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sustainable biomass energy

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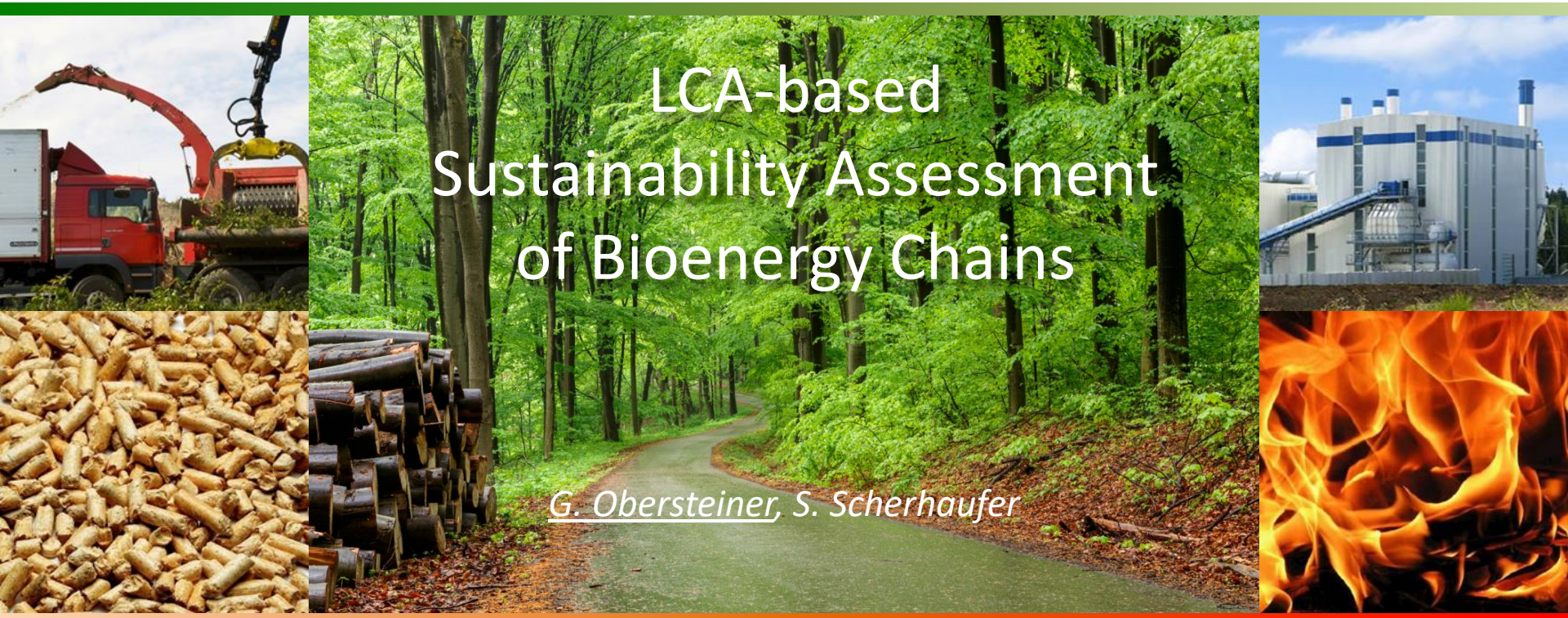

LCA-based Sustainability Assessment of Bioenergy Chains

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Benefits of biomass

- Biomass is a safe and reliable energy source
- can replace non-renewable energy sources
- and reduce greenhouse gas (GHG) emissions
- can support increased demand of energy

- BUT: provision, transformation, conversion of wood energy services cause environmental effects + wood is not an infinite resource

→ necessary to identify the most beneficial and efficient utilization of wood

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Sustainability risks of Bioenergy Chains

- Increased air pollution
- Inefficient use of resources
- Limited GHG savings
- Land use change
- Indirect land use change
- Impact on carbon stocks
- Impacts on biodiversity, water and soils
- Competition with other uses
- Distortion of single market

European Commission, 2017. Sustainable and optimal use of biomass for energy in the EU beyond 2020.

GHG indicator/GHG savings

Global Warming Potential (GWP) is widely applied for the assessment of the contribution of GHGs to climate change

Results influenced by

- treatment of co-products (solving multi-functionality)
- handling of biogenic CO_2 (included or not)

CO_2 sequestered through tree or crop growth and CO_2 emitted through digestion or combustion are set to zero,

BUT the amount of CO_2 sequestered but released as CH_4 as well as other greenhouse gases (N_2O) need to be considered.

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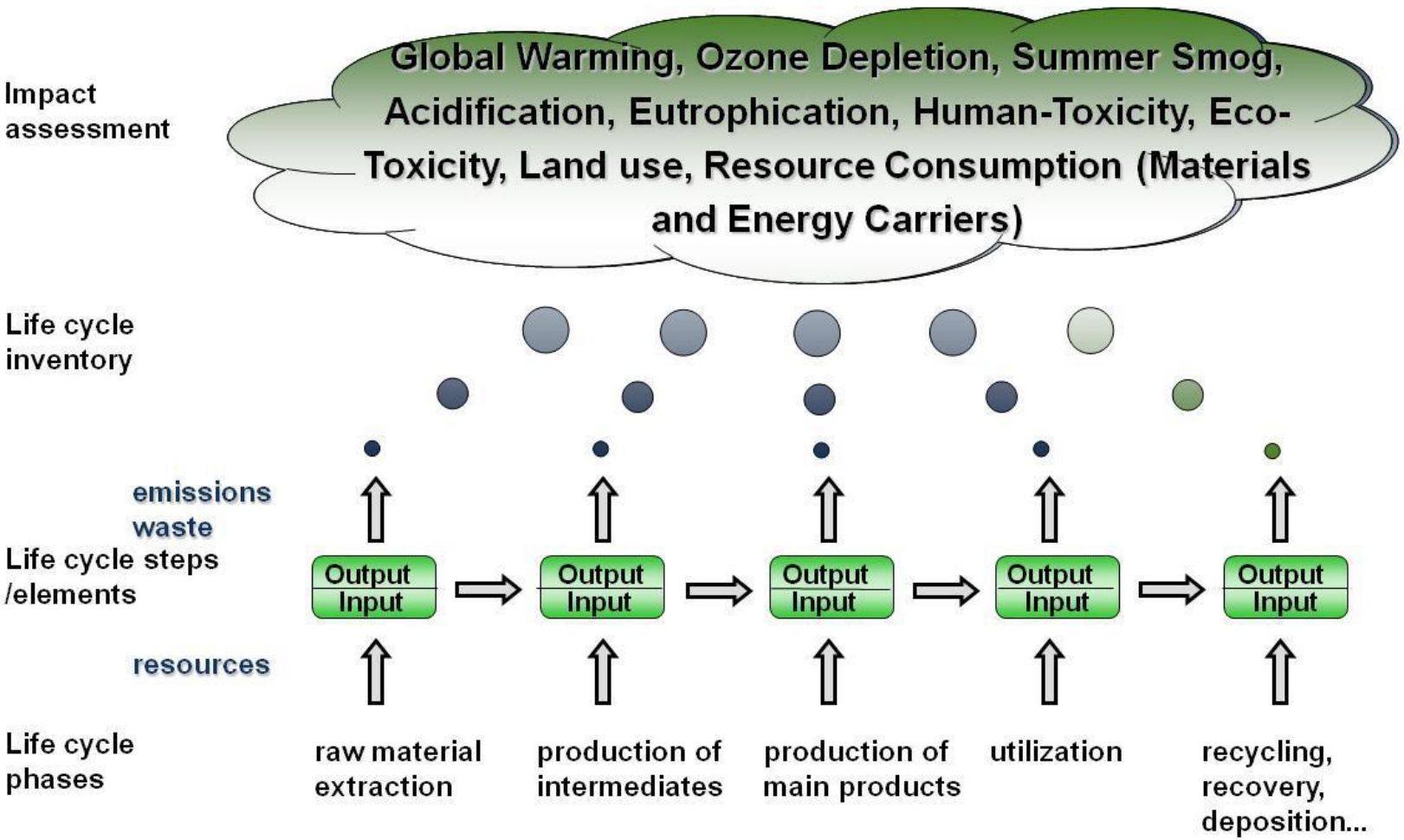
Life Cycle Assessment



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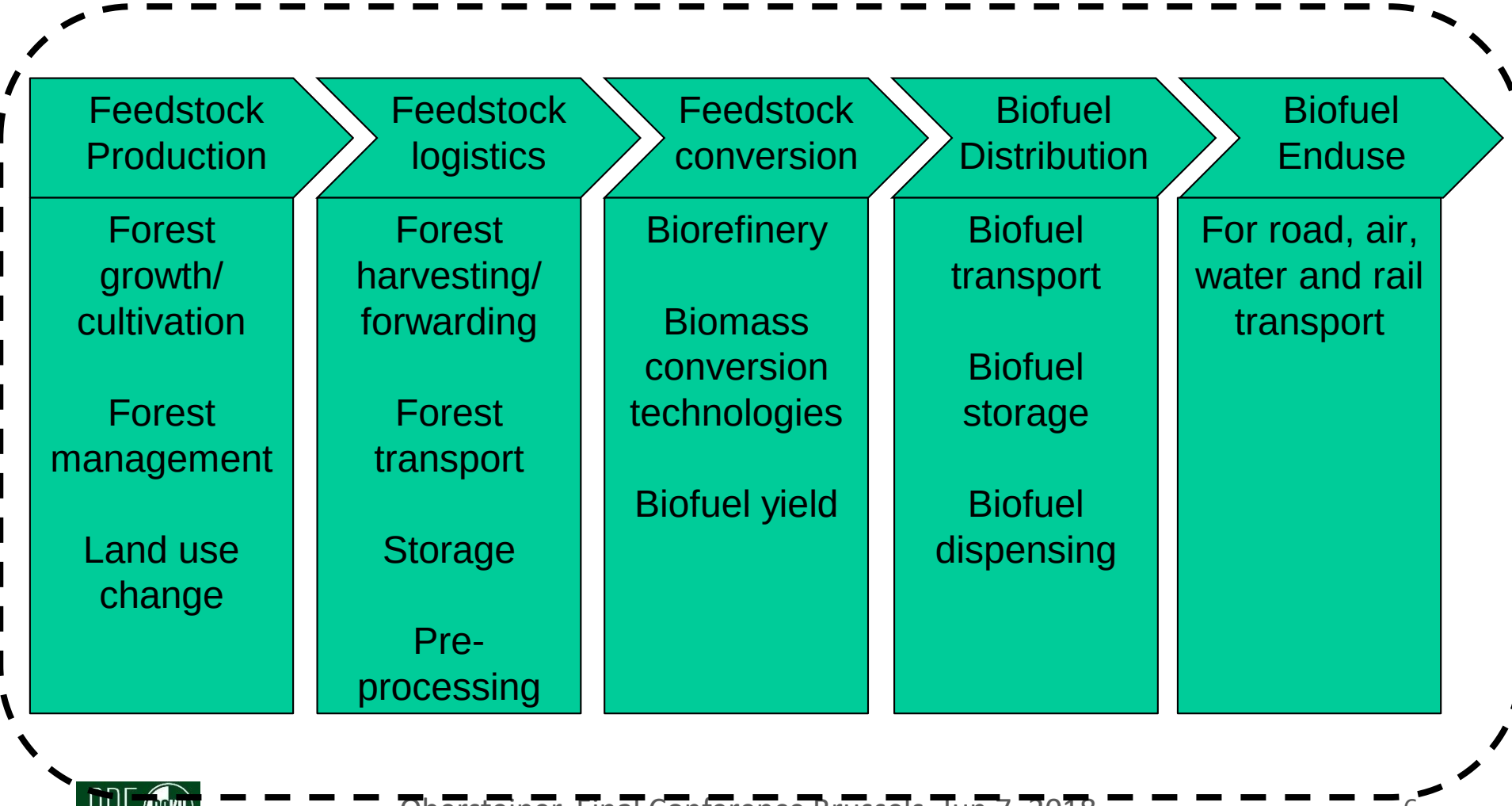
System boundaries



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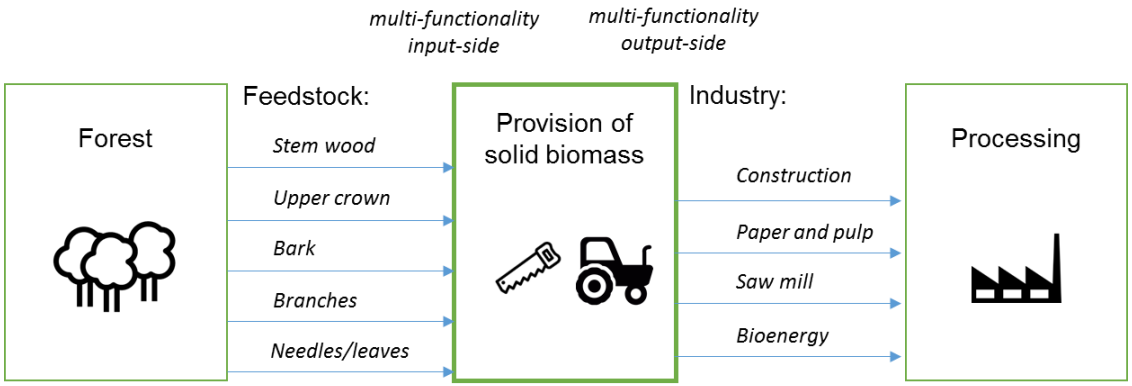
Case study Groups

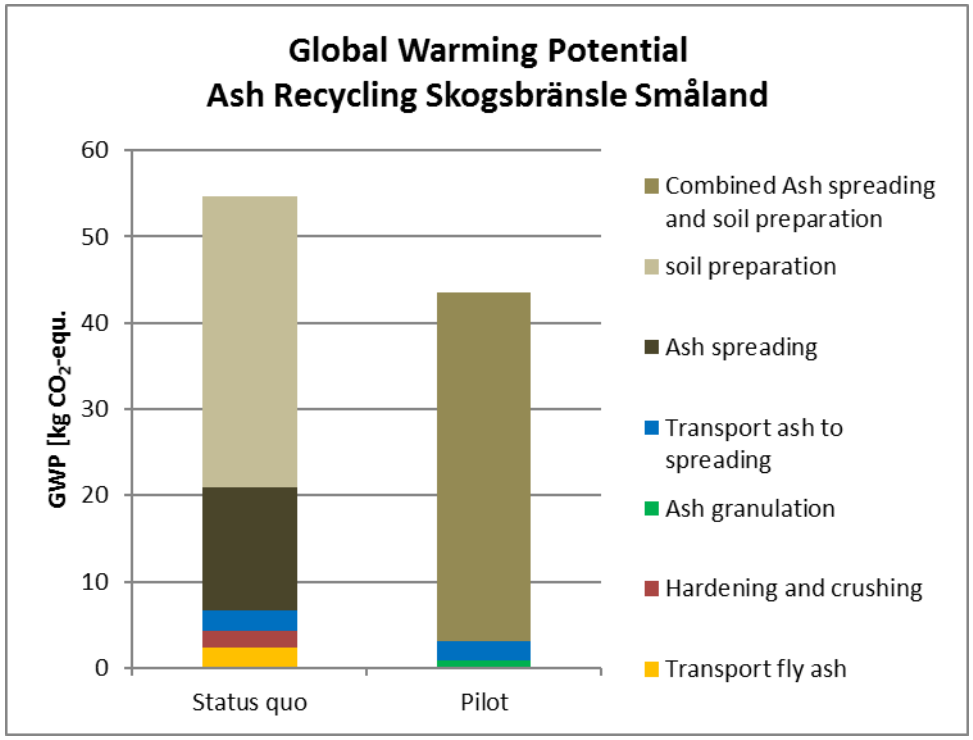
- Options to mobilize more biomass
  - Sustainable company enlargement
  - Acquisition of new regional feedstock for bioenergy
  - Logistical changes to reach more customers
  - Replacement of fossil fuel boilers
- Scenarios to increase resource efficiency and forest health
  - Forest soil improvement
  - Upgrading of energy carriers
  - Optimisation of systems

Solving mulit-functionality



- Forest as a resource has multi-functional outputs (different materials) with multi-functional usages (different sectors)
- Solving multi-functionality by i) subdivision ii) system expansion iii) allocation (by mass or by economic value)

Skogsbränsle Småland



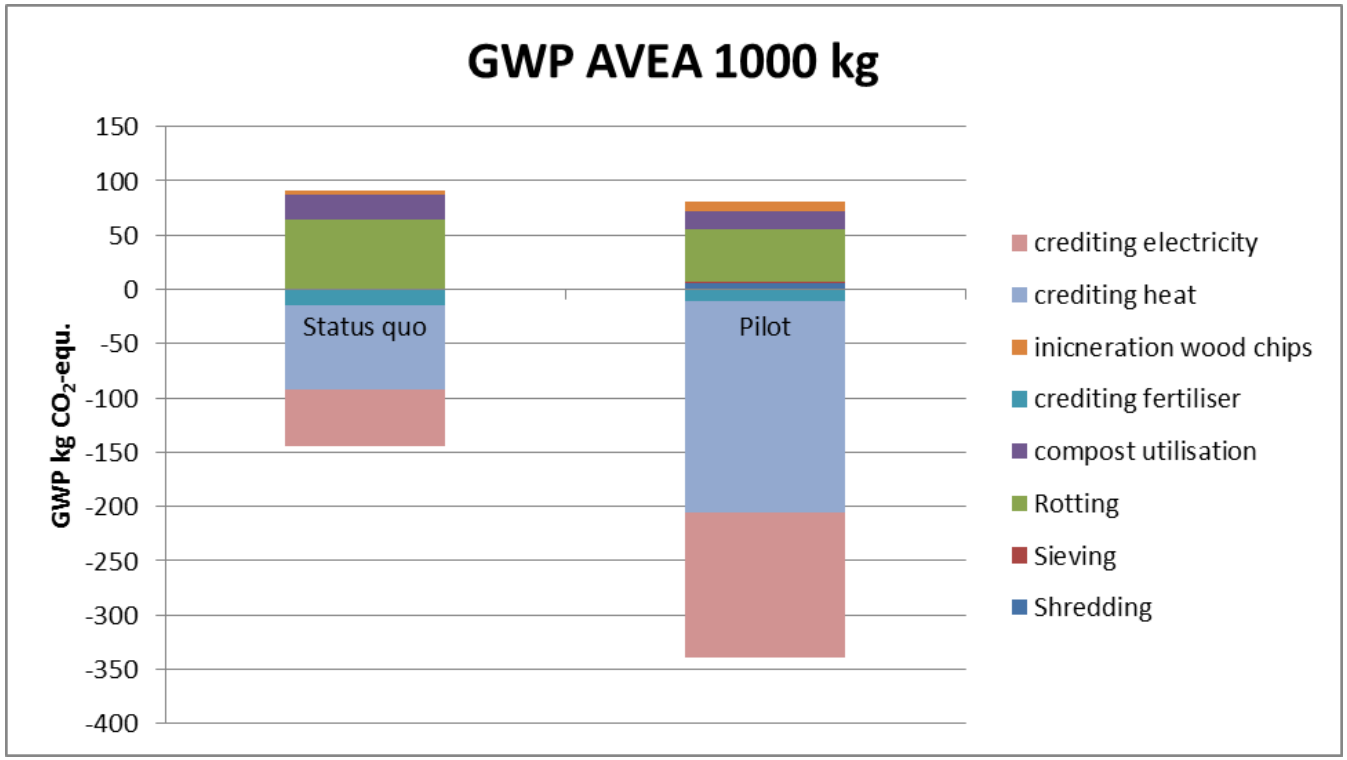
- Granulated **ash saves 20%** of Global Warming
- Ash granulation has a very low impact (Swedish electricity mix)
- Granulated ash fosters increased extraction of forest residues with about 20% (~ 50 GWh/a could be used in small-scale CHP)
- → between **9,000 and 16,350 t CO_2-eq. could be saved** if natural gas or oil boilers at households can be replaced.

North Rhine-Westphalia (NRW) Germany

AVEA

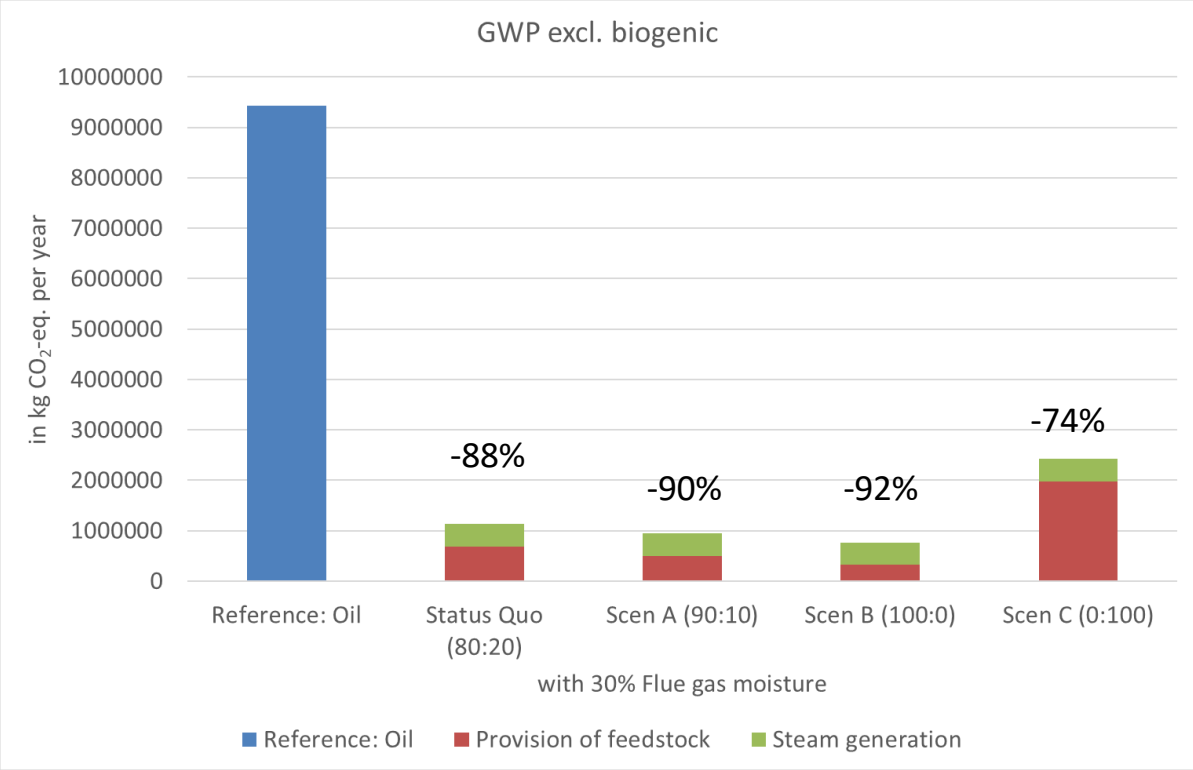
- Improved wood recovery from biowaste sorting
- optimize biowaste sorting logistics,
- valorise a larger share of the wooden fraction from biowaste
- enhance the biowaste handling capacity
- 6,000 t/a → 10,000 t/a by 2018
- Per tonne green waste: 0.14 →0.35 t wood chips

AVEA



- Both options show GHG savings
- Additional GHG savings at pilot: 203 kg CO_2-equ. / t treated waste
- Emissions from rotting process

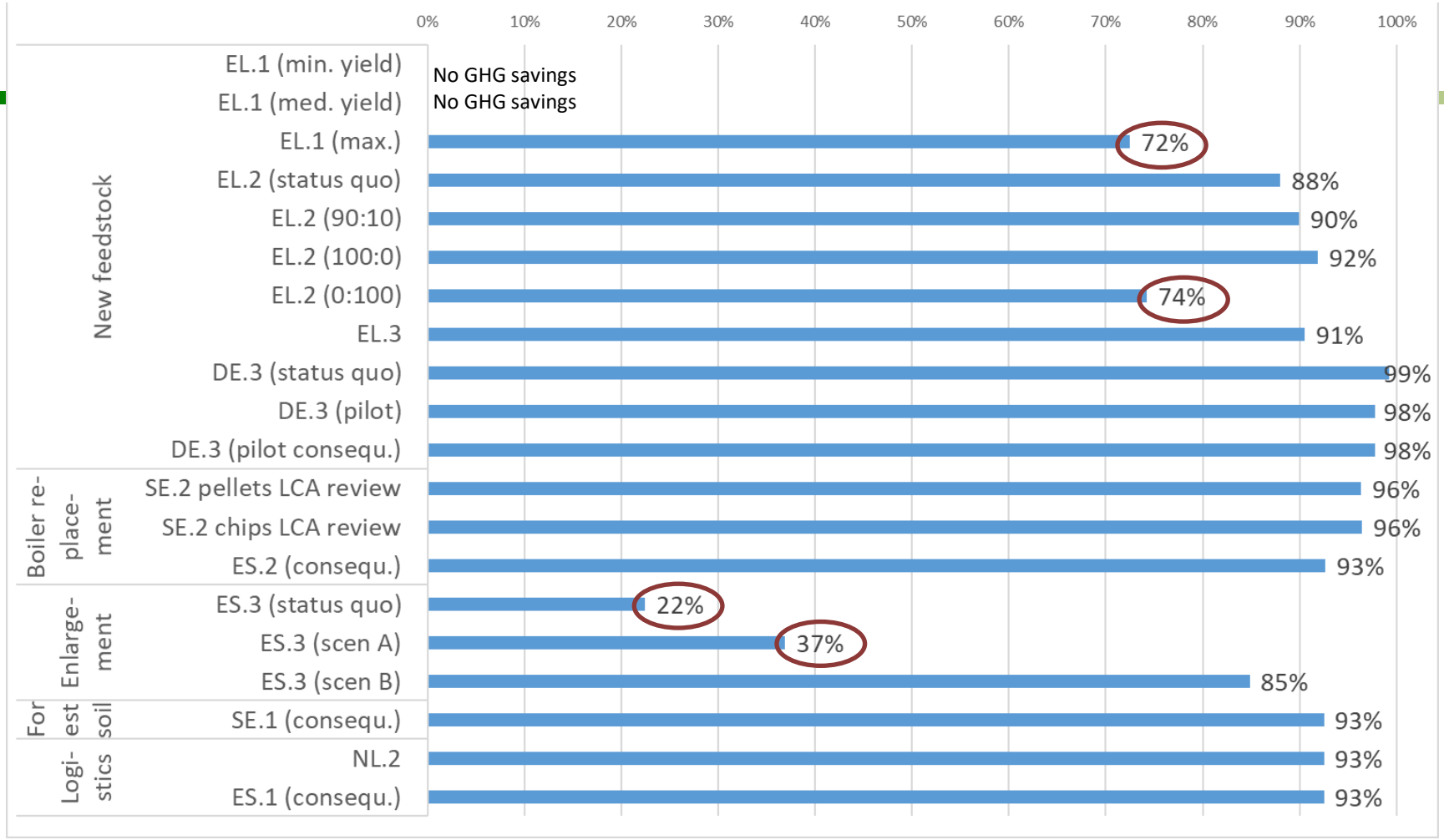
Alfa Wood



- GHG savings currently: 88% compared to fossil system
- However, different fuel composition result in different emissions to air (NO_X emissions!)
- Recommended to monitor NO_X emissions

- In case of AP: -82%, -85%, -87%, -65%

GHG saving results



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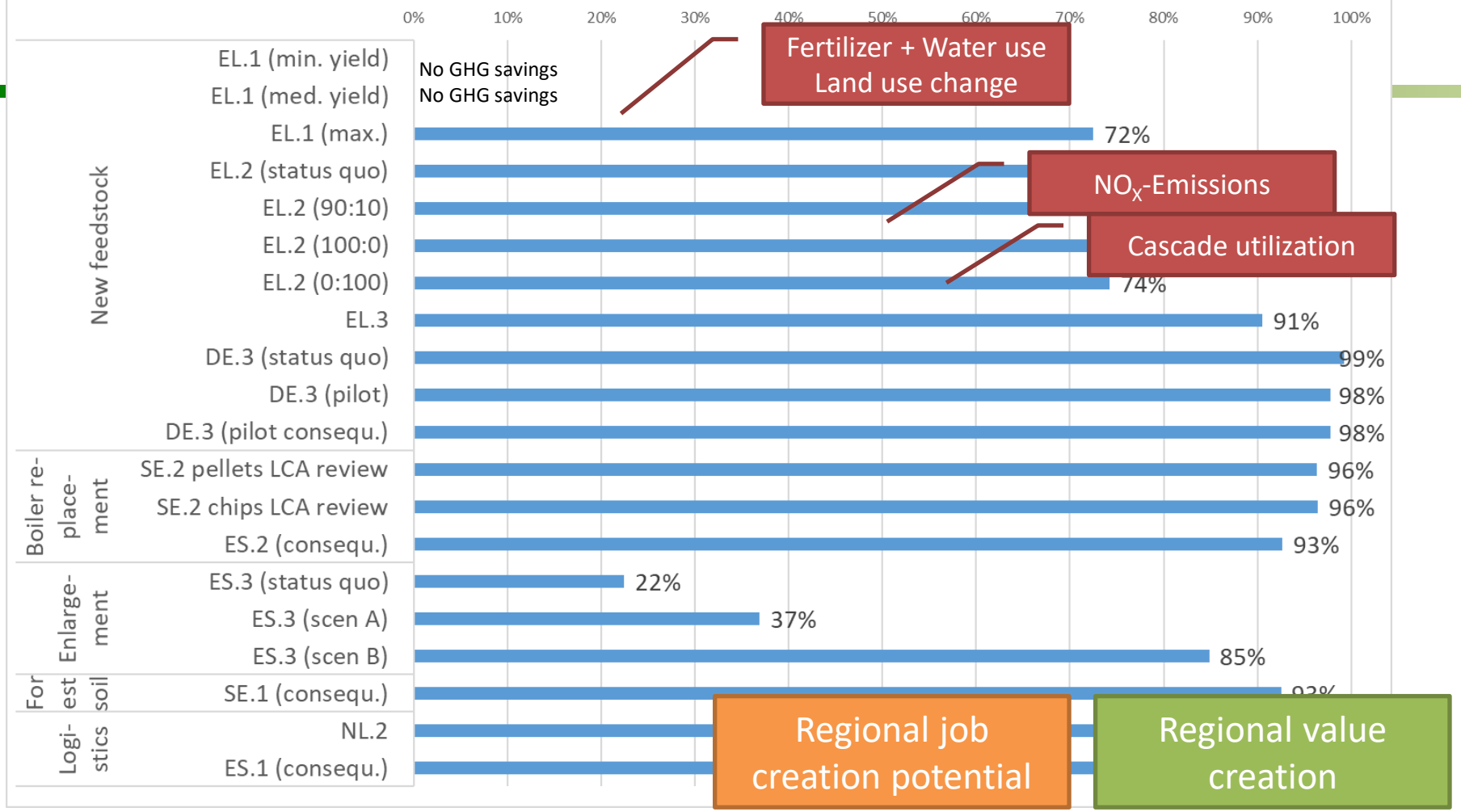
GHG saving results plus other sustainability aspects



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Conclusion

Increased biomass mobilization can lead to

- Energy security
- Energy diversity
- Regional added value
- Reduction of GHG emissions

Bioenergy can contribute to energy revolution and can consequently support the fight against Global Warming (Paris Agreement)

Sustainability aspects shall always be considered to ensure a safe use of resources

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Thank you!