Global economy's circularity:

Current state and future options

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Industrial Ecology:
Science, the Environment and the Circular Economy

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FWF Der Wissenschaftsfonds.

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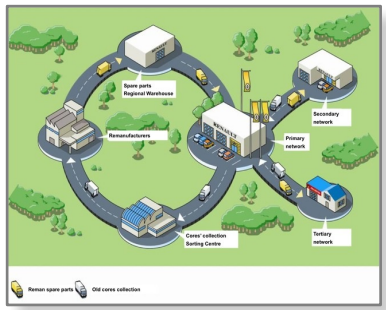
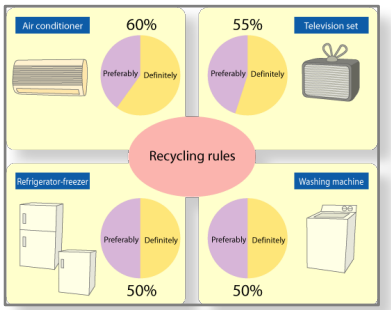
Introduction: Promising cases at industry and national scale



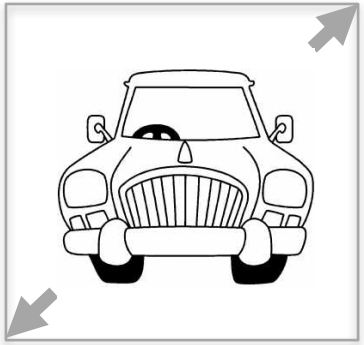
Remanufactured part at company level

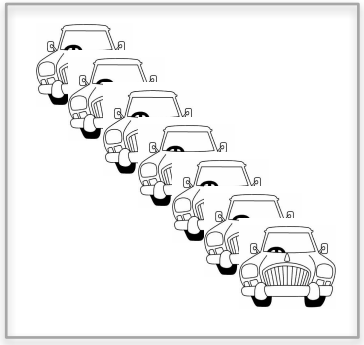


Appliance recycling laws

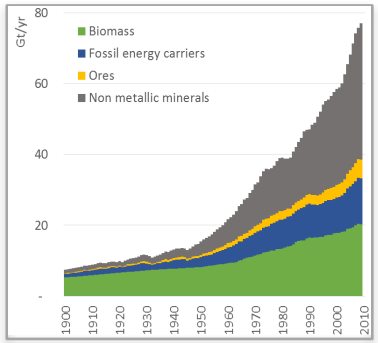
Symbiosis Programme recovered port facilites

- What is the potential?
- What are the limitations?

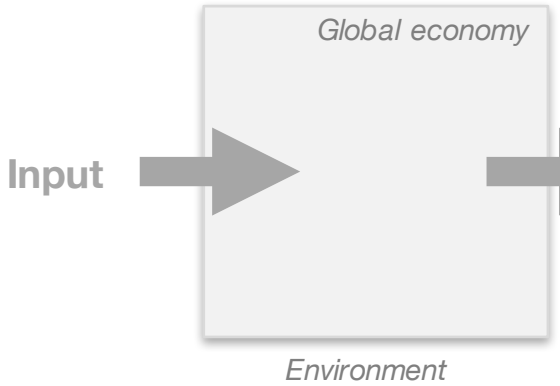


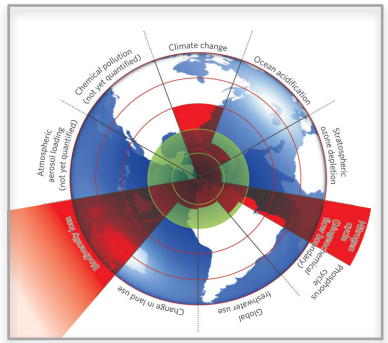


- How circular is the economy (system level)?



Source: Krausmann et al. 2009

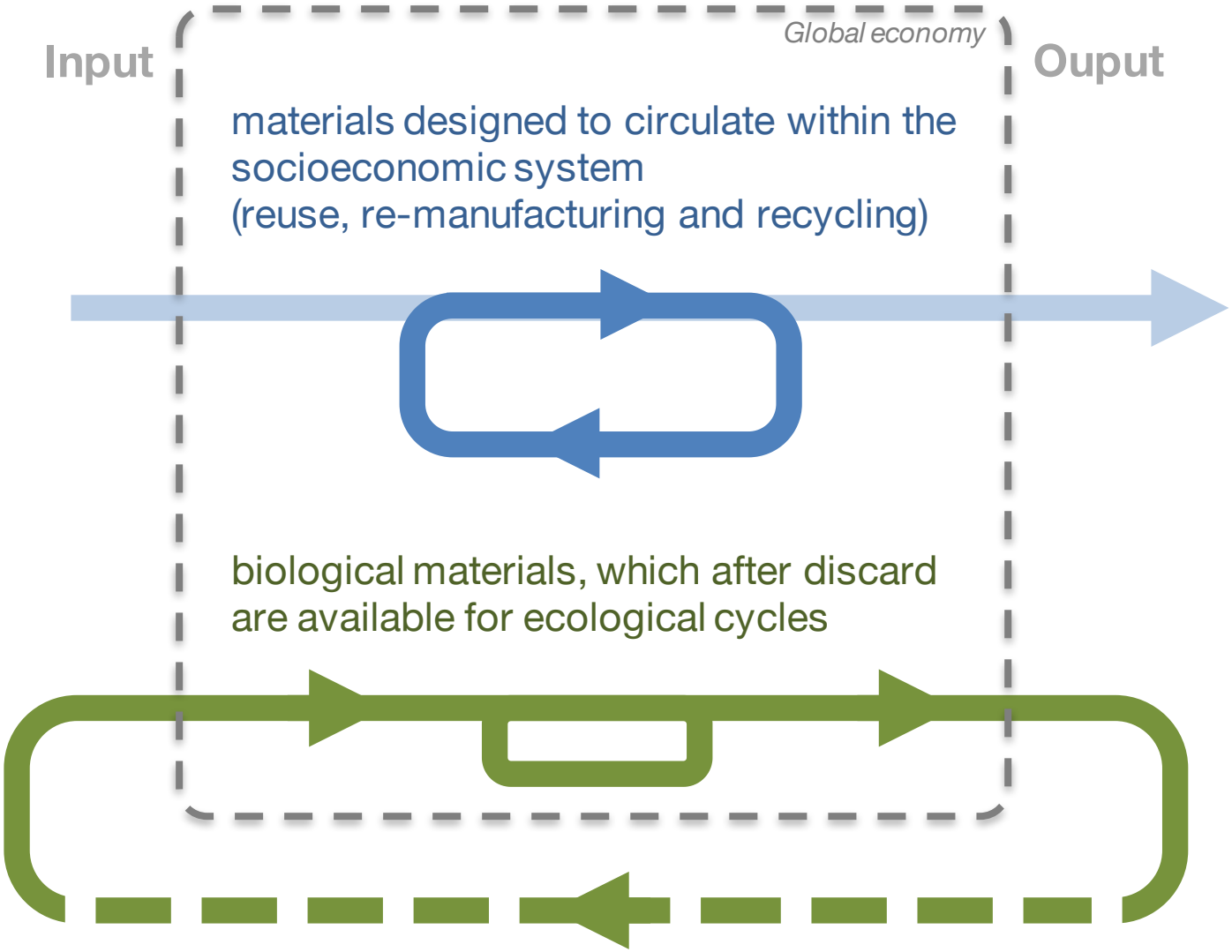




Source: Rockstroem et al. 2009

Defining the Circular Economy

A Circular Economy (CE) is based on two resource loops (GEO5 2012):



Conditions

- effective reduction of virgin material
- carbon neutral energy use
- biomass produced in a renewable way
- no net carbon emissions

difficult to assess these criteria –
our results rather show the **upper range**

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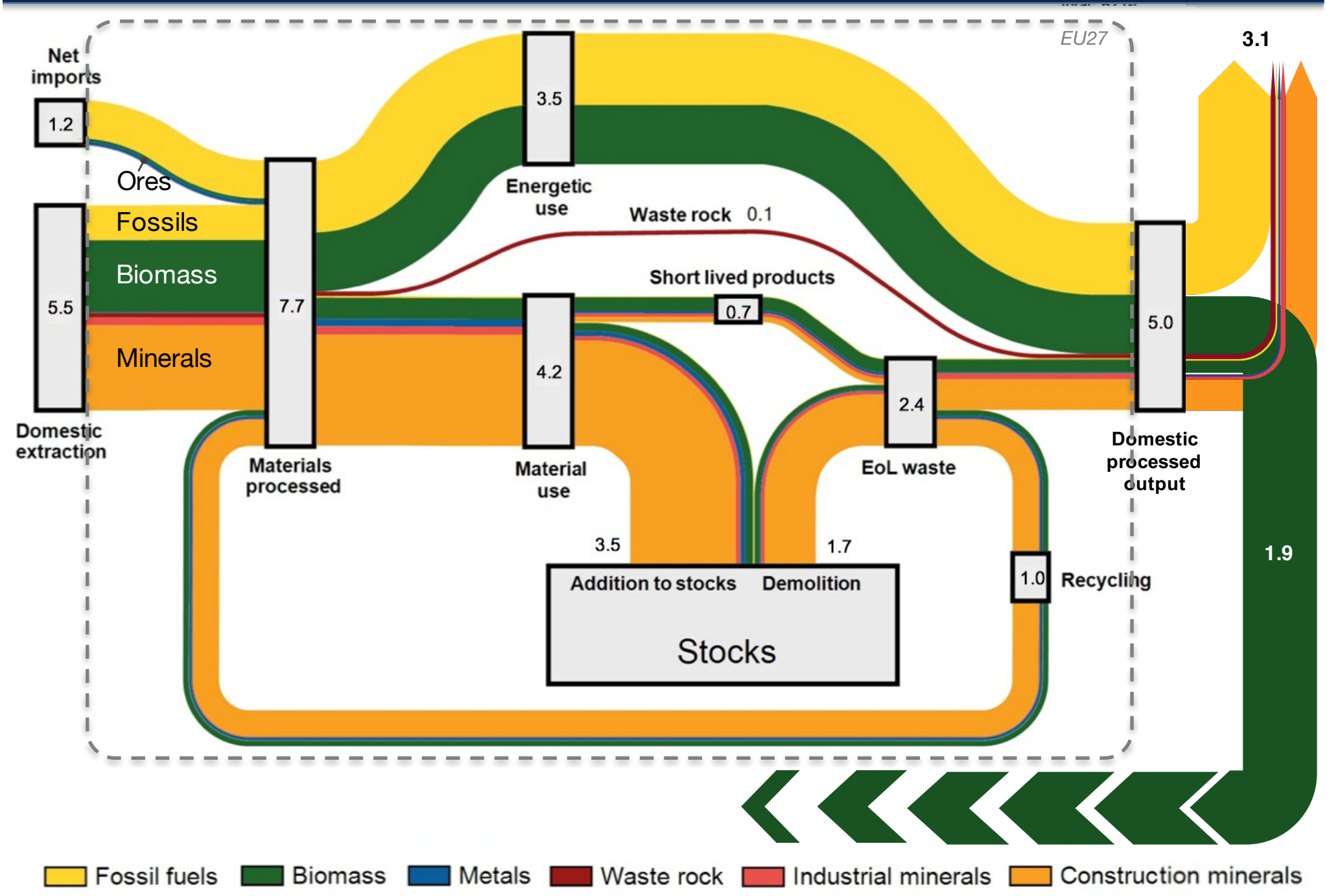
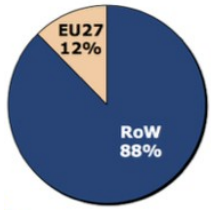
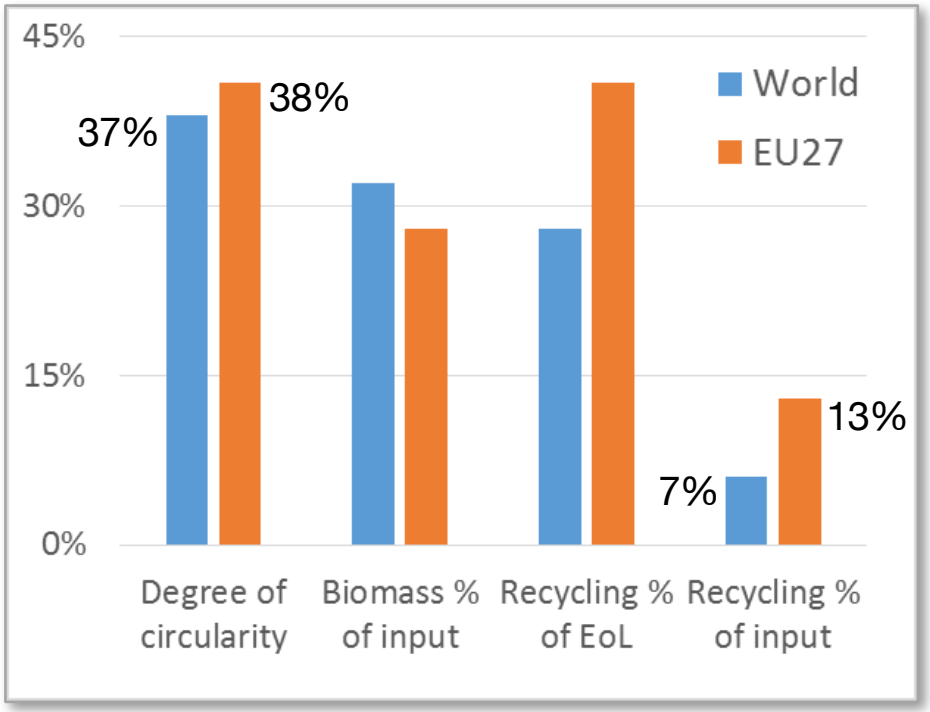
EU27 Material Flows in Gt in 2005



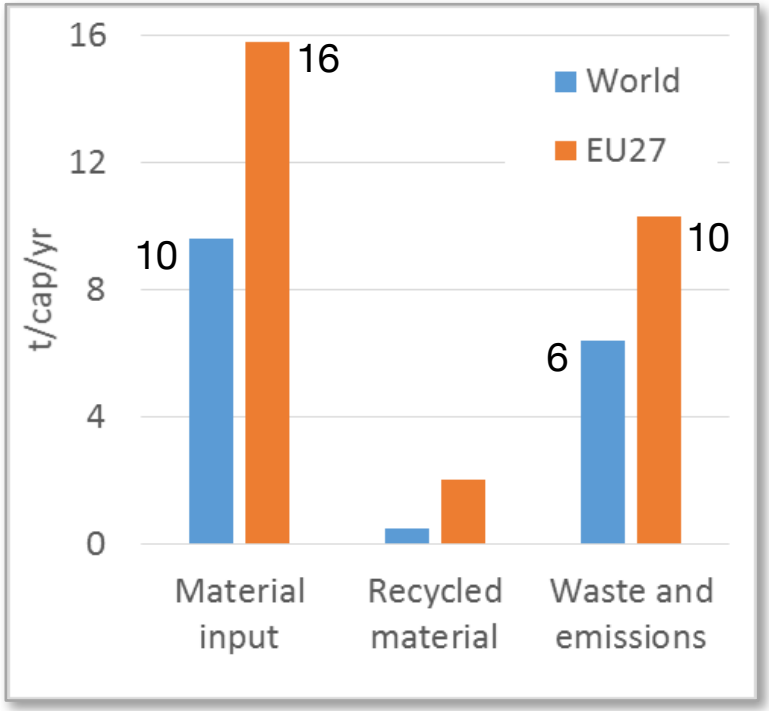
Circular economy indicators in the EU and for the world

Materials processed:





EU27 has slightly **higher degree of circularity** due to much higher recycling shares



but also higher rates of per capita **material inputs and waste output**

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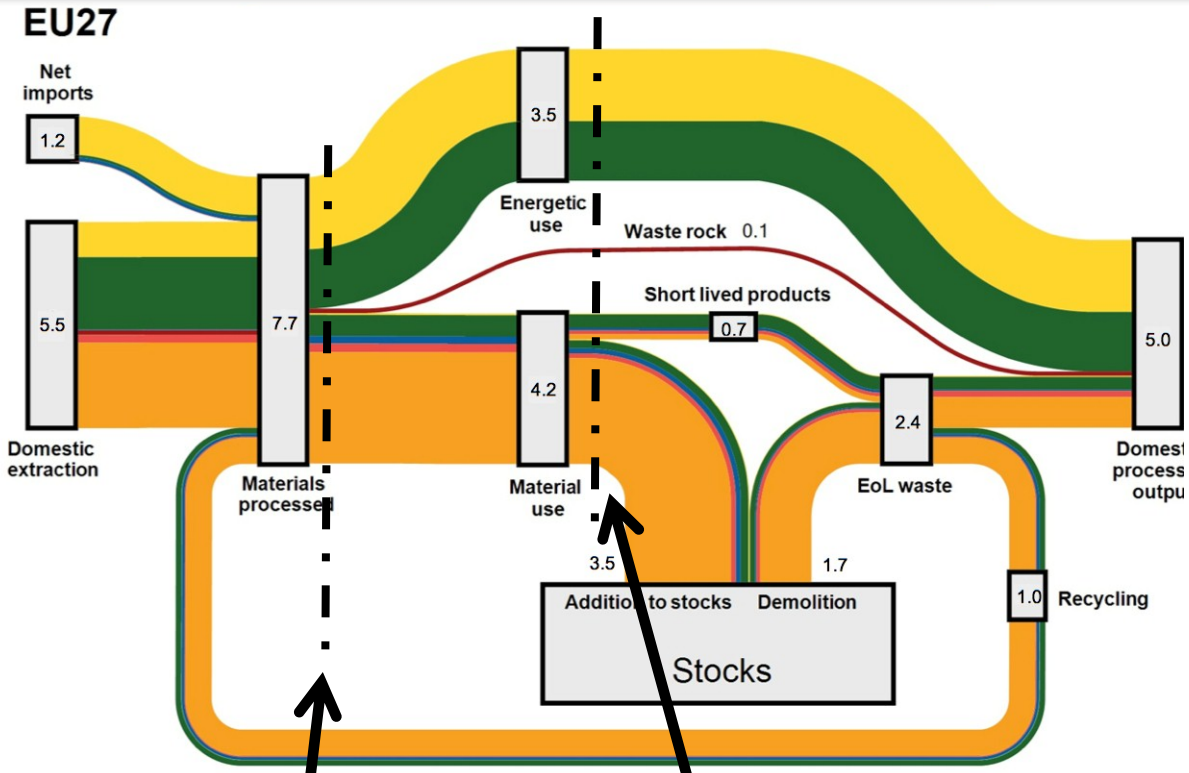
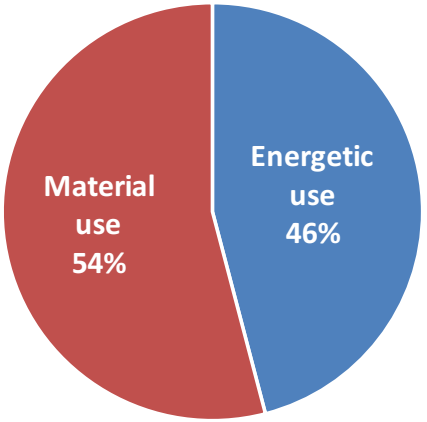
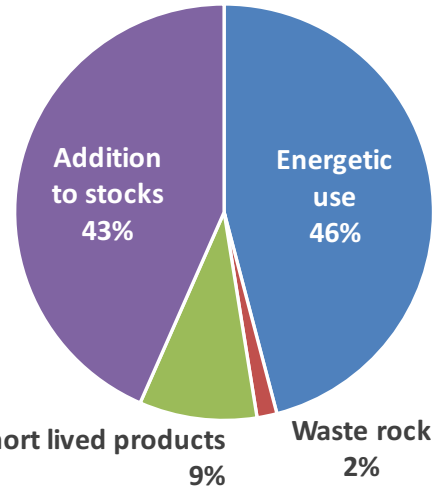
Crucial points towards a circular economy



Processed materials = 7.7 Gt





Energetic use & Stock additions = 89%

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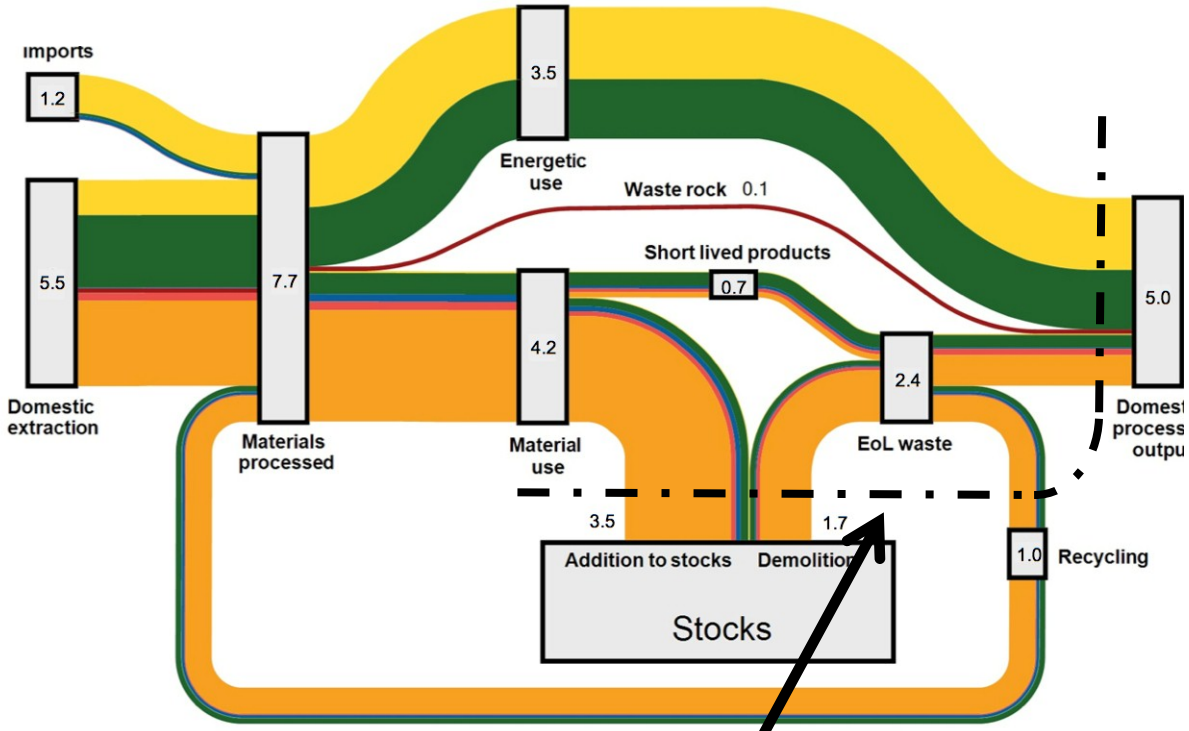
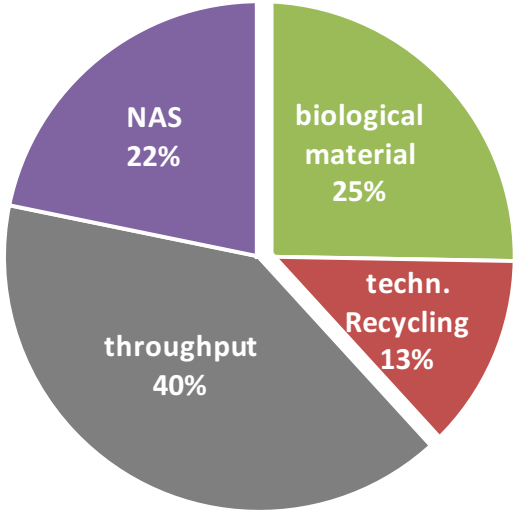


Processed materials = 7.7 Gt

But 62% (4,5 Gt/yr) no loop closing



Potential degree of circularity: 38%

Biomass*) and recycled materials**) as share of materials processed

*) **Assumption:** (1) biomass produced in a renewable way (soil, water, carbon); (2) All biomass waste flows re-enter ecological cycles

) **Assumption: no down-cycling

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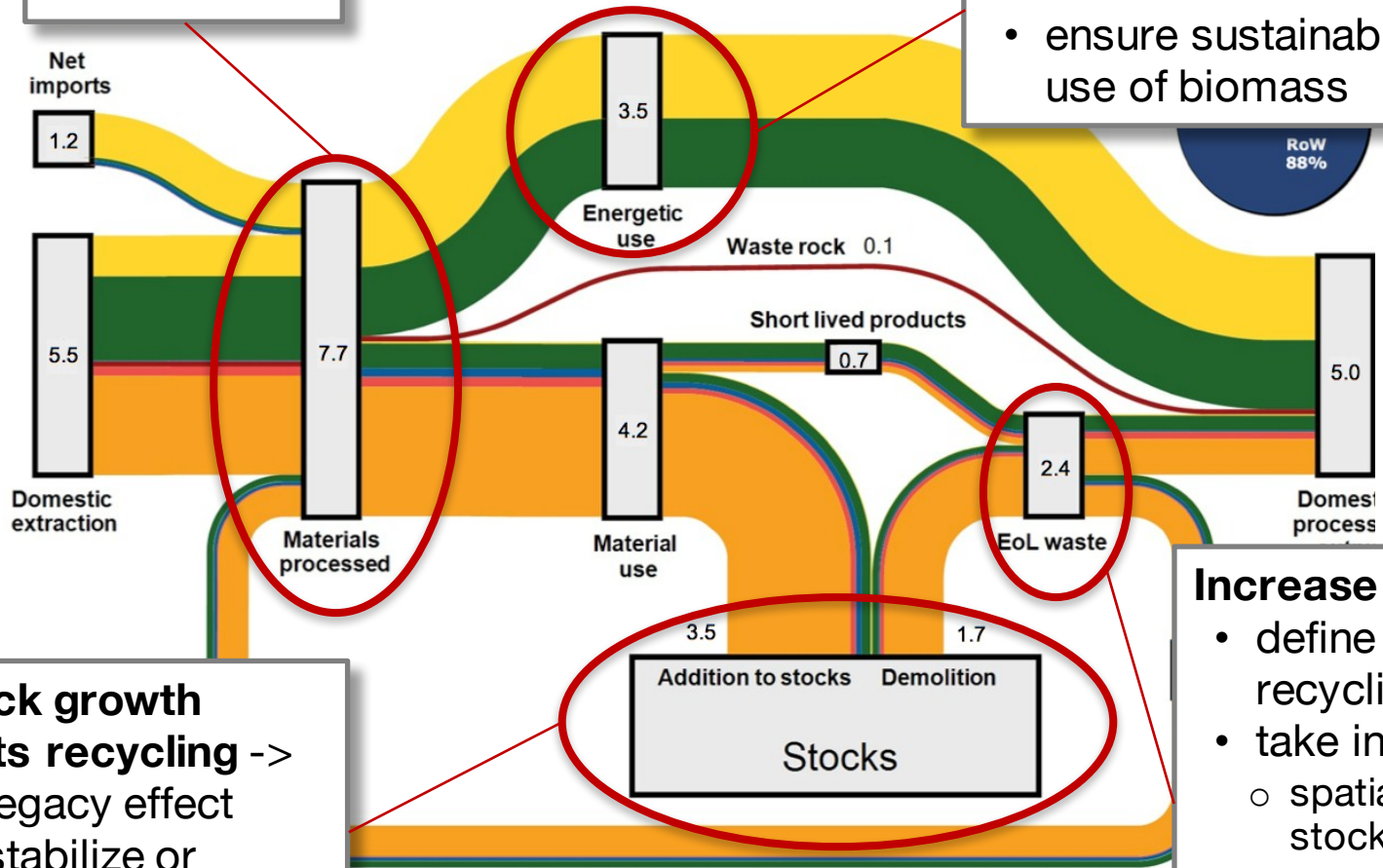
Crucial points towards a circular economy

Downscale
European metabolism

Reduce share of fossils ->
- increase renewables
- ensure sustainable production and use of biomass



Stock growth limits recycling ->
- legacy effect
- stabilize or reduce the size of stocks

Increase EoL recycling ->
- define targets for recycling rates
- take into account:
  - spatial distribution of stocks and production
  - technology gap prod/recycl, downcycling and thermodynamic limitations

Fossil fuels | Biomass | Metals | Waste rock | Industrial minerals | Construction minerals

Conclusions: Potentials, limits and policies

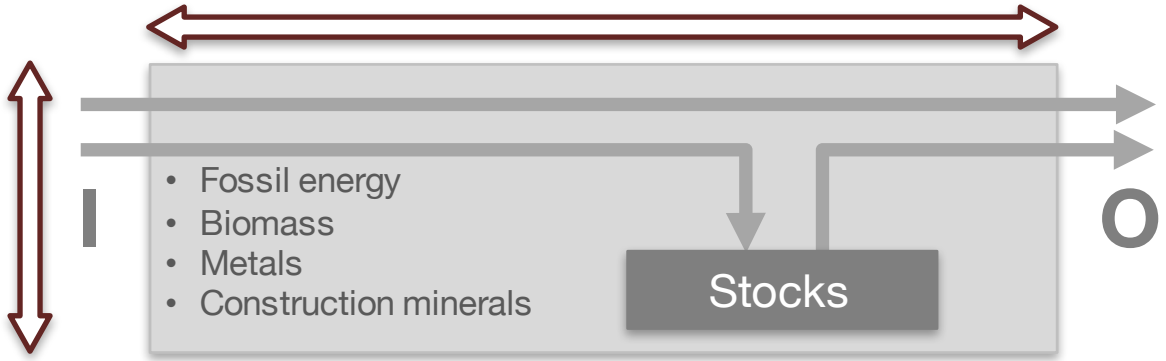
- Closing loops:

What-if analysis	Raw materials	DPO	Recycling / materials
reference 2005	6,7	5,0	13%
20% higher recycling rate	6,5	4,8	15%
50% Decarbonisation	5,7	4,1	14%
50% Addition to stocks	5,1	5,0	16%
combined	4,2	4,5	22%
	-38%	-20%	

Requires modelling of linkages between flows and stocks and flows

- Increasing loop closing (within economy) from 13 to 22% and reducing raw material input by 38% is a big challenge.

- This needs a two-dimensional policy integration for tackling the resource nexus



- Even high circularity needs outputs to stay within planetary boundaries
- Growing stocks determine high flow levels today and in future
- Shrinking flows and stabilizing stocks remains a major policy challenge

Thank you for your attention