A BUSINESS CASE FOR MICROGRIDS WITH SOLAR TO EV CHARGING

[M.K.Anand, University of British Columbia CERC, MEL Clean Energy, 778-751-7885, mkanand@alumni.ubc.ca]
[Balpreet Kukreja, University of British Columbia CERC, MEL Clean Energy, 250-301-6111, balpreet.kukreja@alumni.ubc.ca]
[Bernardo Ruz, University of British Columbia CERC, MEL Clean Energy, 778-751-8412, bernardo.ruz@alumni.ubc.ca]

Overview

There is a need for reducing the carbon footprint of the transportation sector and supporting the ongoing transition to electricification of vehicles. At the University of British Columbia (UBC), the Clean Connected and Safe Transportation Testbed (CCSTT) is a city-scale, living laboratory that will emulate critical links between energy, transportation, ICT, and urban design.

The Advanced Photovoltaic Laboratory is a component of the CCSTT, enabling the reconfigurable and optimized interaction of intermittent solar energy with smart grids and refueling infrastructure, and transportation assets, e.g., electrolyzers and electric vehicles on top of parking structures (Mérida et al., 2017). This study is to establish a business case for the "Advanced PV Laboratory" component of the CCSTT lab looking at connecting renewable energy generation to transportation and exploring both technical and financial viability.

This study builds on existing literature on the viability of microgrids (Moore, 2015) (Murray et al., 2017) and considers microgrids with the combination of photovoltaic solar energy, electric vehicle charging, energy storage; and hydrogen production and refueling. Various models were built to test viability in a university setting and variations of applications in the city as a stand alone venture.

Methods

Microgrid setup:

The feasibility of a microgrid on top of a parkade at UBC was explored. The potential of developing a solar facility on top of the Thunderbird Parkade using solar canopies was verified. Additional DC Level 2 and Level 3 EV chargers are projected to be added to the existing 8. A 100kg/ day Hydrogen production storage and refueling station was been sized for the microgrid. The different components of the microgrid are shown in Figure 1.

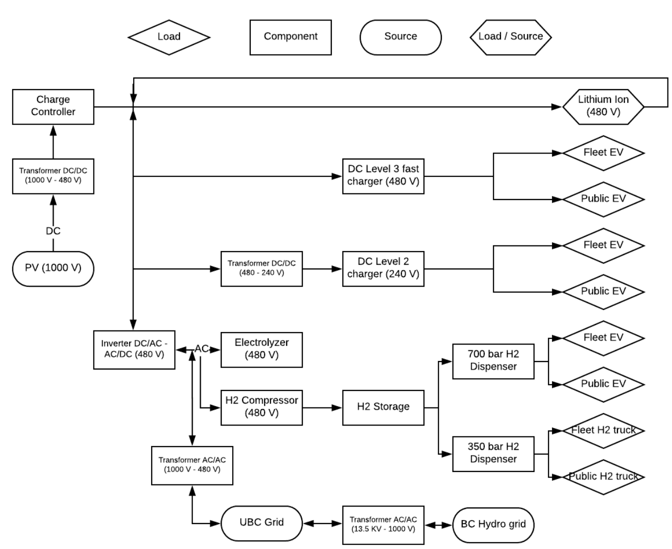


Figure 1: Overview of the different components of the microgrid.

Model Setup:

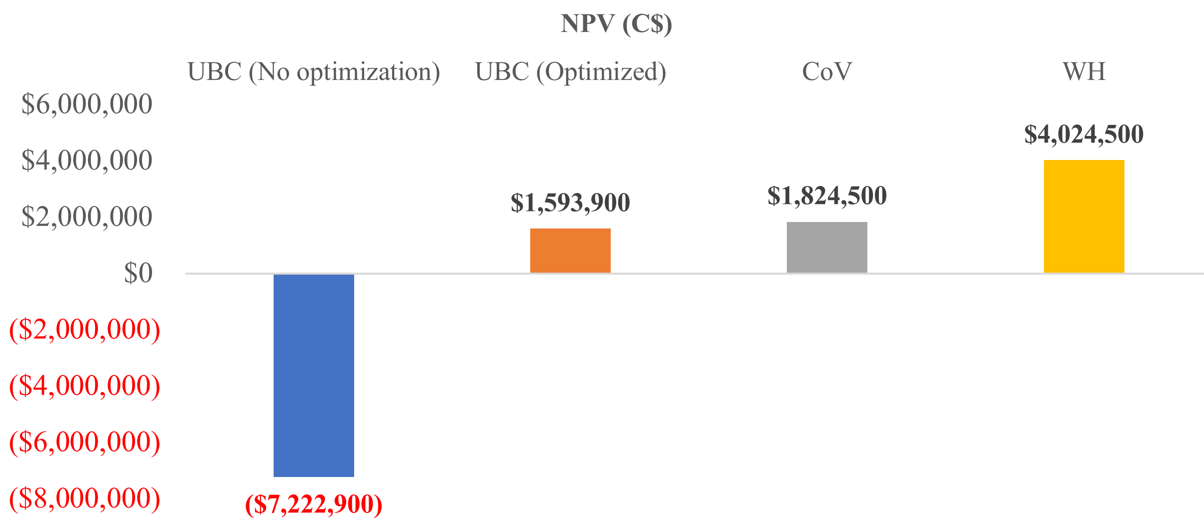
A model with the daily available energy, demand loads, storage needs, costs incurred and revenue earned for the project life (40 years) was created in Microsoft Excel using data from Homer Pro and RetScreen and this was used to calculate the Net Present Value and Payback period. An algorithm was created to govern the flow of electrcity under different usage scenarios. Various components of the model were iterated on e.g. size of components within the microgrid and possible revenue streams until a positive net present value is reached. The model was then replicated in a city setting (City of Vancouver used as a model) and in a commercial warehouse model where no canopies are employed.

Results

The final results of the Net Present Value of the various models are as follows:

- NPV of the UBC Optimized Model: $1,593,900. Payback: 26 Years
- NPV of City of Vancouver Model: $1,824,500, Payback 26 years
- NPV of Warehouse Model: $4,024,500. Payback 24 years

The microgrid is projected to avoid 144,600 tons of CO2 annually in year 40 for the UBC Optimized Model



Conclusions

We see that by performing a sensitivity analysis and optimizing the most critical components of the microgrid, we can achieve positive net present values for all the models and reasonable payback periods. This is an indication that organizations with large fleets, parkades or commercial/industrial buildings should consider working with local governments and utilities to explore the options to build microgrids to support their operations, reduce their carbon footprint and be powered by renewable energy.

References

Mérida, Walter et al., 2017 - Project Summary, Beyond Traffic: Clean, Connected and Safe Transportation Testbed (CCSTT) - 2017 IF #36435

Moore, Maxwell (2015) – Feasibility Study of a Solar Photovoltaic to Hydrogen Electrolyzer System at the Richmond Field Station – University of California, Berkeley – ES 196 Final Project

Murray et al (2017) – Power-to-gas for Decentralized Energy Systems: Development of an Energy Hub Model for Hydrogen Storage, Building Simulation 2017.