Energy Storage and Wireless Charging Technologies for Marine Applications

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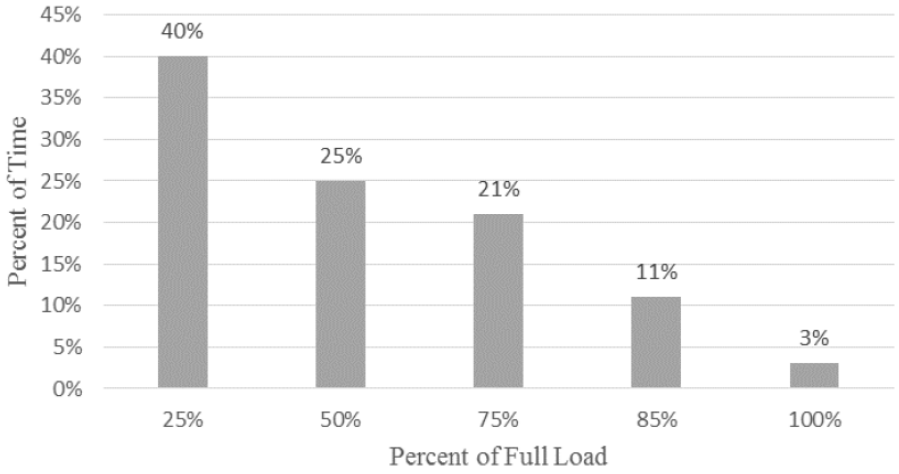
Optimization of Marine Energy Storage Systems for Desired Lifetime, Energy Saving and Safety

- Typical applications of ESS
- Optimal sizing of ESS
- Dynamic balancing of ESS

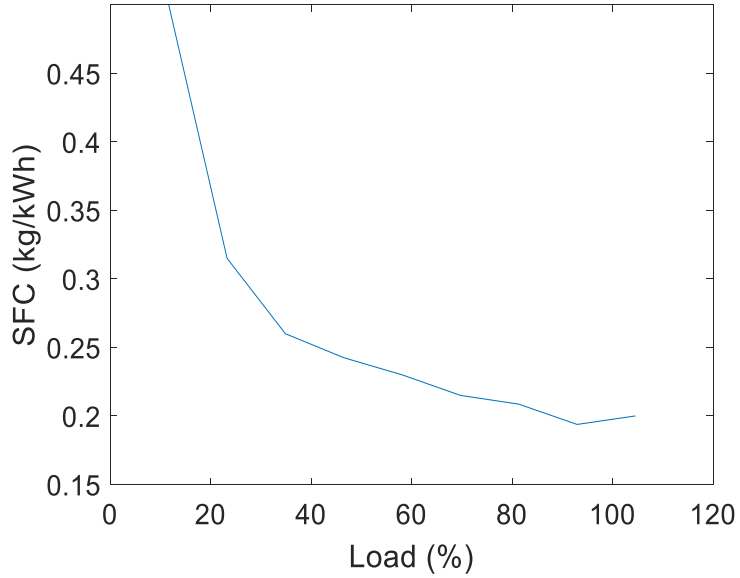
Typical Applications of ESS

- Peak shaving
- Strategic loading
- Spinning reserve
- Dynamic support
- Uninterruptible power supply

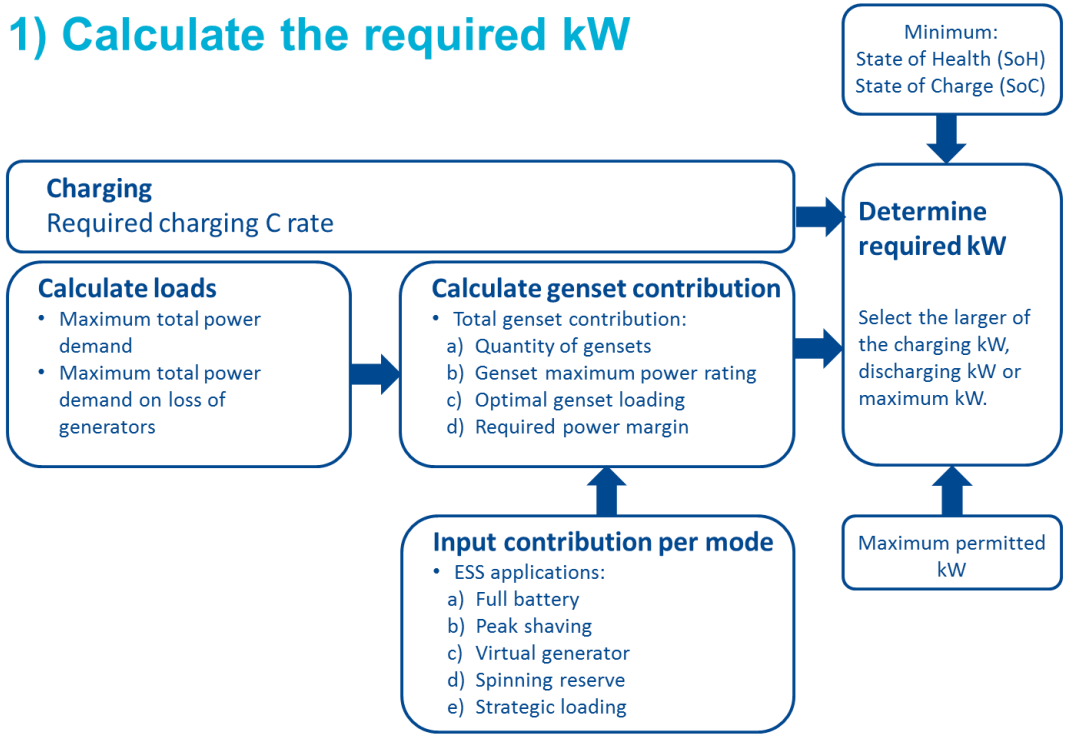
Load profile of harbor Tug

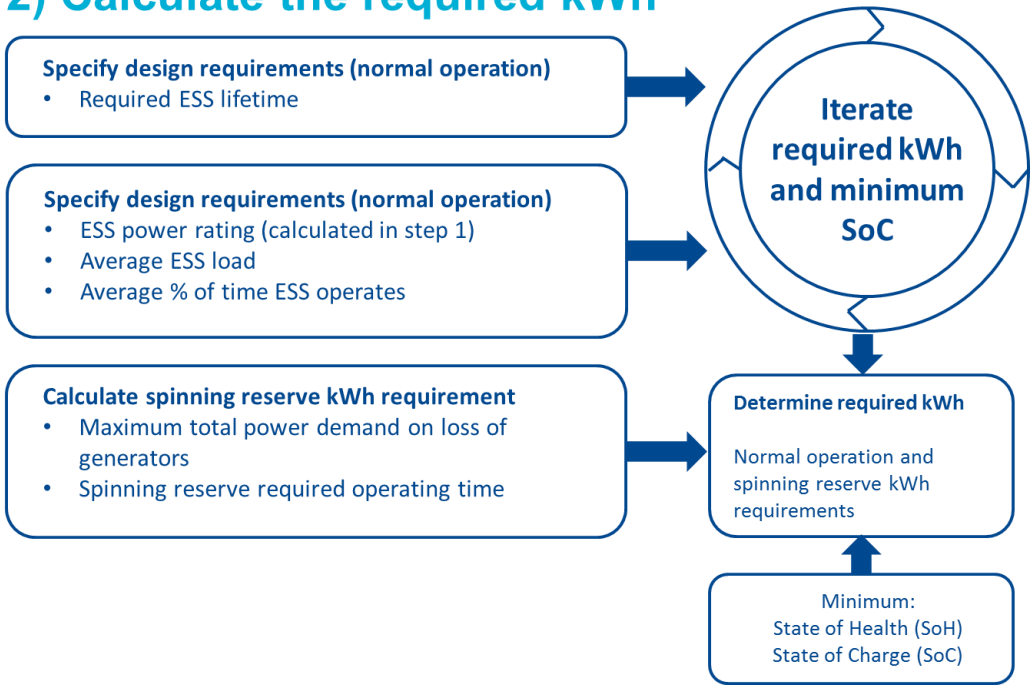


Specific Fuel Consumption

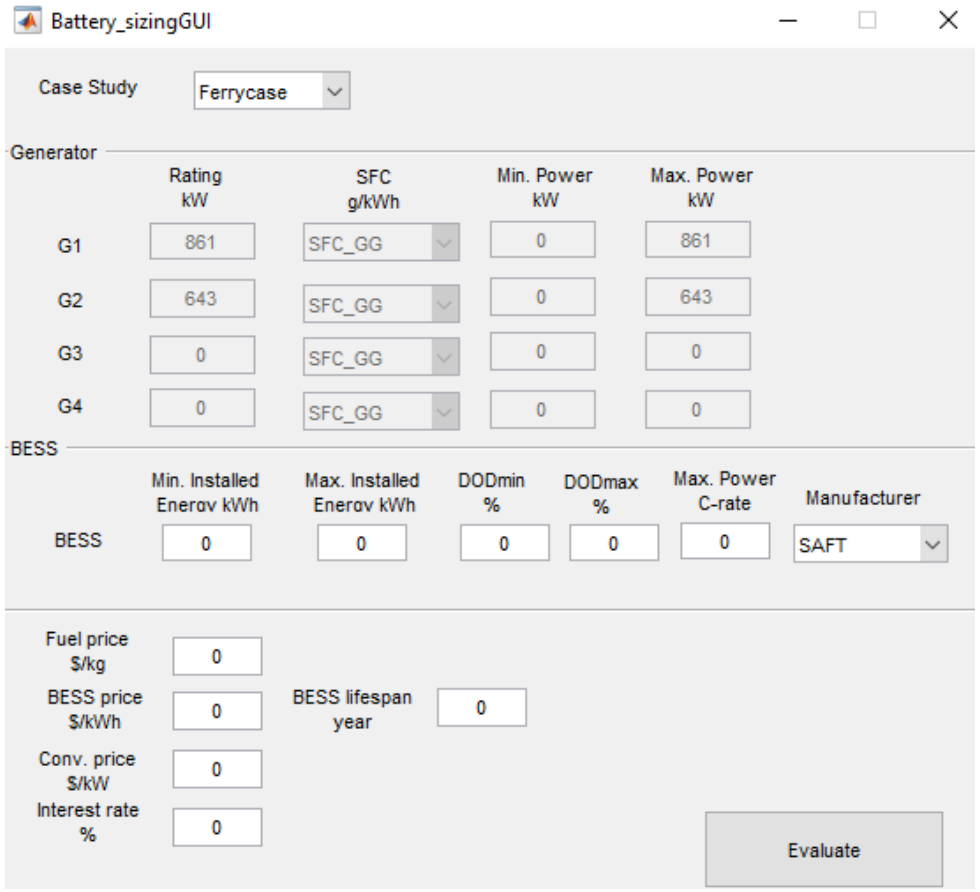


Optimal sizing of ESS

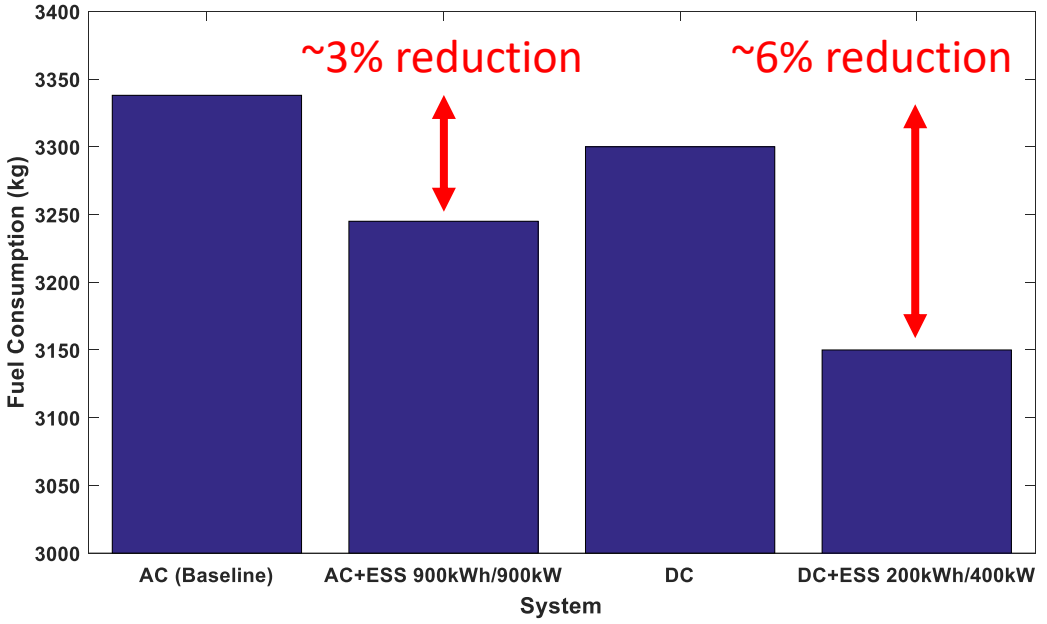




Optimal sizing of ESS



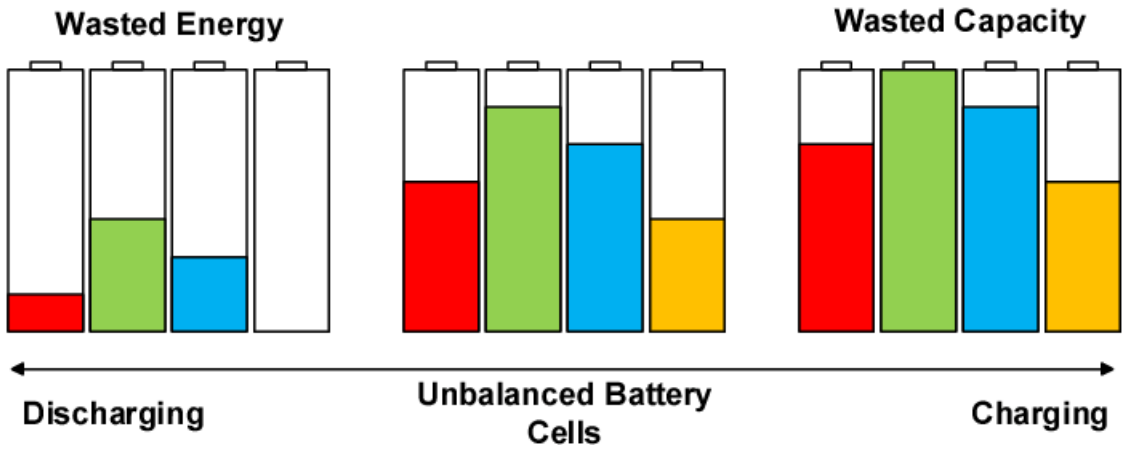
Fuel Consumption for Ferry Case Study



MATLAB

Dynamic balancing of ESS

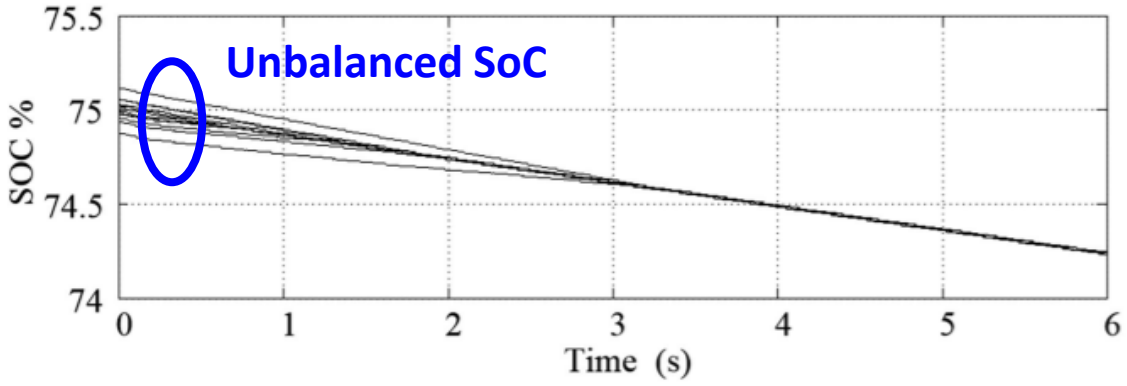
- Aging of batteries could be different, leading to wasted capacity, over-charge/discharge issues, and reduced battery lifetime.
- Failure of one battery will affect the operation of the whole battery bank, necessitating extra fault-ride through schemes.

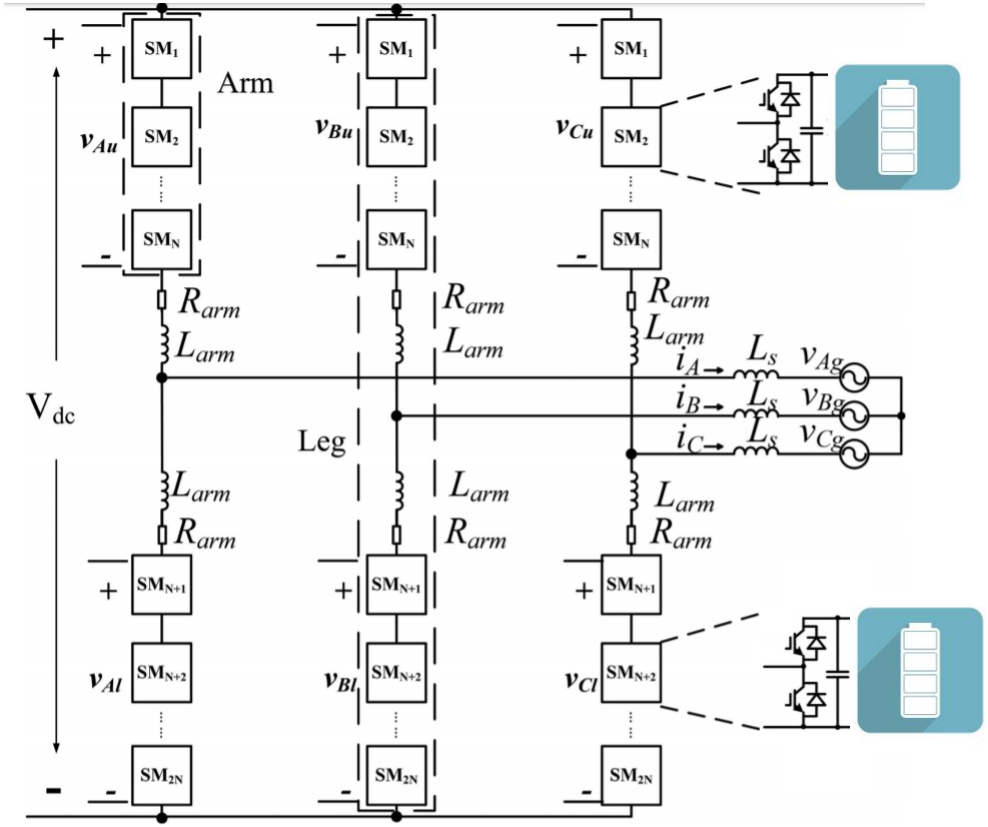


Dynamic balancing of ESS

A modular multilevel converter-based ESS offers

- Dynamic SoC balancing
- Modularized design
- Fault-ride through





Ultra-high Power Density Wireless Charging for Maritime Applications

Advantages of wireless charging

- Safety and Convenience
- Free of corrosion
- Autonomous system
- Reduced labour costs

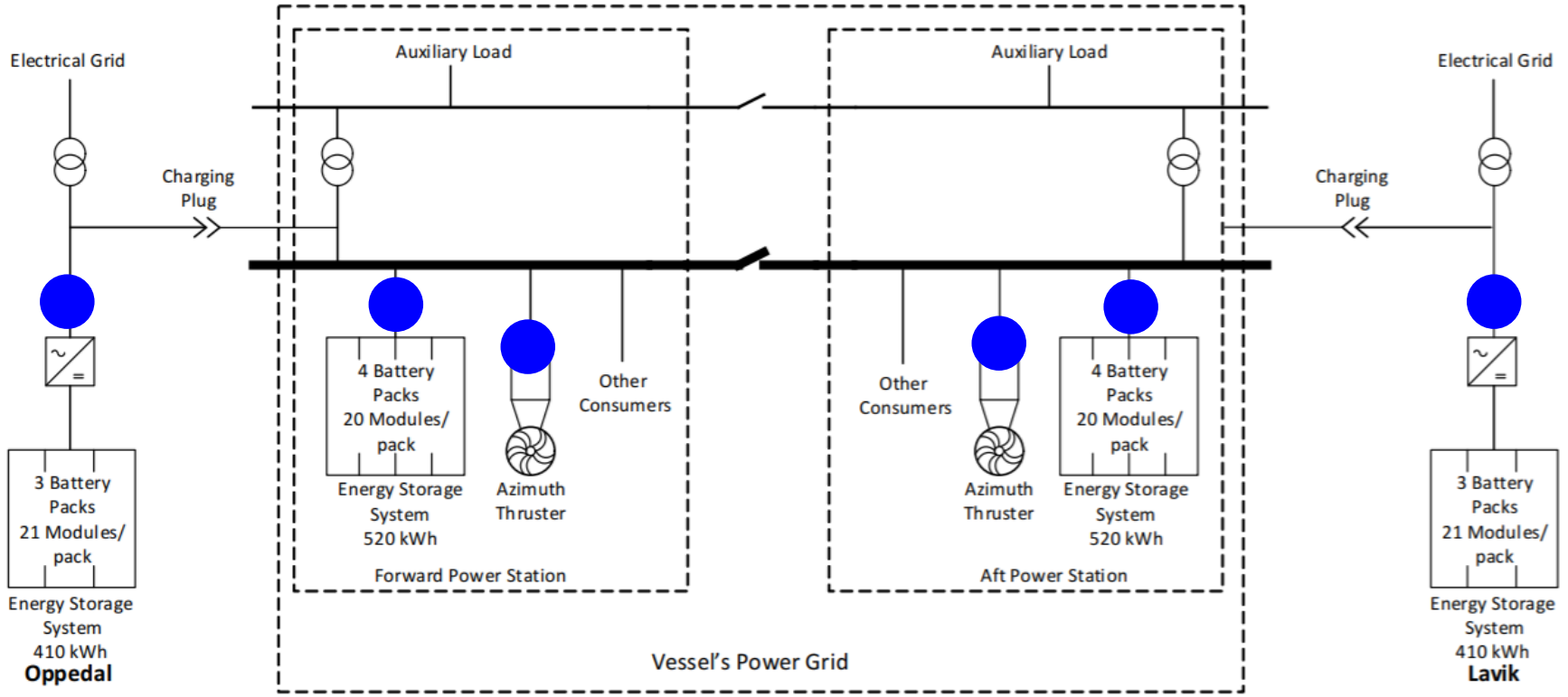
Key challenges:

- Cost & efficiency
- Power density (2kW/kg)
- Charging time (reduction by 50%)

WÄRTSILÄ NTNU Xnergy Autonomous Power Technologies

Other Challenges for Full-electric Harbour Craft

- Power electronics efficiency/reliability (marine frequency converter, battery charger, solar photovoltaic inverter, etc.)



One-line diagram of Norled's MF Ampere all electric battery ferry

Power electronics devices

Other Challenges for Full-electric Harbour Craft

- Hybrid energy storage system (HESS)

Different ESS applications demand different requirements

- Peak shaving
- Strategic loading

} Long-term high energy

- Spinning reserve
- Dynamic support

} Short-term high power