# LCA of Fortuna Fish Packing Cooler

FORTUNA
COOLERS MADE FROM COCONUTS

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## INTRODUCTION

### GOAL

- To assess energy consumption used to produce coconut-based fish packing cooler in the Philippines by:
  - Comparing the product to commonly used expanded polystyrene (EPS) foam cooler.
  - Identifying significant energy consumption stages of the manufacturing process of the coconut cooler.
- To provide Fortuna Cools with comparative data about their product so that they can make informed design and operations decisions based on environmental impacts.

## BACKGROUND

### SIGNIFICANCE

Annually, 9 billion coconut husks are burned as garbage in the Philippines, releasing $CO_2$. Also, EPS foam coolers are used by many fishermen and discarded into landfills where they gradually decompose over 500 years.


Fortuna Cooler

EPS Cooler

Start-up company Fortuna Cools seeks to repurpose coconut husks into fishing coolers and create an environmentally friendly product that can reduce $CO_2$ emissions and provide an economic boost for small impoverished coconut farmers.

### ASSESSMENT RESOURCES

A life cycle assessment compared the Fortuna fish packing cooler and an EPS cooler using the ISO 14040 framework. Information from company sponsors was used in conjunction with SimaPro software (commonly used for LCAs) to create a quantitative analysis of each cooler's respective energy consumption and impacts.

## LCA SCOPE & METHODS

### FUNCTIONAL UNIT

The functional unit used in this analysis is the energy associated with the production of one (1) Fortuna cooler expected to be used 2-3 times per week for its lifetime of 1 year, or 52 weeks. The analysis period is the 1-year lifetime.

The estimated volume of production in one year is 3,120 coolers based on PVC liner as the limiting input.

### SYSTEM BOUNDARIES - CRADLE TO GATE

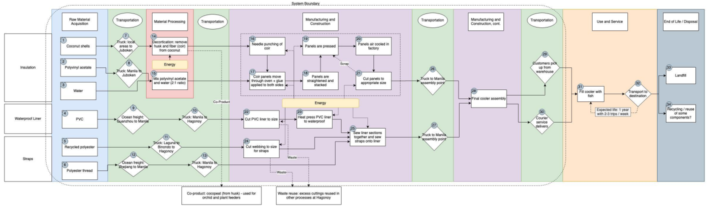
The system boundaries capture energy from the initial material acquisition of liner, coconut waste, and glue to when the cooler product is delivered to the user.

### LIFE CYCLE INVENTORY

The life cycle inventory quantified energy usage for each stage of the cradle-to-gate process. Use and disposal phases were not included in this analysis because the company is less than 3 years old.

### PROCESS FLOW DIAGRAM

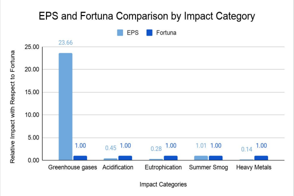
The process flow diagram below displays the life cycle of the cooler from raw material acquisition to the landfill disposal of the cooler. Material and energy inputs are tracked at each stage of the manufacturing and transportation process.



## RESULTS

### ENVIRONMENTAL IMPACT COMPARISON

- Analysis shows that greenhouse gas impacts from the Fortuna cooler are almost 24 times lower than the EPS cooler. Emissions for other impact categories are similar for both products.
- Given the magnitude of the greenhouse gas emissions produced by EPS coolers and the urgency of its reduction (compared to the urgency of reducing other emissions) we feel that **the Fortuna cooler has an overall lower environmental impact.**




### ENERGY COMPARISON

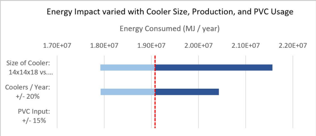
- The table to the right shows that transportation between various manufacturing processes consumes the most energy in the product's life cycle.
- Note that crafting by hand in the final cooler assembly consumes zero MJ of energy but does require manual labor.

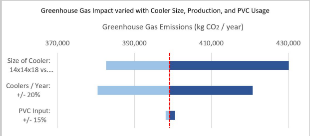
| Energy Input by Process | | |
|---|---|---|
| **Description** | **Value** | **Units** |
| Raw Material Acquisition | 0.00 | N/A |
| Transportation - coconuts to Juboken | 2471407.59 | MJ per year |
| Material Processing | 219505.39 | MJ per year |
| Transportation - glue, liner, webbing | 1298738.39 | MJ per year |
| Manufacturing and Construction | 444157.08 | MJ per year |
| Transportation to Manila | 14641379.95 | MJ per year |
| Final cooler assembly | 0.00 | MJ per year |
| Transportation to customer | 2120.20 | MJ per year |

### SENSITIVITY ANALYSIS

Increasing the cooler volume by 40% created the most significant increase in energy consumption and greenhouse gas production.

1. **Size of cooler** (status quo 16" x 16" x 22")
   -- smaller 14" x 14" x 18" vs. larger 20" x 20" x 24"
2. **Annual cooler production** (status quo 3,120 coolers)
   -- decrease 20% vs. increase 20%
3. **PVC Input** (status quo 0.9 kg)
   -- decrease 15% material vs. increase 15% material




## CONCLUSION AND RECOMMENDATIONS

### CONCLUSION

The Fortuna cooler has lower associated greenhouse gas emissions compared to the EPS cooler. The capability of coconut husks to be degraded and converted into a biodegradable compost and fertilizer minimizes the energy requirement towards the end-of-life disposal.

Note: End-of-Life (EoL) has been excluded from scope. This assessment calculates that 26 EPS coolers are needed to replace each Fortuna cooler. Thus, it is likely that the EoL emissions for EPS would be higher than those for the Fortuna cooler.

### RECOMMENDATIONS

- We have provided an editable spreadsheet for our project sponsors to manipulate design and operations variables. We recommend the following:
  - Closely tracking use phase for additional impact.
  - Varying the PVC material usage to reduce heavy metals impact.
  - Completing studies on end of life (potentially composting coir and recycling PVC).

## REFERENCES & ACKNOWLEDGEMENTS

### REFERENCES

- SimaPro ™ Software, Ré Sustainability B.V.

*Complete assumptions and references in report.*

### ACKNOWLEDGEMENTS

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