Consequential Life Cycle Assessment of Biochar

Comparing Different Biochar Production and Application Pathways

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Research group Environmental Economics

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EUBCE
31st European Biomass Conference & Exhibition
IN PERSON, ONLINE
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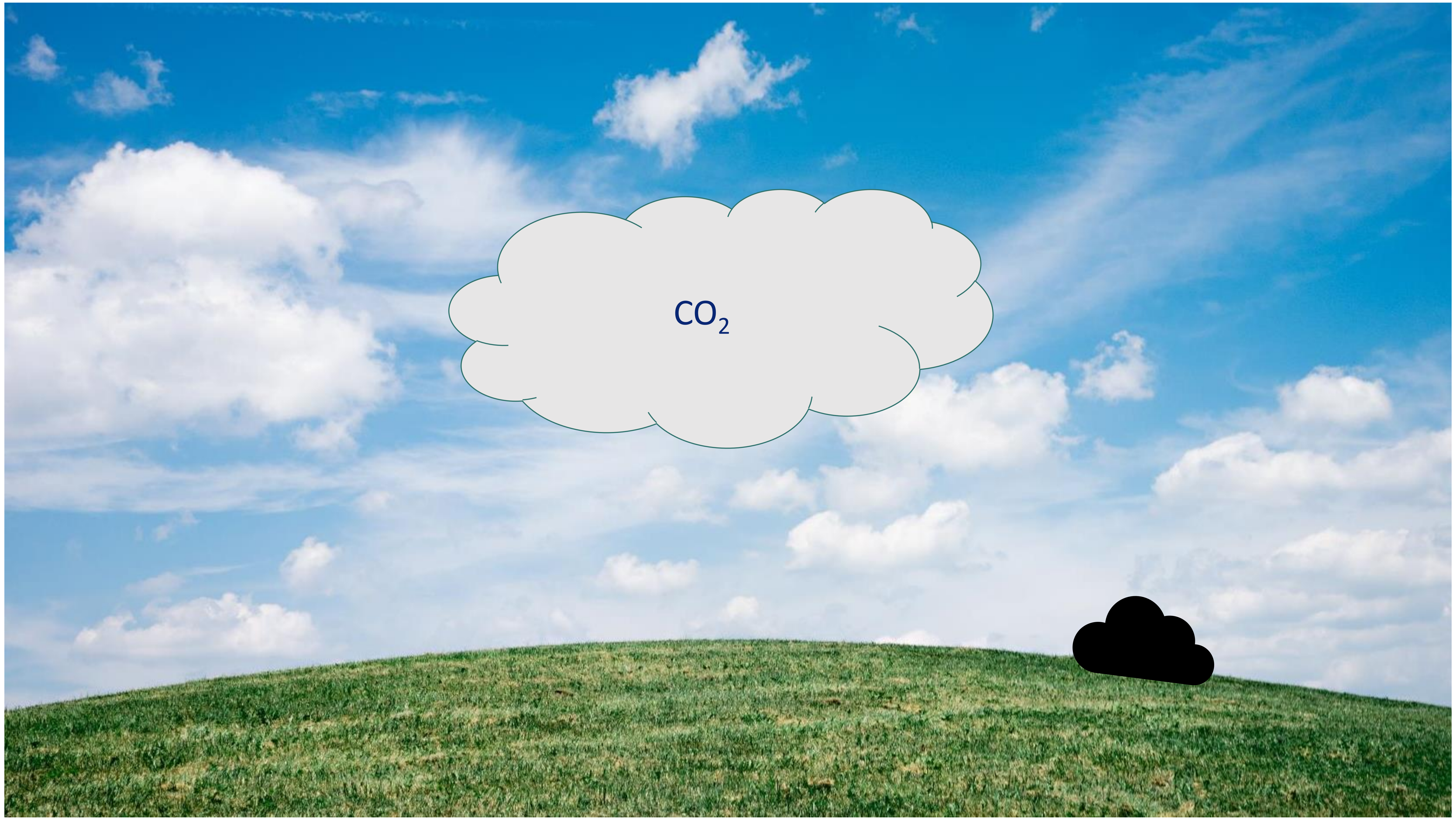
5 – 8 June | Conference & Exhibition
9 June | Technical Tours

Work in progress

CONTEXT



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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

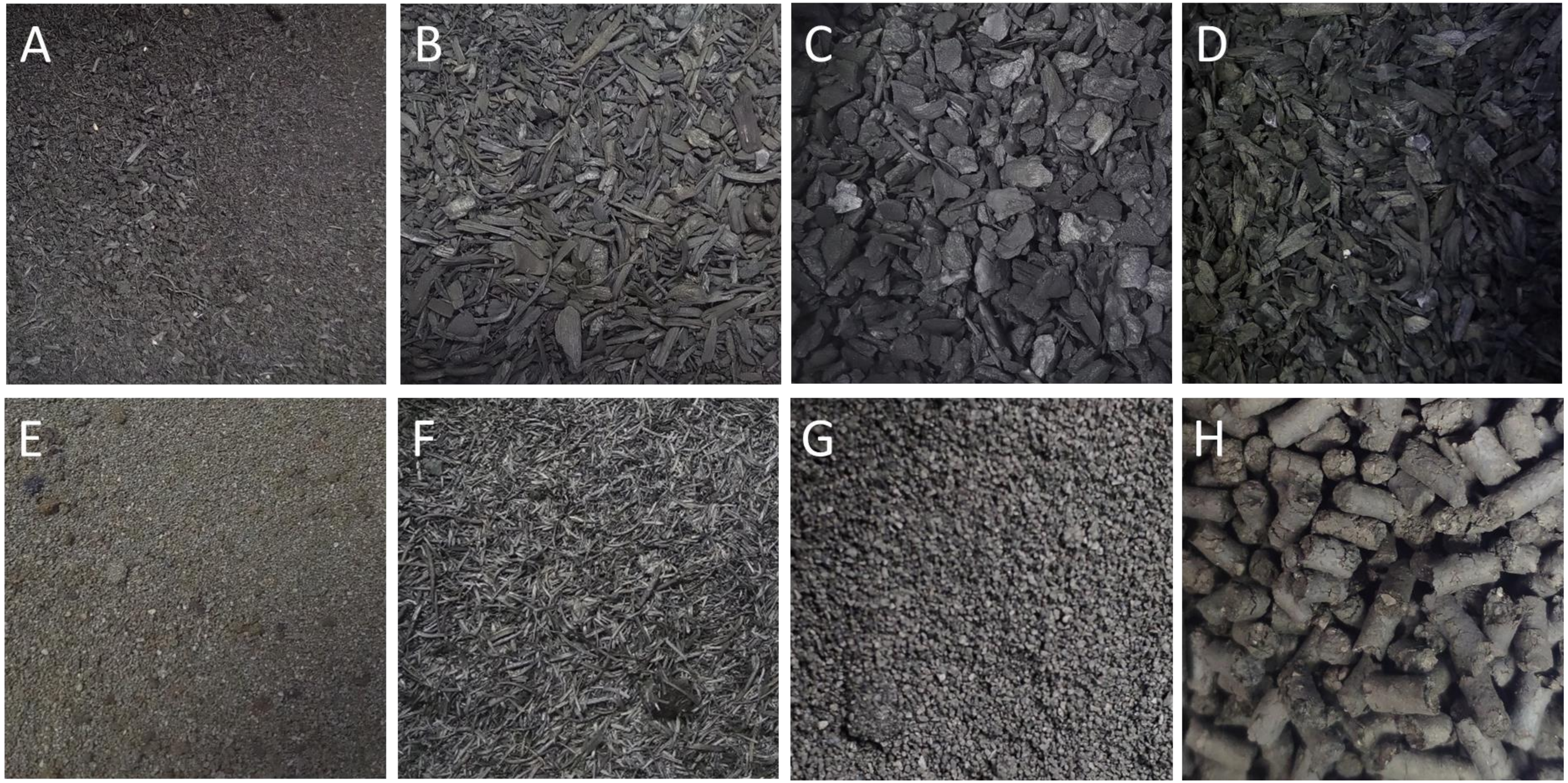
Pyrolysis

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

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 digestion

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

Other

Replacement of cement in concrete
Waste water treatment

BACKGROUND – societal techno-economic assessment

TEA	LCA	TEA + LCA
Business perspective Private costs and benefits	External costs and benefits, expressed in physical units (e.g., CO_2 equivalents).	Societal perspective Monetization of the external costs and benefits and integration with the private costs and benefits.

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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?

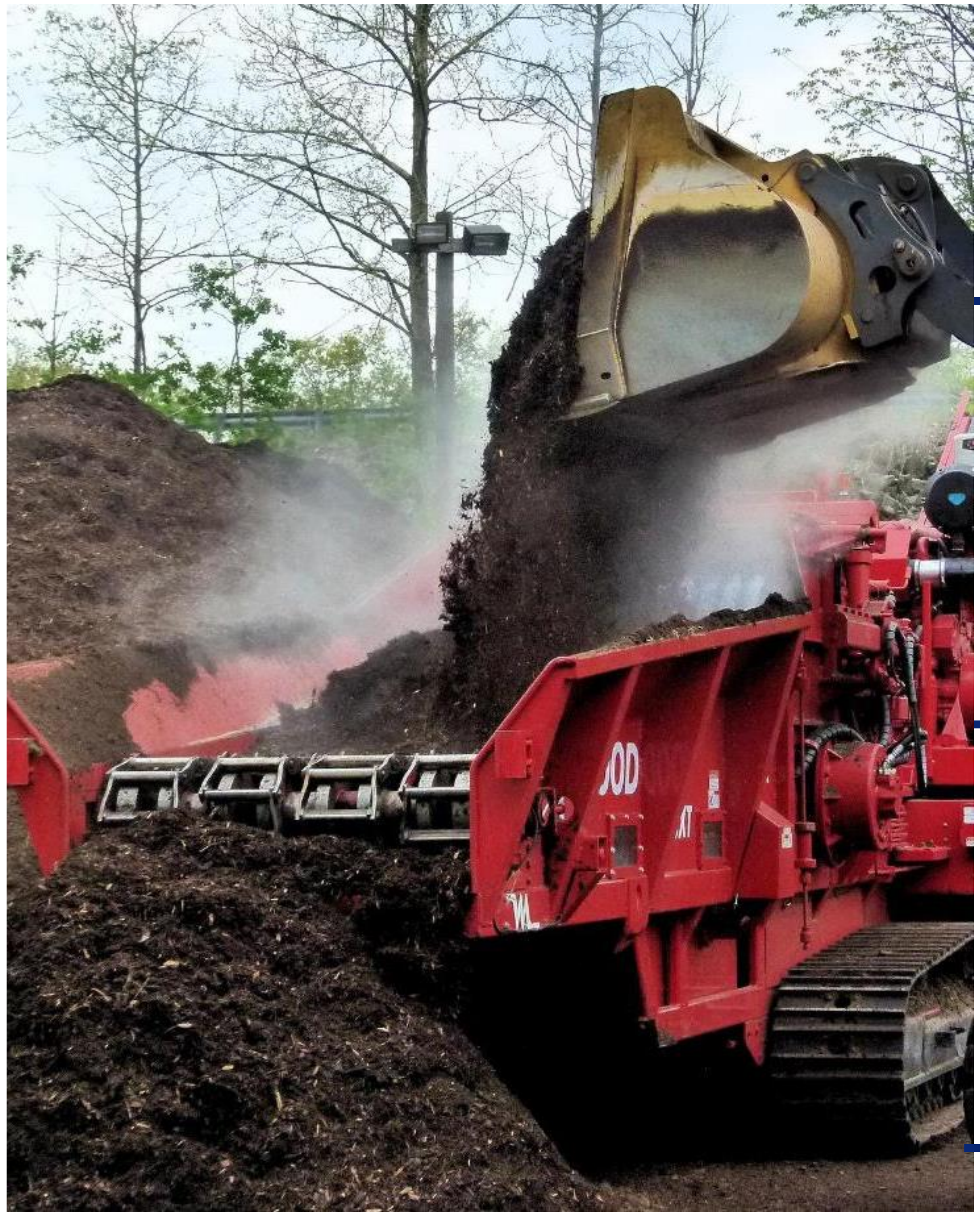
Biochar Direct use

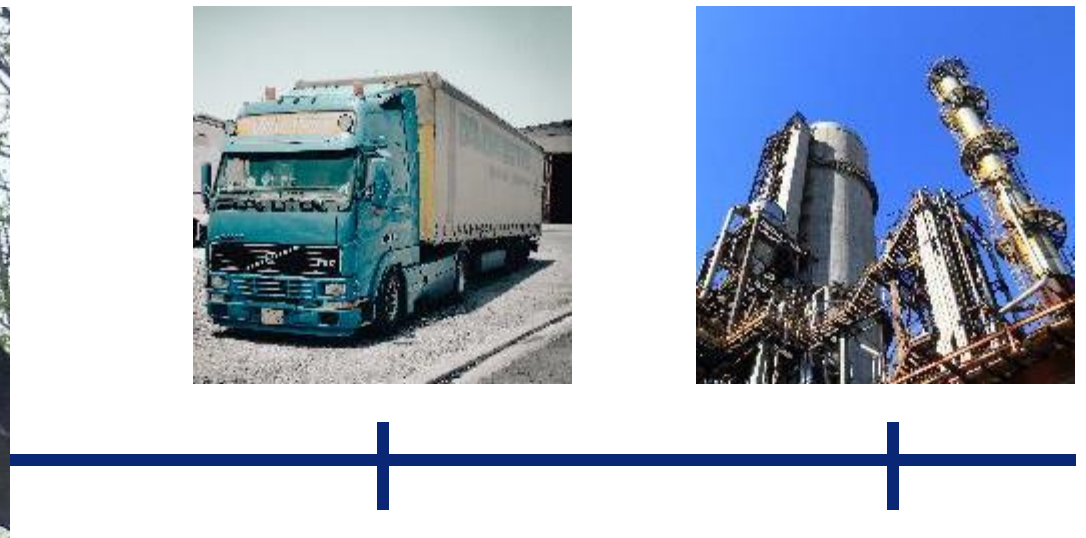
Waste collected at pyrolysis plant. Biochar transported to fields and applied directly.

Biochar Cascading use

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

DEVELOPED SYSTEMS – woody fraction of green waste (wood)





GW REF

GW-450 PYROd
GW-600 PYROd

GW-450 PYROc
GW-600 PYROc

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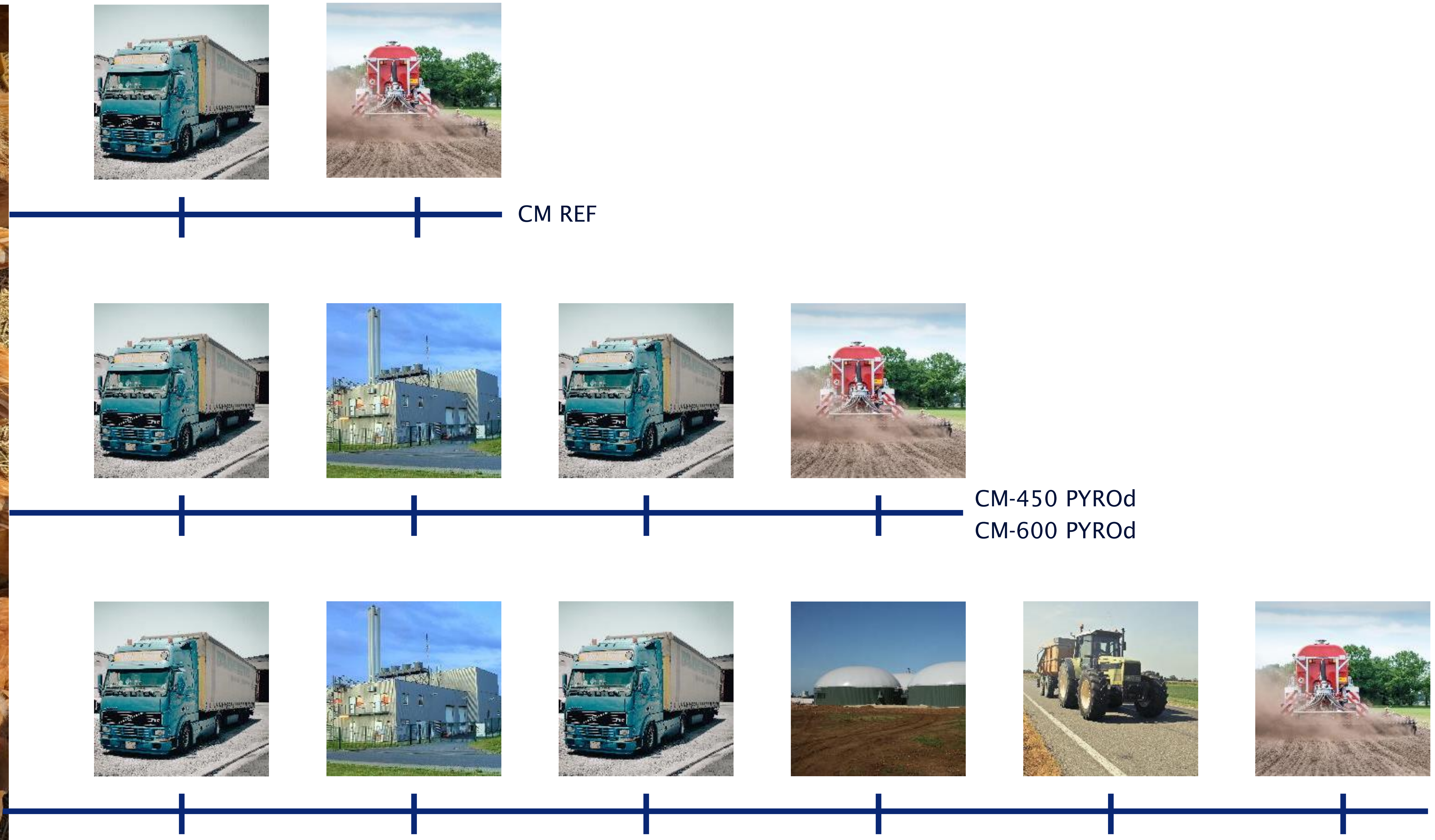
DEVELOPED SYSTEMS – chicken manure pellets (manure)



RESULTS – wood

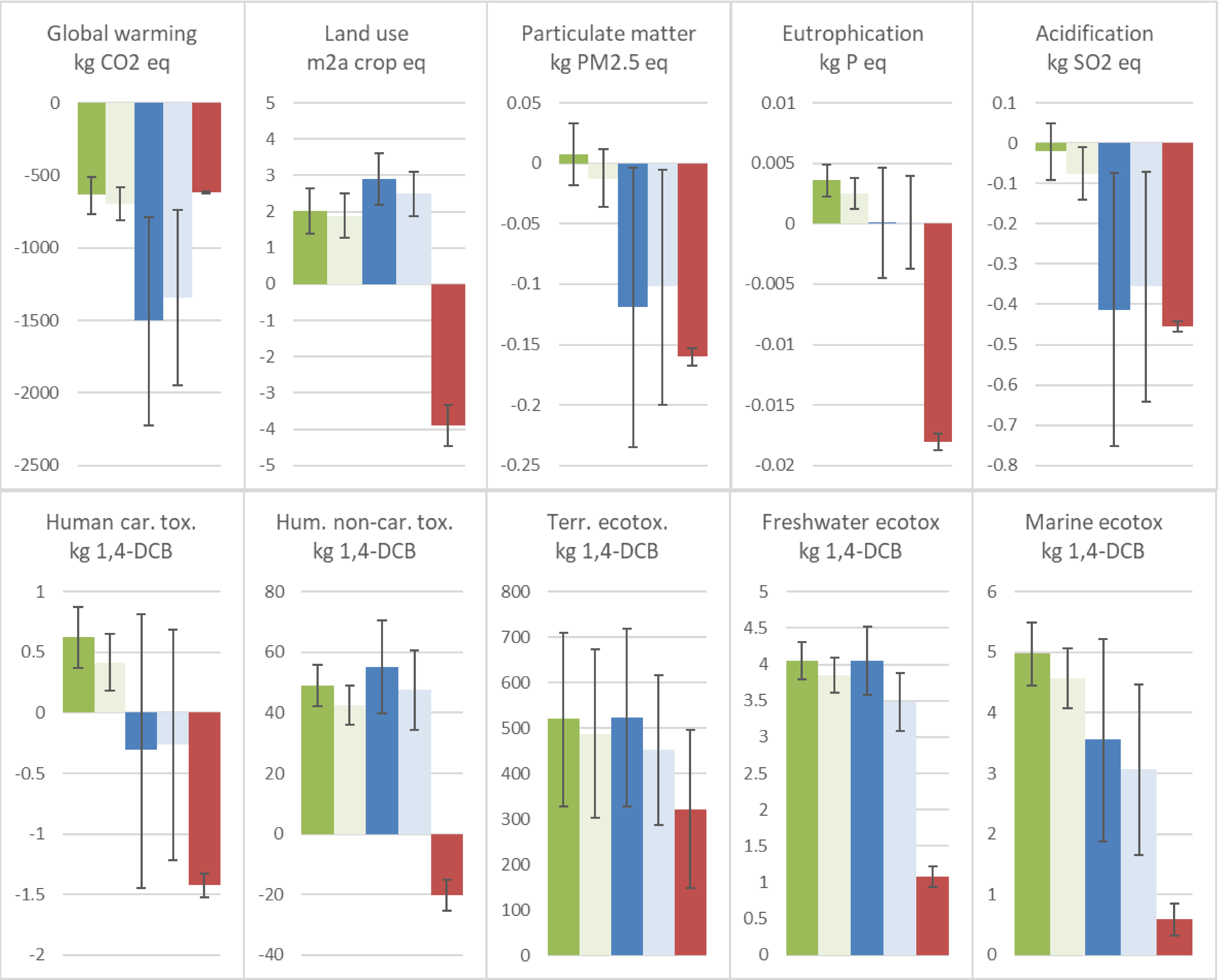
GW-450 PYROd

GW-600 PYROd

GW-450 PYROc

GW-600 PYROc

GW REF



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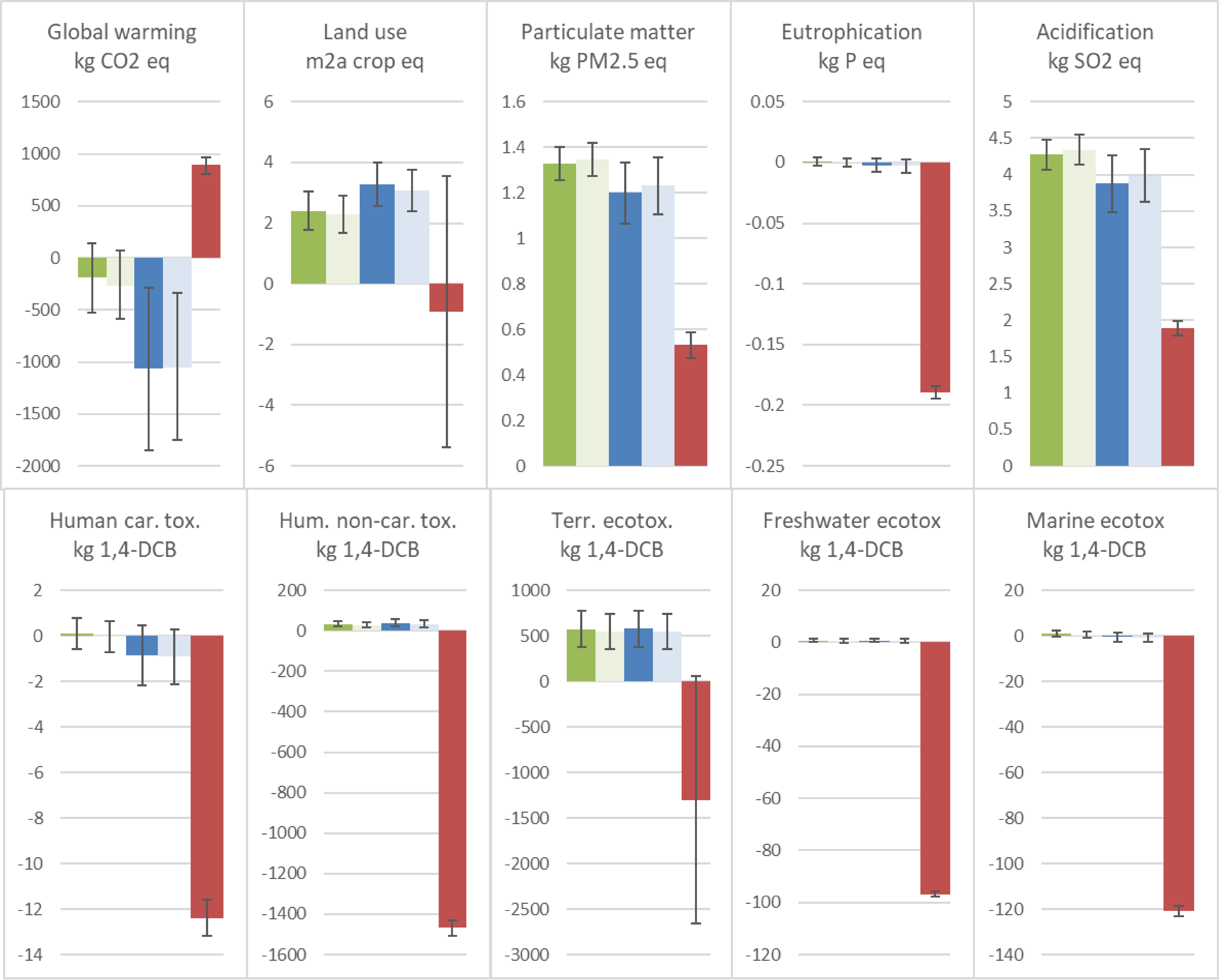
RESULTS – manure



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

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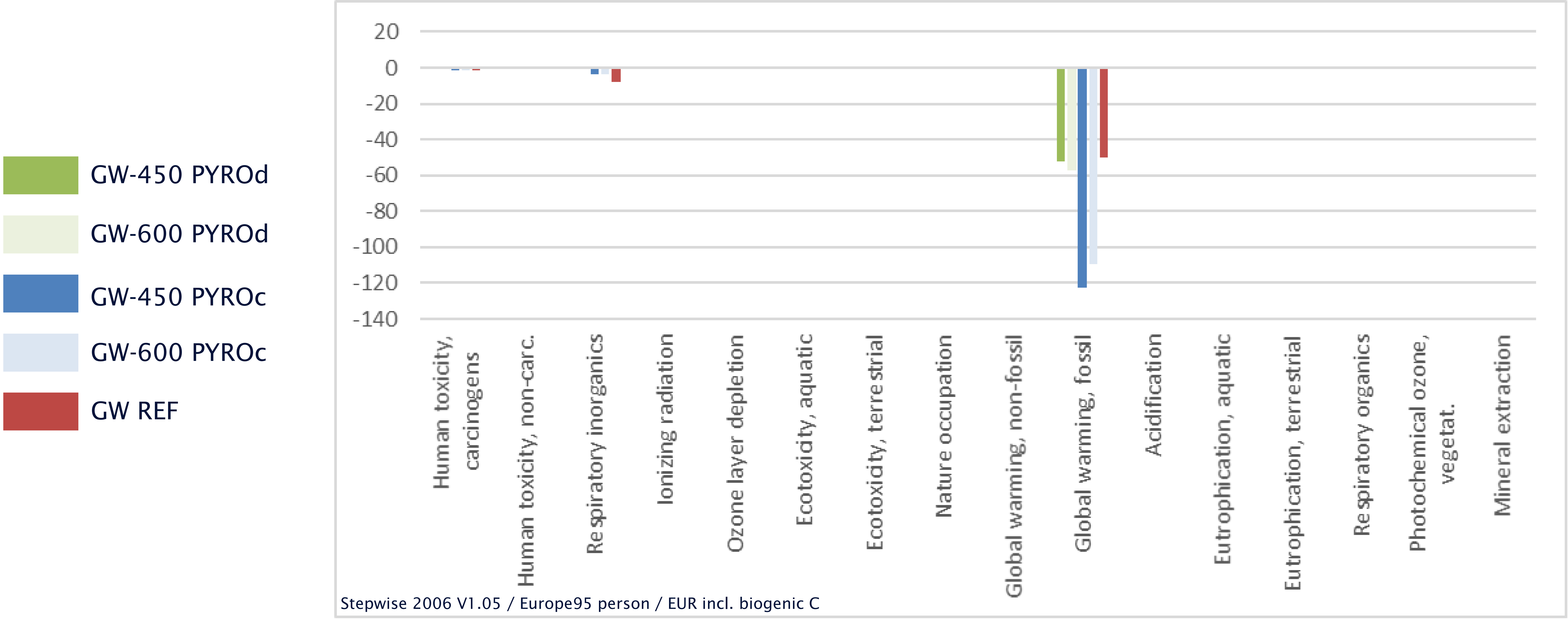
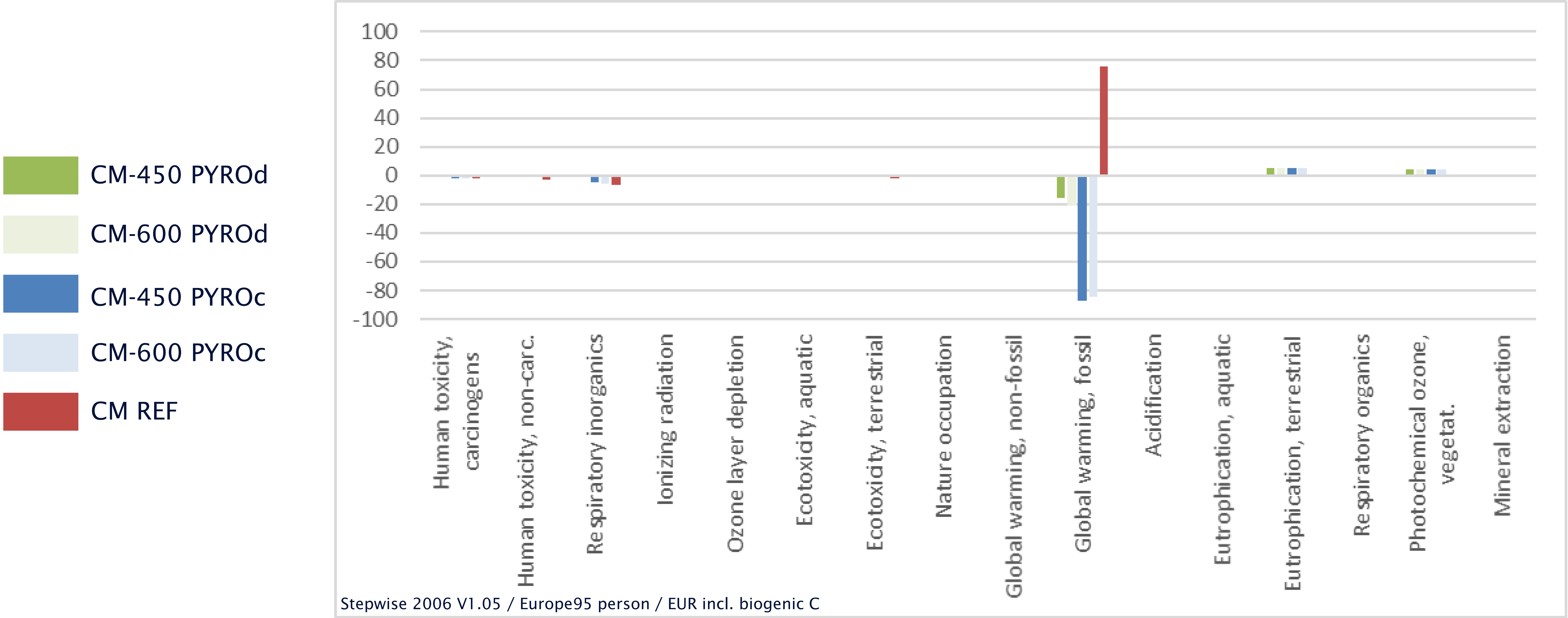
RESULTS – wood (weighting)

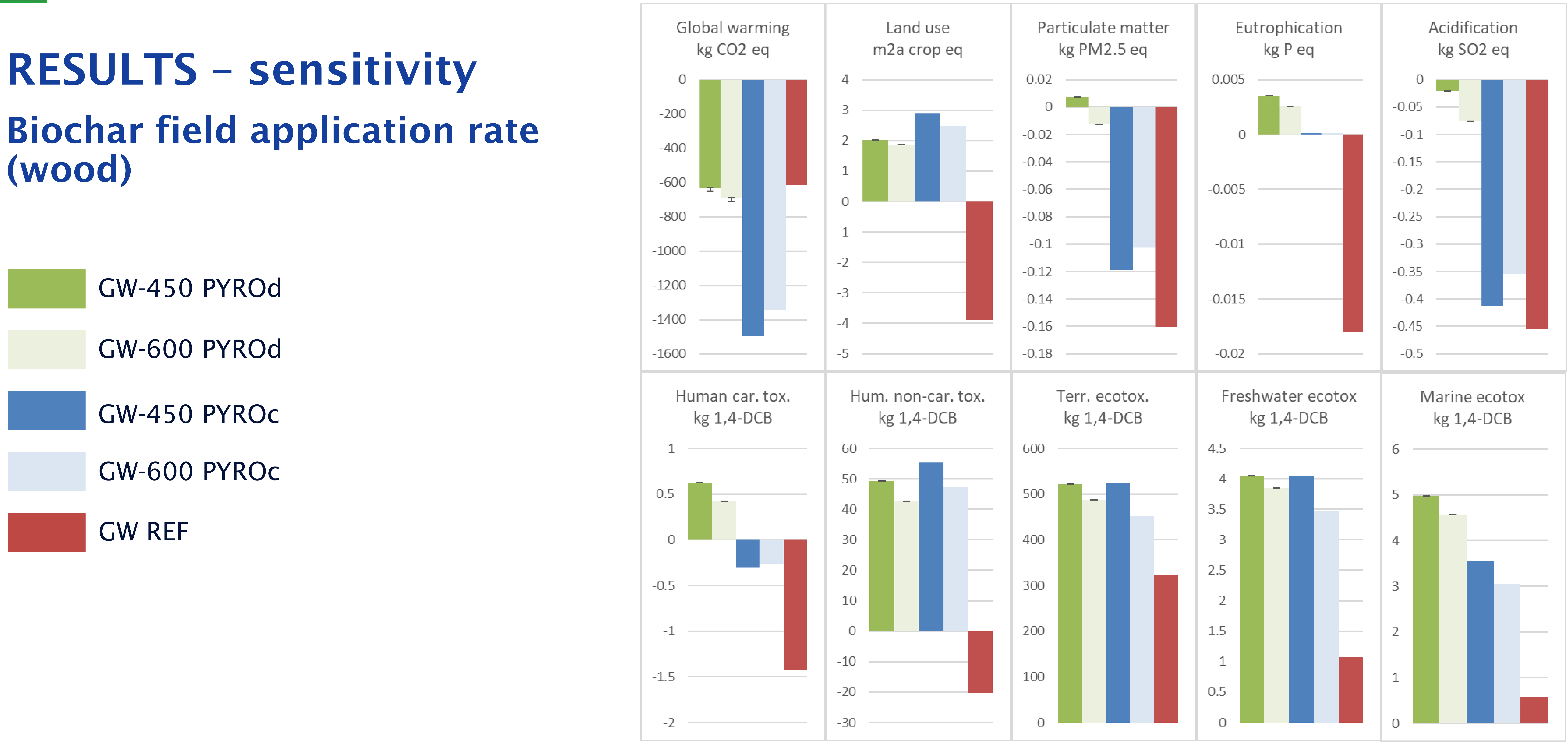


RESULTS – manure (weighting)



RESULTS – sensitivity

Biochar field application rate (wood)



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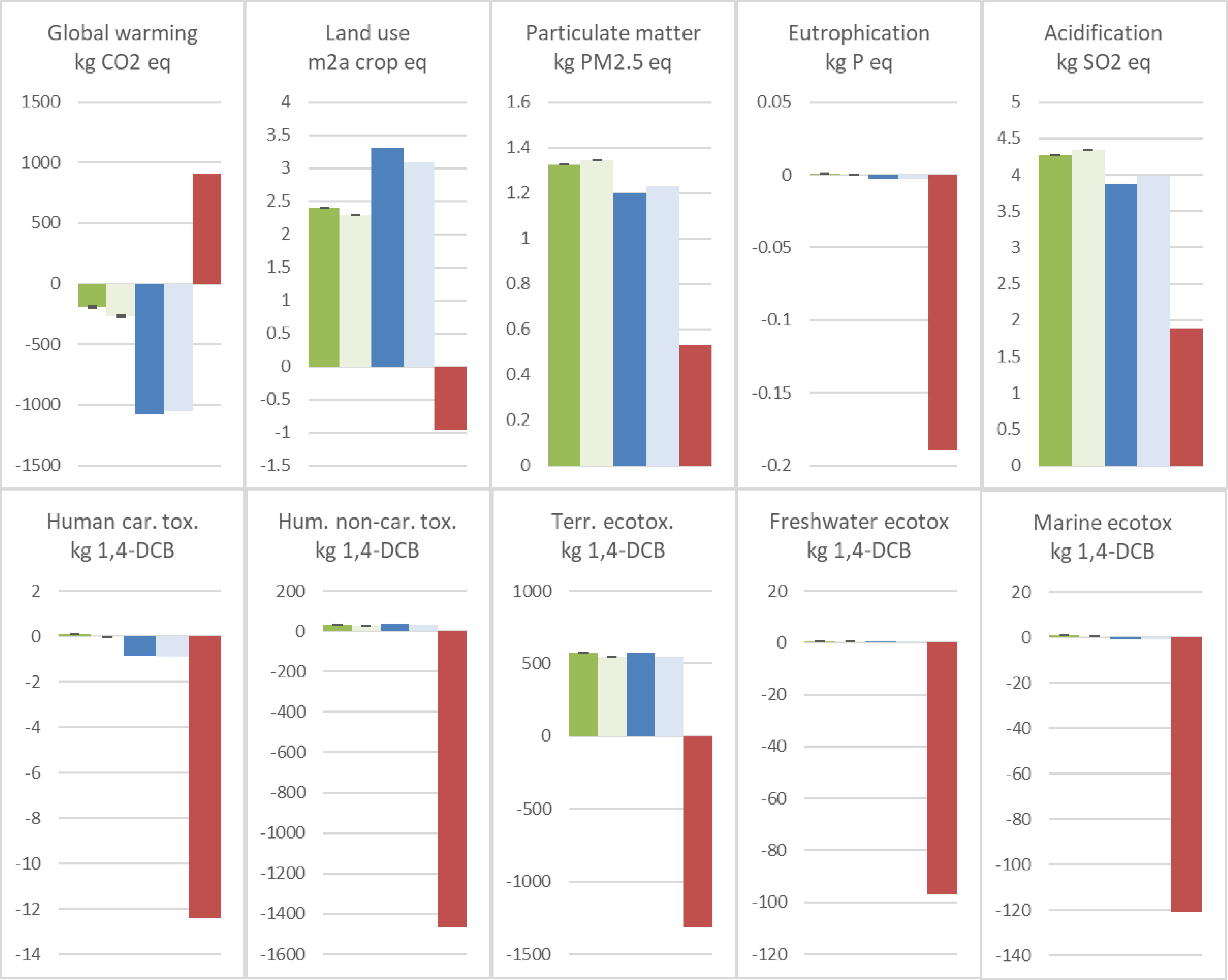
RESULTS – sensitivity

Biochar field application rate (manure)



CM-450 PYROd

CM-600 PYROd

CM-450 PYROc

CM-600 PYROc

CM REF

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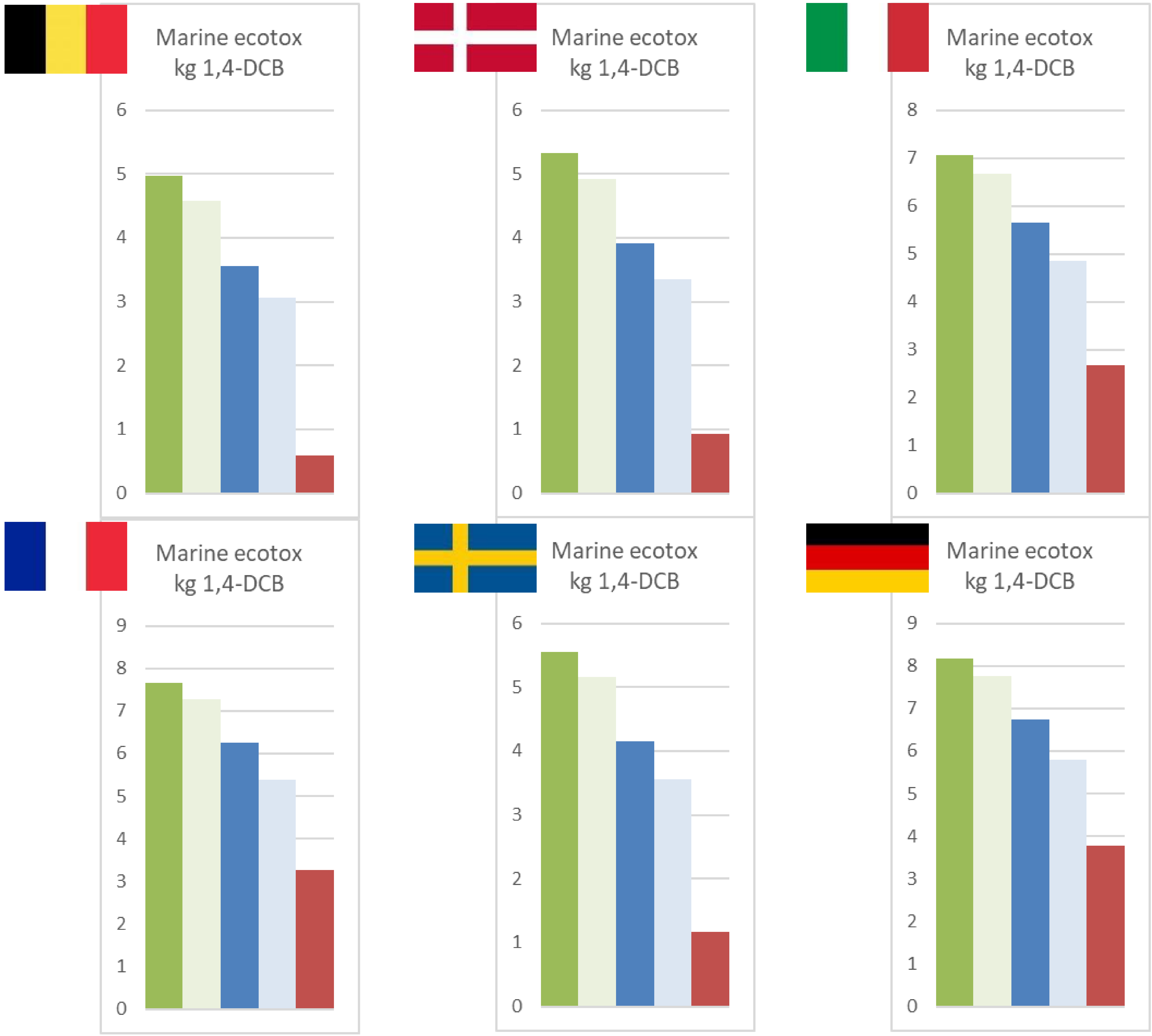
RESULTS – sensitivity

Different electricity (wood)



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

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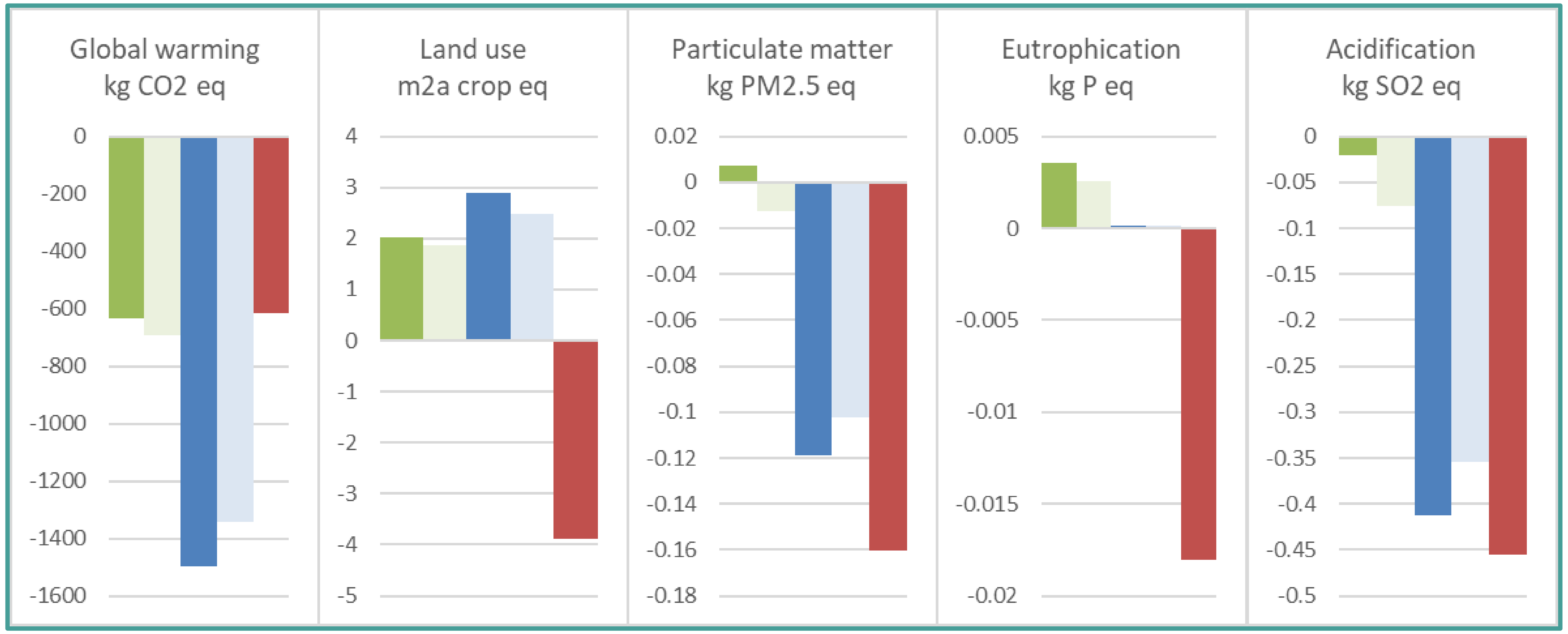
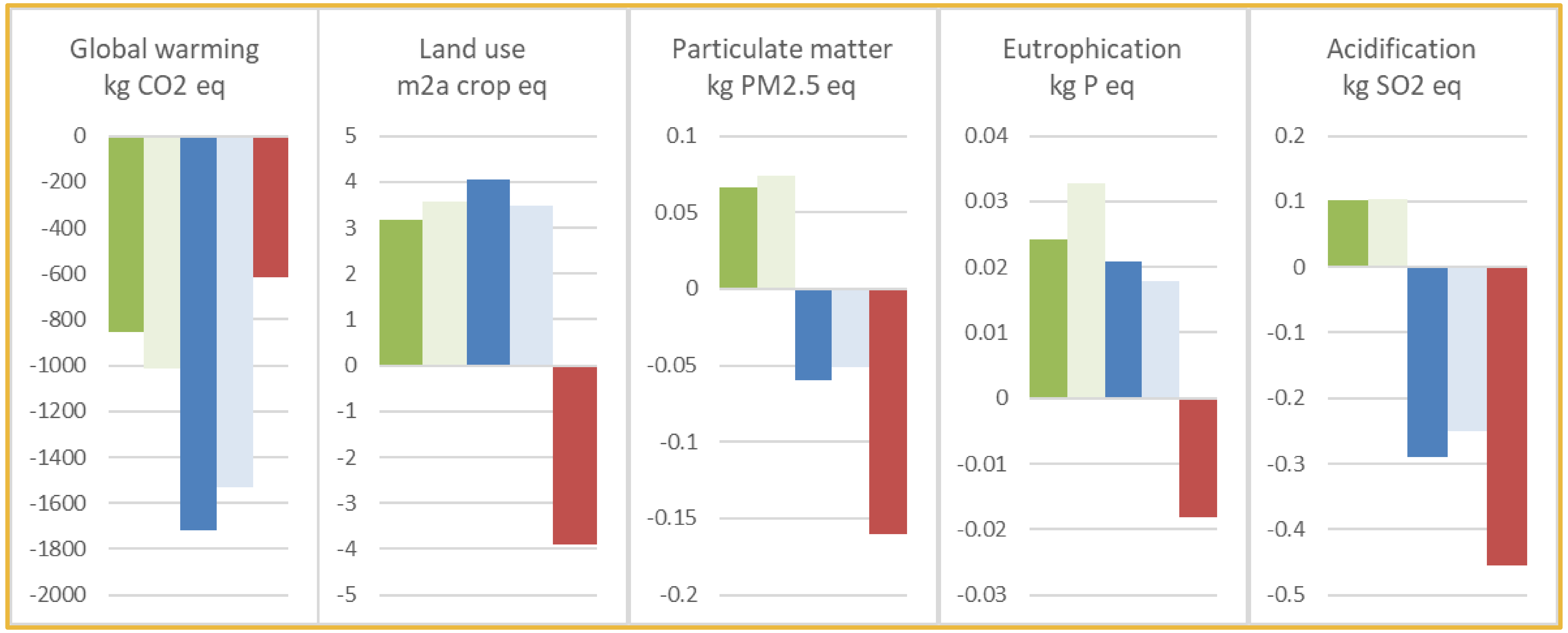
RESULTS – sensitivity

Electricity vs. heat (wood, part 1)





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

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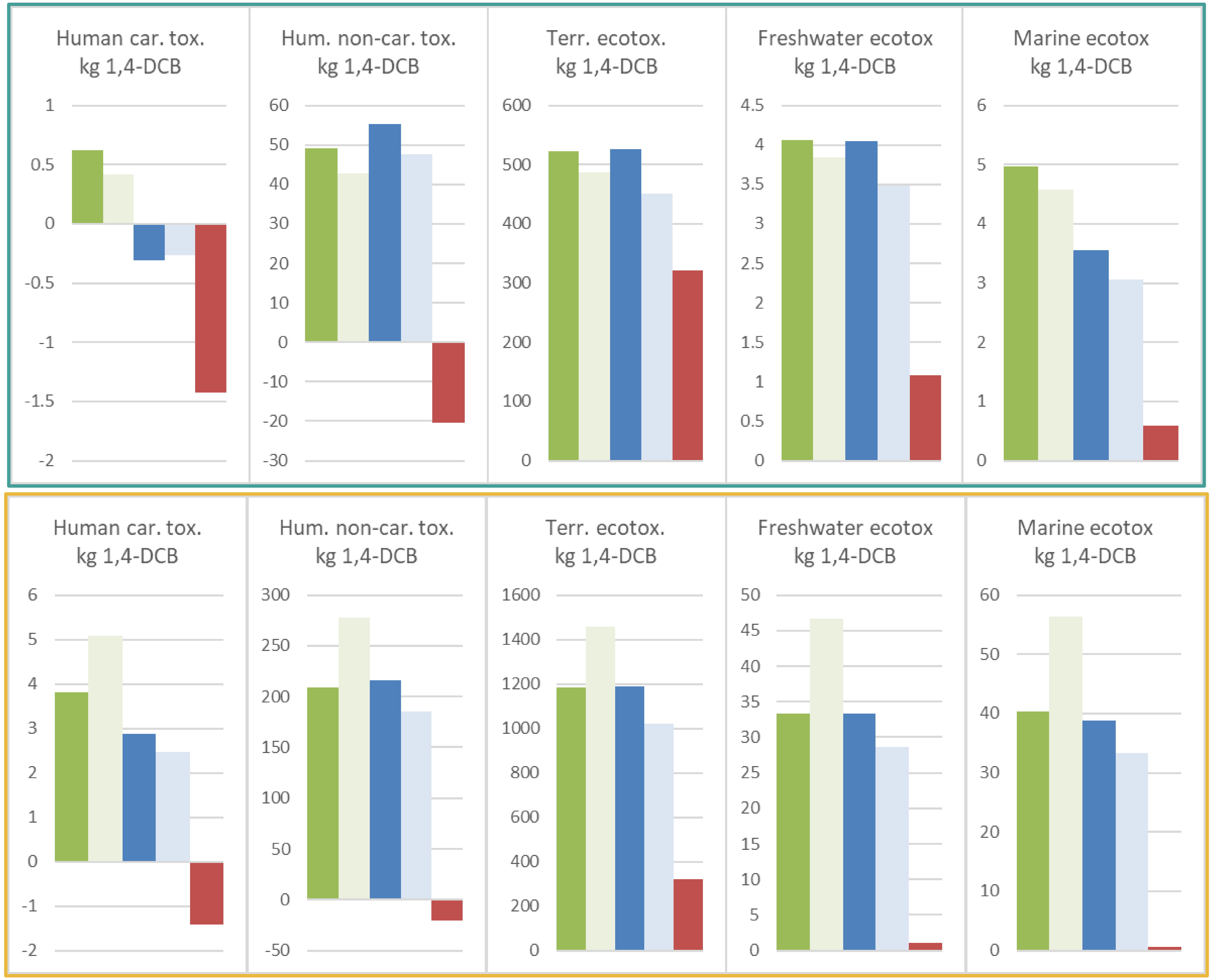
RESULTS – sensitivity

Electricity vs. heat (wood, part 2)

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



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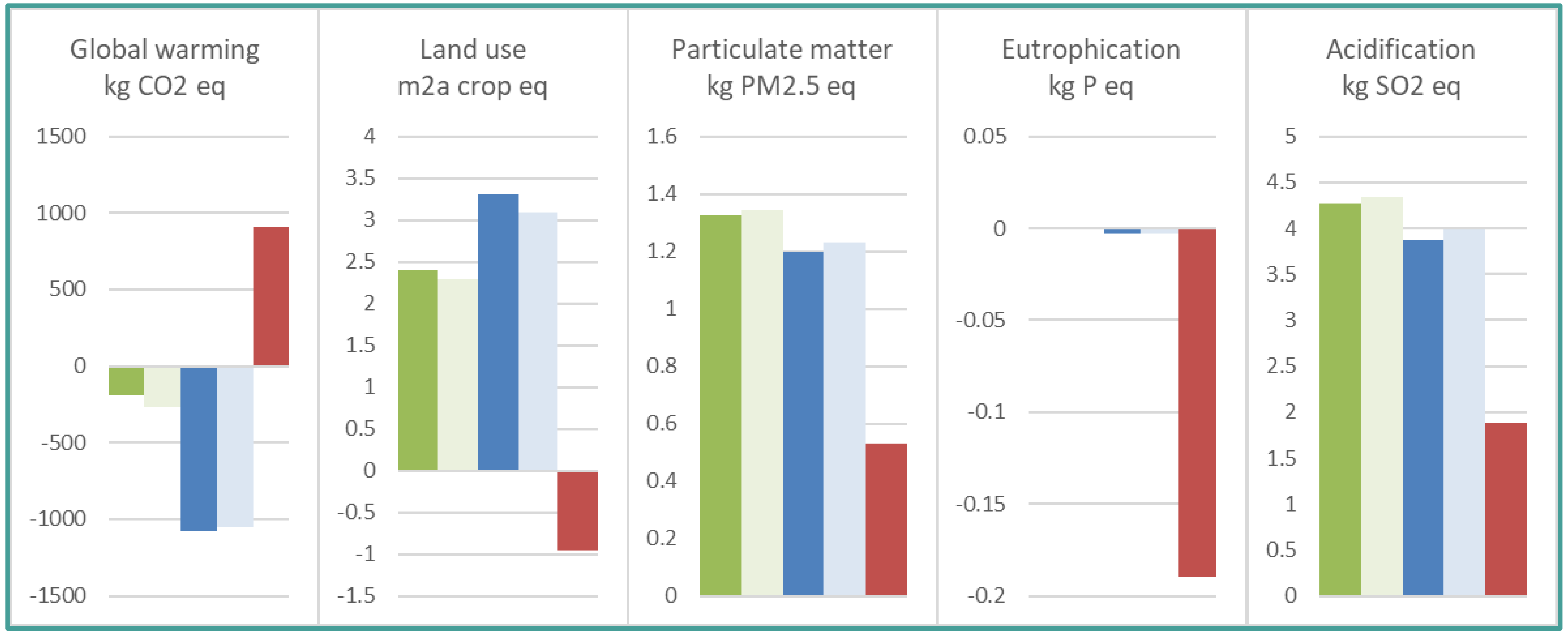
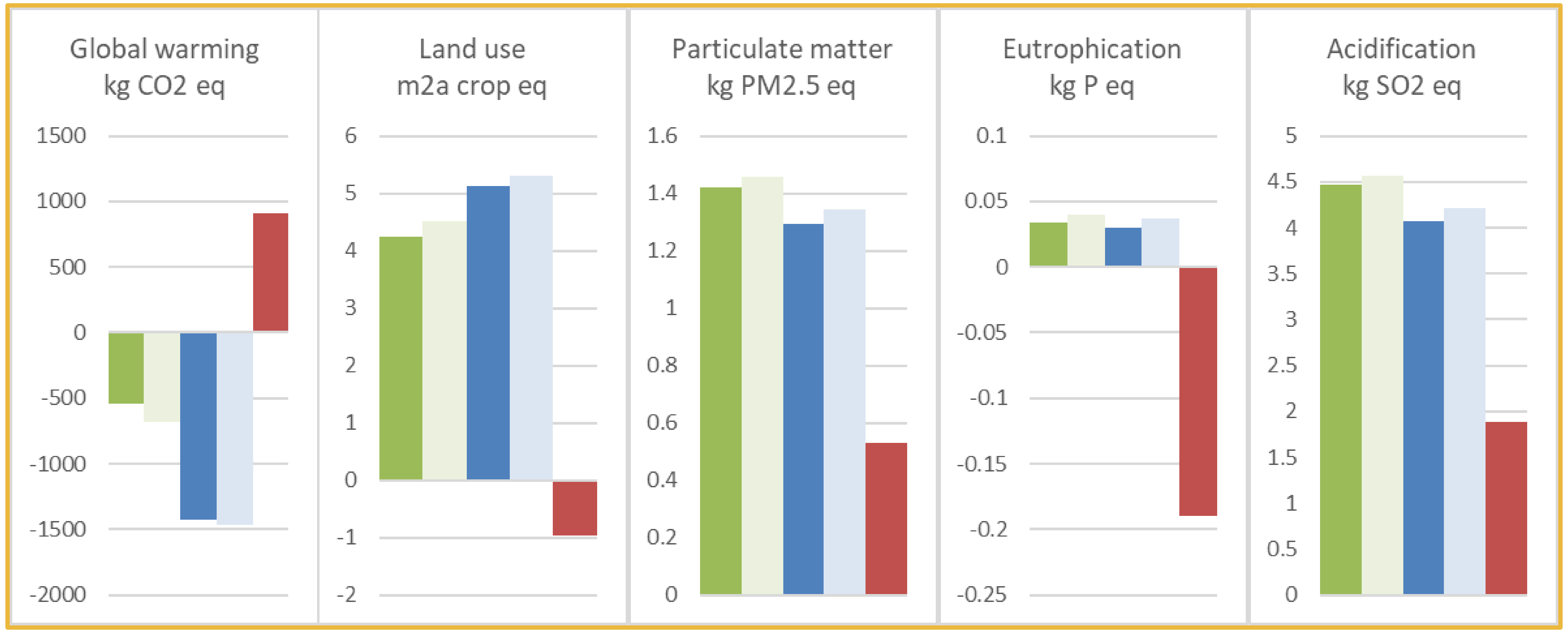
RESULTS – sensitivity

Electricity vs. heat (manure, part 1)





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

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RESULTS – sensitivity

Electricity vs. heat (manure, part 2)

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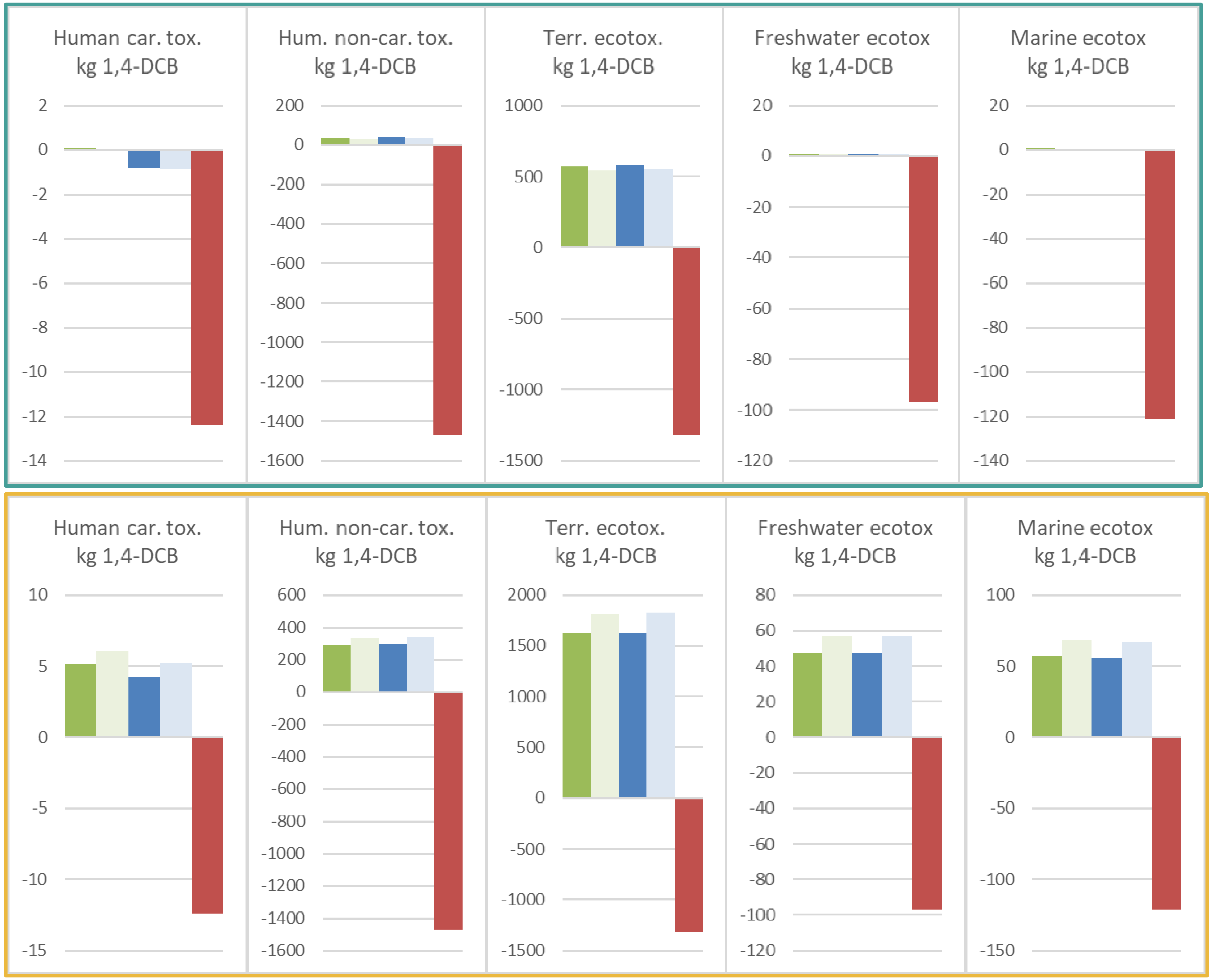

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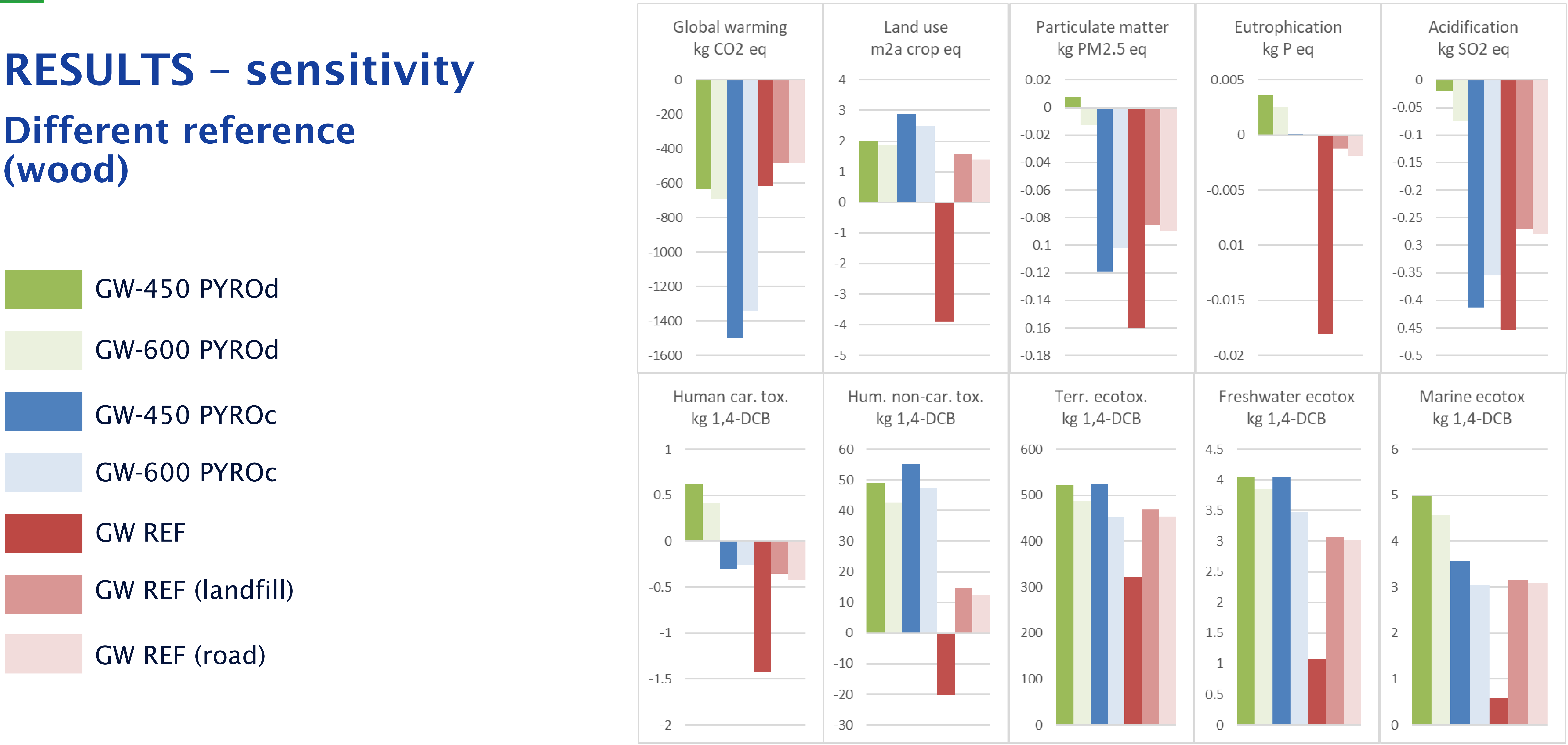
RESULTS – sensitivity

Different reference (wood)



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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

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