

Financial, Logistical, and Environmental Analysis of Reusable Water Bottle Filling and Cleaning Device for the Homeless Population in Phoenix

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Background

This project began when Mary Contreras of Women of Valley of the Sun United Way, a philanthropic social services organization, launched a single use water bottle drive that donated over 400,000 water bottles to the City of Phoenix homeless shelters in 2021. In search of a more sustainable option, Mary Contreras reached out to Dr. Trimble to mentor a reusable water bottle project of GCSP students. This exploratory research supports the overall project effort.

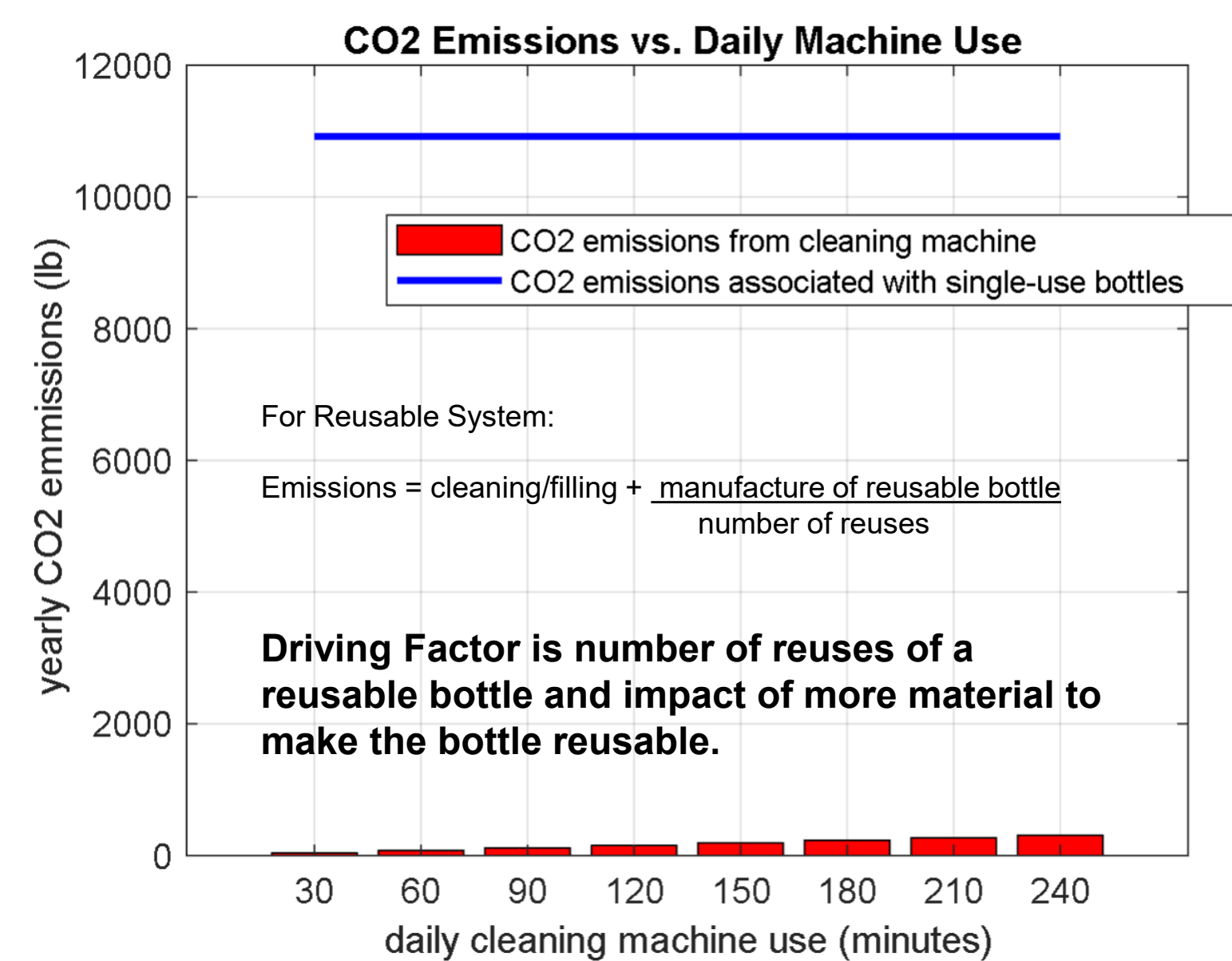
Abstract

This exploratory research project identified the variables involved in comparing a reusable versus single use water bottle system. Mathematical models for comparing the environmental and financial impacts of the two approaches were initiated. A baseline concept for a reusable bottle system was developed by the larger research group. This was used to make initial comparisons between aspects of the two systems. The specific needs of the City of Phoenix homeless shelters were investigated along with existing products available for cleaning and filling reusable bottles. For example, initial results shown below indicate that the number of refills per bottle rather than the cleaning/filling process is the driving factor. Work continues on refining these comparison models in parallel with further development of the reusable water bottle system.

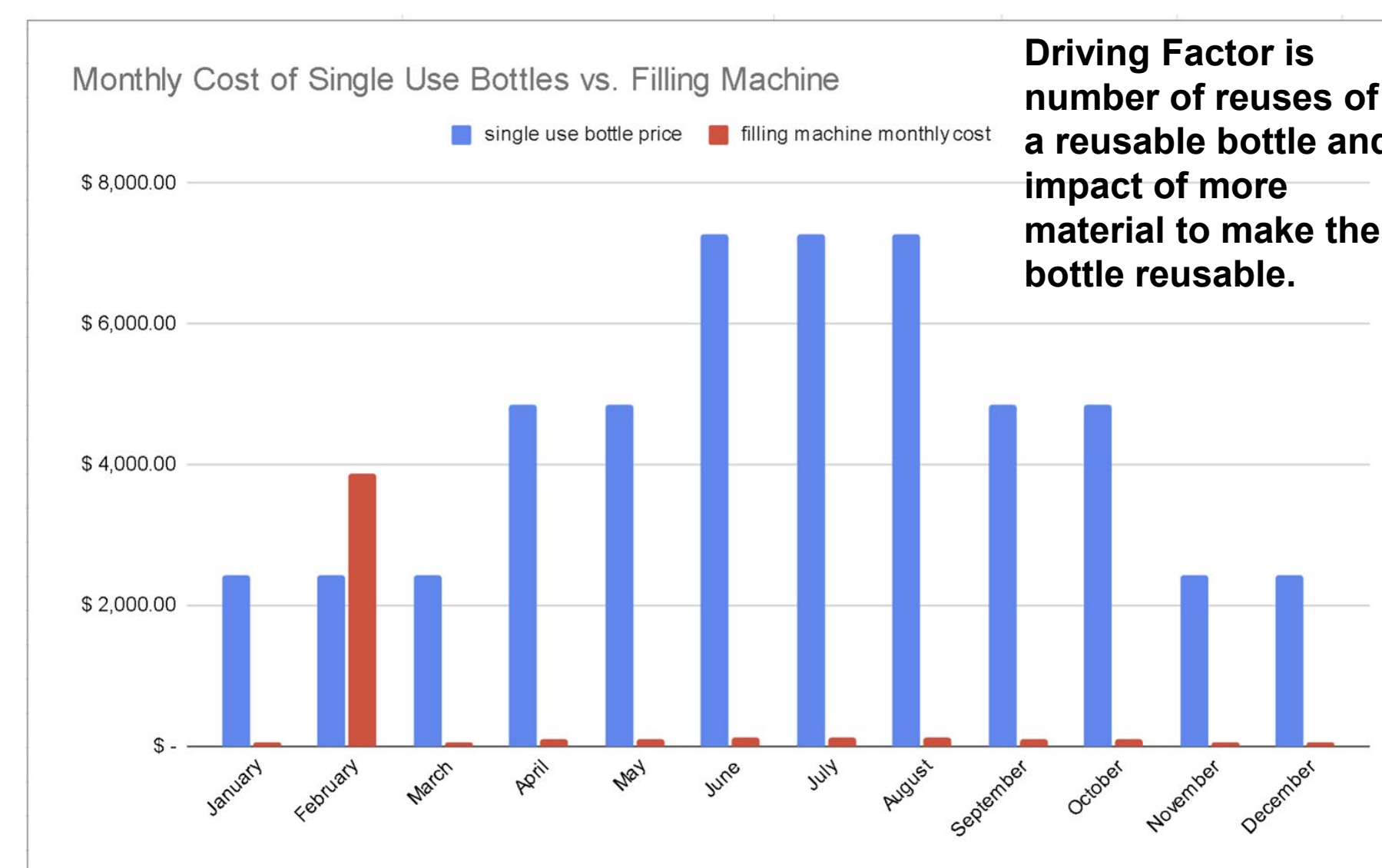
Methodology

A preliminary reusable bottle system was developed by the Clean Water Research Group. The environmental advantages of this system were determined through EPA environmental impact methodology, using data from GHG emissions associated with materials production from EPA WARM [1]. The GHG analysis followed a similar procedure as a case study conducted by researchers in Japan on water bottle refilling stations [2]. The water bottle use data for both the financial analysis and the GHG analysis were provided by Valley of the Sun United Way and UMOM New Day Centers. Cost data for the bottles and the machine components were obtained from various internet commerce sites and water pricing was obtained from Tempe City Water [3]. The MATLAB model is designed to run different scenarios to determine optimized pricing to meet water demand.

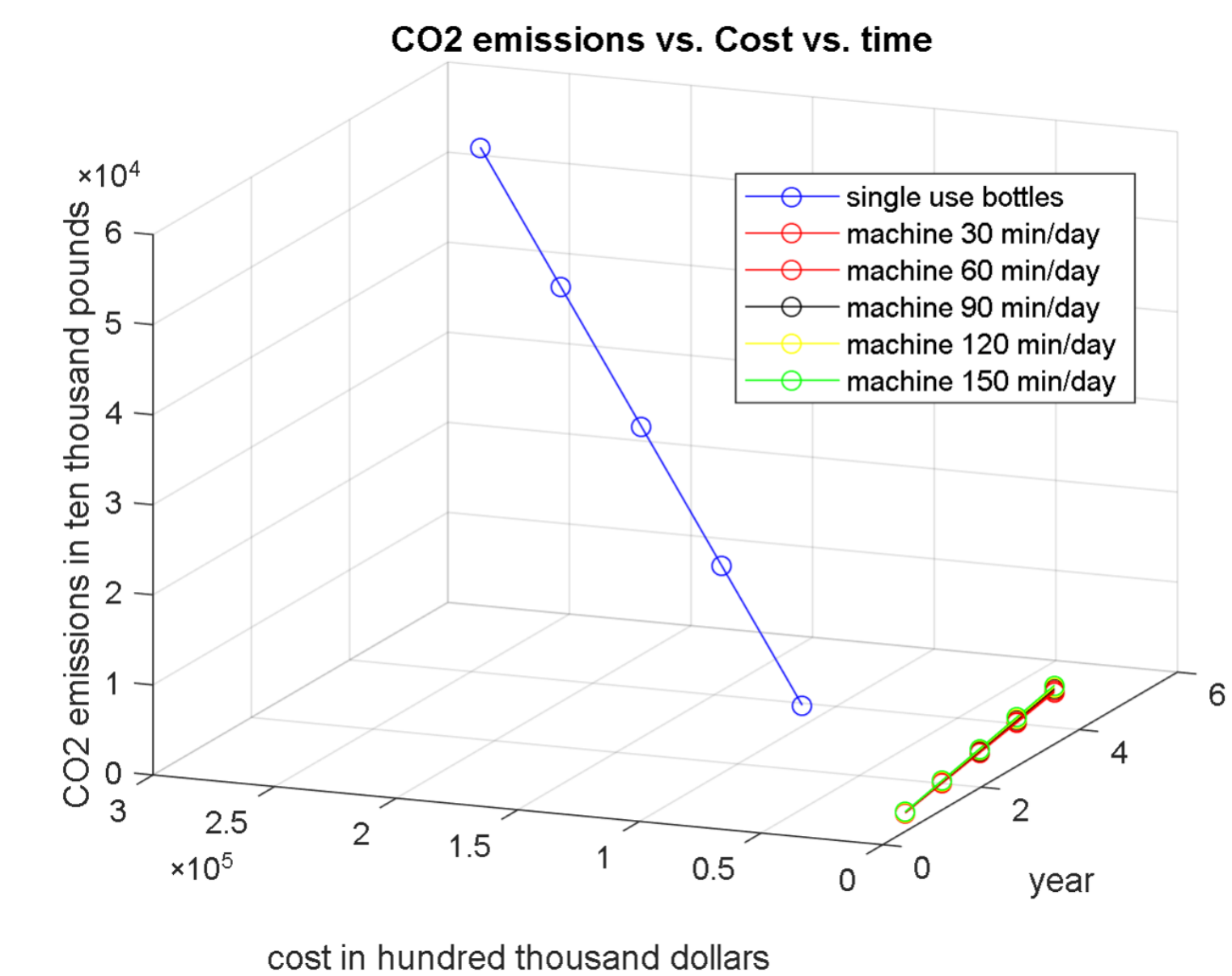
Environmental Analysis



Financial Analysis



Combined Analysis



References

- [1] "Documentation Chapters for Greenhouse Gas Emission, Energy and Economic Factors Used in the Waste Reduction Model (WARM)," EPA, 2019. [Online]. Available: <https://www.epa.gov/warm>.
- [2] T. Uehara and A. Ynacay-Nye, "How water bottle refill stations contribute to campus sustainability: A case study in Japan," Sustainability, vol. 10, no. 9, p. 3074, 2018.
- [3] "Water Monthly Service Charges," City of Tempe, AZ, 2022. [Online]. Available: <https://www.tempe.gov/government/municipal-utilities/utility-rate-information/water-monthly-service-charges>. [Accessed: 11-Apr-2022].



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