Main Controller of DC Microgrid

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Introduction

Microgrids are a great up and coming segment in the energy industry. It represents a shift from larger, in-depth power system to a more localized and easier to shape power distribution system. The control to move away from the larger grid with the use of renewable energy makes microgrids resilient and flexible. Microgrids provide efficient, low-cost, clean energy, to improve the operation of the electric grid.

System Specifications

- Renewable energy generation
- Buck converters
- PID feedback controller
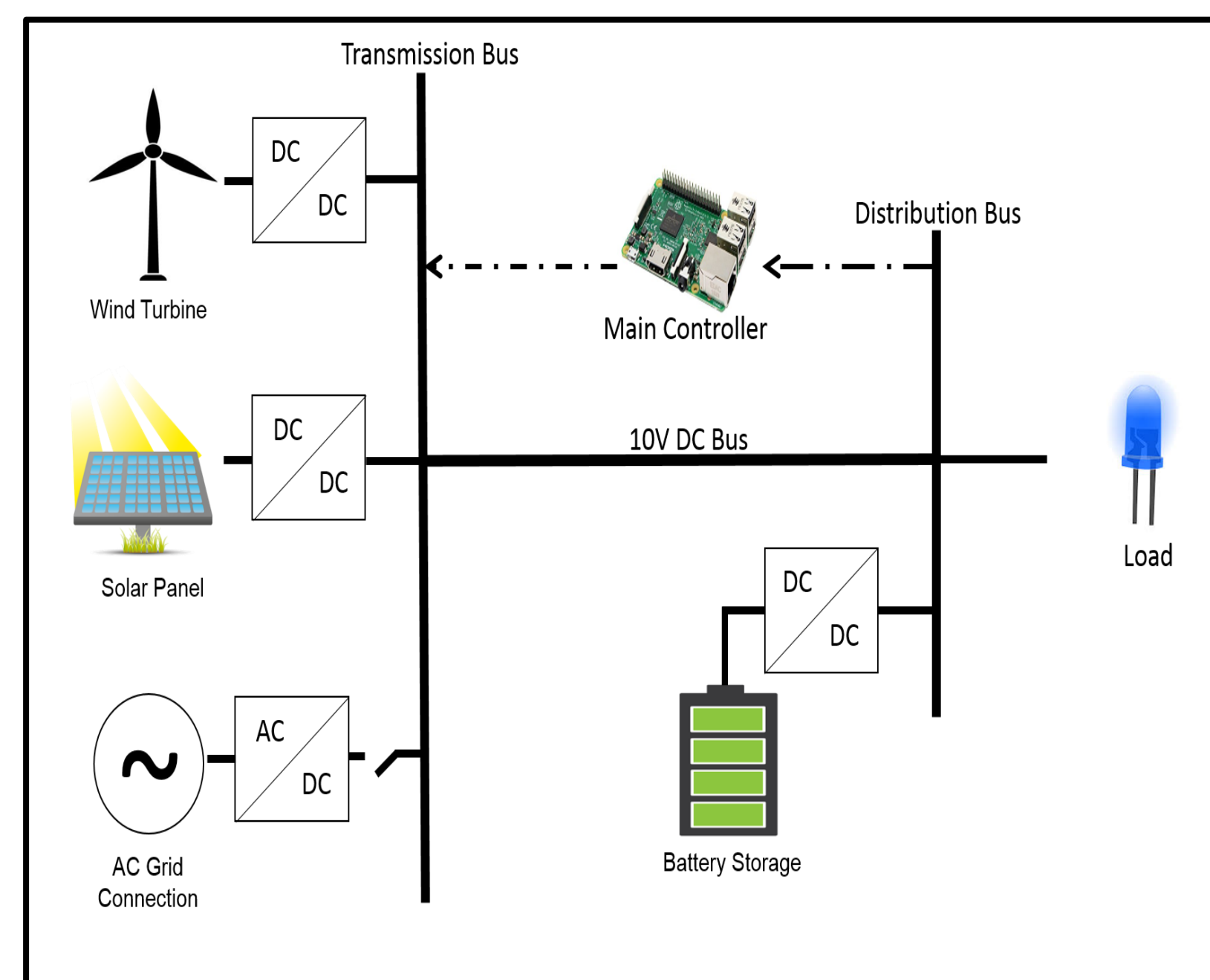- Emergency grid connection
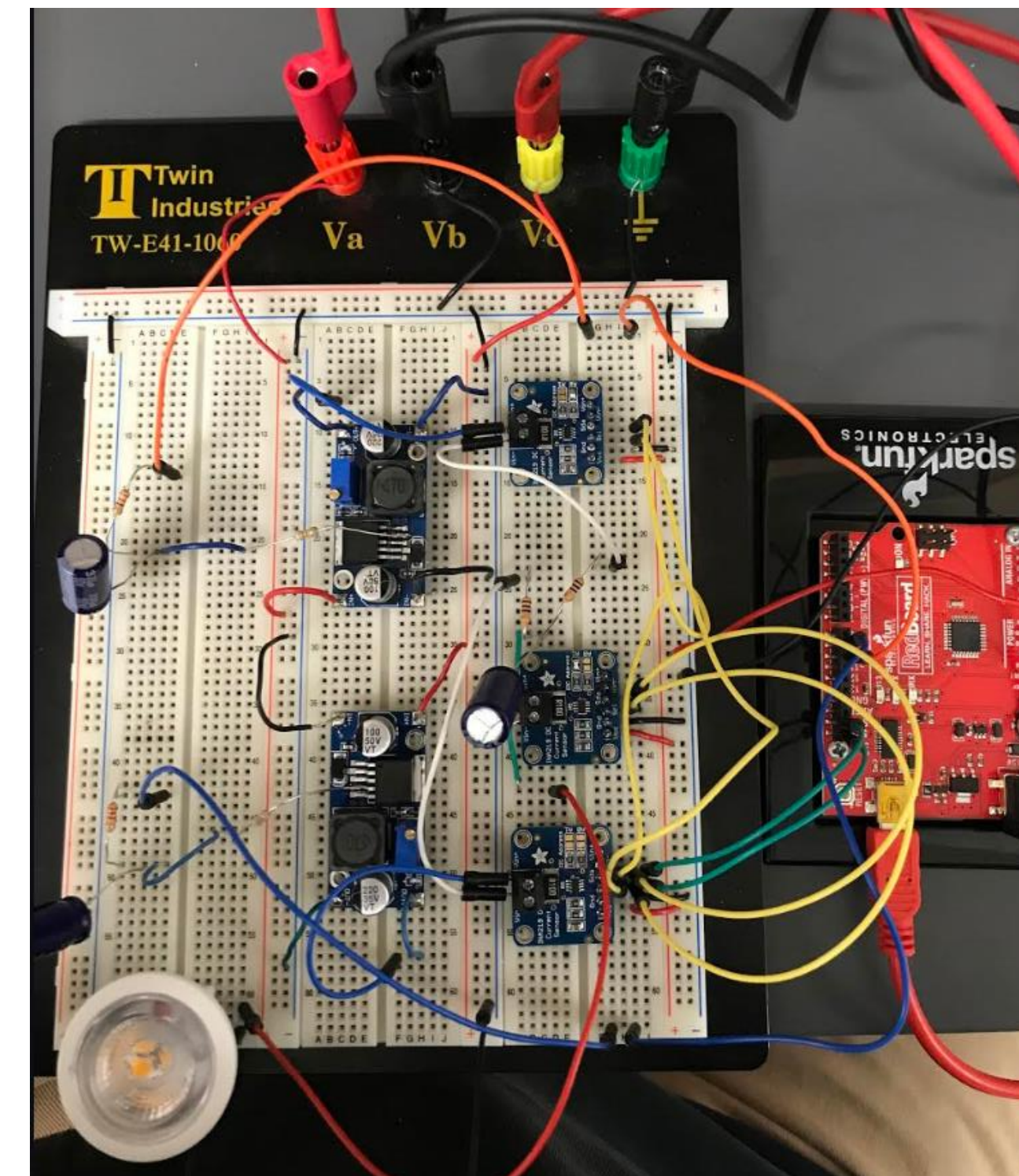- Battery storage

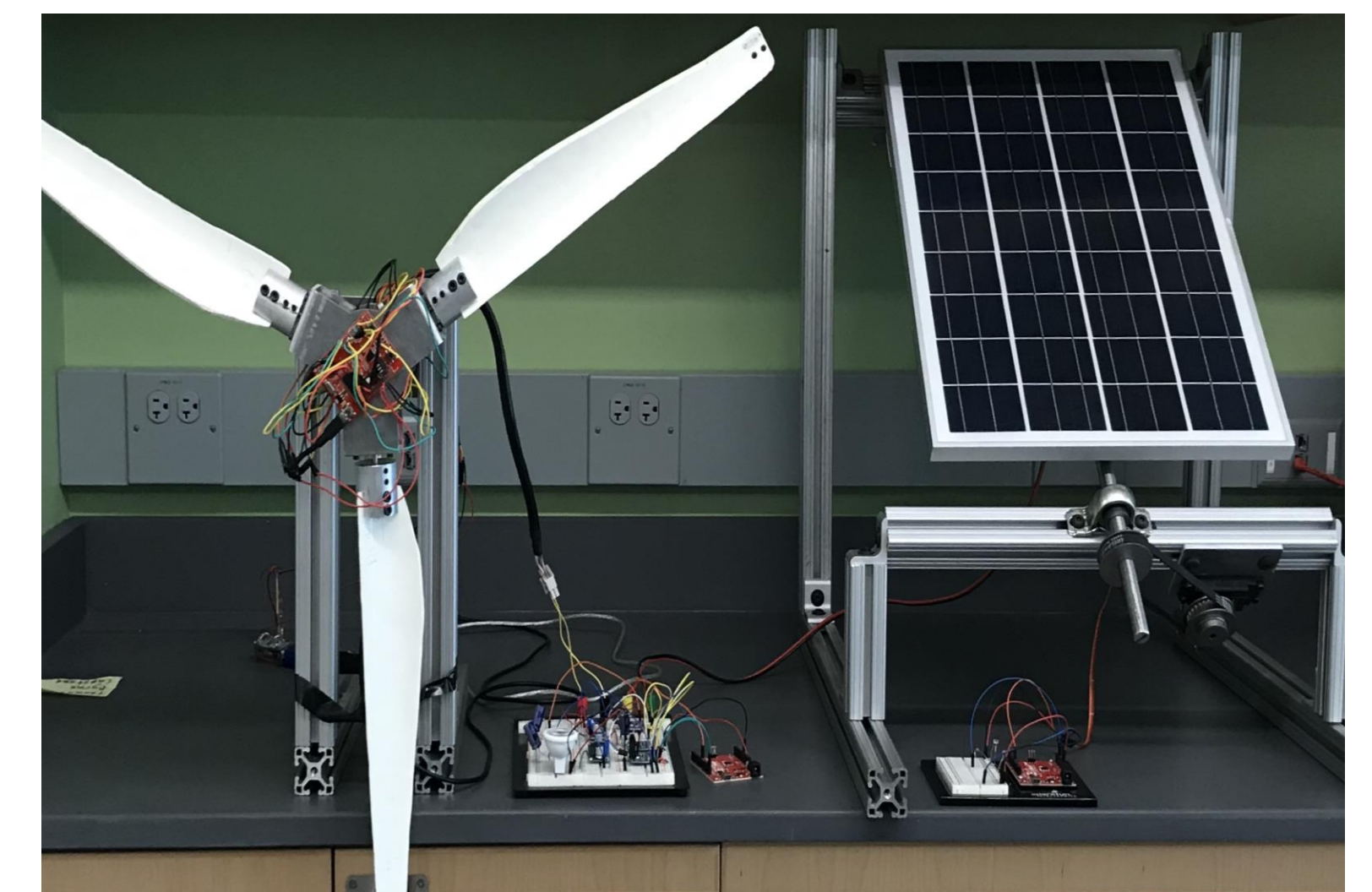Figure 1: Block diagram of DC Microgrid

Figure 3: Circuitry of controller

Figure 4: Final design with wind and solar attached

System Design

- The control system used is derived from the power equation using voltage and currents at the load. Each input is designed to have a desired power percentage.
- The power percentages allow the grid monitor to issue constraints to the generation sources. The load resistance is constantly be measured and being fed back into the input of the controller.
- The output of the PID controller is a PWM signal, generated from an Arduino, which goes through a RC filter to stabilize the bus voltage at 10 volts. As the duty cycle increases the voltage after the buck converter decreases.
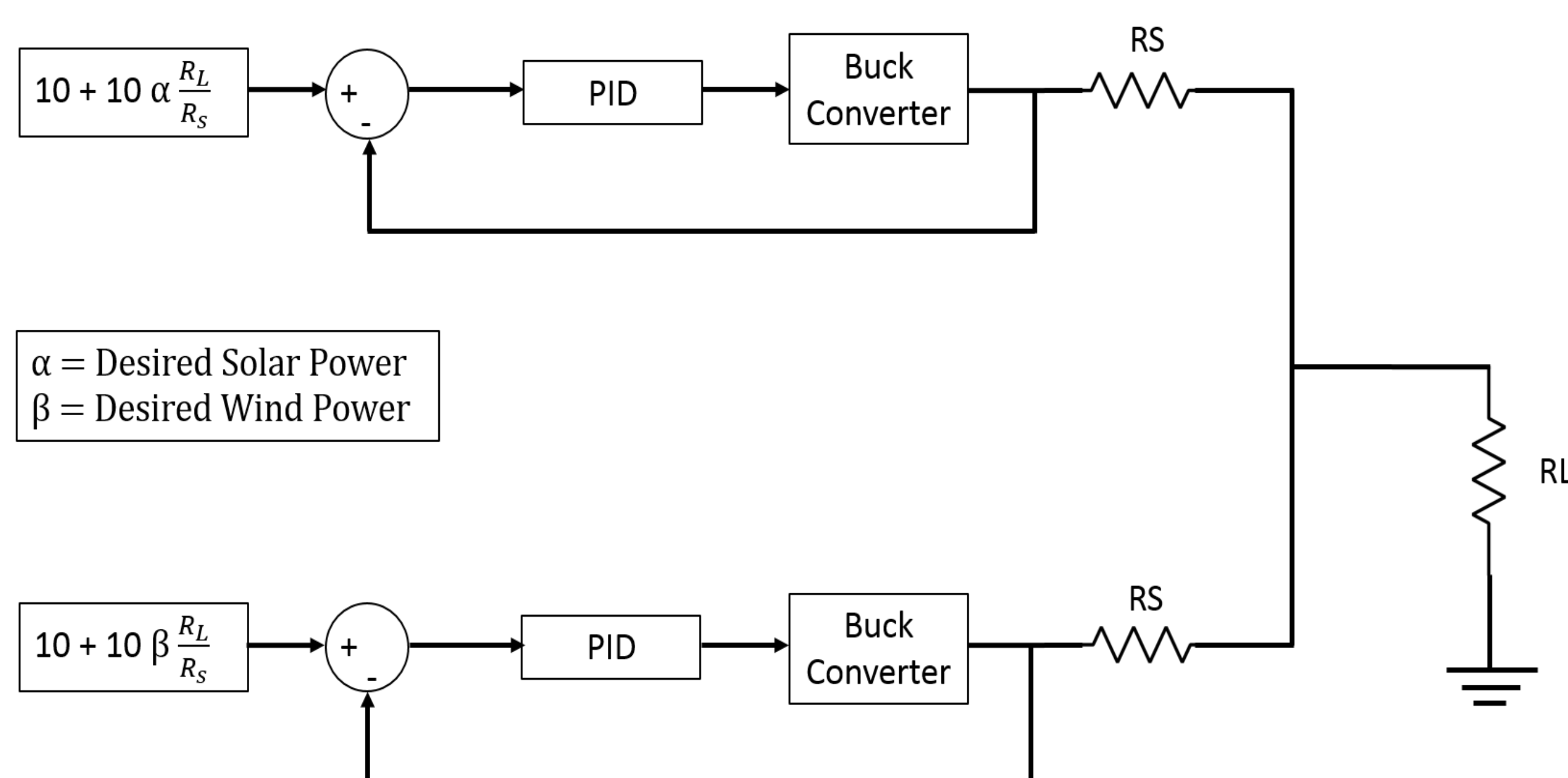- The controller will stabilize the bus voltage to 10 volts within 10 seconds.

α = Desired Solar Power
β = Desired Wind Power

Figure 2: Control system of DC Microgrid

Results

- The given results are based on a power percentage of 80% solar and 20% wind generation.
- The voltage is stabilized at 10 volts with in 10 seconds.
- The desired power percentages are stabilized within 10 seconds at 80% and 20%.
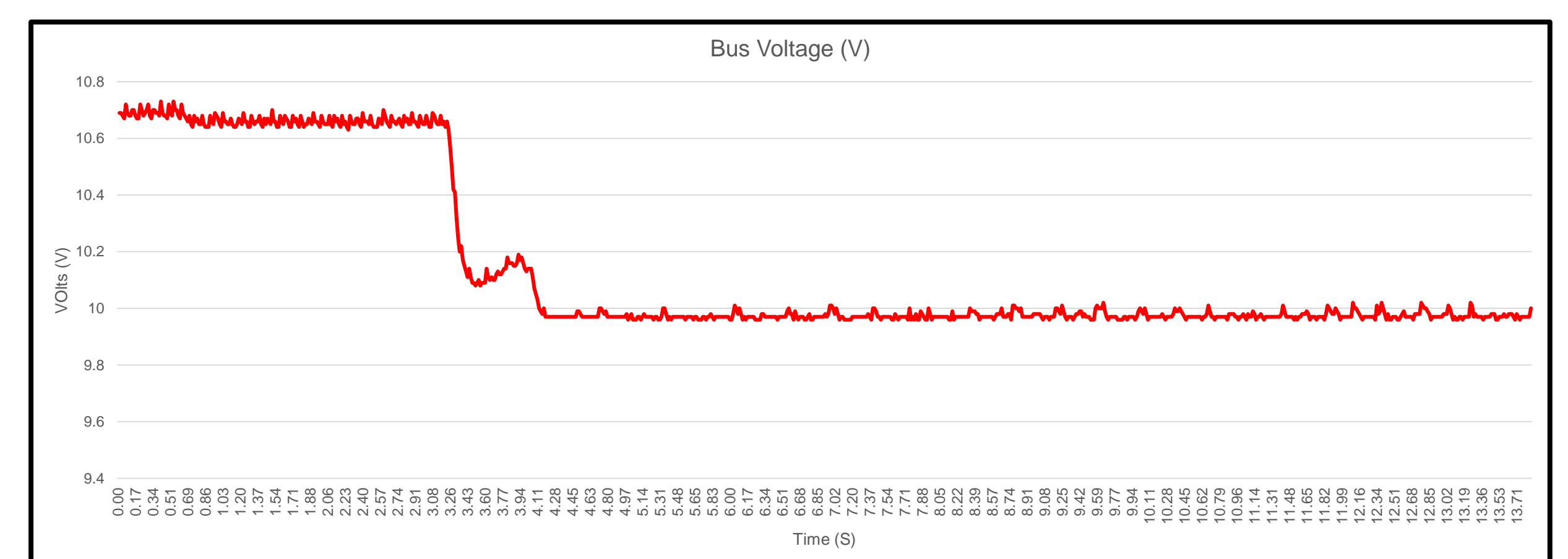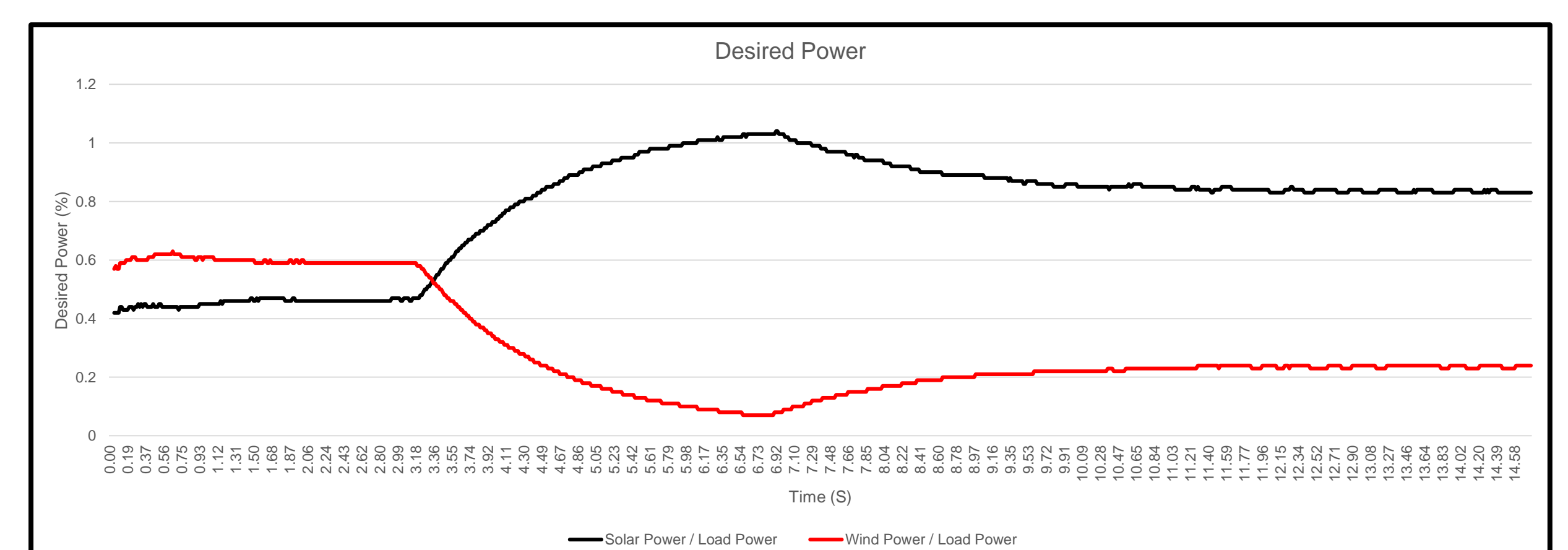

Figure 5: Output bus voltage vs. time

Figure 6: Desired power percent of wind and solar vs. time

Future Work

- Bidirectional battery control system
- Economic control system for generation sites