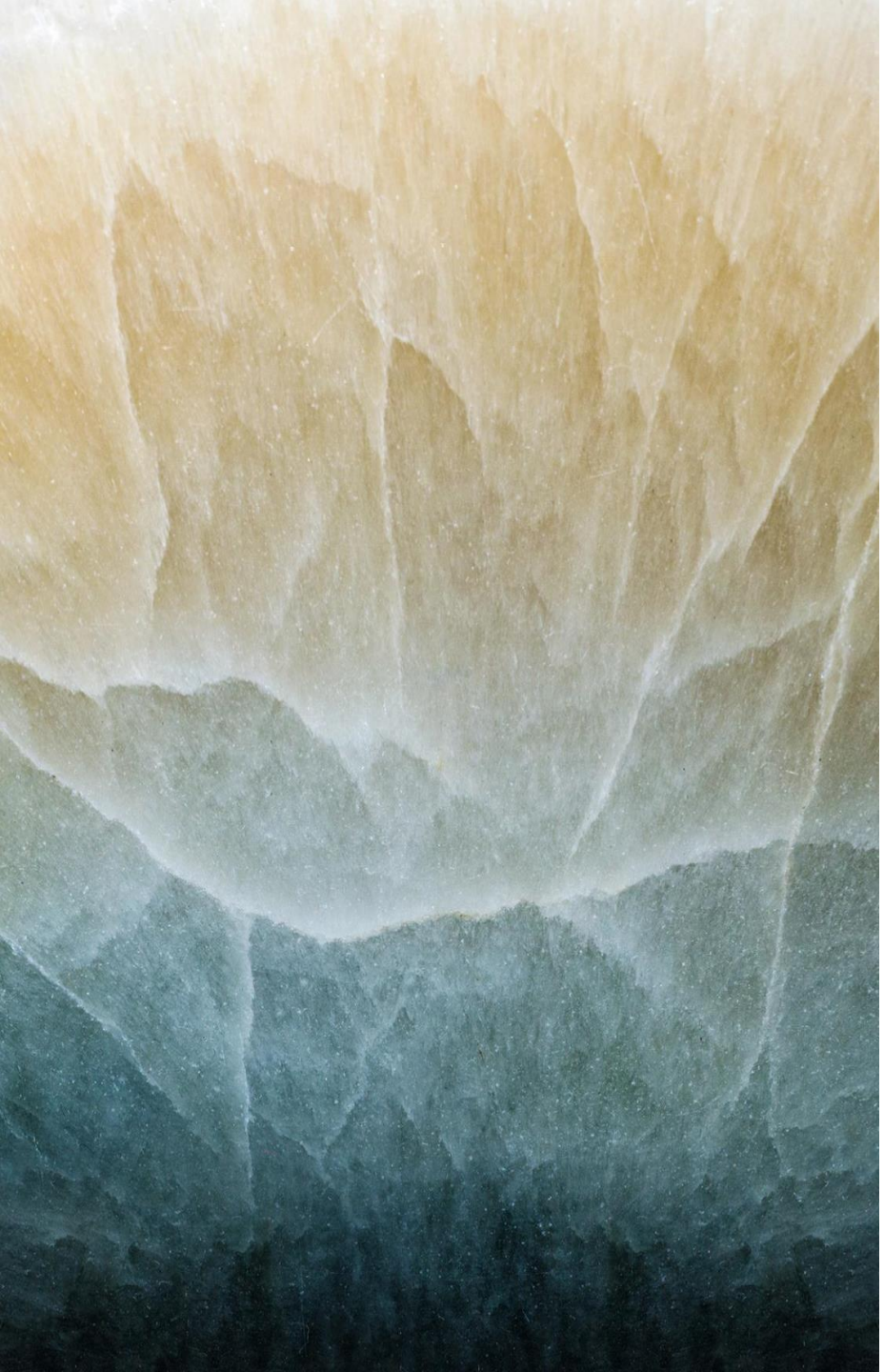
# Process4Planet (HorizonEurope): CCU, Waste Minimisation and Hubs for circularity

Ludo Diels

27 September, 14th CONCAWE symposium, 27-28 September, Brussels



# Outlook

- Processes4Planet
  - Who are we?
  - Problems & Ambitions
  - SRIA

- Decarbonization: the right word?

- Refinery of the future and the ambition of P4Planet

# Process industry ambition in line with the Green Deal

## A vibrant community with a common strategic Vision

### A.SPIRE – European cross-sectorial association

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DG R&I
DG Grow

COMMISSION EUROPÉENNE

### PROCESSES4PLANET

**2050 Process Industries**

- ✓ Develop & deploy climate-neutral solutions
- ✓ Closing the energy and feedstock loops
- ✓ Achieve global leadership of the Process Industry
- ✓ Accelerate innovation & unlock public-private investments

### OPEN APPROACH: inclusive of different stakeholders and welcoming Newcomers

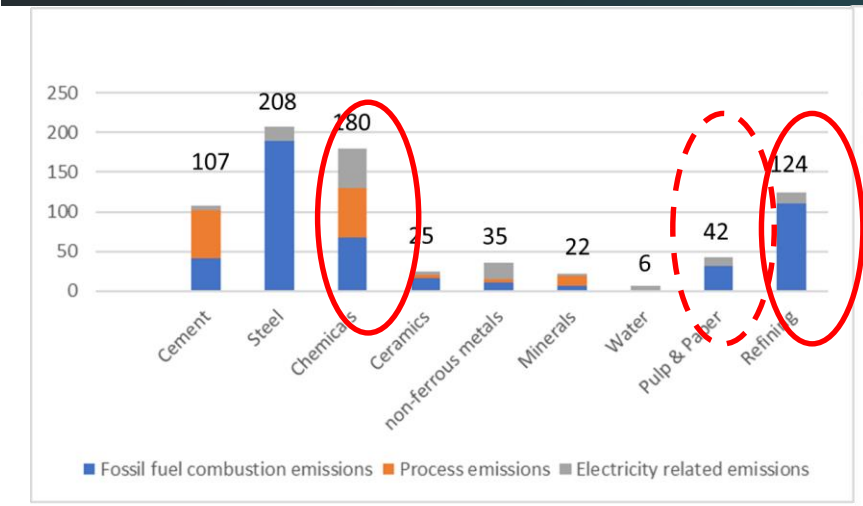
- Industries, incl. SMEs
- Industrial Associations & Clusters
- Consultancies

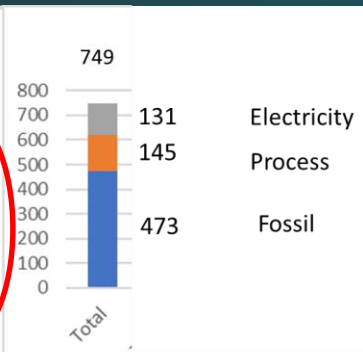
- RTOs
- Higher Education Institutions
- NGOs

- Public institutions
- Innovation Agencies
- MS and Regional representatives

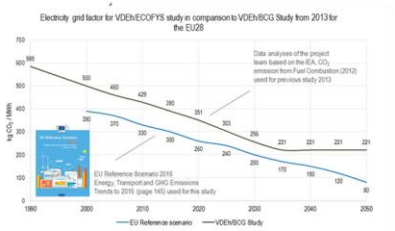
- Partnerships & EITs
- Financial parties
- New sectors

# Three problems

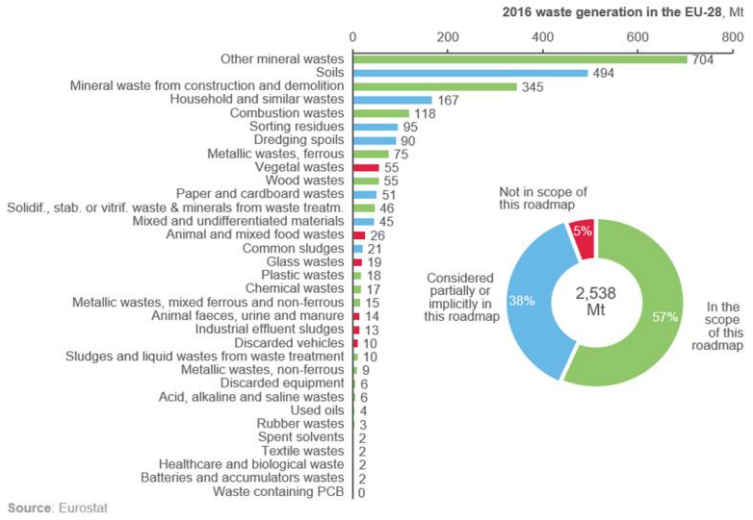


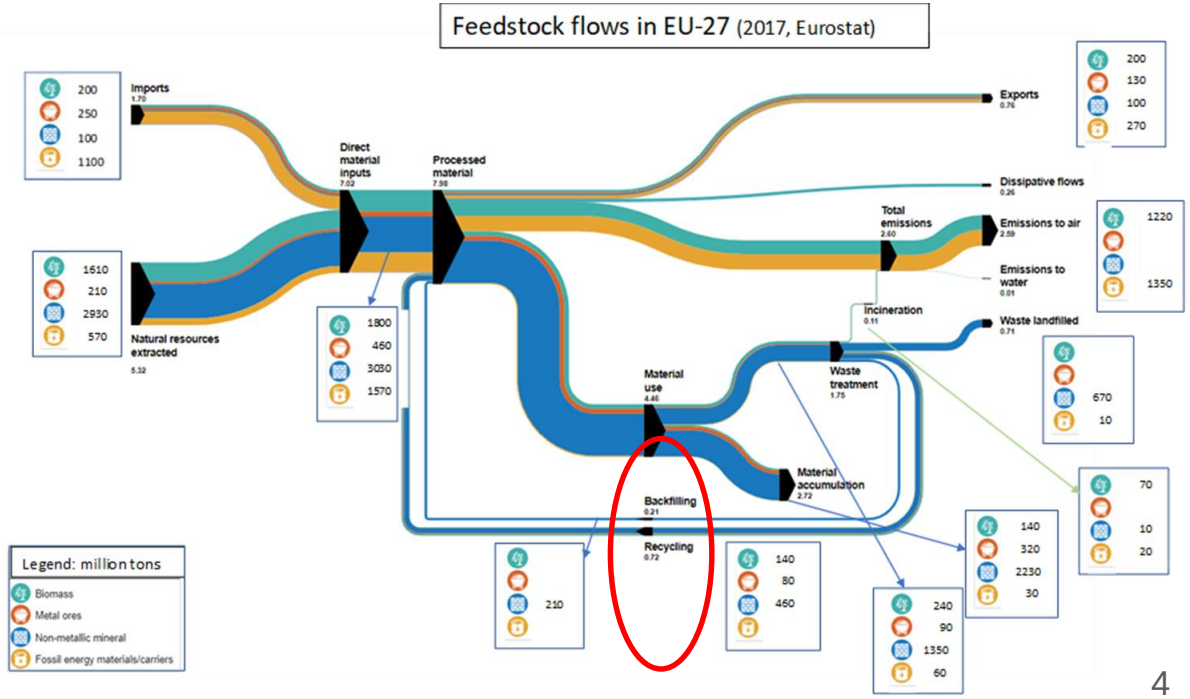

750 M tons
CO2 emissions




Competitiveness

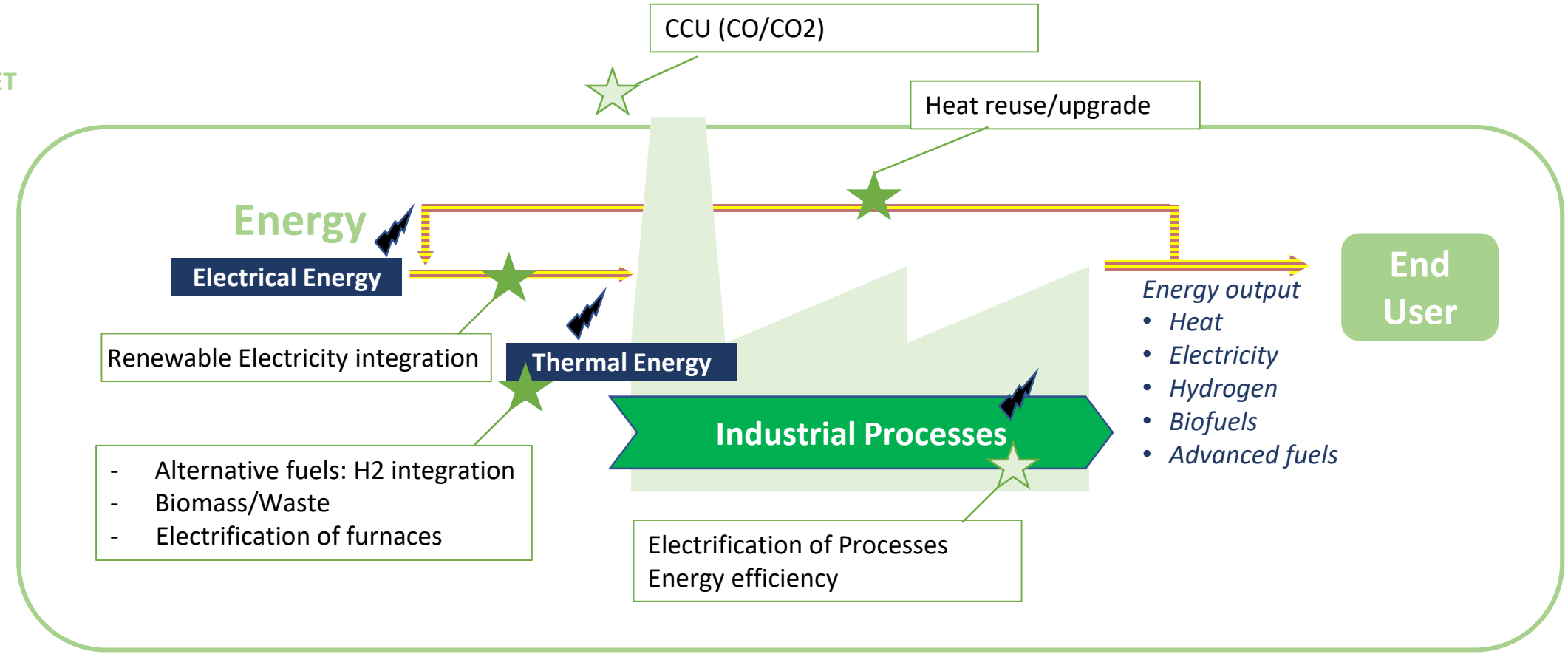



2500 M tons
Waste



# Climate neutrality ambition is strongly related to energy issues
# Efficient integration of renewables and valorization of process

P4PLANET

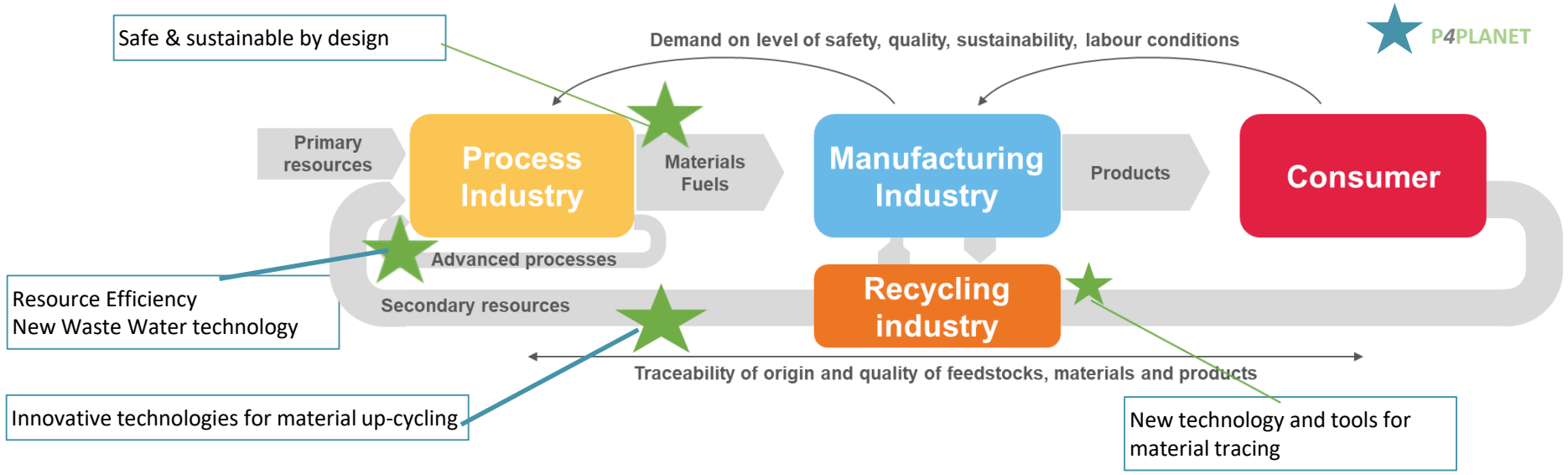


# Circular resources ambition

Disruptive process innovation to close the loops

Moving away from: Landfilling, Incineration at the end of a linear value chain

**To UPCYCLING large volumes of secondary resources reused by the PI in a circular value chain**




**Near zero-landfilling / Near zero-water discharge**

# Competitiveness ambition

Disruptive Process Innovation to transform process industry globally

EU Process Industries are highly exposed to global competition

**UNLOCKING PRIVATE INVESTMENTS & THE BARRIERS TO MARKET FOR CLIMATE NEUTRAL & CIRCULAR SOLUTIONS**

P4PLANET

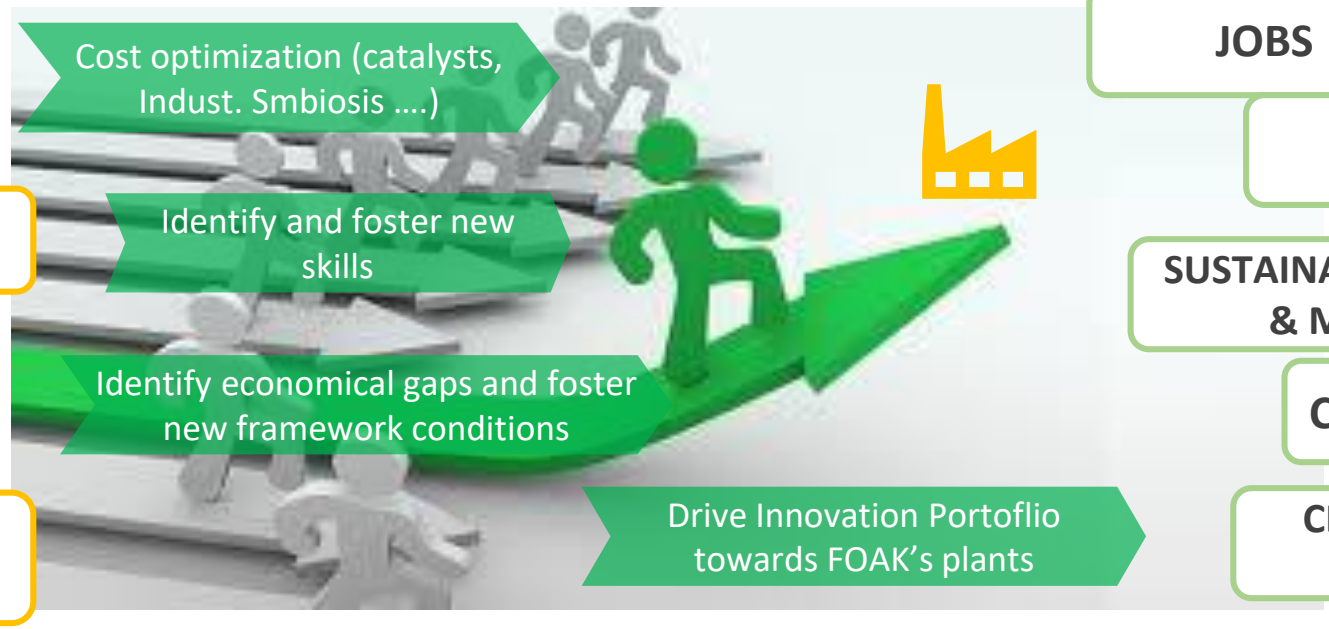
**De-risk Investments**

**FINANCIAL FLOW**

**Generate a market for climate neutral & circular products**

**Available & Affordable Green Energy**

**Digitalisation & H4Cs to accelerate innovation**




**JOBS**

**CIRCULAR ECONOMY**

**SUSTAINABLE PROCESSES & MATERIALS**

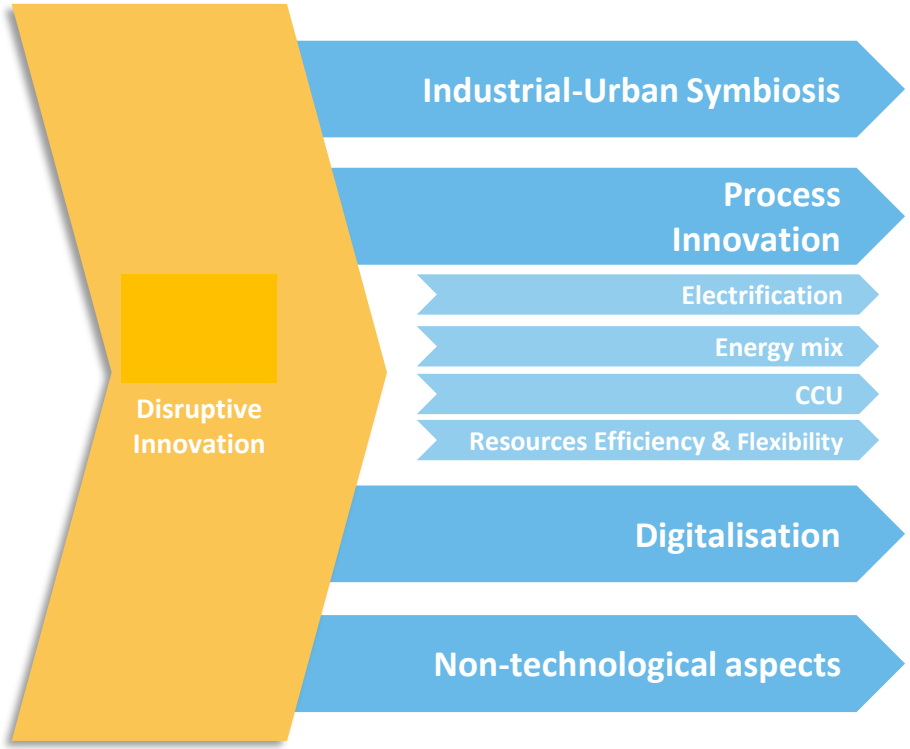
**CIRCULAR REGIONS**

**CLIMATE NEUTRAL CONTINENT**

**EU Process Industry's GVA to grow quicker than the EU GDP**

# 3 ambitions, 14 Innovation areas

9h15 -9h30




| Innovation area | Progress up until milestone year[1] 2024 | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| Renewable energy integration | | | | |
| Heat reuse | | | | |
| Electrification of thermal processes | | | | |
| Electrically-driven processes | | | | |
| Hydrogen integration | | | | |
| $CO_2$ capture for utilisation | | | | |
| $CO_2$ utilisation in minerals | | | | |
| $CO_2$ & CO utilisation in chemicals and fuels | | | | |
| Energy and resource efficiency | | | | |
| Circularity of materials | | | | |
| Industrial-Urban symbiosis | | | | |
| Circular regions | | | | |
| Digitalisation | | | | |
| Non-technological aspects | | | | |

[1] Progress is depicted here as % of total TRL9 projects programmed in each area, and for circular regions, digitalisation, and non-technological aspects % of total investment needs until 2050

# Industrial Symbiosis via Hubs4Circularity

Reduce waste, emissions, pollution – become climate neutral by 2050

**Physically connected plants to use underutilised resources of one in another**

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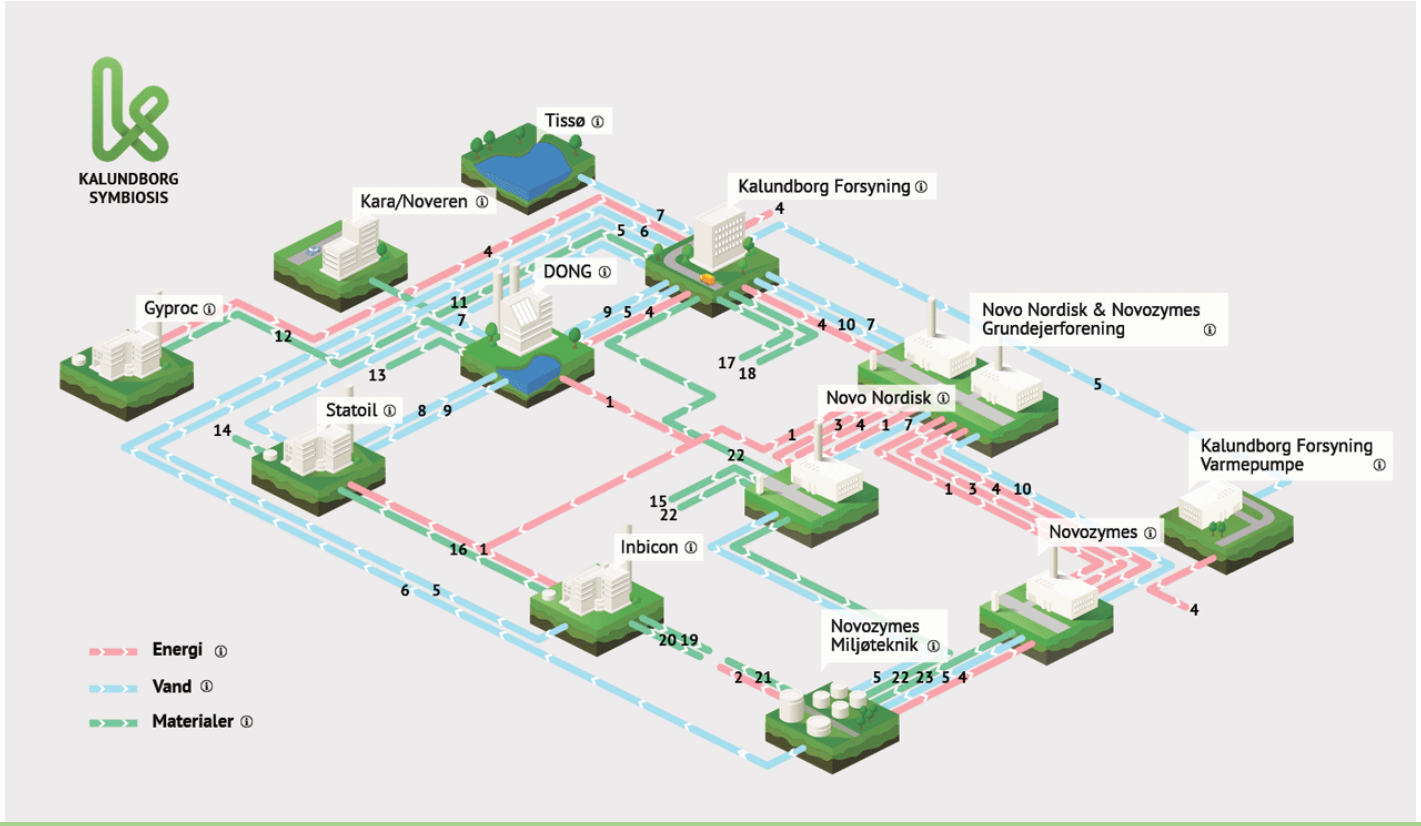



Connection of **geographically close units** to keep resources in the loop as long as possible

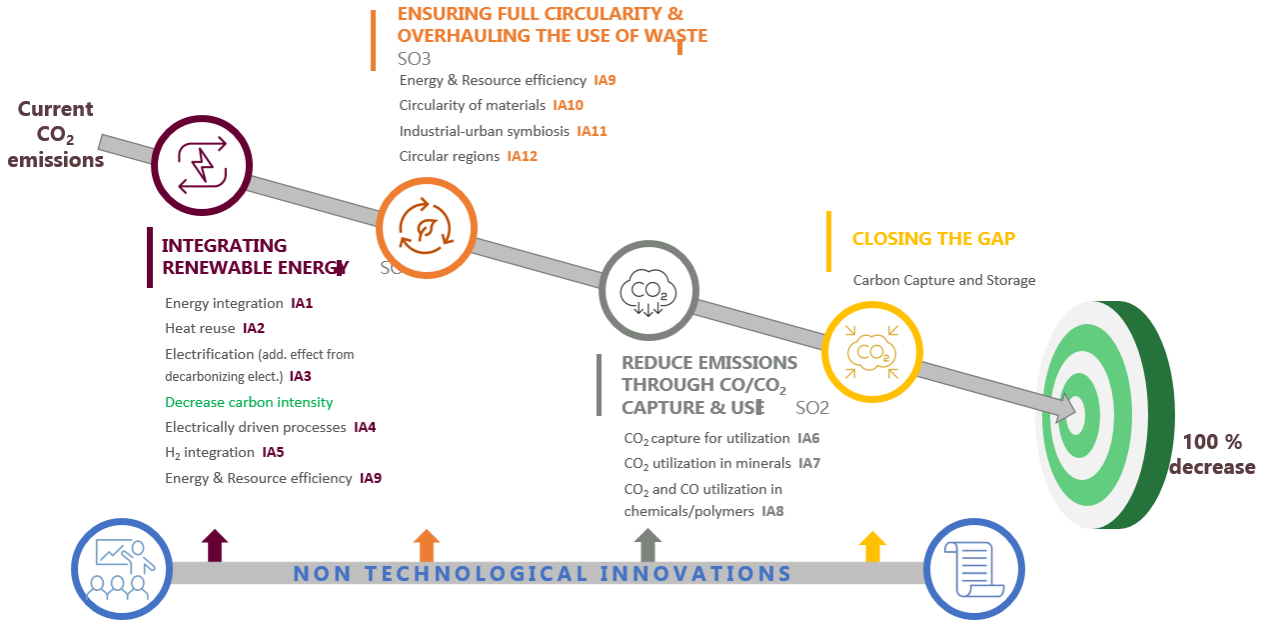
*Self-sustaining economic industrial ecosystems for **full-scale Industrial-Urban Symbiosis and Circular Economy, closing energy, resource and data loops** and bringing together all relevant stakeholders, technologies, infrastructures, tools and instruments necessary for their incubation, implementation, evolution and management.*

**Near zero waste / Near zero emissions / Near zero water discharge**

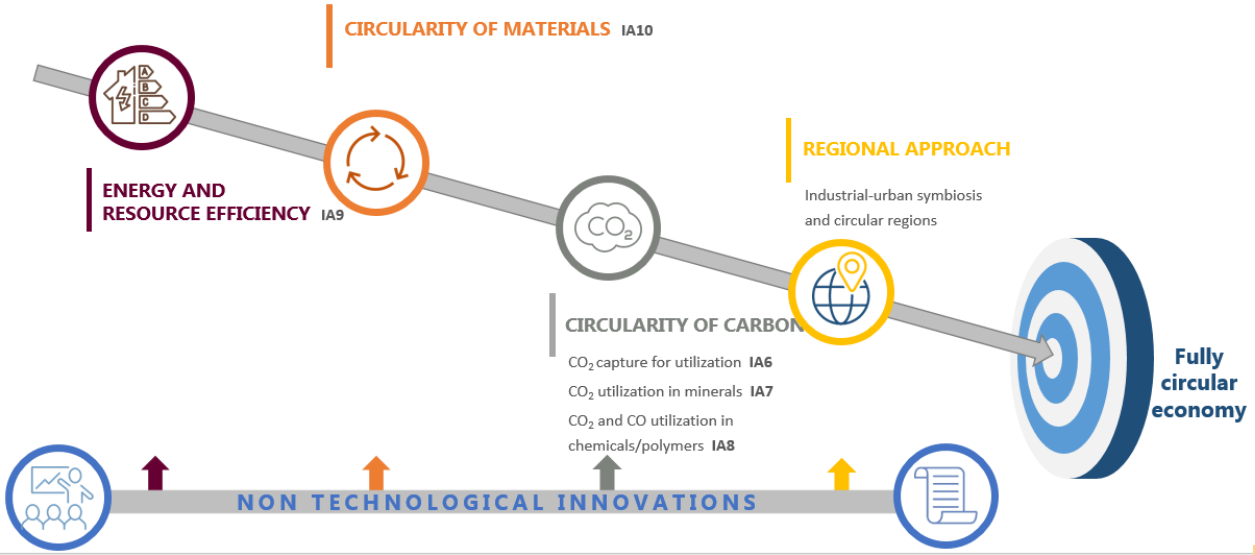
Source of image: http://www.energycrossroads.org/industrial-symbiosis-circular-economy

# Process industry relies on many measures to reduce its emissions and increase its circularity

## A tapestry of innovations to achieve climate neutrality




## A tapestry of innovations to achieve circularity



# The integrated approach

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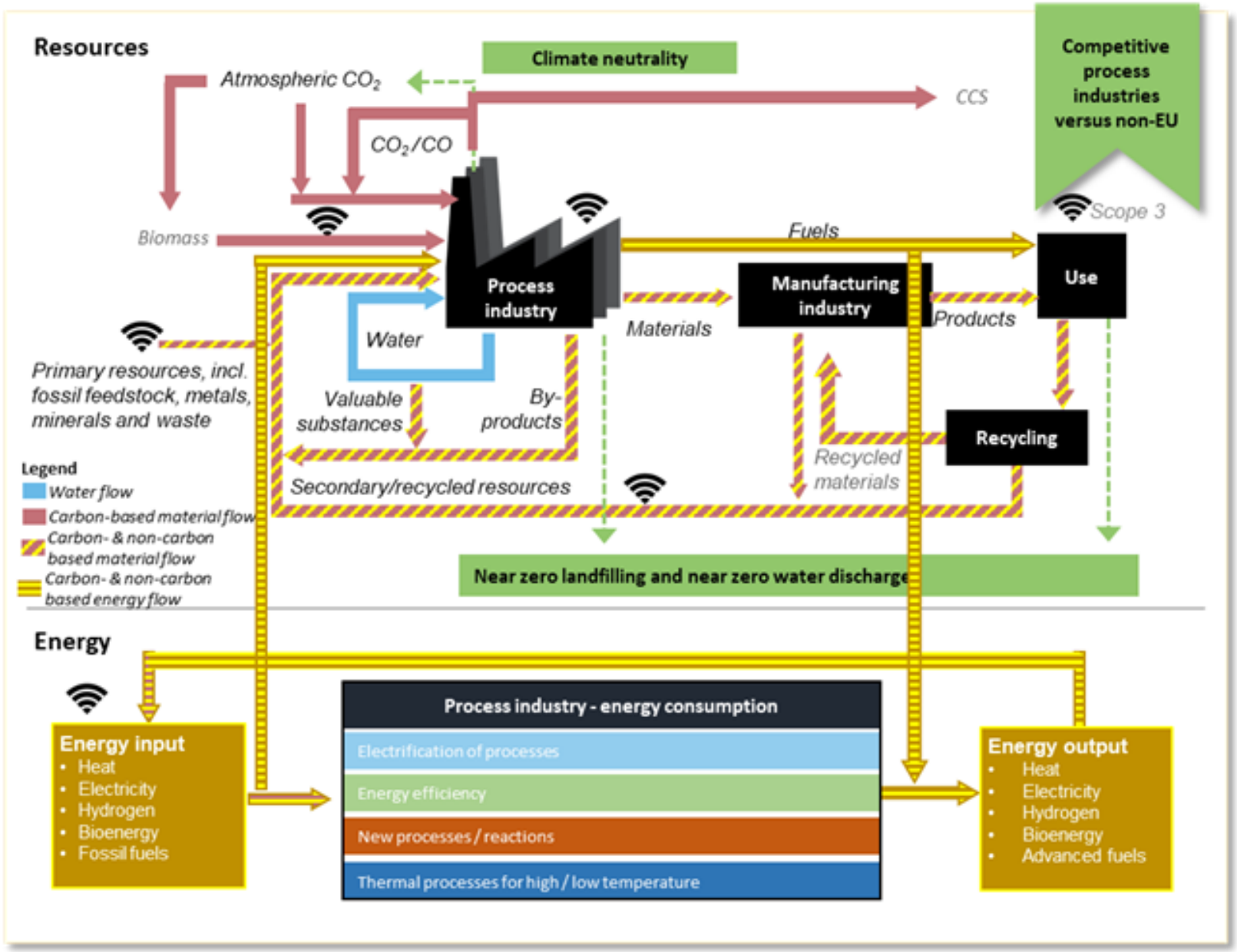
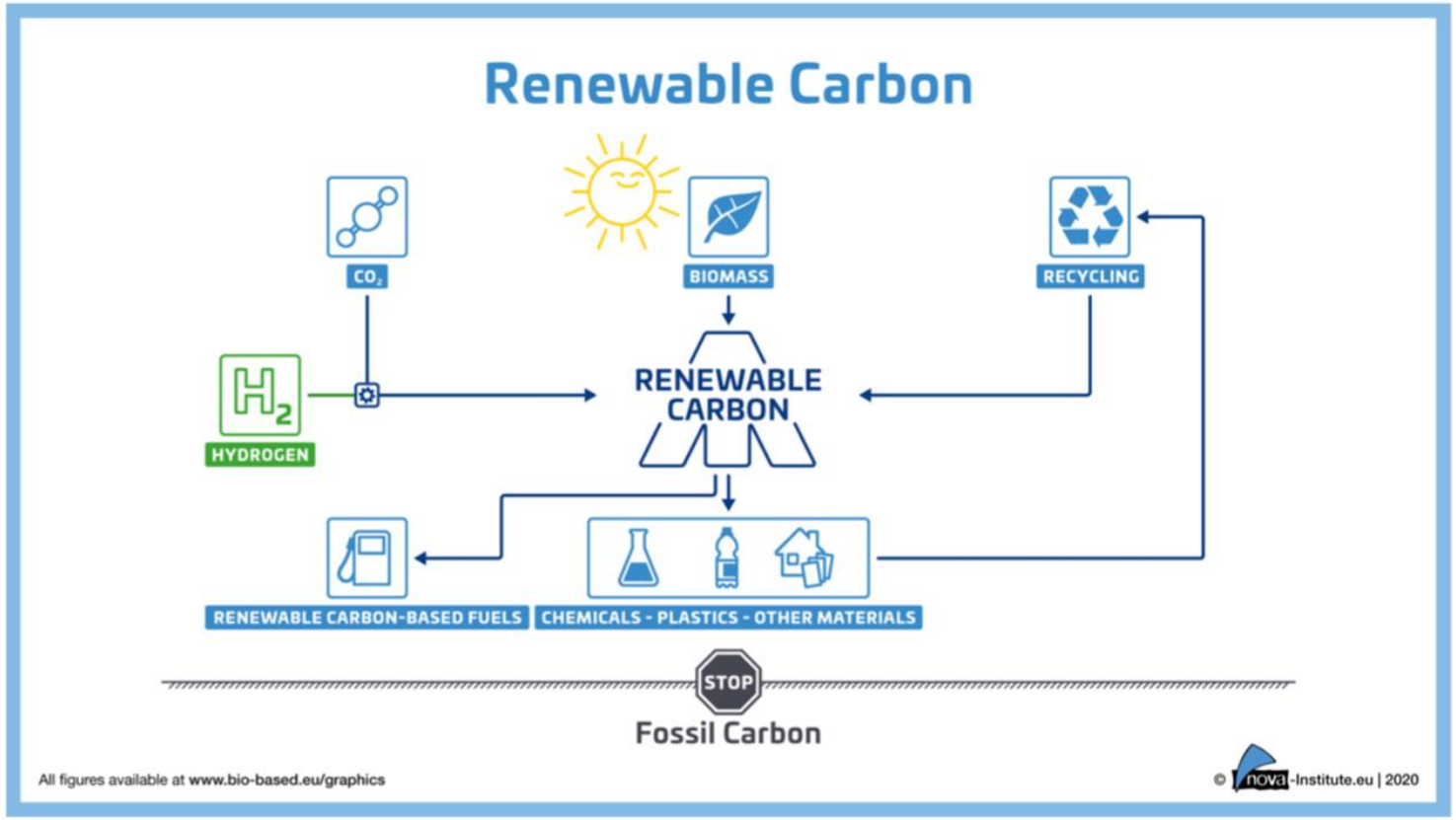


# Is decarbonization the right word?

- Circular/renewable carbon from atmosphere, biosphere, technosphere & not from geosphere

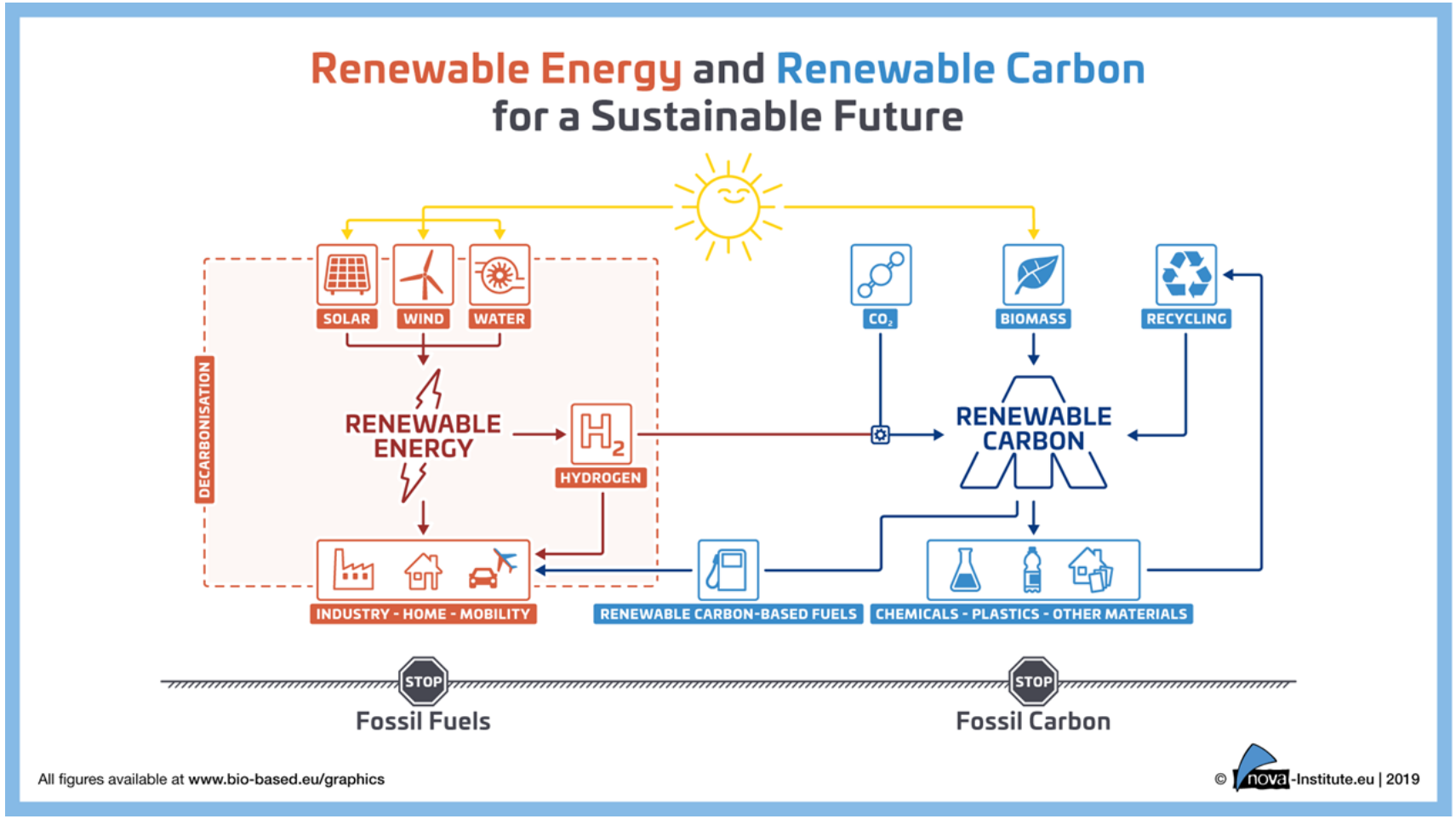
- Carbon from CO2 or recycling enters in the classical chemistry. Carbon from biomass has innovative potential to increase performance!



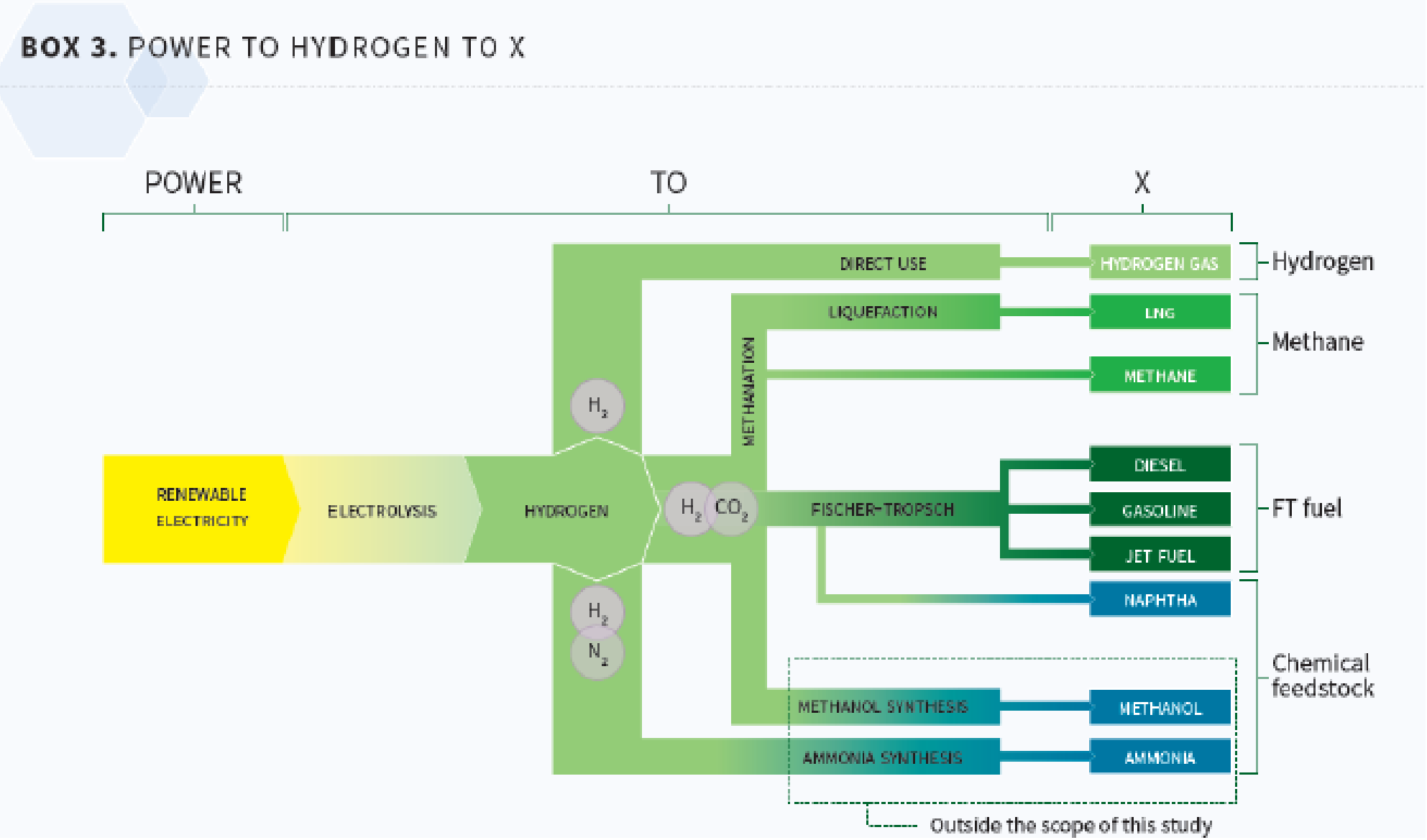

If we know that:
Waste Directive: separate collection of the organic fraction.
Recycling Directive: plastic packaging must contain 50% recycled materials in 2025 (55% in 2030)
Landfill directive: only 10% of MSW can go to landfills in 2035

# Renewable carbon and renewable energy

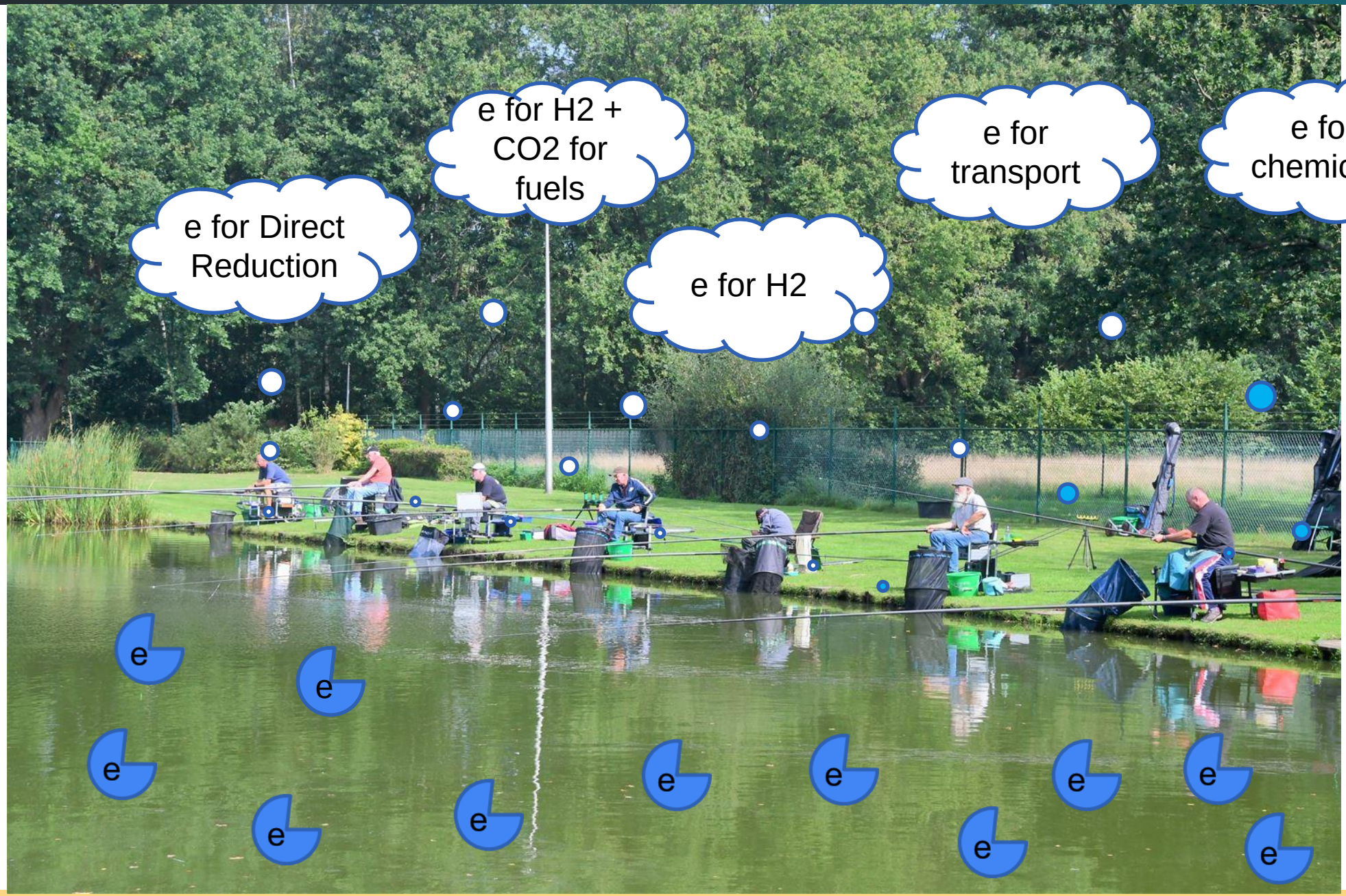
- Energy
  - Lower fossil
  - Lower carbon
  - Fossil free ?
- Materials
  - Biomass
  - CO2
  - Recycling



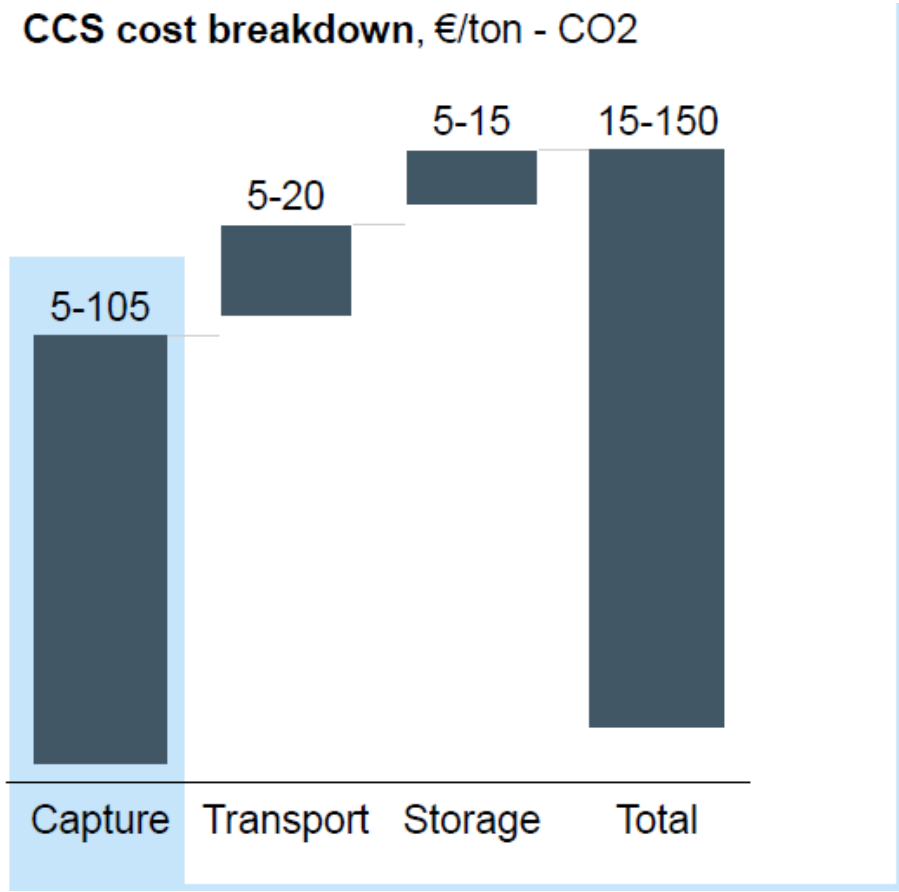
# Power to hydrogen to X

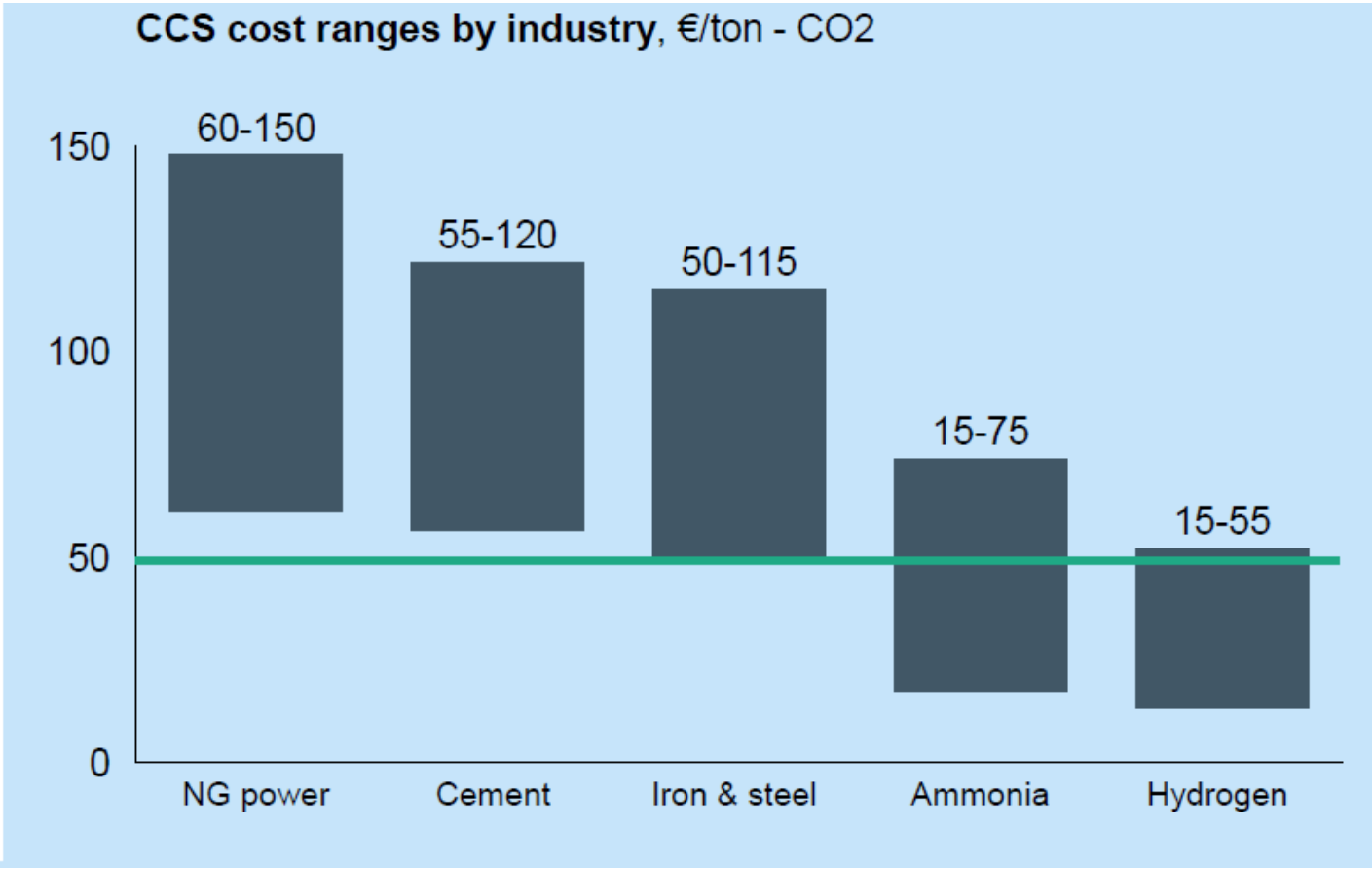


# All fishing in the same electron pool



# We also need CO2, but different capture costs

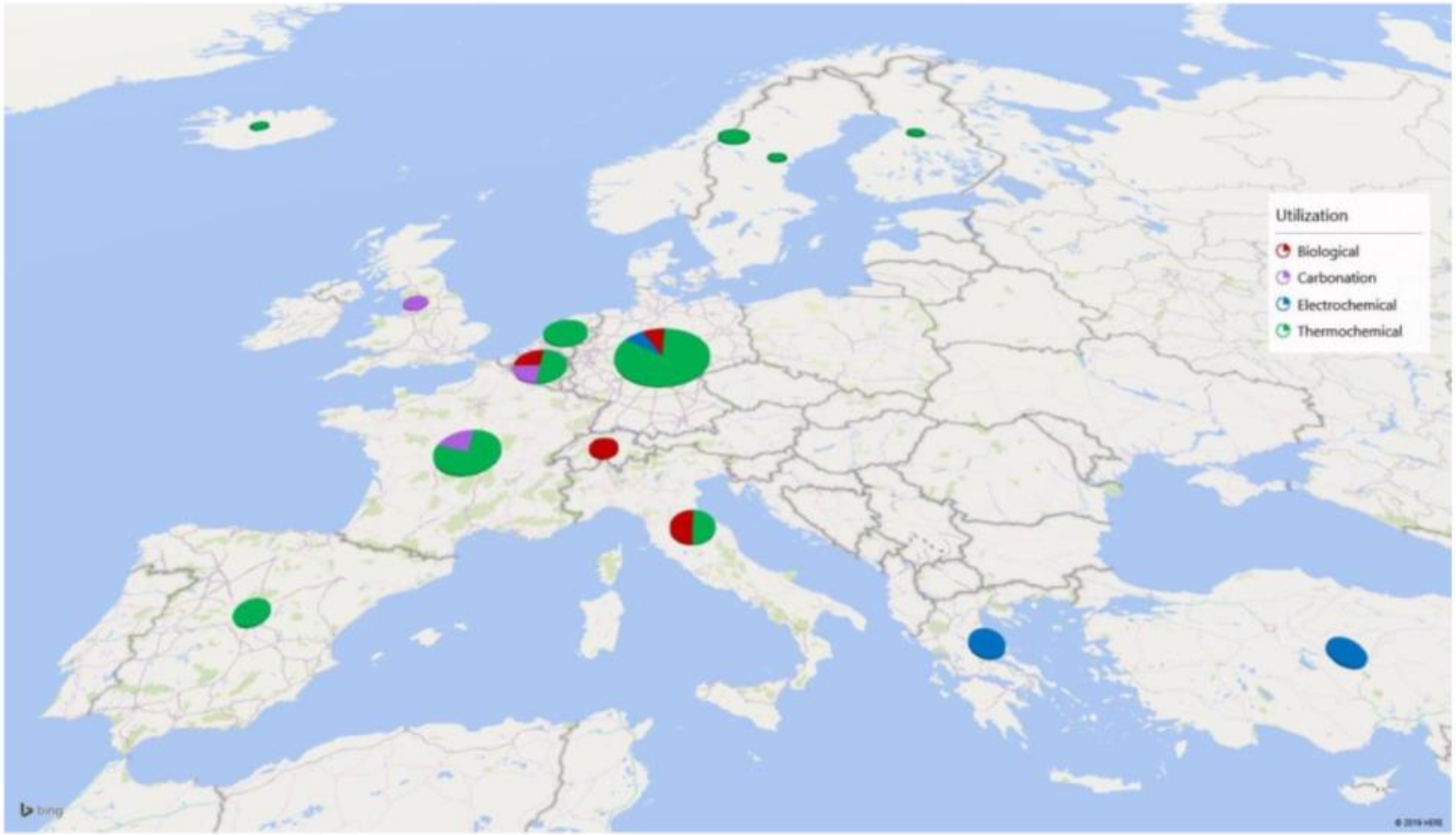



NETL

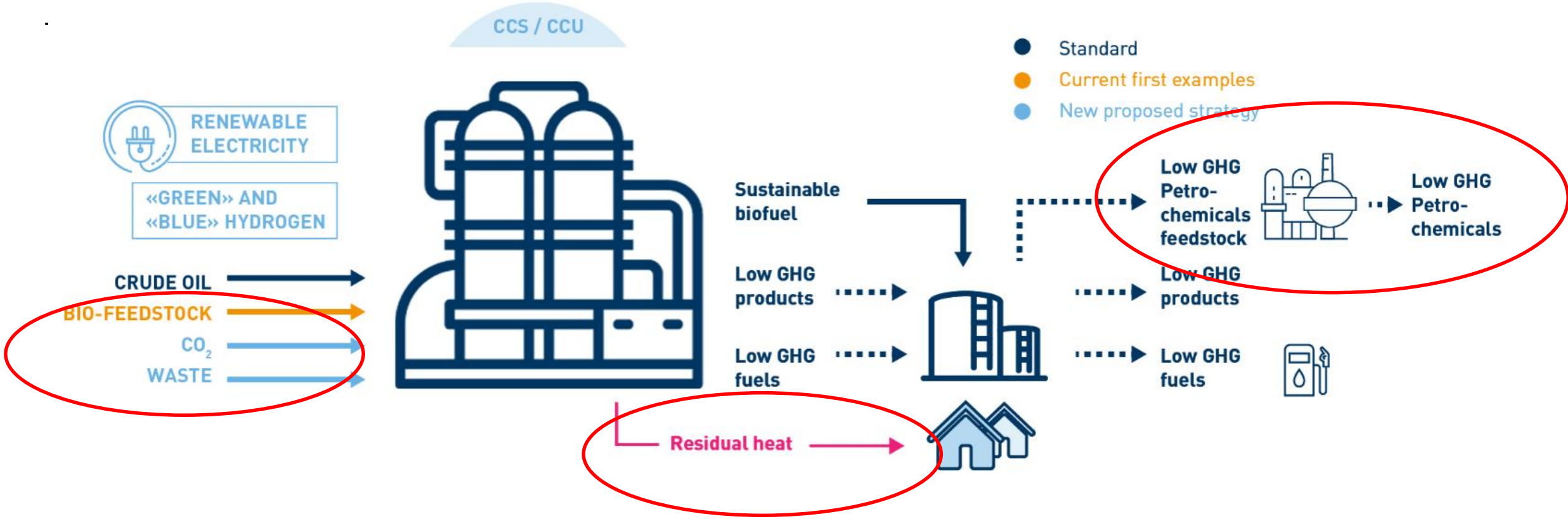
# Luckily more than 125 CCU projects ongoing in Europe

## Collective intelligence: **>125 CCU projects** in Europe



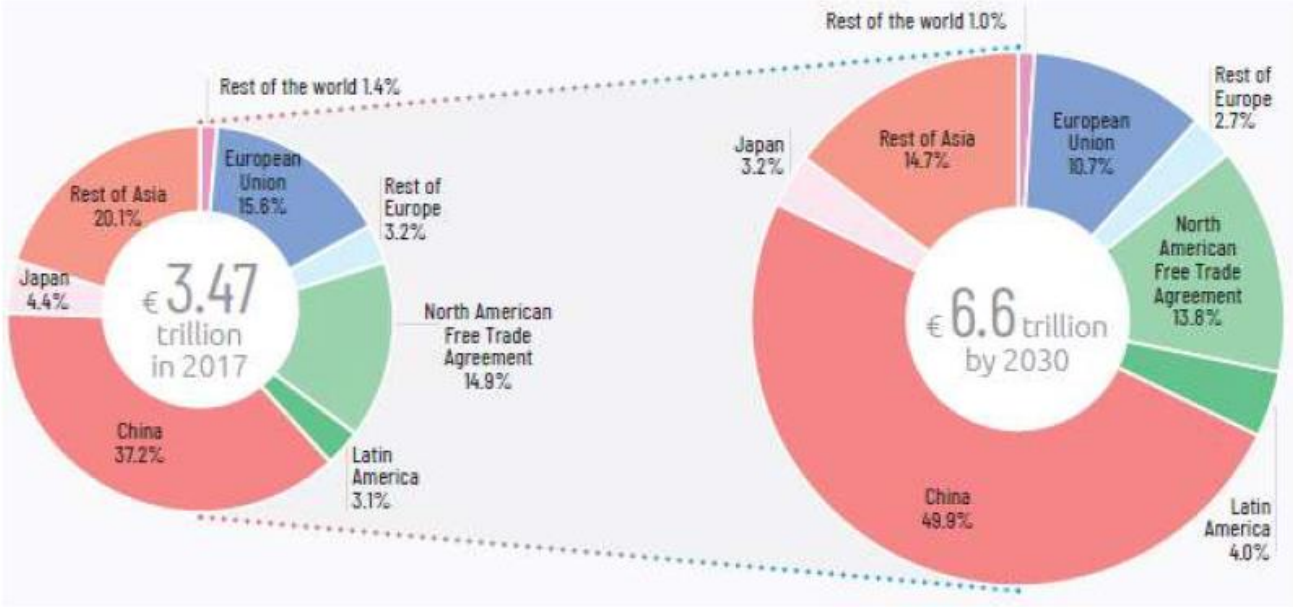

- approx. 50% high TRL projects (from demo. to commerc.)
- approx. 63% $CO_2$ to chemicals and fuels projects
- approx. 27% $CO_2$ Capture projects
- approx. 10% $CO_2$ to mineralization projects

# Refinery of the future



# Global chemicals industry growth linked to global growth of need for materials

## Global chemical industry projected to double by 2030

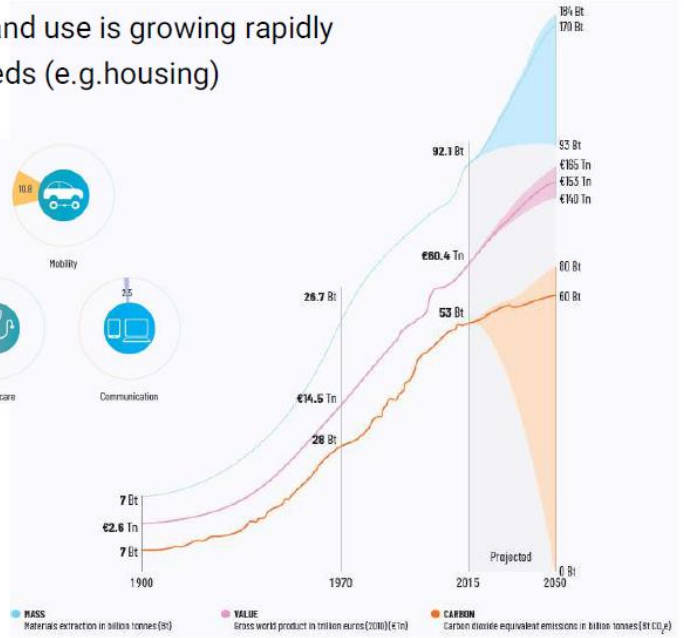



*Projected growth in world chemical sales (excl. pharmaceuticals) (CEFIC)*

- Materials extraction and use is growing rapidly
- Driven by societal needs (e.g.housing)

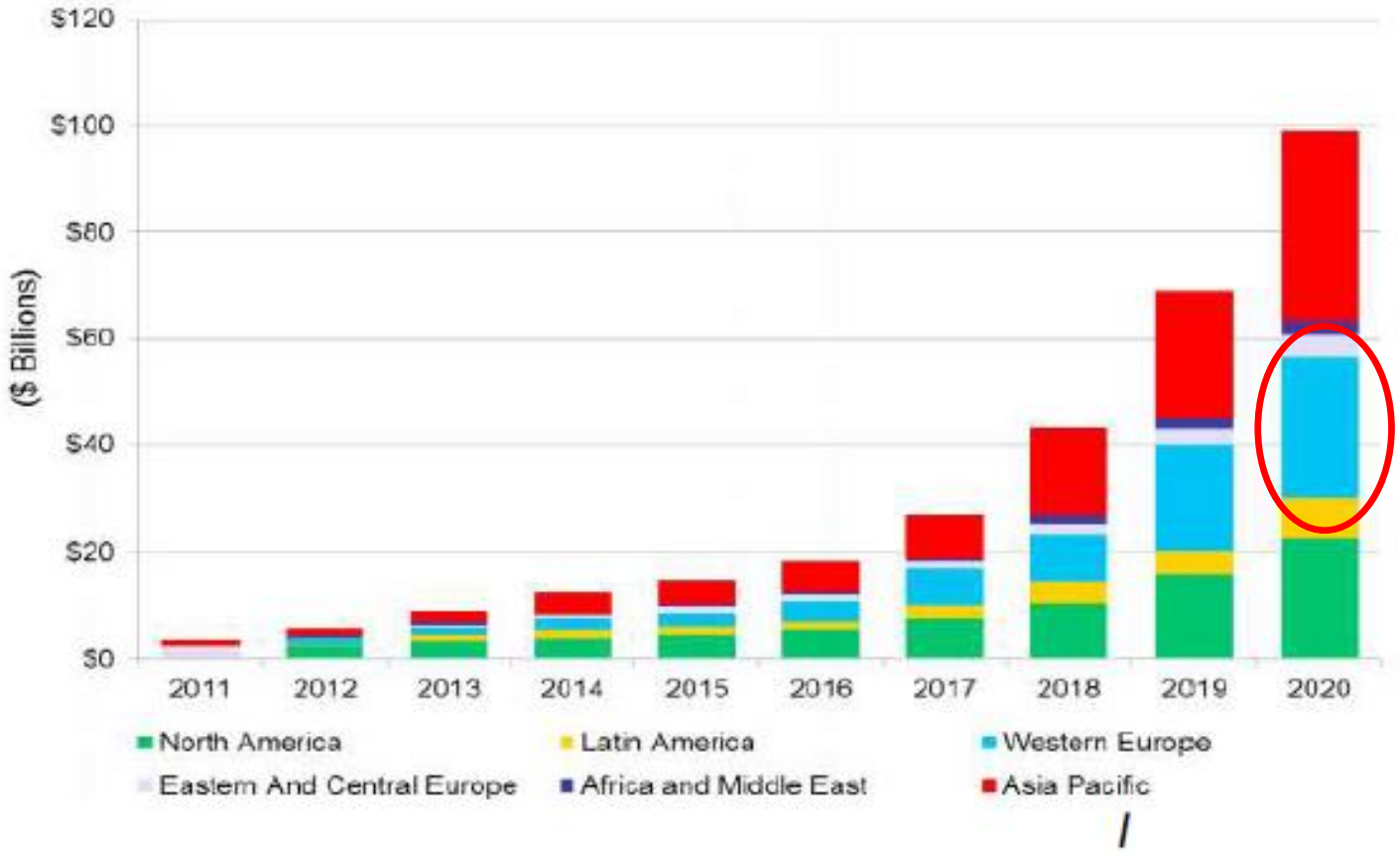

*The global material footprint: extracted resources by key societal needs and consumables (billion tonnes) (based on de Wit et al. 2019)*

*Trends in materials extraction, financial value creation and greenhouse gas emissions (1900-2050) (adapted from de Wit et al. 2019)*




We don't have oil, shale, …
But we have a strong bio-economy, biomass, recycling, CO2-conversion & we are strong in hydrogen
We import every year > 640 Million tons crude oil
Carbon is the only raw material that is available in practically unlimited quantities in contrast to metals & minerals

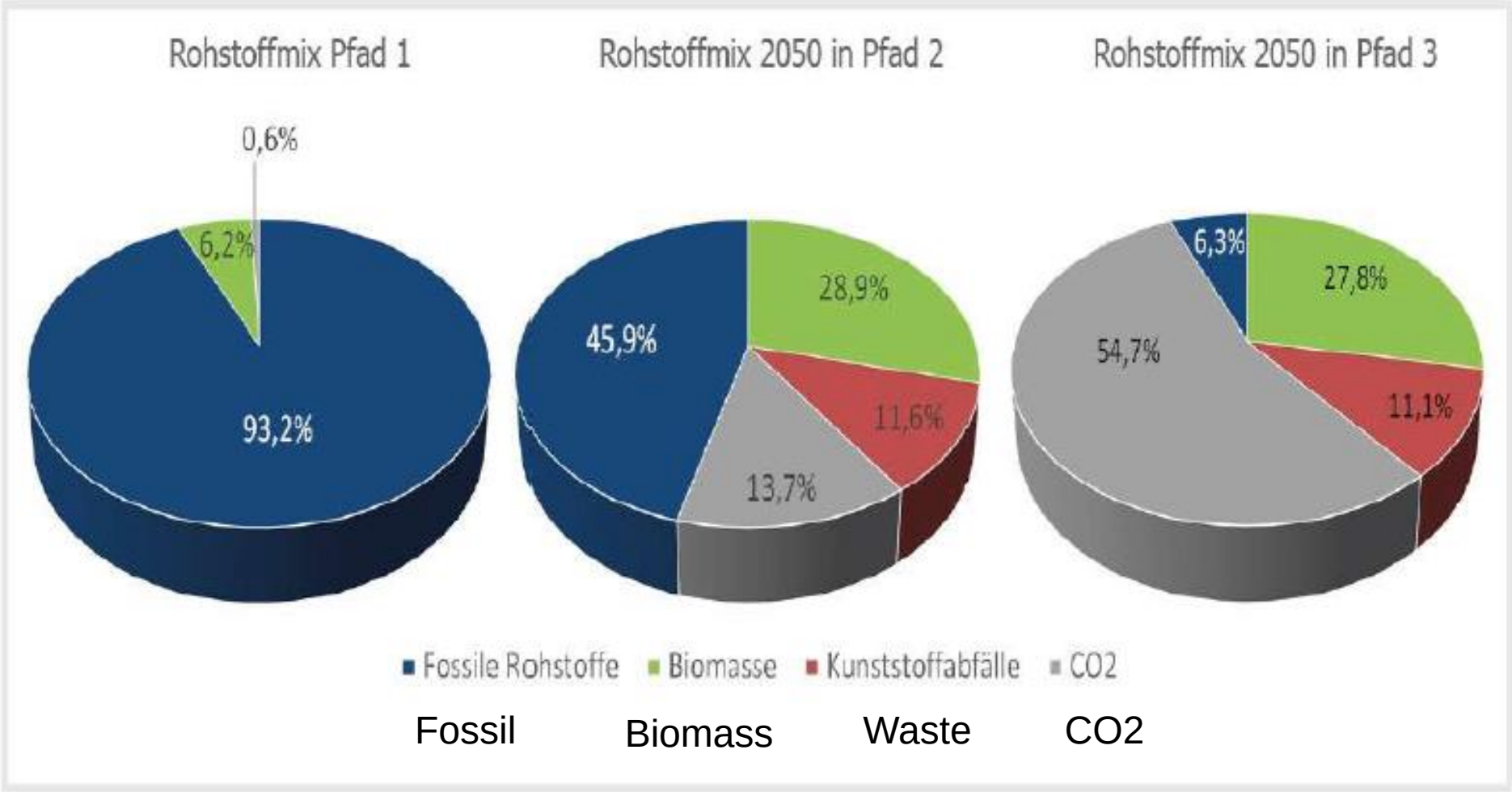
# Europe has a very high share in the Global Green Chemicals Market
# From challenges to opportunities
# Innovations in chemistry have a significant potential in advancing




*Global Green Chemicals Market by Region 2011-2020 (GC3 2015)*

# Which will be the feedstock mix? It's a guess.

## E.g. Changing resources and feedstock in the German chemical industry (VCI 2019)



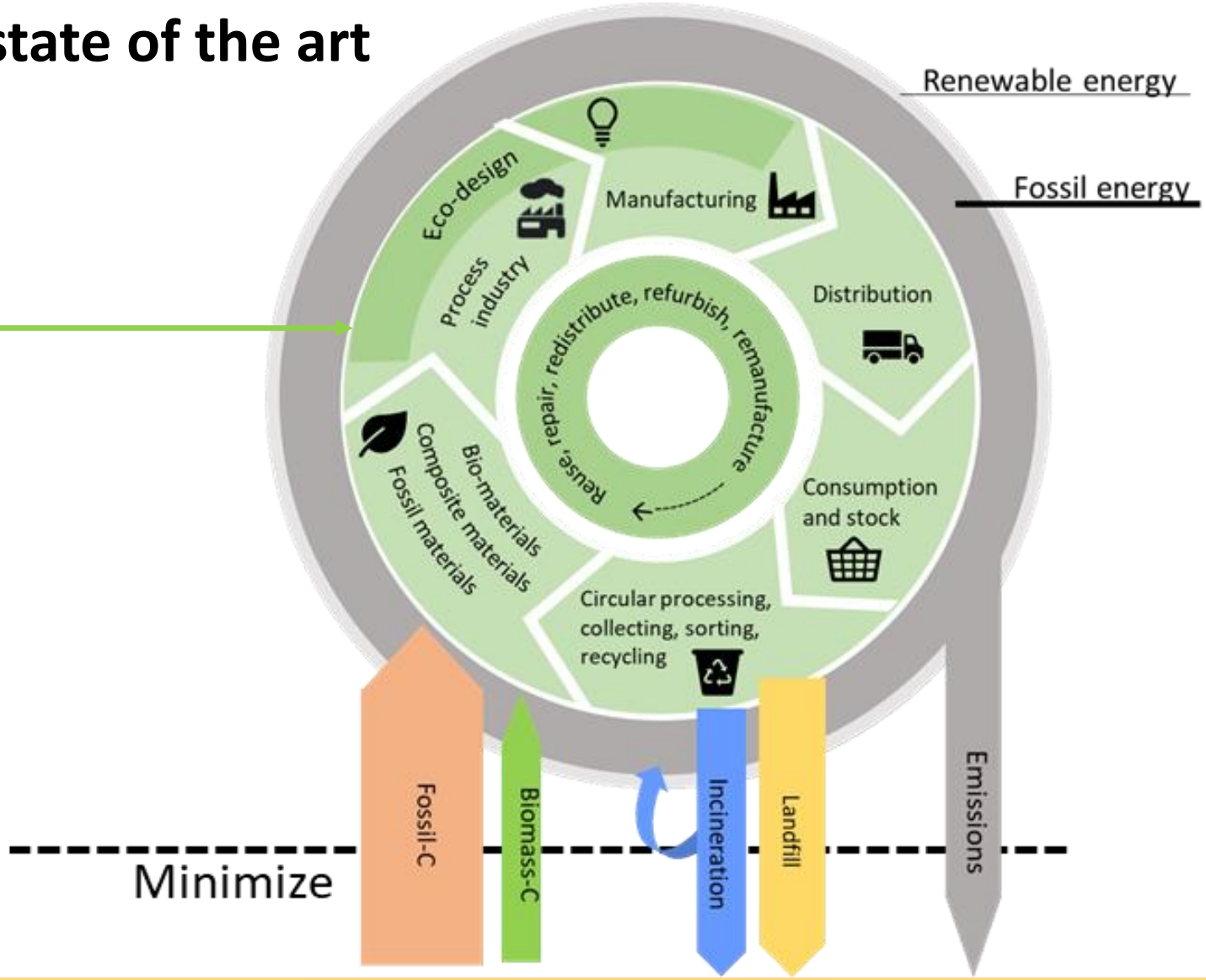

Halpaap

**Abbildung 33:** Rohstoffmix in den Transformationspfaden als Prozent Kohlenstoff [48]

# But we know the trends

## Circular carbon state of the art

Recycle carbon



# Circular carbon the coming years

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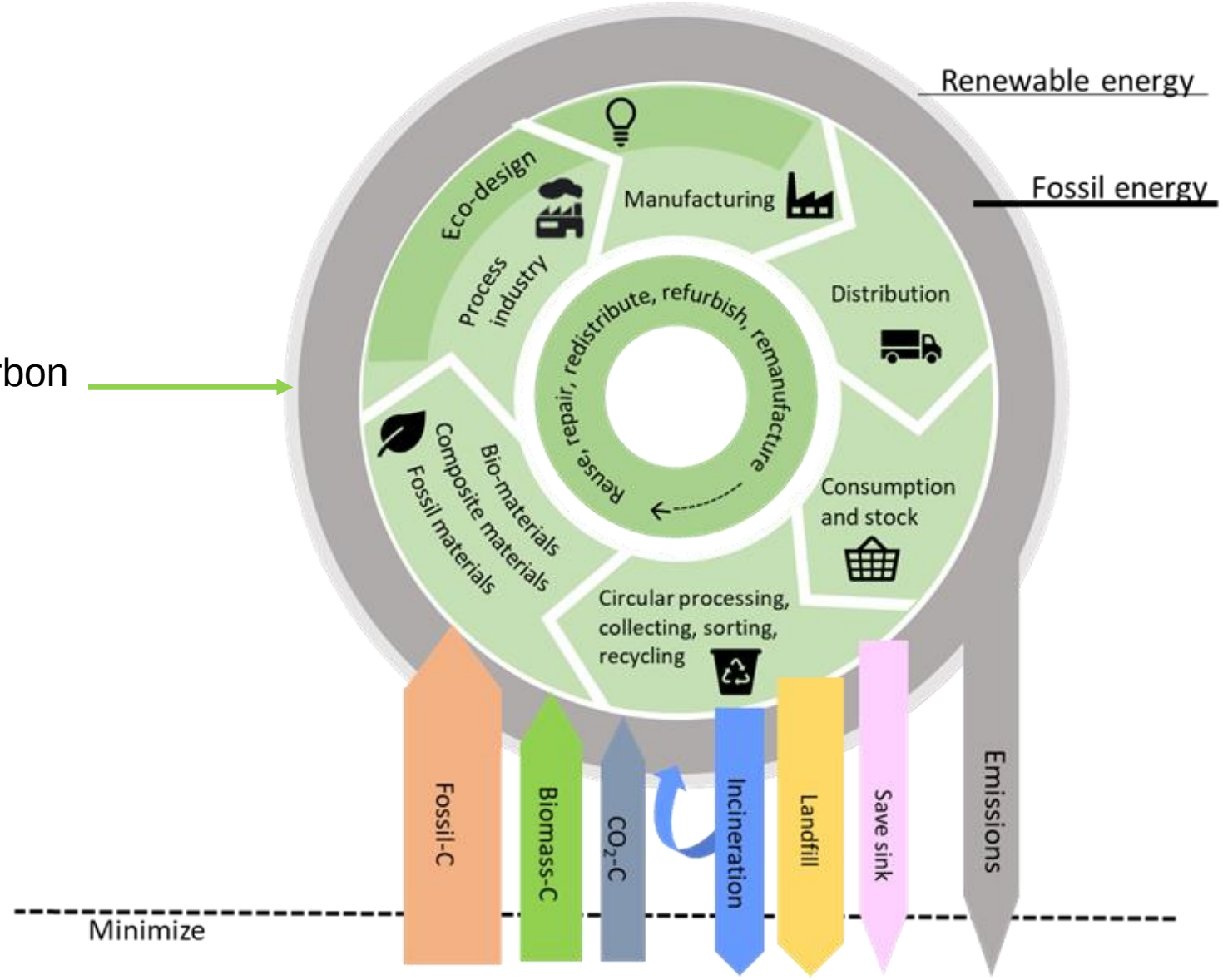
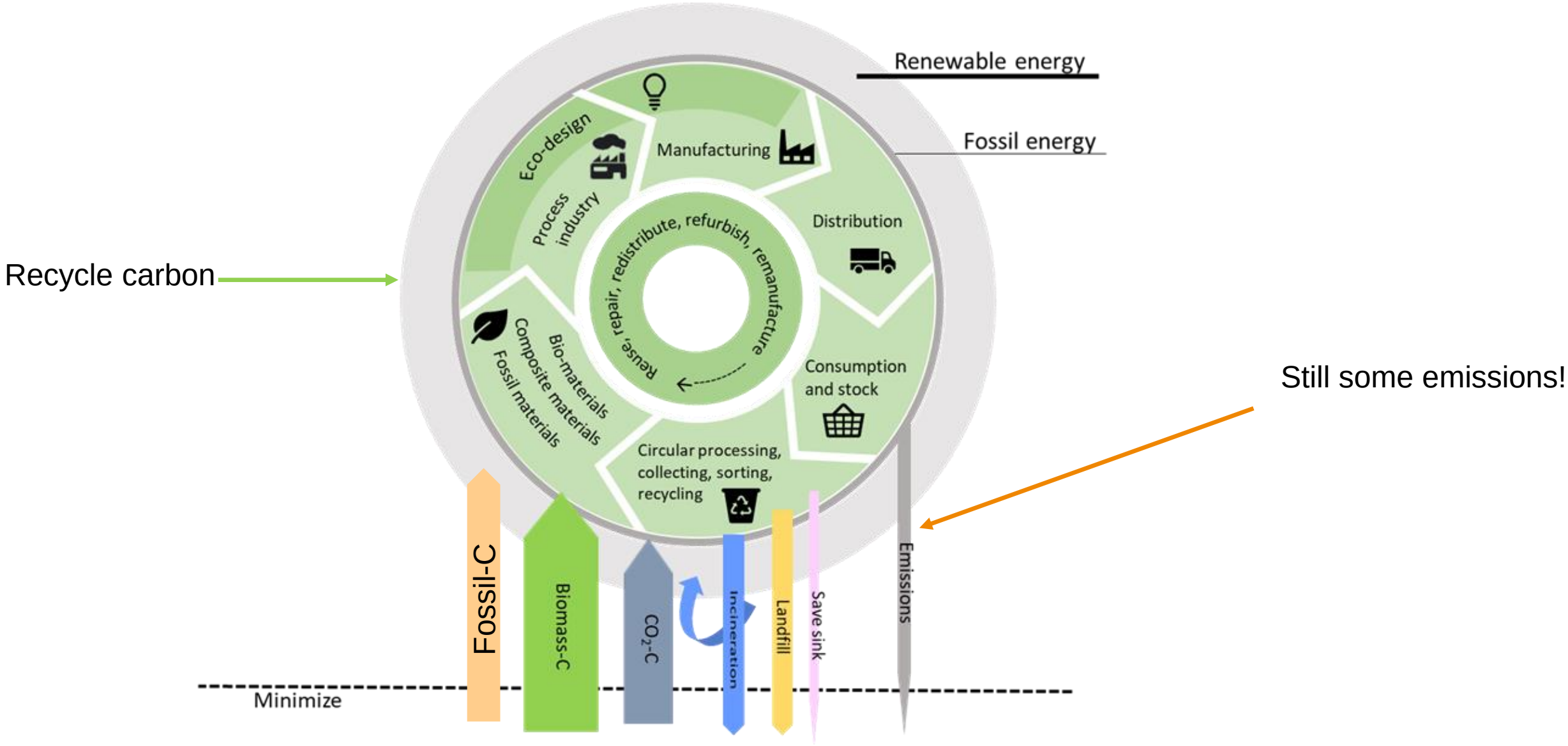
Recycle carbon



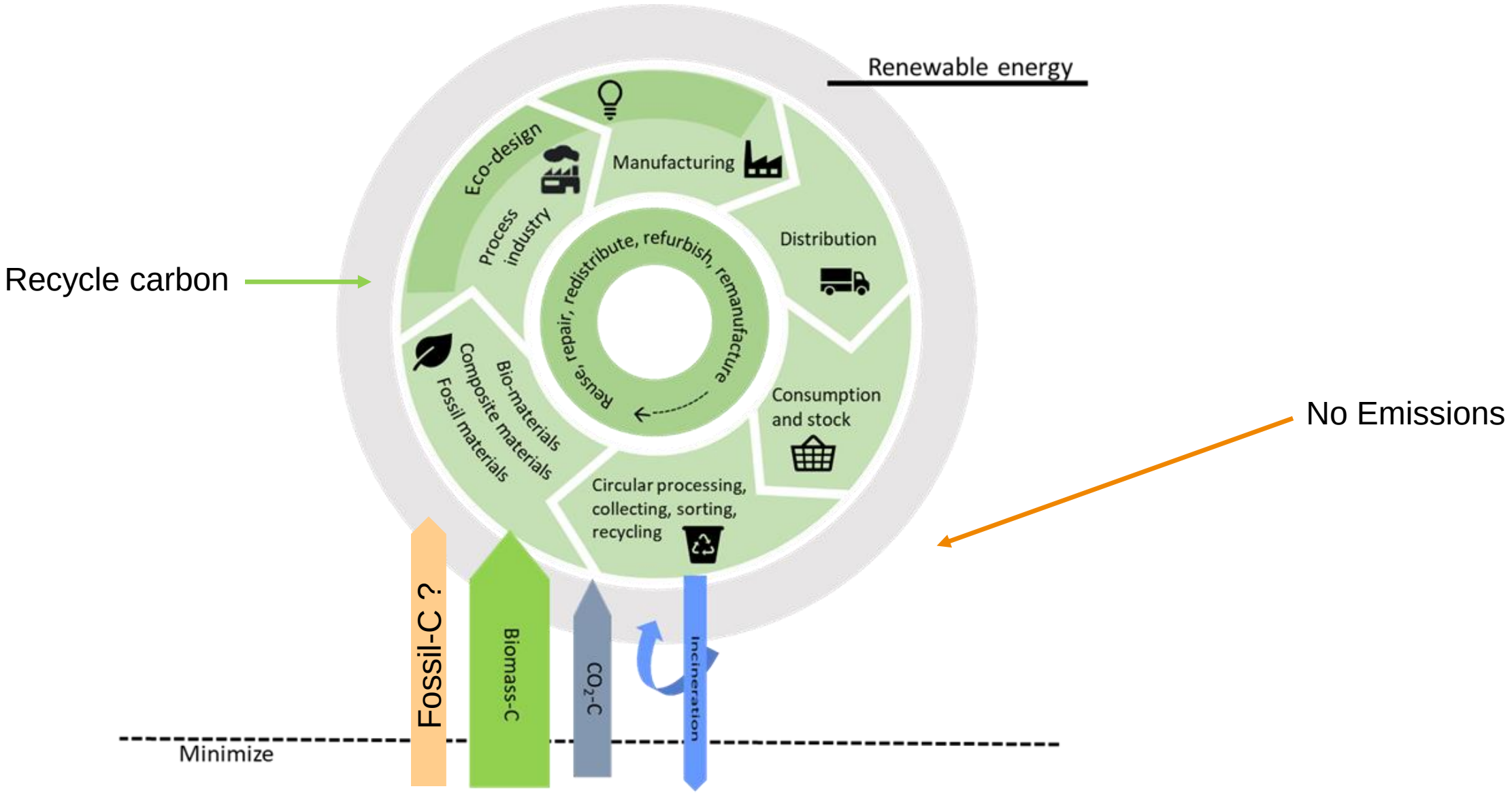

Transition to a circular economy is transition to a non-toxic economy

Safe & Sustainable by design

# Circular carbon in 20 years



# Circular carbon in more than 20 years



# Conclusions

- P4PLanet offers large opportunities to go for sustainable and circular production in a competitive way
- For energy we will move away from fossil
- But some energy sources will still be based on fuels
- But we are all fishing in the same electrons pool
- We will not decarbonize our materials
- They will be based on biomass, waste and CO2
- There is a growing opportunity via the chemical industry (including refining and pulp & paper) to make more sustainable materials
- Let us not loose energy on defining the winner. We will need them all. Availability and costs will define where we need what
- P4Planet is a platform to manage this strategically and to create impact via demoplants and FOAKs (marbles)

# Thank you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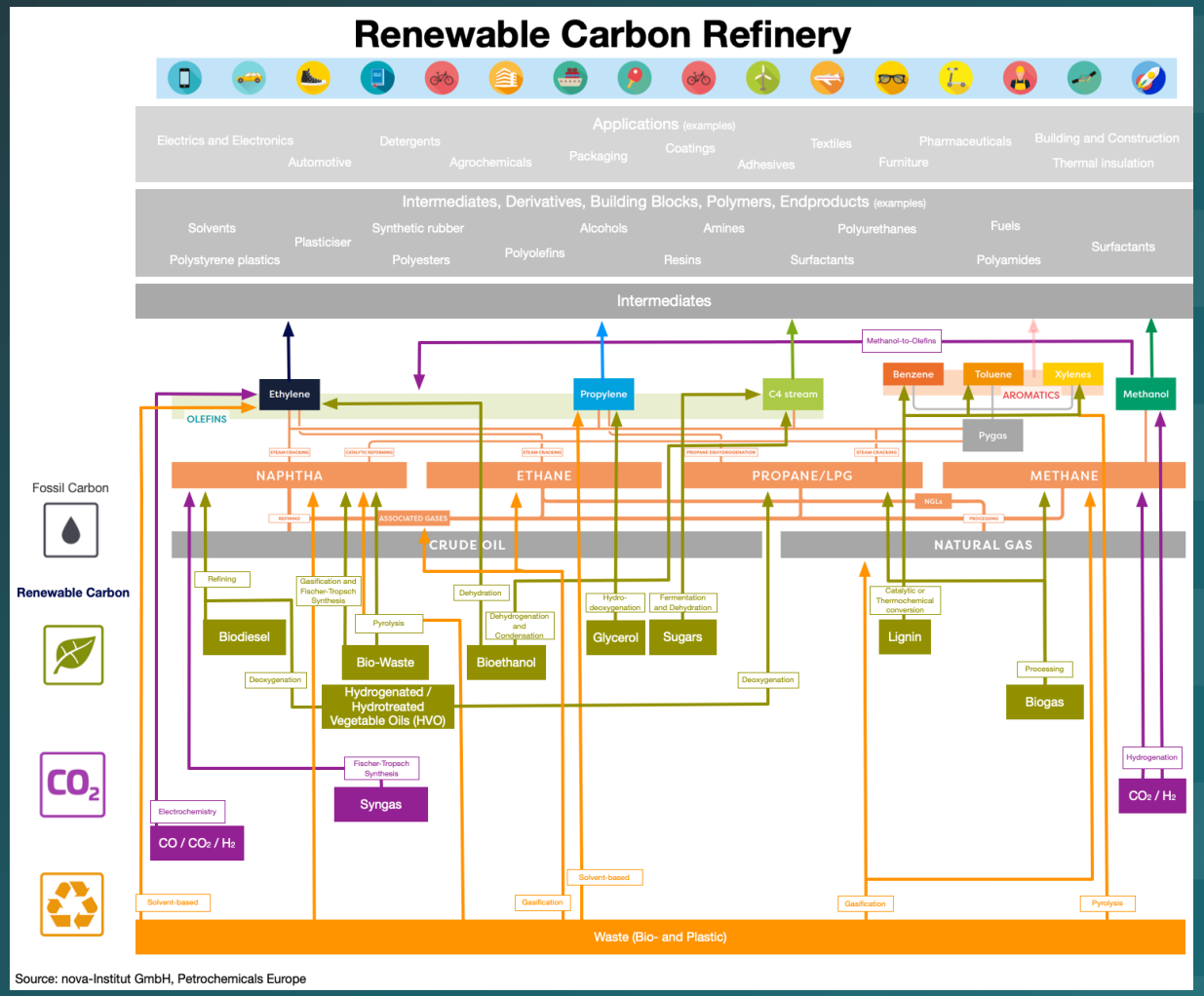


Source: nova-Institut GmbH, Petrochemicals Europe