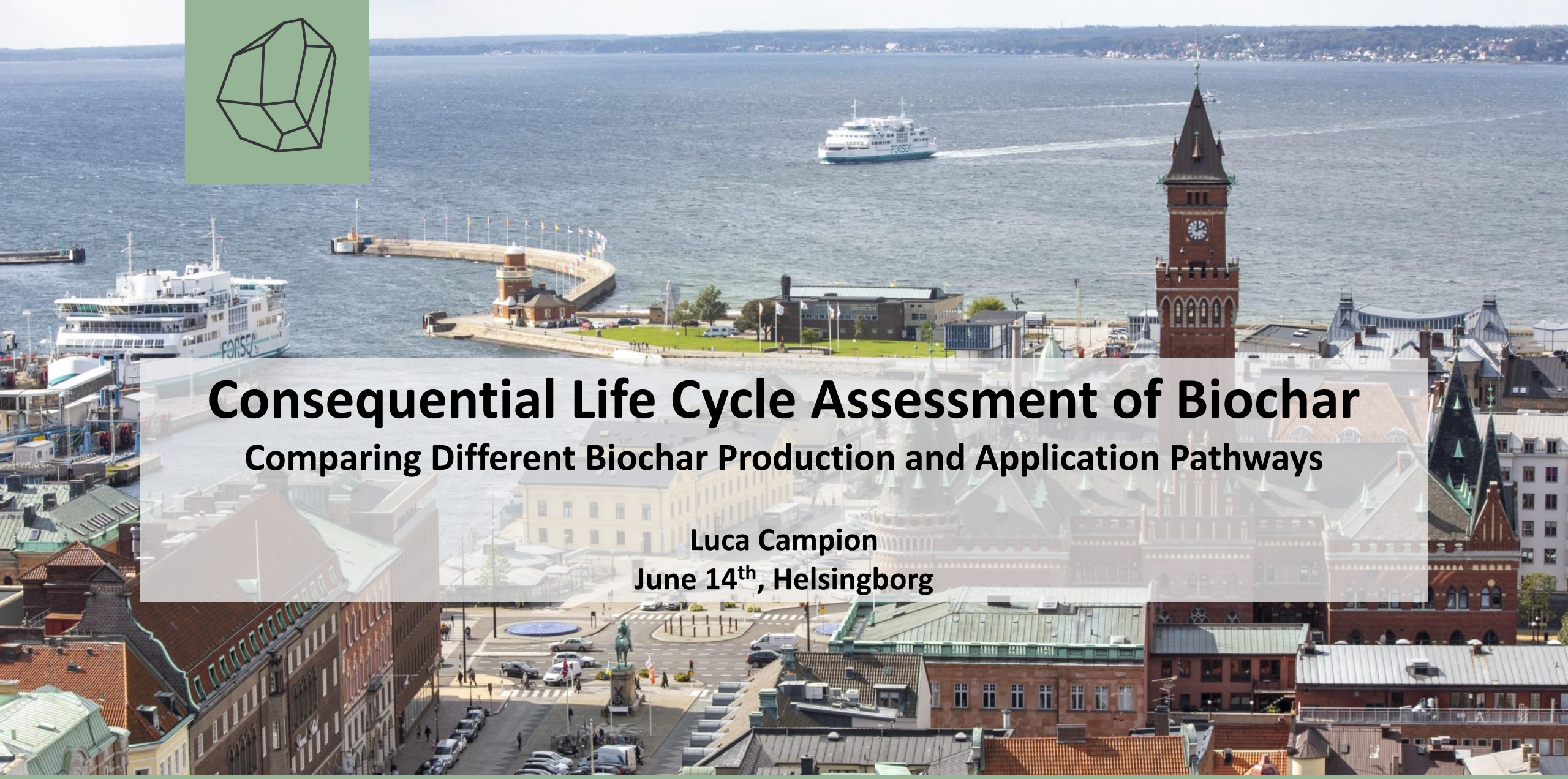


Consequential Life Cycle Assessment of Biochar

Comparing Different Biochar Production and Application Pathways

Luca Campion

June 14th, Helsingborg

CONTEXT

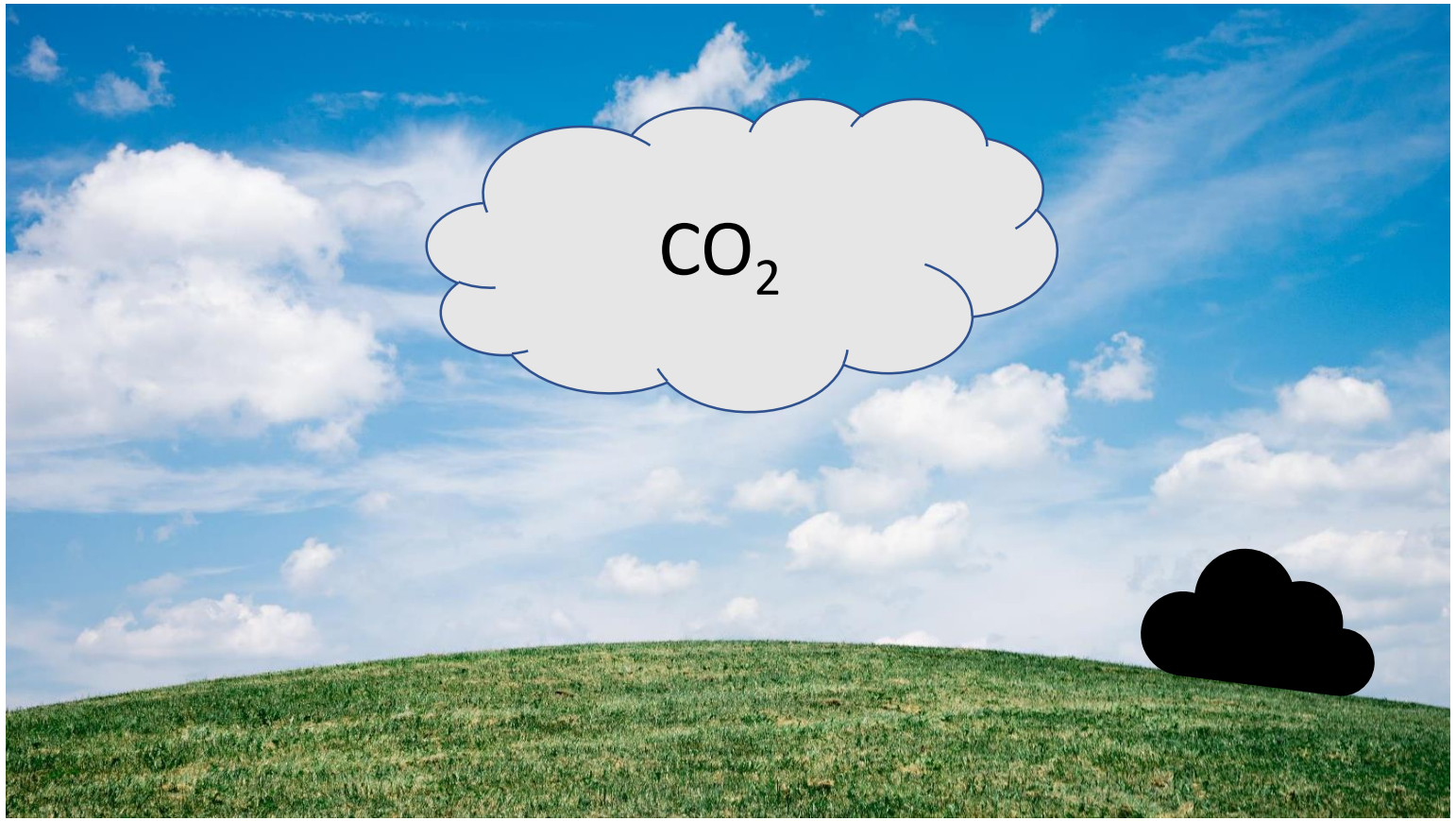
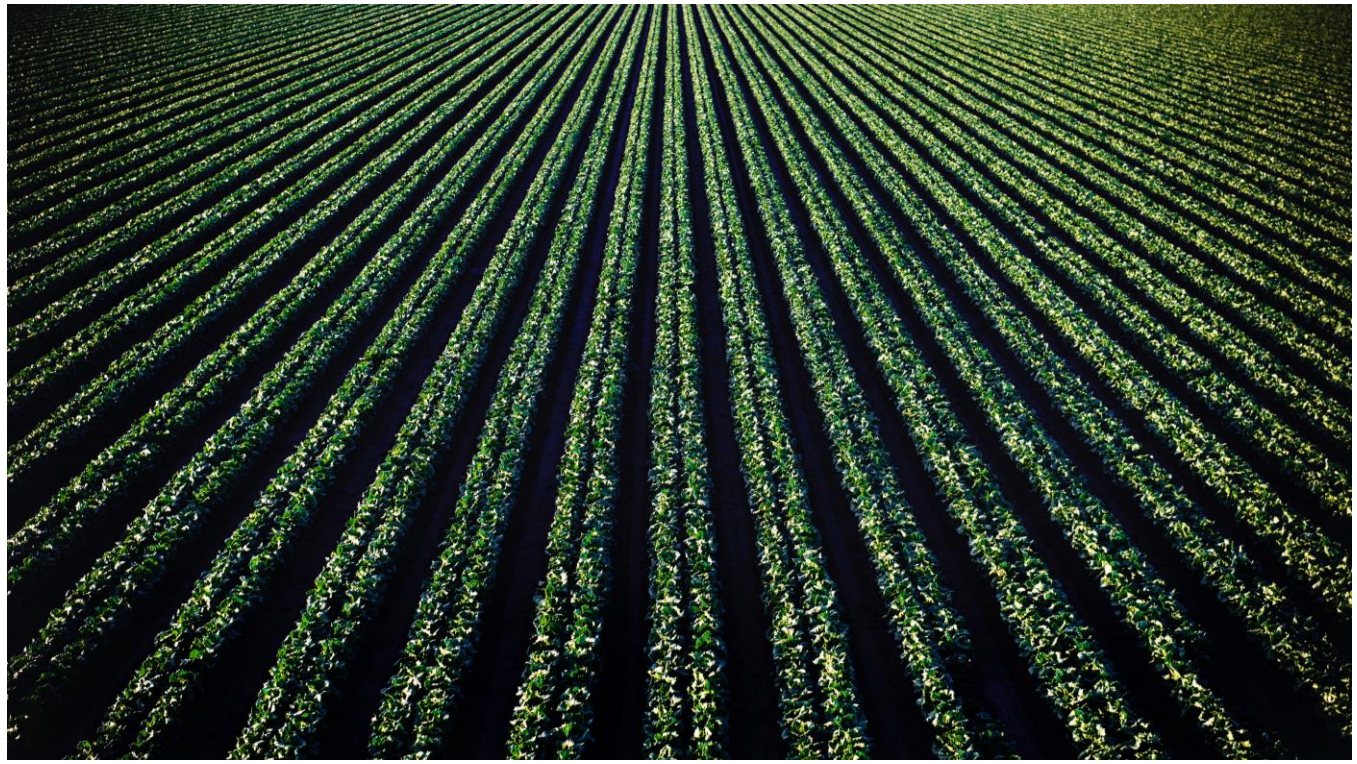


TABLE OF CONTENTS

1. Background
2. Goal and scope
3. Developed systems
4. Results
5. Conclusions



BACKGROUND – project

BASTA stands for

Biochar's Added value in Sustainable land use with Targeted Applications in processes, growing media & (future proof) open-field cultivation

Project partners are

ILVO (Flemish institute for agricultural and fisheries research) and
UHasselt–CMK (biology, chemistry, law, economics)

BACKGROUND – biochar

Biomass

Dedicated crops or residual streams

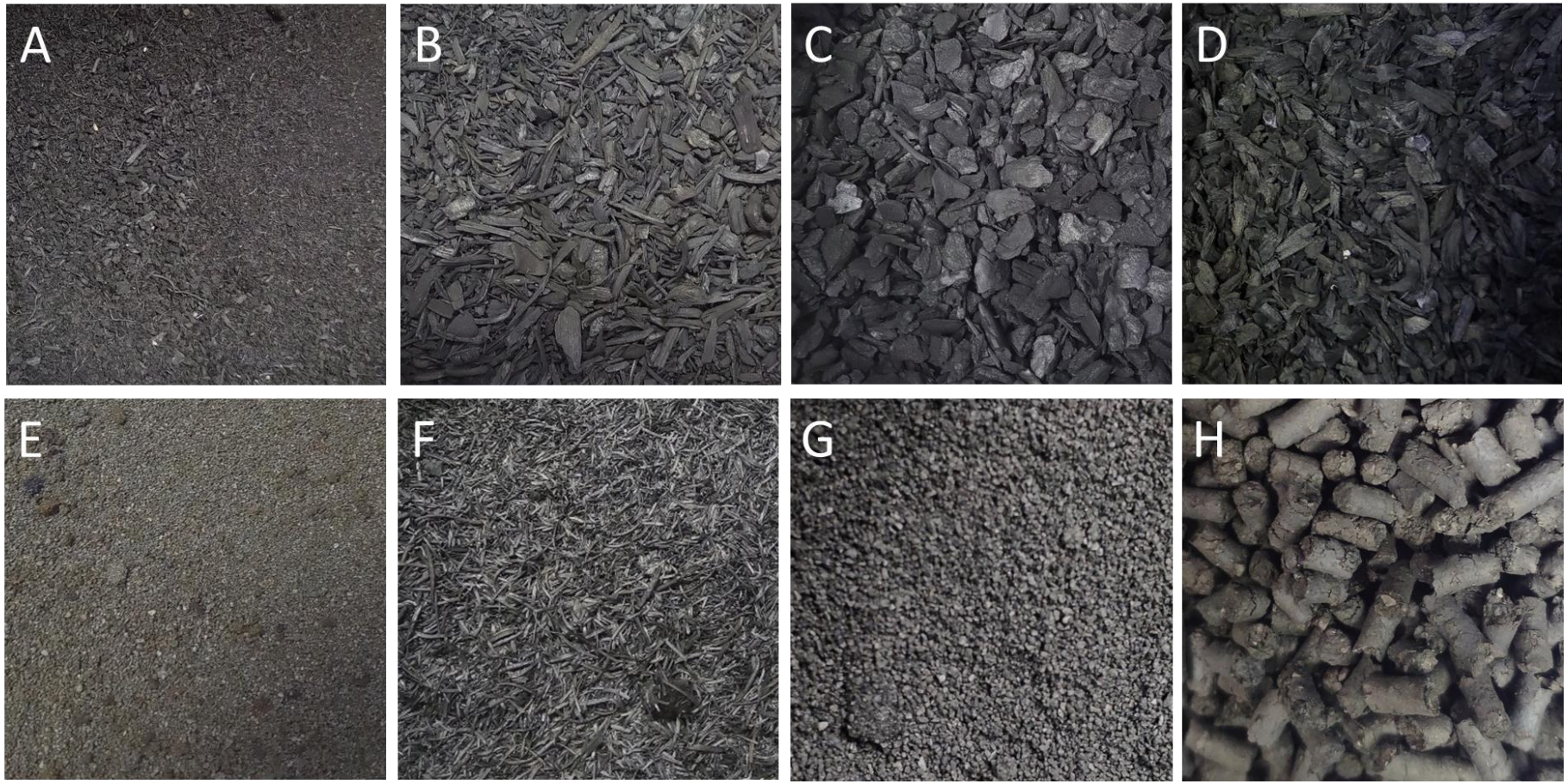
Pyrolysis

Heating in the absence of oxygen (400°C – 800°C)

Biochar

Charcoal-like substance

BACKGROUND – biochar



Lataf et al. (2022). The effect of pyrolysis temperature and feedstock on biochar agronomic properties. Journal of Analytical and Applied Pyrolysis, 168, 105728.

BACKGROUND – biochar applications

Manure storage

Reduced NH_3 emissions

Composting

Faster decomposition
Lower greenhouse gas emissions
Less odour

Anaerobic digest.

Higher biogas yield
Higher biogas purity

Horticulture

Replacement of peat
Increased disease resistance

Field application

Higher crop yield
Increased WHC
Carbon sink (NET)
Metal immobilisation

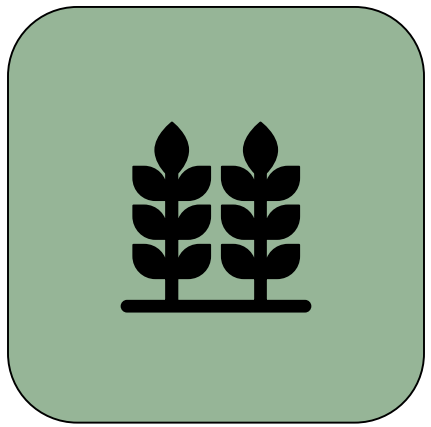
Others

Replacement of cement in concrete
Waste water treatment

BACKGROUND – societal techno-economic assessment

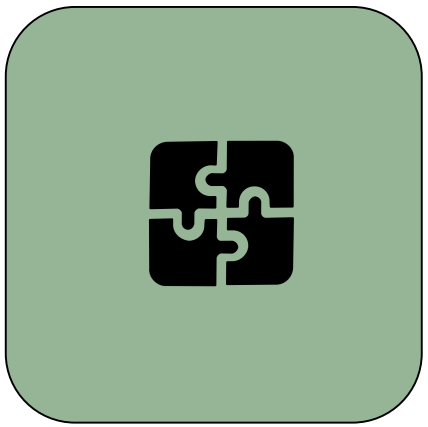
TEA

Business perspective
Private costs and benefits



LCA

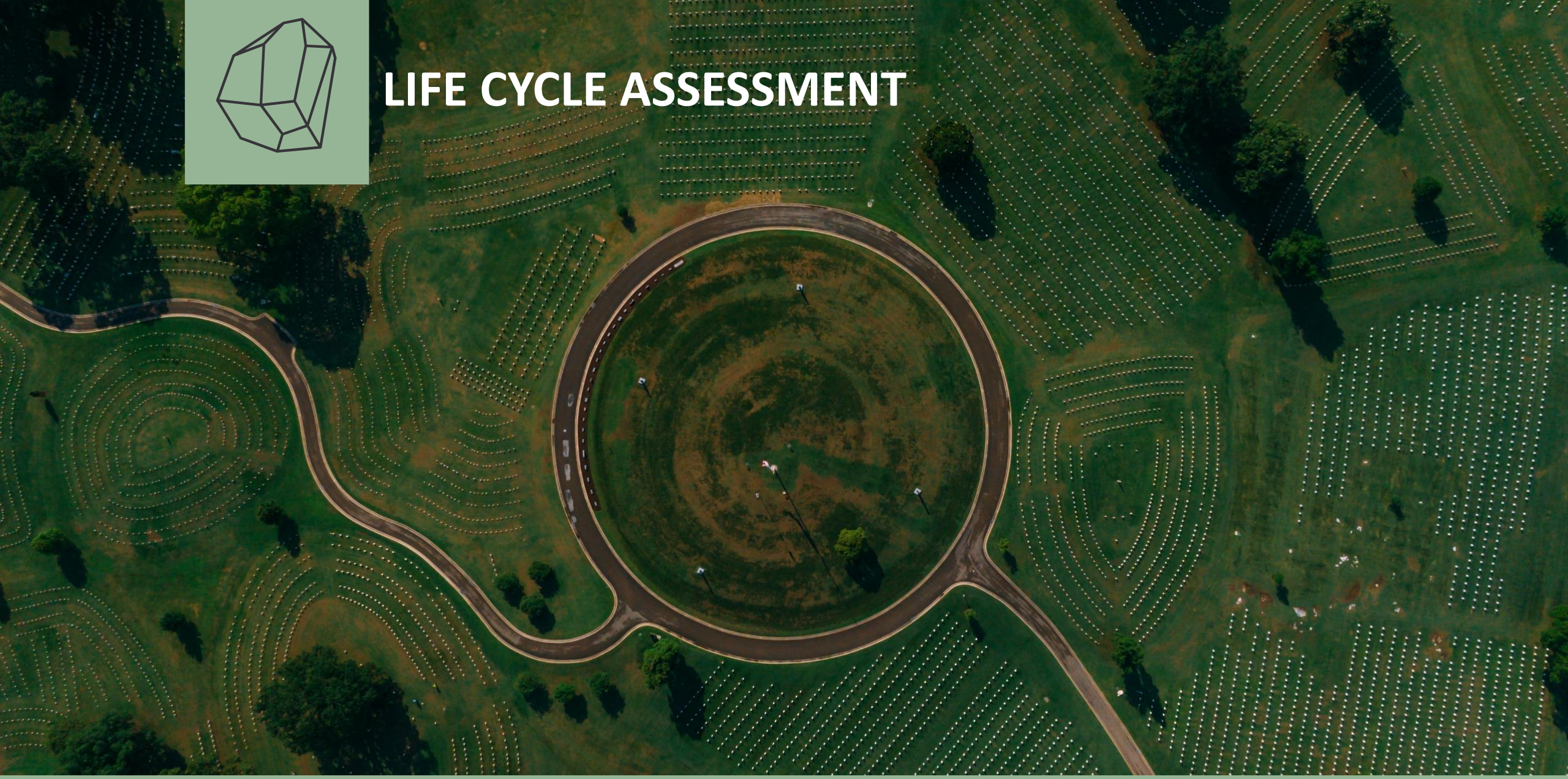
External costs and benefits, expressed in physical units (e.g., CO2 equivalents).



TEA + LCA

Societal perspective
Monetization of the external costs and benefits and integration with the private costs and benefits.

LIFE CYCLE ASSESSMENT



GOAL AND SCOPE

What?

Assess the lifecycle environmental consequences of using different biochars in different applications, in Belgium

Why?

Map the uncertainty regarding biochar to deploy this negative emissions technology in Belgium

How?

Consequential life cycle assessment of treating 1 tonne of waste (functional unit)

DEVELOPED SYSTEMS – general

Reference system

What is the current waste treatment?

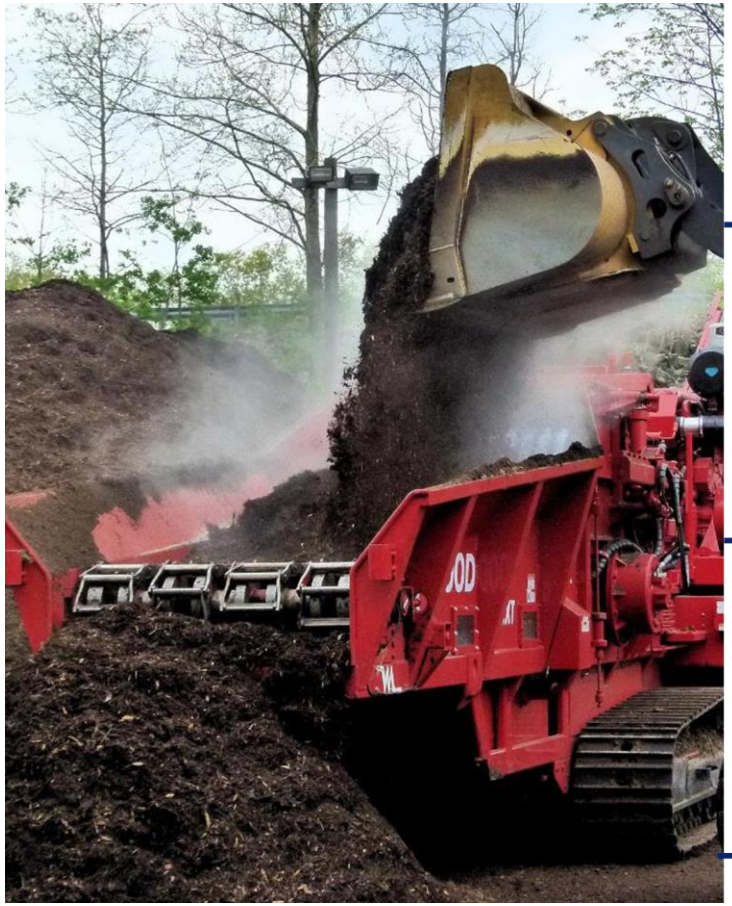
Biochar Direct use

Waste collected at pyrolysis plant. Biochar transported to fields and applied directly.

Biochar Cascading use

Waste collected at pyrolysis plant. Biochar transported to anaerobic digestion facilities. Digestate containing biochar applied to fields.

DEVELOPED SYSTEMS – wood
woody fraction of green waste

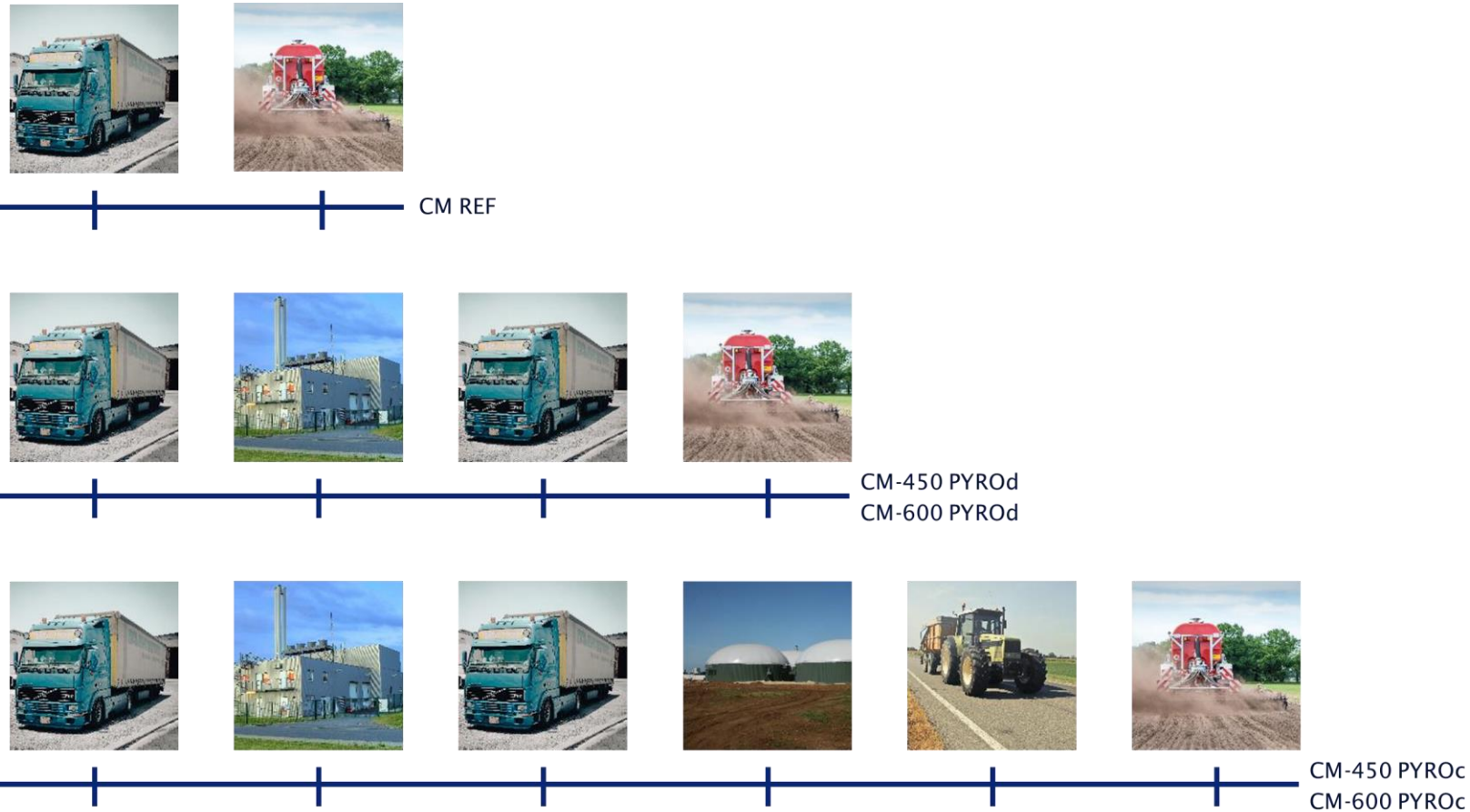


GW REF

GW-450 PYROd
GW-600 PYROd

GW-450 PYROc
GW-600 PYROc

DEVELOPED SYSTEMS – manure
chicken manure pellets



RESULTS – wood

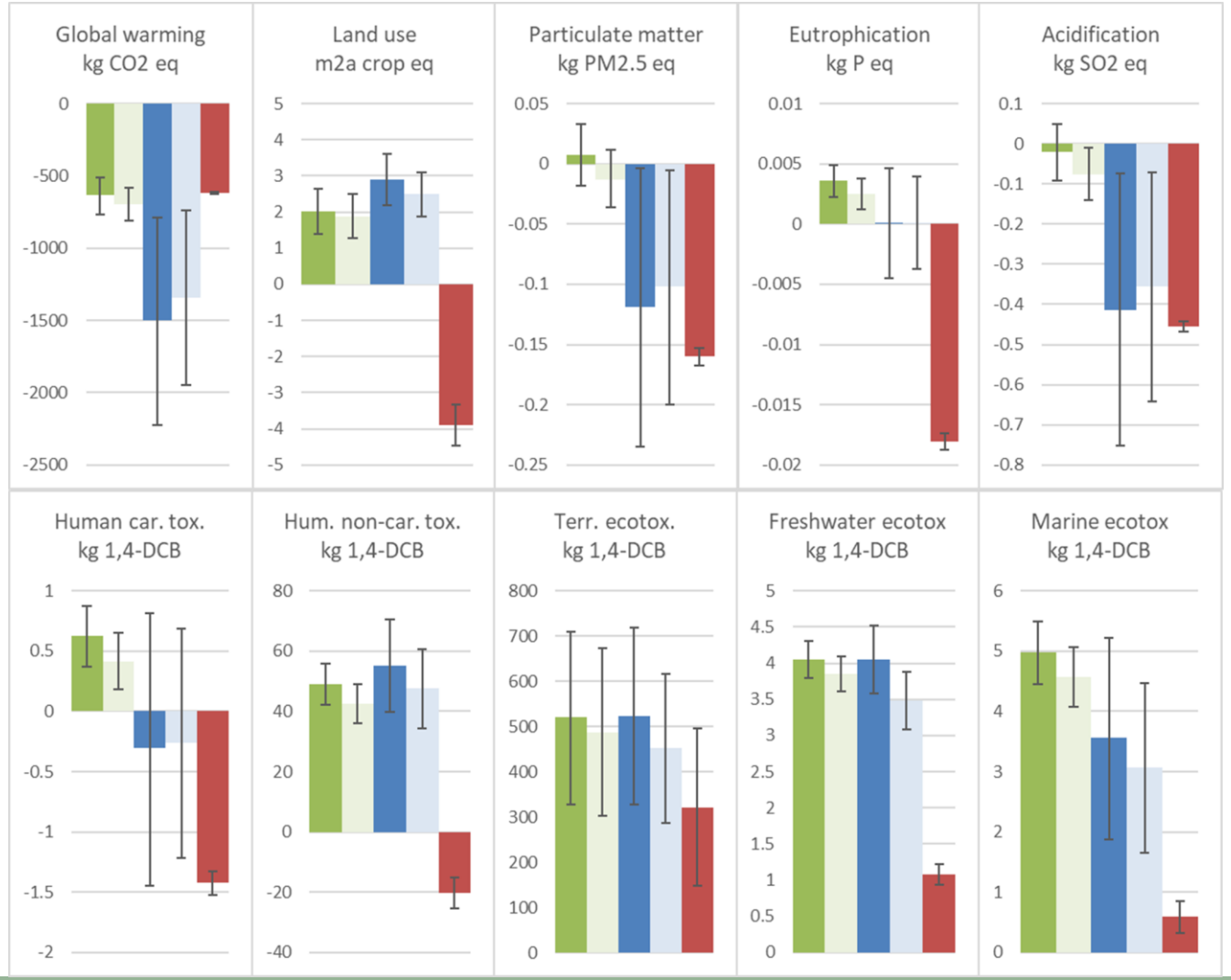
GW-450 PYROd

GW-600 PYROd

GW-450 PYROc

GW-600 PYROc

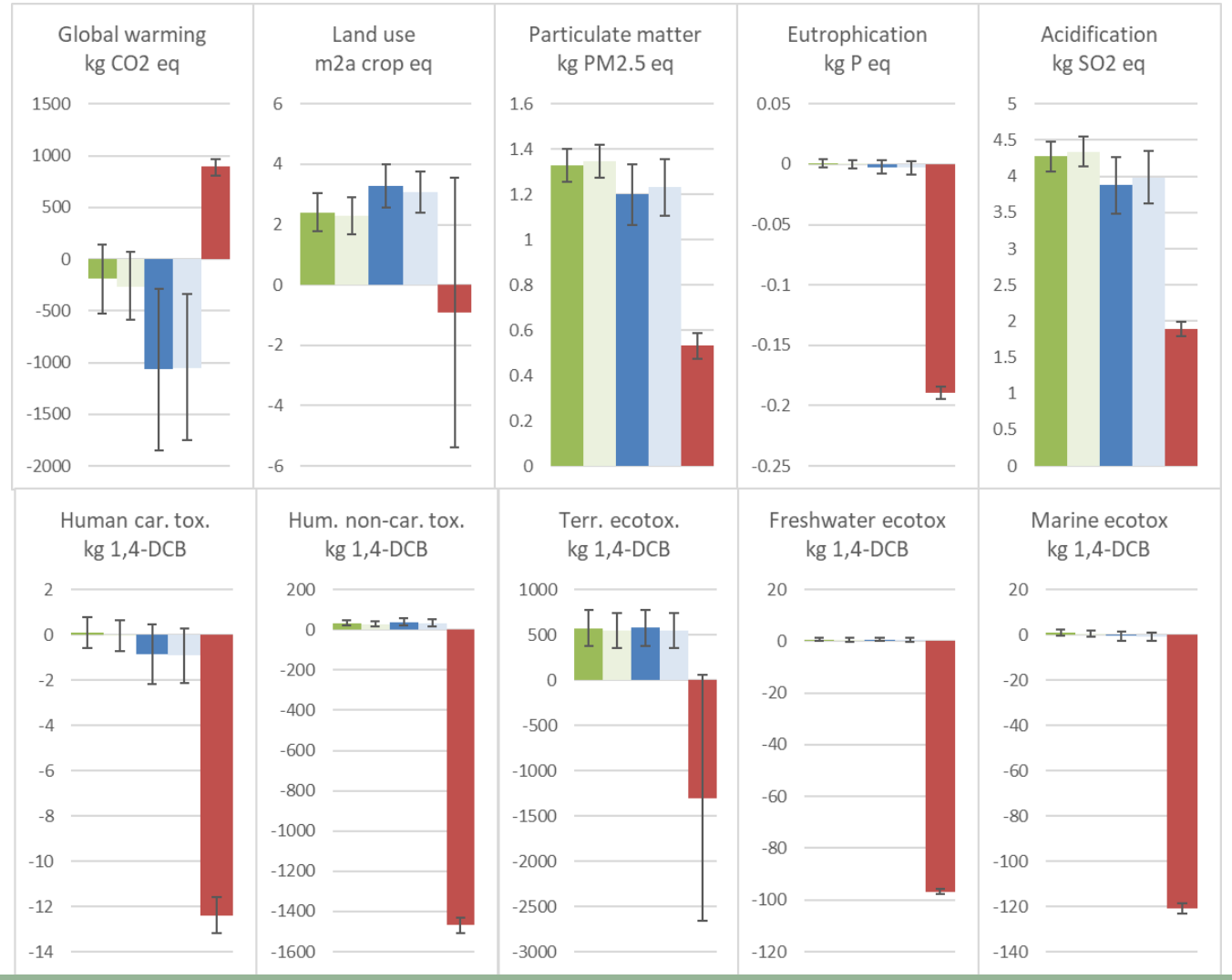
GW REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – manure

- CM-450 PYROd
- CM-600 PYROd
- CM-450 PYROc
- CM-600 PYROc
- CM REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – wood (weighting)

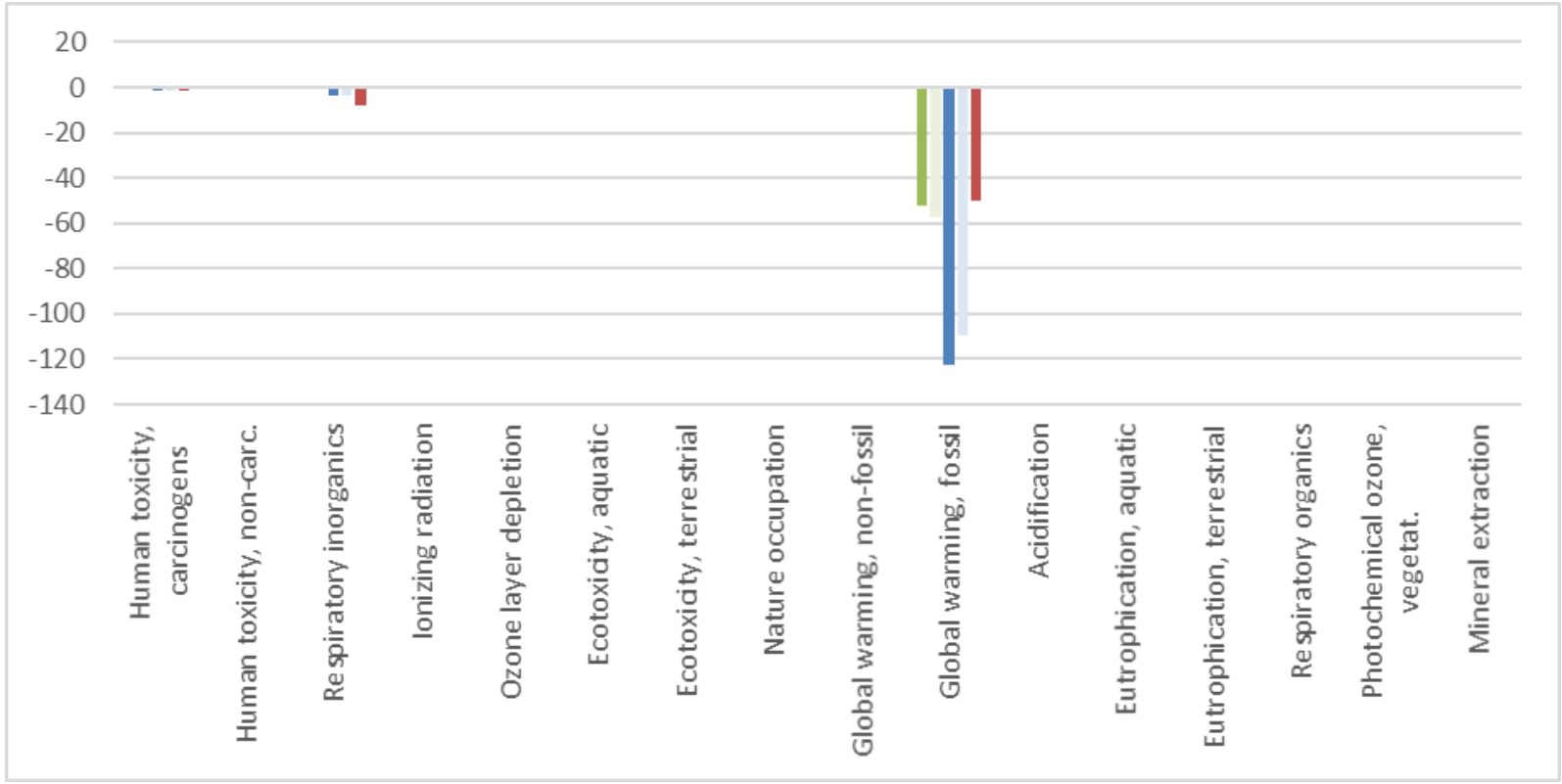
GW-450 PYROd

GW-600 PYROd

GW-450 PYROc

GW-600 PYROc

GW REF



Stepwise 2006 V1.05 / Europe95 person / EUR incl. biogenic C

RESULTS – manure

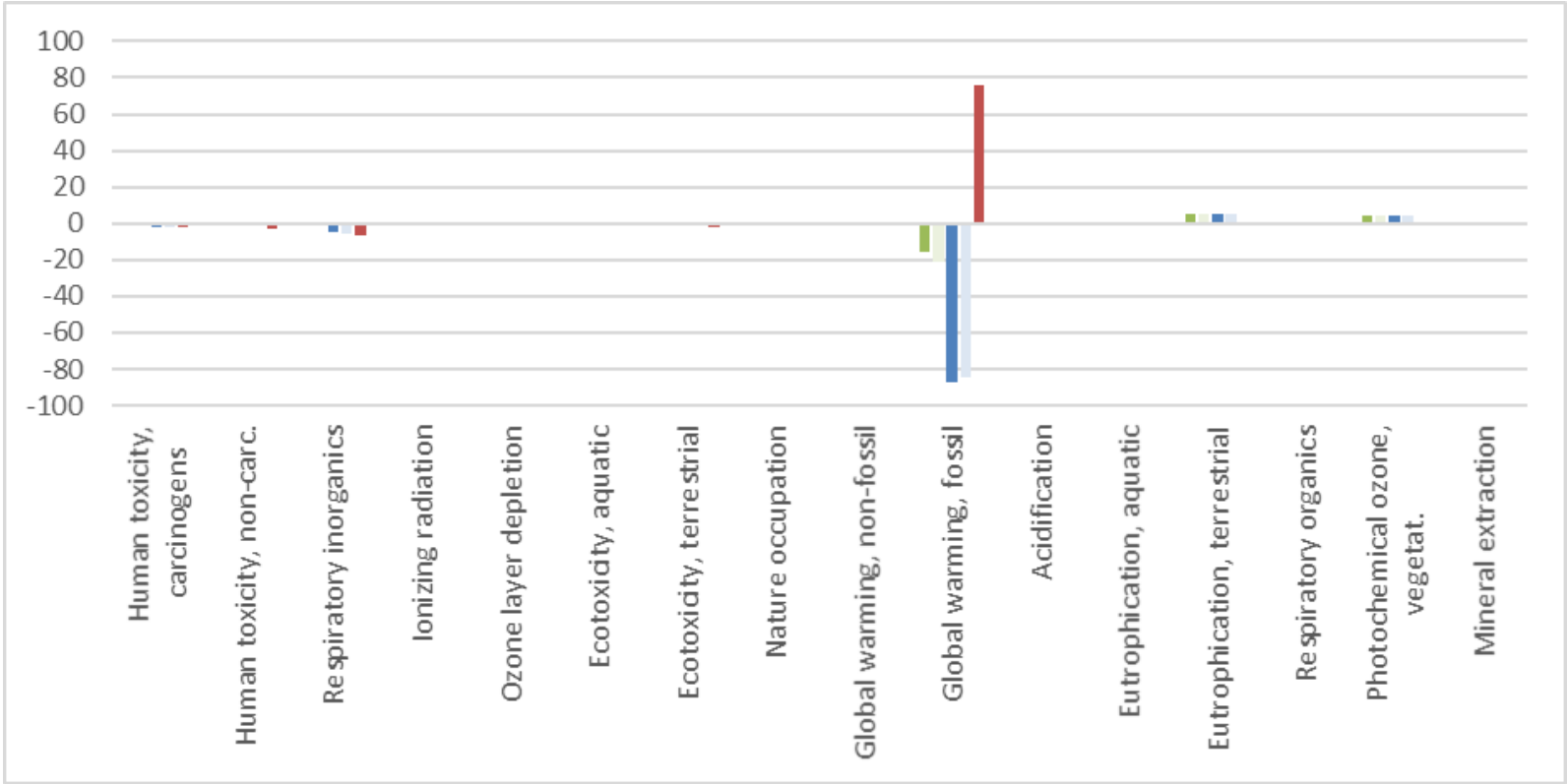
CM-450 PYROd

CM-600 PYROd

CM-450 PYROc

CM-600 PYROc

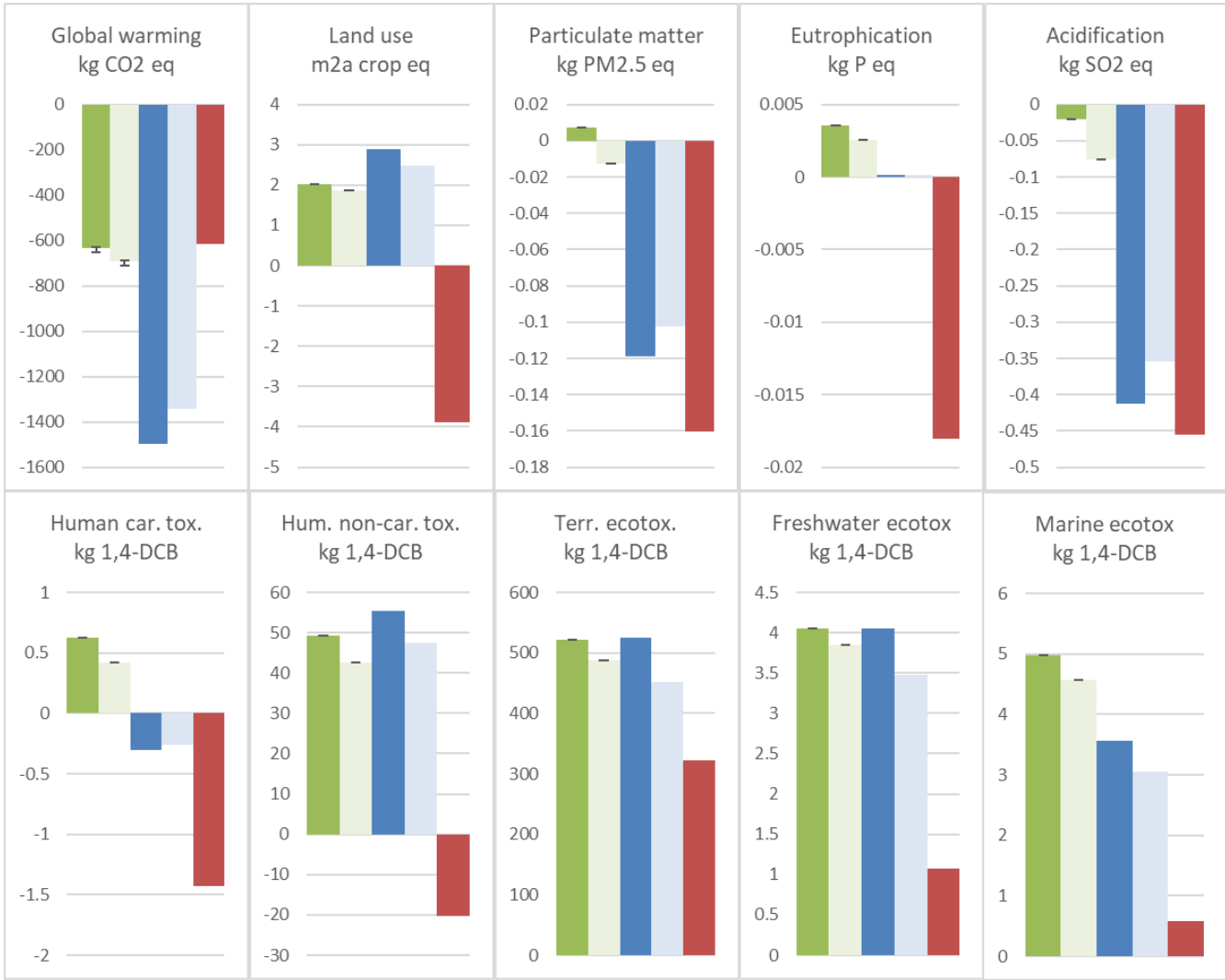
CM REF



Stepwise 2006 V1.05 / Europe95 person / EUR incl. biogenic C

RESULTS – Biochar field application rate (wood) Sensitivity

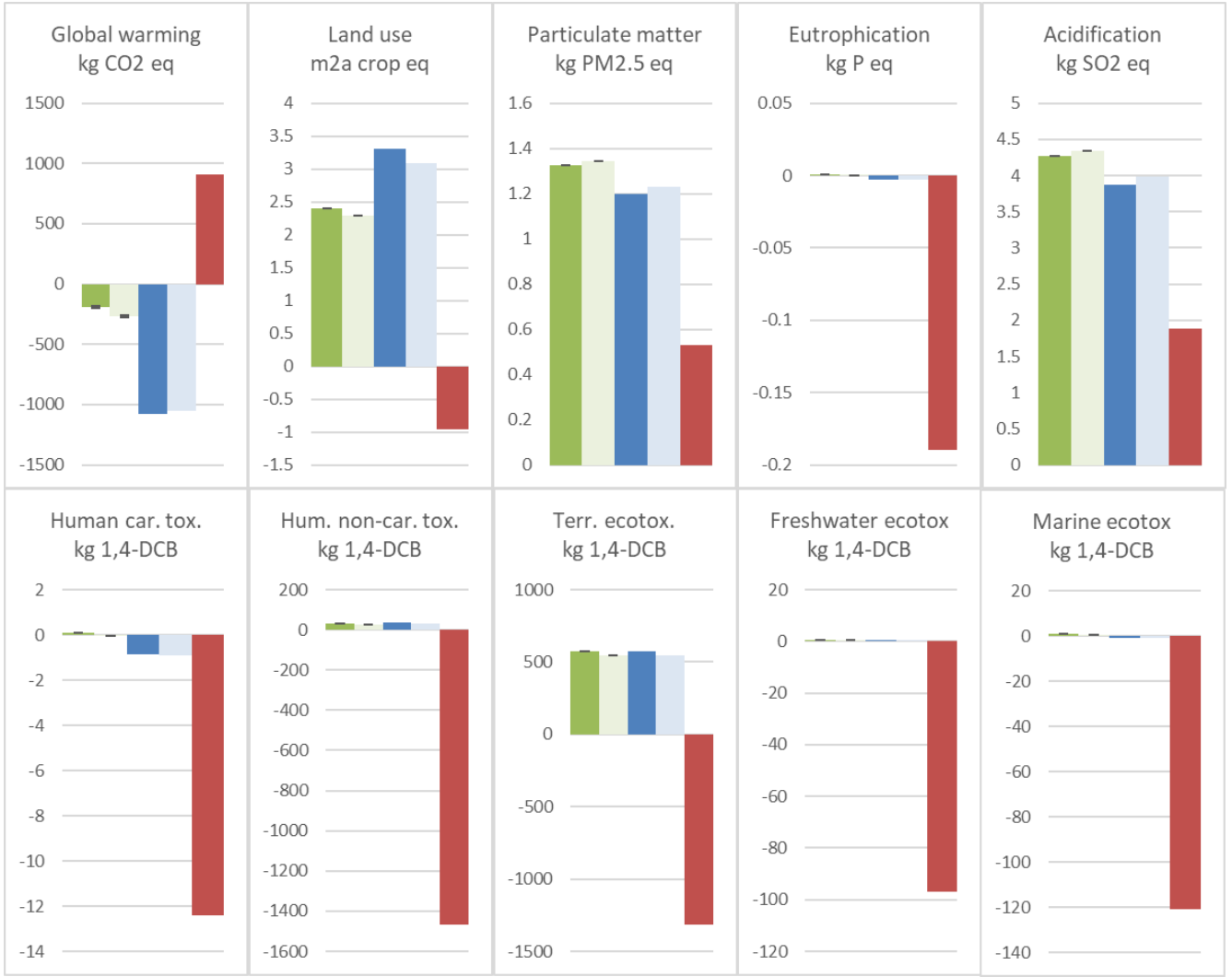
- GW-450 PYROd
- GW-600 PYROd
- GW-450 PYROc
- GW-600 PYROc
- GW REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Biochar field application rate (manure) Sensitivity

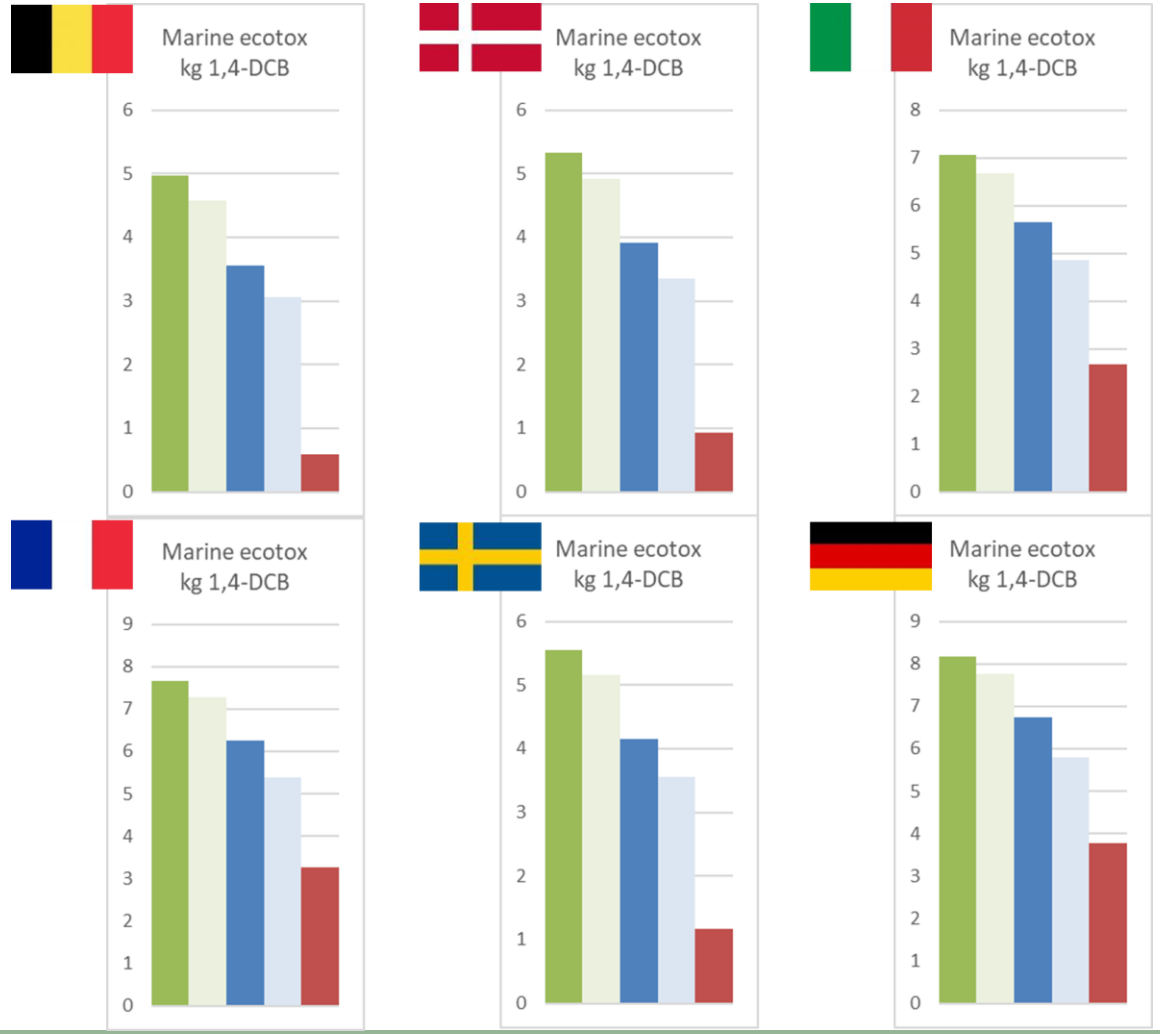
- CM-450 PYROd
- CM-600 PYROd
- CM-450 PYROc
- CM-600 PYROc
- CM REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Different electricity (wood) Sensitivity

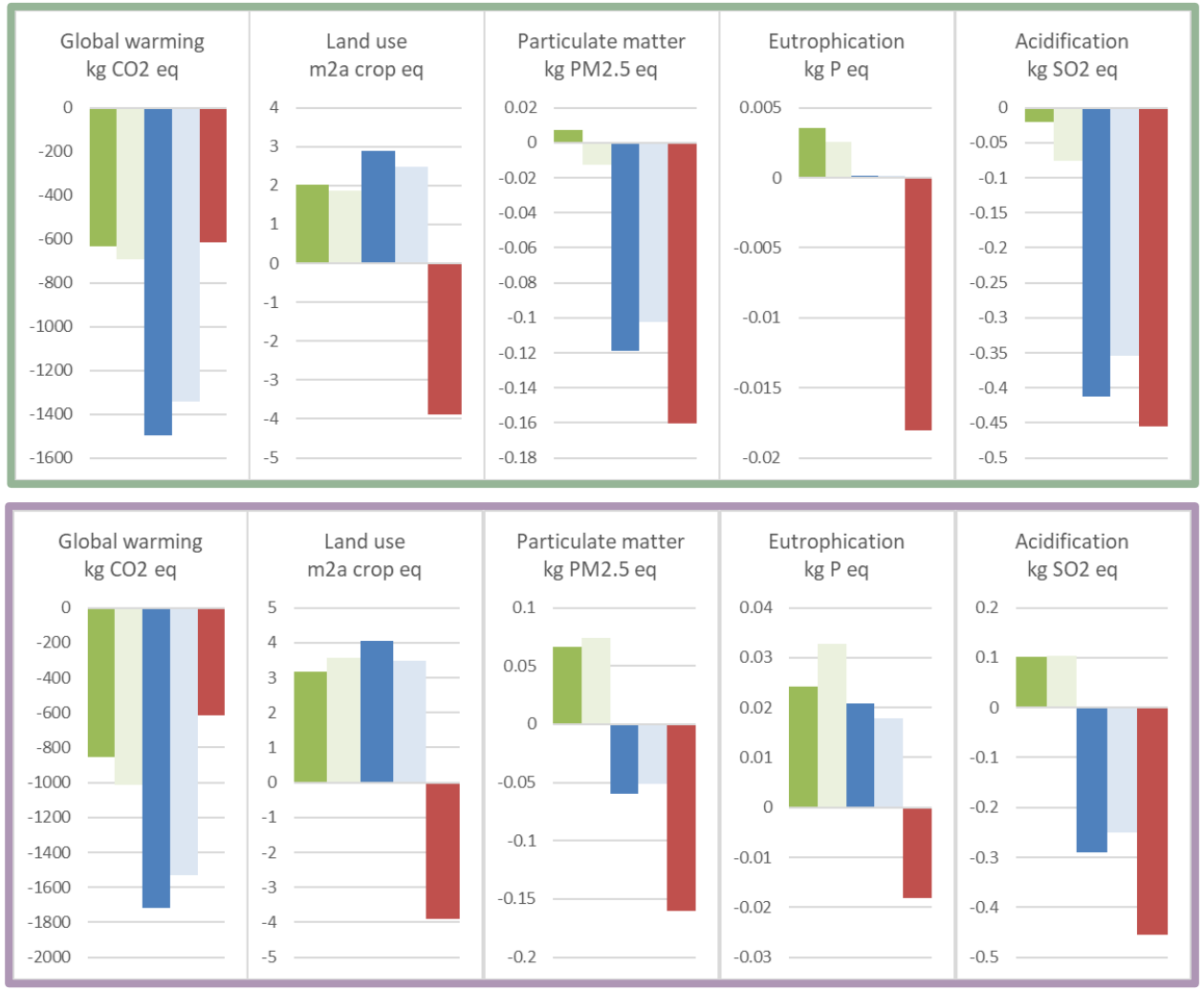
- GW-450 PYROd
- GW-600 PYROd
- GW-450 PYROc
- GW-600 PYROc
- GW REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Electricity vs. heat (wood, part 1)
Sensitivity

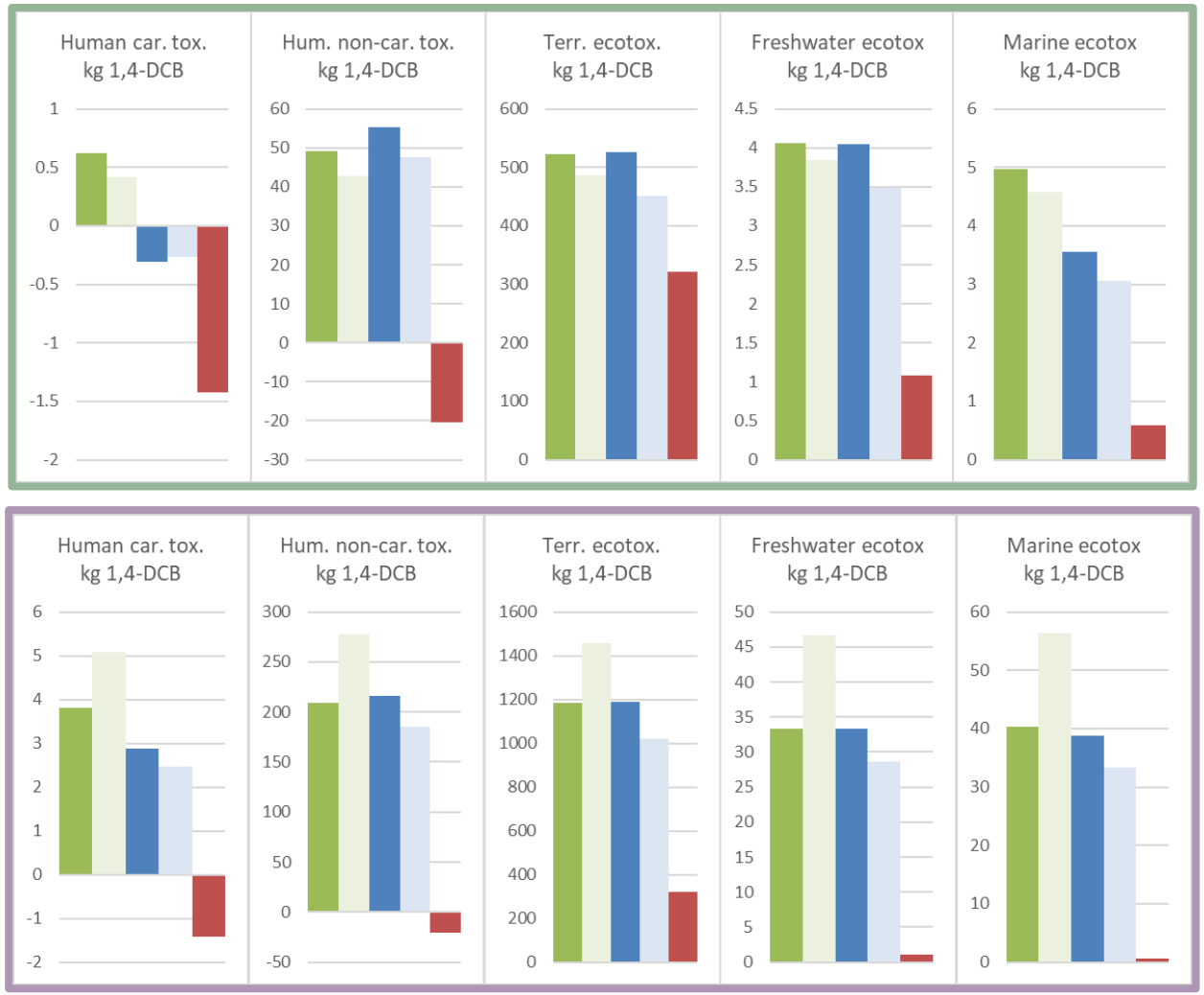
- GW-450 PYROd
- GW-600 PYROd
- GW-450 PYROc
- GW-600 PYROc
- GW REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Electricity vs. heat (wood, part 2)
Sensitivity

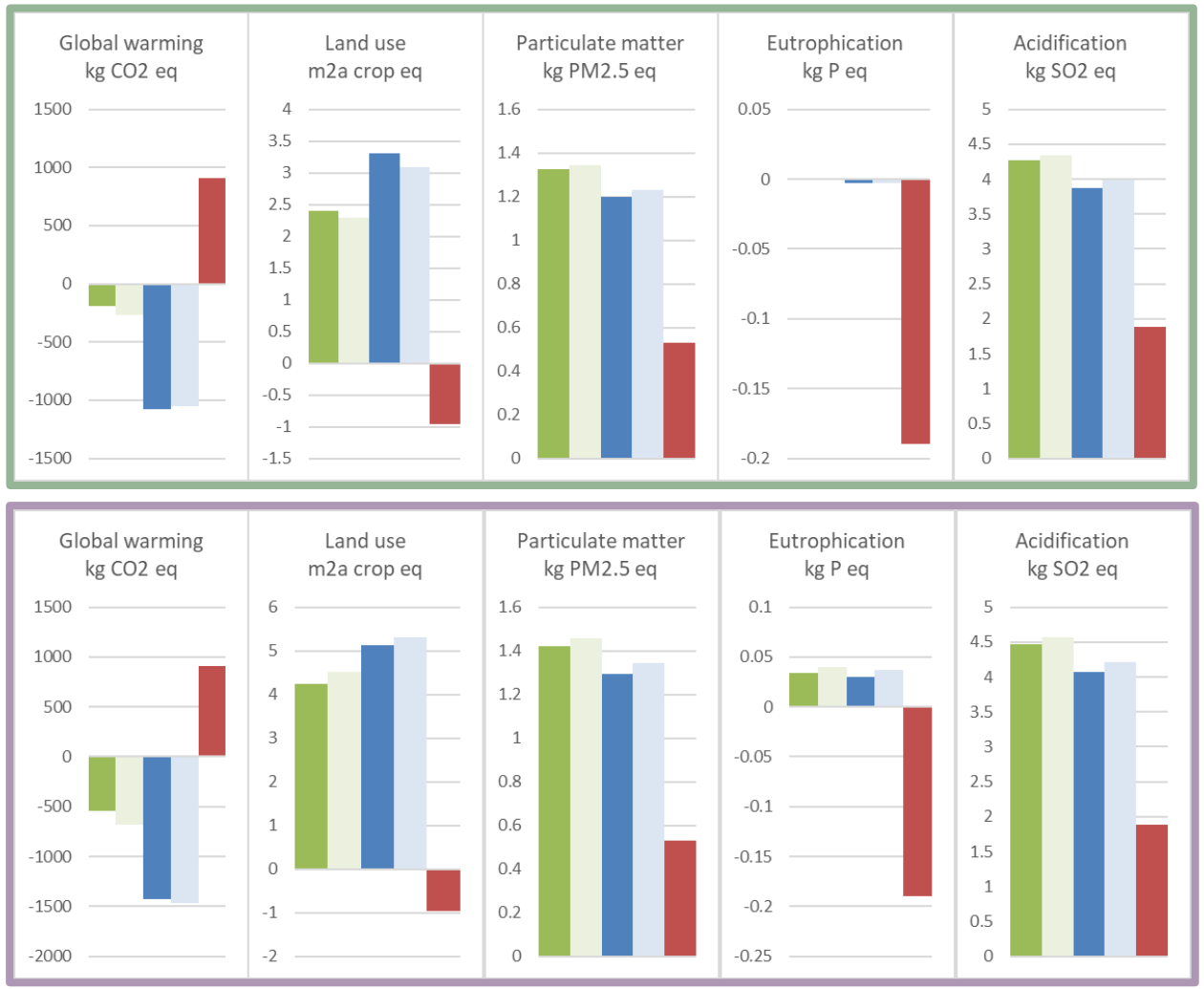
- GW-450 PYROd
- GW-600 PYROd
- GW-450 PYROc
- GW-600 PYROc
- GW REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Electricity vs. heat (manure, part 1)
Sensitivity

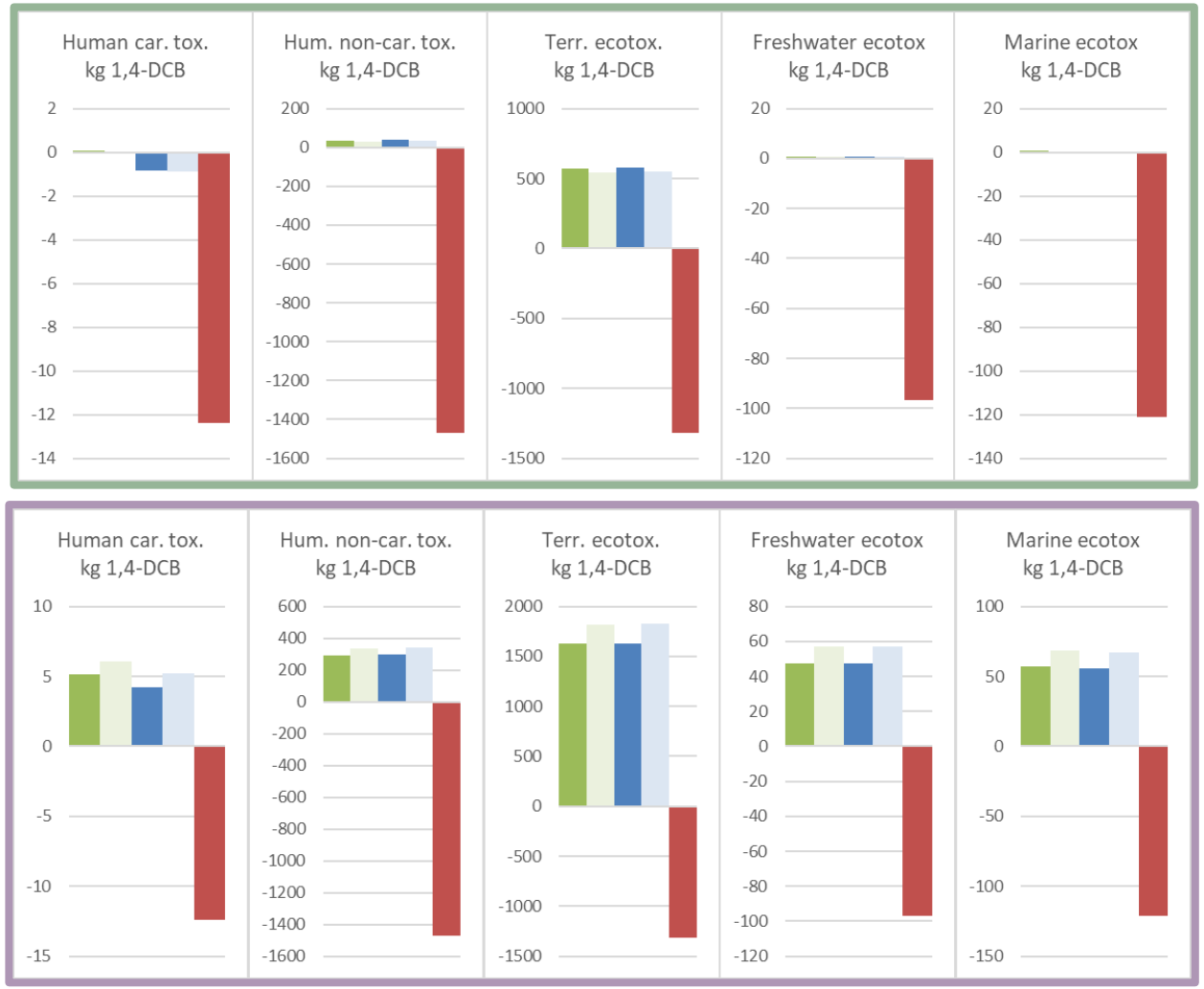
- CM-450 PYROd
- CM-600 PYROd
- CM-450 PYROc
- CM-600 PYROc
- CM REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Electricity vs. heat (manure, part 2)
Sensitivity

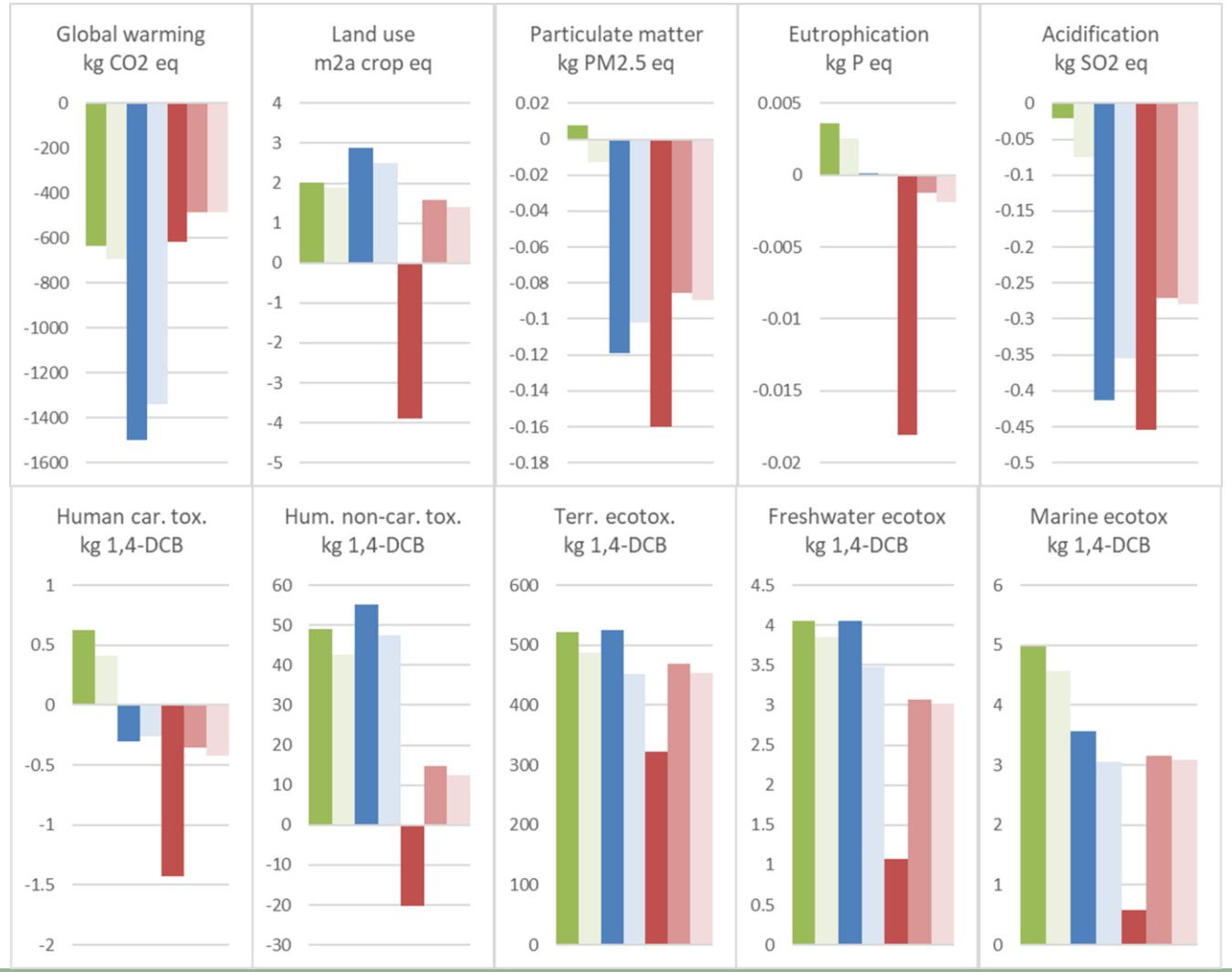
- CM-450 PYROd
- CM-600 PYROd
- CM-450 PYROc
- CM-600 PYROc
- CM REF



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

RESULTS – Different reference system (wood)
Sensitivity

- GW-450 PYROd
- GW-600 PYROd
- GW-450 PYROc
- GW-600 PYROc
- GW REF (cement)
- GW REF (landfill)
- GW REF (road)



ReCiPe 2016 Midpoint (H) V1.04 / World (2010) H

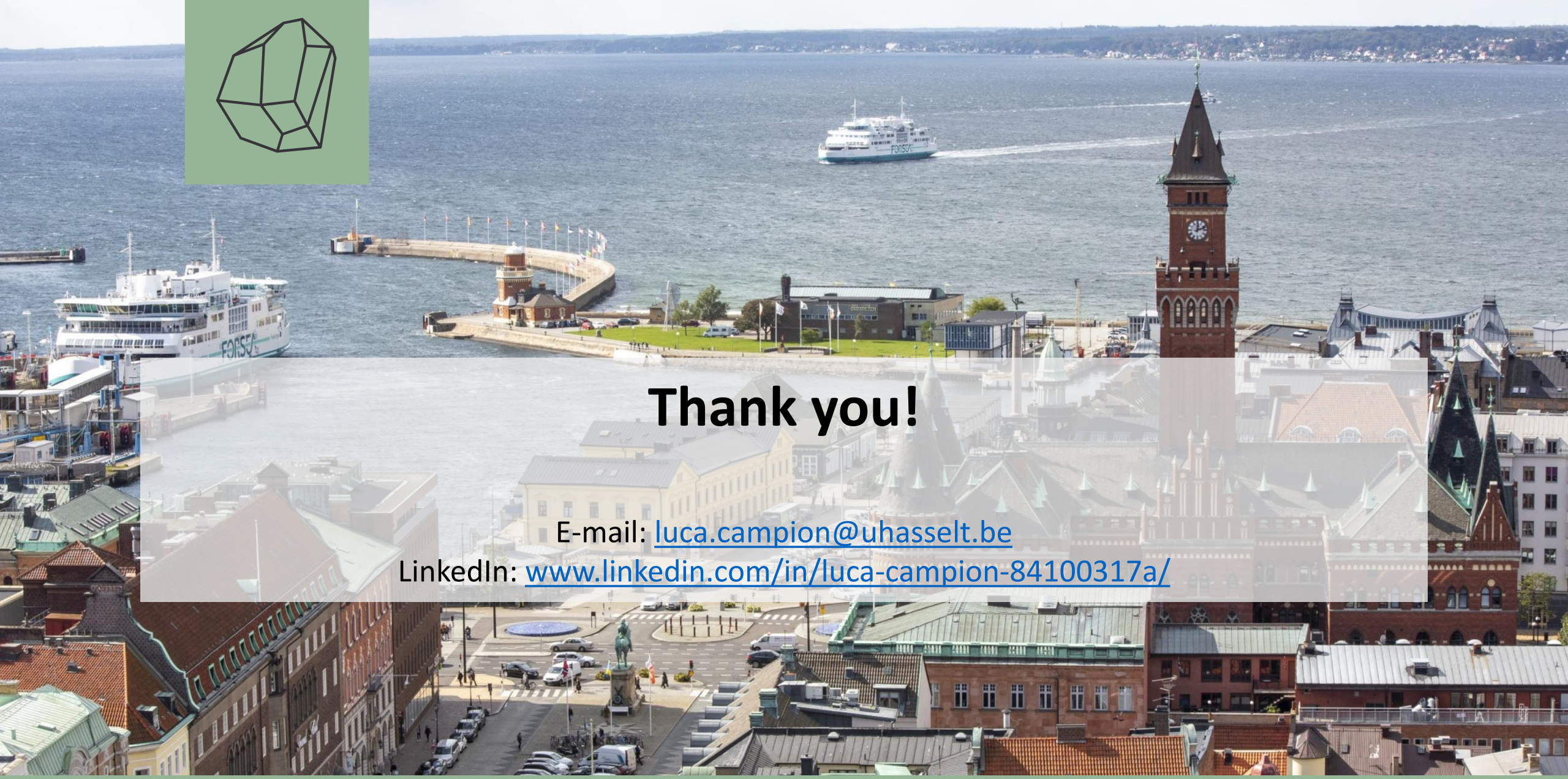
CONCLUSIONS – as it stands

Biochar does what it is supposed to, namely mitigate climate change

- However, when using the woody feedstock, a cascading use of the biochar is required

For other impact categories, both biochar feedstocks tend to perform slightly worse than the reference system

- However, the increased external costs are outweighed by the increased external benefit from carbon sequestration.



Thank you!

E-mail: luca.campion@uhasselt.be
LinkedIn: www.linkedin.com/in/luca-campion-84100317a/