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Hemp-lime Insulation: A Climate Friendly Building Material

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1. Motivation

Reduce green house gasses in atmosphere

Reduce emissions

Increase sequestration

Oregon's Climate Action Plan

Clean buildings

Natural and working lands

Hemp-based construction materials

2. Industrial Hemp

What is Industrial hemp?

A variety of Cannabis Sativa L. with no more than 0.3% delta-9 THC

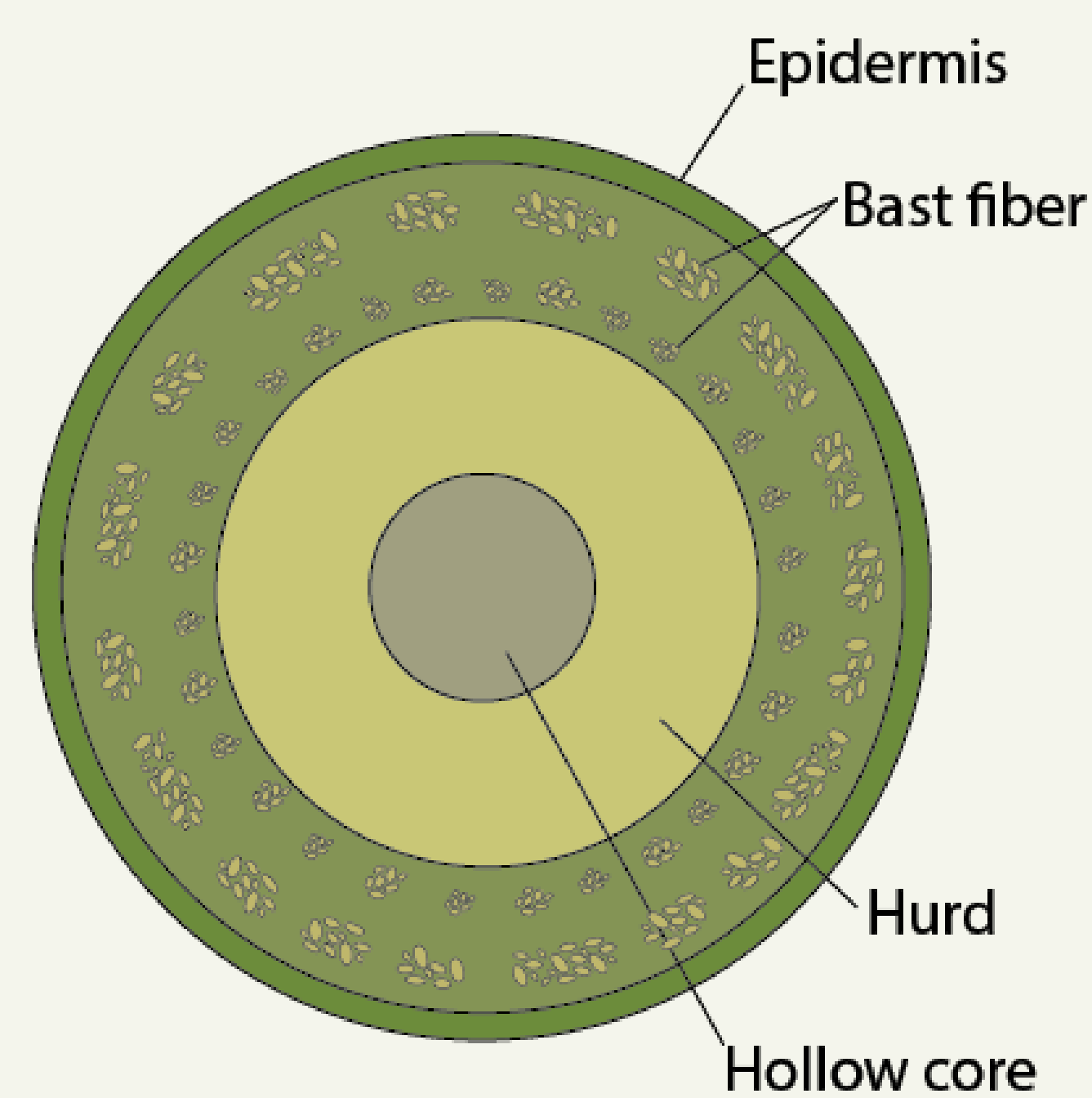
Industrial hemp varietals:

- 1) Flower
- 2) Seed/grain
- 3) Fiber

Environmental benefits:

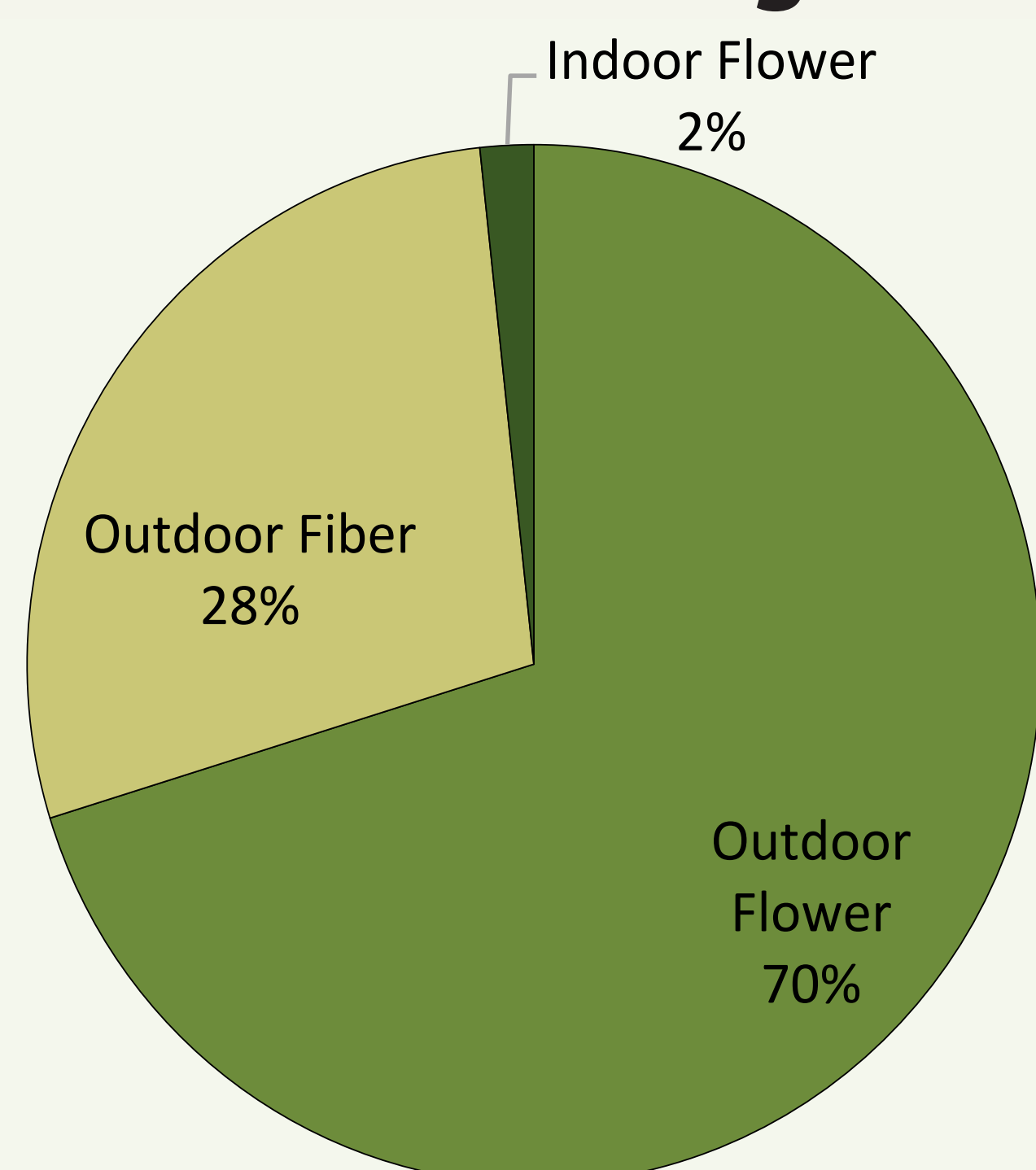
- 1) CO₂ sequestration
- 2) Phytoremediation
- 3) Improves soil quality

Cross Section of Hemp Stalk



3. Oregon's Hemp Industry

Acres of Hemp Grown in Oregon



Source: USDA, 2021

Flower

- Consumer CBD products
- Growth phase limited by over saturated supply
- High margins
- High competition

Fiber

- Industrial products
- Growth phase driven by demand for sustainable materials
- Low margins
- High competition

4. Hemp-lime Insulation

Hemp-lime: A non-structural insulation material made from hemp hurd, a lime-based binder, and water



International Residential Code Commission Proposal RB316-22:

- Defines requirements and limitations of hemp-lime insulation

Hemp-lime characteristics: Non-toxic, mold resistant, improves acoustics of structure, multiple installation methods and applications

5. Research Questions

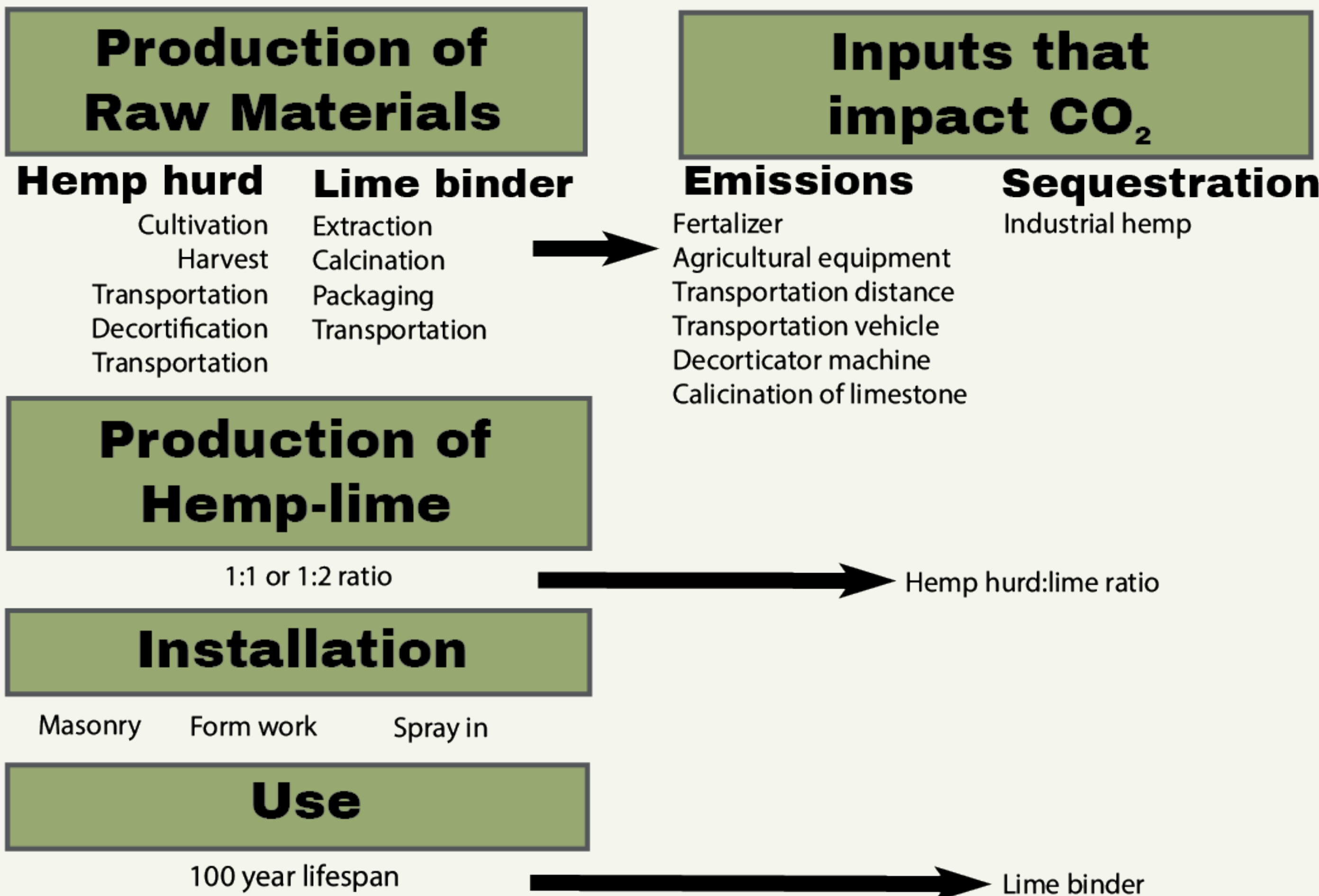
How much CO₂ is emitted by 1 tonne of hemp-lime insulation?

What factors impact CO₂ emissions?

6. Methodology

- 1) Meta-analysis of existing literature
- 2) Multiple variable sensitivity analysis
- 3) Lifecycle assessment of CO₂ emissions

7. Hemp-lime Lifecycle



8. Results

	Scenario 1	Scenario 2
Fertilizer	Good agricultural practice	Pig slurry
Yield estimate (tonne dry hemp/ha)	2.3	2.3
Hemp species	Carmagnola (Fiber)	Carmagnola (Fiber)
Hemp cultivation	ploughing to bailing	ploughing to bailing
Transportation vehicle	Conventional Class 8	Fully Electric Class 8
Warehouse to farm (empty)	100	0
Farm to processor (full)	100	0
Decorticator	FiberTrack 660	HurdMaster (Micro)
Energy source	Hydropower	Hydropower
Warehouse to processor (empty)	100	25
Processor to point of sale (full)	100	25
Binder	Hydrated lime	Hydrated lime
Warehouse to farm (empty)	100	50
Farm to processor (full)	100	50
Mixing (hemp:binder)	1:2	1:1

(1 tonne)	Emission Variable	Scenario 1		Scenario 2	
		Sequestration	Emission	Sequestration	Emission
Dry hemp	Cultivation	-1.333	1.117	-1.333	0.848
	Farm machinery		0.005		0.005
	Transportation		0.037		0.000
Hemp hurd	Decorticator		0.003		0.001
	Transportation		0.037		0.009
Binder	Production		0.001		0.001
	Transportation		0.037		0.003
Hemp-lime	Hemp hurd	-0.453	0.408	-0.667	0.428
	Hydrated lime	-0.0003	0.025	-0.0002	0.002
Total CO₂ emissions		-0.021 tonnes		-0.237 tonnes	

9. Conclusions

- Hemp-lime is carbon negative
- Scenario 1 is estimated to emit an additional 0.216 tonnes of CO₂
 - Fertilizer
 - Transportation distance and vehicle
 - Hemp:binder ratio

Acknowledgments

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