kpff

Shoreside Electrification: Challenges & Solutions

April 26, 2023

Contents

Overview & Background

Objective: Maximize greenhouse gas emissions using currently available power and allow for further reductions as more and greener power becomes available

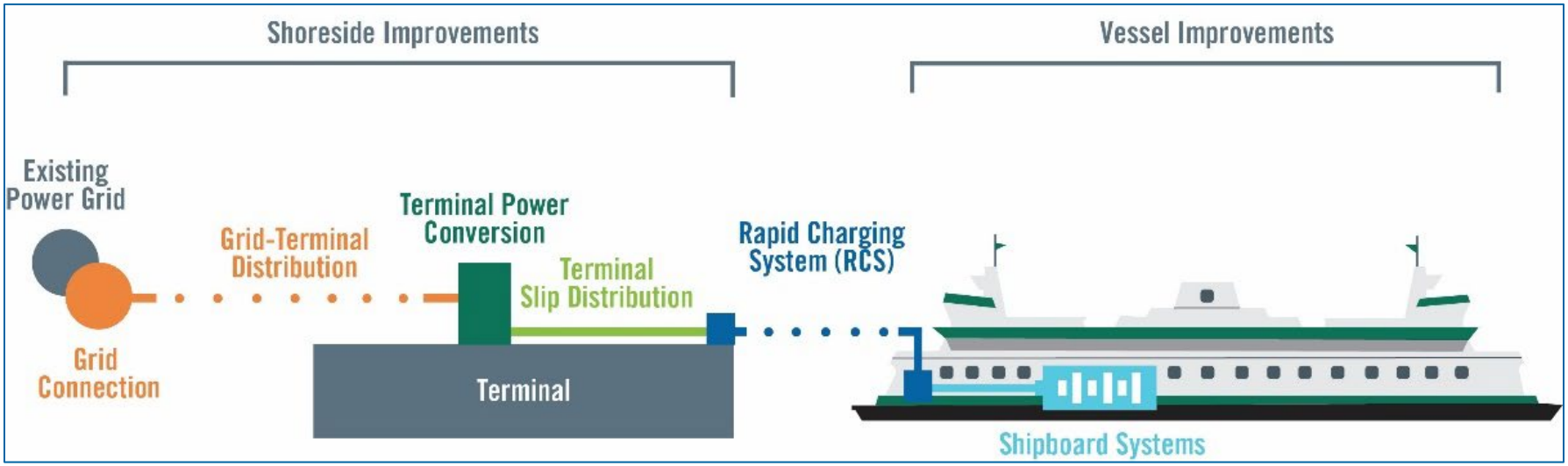
* Take advantage of existing grid capacity and shoreside energy storage to get partial zero-emission operations
* Design infrastructure to simplify long-term improvements

Round Trip Energy & Emissions		
Fuel Consumption (100% diesel)	278	gallons per R/T
Local CO2 Emissions (100% diesel)	6,244	pounds per R/T
Energy Required	4,372	kWh per R/T
Diesel Cost	$973.00	per R/T
Electric Cost	$524.64	per R/T
Energy Cost Savings	$448.36	per R/T
Cost Assumptions		
Diesel Fuel (per gallon)	$3.50	per gallon
Electric Cost (per kilowatt-hour)	$0.12	per kWh

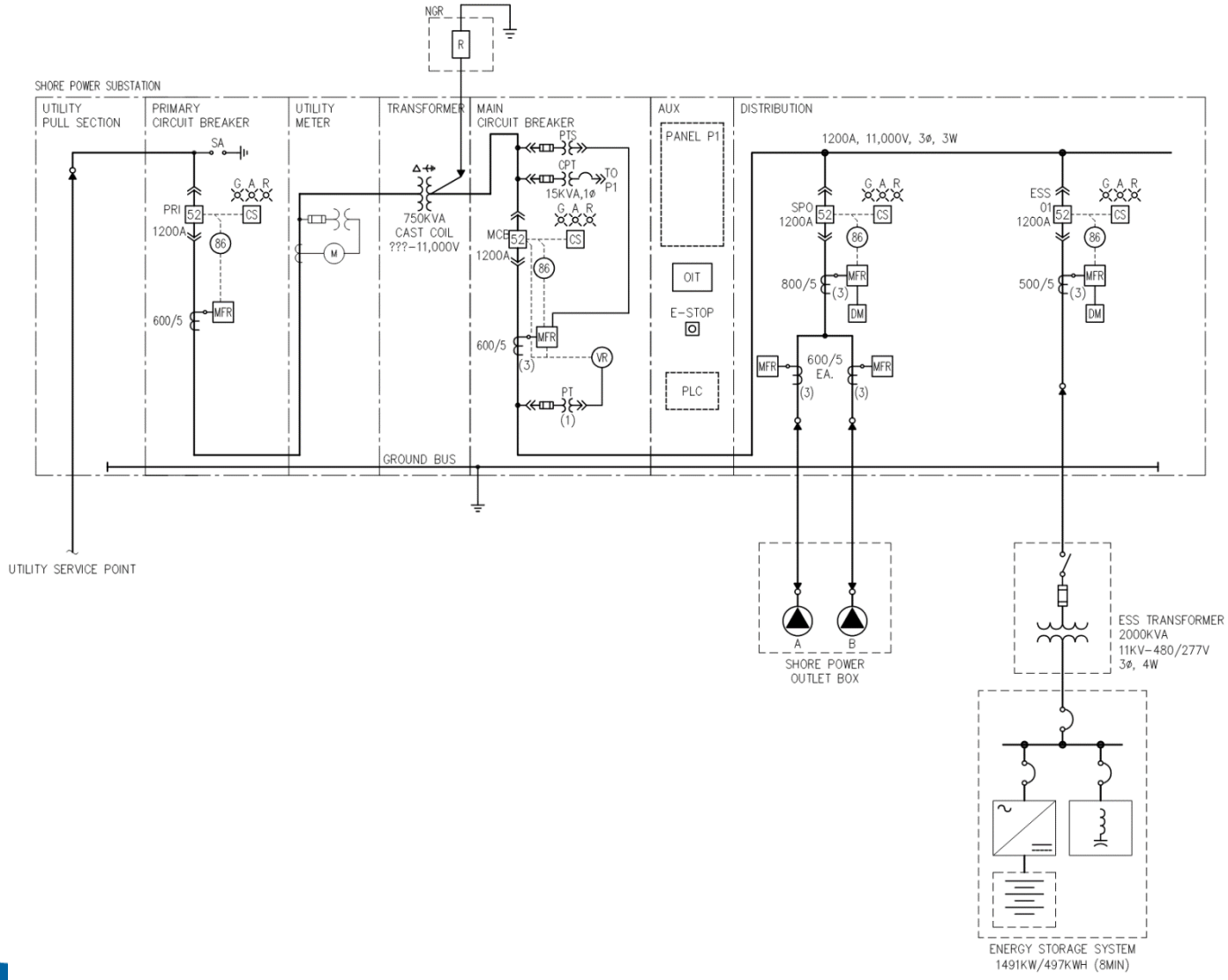
Phasing Assumptions

- Phase 1: Currently Available Power
  - Assume 1 MW available
- Phase 2: Increase in available power without major grid improvements
  - Assume 2 MW available
- Phase 3: Grid improvements to allow 100% electric ferry operations
  - Line voltage increase from 12.47 kV to 69 kV
  - New substation on-site

Shoreside Infrastructure



Local Switchgear



Battery Energy Storage Systems

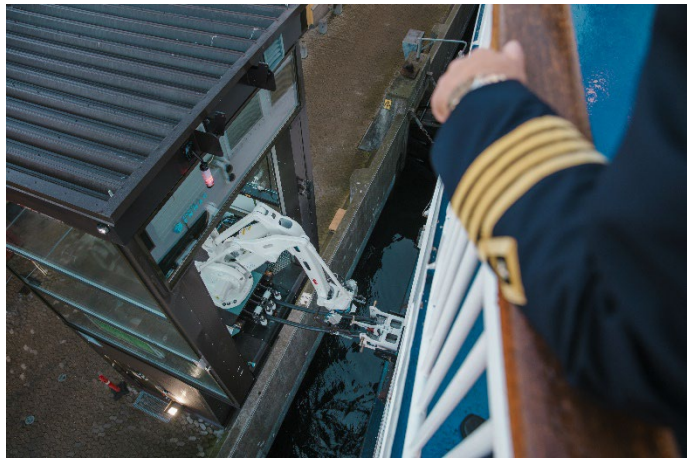
- Standard ISO 20’ or 40’ Container
- Batteries
- Energy Management System
- Safety, Alarm, and Firefighting Systems

SAFT 20’ Container BESS

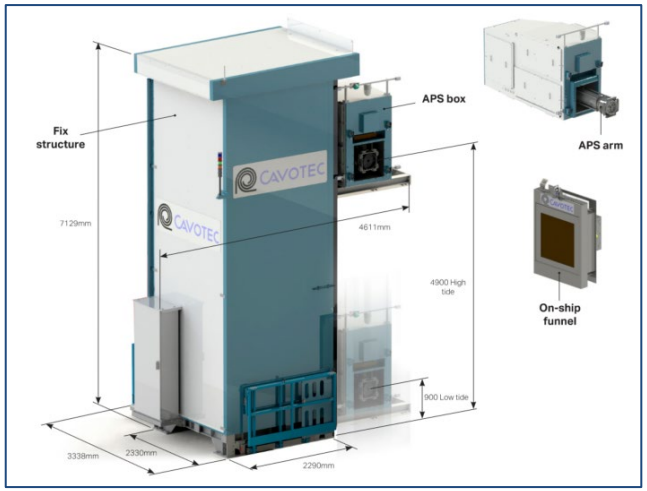
Kokam 40’ Containter BESS

Rapid Charging Systems

- Matched active plug and passive receptacle
- Partially or fully eliminates crew handling power cables
- Reduce time to engage / maximize time for charging
- Control, monitoring, communication, and alarm systems



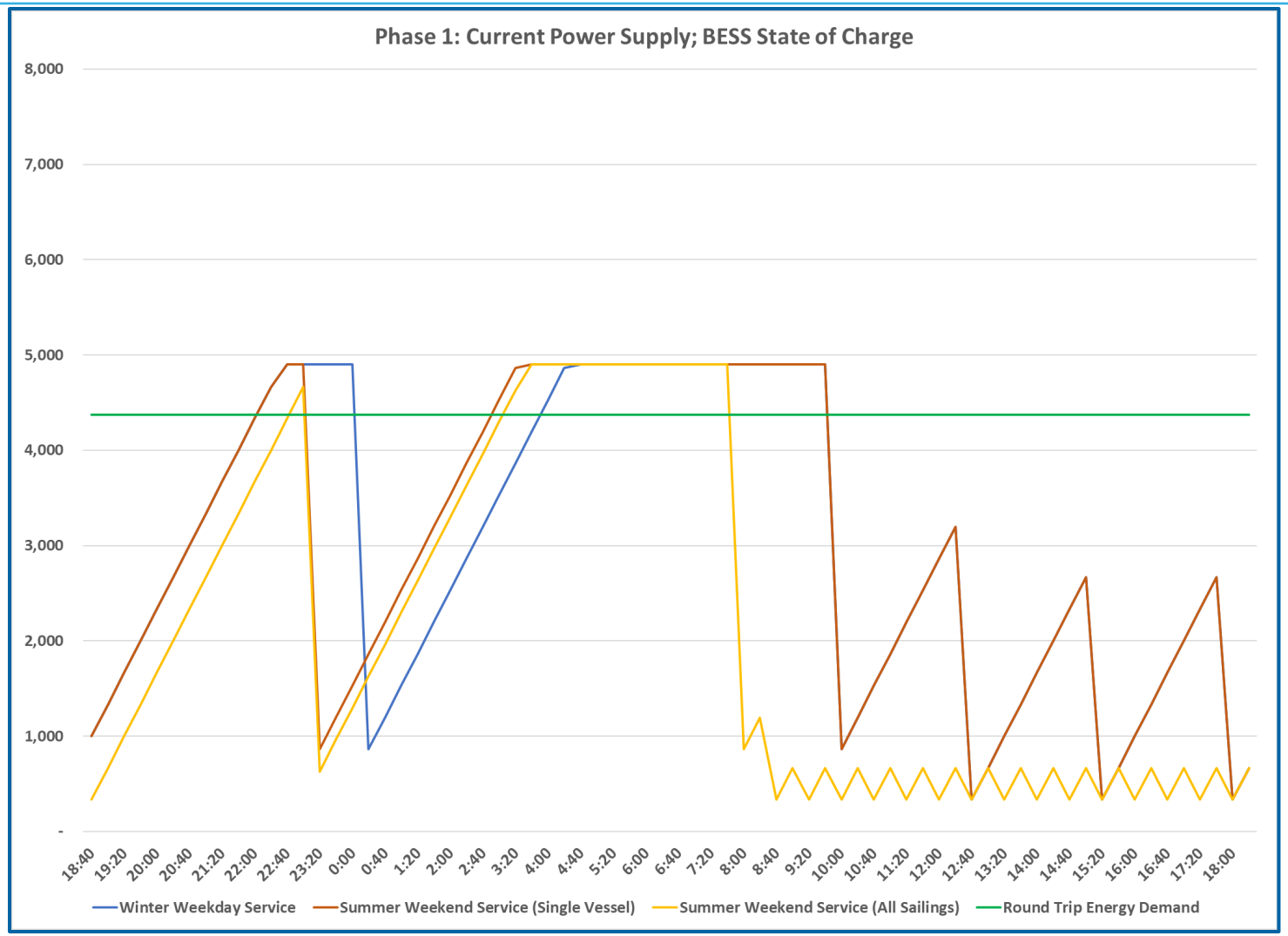
ABB/ForSea



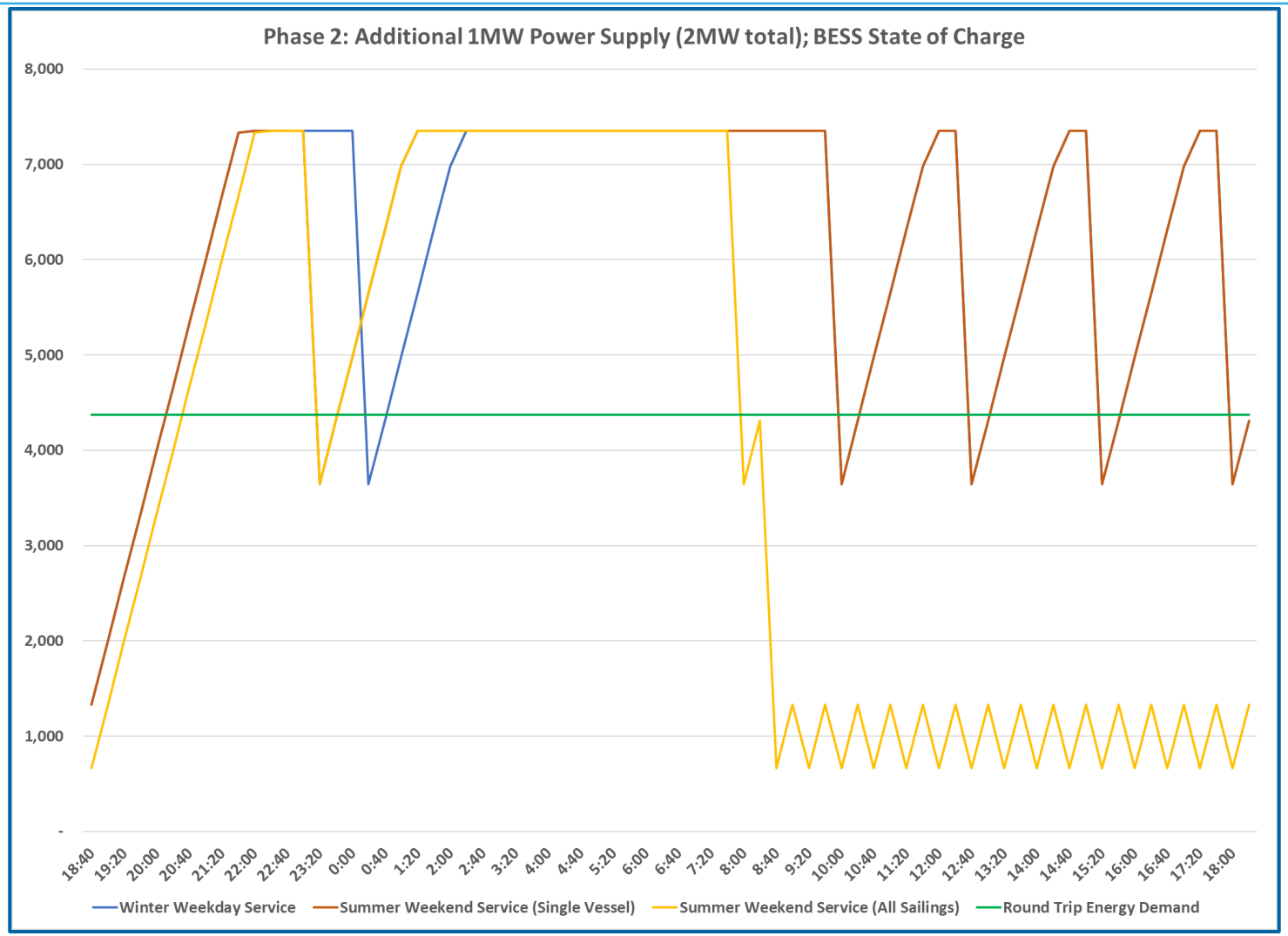
Cavotech PowerReach

Stemmann Technik FerryCHARGER

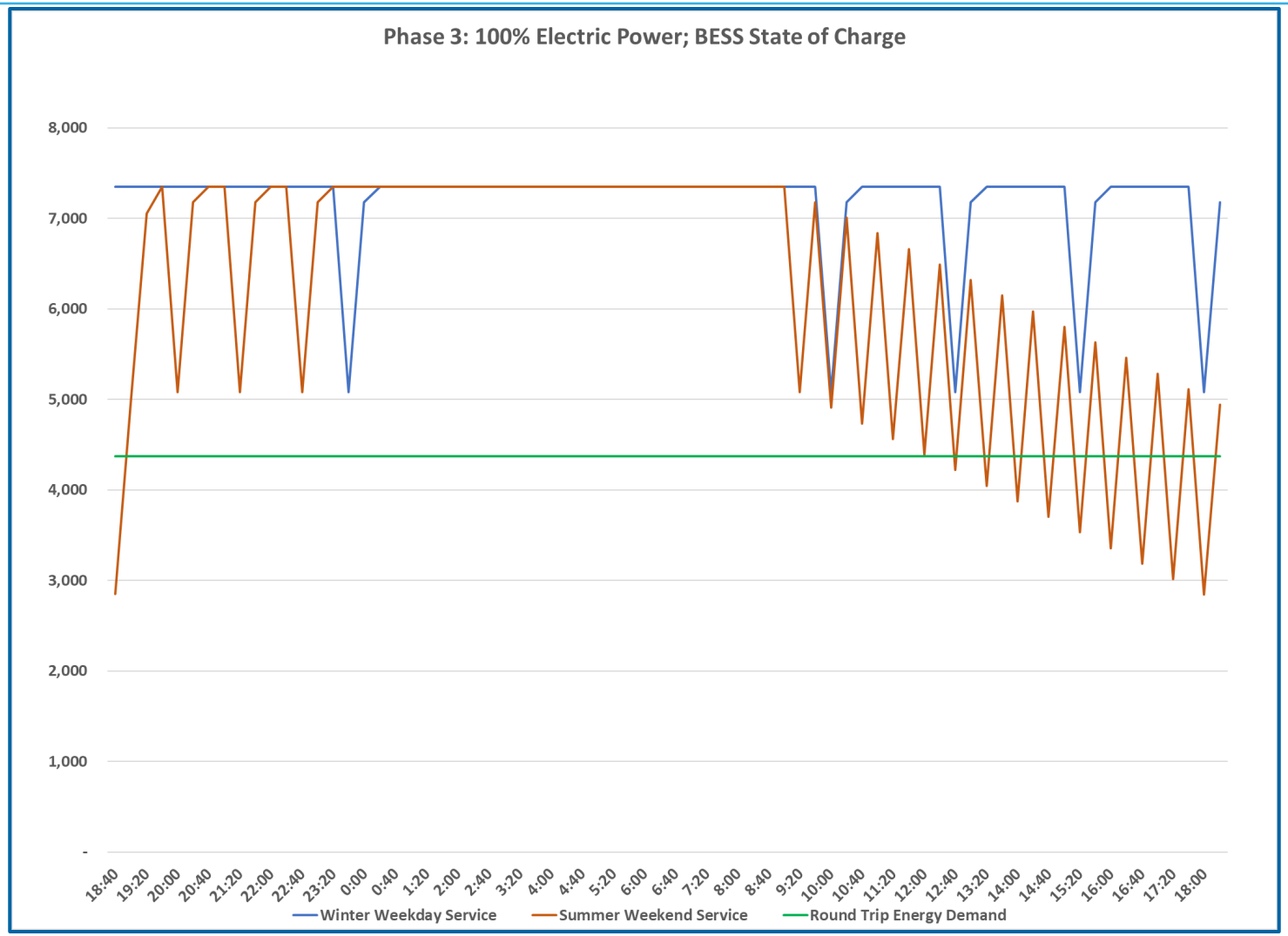
Phase 1 Charging Cycle



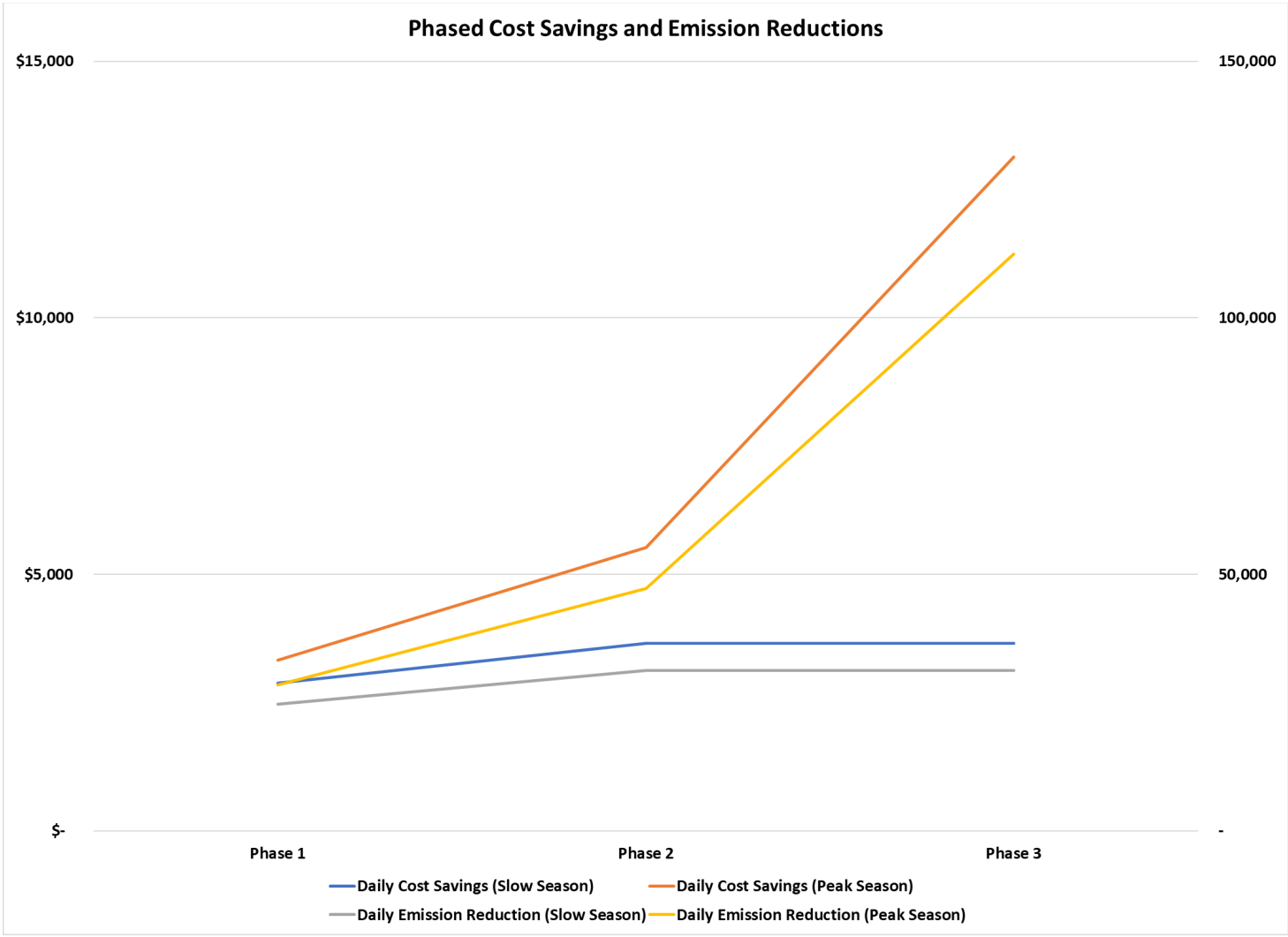
Phase 2 Charging Cycle



Phase 3 Charging Cycle



Improvements by Phase



Conclusion

- Plug-in hybrid ferry technology can produce immediate cost savings and emission reductions
- Infrastructure can be designed to allow increased zero-emission operations with grid capacity improvements