LCA OF PEAT, ALTERNATIVE SUBSTRATES AND GROWING MEDIA IN DENMARK

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Why growing media?

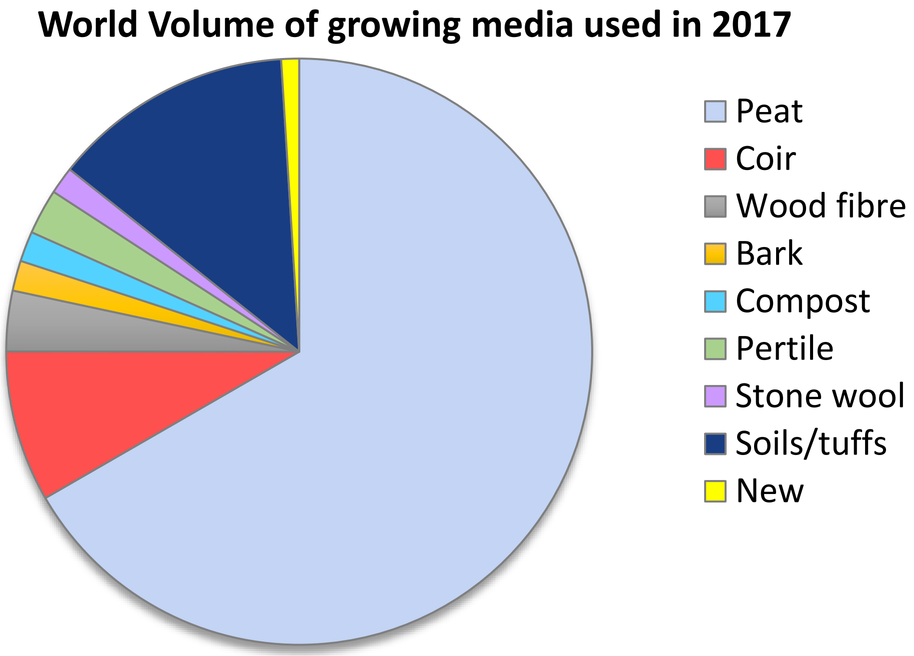
Growing media in soilless cultivation are relevant in several ways:

- Growers: because of the more accurate application of water and nutrients (+15% growth) and avoiding soil diseases (+5/50%).
- Society: because vegetables are essential in a more healthy life style and ornamentals promote wellbeing for the 70% of people living in cities in 2050.
- Authorities: because growing media allow recirculation of drainage which saves 50% of water and eliminates emissions of nitrate, phosphate, etc.

<u>But there is a societal problem!</u>

The societal problem

- Peat is the most used growing media in the world (68%)
- Extraction and removal of peat increase CO_2 emission.
- In 2018, peat soils (7% of the agricultural areas) in Denmark emitted around 4.8 million tons CO_2 eq. which is more than half of the total emissions related to cultivation of the soil in Denmark.
- The reduction of peat extraction and imports should reduce greenhouse gas emissions and therefore GWP.
- A shift to other unsustainable substrates must be avoided



Blok et al., 2020

<u>Which peat substitutes can be recommended?</u>

Which peat substitutes can be recommended?

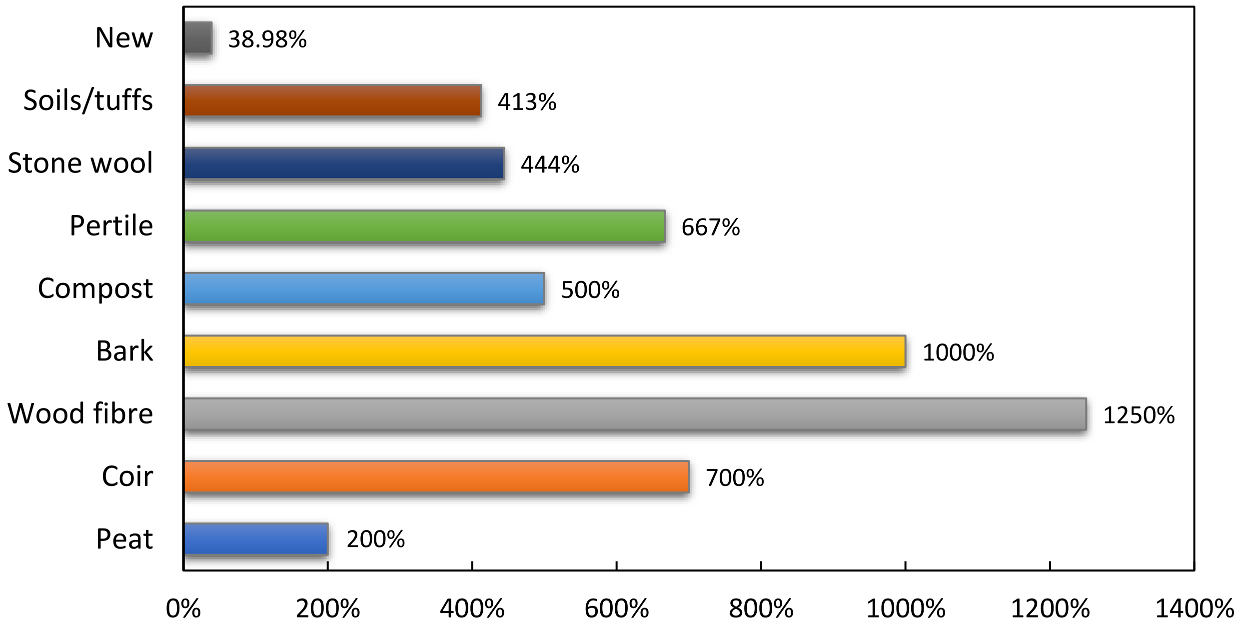
It depends:

- Is it available in near future?
- Can it provide physical and chemical properties similar to peat?

- Which one has the lowest social and economic impacts?
- Which one has the lowest environmental impacts?

<u>Assessment of GWP is required</u>

Estimated increase in world volume of growing media use in 2050 compared to 2017



Blok et al., 2020

Aim of the assessment




To assess and compare climate change impacts of different bio-substrates via LCA

- Peat-based growing media, and
- Peat-free growing media

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Considered growing medias- list of constituents

Sphagnum

Compost

Wood fiber

Hydrochar

AST fiber

Constituent	Vol [%]	Density fresh [kg/m^3]	Moisture content [%]	Bulk dry density [kg/m^3]	PH	Buffer capacity	Nutrient content mg/l NO_3-N, NH_4-N	Nutrient content mg /l P_2O_5	Nutrient content mg /l K_2O	Salt content [g/l]	N-immobilization	Water retention vol [%]	Air capacity vol [%]	Structural stability	Carbon content [C/m^3]
Peat	**100**	**366**	**47.6**	**191.9**	**4.8**	**Medium**	**Low**	**Low**	**Low**	**Low**	**Low**	**80**	**10**	**Medium**	**35-40**
Compost	25	325	50	165	7	Medium	-	-	-	Medium	Low	-	-	-	30-35
Peat	75	366	47.6	191.9	4.8	Medium	Low	Low	Low	Low	Low	80	10	Medium	35-40
Substrate	**100**	**356**	**48**	**185.2**	**5**	**Medium**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Medium**	**35-40**
Wood fiber	25	110	50	105	7	Medium	Low	Low	Low	Low	Low	75	15	Medium	35-40
Peat	75	366	47.6	191.9	4.8	Medium	Low	Low	Low	Low	Low	80	10	Medium	35-40
Substrate	**100**	**302**	**43.7**	**170.2**	**5.2**	**Medium**	**Low**	**Low**	**Low**	**Low**	**Low**	**78**	**12**	**Medium**	**35-40**
Hydrochar	25	300	20	240	7	High	Low	Medium	High	Medium	Low	-	-	-	-
Peat	75	366	47.6	191.9	4.8	Medium	Low	Low	Low	Low	Low	80	10	Medium	35-40
Substrate	**100**	**350**	**41.7**	**203.9**	**5**	**Medium**	**Low**	**Low**	**Medium**	**Low**	**Low**	**-**	**-**	**-**	**-**
AST fiber	25	150	30	105	8.5	Medium	Low	Medium	High	High	Low	-	-	-	-
Peat	75	366	47.6	191.9	4.8	Medium	Low	Low	Low	Low	Low	80	10	Medium	35-40
Substrate	**100**	**312**	**45.5**	**170.2**	**5.2**	**Medium**	**Low**	**Low**	**Medium**	**Medium**	**Low**	**-**	**-**	**-**	**-**

Approach- functional unit &data

- Functional Unit: 1 m^3 of growing media for greenhouse application
- Foreground data from industry and literature
- LCI background data from ecoinvent V3.8
- Impact assessment by the SimaPro 7.1 software

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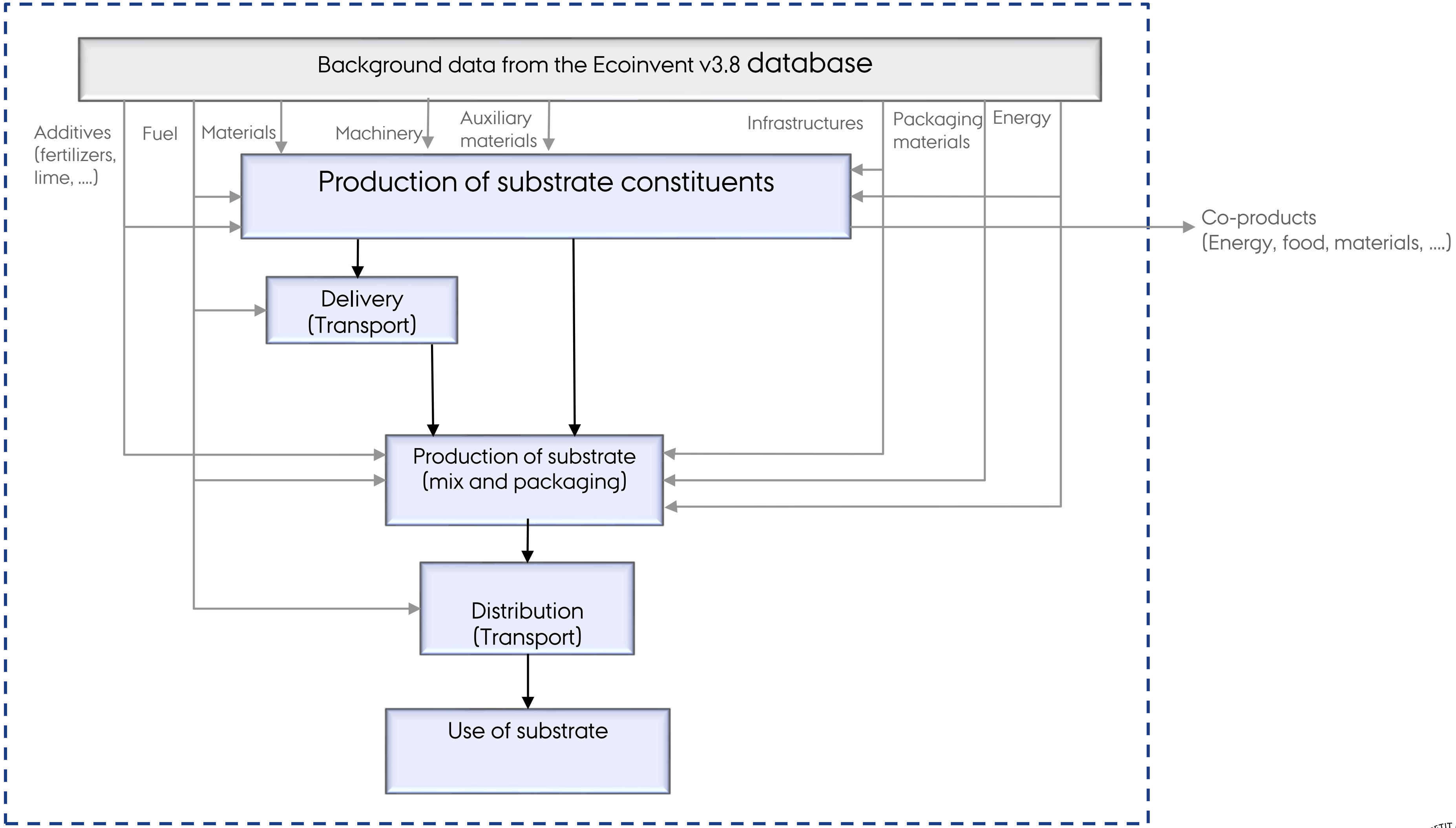
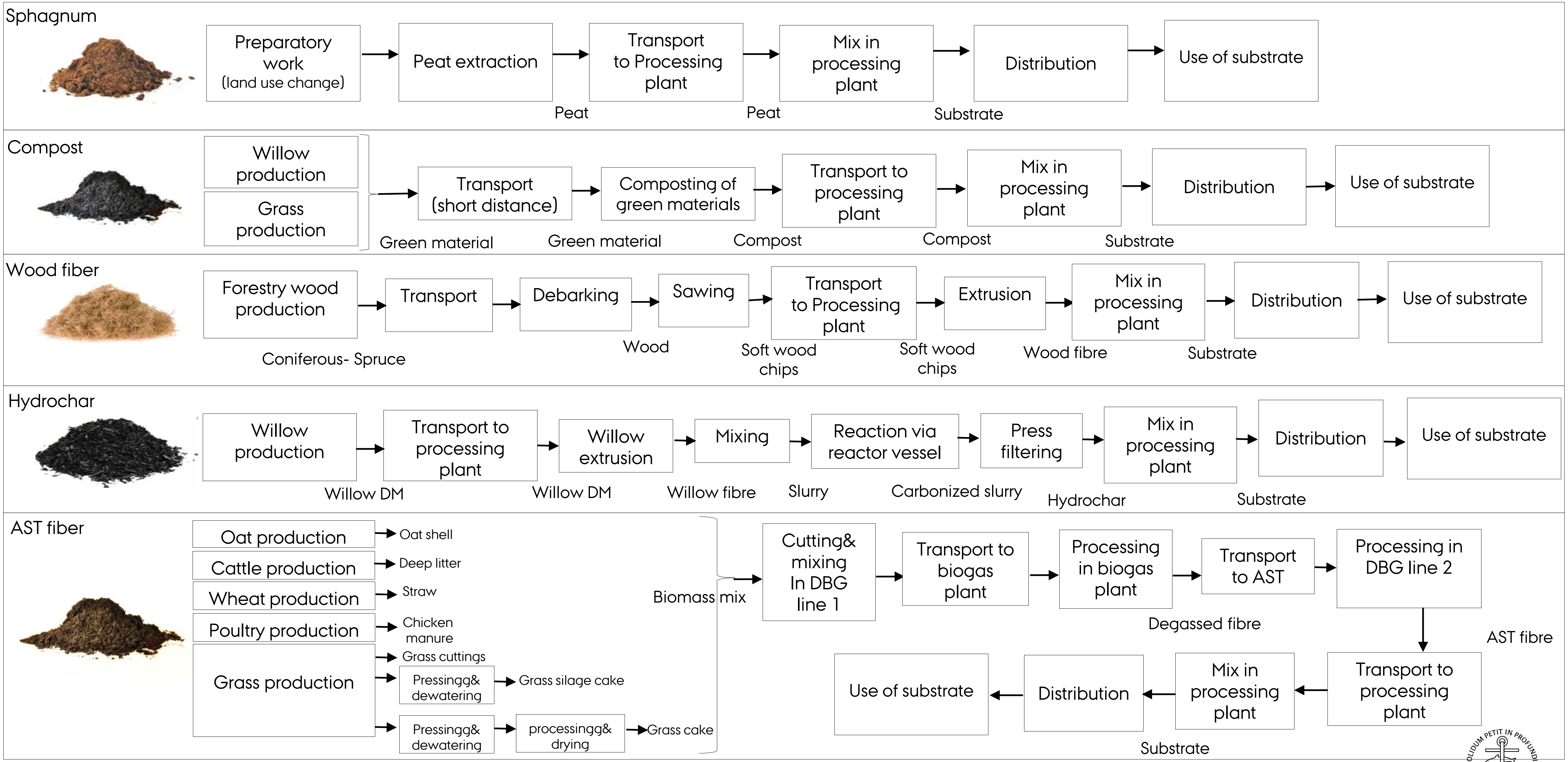
Approach- system boundary

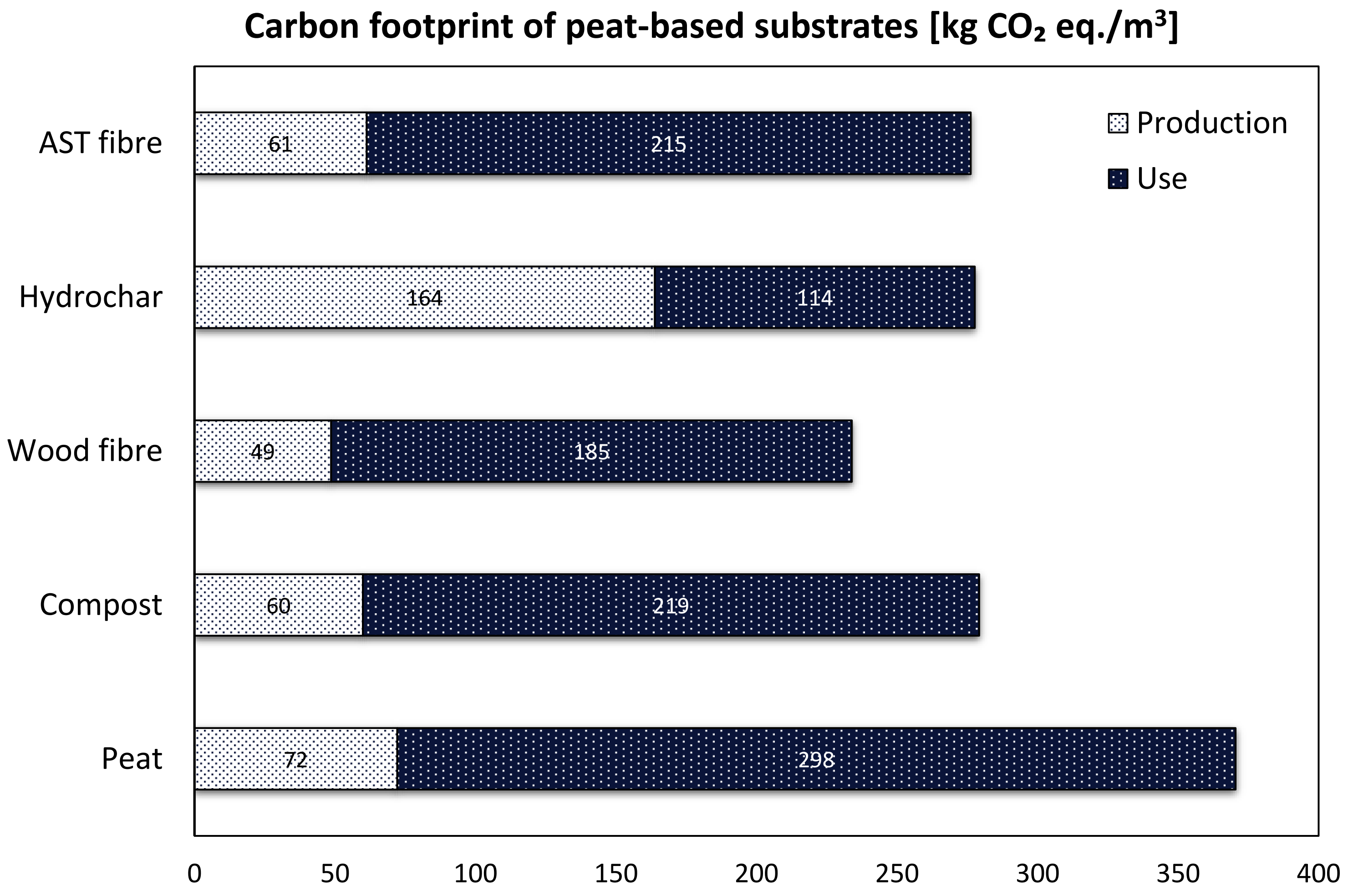


System boundary for the life cycle assessment

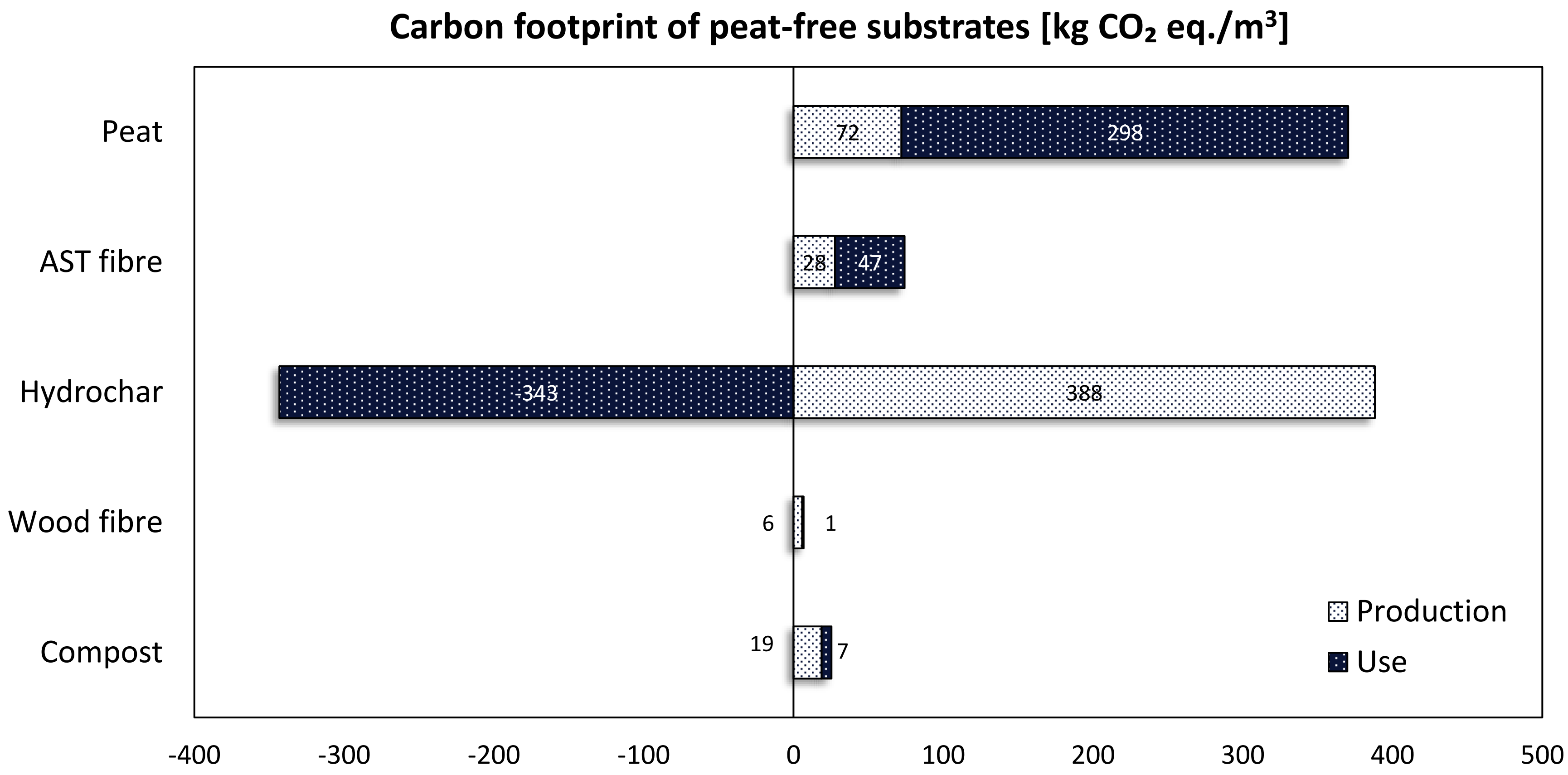
Approach- scenarios



Carbon footprint of peat-based substrates



Carbon footprint of peat-free substrates

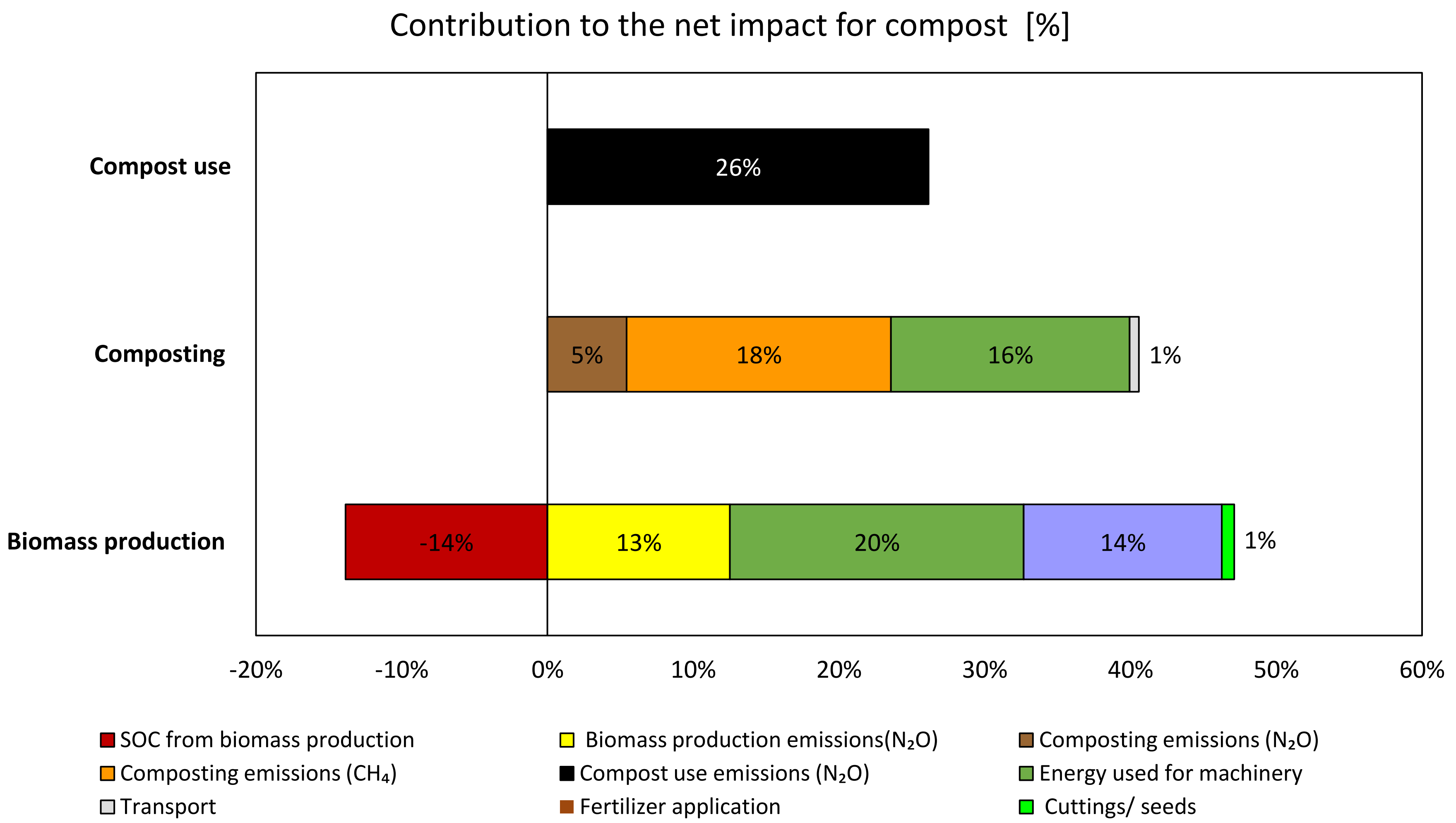


Note:

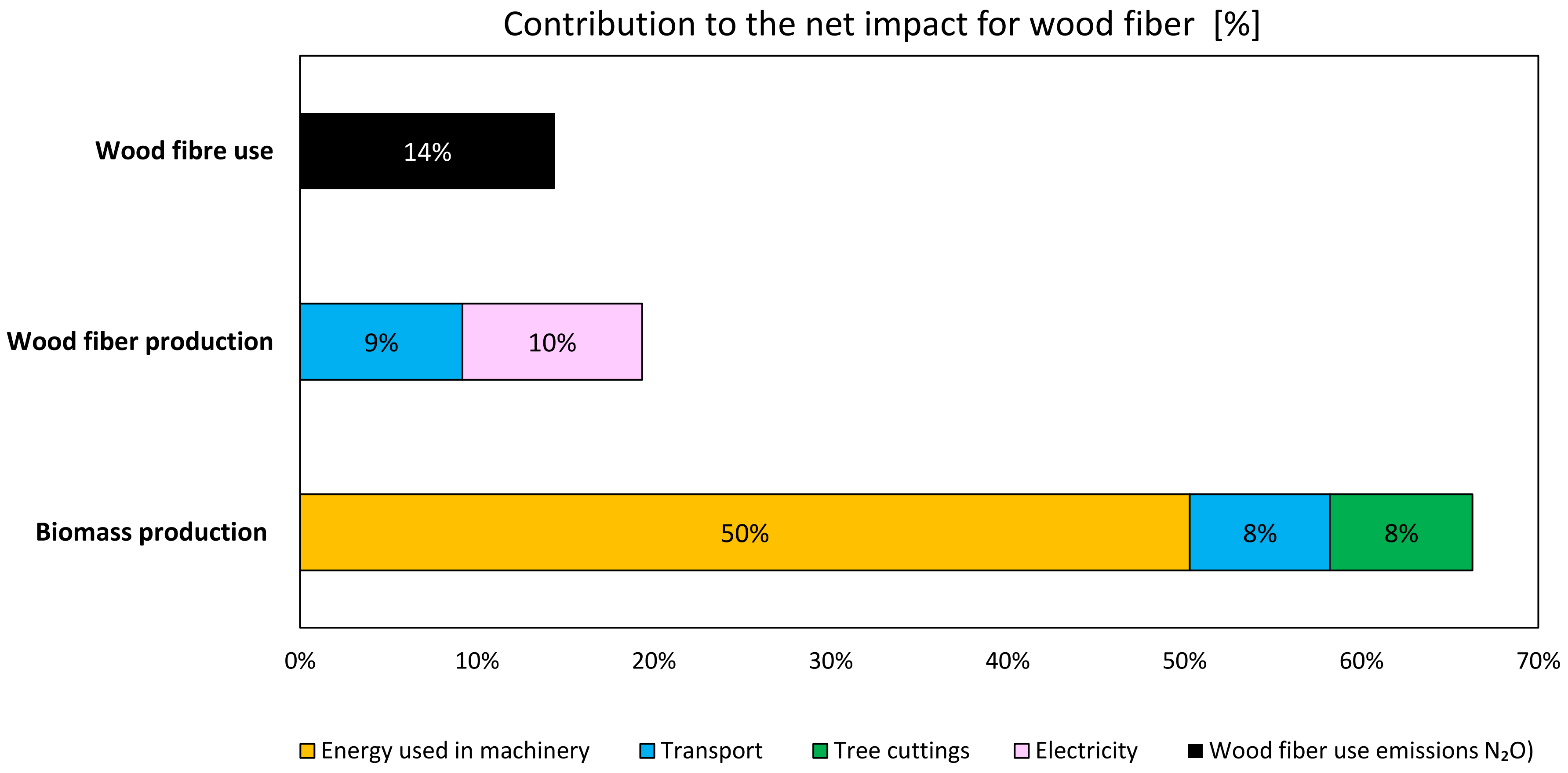
SOC reported for Hydrochar is related to use phase

SOC from biomass production has been already deducted from compost, Hydrochar, and AST fiber

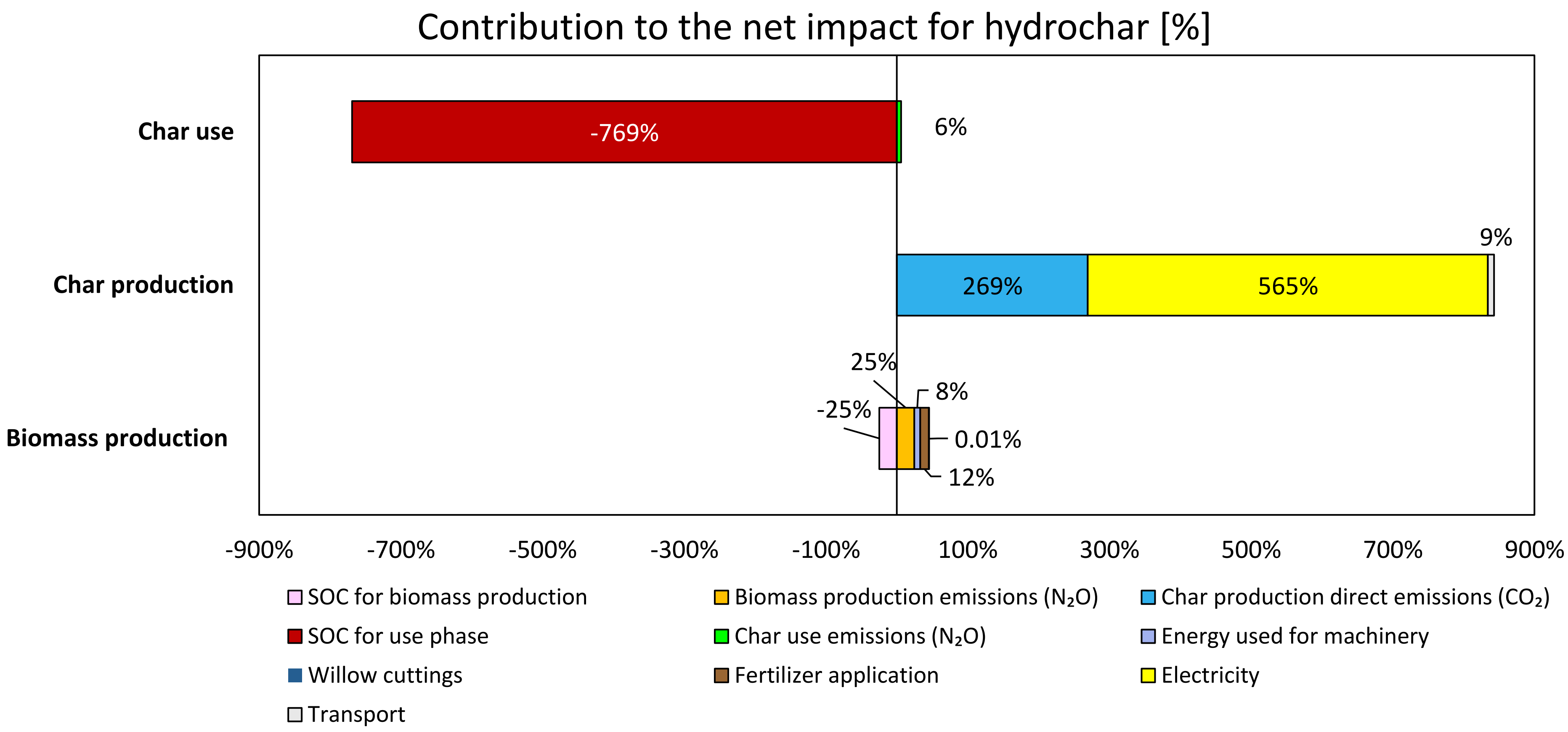
Contribution to the net impact for compost



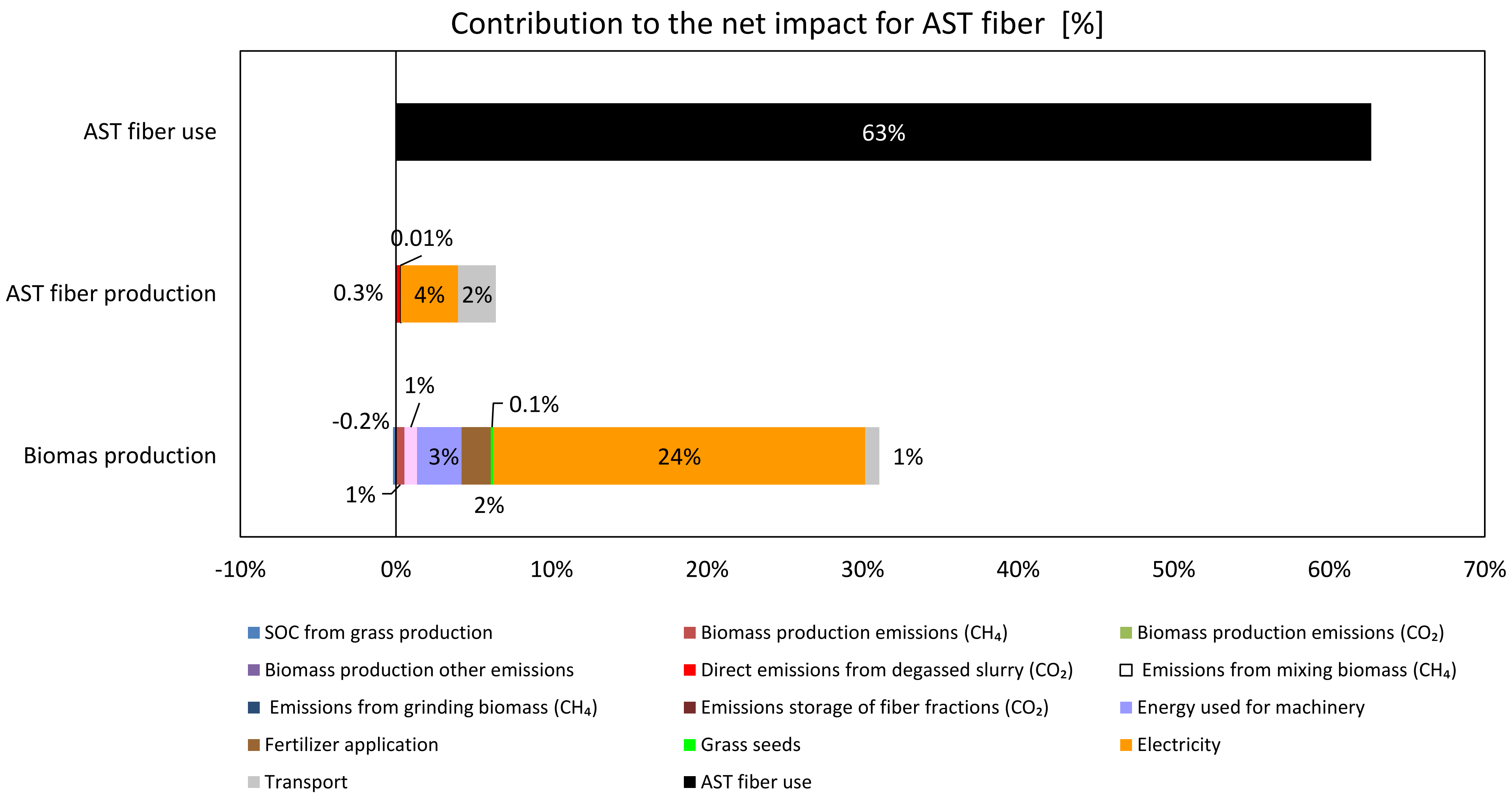
Contribution to the net impact for wood fiber



Contribution to the net impact for hydrochar



Contribution to the net impact for AST fiber



Conclusions

- All substrate components analyzed have a lower carbon footprint compared to peat
- Carbon footprint of peat-based substrates is almost the same except for wood fibre
- In order to achieve favorable plant cultivation properties, different components need to be blended depending on specific plant requirements
- We recommend substrate components:
    - ✓ That can be used without much processing,
    - ✓ That are not in competition with other users, and
    - ✓ That are based on local, low value, residual materials or wastes from forestry or agriculture

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Thank you

"On the bright side, since the collapse of the modern world due to climate change, we've had no trouble attaining zero carbon emissions."

TEKNOLOGISK INSTITUT

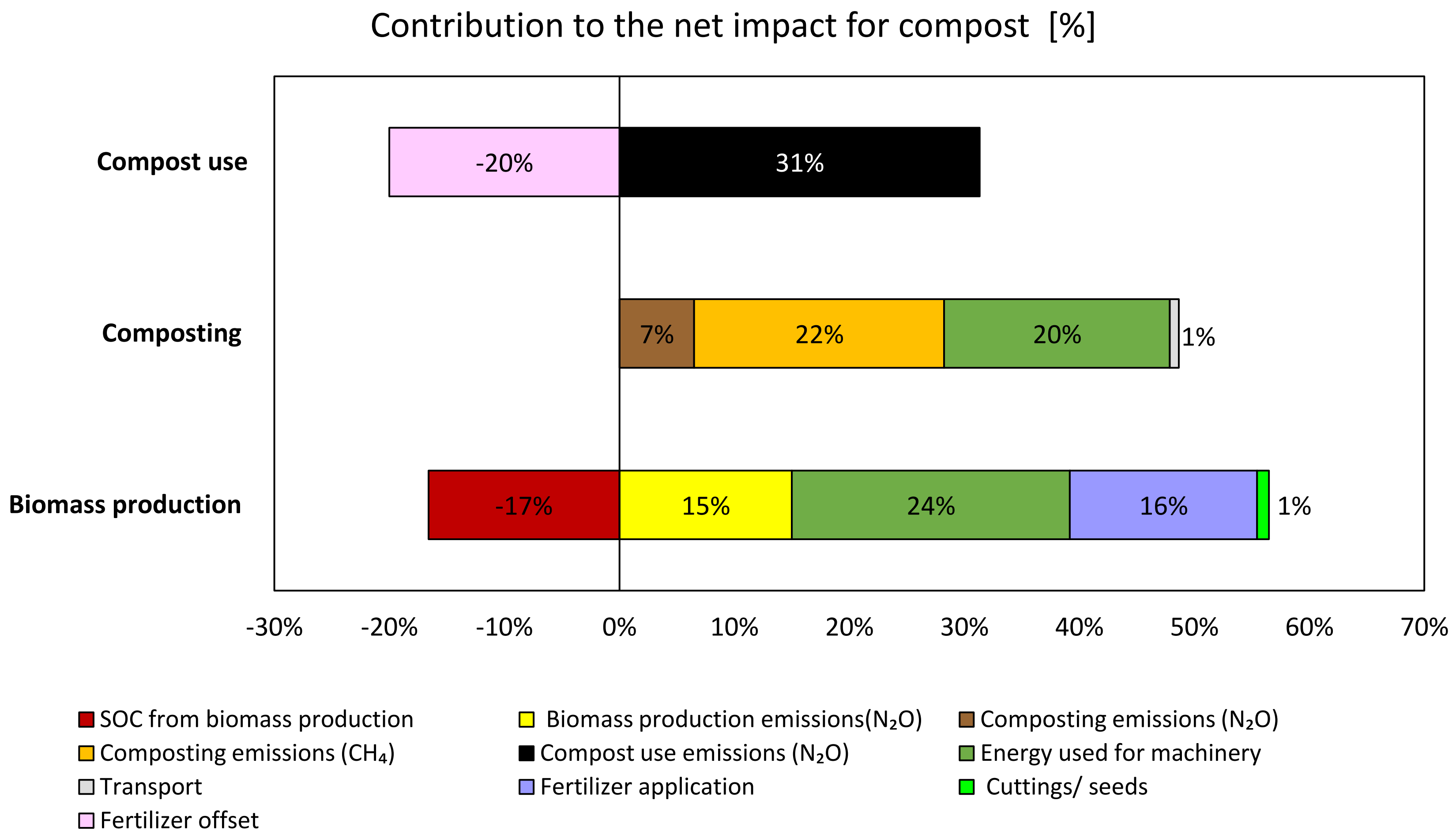
PINDSTRUP

NY VRAA BIOENERGY

AST Advanced Substrate Technologies

AARHUS UNIVERSITY

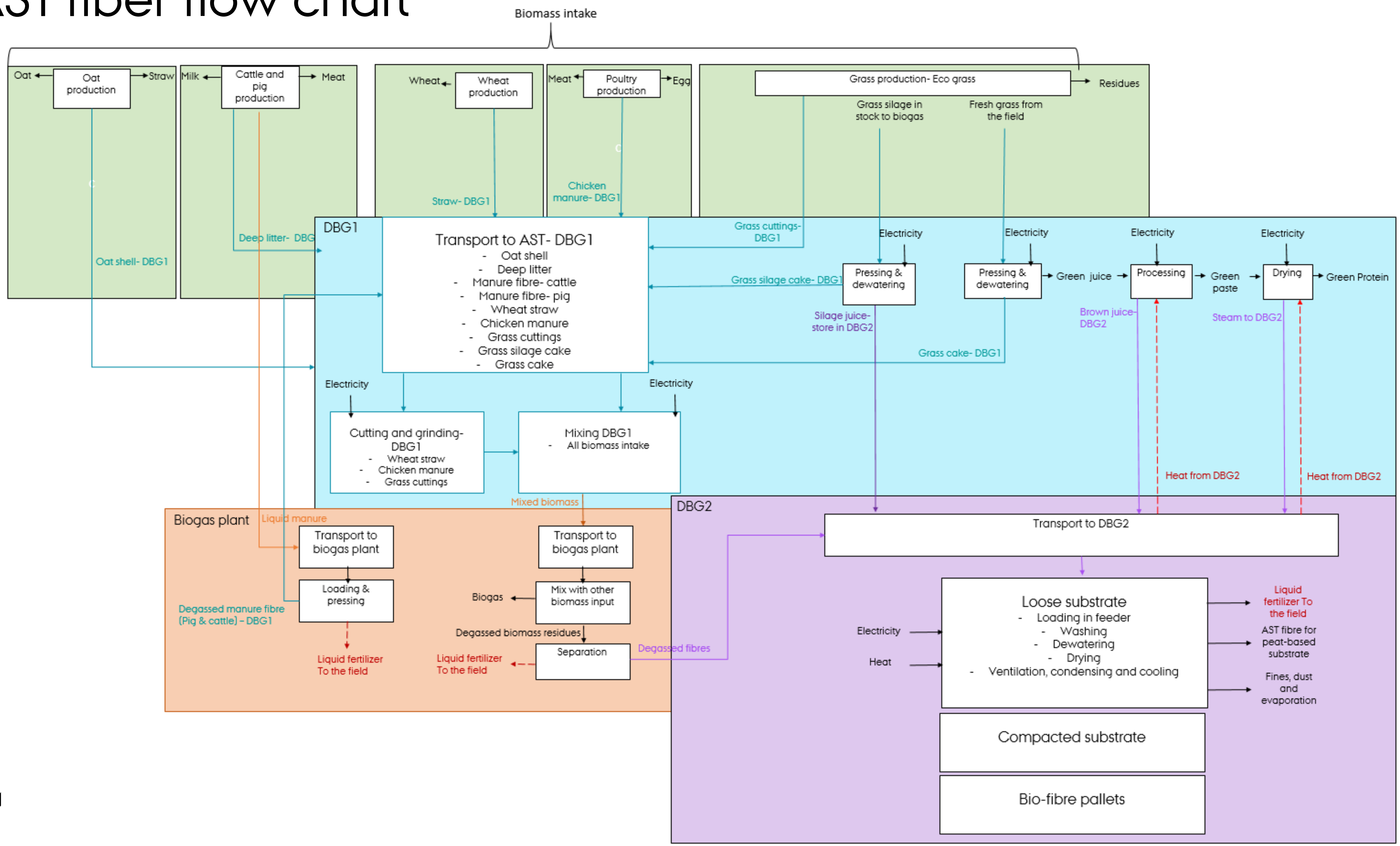
Contribution to the net impact for compost-considering fertilizer offset for mixing with peat



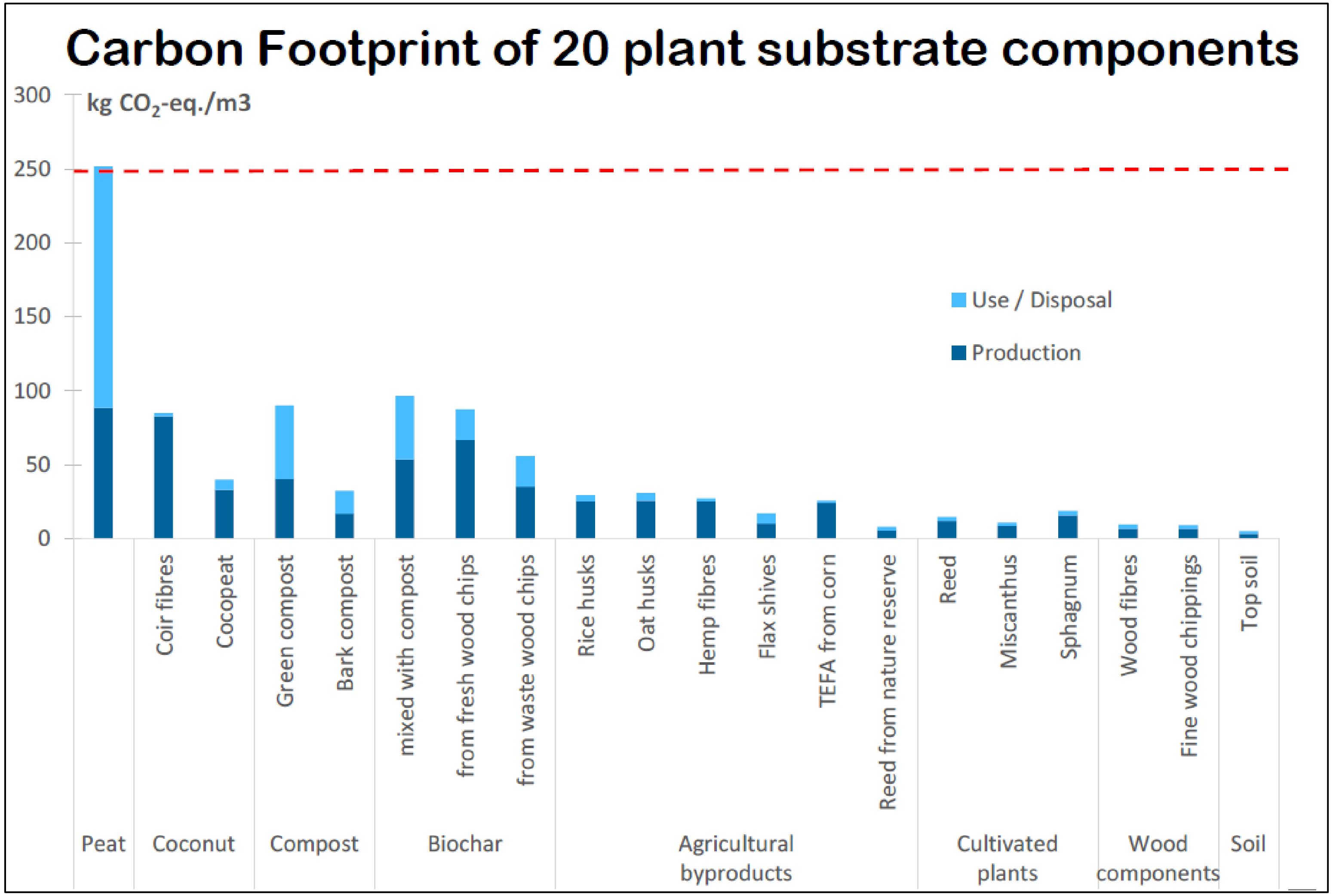
Note:

This is not the case in our study, because in PINDSTRUP, they added fertilizers to the mixture of peat and compost without considering the fertilizer offset of compost

AST fiber flow chart



Result of other studies



Stucki et al., 2019

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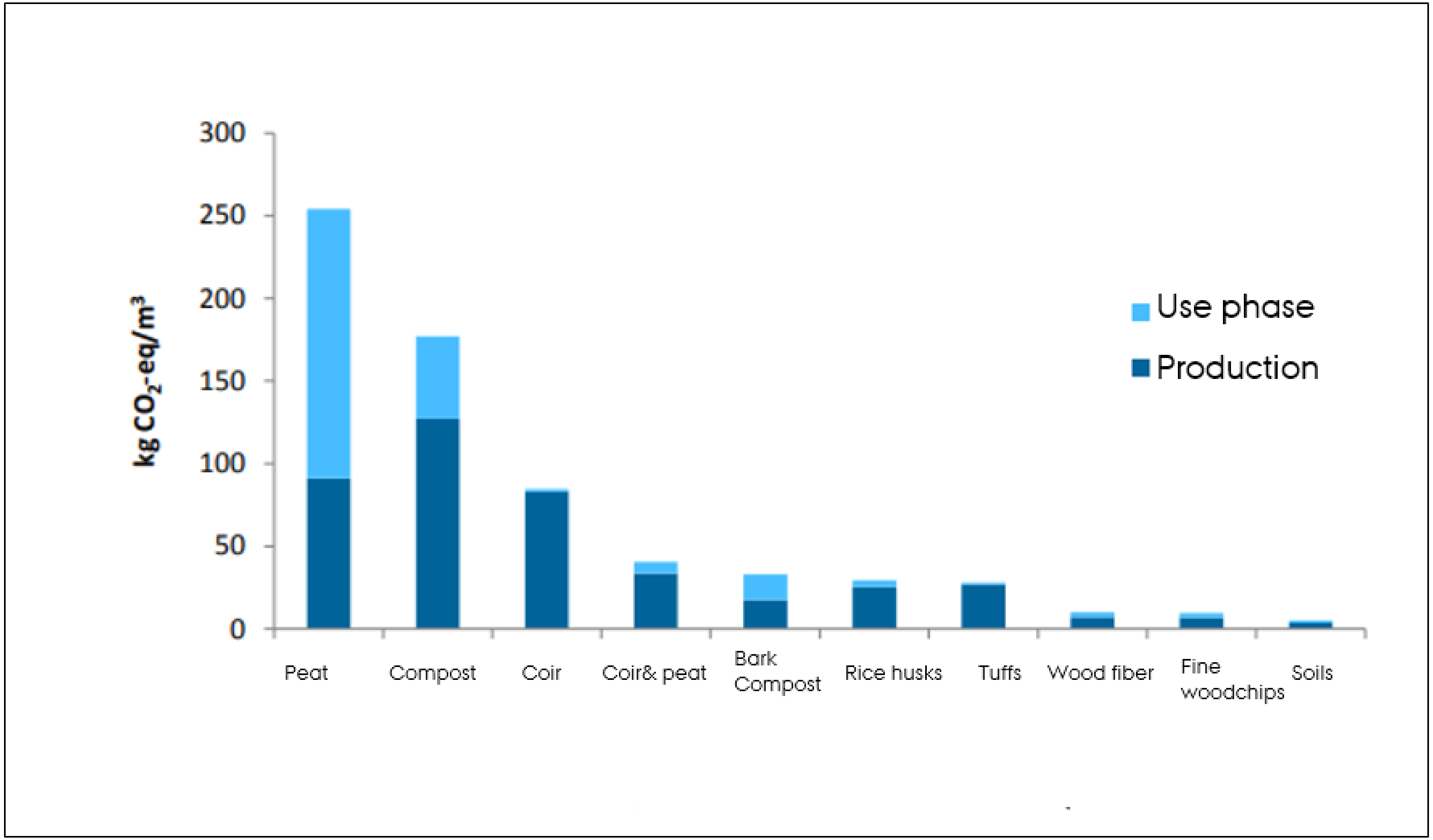
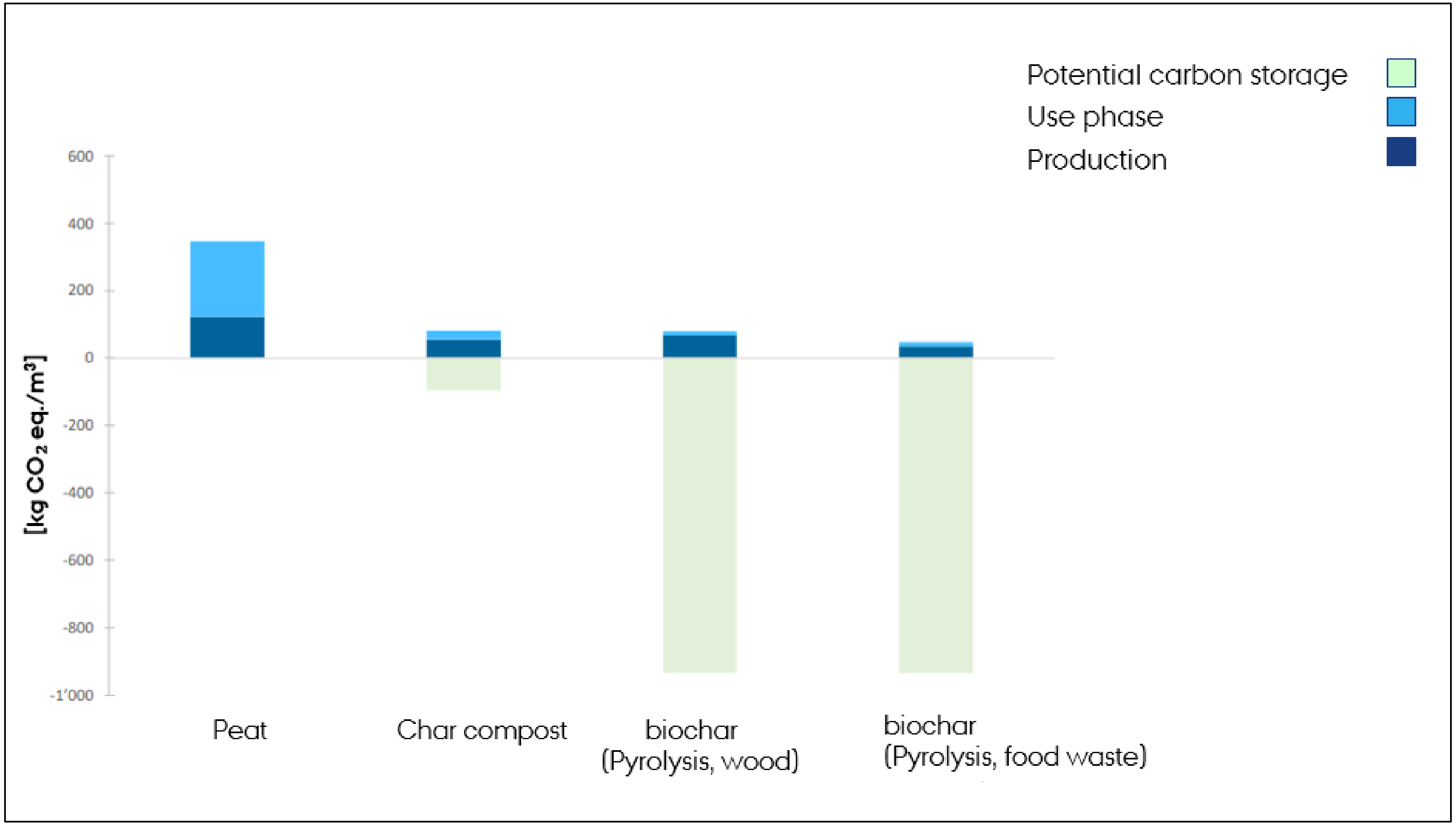


Eymann et al., 2015

Result of other studies



Stucki et al., 2019