

BIGGBY COFFEE PET Cup Environmental Impact: Comprehensive LCA of Varying End-of-Life Scenarios (Under NDA)

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Client: BIGGBY COFFEE

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Background

Today, it is reported that over 69% of people in the United States are concerned about climate change. ¹ This has resulted in increased awareness of sustainability practices, and many companies are working on being more sustainable. Biggby Coffee is working to implement more sustainable practices into their business model. Ian Sanwald, BIGGBY's communications manager, reached out to the senior design project team to analyze the environmental impact that they are currently producing as a company. This was done by completing a life cycle assessment of four different end of life scenarios for Biggby's plastic cup used for cold beverages, composed of polyethylene terephthalate (PET). The disposal methods analyzed were landfilling, physical recycling, combustion, and chemical recycling. To quantify the environmental footprint the team utilized five different impact categories; global warming potential, eutrophication, water use, energy demand, and smog potential.

Objectives & Constraints

This project had some key objectives that needed to be met.

- Quantify Biggby Coffee's impact from using single-use plastic beverage cups.
- Compare varying end-of-use scenarios.
 - Landfill
 - Physical recycling
 - Combustion
 - Chemical Recycling

Some constraints were also identified for the project.

- Project team has no authority over franchised locations.
- Must follow Michigan's Public Health Code, section 4-204.13 (A), (B), and (D).²
- FDA Impact Assessment section 40 of the Code Federal Regulations (CFR) Part 258.
 - Plastics combusted to be disposed of must be non-volatile. ³
- PET waste may not be returned to food grade quality.
- Cup collection must be outside.

Design Alternatives

Landfill

- In 2018, 75.6% of the PET that was created was disposed in landfills. ⁴
- PET is inert. ⁵
- Impacts will be from creation of PET

Physical Recycling

- Involves melting PET without breaking down the individual polymer. ⁶
- Not all recycled PET is food grade quality.
- Multistep process including: ⁶
 - Collection and Sorting
 - Washing
 - Melting
 - Reforming



Figure 1: Recycled PET Pellets. ¹¹

Combustion



- Reaction is done at over 500°C. ⁷
- The process gives off heat that can be used as power.
- Heating value estimated to be 23.8 MJ/kg PET. ⁷

Chemical Recycling

- PET is depolymerized into its original monomers. ⁸
- Dimethyl terephthalate and ethylene glycol are the resultant monomers. ⁹
- These monomers can be repolymerized into new PET. ⁹

Analysis

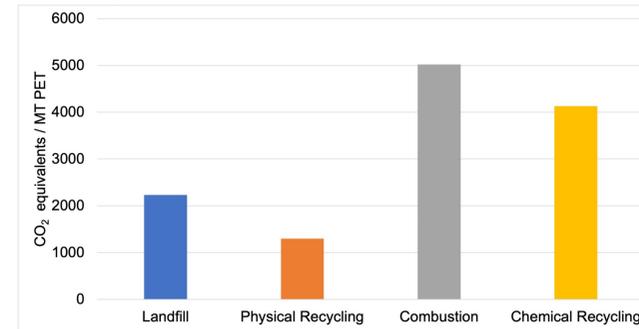


Figure 2: Global Warming Potential per 1 tonne of PET

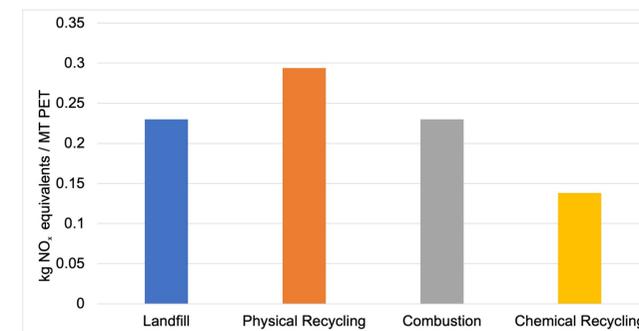


Figure 3: Eutrophication Potential per 1 tonne of PET

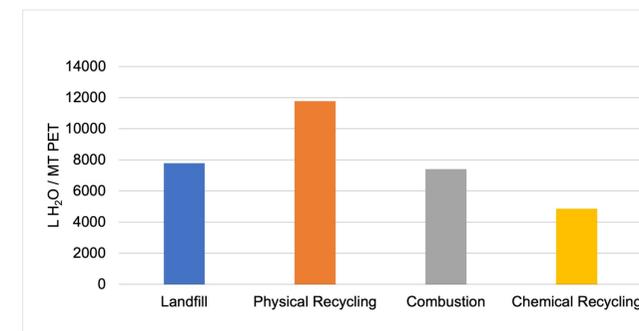


Figure 4: Water Consumption per 1 tonne of PET

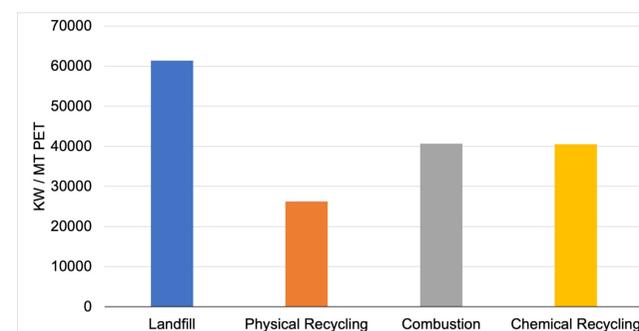


Figure 5: Energy Demand per 1 tonne of PET

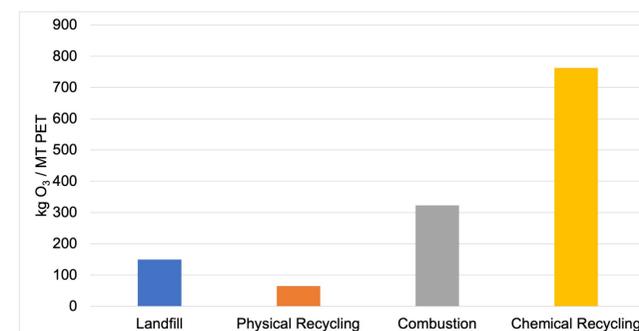


Figure 6: Smog Potential per 1 tonne of PET

Economics & Conclusion

After completing the analysis, it was found that physical recycling was the optimum disposal method for BIGGBY COFFEE PET cups. It had the lowest impact in three out of the five impact categories: smog potential, global warming potential, and energy usage.

Moving forward, suggestions will be given to BIGGBY on what can be done to minimize the impact. BIGGBY COFFEE uses clear PET, which is considered high quality, meaning products sent to reclaimers will be 100 percent likely to be recycled. One suggestion to minimize impact is to increase collection efficiency by setting up a PET cup collection program, rewarding consumers for recycling PET cold cups. BIGGBY does not own a reclaimer facility so the cost to process consumer grade PET back into recycled PET will not be absorbed by them.

Since BIGGBY does not own their own facility, they would need to set up contracts with local recycling plants. These plants could also provide bins which would allow BIGGBY patrons to dispose of their cups. PET prices are currently high, estimated at a value of around \$1,100 per tonne of clear PET¹⁰. BIGGBY COFFEE utilized 188 tonnes of PET for cold cups in 2019. Due to the high volume of cups that BIGGBY produces, recycling facilities would most likely want to partner with BIGGBY.

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