Analysis of alternatives to the use of diesel fuel in mining trucks

D Canullan1, A Anani2 and S Adewuyi3

1. Research Assistant, University of Arizona, Tucson, Arizona, 85719. Email: diegoc@arizona.edu

2. Associate Professor, University of Arizona, Tucson, Arizona, 85719. Email: angelinaanani@arizona.edu

3. Postdoctoral Research Associate, University of Arizona, Tucson, Arizona, 85719. Email: sadewuyi@arizona.edu

Keywords: CO2 emissions reduction, software simulation, alternative fuels, diesel substitution, mining operations, surface mining.

# ABSTRACT

The increasing effects of climate change have resulted in a global agreement on the urgent need for decarbonization, with governments establishing ambitious emissions reduction targets, such as those set in the 2016 Paris Agreement. The main activities in the mining sector that contribute to greenhouse gas (GHG) emissions are loading and transportation. Minerals are typically transported on large trucks with diesel engines. In order to meet the urgent need to reduce CO2 emissions in the mining industry, this study examines diesel fuel substitutes for use in mining vehicles. The research analyzed the feasibility of using electricity, renewable diesel, and liquefied natural gas (LNG) as alternatives to diesel fuel. We used discrete event simulation (DES) to compare these energy alternatives across various parameters and scenarios. The analysis was performed on data from an opet pit mining operation over a 24-hour period. Our results showed that short-term production levels remained largely unaffected by the type of energy used. However, the electric truck scenario required 13 additional trucks to match the production levels of diesel fuels due to the smaller size of electric trucks. LNG trucks demonstrated a significant increase in fuel consumption (+50%) compared to diesel trucks, leading to higher operational costs (+46%). In terms of emissions, electric trucks achieved a 95% reduction in CO2 emissions, while renewable diesel trucks reduced emissions by 90%. On the other hand, an increase in fuel consumption by LNG trucks compared to diesel trucks resulted in a 30% increase in CO2 emissions. In addition, simulations with LNG and electric trucks resulted in longer cycle times and queue lengths. The results showed that the assumptions used in this analysis have a major impact on the outcomes, indicating the need for further research as the industry continues to investigate and implement these technologies.