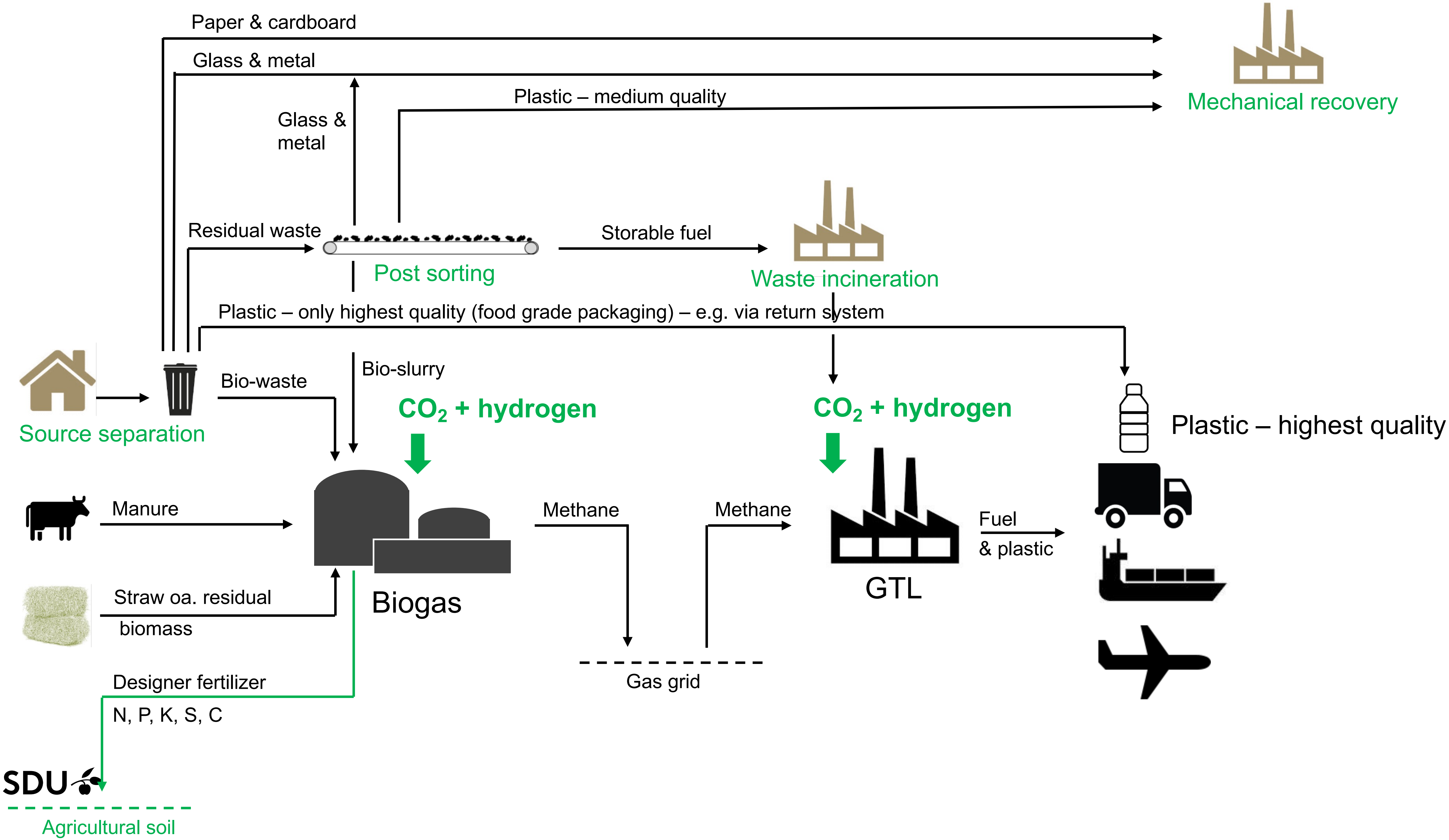
The system design: integrating municipal waste management



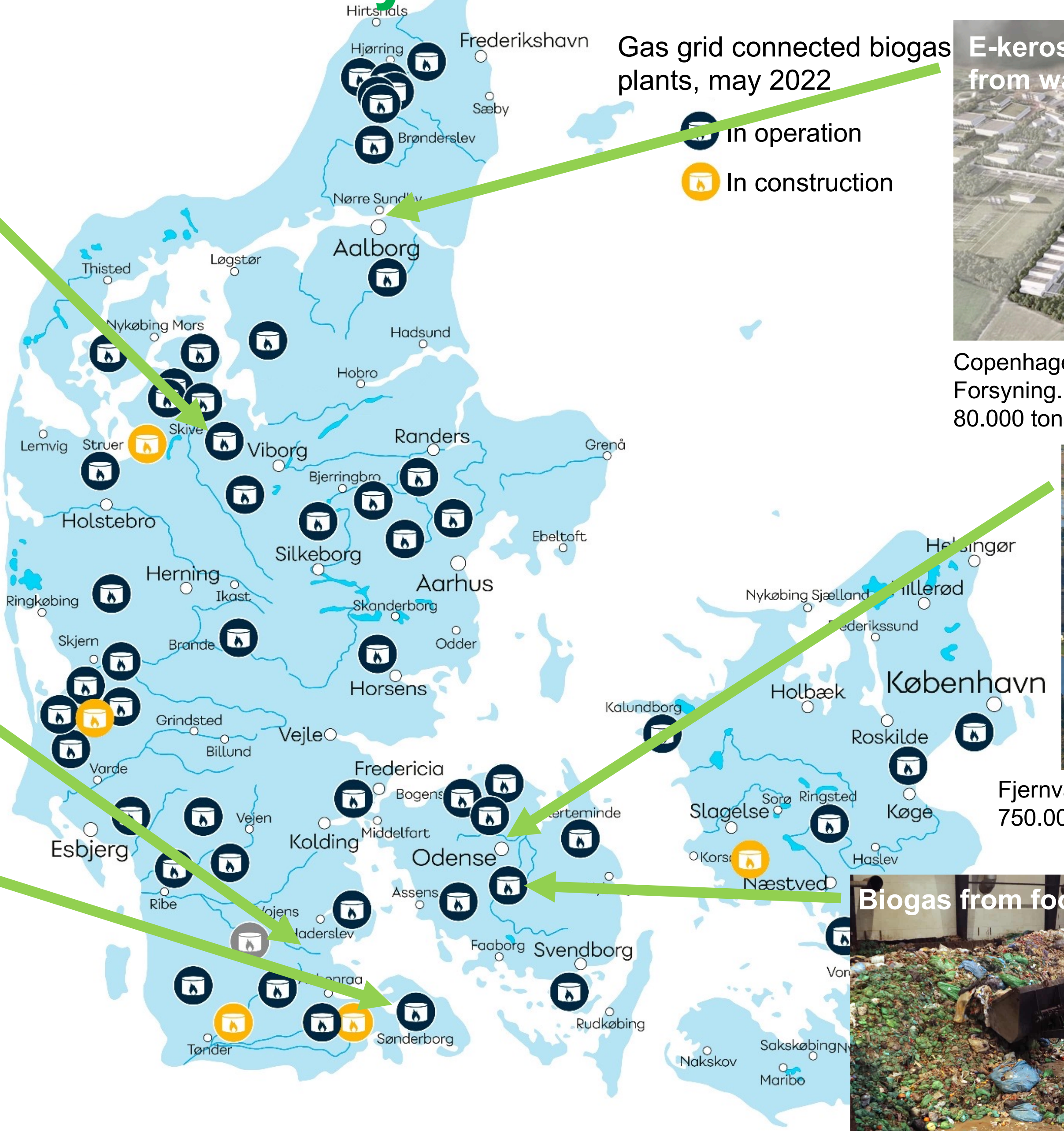
SDU

Latest news on biowaste ecosystems in Denmark

Stiesdal – SkyClean, Skive, Denmark (2023)

European Energy, LEGO, Novo
Kassø, near Aabenraa, Denmark
32.000 tons/year (2024) – to be used for POM plastic

Nature Energy, Biogasclean, Andel, SDU
Glansager, near Sonderborg, Denmark
4 million m3/year (2023), 13 million m3/year (2024)



Copenhagen Infrastructure Partners, Reno Nord, Aalborg Forsyning. Aalborg, Denmark
80.000 tons e-kerosene/y + 17.000 e-naphta/y (2027)

Fjernvarme Fyn and Fortum, Odense, Denmark
750.000 tons CO2/y for plastic production through methanol

Ragn-Sells and Nature Energy,
Heden ,near Ringe, Denmark

Thank you for your attention

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