

Second-use Battery Storage System Testing: NICE Demonstration Project

ALYSSA MCQUILLING, PHD | MAY 5, 2022



Agenda of Presentation

BACKGROUND

PROJECT OBJECTIVES

PROJECT OUTCOMES

FUTURE GOALS

QUESTIONS

Background

Background

- Vehicle duty cycles are demanding of batteries
- That means, after a battery's useful life in a vehicle ends, a significant amount of capacity remains
- There is both technical and economic potential in these batteries and there are a range of alternatives for what happens next: disposal, recycling, or re-use
- Systems may involve different levels of re-packaging/re-manufacturing

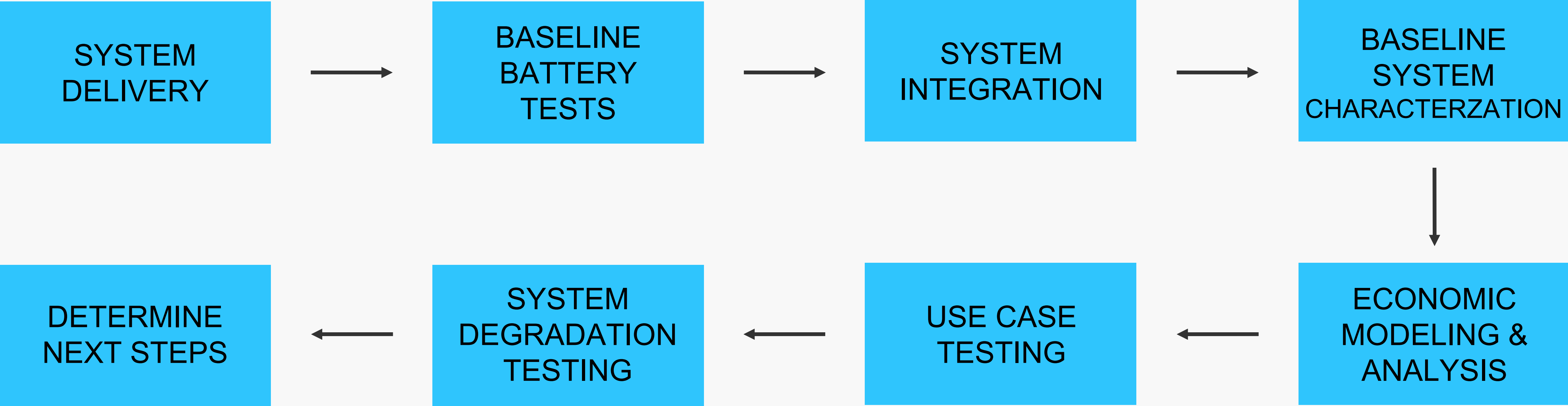


Project Objectives

Project Goals

- Work with project partner to integrate a novel Distributed Power Energy Storage (DPESS) System based on second-use electric vehicle (EV batteries)
- Perform baseline characterizations and duty cycle testing on the system and its component batteries
- Analyze the test results and prepare an economic assessment of this new battery energy storage system
- Identify opportunities and challenges with system

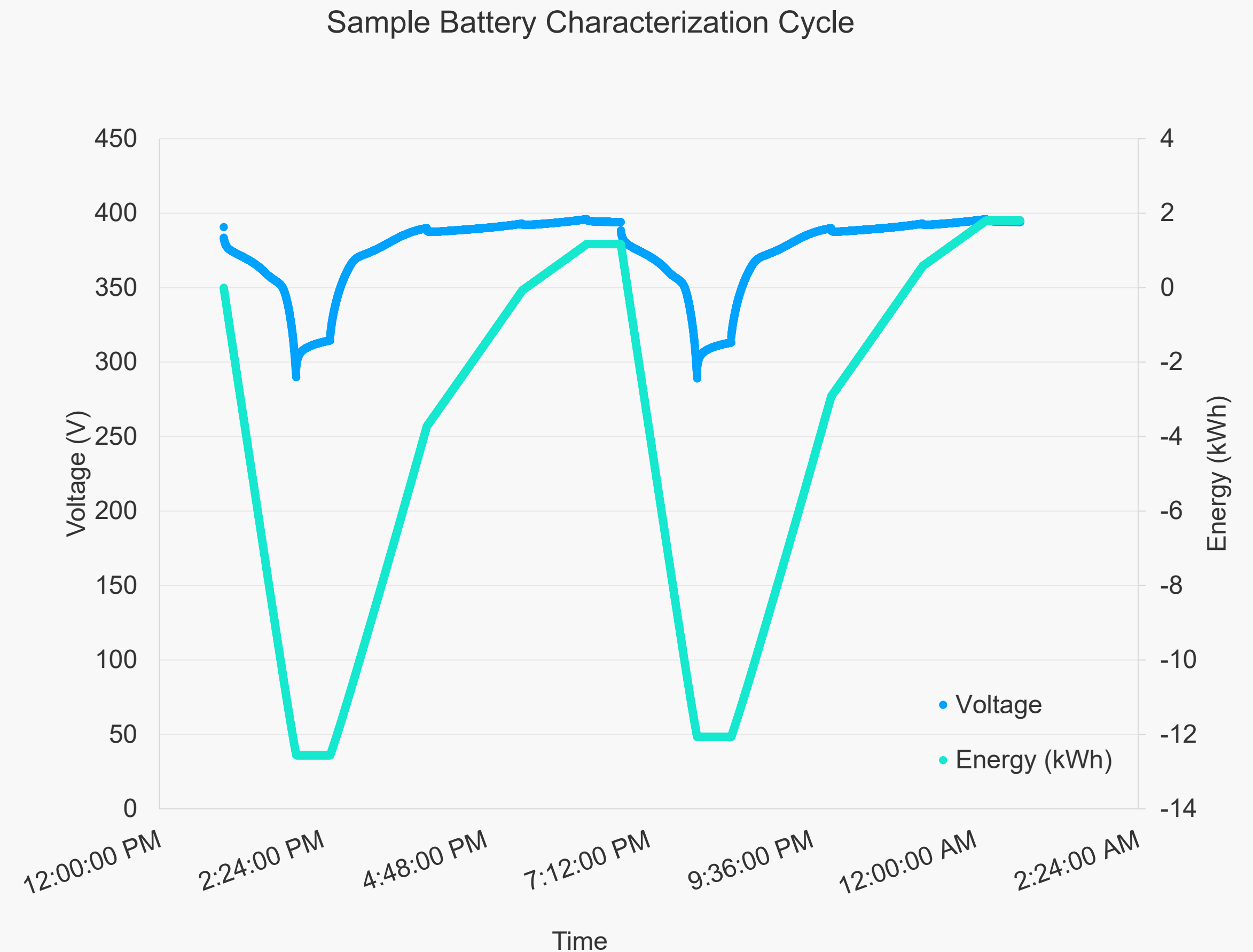
Project Timeline



Project Results

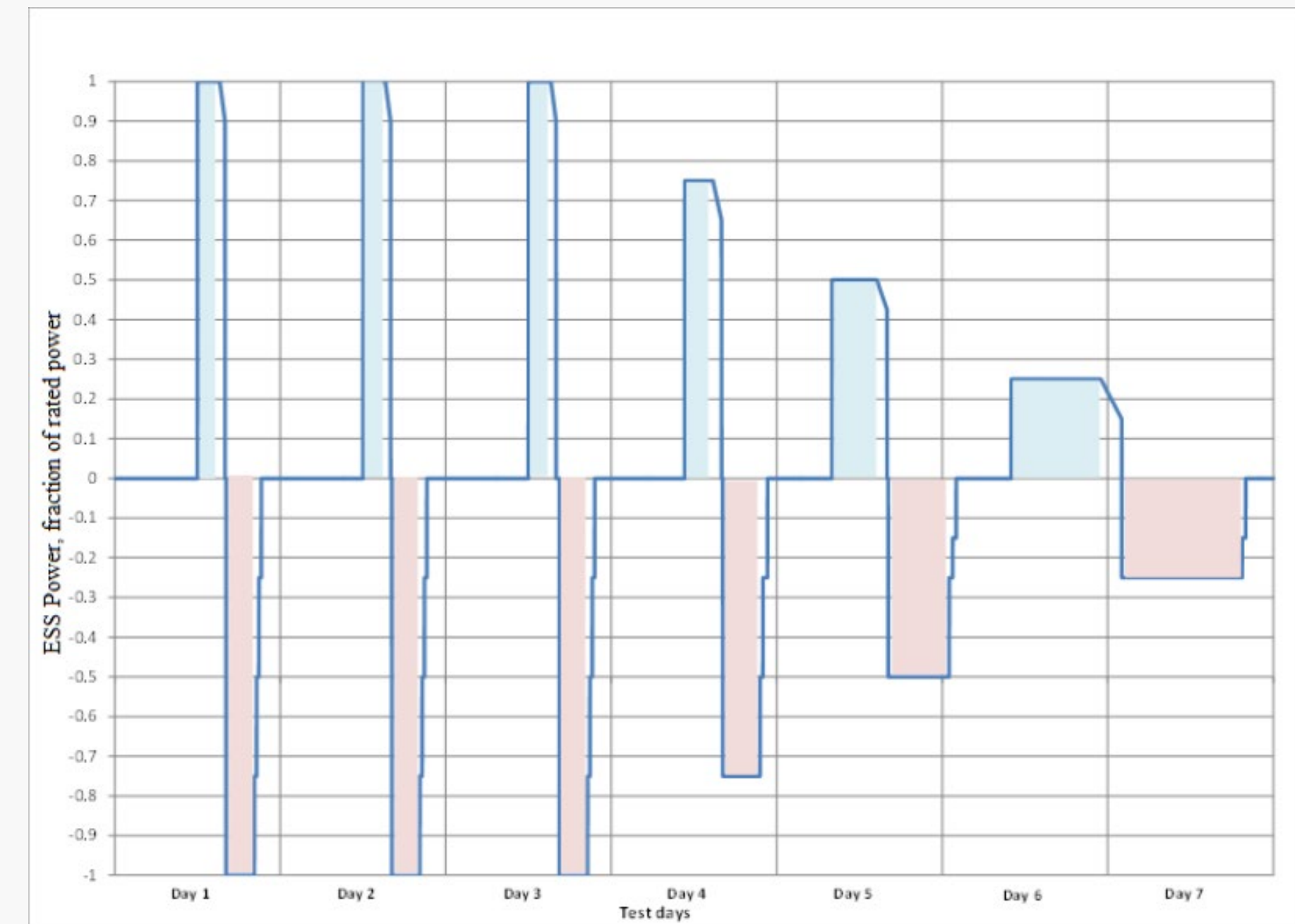
Step 1: Battery Characterization

- Prior to system-level testing, we evaluated each battery alone
- We ran through 2 full charge/discharge cycles to characterize battery capacity
- The batteries in the system ranged in capacity from 12.5 kWh to 15.5 kWh
- A sample characterization cycle is shown in the adjacent figure



System Testing

- We completed both functional and performance testing for the system
- We followed test procedures detailed in IEEE 2030.3 as well as EPRI's ESIC Test Manual utilizing our onsite battery test facility (pictured)
- The Available energy capacity test (top figure) was completed multiple times during the project to evaluate how system performance degraded over time



Duty Cycle Testing

- It was critical to the project to understand what duty cycles the system was capable of completing
- We referenced the “Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems”
- We considered 2, 4, and 6 hour peak shaving, solar firming and 24 hour load following
- The particular system was operable approximately 22 hours of the day due to an overnight sleep period from 2-4am

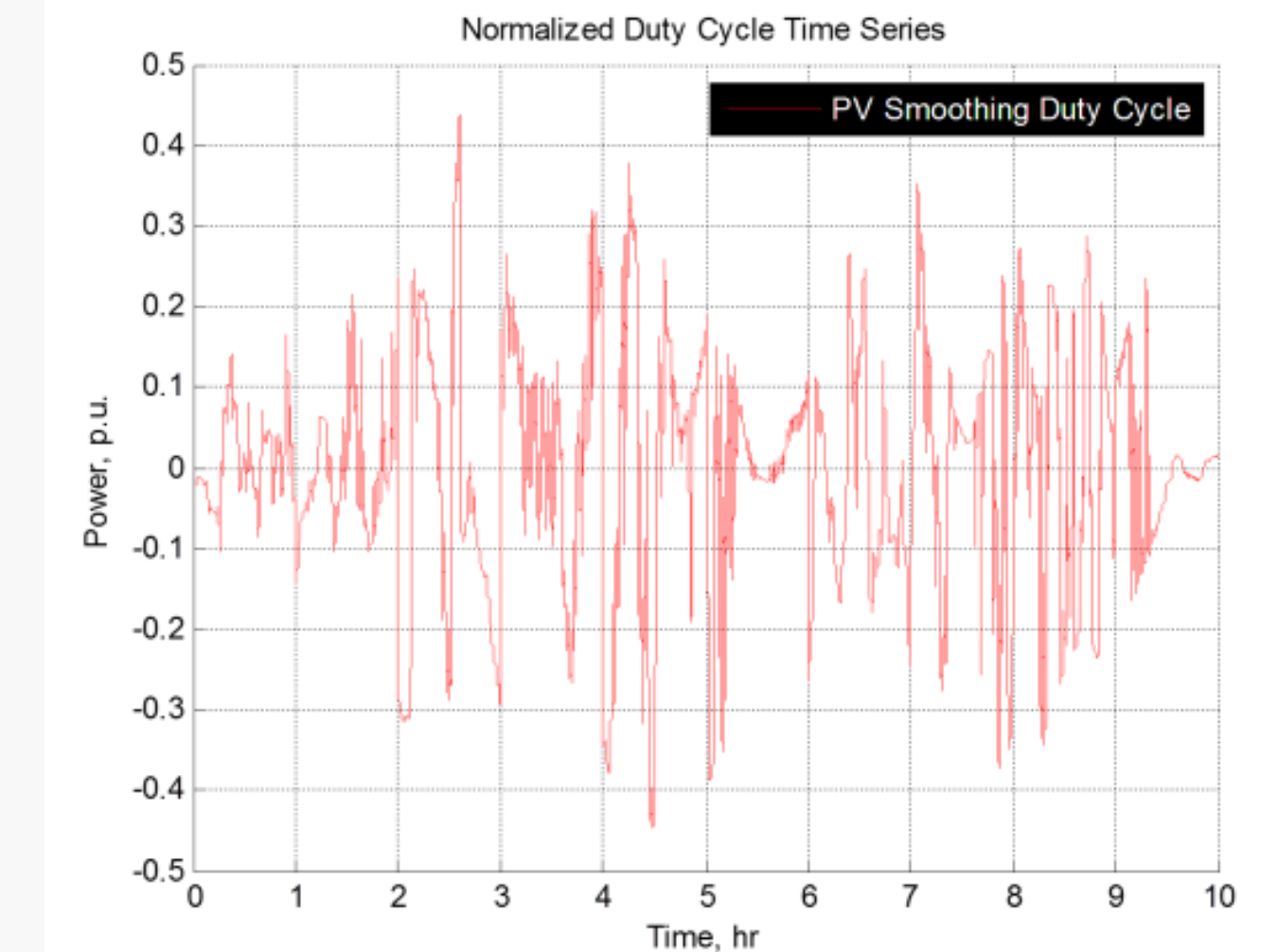
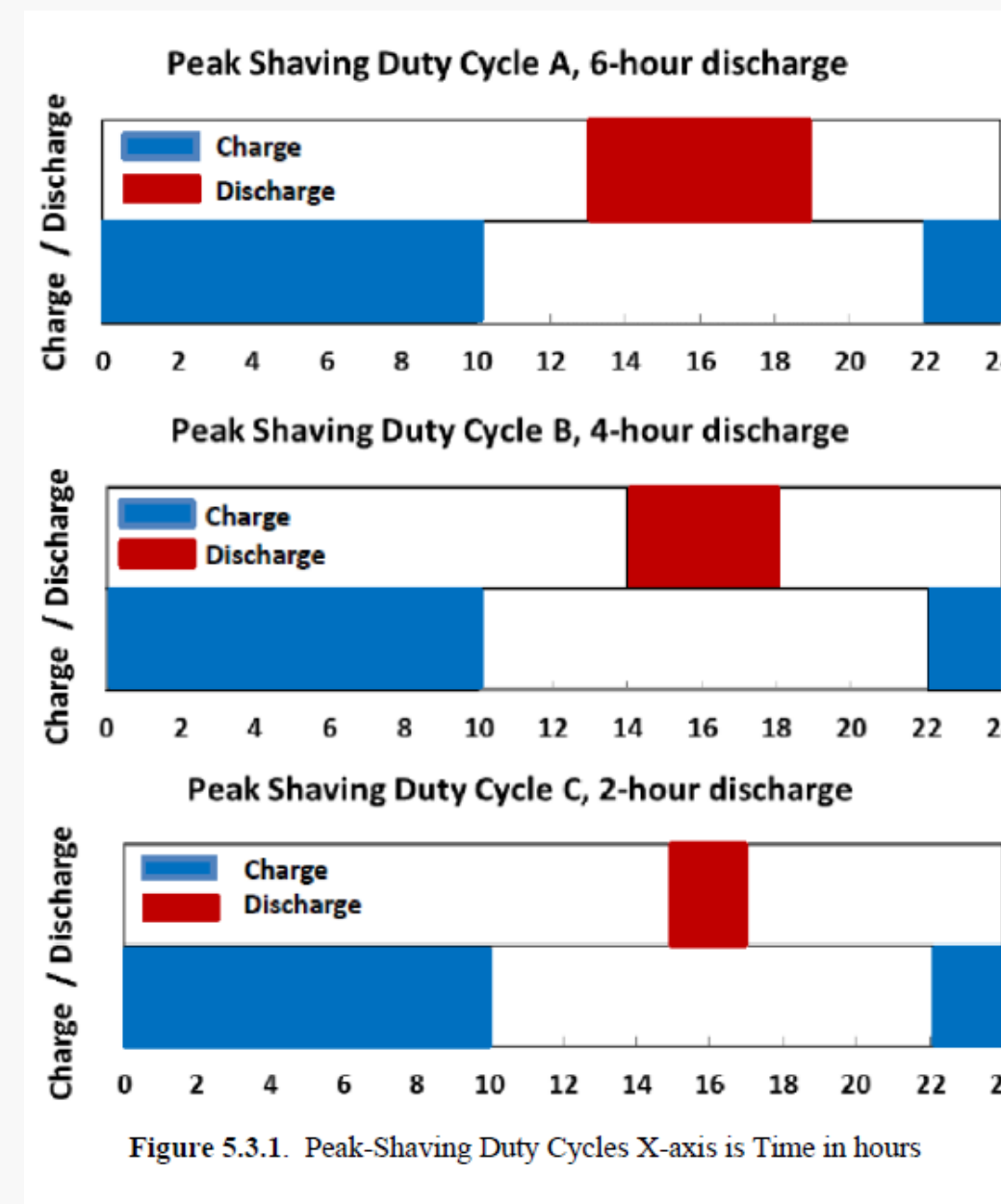


Figure 5.3.4. Duty Cycle – PV Smoothing

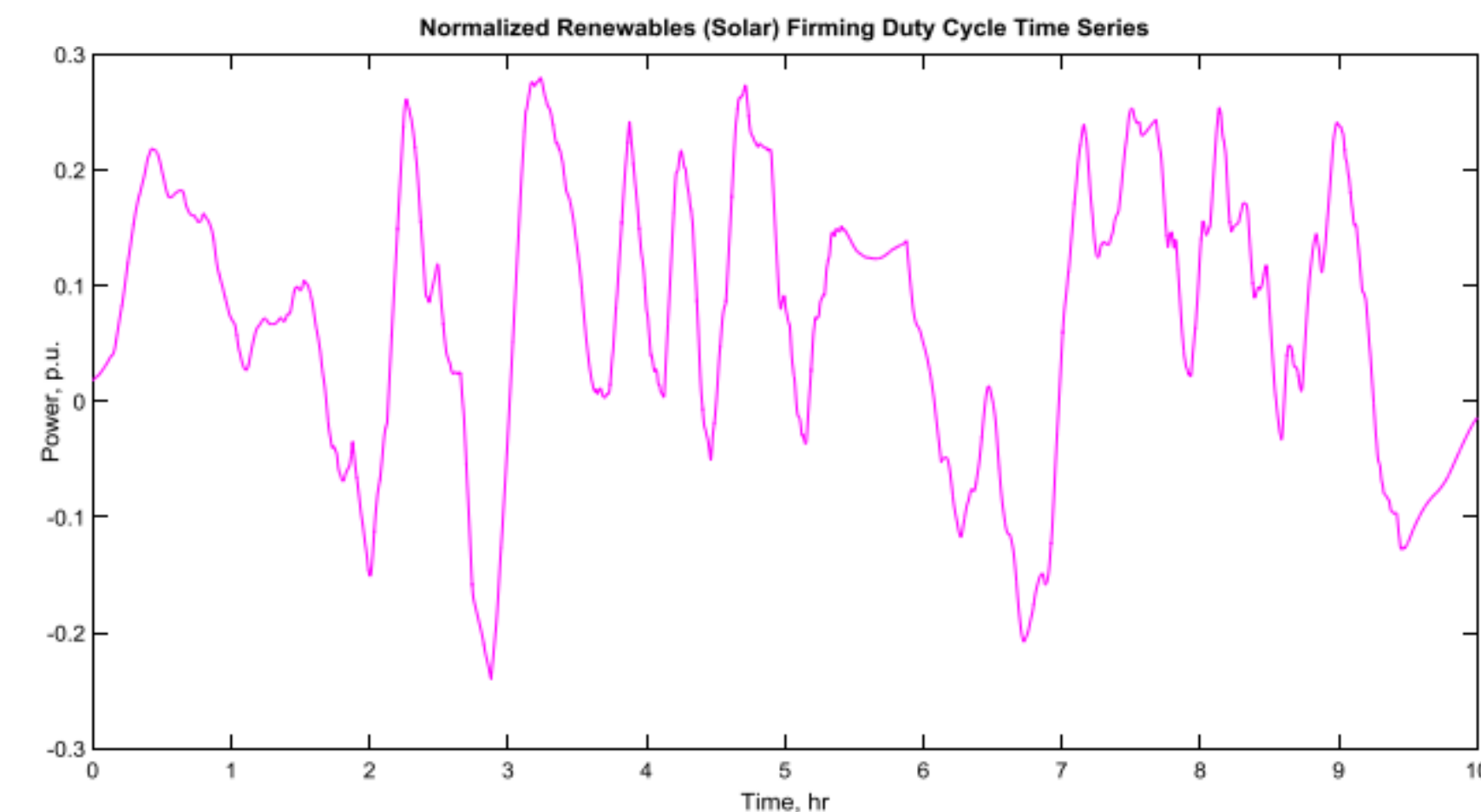


Figure 5.3.6. Duty Cycle – Renewable (Solar) Firming

Future Goals and Directions

Summary

- Over the past 3.5 years, Southern Research tested and evaluated a novel energy storage system based on used Nissan LEAF
- The system was able to support a range of duty cycles with minimal downtime, mostly due to network issues
- Approximately 1-2% performance degradation annually was observed over the study period
- Second-use systems, when managed and controlled properly, can serve a variety of customer needs
- Supply chain constraints may drive desire for second-use systems, recycled materials

Questions?

Southern Research appreciates the opportunity to present our work and the support of the Department of Energy's Office of Electricity.



