

Societal techno-economic assessment

of biochar production and use as soil amendment

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Luca Campion
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OVERVIEW

- Introduction
- Methodology
- Results
- Limitations and future research
- Conclusion
- Discussion

INTRODUCTION

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BIOCHAR

What is it?

BIOMASS



BIOCHAR



APPLICATION



BIOCHAR

What is it used for?

APPLICATIONS

- Soil amendment
- Carbon sequestration
- Plant disease resistance
- Soil decontamination
- Peat substitute
- Water treatment
- Feed additive
- ...

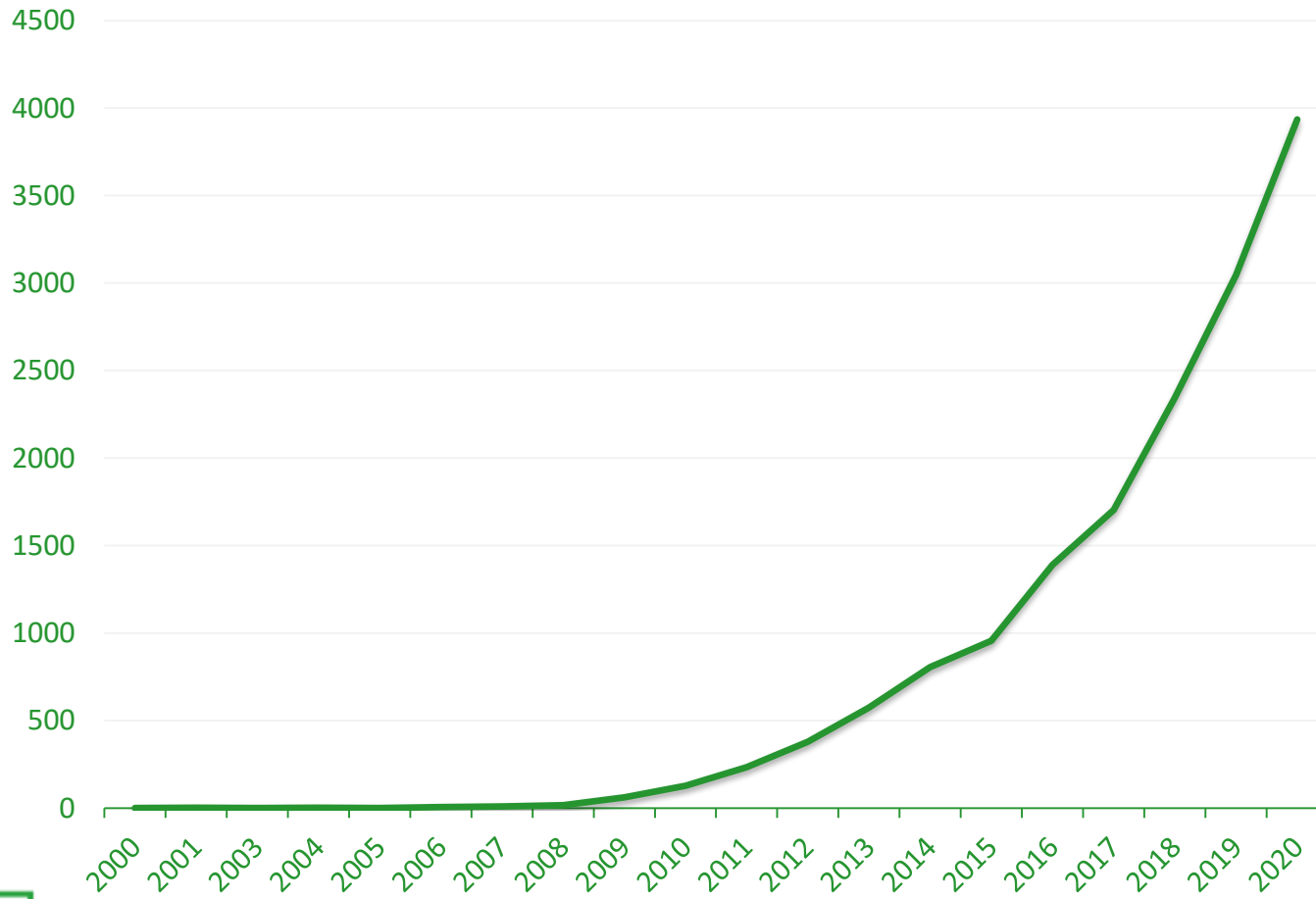
Climate change mitigation

Environmental remediation

Private benefits

BIOCHAR

Increasing research interest



BIOCHAR

Current state

Expectation

Big biochar industry that is well developed

Large scale commercialization is lacking

Reality

BIOCHAR

Possible explanation

Maybe, even though biochar is beneficial to the environment, there is no incentive for people to produce it?

We can investigate the difference between individual and societal value using a societal techno-economic assessment.

METHODOLOGY

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SOCIETAL TECHNO-ECONOMIC ASSESSMENT

Background

Goal

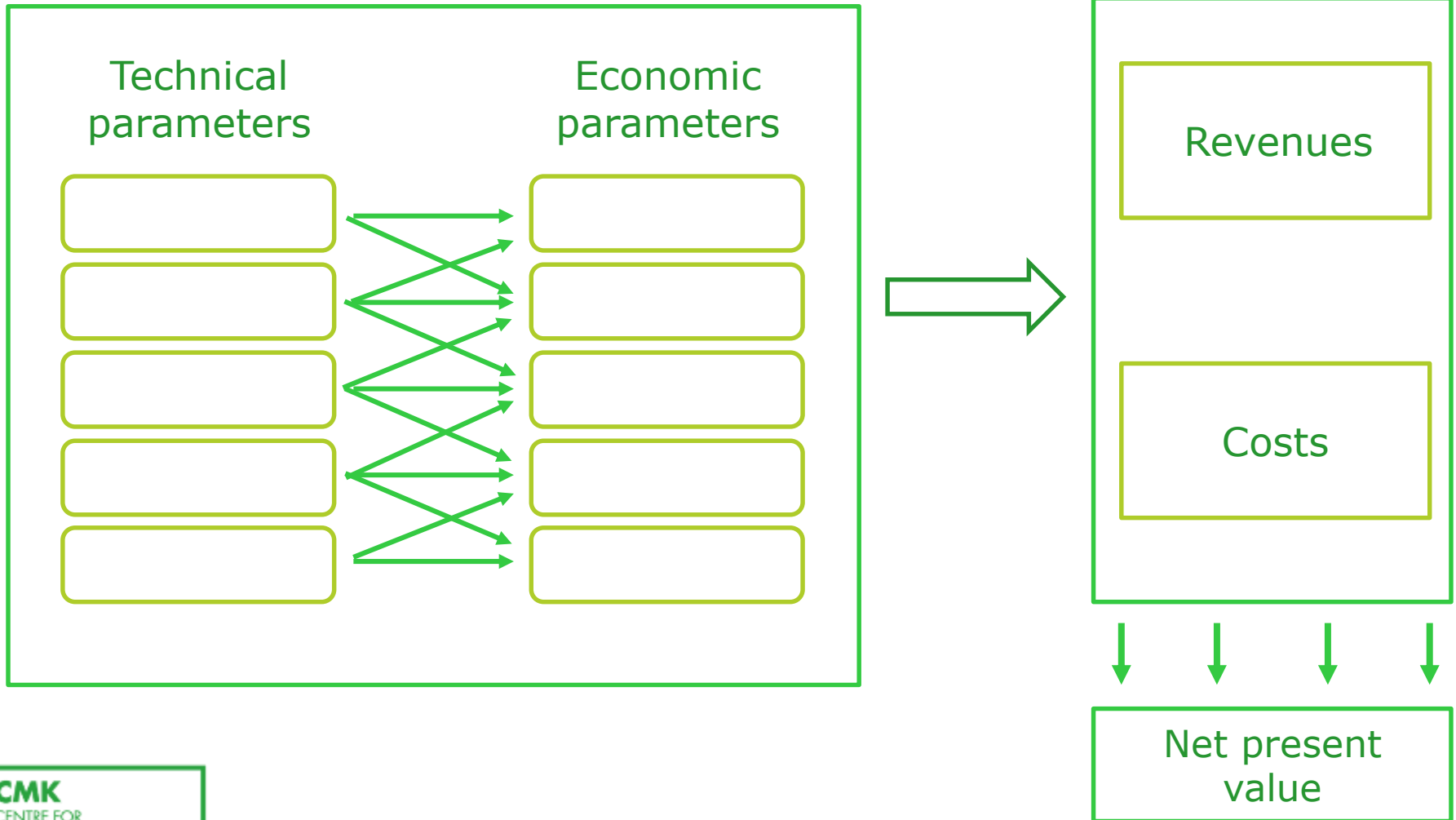
Get the full picture of the technology (economic, environmental and social effects) and still benefit from the variability provided by a techno-economic assessment.

Means

Integrate environmental and social effects in a classic techno-economic assessment through their monetization.

SOCIETAL TECHNO-ECONOMIC ASSESSMENT

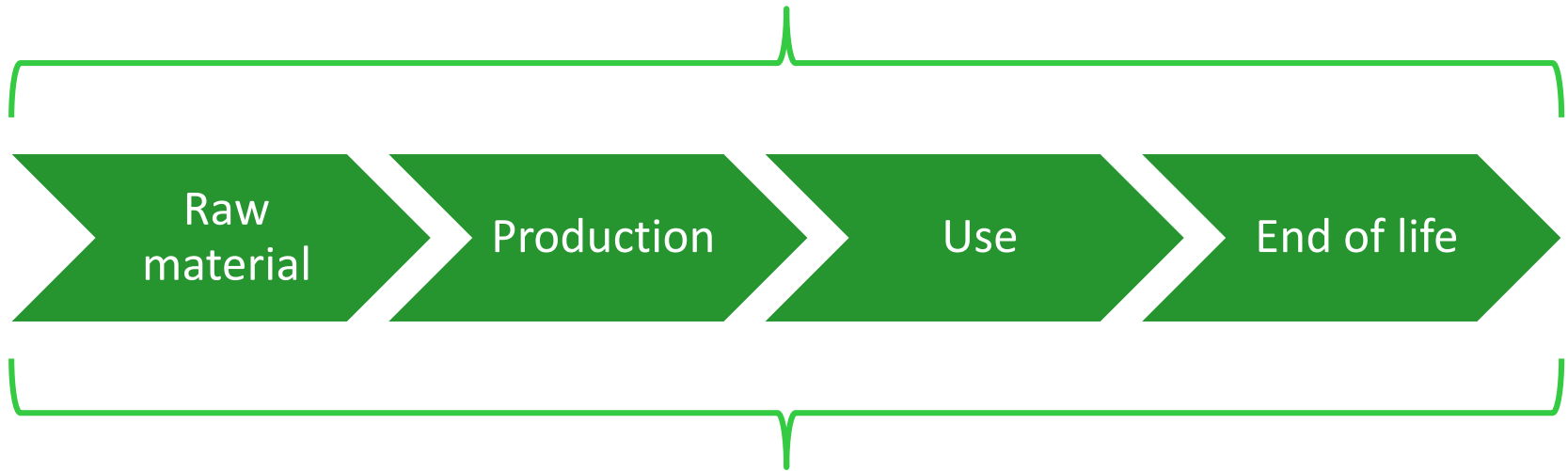
Techno-economic assessment



SOCIETAL TECHNO-ECONOMIC ASSESSMENT

Life cycle assessment

Environmental impacts



Social impacts

SOCIETAL TECHNO-ECONOMIC ASSESSMENT

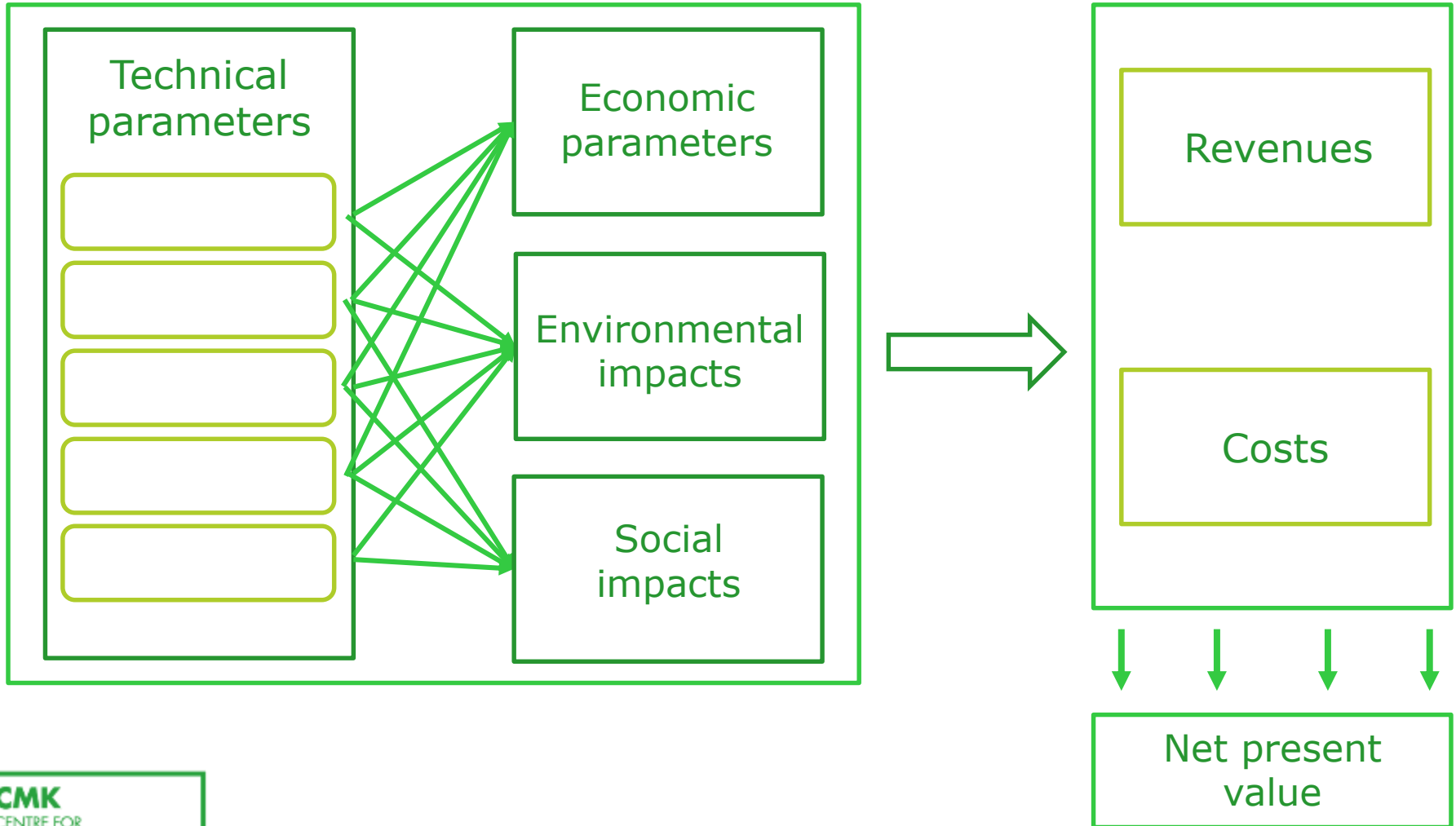
Shadow prices

Shadow prices:

- Represent the societal value of goods for which no market price exists.
- Provide monetary values where these are lacking.

SOCIETAL TECHNO-ECONOMIC ASSESSMENT

Extended techno-economic assessment



RESULTS

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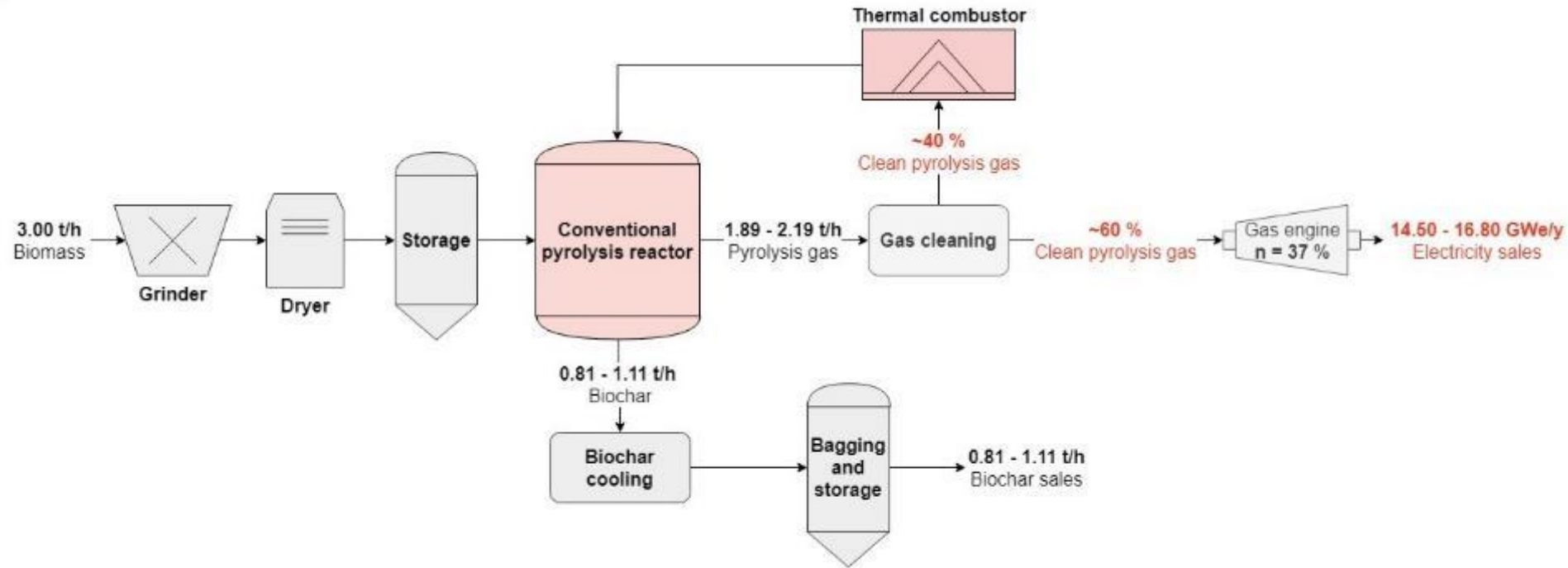
CASE STUDY FOR BIOCHAR

Background

- Biomass waste
 - Medium density fiberboard (MDF)
 - Tree bark (TB)
- Biochar to be used as a soil amendment.

CASE STUDY FOR BIOCHAR

Process description



Haeldermans, T., Campion, L., Kuppens, T., Vanreppelen, K., Cuypers, A., & Schreurs, S. (2020). A comparative techno-economic assessment of biochar production from different residue streams using conventional and microwave pyrolysis. *Bioresource Technology*, 318, 10. doi:10.1016/j.biortech.2020.124083

CASE STUDY FOR BIOCHAR

Private techno-economic assessment

Net present value (million €)

	Static	Dynamic			
		Min.	Mean	Max.	Prob.
MDF	20.34	-27.00	31.95	110.47	91.60%
TB	33.64	-26.34	48.65	145.71	94.90%

Haeldermans, T., Campion, L., Kuppens, T., Vanreppelen, K., Cuypers, A., & Schreurs, S. (2020). A comparative techno-economic assessment of biochar production from different residue streams using conventional and microwave pyrolysis. *Bioresource Technology*, 318, 10. doi:10.1016/j.biortech.2020.124083

CASE STUDY FOR BIOCHAR

Private techno-economic assessment

- The production of biochar is feasible for a private investor. Therefore, this cannot be the reason large scale commercialization is lacking.
- Still, we need to analyze whether value is being created for society as a whole.
- If this is the case, this justifies further research and support.

CASE STUDY FOR BIOCHAR

Life cycle assessment of environmental impacts

Methodological choice:

Zero burden approach



Full burden approach



CASE STUDY FOR BIOCHAR

Life cycle impact assessment

Main results:

- In the full burden case, biochar made from medium density fiberboard (MDF) has a very heavy environmental burden, mostly caused by the glue used for MDF production.
- Biochar made from tree bark, and MDF, in the zero burden case, have positive environmental effects.

CASE STUDY FOR BIOCHAR

Monetization using shadow prices from literature

IMPACT CATEGORY	UNIT	MIN. PRICE	AVG. PRICE	MAX. PRICE
CLIMATE CHANGE	€/tonne CO ₂ eq.	10	84	431
HUMAN TOXICITY	€/kg 1,4-DB eq.	0.0004	0.75528	2.512
FRESHWATER EUTROPHICATION	€/kg P eq.	1.944	5.264	11.904
FOSSIL DEPLETION	€/kg oil eq.	0	0.0001304	0.0005106
IONIZING RADIATION	€/kBq U235 eq.	/	0.0425	/

CASE STUDY FOR BIOCHAR

Societal techno-economic assessment

€	PRIVATE NPV (STATIC)	PRIVATE NPV (DYNAMIC MEAN)	SOCIETAL NPV (ZERO BURDEN)	SOCIETAL NPV (FULL BURDEN)
MDF	20,340,000	31,950,000	438,000,000	- 13,410,000,000
TB	33,640,000	48,650,000	462,560,000	454,200,000

LIMITATIONS & FUTURE RESEARCH

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LIMITATIONS & FUTURE RESEARCH

- Life cycle assessment
 - To what extent should the previous life cycle be included?
 - Extend analysis of use phase
- Shadow prices
 - Tailor to location and time
- Societal techno-economic assessment
 - Social effects

CONCLUSION

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CONCLUSION

A societal techno-economic assessment is a classic techno-economic assessment to which environmental and social effects are added through their monetization.

Biochar production is feasible for a private investor and it creates value for society as a whole, in most cases. Therefore, further research and policy efforts seem warranted to facilitate large scale commercialization.

DISCUSSION

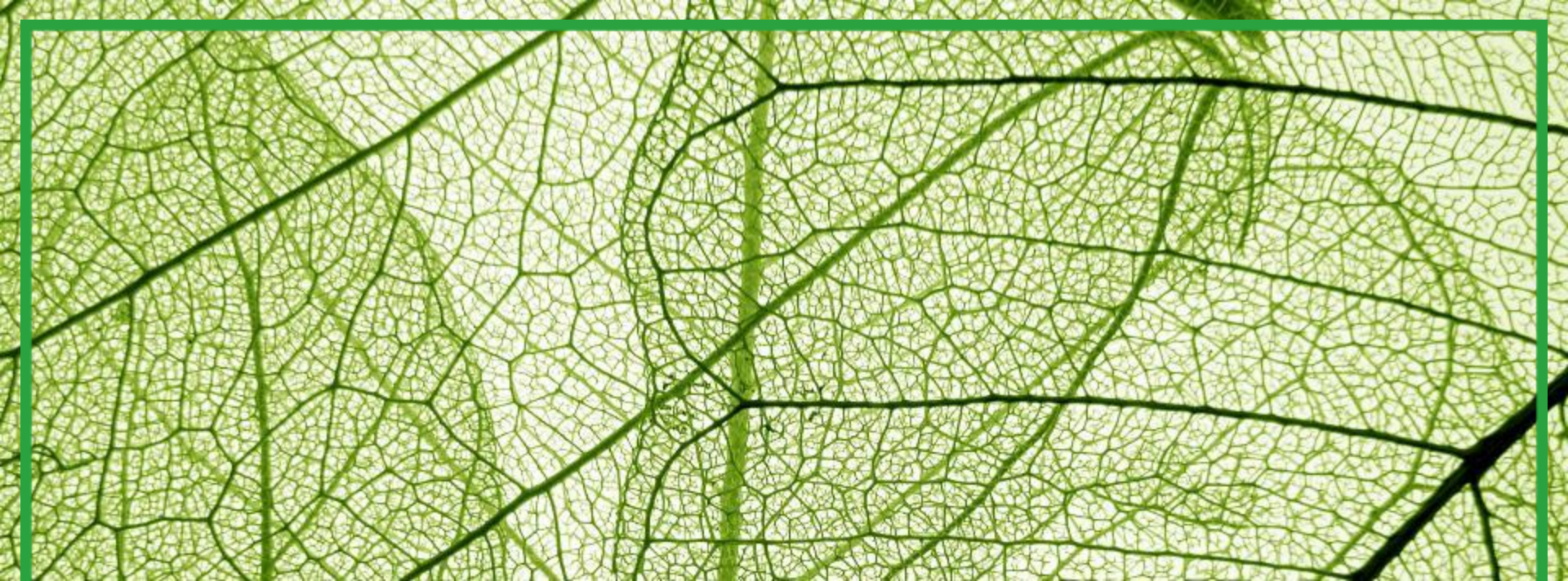
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