Environmental Comparison

Bettercup / Compostable / Plastic Cups

Green Music Australia & Bettercup

OVERVIEW

This feasibility study compares Bettercup's reusable product with the common products they are replacing, namely compostable cups and single-use plastic cups. The goal of this study was to assess the environmental impact of replacing single use cups (compostable or plastic) with reusable cups by comparing energy and water usage. The comparison focuses on two stages of the product life-cycle:

1. Upfront energy and water consumption of manufacturing reusable cups vs compostable cups vs single-use plastic cups.
2. The energy and water required for cleaning reusable cups vs producing an equivalent number of single use cups (both plastic and compostable)

DATA / METHODOLOGY

Reusable Cup (Bettercup)

Bettercup uses food-grade polypropylene (PP) to create their tumbler cups in their Melbourne factory. It is noted that all water in the process is recycled, cooled through the chiller system and pumped through the machinery while manufacturing, so no water is lost in the process. An exception to this is when the cups change colour, which causes the loss of 2L of water during changeover. This study will assume no colour changes will occur and net water use will be zero. The cups can be recycled at the Bettercup factory into materials like garbage bins and outdoor furniture.

Compostable Cup (BioPak)

The compostable cup selected for comparison was BioPak's tumbler, a commonly used clear 'bioplastic' cup. Made from Ingeo Polyactic Acid (PLA) biopolymers, the cups are certified commercially compostable. The cups require energy to both manufacture the PLA polymers and thermoform the polymers into cups. This report assumes that once used, the cups are commercially recycled, however it is noted a significant portion of compostable cups will end up in landfill at events, which does not allow the cups to biodegrade.

Single-use Plastic (polystyrene) Cup

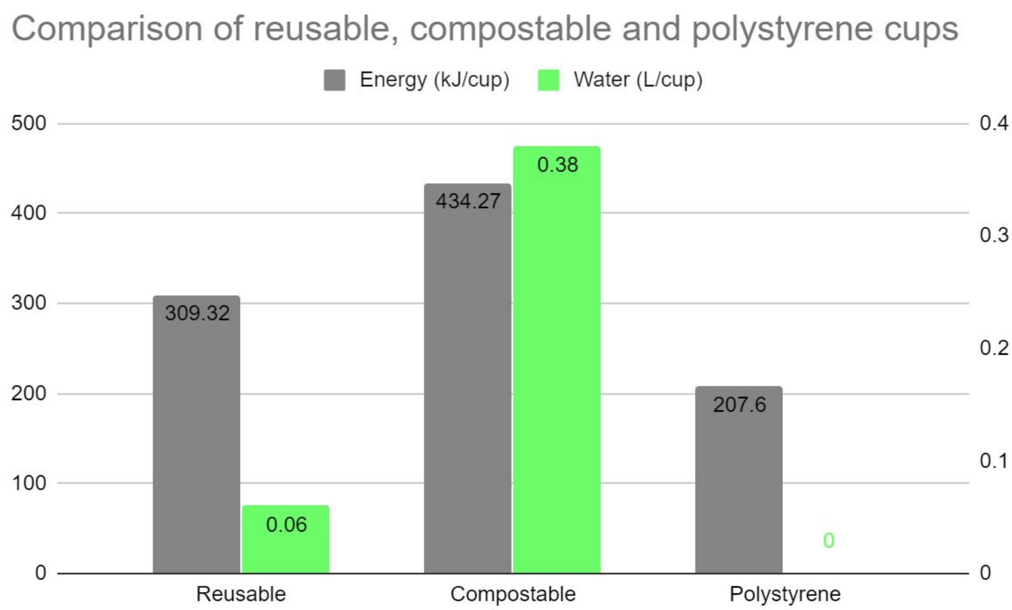
The cup selected for comparison was a standard 470 ml (16 oz.) plastic (polystyrene) drinking cup, commonly used at parties and events. Energy data for the manufacturing of one polystyrene cup was collected from a Canadian study by Hocking (1994), which compared various single-use cups to reusables. Though these cups can be recycled, it is noted that many end up in landfills, and they are not biodegradable.

RESULTS

Overall, the energy consumption for polystyrene is the lowest, with reusable cups (including the energy required to wash once) in the middle, and compostable PLA cups requiring the most energy (Table 1). The **breakeven point** is calculated as (energy required to produce 1 reusable cup) / (energy for 1 disposable cup - energy to wash one reusable cup). Consequently, a **Bettercup only has to be used 2 times** before it is more sustainable than one plastic polystyrene cup, and it is overall more sustainable (including washing) than one compostable PLA cup.

Table 1. Comparison for reusable, compostable and polystyrene cup

(all data to 2 d.p.)		Reusable Bettercup	Compostable PLA cup	Single-use polystyrene cup
Water usage comparison (L/cup)	Manufacturing consumption	-	0.38	-
	Water required to wash cups	0.06	-	-
	Total	**0.06 L/cup**	**0.38 L/cup**	**0.0 L/cup**
Energy usage comparison (kJ/cup)	Manufacturing consumption	249.23	434.27	207.6
	Energy required to wash cups	60	-	-
	Total	**309.32 kJ/cup**	**434.27 kJ/cup**	**207.6 kJ/cup**



Assumptions

Where it has not been possible to collect sufficient data, previous studies have been used to assume quantities. Additionally, nearly all reports said water usage for polystyrene was low and difficult to determine, due to discrepancies between what water is actually used, and what is recycled through a cooling process. However, like other research, this report does assumes that water use for polystyrene is significantly lower than compostable, as polystyrene requires no need to wash the raw material, unlike compostable cups .

Limitations

It is noted that this report does not include transportation of materials or the cups themselves, and it also does not calculate the emissions from obtaining materials such as oil (for polystyrene and the reusable Bettercup), as well as plant matter for the compostable cups. The report is only focused on the energy and water usage of creating one cup, and washing it, if it's a reusable cup.

REFERENCES

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APPENDIX

Table 1. Bettercup manufacturing energy use per cup, assuming 195 cups per hour (2019)

Manufacturing item	Energy use (kW/hr)	Energy use (kJ/hr)	Energy (kJ/cup)
Moulding Machine incl. Robot	7.5	27000	138.46
Water Chiller	1	3600	18.46
Water Pumps	1	3600	18.46
Compressor	4	14400	73.85
Total energy use per cup	**13.5 kW/hr**	**48600 (kJ/hr)**	**249.23 (kJ/cup)**

Table 2. BioPak PLA energy/water requirements, assuming one cup weighs 10.8g (2018)

Manufacturing of..		Energy for polymer production	Per cup
Polymer from plant matter	Water	35 L/kg	0.378 L/cup
	Energy	40 MJ/kg	432 kJ/cup
Thermoformed cup	Water	-	-
	Energy	0.21 MJ/kg	2.268 kJ/cup
Total	**Water**	**0.378 L/cup**	
	Energy	**434.268 kJ/cup**	

(Water is not consumed during the thermoforming of cups as it is only used for cooling, and the water used for this is recycled in a closed loop at the factory.)

Table 3. Polystyrene energy and water use per cup

Assuming one cup weighs 1.5 grams, a single plastic cup takes 138 kJ/g (Hocking, 1994), resulting in 207.6 kJ/cup. Water use to cool the polystyrene cup is recycled in a closed factory loop (Chandra et al., 2016).