Towards circular & sustainable plastics -
A global perspective

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Plastic pollution – a global crisis


[1]

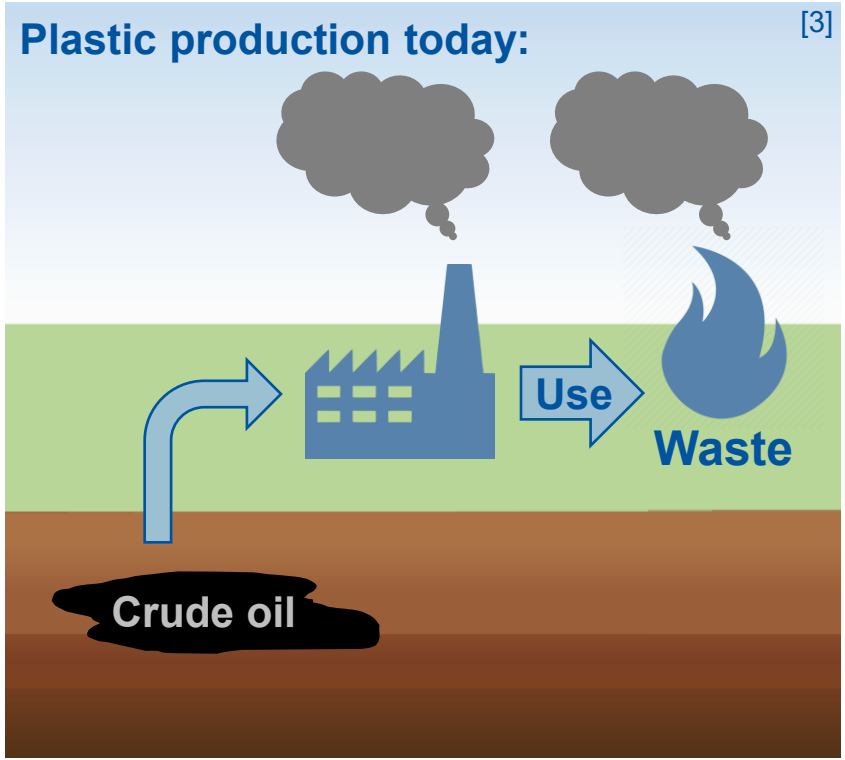
Facts from the Global Plastic Outlook: [2]

- Plastic production doubled since 2000
- Plastic waste more than doubled since 2000
- Only 9 % effective recycling rate
- 22 % disposed in uncontrolled dumpsites
- Contributes to global GHG emissios

We have reached a plastic crisis

[1] **Von Wong**, https://www.vonwong.com/
[2] **OECD**, Global Plastic Outlook, Economic Drivers, Environmental Impacts and Policy Options, 2022

Greenhouse gas emissions of the plastics industry

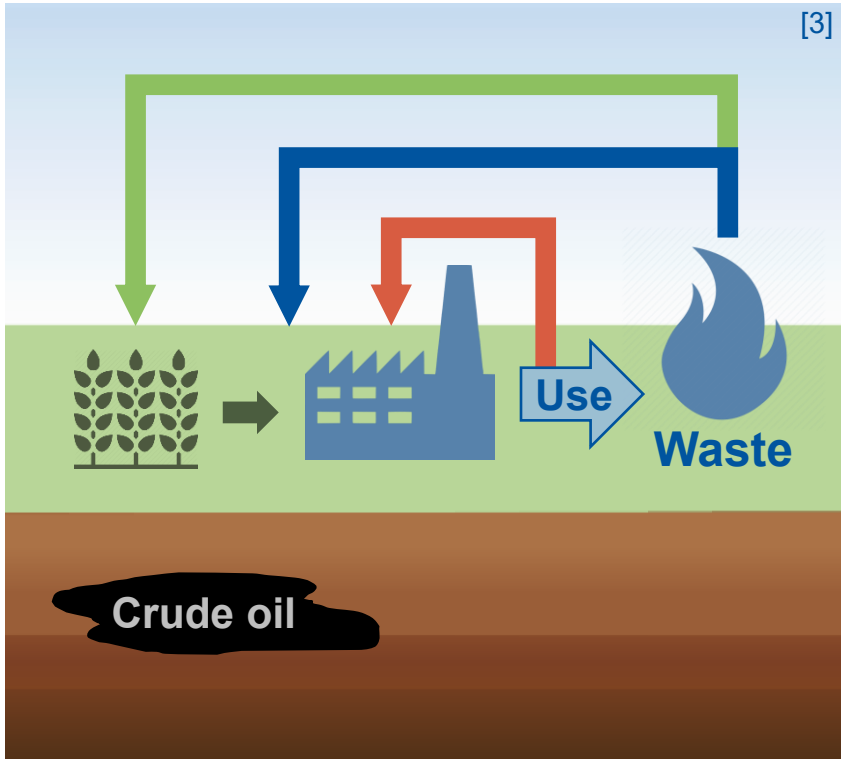


GHG emissions of plastics in 2050: [3]

4.7 Gt CO_2-eq

[3] Meys et al. (2021) - Achieving net-zero greenhouse gas emission plastics by a circular carbon economy, *Science*

Circular production pathways



Circular carbon technologies:

- **Recycling**
- **CO_2** via carbon capture and utilization (CCU)
- **Biomass** utilization

1. **Can we achieve net-zero GHG emission plastics by circular carbon technologies?**

2. **Can we achieve absolute environmentally sustainable plastics?**

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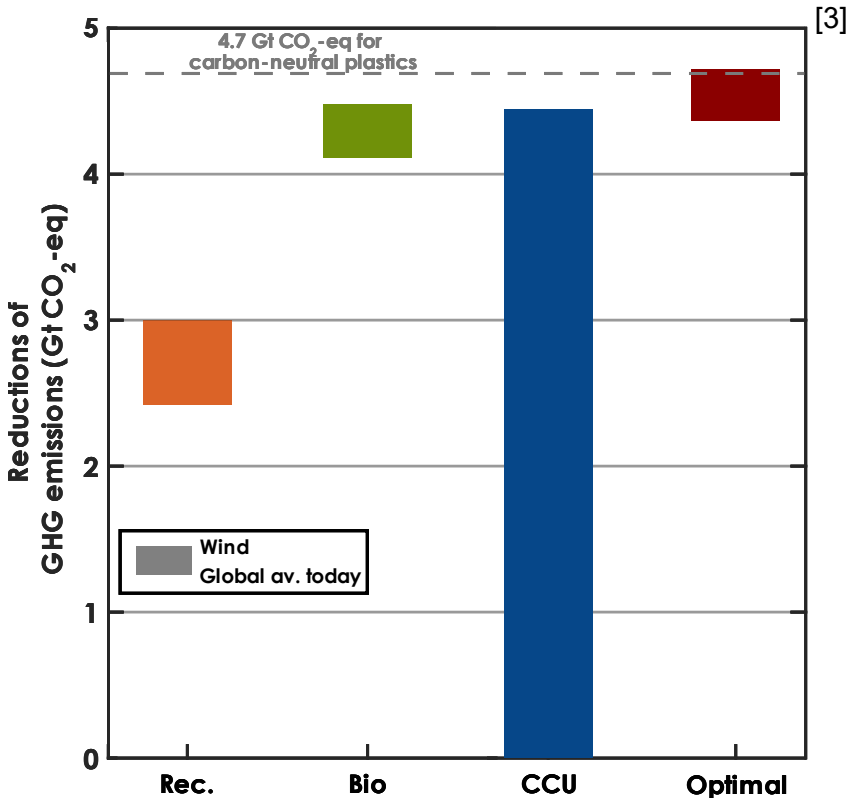
Achieving net-zero GHG plastics by a circular economy



[3]

In 2050, a **fossil** industry would emit 4.7 Gt CO_2-eq

Reductions from circular carbon technologies:

- ✓ **Recycling**: 3.0 Gt CO_2-eq
- ✓ **Biomass**: 4.5 Gt CO_2-eq
- ✓ **CCU**: 4.4 Gt CO_2-eq

- ✓ CO_2 requires very clean electricity

- ✓ **Combining circular technologies** achieves net-zero plastics

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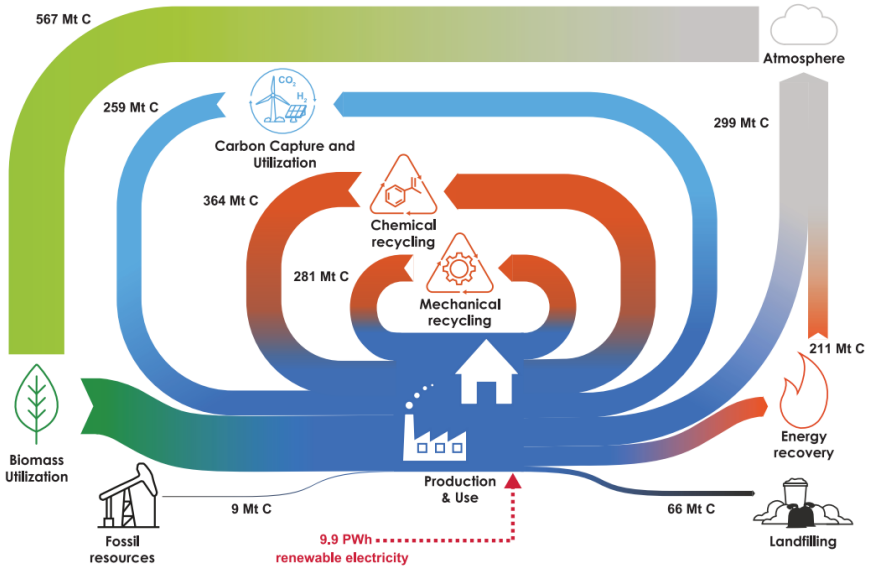
Achieving net-zero GHG plastics by a circular economy



Combining circular technologies

- ✓ Optimal combination includes all three circular technologies
- ✓ **Recycling**: minimizes GHG emissions from biomass cultivation and electricity supply
- ✓ **Biomass** / **CCU**: supply remaining renewable feedstock for polymers

Recycling is a key to net-zero GHG emissions

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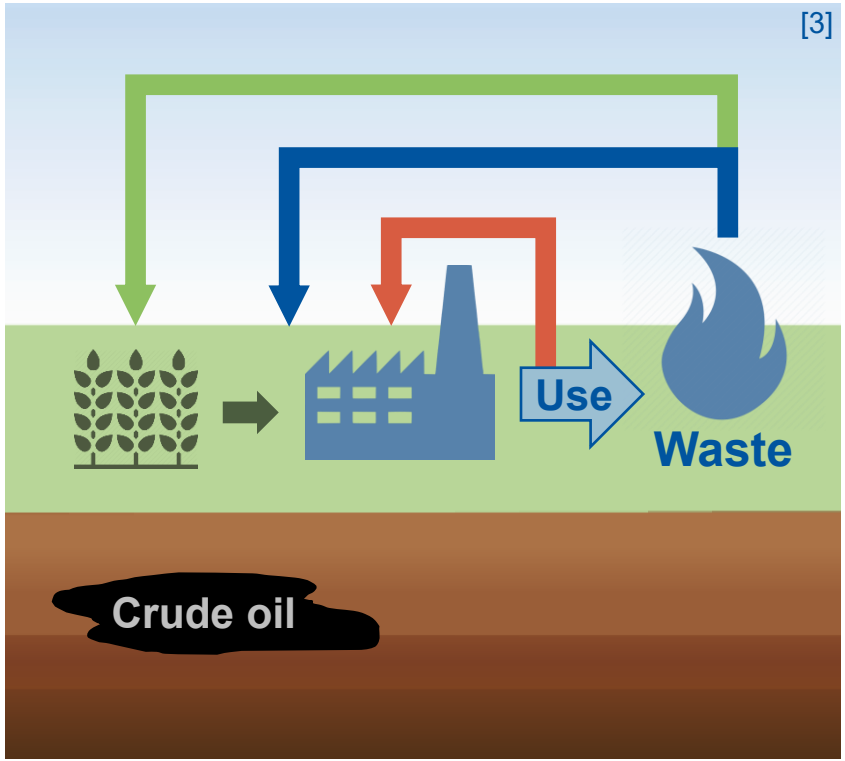
Circular production pathways



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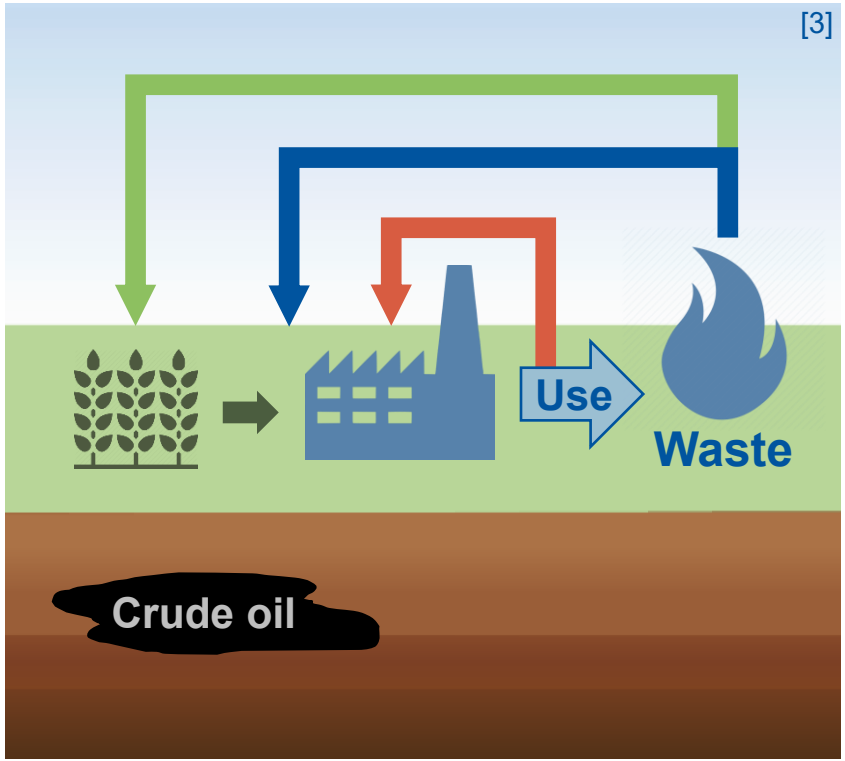

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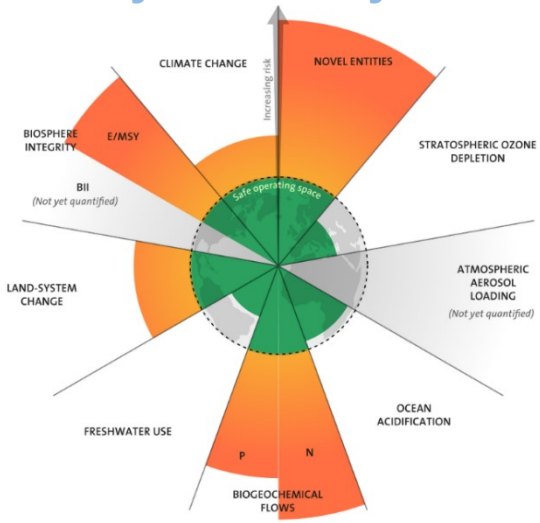
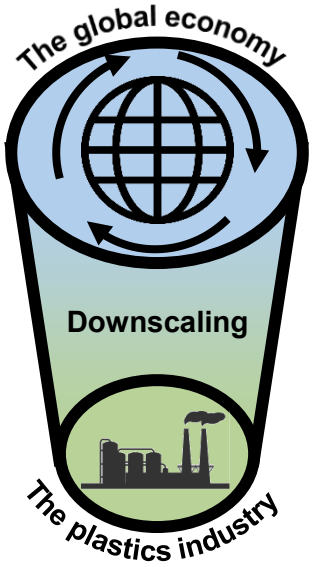
Towards absolute environmentally sustainable plastics

Planetary Boundary Framework



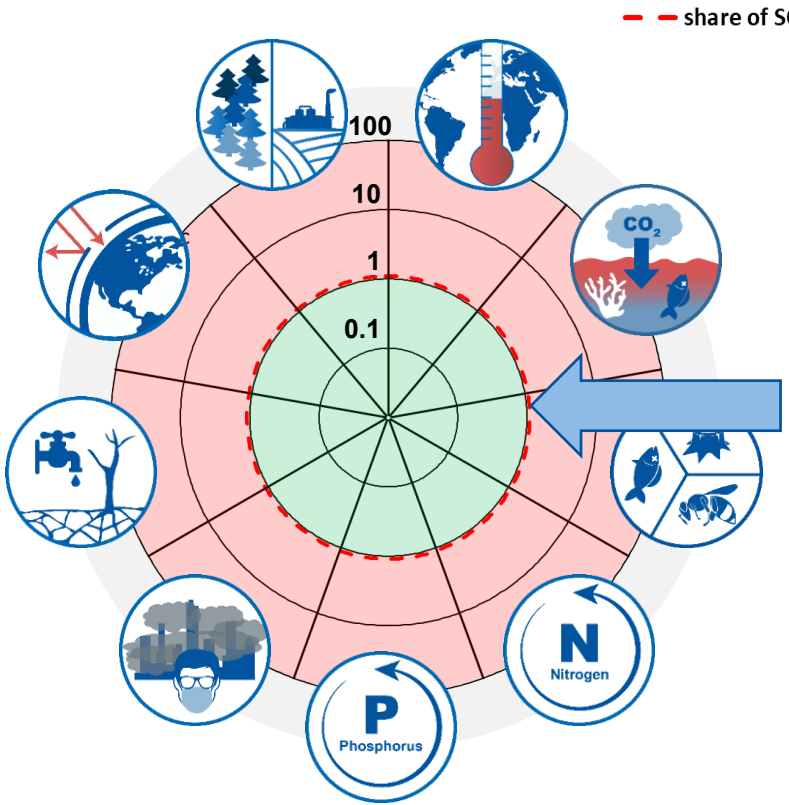


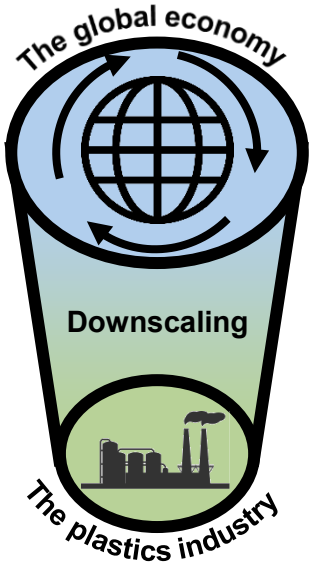
Environmental thresholds: „safe operating space“ (SOS)

allocation to maximize welfare [consumption expenditure] → 1.1 % of global SOS

[4] https://www.stockholmresilience.org/research/planetary-boundaries.html

Downscaling to thresholds on industry level





1.1%

of global SOS

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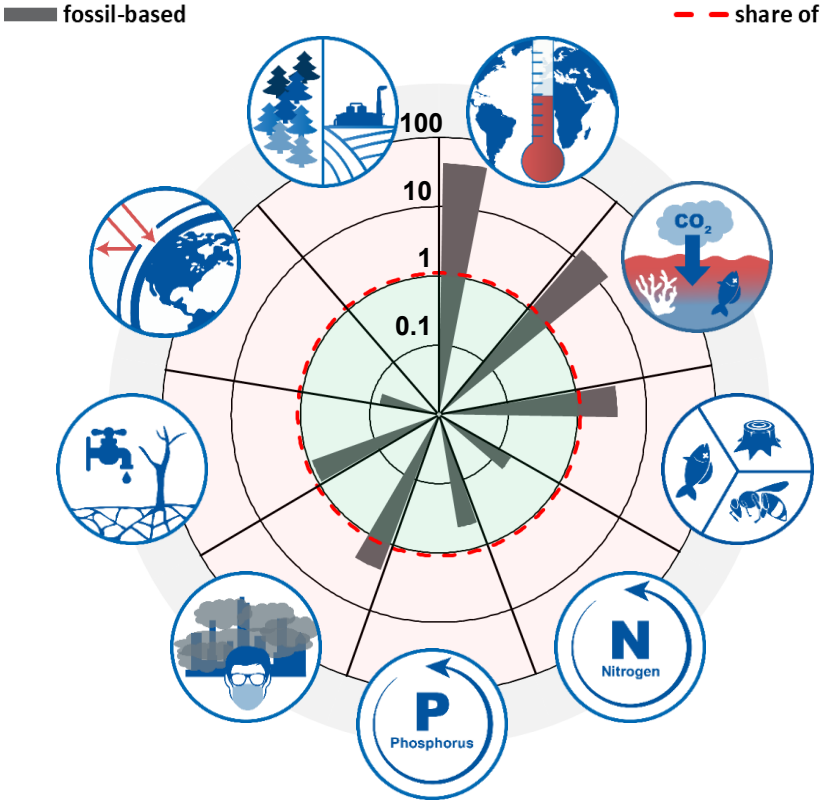
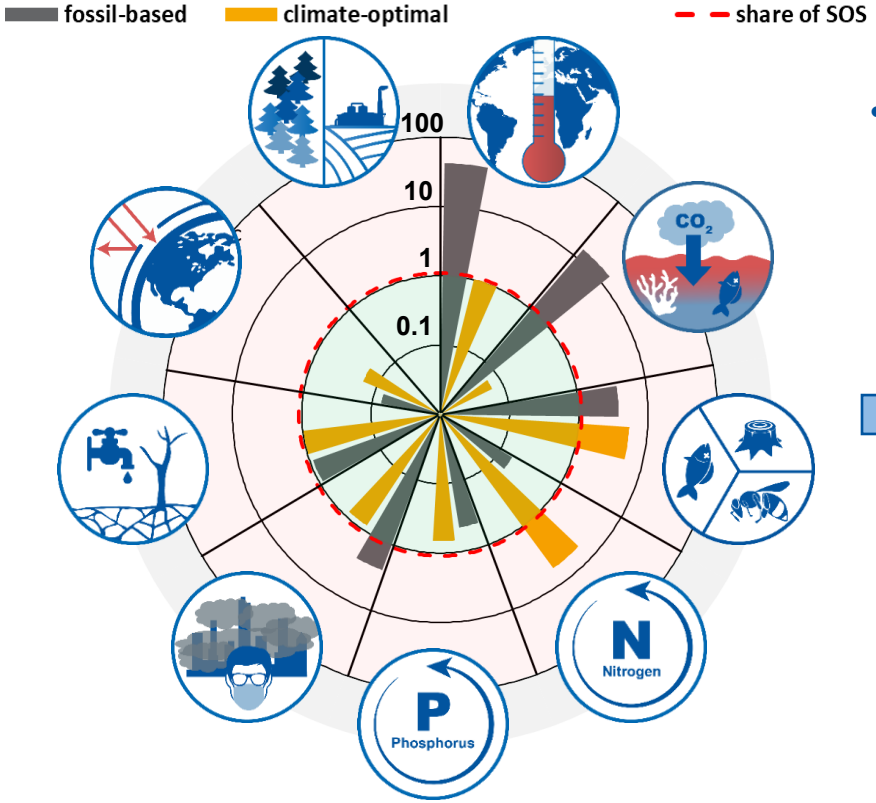
The planetary footprints of global plastic production



Fossil-based plastics exceed share of safe operating space.

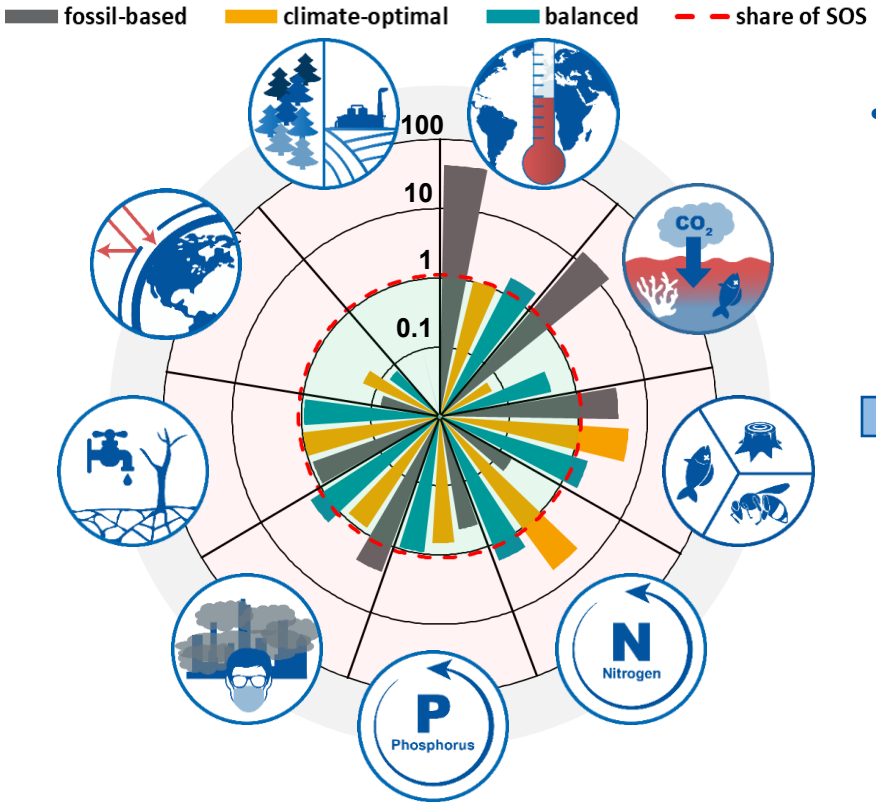
The planetary footprints of global plastic production



- Goal: Minimum transgression of all planetary boundaries

Climate-optimal plastics exceed share of safe operating space.

The planetary footprints of global plastic production



- Goal: Minimum transgression of all planetary boundaries

With mature technologies plastics exceed share of safe operating space.

Improvements towards absolute sustainability

Improve recycling efficiency

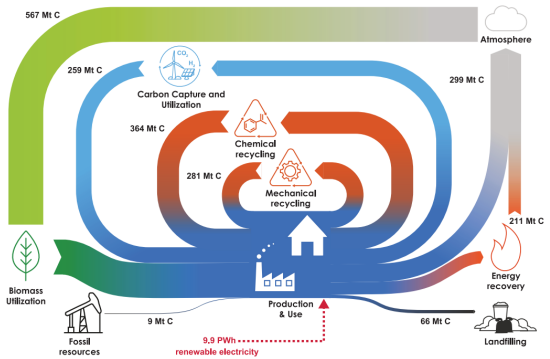
High efficiency chemical monomer recycling

Keys towards sustainable plastics
- **Improve recycling efficiencies**
- **Realize high recycling rates**
- **Mechanical & chemical recycling**

Wind power

Energy crops

Conclusion



We need **ALL** circular technologies

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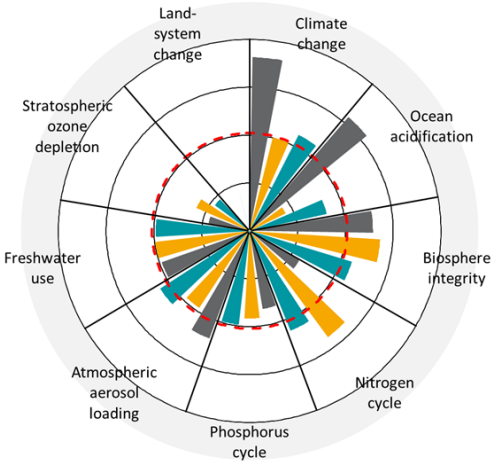
Recycling is a key to net-zero



There are **MORE** impacts than climate change

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Enhance recycling efficiencies

Consider plastic waste as a **VALUABLE** resource

+

Recycling tackles the plastic crisis at all levels

Thank you for your attention!

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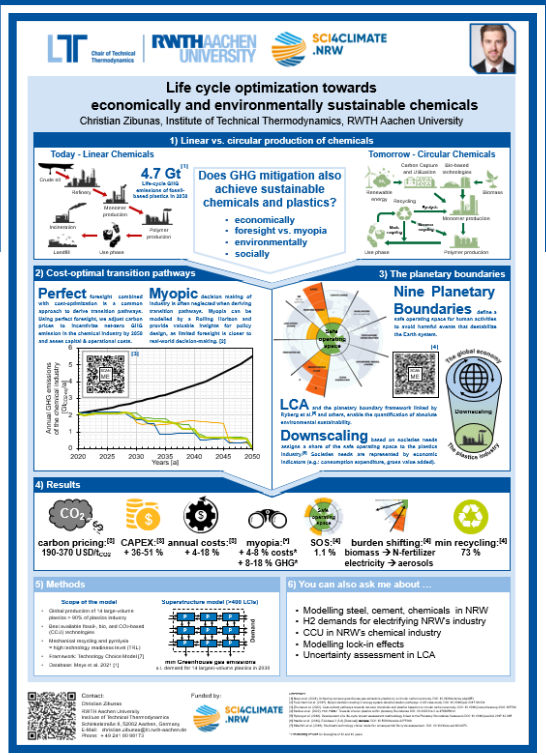

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