CO_2 and Cost Impacts of a Microgrid with Electric Vehicle Charging Infrastructure: a Case Study in Southern California

Luis Fernando Enriquez-Contreras*†, Matthew Barth*†, Sadrul Ula†
*Department of Electrical and Computer Engineering
University of California, Riverside
Riverside, United States of America
lenri001@ucr.edu, barth@ece.ucr.edu
†College of Engineering, Center for Environmental Research & Technology
University of California, Riverside
Riverside, United States of America
lenri001@ucr.edu, barth@ece.ucr.edu, sula@cert.ucr.edu

***Abstract*—As an important part of Intelligent Transportation Systems (ITS), this paper presents a case study at the University of California, Riverside (UCR) that evaluates the effectiveness of different transportation-based microgrid configurations in reducing both carbon dioxide (CO_2) emissions and electricity costs. CO_2 emissions are calculated using high-resolution California Independent System Operator (CAISO) CO_2 emissions data to accurately assess the environmental impact of each setup. Electric costs were also compared to determine the financial savings potential for the consumer. The results demonstrate that a peak-shaving transportation-microgrid strategy can effectively reduce CO_2 emissions in the range of 24% to 38% and costs from $27,000 to $29,000 per year, even when considering the additional demand from 12 vehicles charging daily at the building. However, careful consideration should be given to battery sizing, as peak-shaving has diminishing returns. Doubling the battery size may only provide an additional savings of $2,000 per year with a negligible reduction in emissions. This highlights the importance of optimizing battery capacity to maximize cost-effectiveness and environmental impact.**

***Index Terms*—microgrids, demand response, CO_2 emissions, modelica, EV charging**