

**VALUTAZIONE DELLE BRICCHETTE DI MATERIALE
CELLULOSICO COME COMBUSTIBILE ALTERNATIVO:
APPLICAZIONE DELL'APPROCCIO LIFE CYCLE THINKING
AD UN CASO STUDIO BOLIVIANO**

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Introduction: *LaPazRecicla* project

LaPazRecicla: project founded by the Italian Agency for Development Cooperation (AICS) and led by the Italian NGO COOPI in LaPaz with collaboration of University of Insubria and University Mayor de San Andrés (BO).

The aim of the project is to improve the sustainability of the city of La Paz through the introduction of adequate MSW recycling systems favoring the recovery of materials to activate a circular economy.

Waste-based briquette production generated with:

- 80% of non-recyclable cardboard waste
- 20% of sawdust waste

Possible uses:

- Heating
- Local small-scale factories



Methods: Life Cycle Thinking

Life Cycle Thinking

Conventional fuels



Environment

Life Cycle Assessment
Environmental assessment vs
conventional fuels

Briquettes



Social

S-Life Cycle Assessment
Qualitative analysis according to
UNEP guidelines

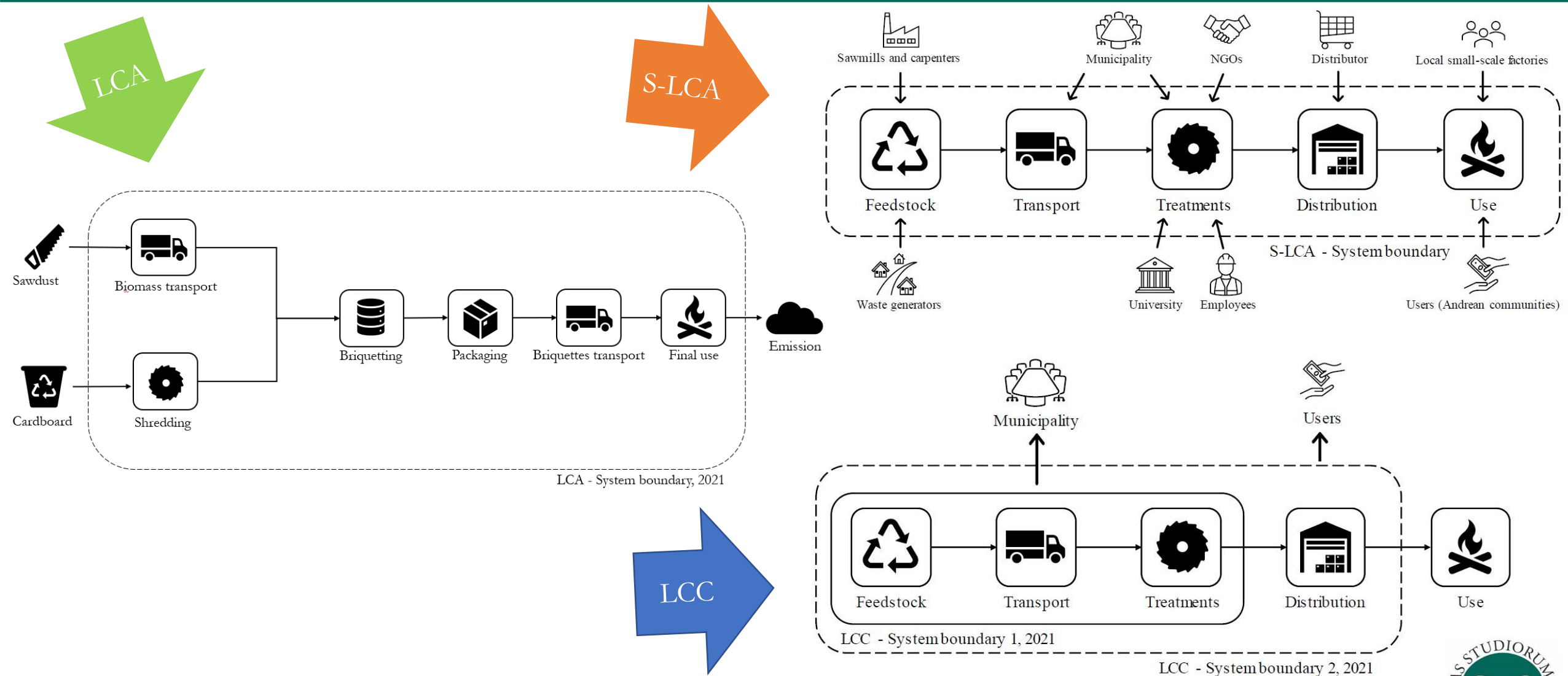


Economic

Life Cycle Costing
Definition of cost per unit of
energy (MJ)



Methods: system boundaries



Results: Life Cycle Assessment

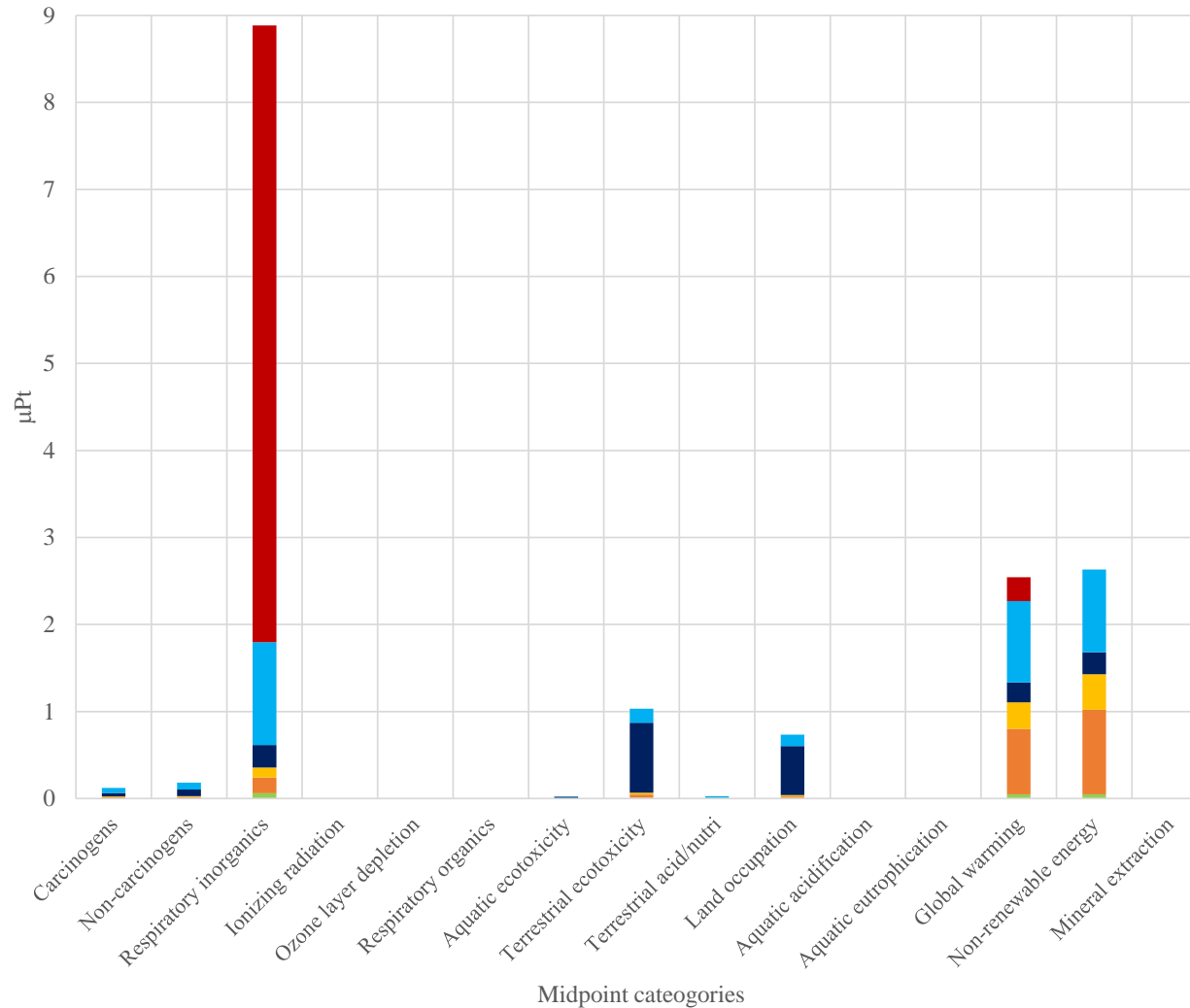


Software: SimaPro v.9.0

Database: Ecoinvent v.3.5

Impact assessment method:
IMPACT 2002+

Functional Unit: 1 MJ of gross
energy obtained from briquettes
combustion



- Final use
- Briquettes transport
- Packaging
- Briquetting
- Shredding
- Biomass transport



25.2 g CO₂ eq MJ⁻¹



0.4 MJ primary MJ⁻¹



Results: Life Cycle Assessment fuels comparison



- Natural gas: +13%
- LGP: +23%
- Coal: +230%



Results: Life Cycle Costing

Municipality costs

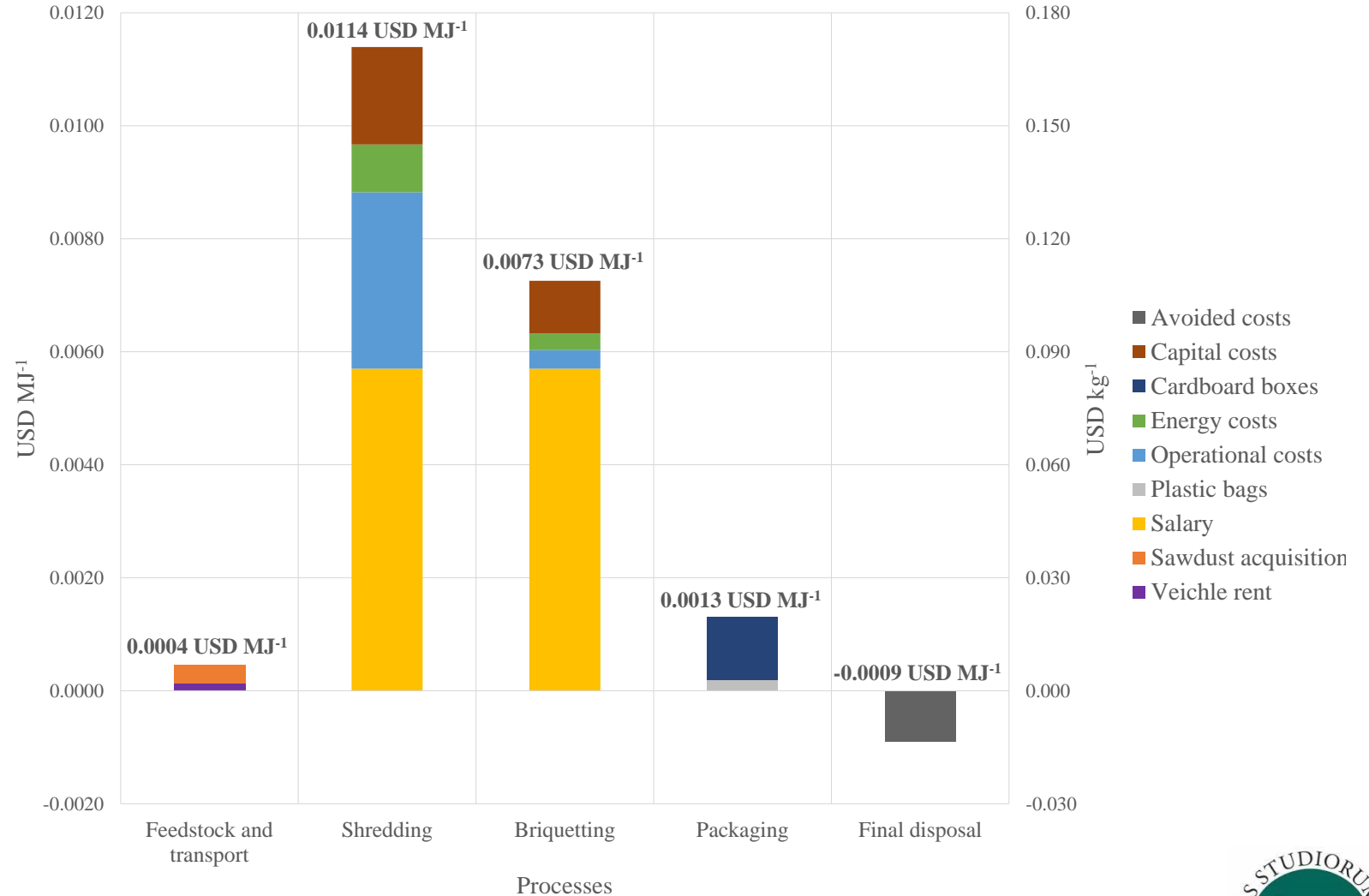
Tot
0.0195 USD MJ⁻¹

Tot
0.260 USD kg⁻¹

Final price:

- VAT 13%
- Monthly salary 540 USD
- Increased price 52%
- Transport cost 0.033 USD kg⁻¹

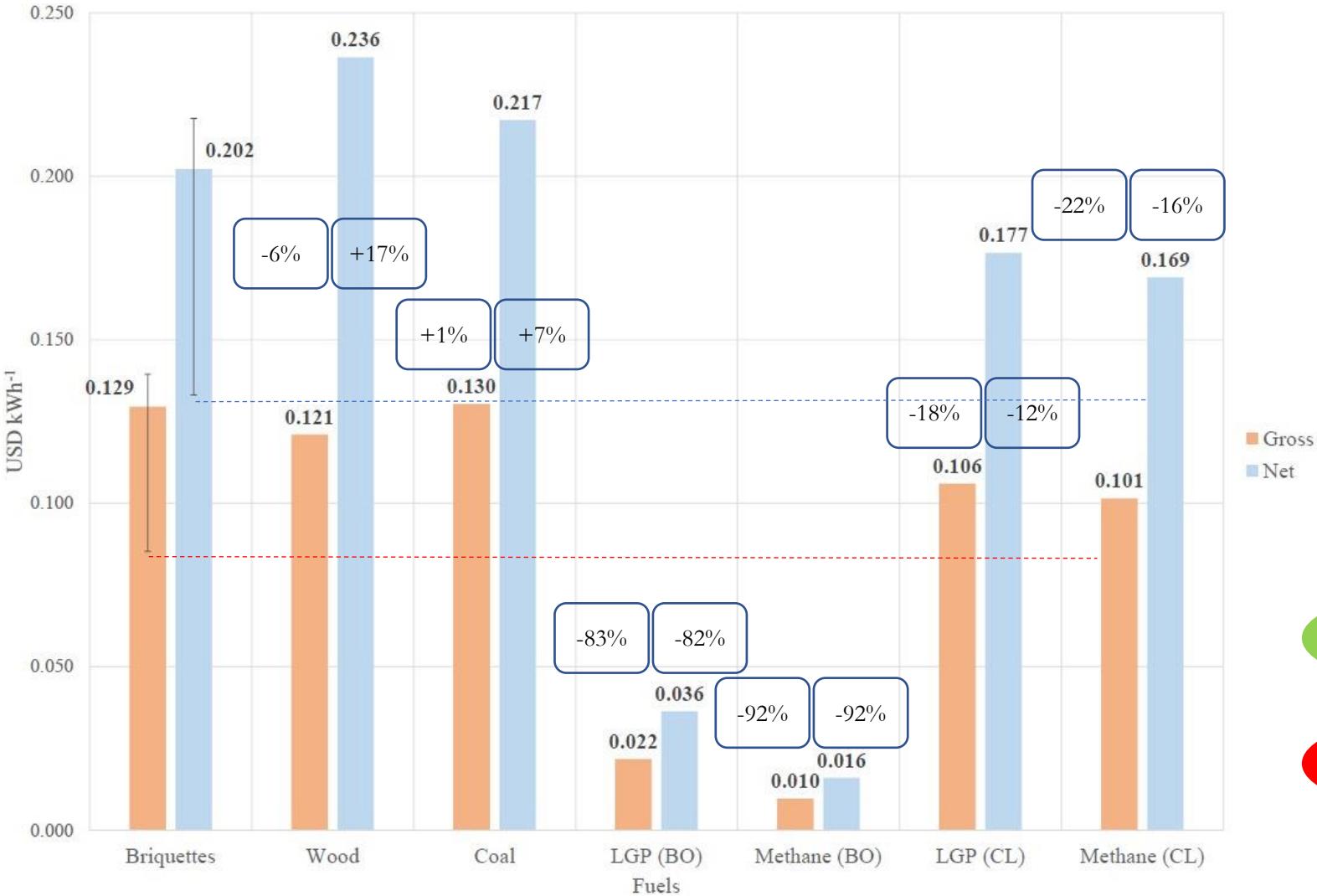
Tot
0.479 USD kg⁻¹



Results: Life Cycle Costing fuels comparison

Tot
0.202 USD kWh⁻¹

Tot
0.129 USD kWh⁻¹



Chile
(nonsubsidized)

Bolivia
(subsidized)



Results: Social Life Cycle Assessment

- Qualitative analysis
- Identified the stakeholder categories from UNEP guidelines
- Selected ten impact subcategories
- Comparison with business as usual (BAU)

Stakeholder category	Impact subcategory	Better fuel consumption
Value chain actor	Fair competition	Briquettes
	Promoting social responsibility	Briquettes
	Supplier relationships	Briquettes
Society	Public commitments to sustainability issues	Briquettes
	Contribution to economic development	BAU
	Technology development	Briquettes
Workers	Fair salary	BAU
	Social benefits	Briquettes
Consumer	Health and Safety	BAU
	Feedback mechanism	BAU

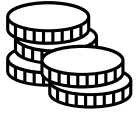


Briquettes are better than BAU in six impact categories

Conclusions: consideration about results



Briquettes **appear to have better environmental performance** than conventional fuels. In detail, the environmental impacts are higher respectively for natural gas, LPG and coal by 13%, 23% and 230%.



The estimated **consumer's price** of final product is 0.479 USD kg⁻¹, which is equal to 0.129 USD kWh⁻¹ (ranging from -34% to +7%). Although the cost per kWh is higher than LPG and methane (in Bolivia), it **remains lower than wood and coal**.



From a social point of view, briquettes encourage the separate collection and waste valorization with the introduction of new sustainability technologies, although the disadvantages mainly concern the indoor emissions of particular matter compared to natural gas.

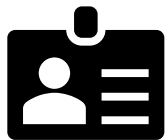


On balance, the results indicates that waste-based briquettes can have environmental, economic and social benefits compared to fossil fuels, although it is necessary to support its diffusion in Bolivia through incentives and market analysis.





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