



POPFULL

Environmental aspects of short-rotation coppice culture : greenhouse gas balance and environmental life cycle analysis

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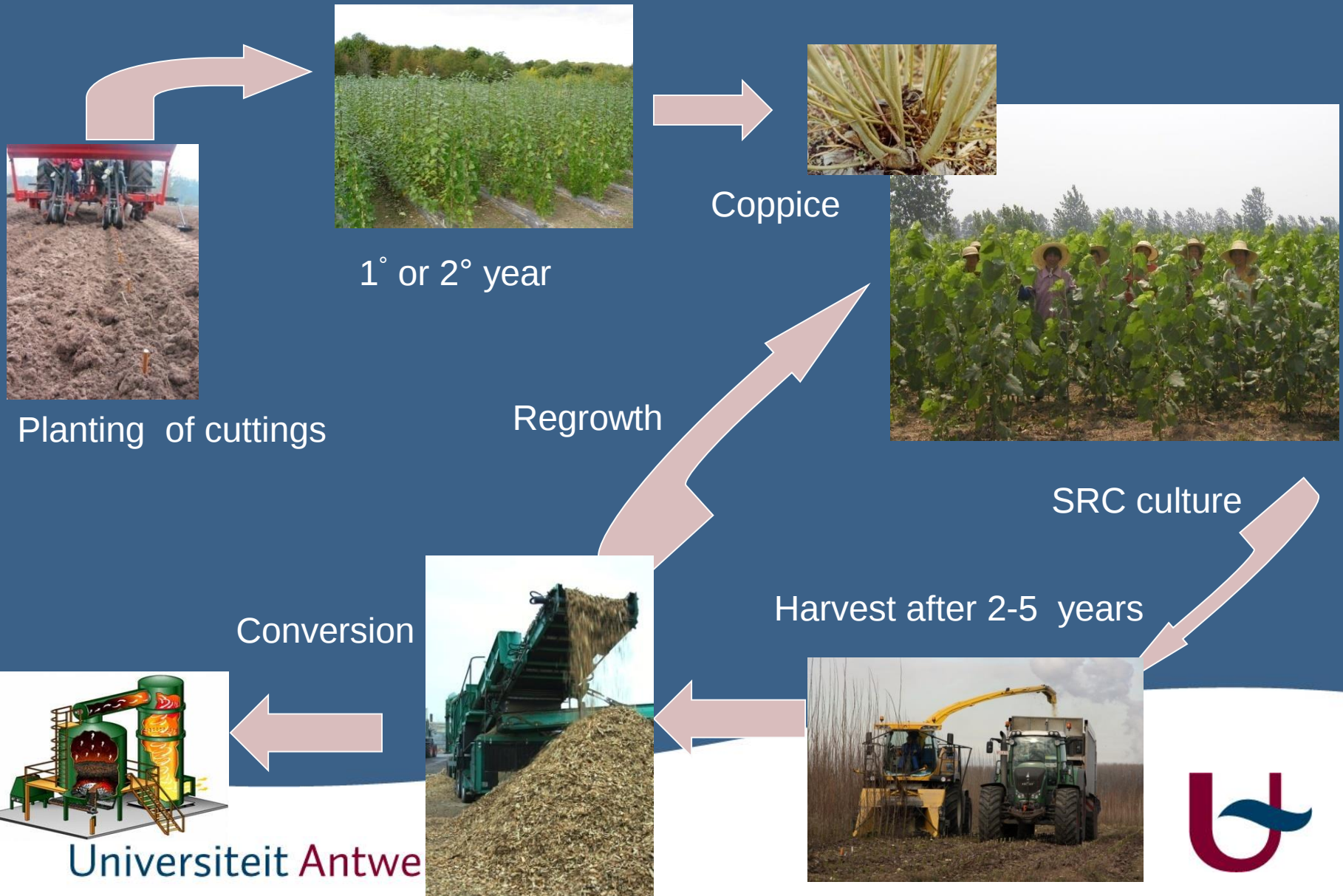
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Bio-energy from Short Rotation Coppice (SRC)



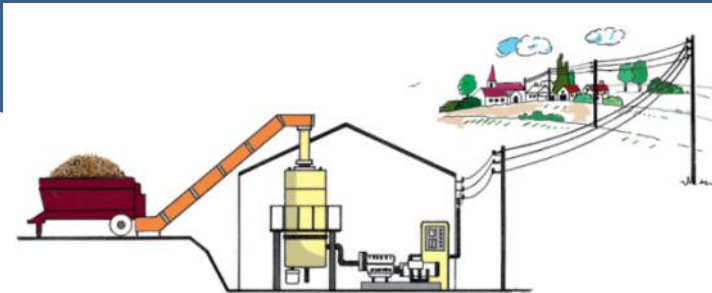
Is SRC a CO₂ neutral (bio-)energy !?

1. C from atmosphere is taken up – by the leaves – as CO₂ during the photosynthesis process

2. This C is used by the trees for growth and production, of e.g. wood



3. When using the wood (combustion, gazification), CO₂ is released back into the atmosphere, with a net 0 emission of CO₂...



Questions on SRC:

- ✓ Efficient reduction of greenhouse gases?
 - ✓ Energetic efficiency?
 - ✓ (*Economic feasibility?*)
-
1. Full balance of most important greenhouse gases (CO_2 , CH_4 , N_2O)
 2. Full energy balance, incl. overall energy efficiency + full economic balance
 3. Full life cycle analysis (LCA) of global warming contribution of SRC

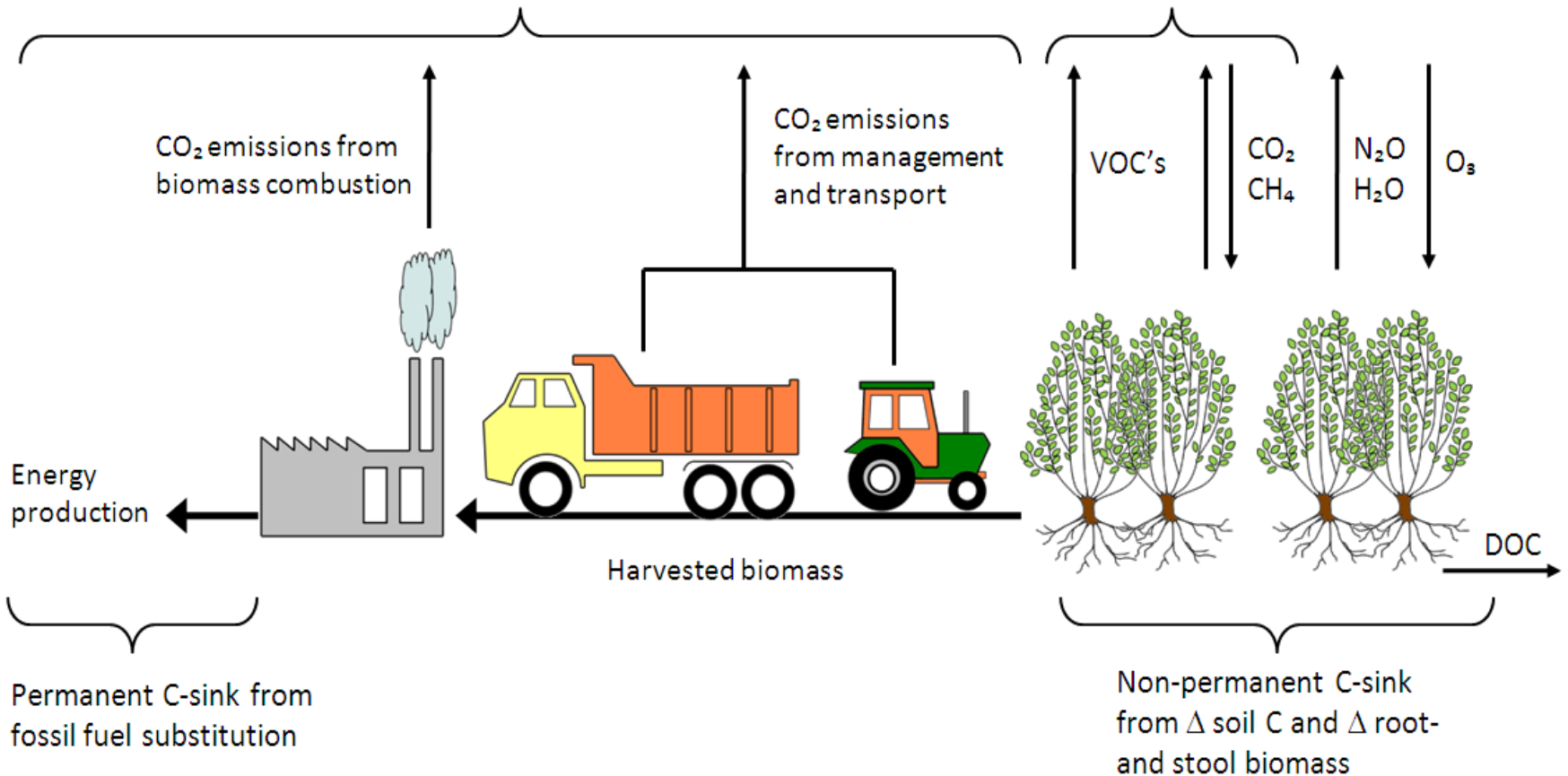


Full LCA global warming contribution of SRC

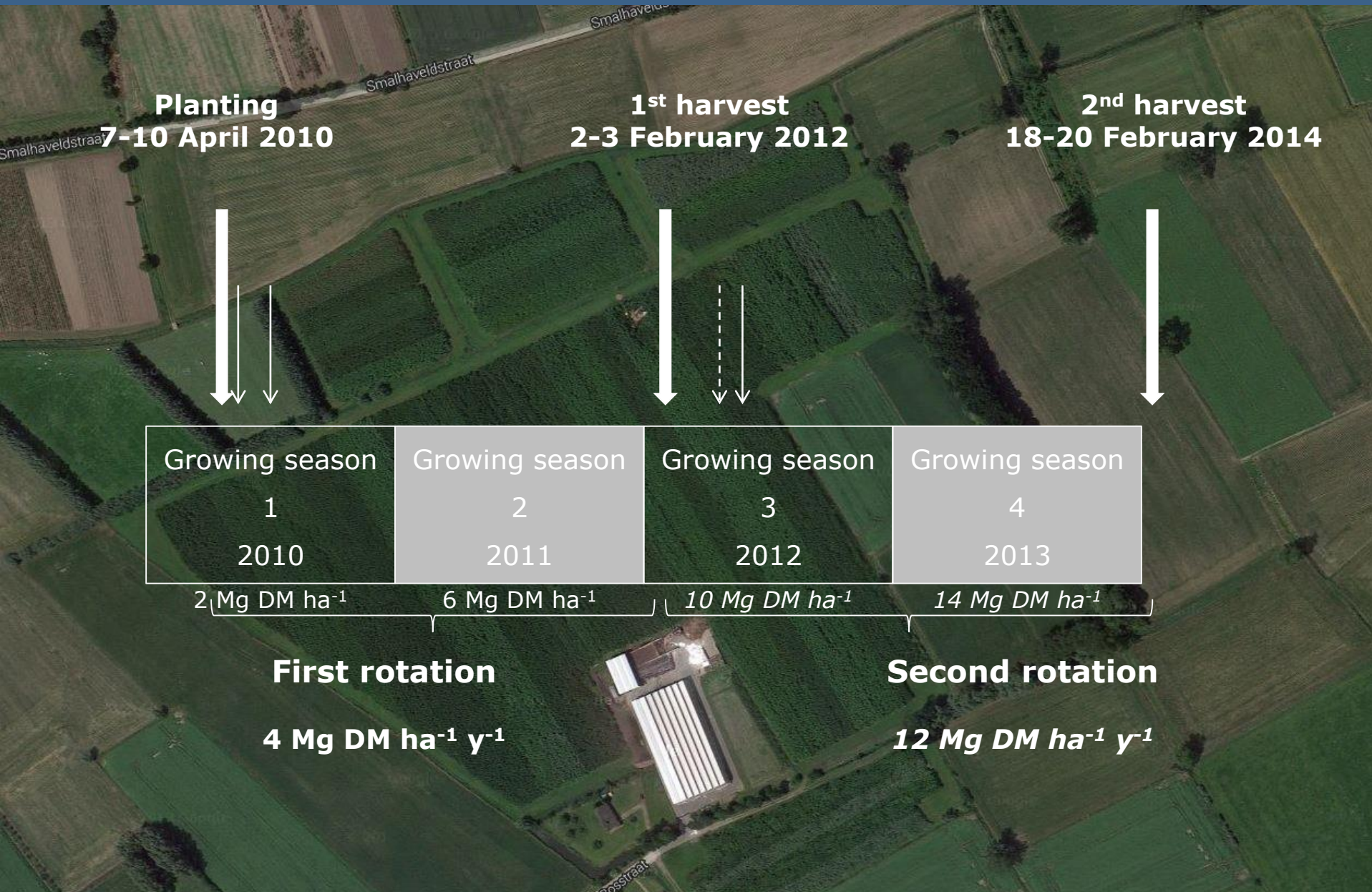
Full LCA C-balance of SRC system

SRC energy efficiency

Ecosystem C-balance



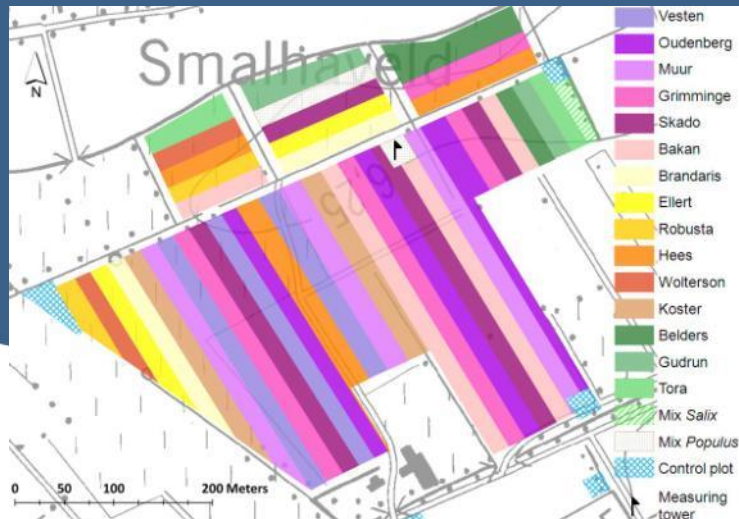
POPFULL : 2 + 2 year rotation scheme





Planting density of 8000 plants per ha
No fertilization, no irrigation

12 (*Populus*) poplar & 3
willow (*Salix*) clones



Lochristi, East-Flanders

Total area: 18.4 ha
Planted area: 14.5 ha



June GS1



August GS1



March GS2



August GS2



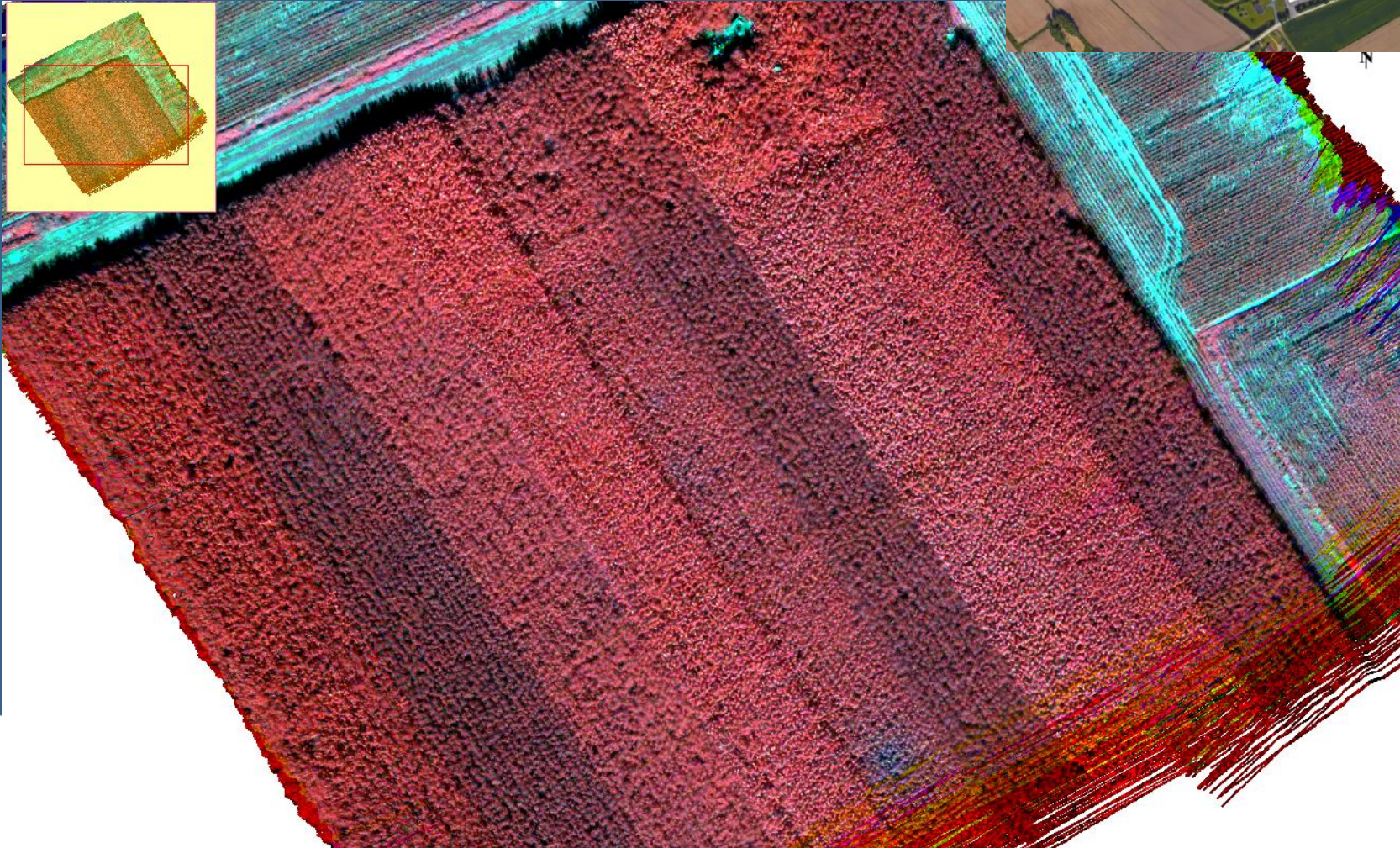
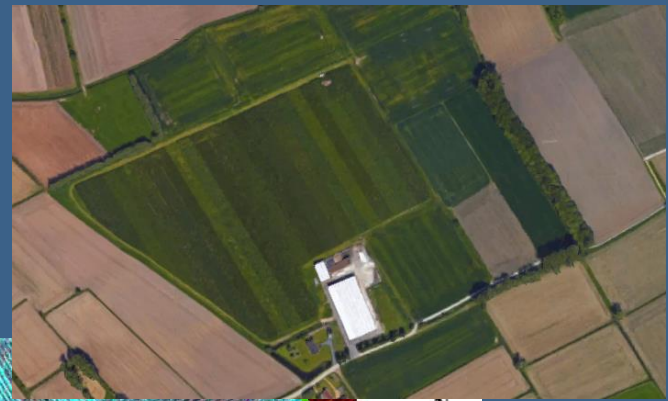
May GS1-R2



August GS1-R2



GS2 – R2

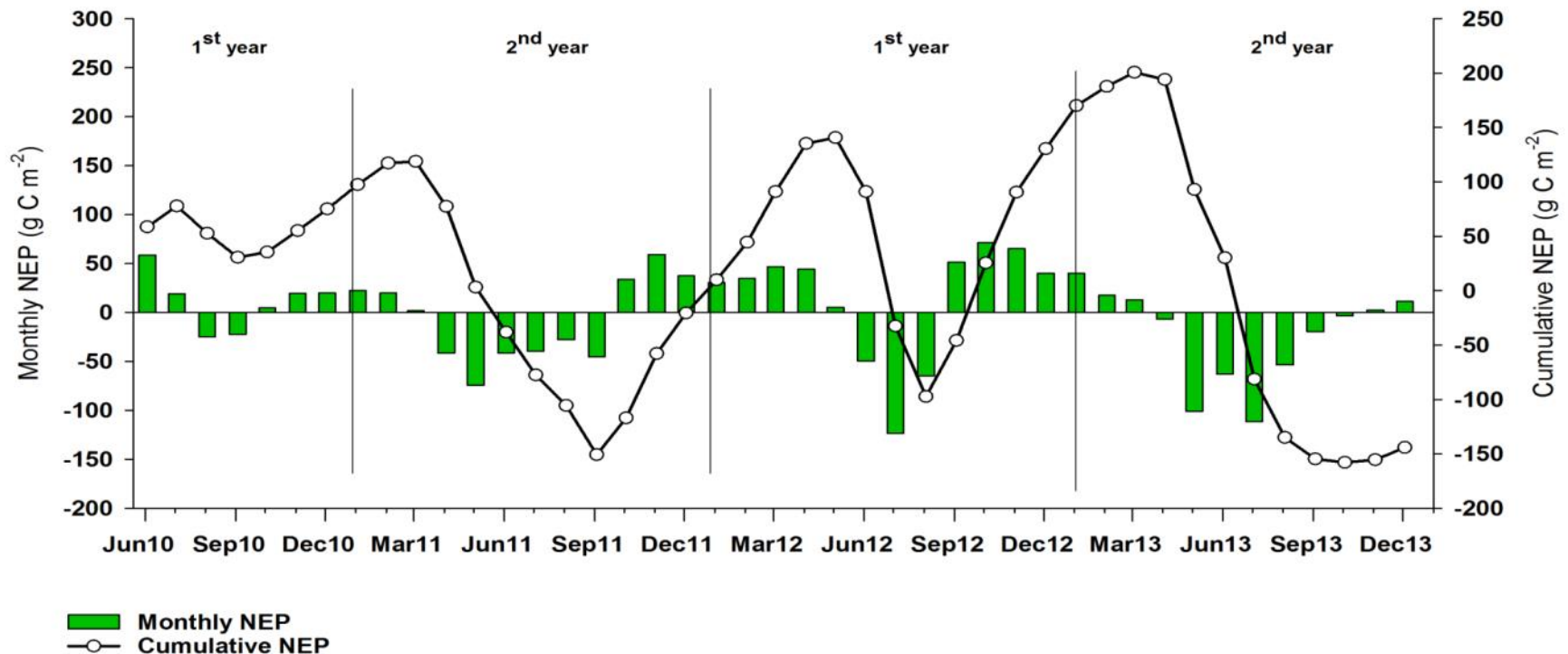


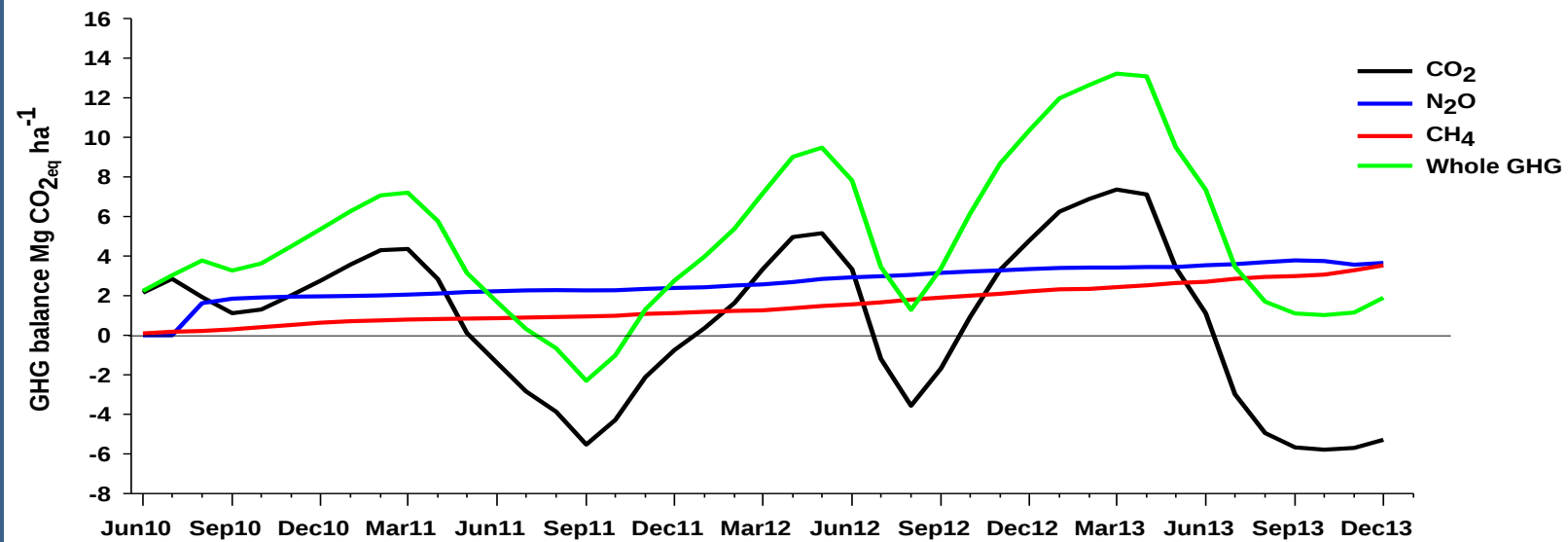
Continuous flux measurements using eddy covariance flux tower

Greenhouse gases (GHG): CO_2 ,
 CH_4 , N_2O , and also O_3 , H_2O



Carbon balance: net uptake (-) vs. release (+) fluxes





2nd rotation

Field measurements and LCA approach

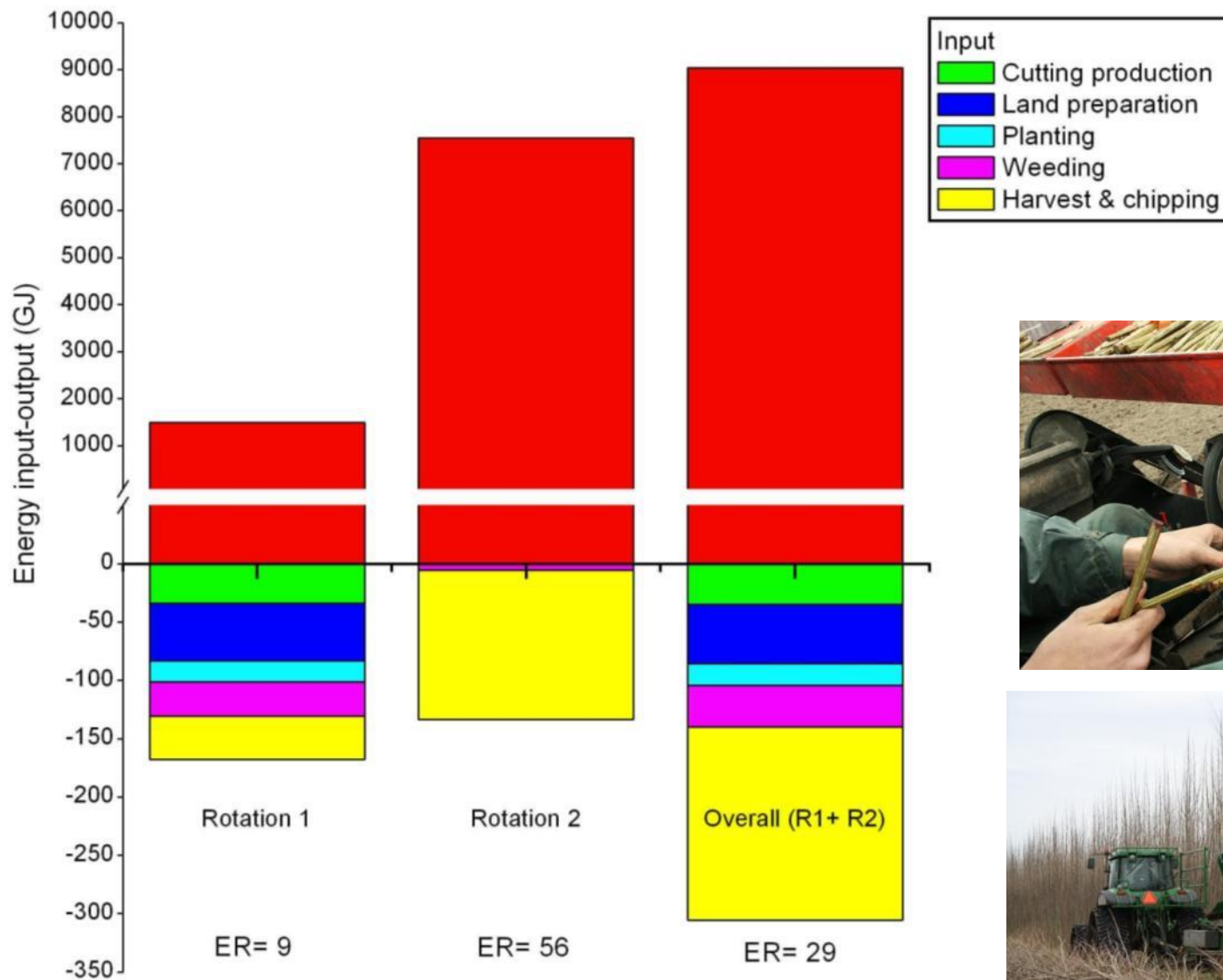


Quantification of
all energy inputs
and outputs

$$ER = E_{\text{output}} / E_{\text{input}}$$

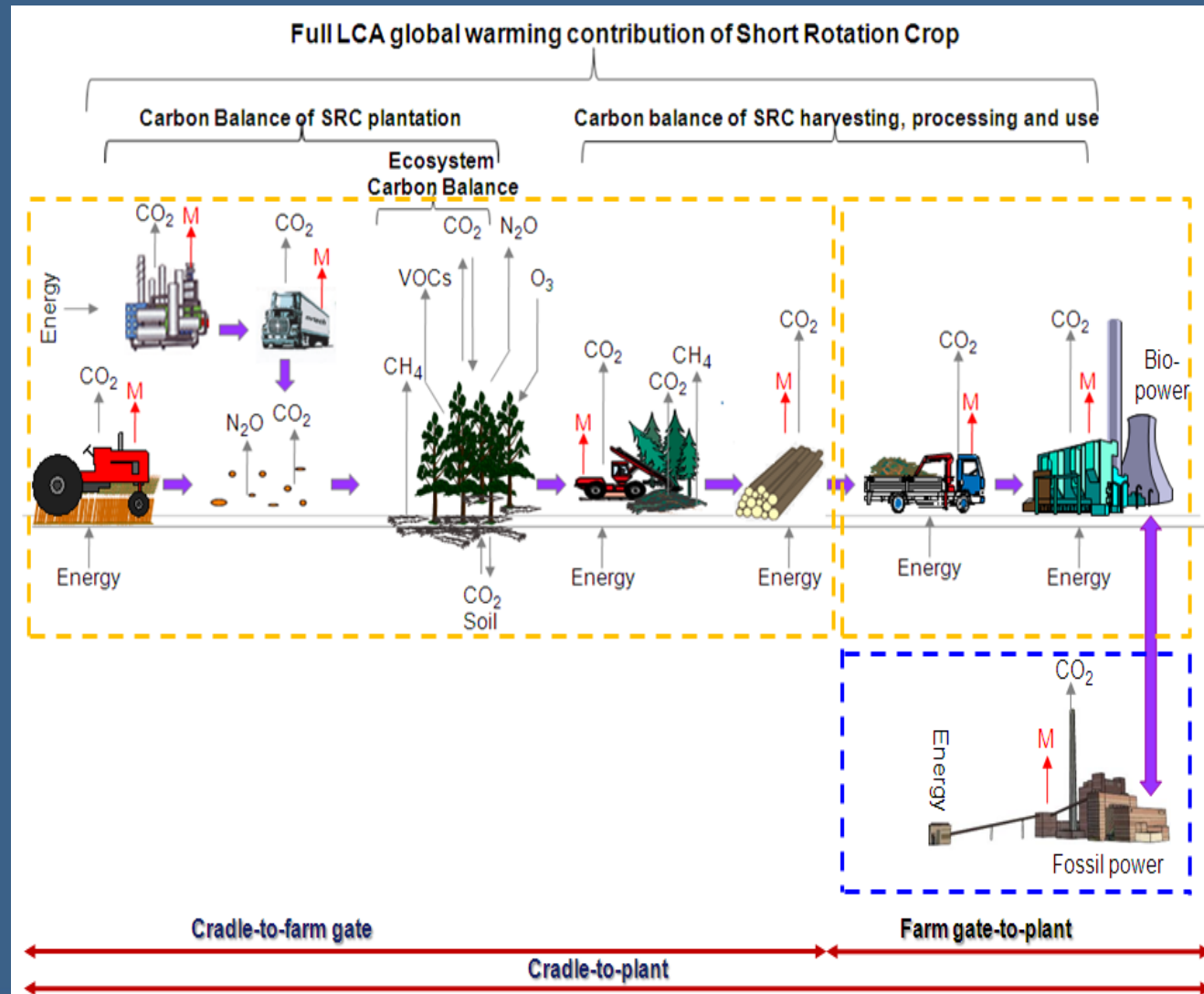


Energy output & input – energy ratio (ER) at farm gate



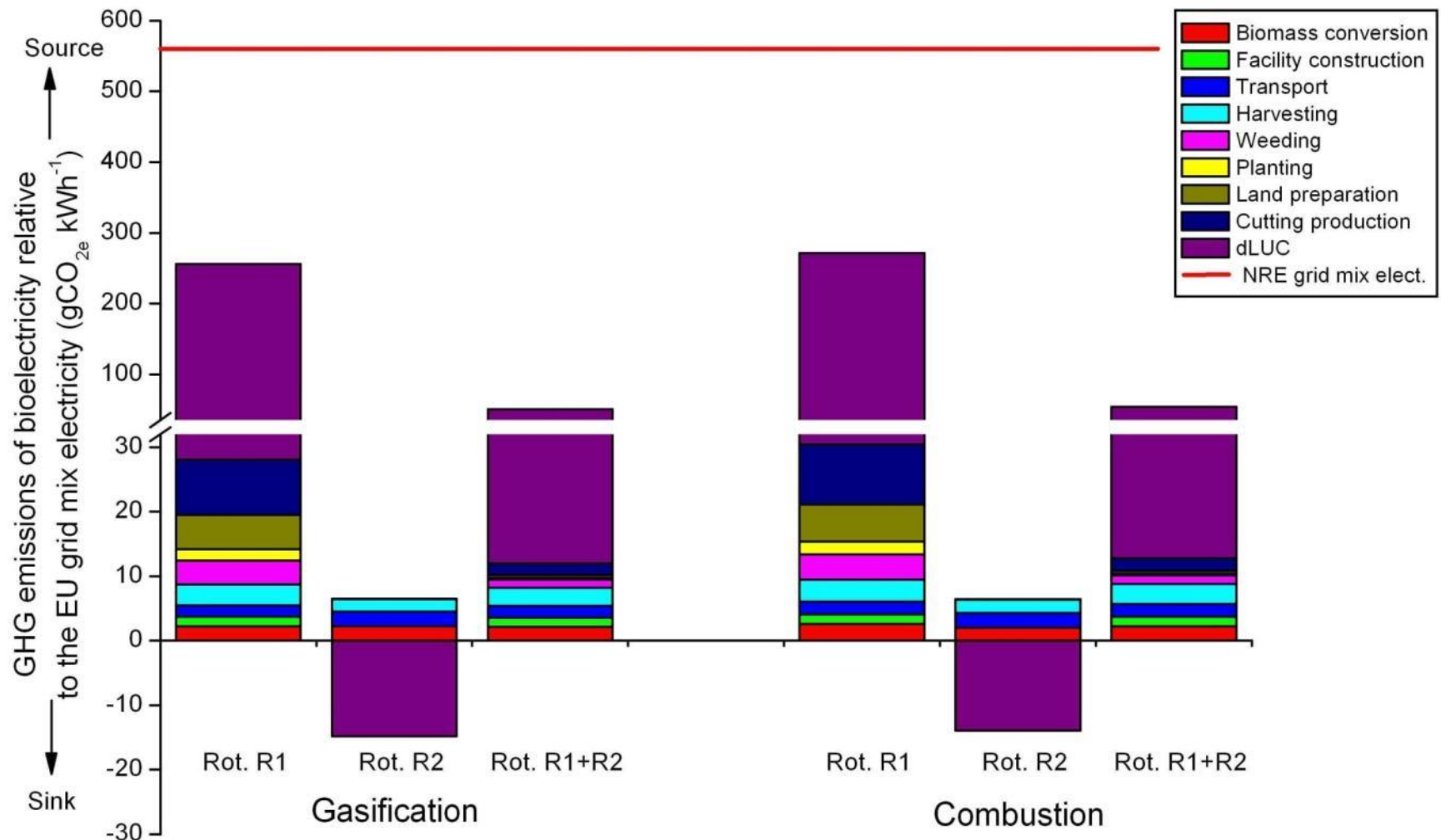
Life Cycle Analysis of SRC

- production
- transport
- conversion
- bio-energy vs fossil energy



GHG emission savings through substitution of fossil fuel grid electricity by renewable SRC

SRC bio-energy : 10 times less GHG emissions



In conclusion.....

- Hard data that bio-energy from SRC has environmental and energetic potential (in comparison with non-renewable energy sources)
- Overall GHG balance close to neutral; other stronger greenhouse gases counteract carbon uptake only after soil preparation
- 10 times less GHG emissions than non-renewable energy sources
- Beneficial energy balance: output/input = 29 (farm gate) and electricity/input = 8.6



POPFULL team

<http://uahost.uantwerpen.be/popfull>

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Boombedrijf Mouton
Groep Mouton bvba



Met steun van de
Vlaamse overheid



Fonds Wetenschappelijk Onderzoek
Research Foundation – Flanders



Want to know more?

- <http://uahost.uantwerpen.be/popfull>
- <http://natgeotv.com/nl/behind-the-science>
- <http://behindthescience.uantwerpen.be/> *and then choose English*
- Public Ph.D. defense of Stefan VANBEVEREN on Friday 30 June 2017 (10:00) University of Antwerp



Thanks !



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Economic analysis

POPFINUA model based on
measurements

Simulations for 3-yr cycles

Break-even only after 21 yrs

