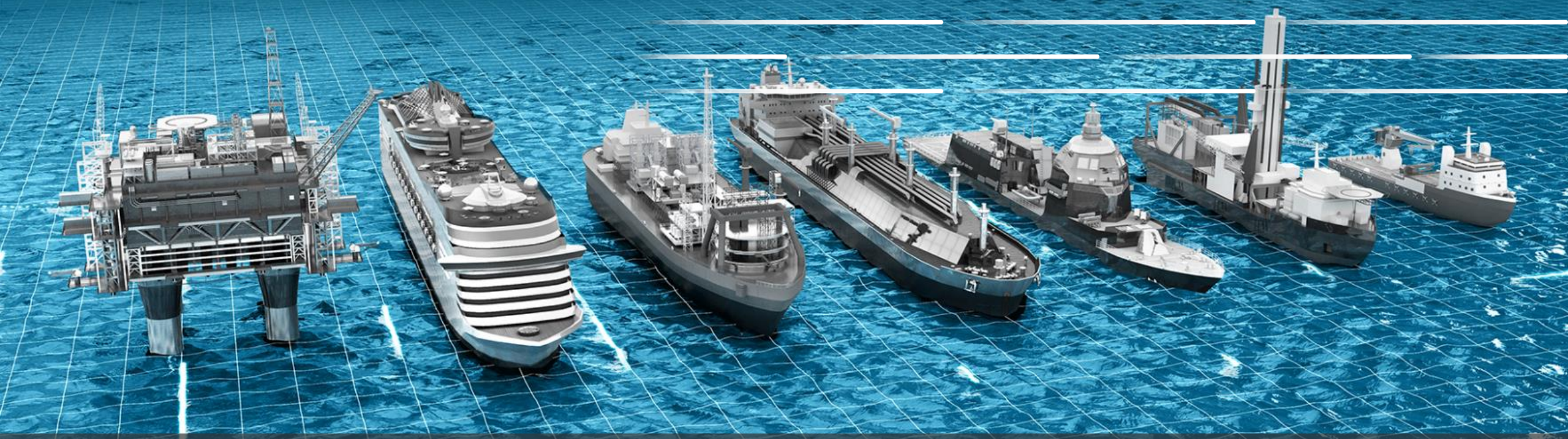
Energy-Efficient Future Fleets



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Discussion Points - Overview

- Industry Need
- GE's Solution
- Vessel Integration & Product Functionality
- Batteries & Power Converter

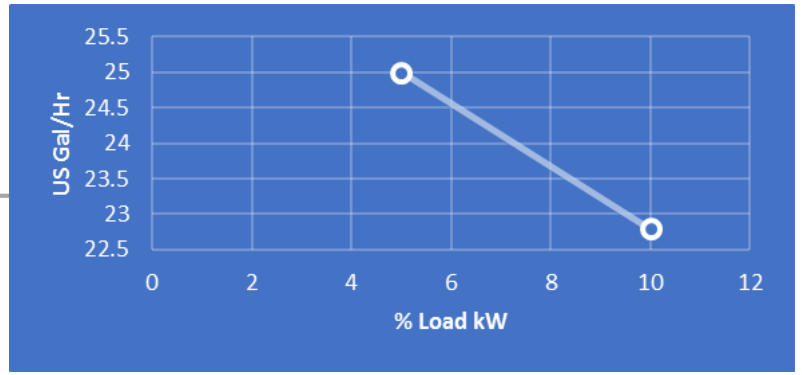
Do we need energy efficiency in Offshore Energy?

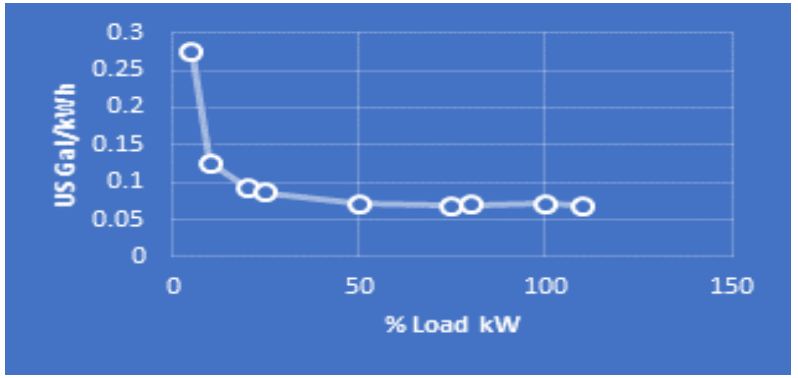
Regulation	Sustainability & CSR	Operational Availability	OPEX, Return on Assets
IMO 2020 ECA expansion Global sulphur cap 0.5% EEDI EEOI SEEMP	Technology and supply chain Reputation with stakeholders	Anti-blackout Stay ‘on-mission’ for longer Control and prioritise loads Peak Shaving	Fuel costs Fewer assets, less maintenance Sweet-spot running of assets

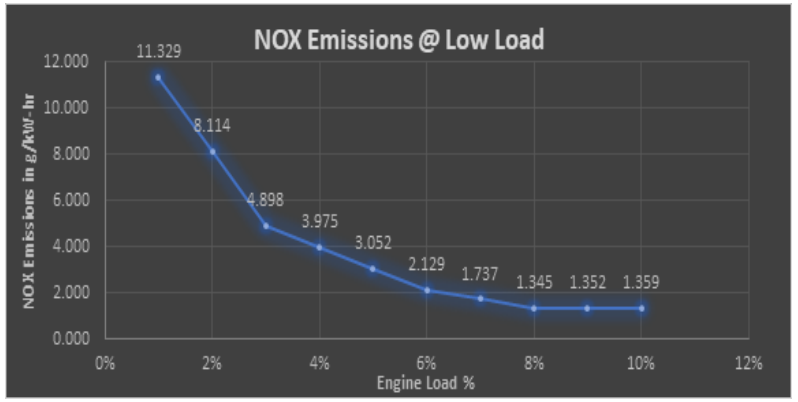
Delivering the Energy Efficiency Vision

SAVINGS

- Oil Companies:
  - Fuel & Carbon Reductions
- Vessel Owners:
  - Engine Maintenance Reduction
  - Emissions Reduction
- Strategy:
  - Optimize Load Profile for the Engines
  - Prime Mover Load increase from 5% to 10% reduces Fuel consumption and NOX Emissions.
  - In DP Mode with spinning reserve up to **50%** savings are available:
    - Fuel Costs
    - NOX Emissions
    - Engine Run Hours







GE's SOLUTION - SeaGreen

- Containerized Battery Energy Storage Modular System
  - Plug and Play Concept
  - Rapid Mobilization
- Container size 25ft x 8ft x 9.6ft
  - Li-ION Battery Packs ~ 750kWh
  - GE Power Convertor ~ 1.4MW
  - HVAC/Cooling Cabinets Integrated
  - Fire Suppression System
  - A60 Fire Rating Container
  - DNV Type Approved – In Progress

SeaGreen Energy Storage Product Features

Continuity of Operations

Mitigating Black Out Concerns
Instantaneous Discharge Upon Loss of Diesel Generators
Contributing Power On Demand to Ride Through Generator Overload

Vessel Efficiency

Dynamic Load Levelling
Reducing Stress on Prime Movers
Active Heave Compensation and Crane Load Balancing
Optimizing Operating Profile of Prime Movers

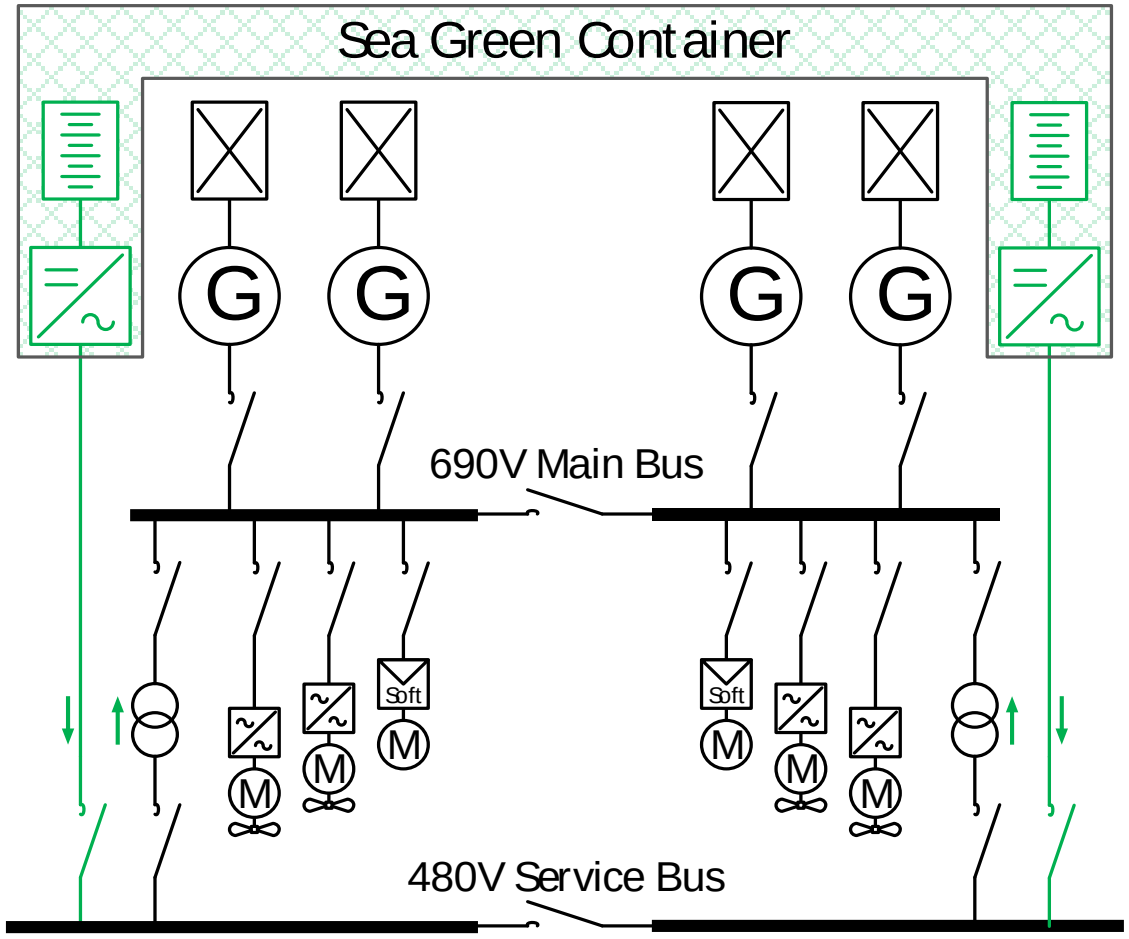
Emissions Control

Reducing Combustion Emissions and Noise in Port
Battery Power Manoeuvring for Port Entry and Egress
Short stay in harbor with no use of engines.

Applications in all vessel types requiring cycling operations

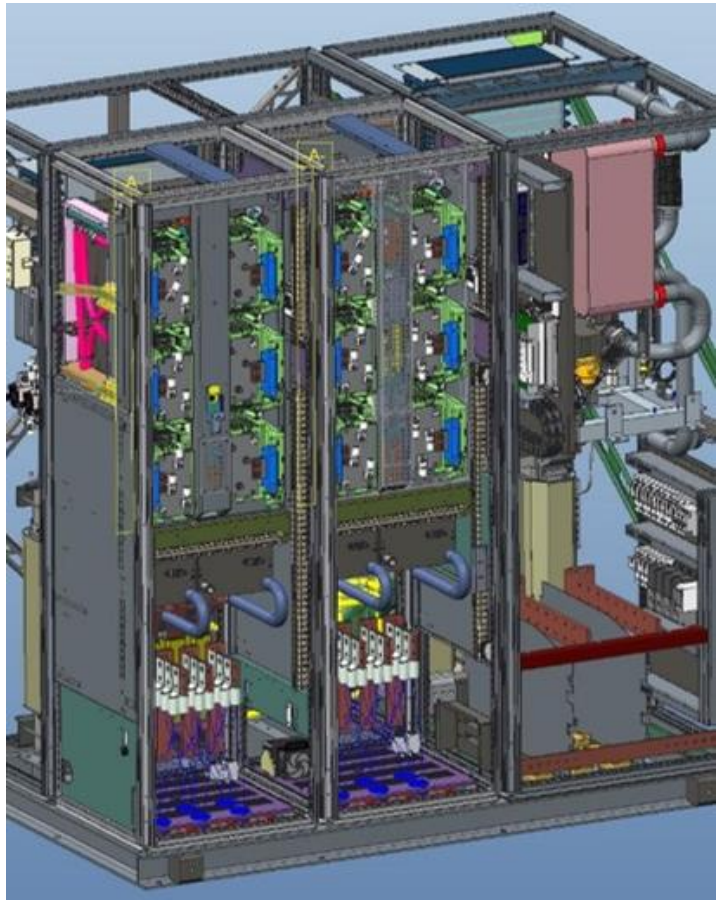
SeaGreen Energy Storage Electric Plant Integration

- Container Integration to 480Vac Ship Service Transformer
- Allows for Use of Increased Battery Capacity compared to integration to 690Vac Side of Transformer
- Easy Electrical Plant Integration allows for Plug and Play capability



GE POWER CONVERTER

- 480V AC Standard for Main and Aux Supply
- Fresh Water Cooled, Standard Range 15-38 DegC
- Front Access Only Required, can be pushed back to bulkhead
- IP44 Sealed, no External Air Exchange, Ambient 45 DegC with Derate to 55 DegC
- Bottom Cable Entry via MCTs at front of each cubicle
- Substantial Mounting Plinth included
- Optional Cooler Cabinet Included within Cubicles, dual Pump, three way valve
- Pull Out Control Section, Local Controls on Control/Cooler Door.
- Easy Integration to GE PMS



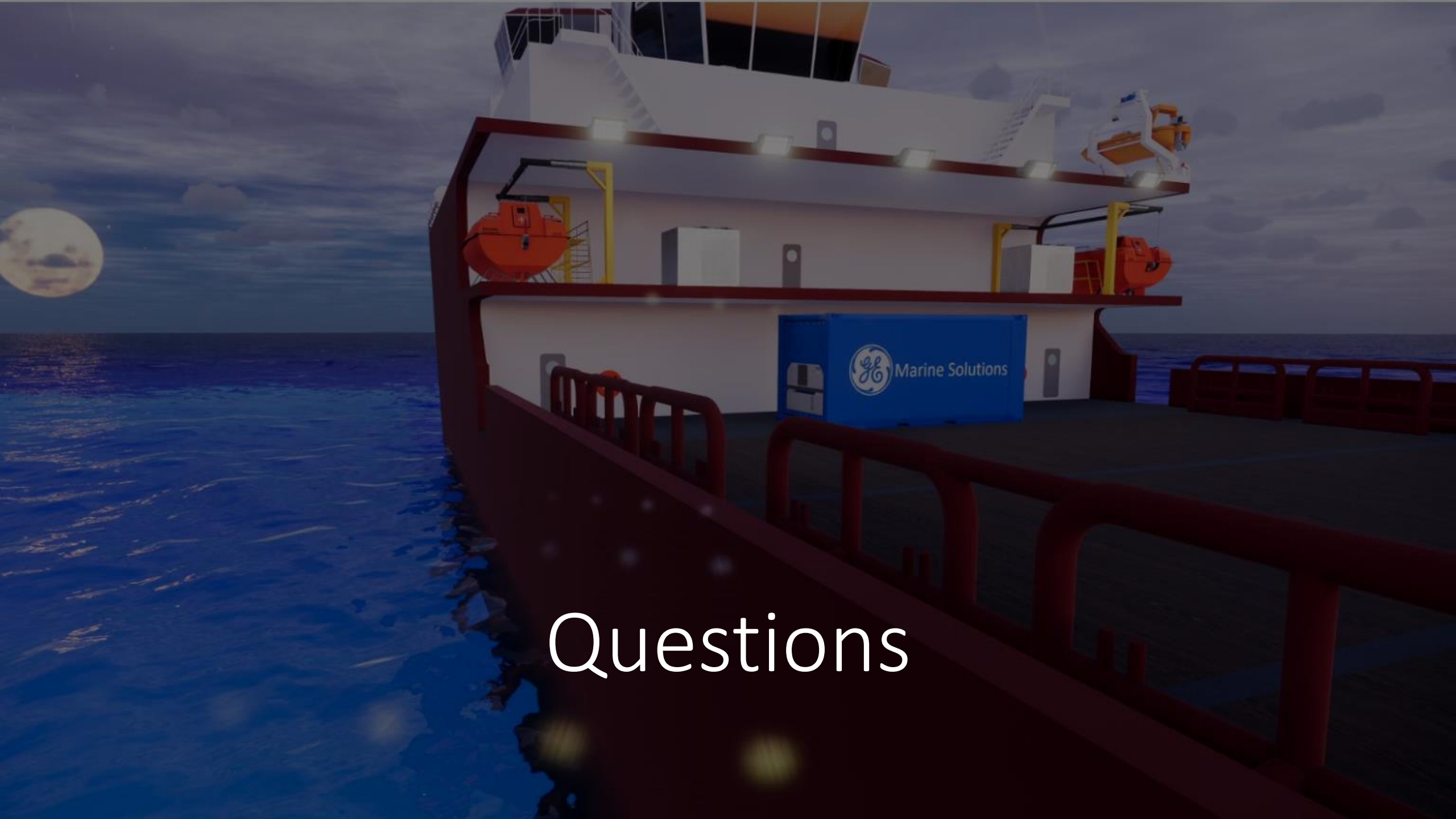
BATTERIES – Li Ion

Lithium-ion battery

Advantages:
- High Energy Density
- Relatively low self discharge
- Capability of providing very high currents
- Longer Life

Limitations:
- Requires Protection circuits
- Transportation restrictions
- Expensive to manufacture
- Requires Proper Thermal Management

	PROS	CONS
AIR COOLED BATTERIES	Reduced Cost	Potential for Temperature Imbalance through the Battery Pack
	Less Complicated, Easier to Maintain/Service	Less Efficient for Pulsed Discharge: Liquid can transfer Heat more efficiently
	Maturity of Battery System in Marine Industry	May Harm Battery Longevity
LIQUID COOLED BATTERIES	**PROS**	**CONS**
	Higher Energy Density	Potential Leaks could compromise system performance
	Batteries can Discharge Larger Pulse of KW, More Efficient Thermal Management	Difficult to Service/Maintenance compared to Air cooled
	Electric Vehicles Choice of cooling: Tesla, GM & Ford	Only 10% market for Marine applications



Questions