A Discrete Events Simulation Approach to Evaluating the Efficiency and Environmental Impact of Electrifying Mining Haul Trucks

T. Chimbwanda1, A. Anani2 and N. Risso3

1. Master of Science Student, University of Arizona, Tucson Arizona 85721-0012. Email: tchimbwanda@arizona.edu

2. Associate Professor, University of Arizona, Tucson Arizona 85721-0012. Email: angelinaanani@arizona.edu

3. Assistant Professor, University of Arizona, Tucson Arizona 85721-0012. Email: nrisso@arizona.edu

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# ABSTRACT

As near surface deposits deplete, the demand for mineral resources continues to soar driven by an exponentially expanding global population. To meet this growing demand, mining must scale commensurately. The trend for the contemporary mining industry is not only to maximize resource extraction but to do so with minimal environmental footprint. As such, the mining industry is transitioning to electrically powered haulage solutions to decarbonize, with targets to achieve net zero. However, this shift is highly capital-intensive, underscoring the need for reliable and robust simulations to ascertain the feasibility of emerging electric haulage technologies. This study uses stochastic Discrete Events Simulations to investigate the efficiency and environmental impact of transitioning from the conventional diesel-powered, truck-shovel configuration to more sustainable battery electric haul trucks. In this study, operational data from an open pit mine in the USA is used to develop and validate a simulation model. The base case scenario of conventional diesel-powered trucks is modelled and compared against the alternative case of the battery electric truck-shovel configuration. The outcome of this study aims to provide insights into the operational, environmental, and economic implications of the transition to battery electric haul trucks with a particular focus on quantifying reduction of emissions and changes in productivity.