

# The Practical Application of Hybrid Technology in the Marine Industry



**ASPIN KEMP & ASSOCIATES**

CANADA • USA • SINGAPORE

# Aspin Kemp & Associates (AKA)

- ✓ A Canadian based company specializing in the design and development of power, propulsion and control systems primarily in the marine and offshore oil and gas industries.
- ✓ Designed and manufactured the world's first hybrid tug.
- ✓ Developers of the Advanced Generator Protection (AGP) system.
- ✓ Operate a manufacturing and R&D facility in PEI with complete test lab and training facilities.



AKA - OWEN SOUND, ONTARIO



AKA - PRINCE EDWARD ISLAND



# AKA Operations





# Hybrid Projects

# Marine Hybrid Reality



# Patents Have Been Granted!

(12) **United States Patent**  
**Barrett et al.**

(10) **Patent No.:** **US 8,062,081 B2**  
(45) **Date of Patent:** **Nov. 22, 2011**

(54) **HYBRID PROPULSION SYSTEMS**

(75) Inventors: **John Barrett**, Leavenworth, WA (US);  
**Elizabeth Boyd (nee Reynolds)**, Seattle,  
WA (US); **Tim Stewart**, Longview, WA  
(US); **Rick McKenna**, Seattle, WA (US);  
**Jason Aspin**, Charlottetown (CA); **John**  
**Eldridge**, Chamcook (CA); **Paul Jamer**,  
Fall River (CA); **John Stratton**, Bedford  
(CA); **Chris Wright**, Collingwood (CA)

6,064,161 A 5/2000 Takahara et al.  
6,150,776 A 11/2000 Potter et al.  
6,170,587 B1 1/2001 Bullock  
6,619,223 B2 9/2003 Beato

(Continued)

## FOREIGN PATENT DOCUMENTS

GB 2 290 281 A 12/1995  
(Continued)

## OTHER PUBLICATIONS



# Evaluating Emission Benefits of a Hybrid Tug Boat

**Final Report  
October 2010**

**Prepared for:**

**Mr. Todd Sterling**  
California Air Resources Board  
1001 I Street, Sacramento, CA 95814

Contract #07-413 and #07-419



**Authors:**

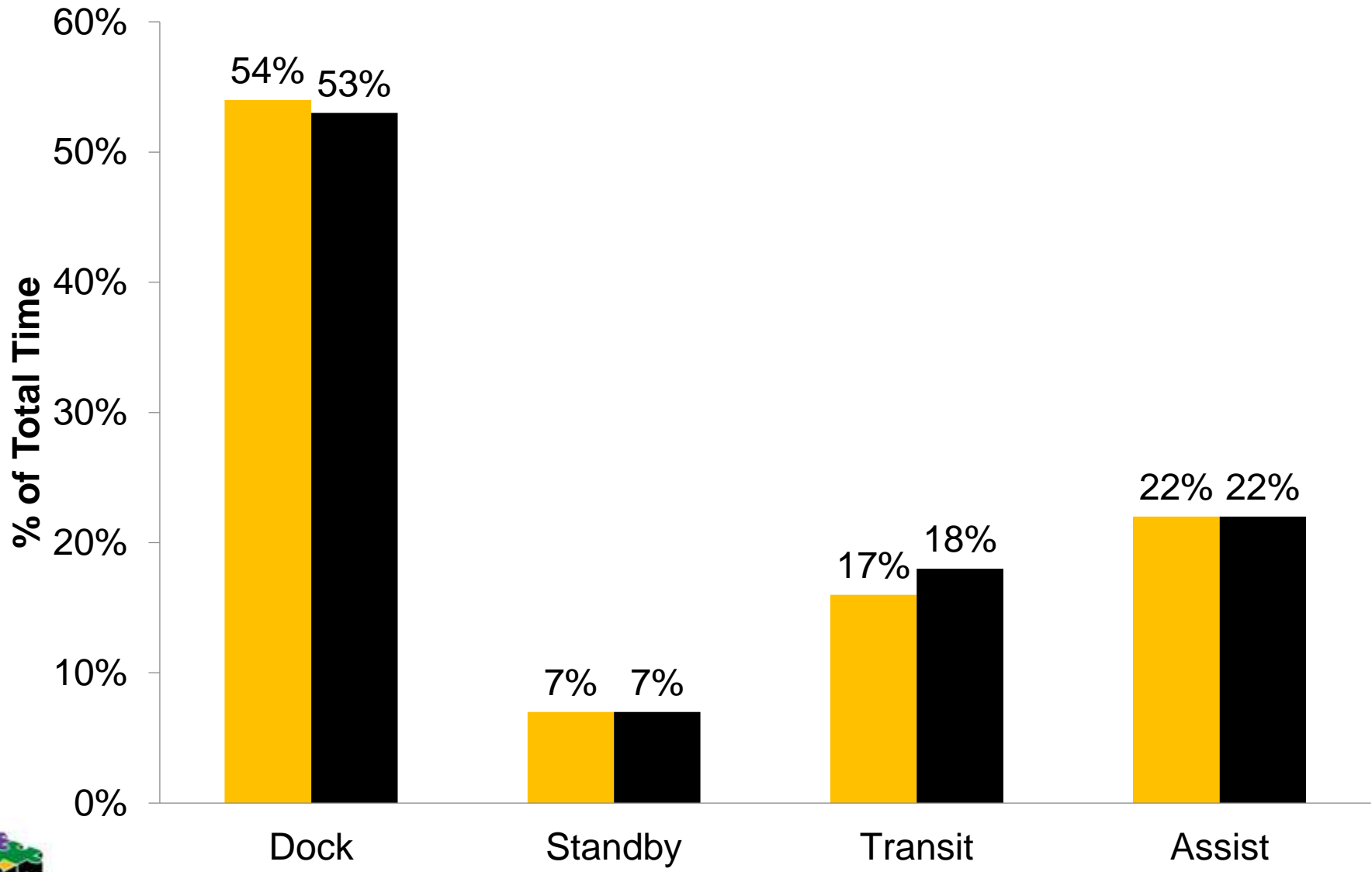
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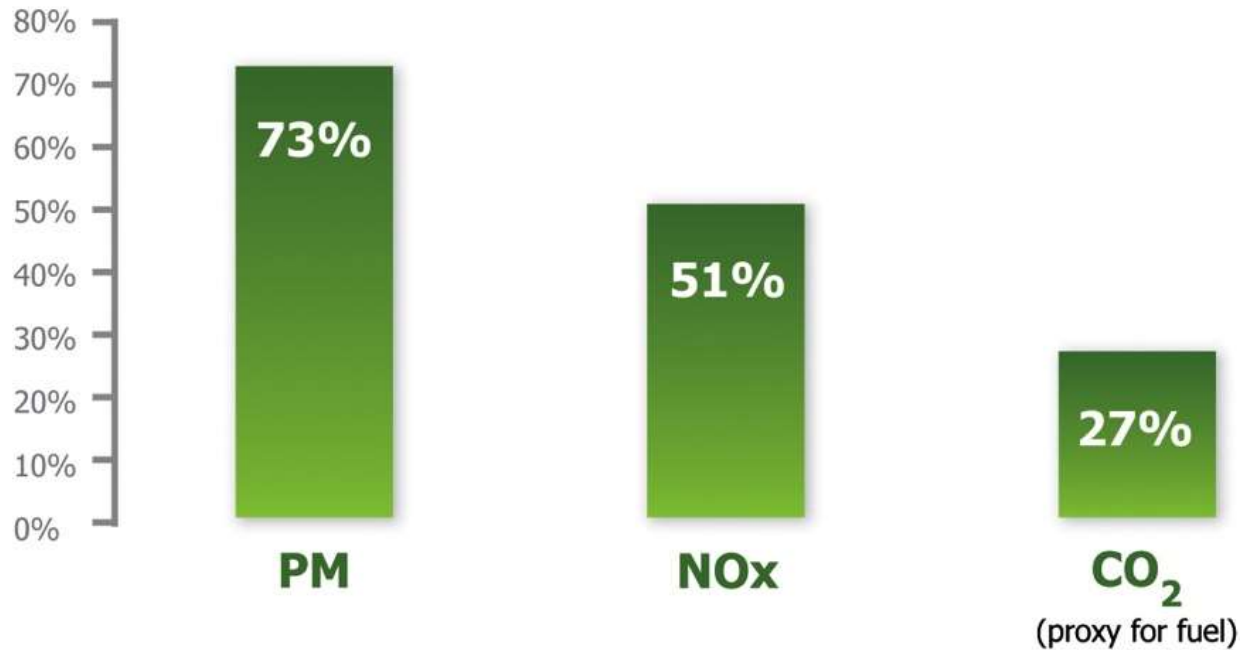




■ Alta June   ■ Carolyn Dorothy



## Hybrid Emissions Reductions



SOURCE: California Air Resource Board Report  
Prepared by: University of California - Riverside  
College of Engineering - for Environmental Research and Technology

# Press Release - EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY



National Clean Diesel Campaign

## **EPA Clean Diesel News: 7/11/13**

EPA recently approved the verification of the Foss Maritime Company and Aspin Kemp & Associates (Foss Maritime / AKA) *XeroPoint Hybrid Tugboat Retrofit System* (XeroPoint). XeroPoint is an alternative drive system for use on certain marine vessels. XeroPoint includes a new generator and engine set, modification to the vessel's propulsion system, an energy management system, and other components to reduce emissions and fuel consumption for harbor tugboats.

Foss Maritime / AKA's testing showed emission reductions of about 25% for PM, 30% for NOx, and 30% for CO<sub>2</sub>. Additionally, these results indicate an approximate 30% fuel savings with the XeroPoint Hybrid System.

# Green Technology Integration

There are many options!



# Making the right decision is tough!

- Evaluating options and selecting the appropriate technologies for a project can be a challenge.
- Use common sense and any available hard data to determine a technology's suitability.
- Beware of "Greenwashing" and understand the limitations of any selected technology.
- Non-monetary benefits might drive a project.

Post Combustion Technology  
LNG  
Fuel Cell  
Tier III Diesels  
Hybrid  
Solar  
Batteries  
Waste  
Hull Coatings  
Diesel Electric



Hybrid

Tier III Diesels

Hull Coatings

# Making the right decision is tough!

- The choice must meet requirements operationally, commercially and environmentally.
- Include stable technologies...don't experiment with mission critical systems.
- The proper balance is reached when green solutions are delivered at a competitive cost, without losing sight of operational performance.

Post Combustion Technology  
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Hybrid

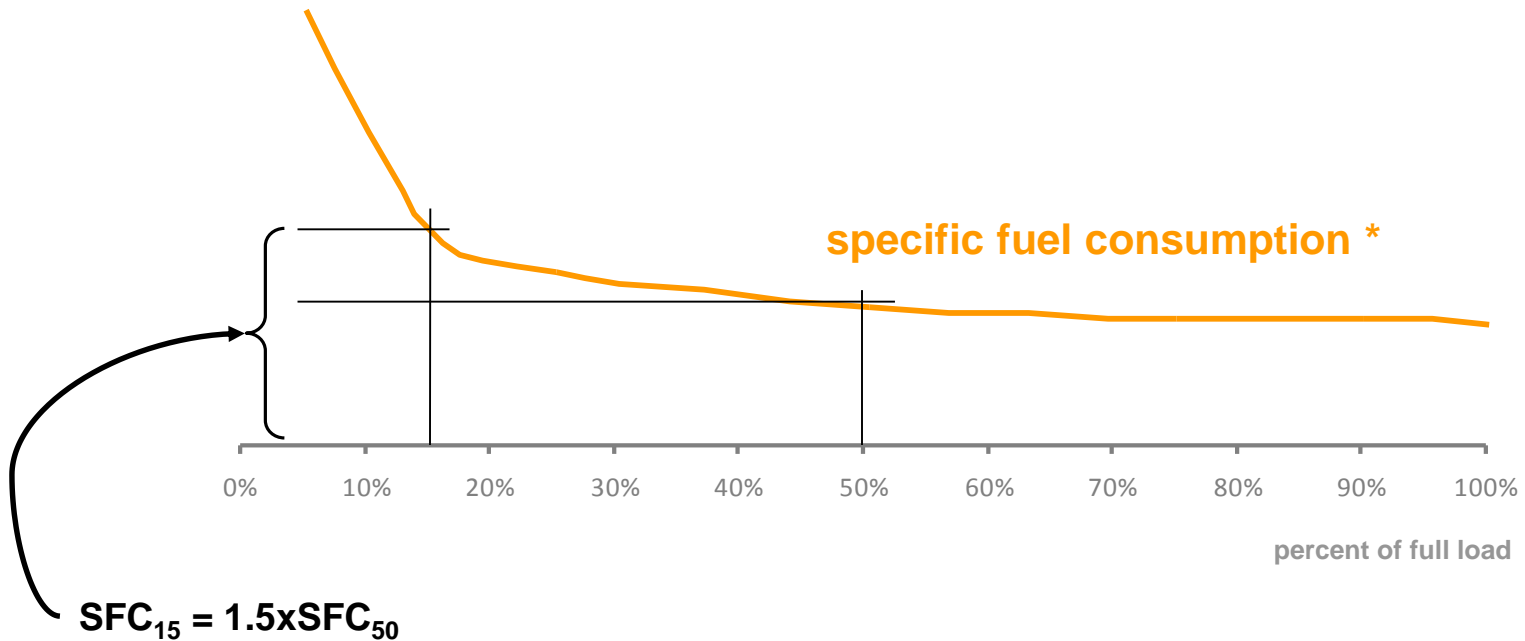
Tier III Diesels

Hull Coatings

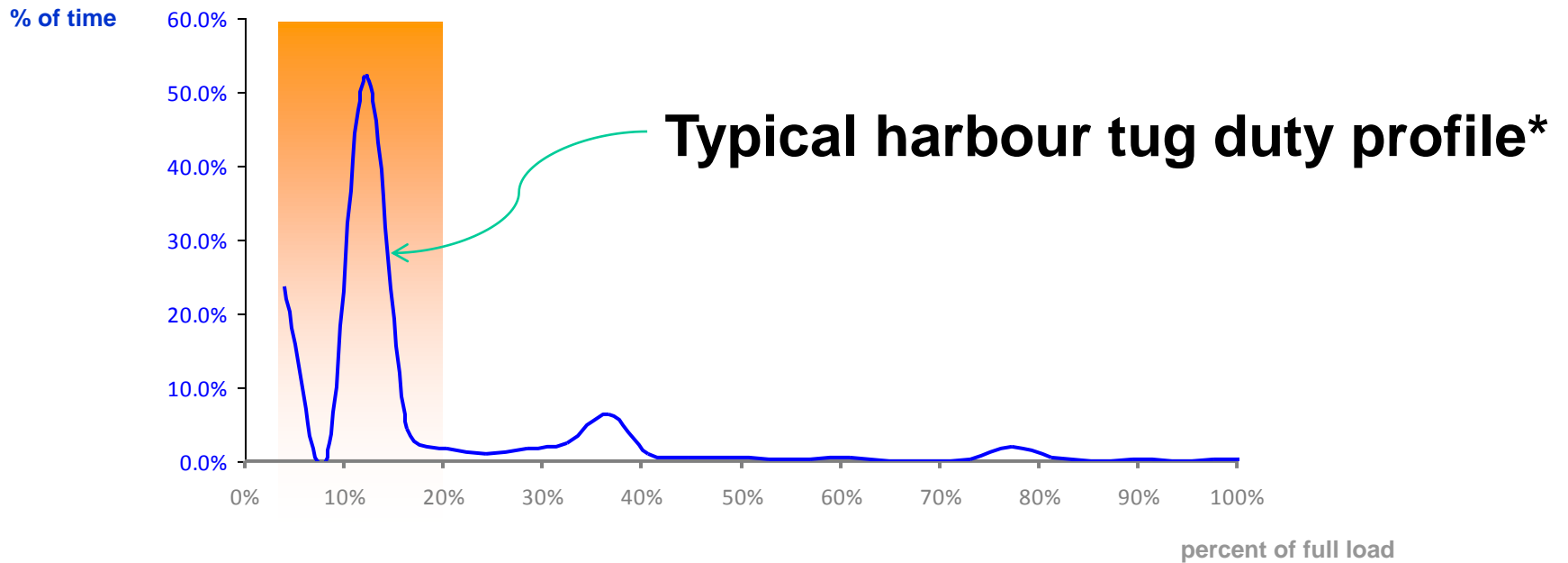
# Duty Cycle Considerations



# The Hybrid Tug Rationale

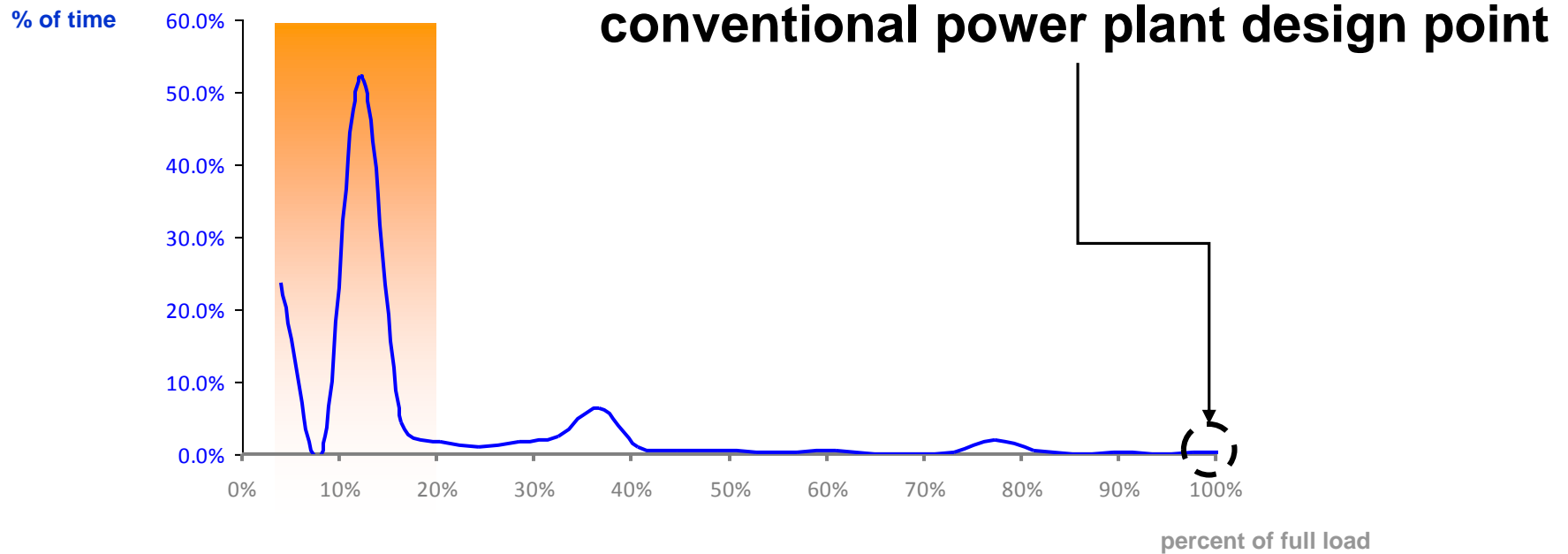


# The Hybrid Tug Rationale

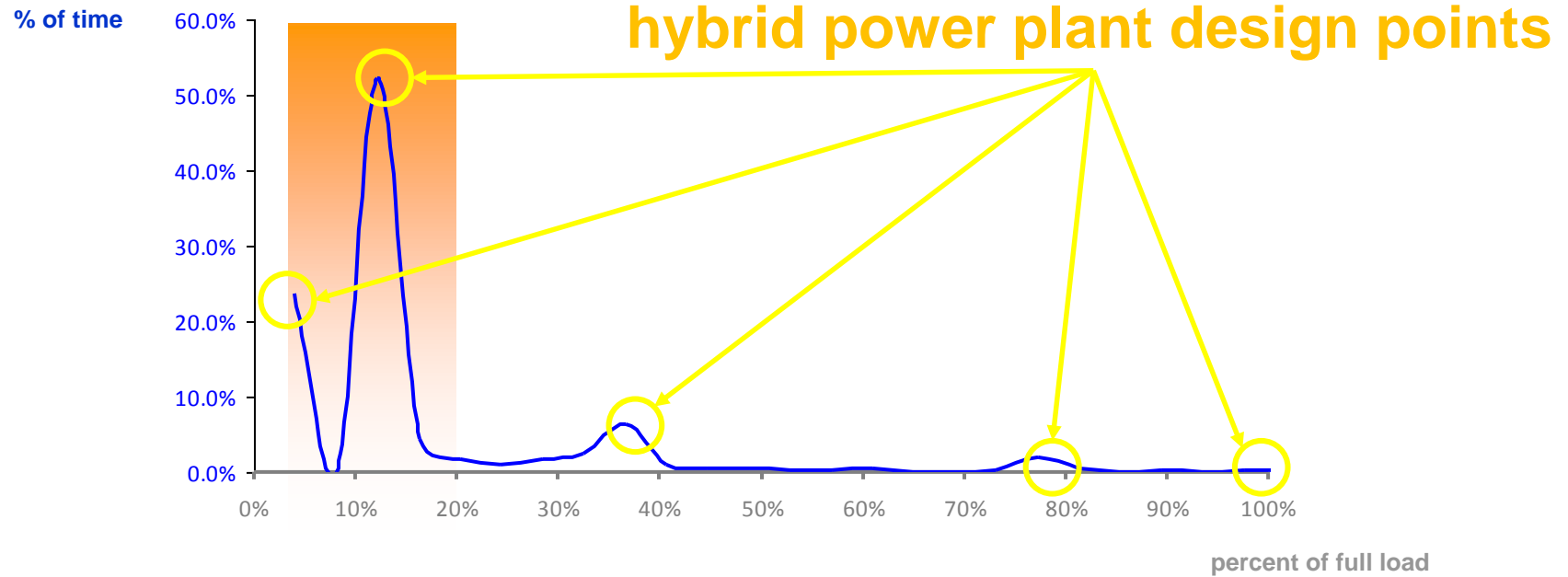


\*data from actual operations, Foss Maritime SoCal

# The Hybrid Tug Rationale



# The Hybrid Tug Rationale

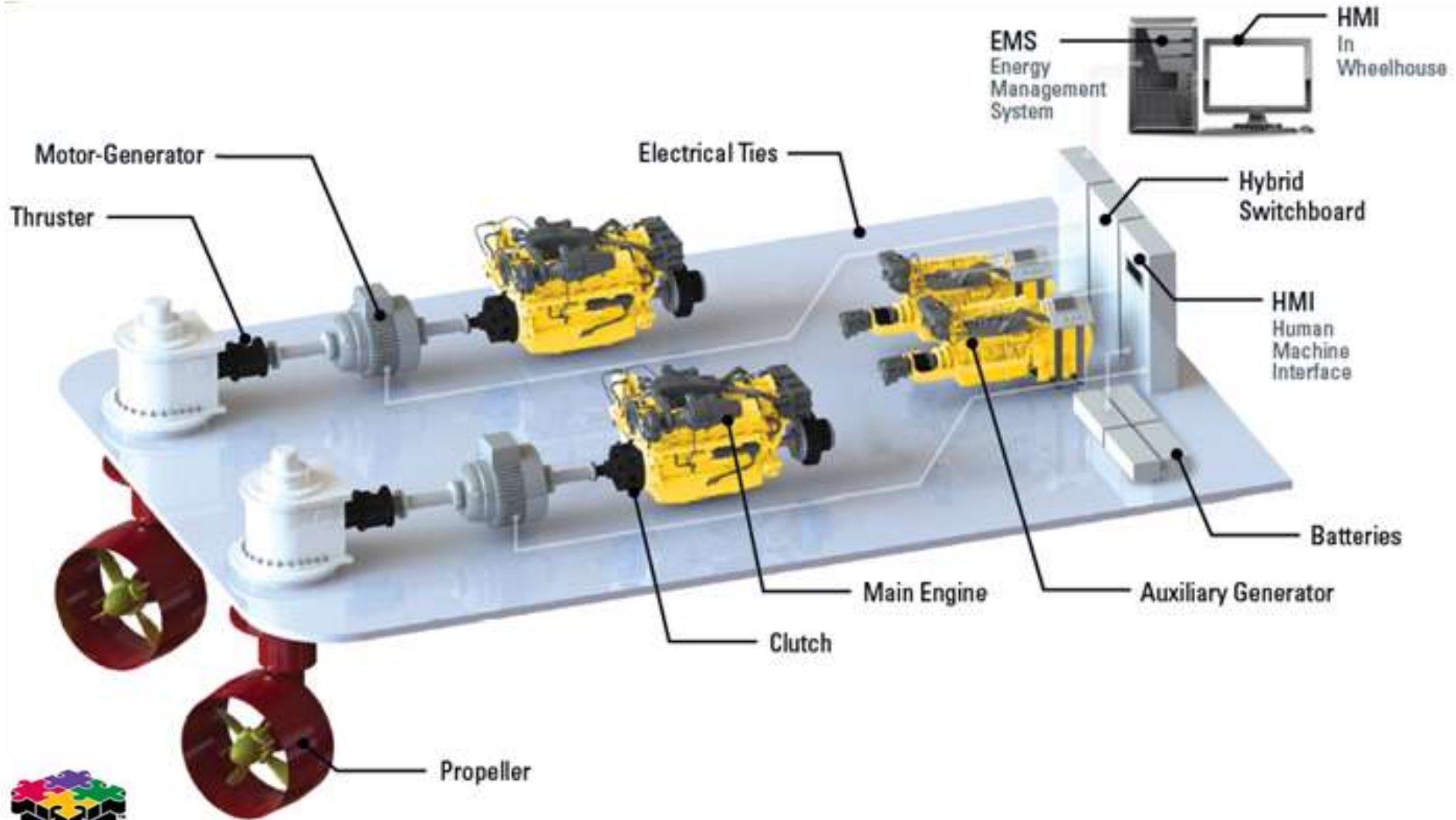


# Tugs: A Hybrid Realty Duty Cycle!

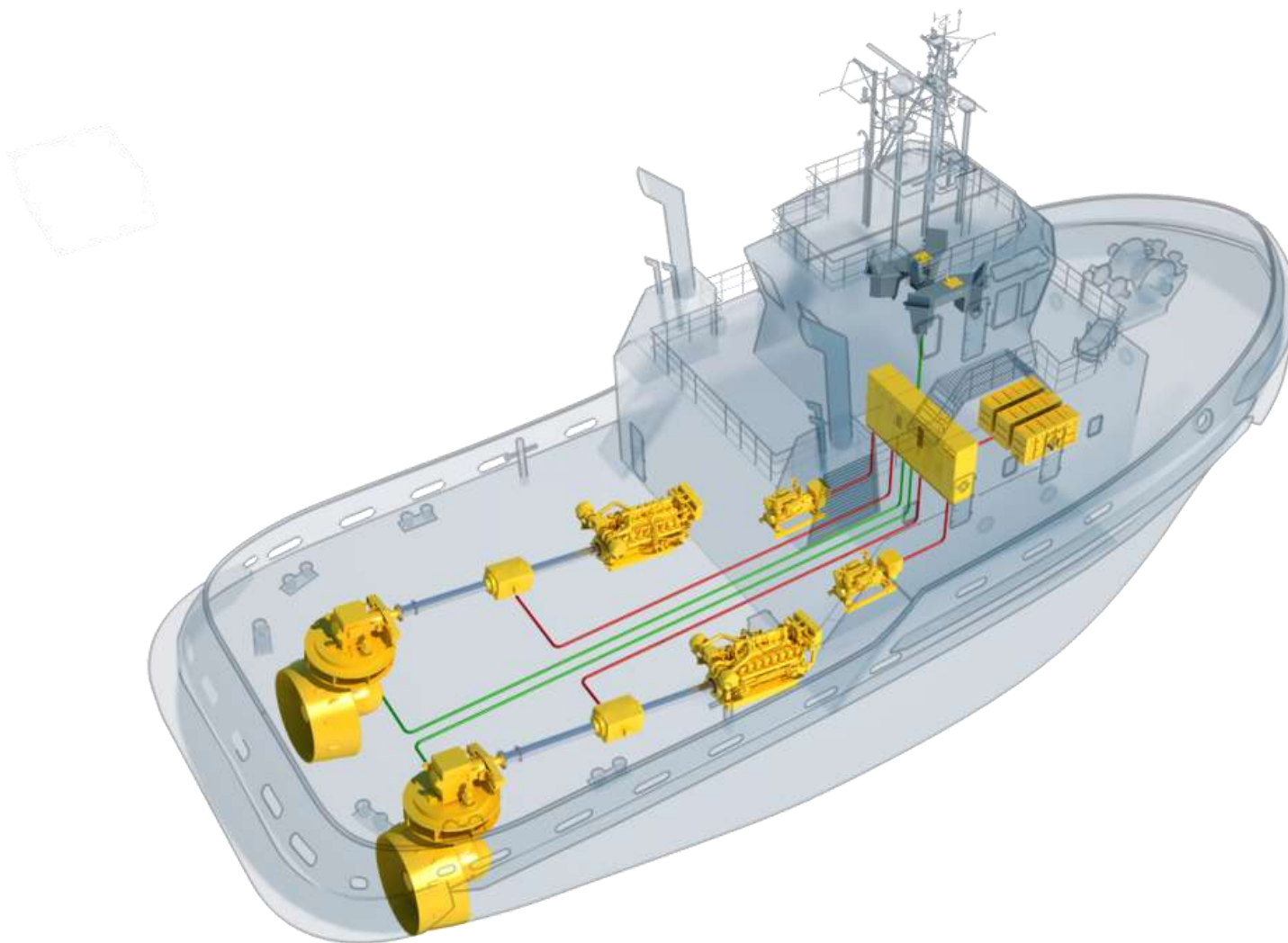
- As with many other vessel types, tugs need a significant amount of power....but not very often.
- Their propulsion design is typically focused on the tug's rated bollard pull...where the vessels do not spend much time.
- Lack of flexibility in plant configuration leads to inefficiency.



# XeroPoint Hybrid System



# Cat Powered Marine Hybrid



# Hybrid Definition & Illustrations



# Hybrid Marine Propulsion System

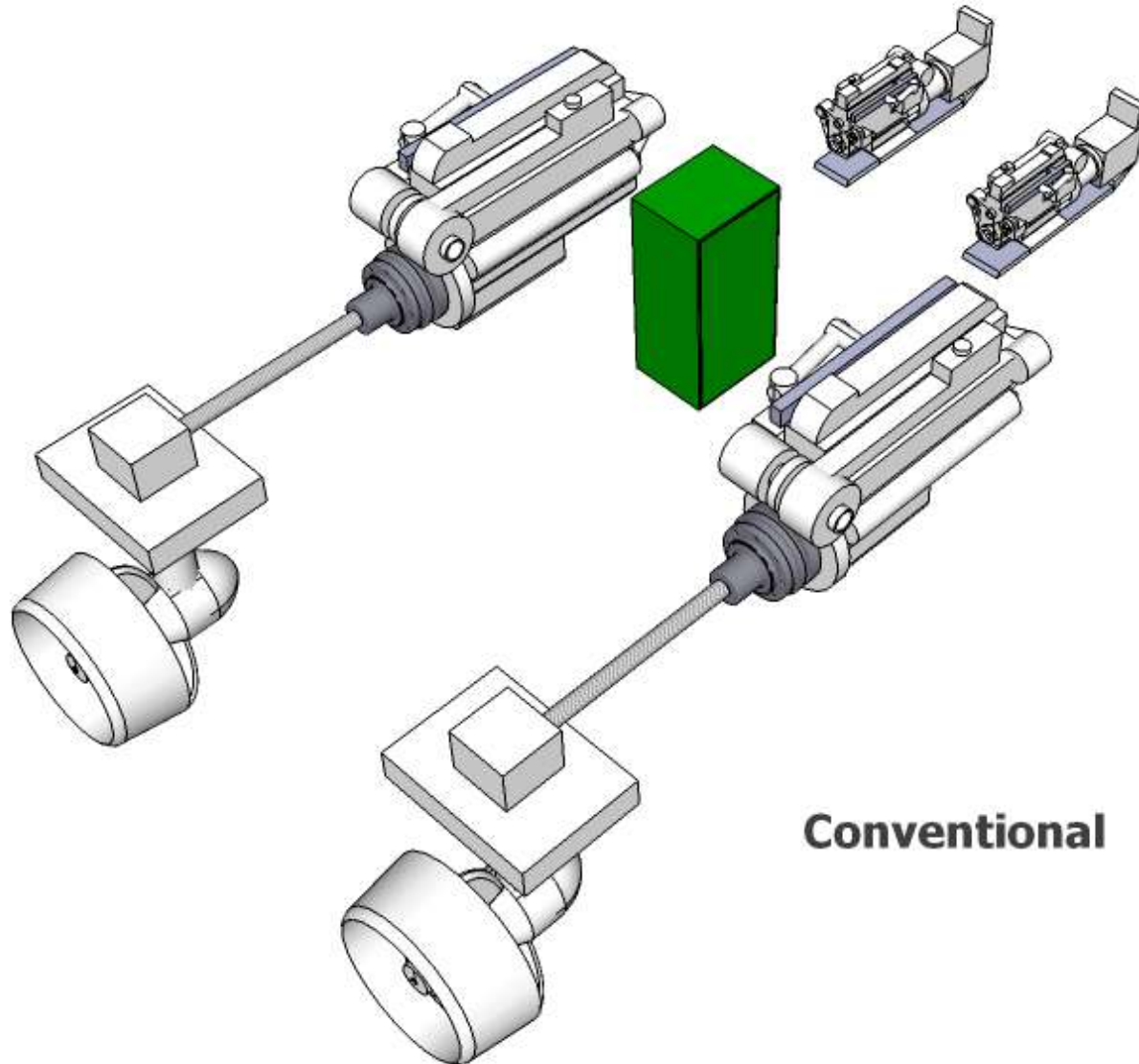
A propulsion system which incorporates combination of energy storage and/or drive line configurations to reduce or eliminate the low efficiency operation of combustion engines.

## Incorporating:

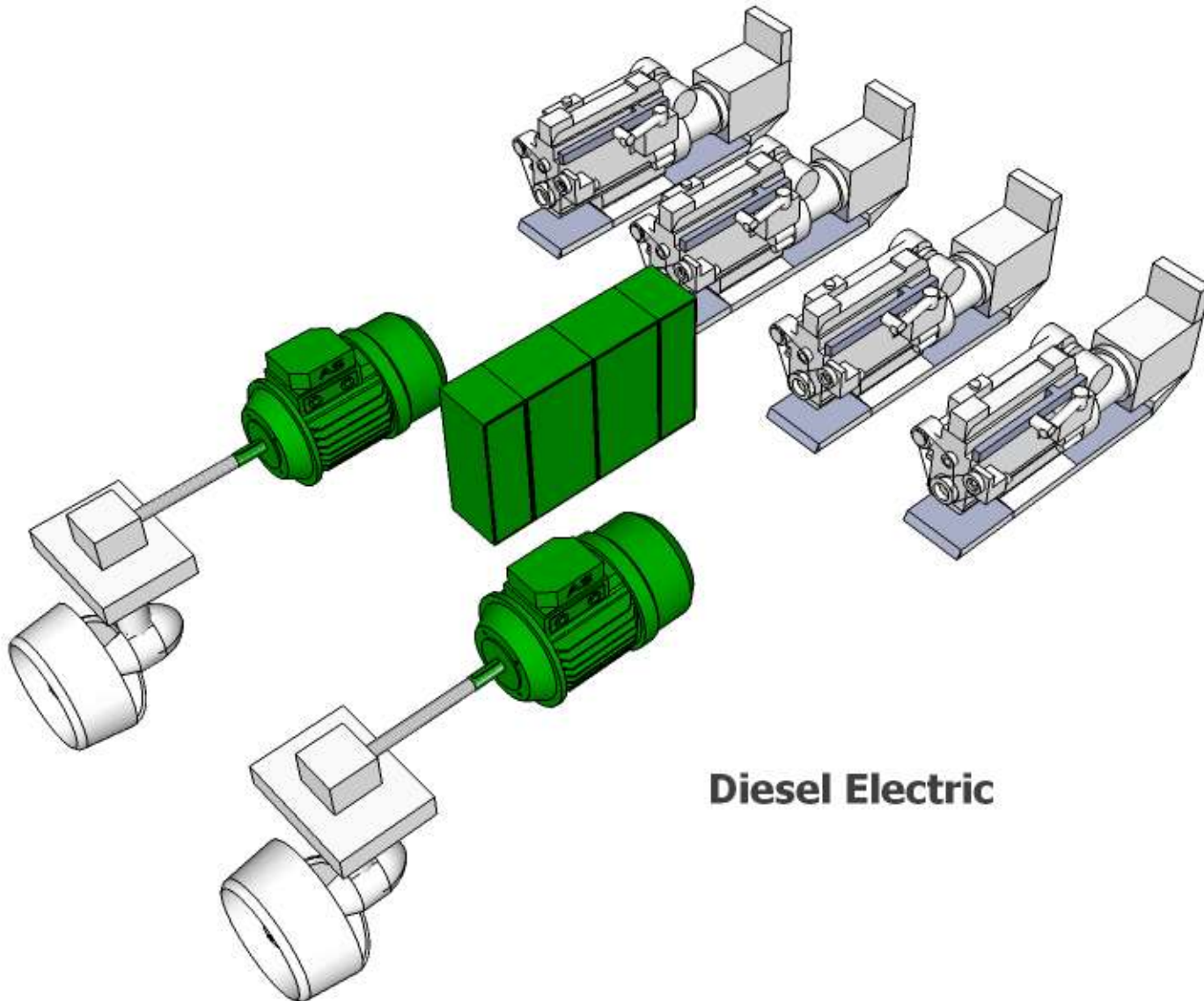
1. **Generation** and transmission of mechanical, mechanical-electrical and electrical power for propulsion
2. Energy **storage** (Electrical, chemical and/or mechanical) to absorb excess power developed and to allow it to be re-used later in the operational duty cycle
3. Energy **management & distribution** system capable of maximizing the vessel's efficiency at multiple points on its duty cycle.



# Conventional Configuration

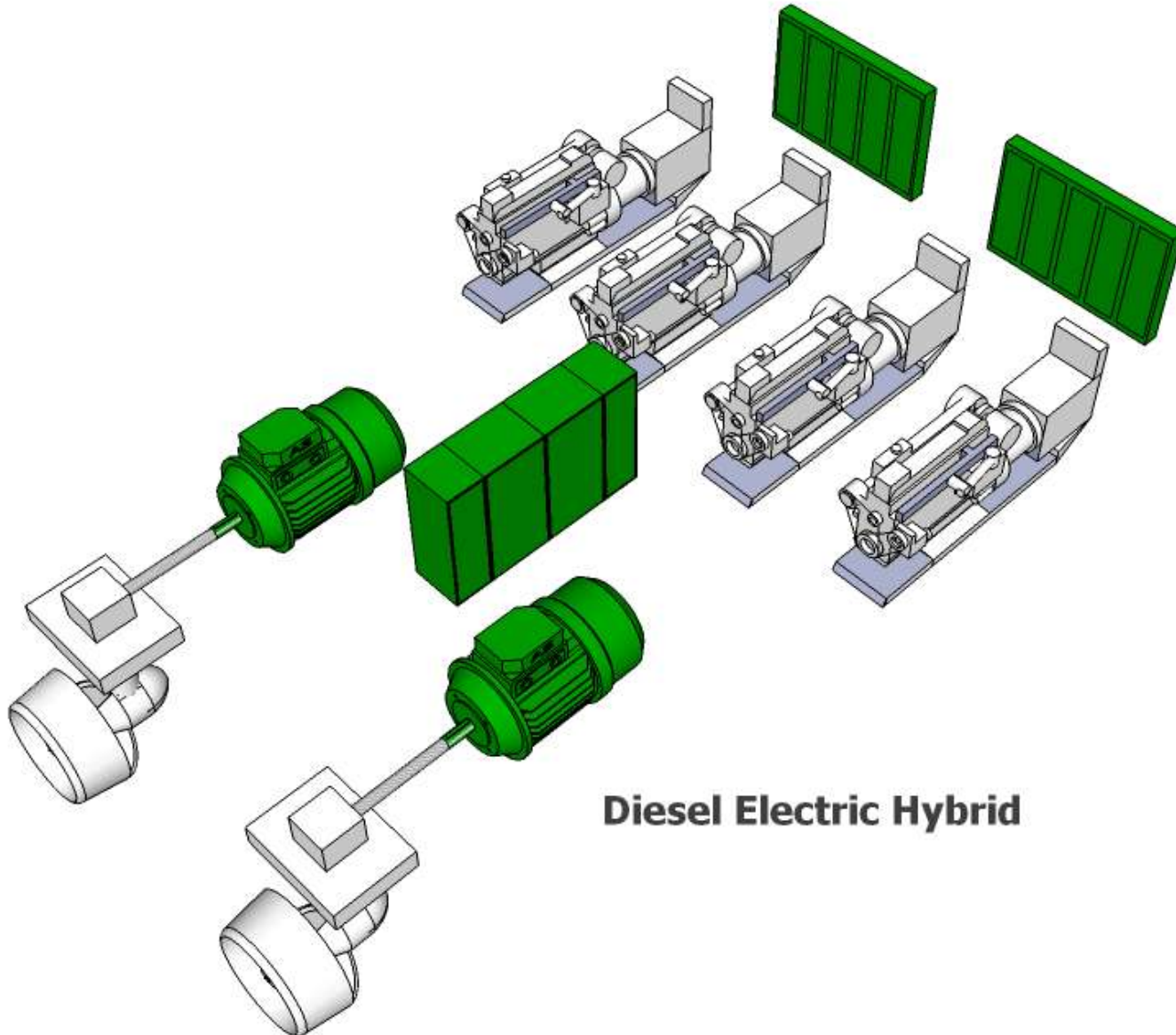


# Diesel-Electric



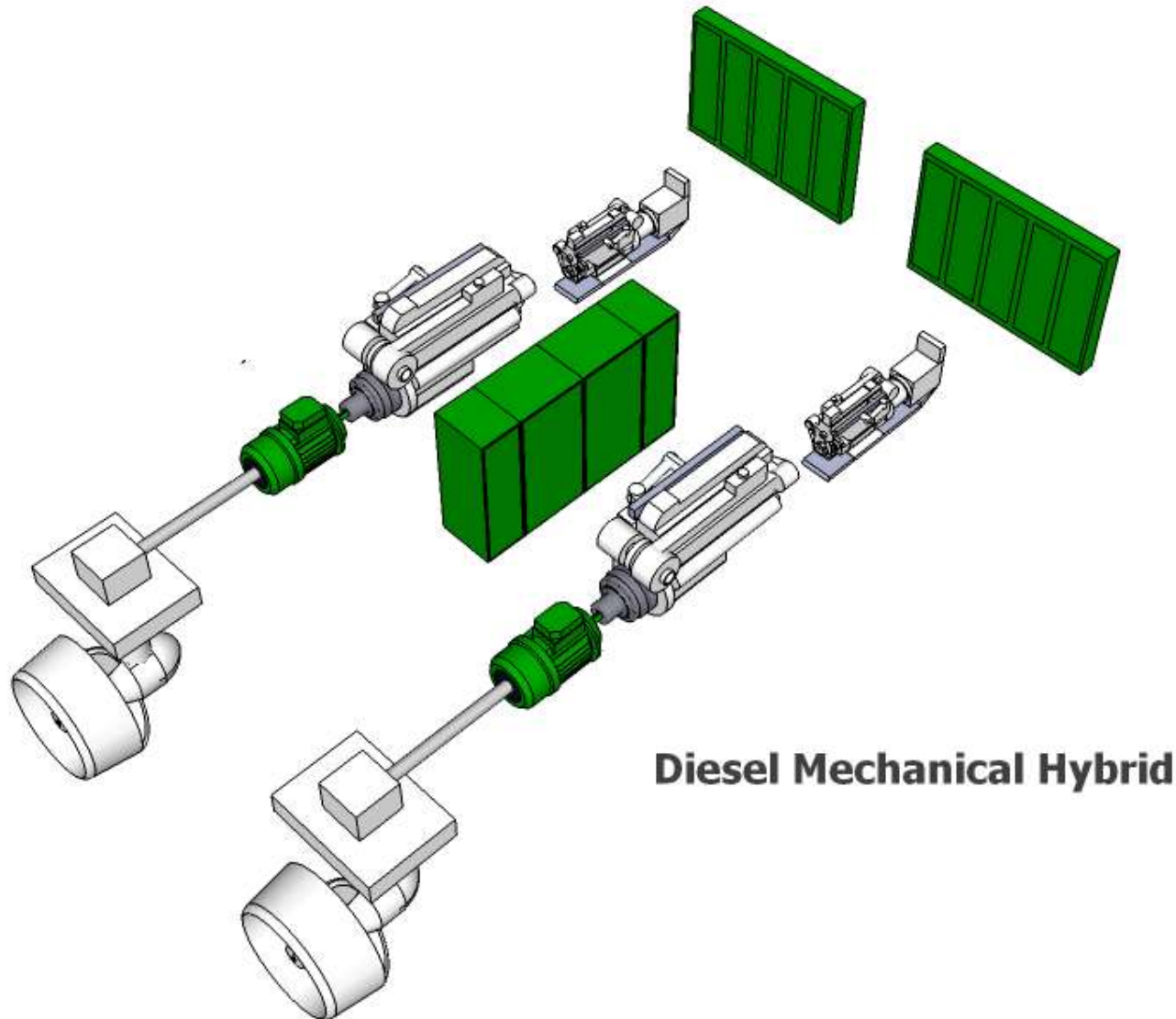
**Diesel Electric**

# Diesel-Electric with Storage



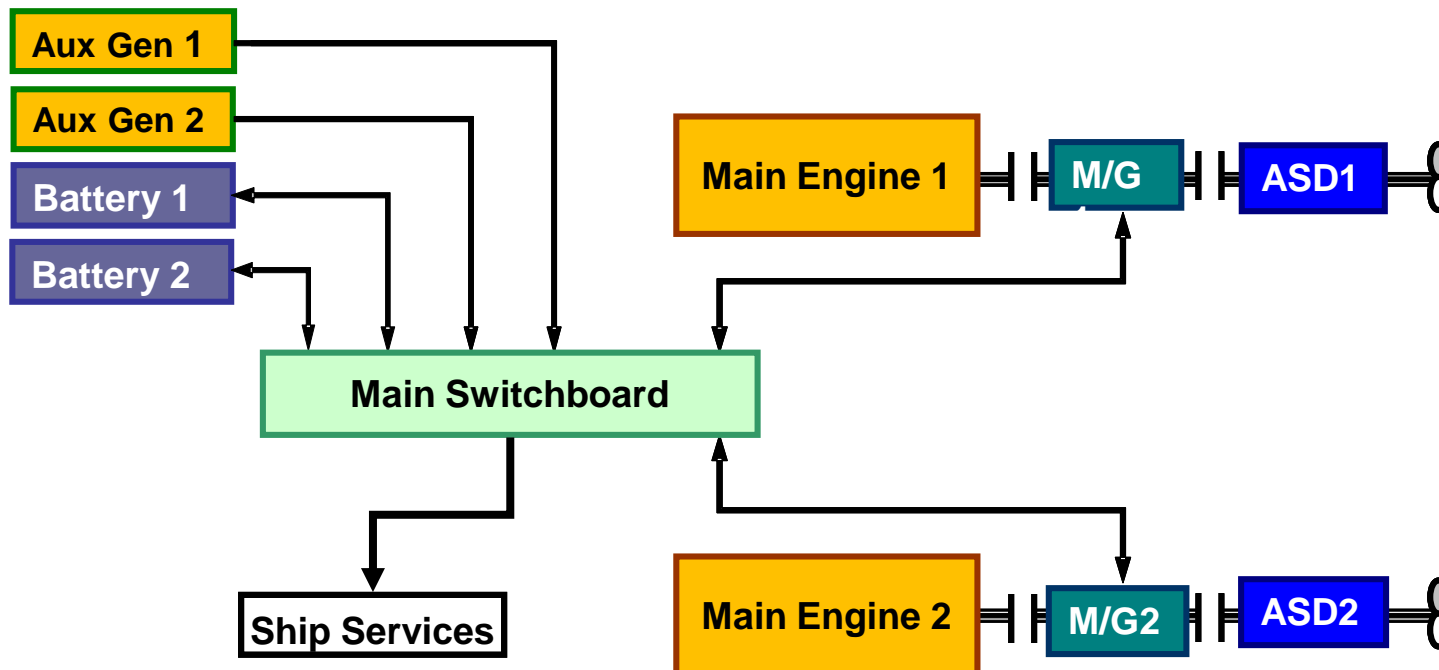
**Diesel Electric Hybrid**

# Hybrid



**Diesel Mechanical Hybrid**

# Hybrid Schematic



# System Control & Monitoring

# Human Machine Interface

- Mounted on wheelhouse console and in engine room.
- Simple to use - lots of valuable information.
- Dynamic elements.
- Trending & Data Capture.

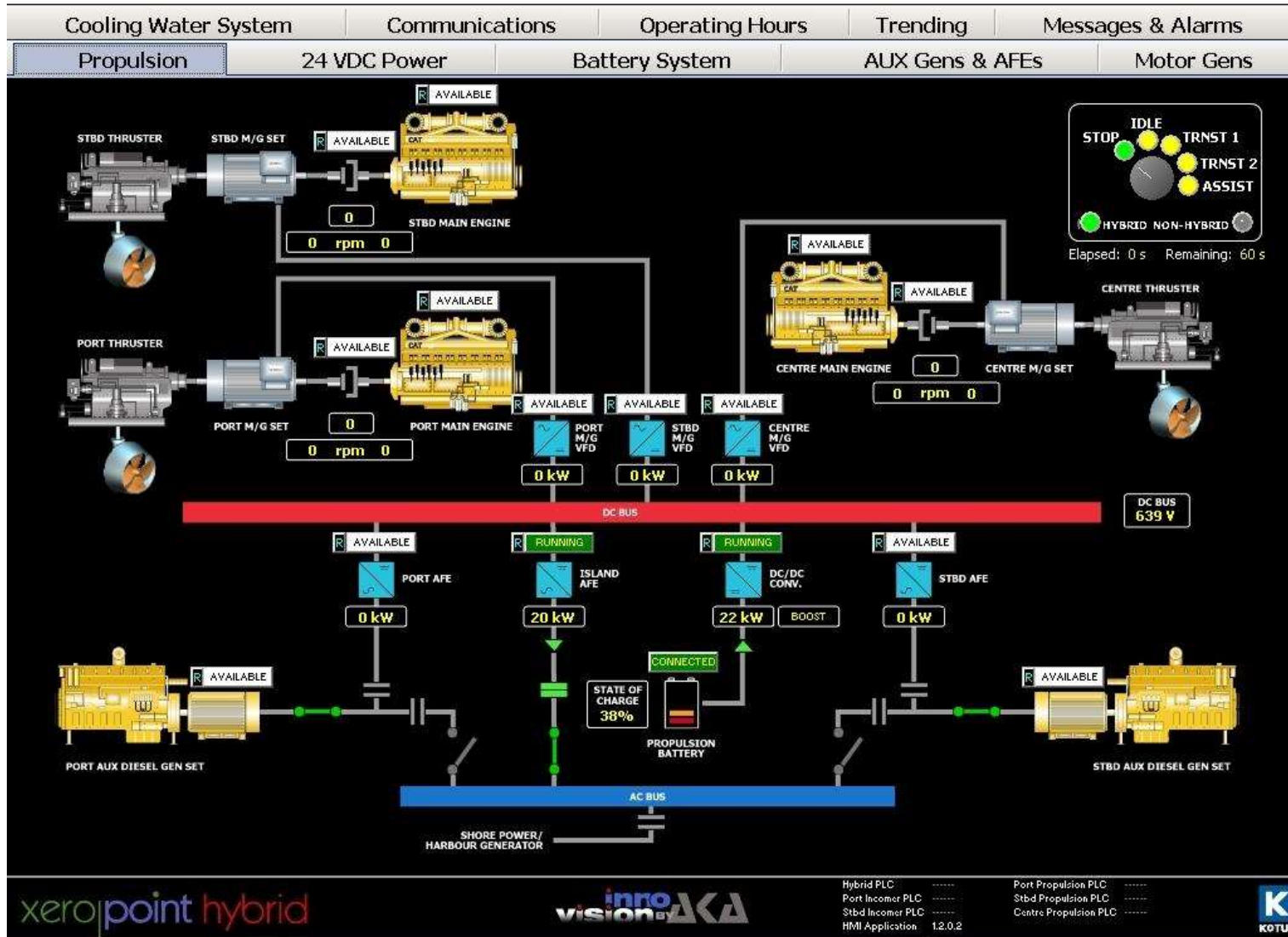




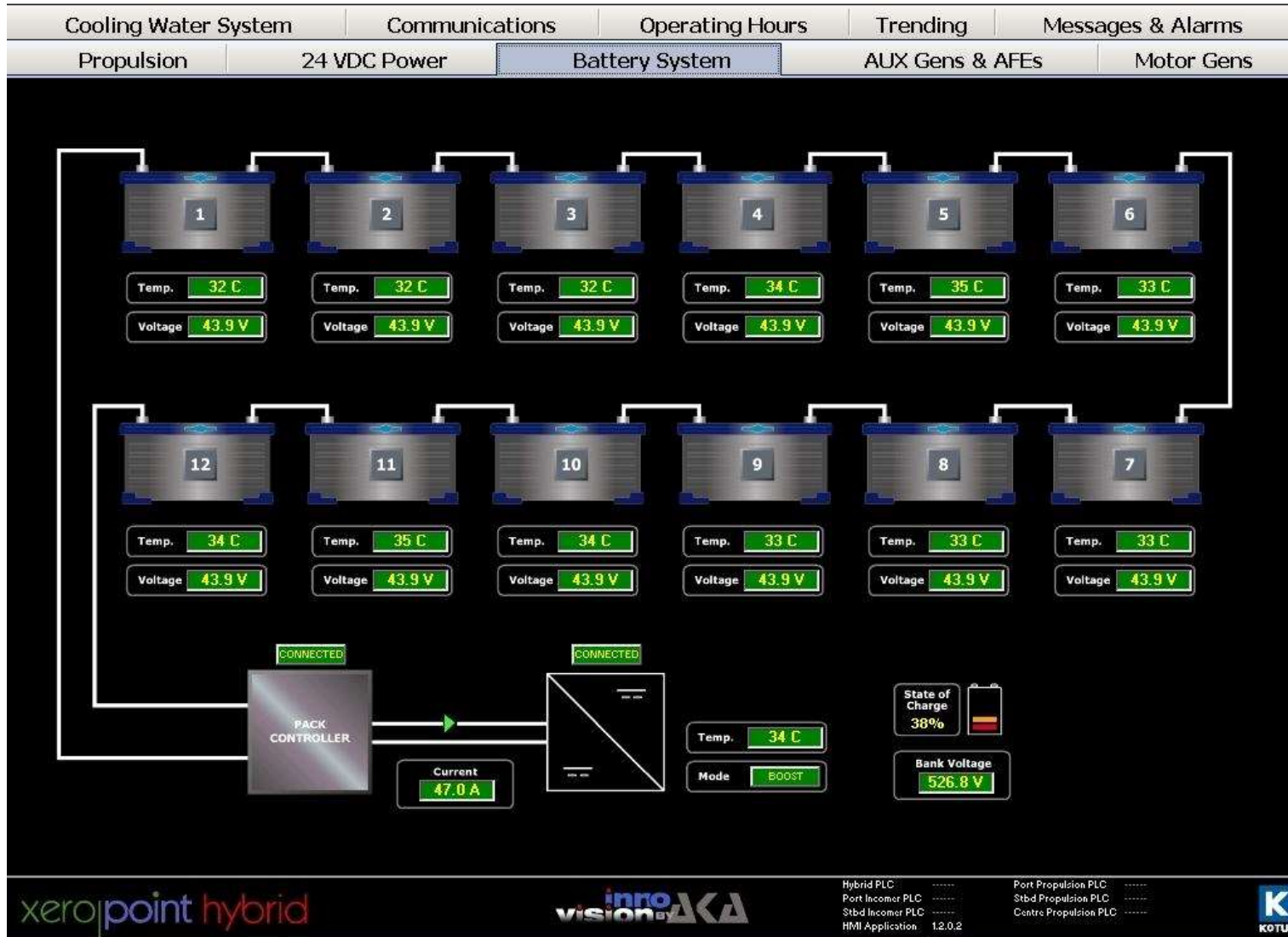
# Control Console



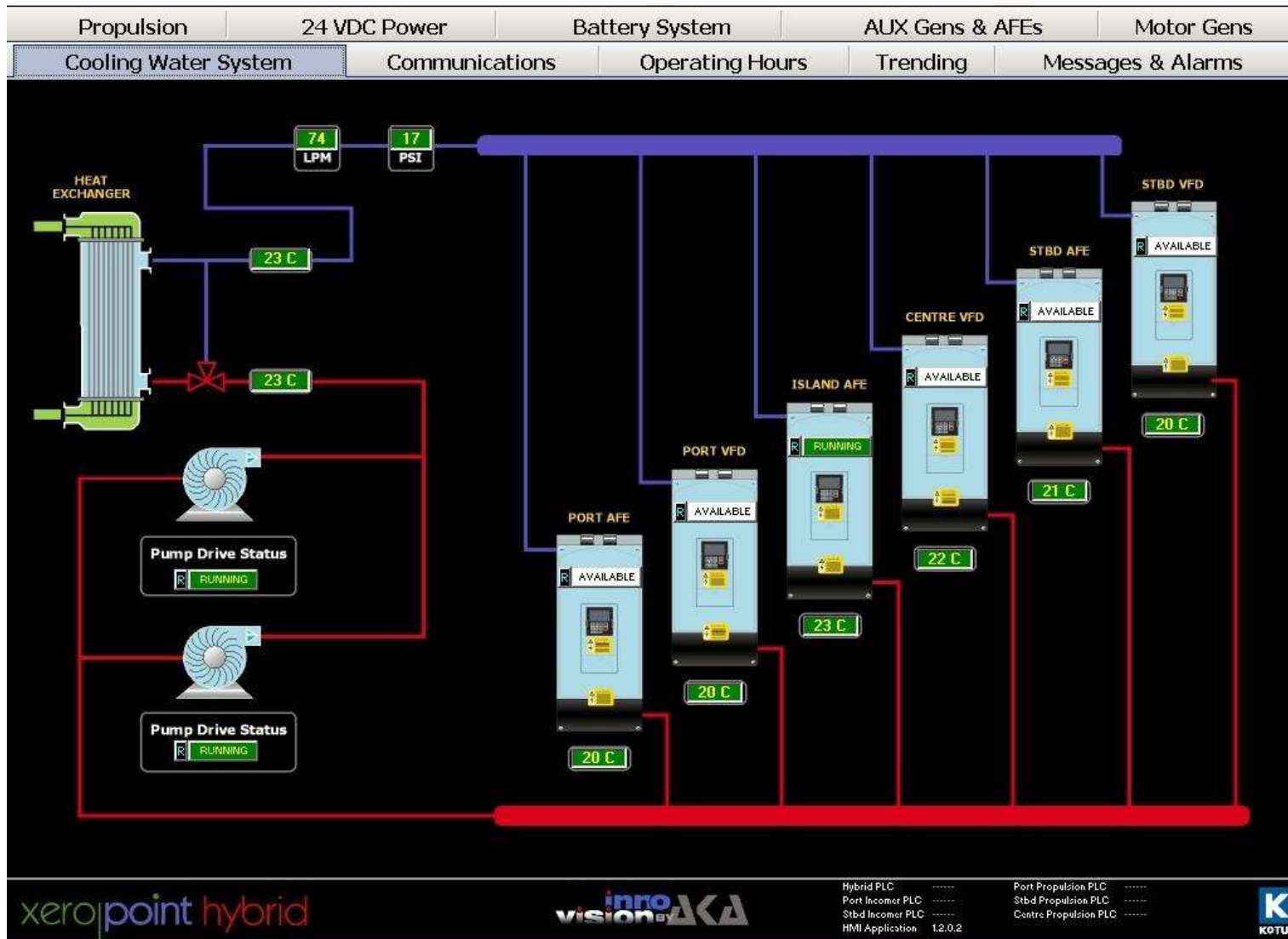
# Human Machine Interface



# Human Machine Interface



# Human Machine Interface



# Trending



# Key Features & Benefits

- Fuel Savings
- Reduced Emissions
- Increased Redundancy
- Reduced Maintenance Costs
- Healthier Workplace for operators



# Conclusions

- Environmentally friendly technologies can be incorporated into vessel design and manufacturing without compromising operation performance or sacrificing cost competitiveness.
- The flexibility that can be achieved has the potential to dramatically improve efficiency and life-cycle costs compared to conventional vessels.
- Best achieved by taking a balanced, pragmatic and methodical approach to selecting and incorporating the available options.

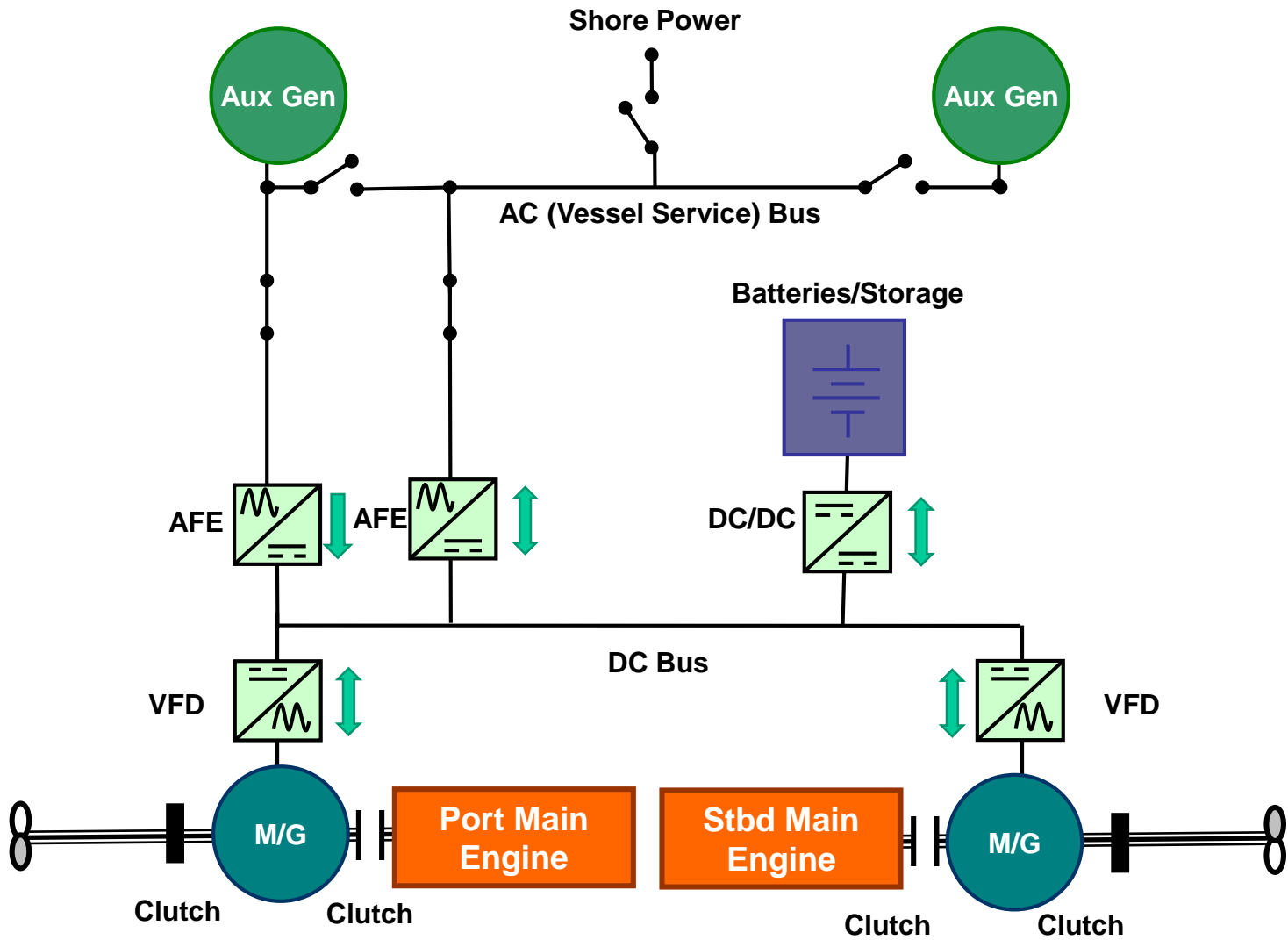


Thank  
You



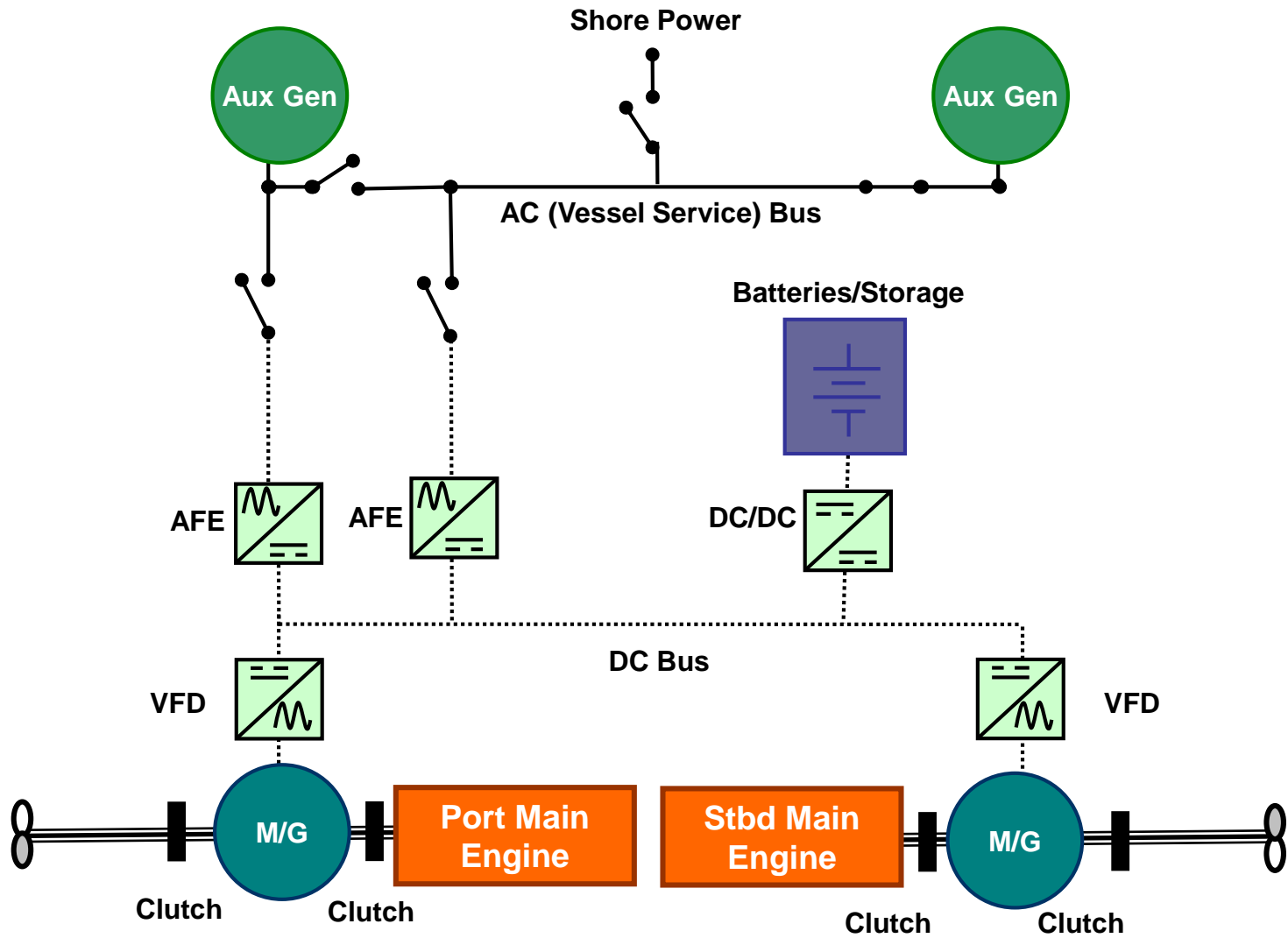
# Energy Management System Overview

# Detailed System Schematic

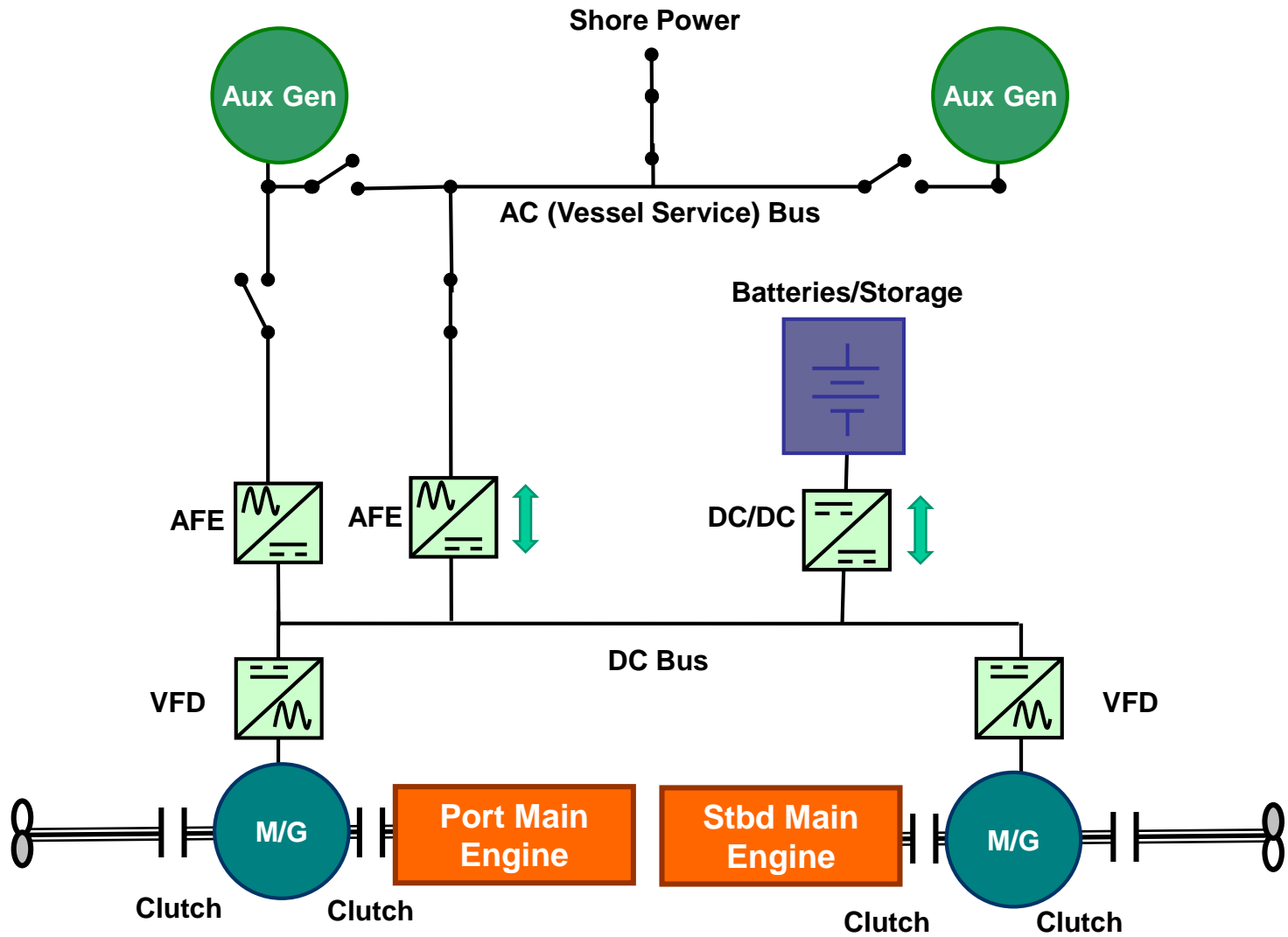


# Power Plant Modes of Operation

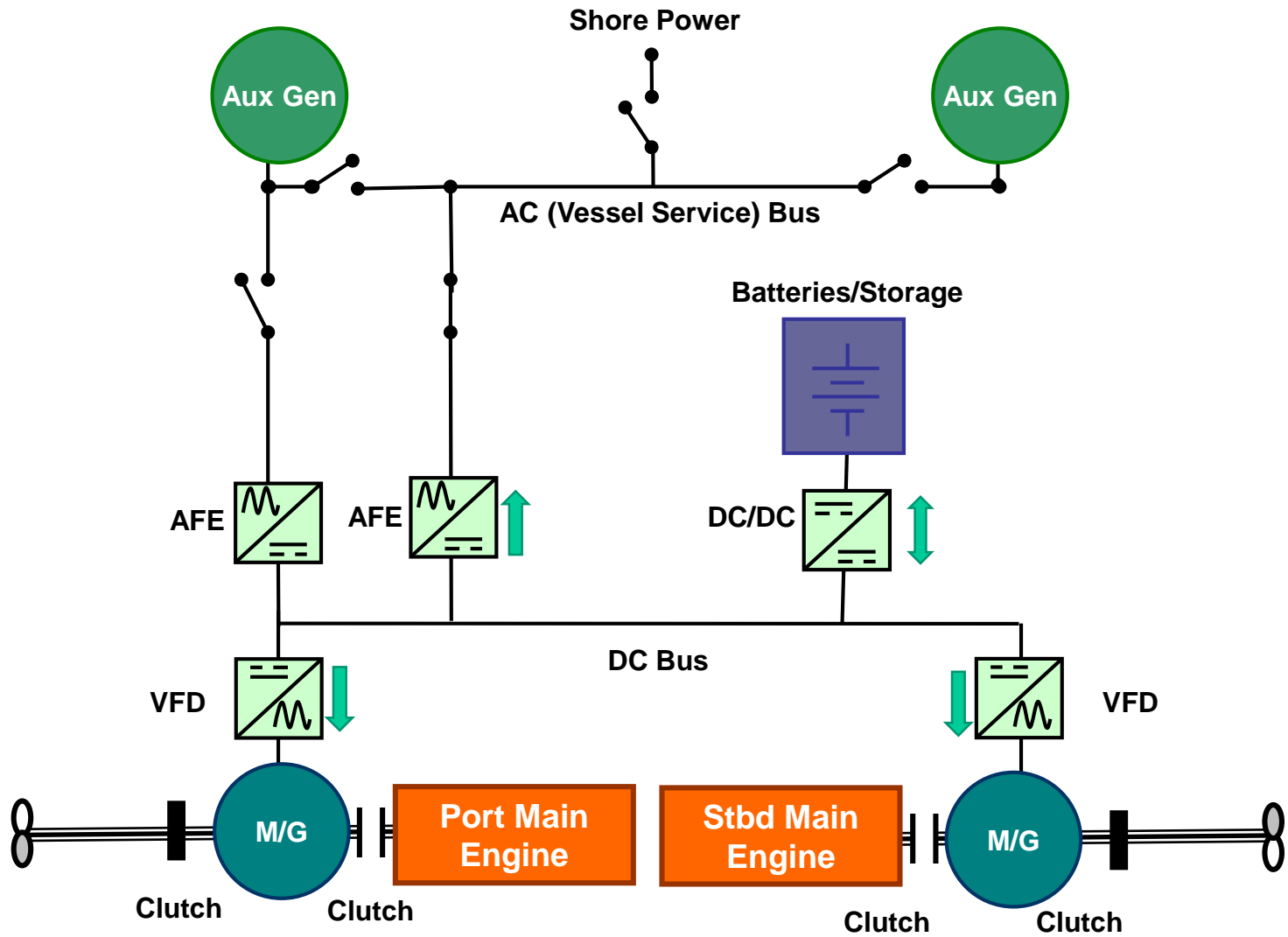
# Non-Hybrid Mode



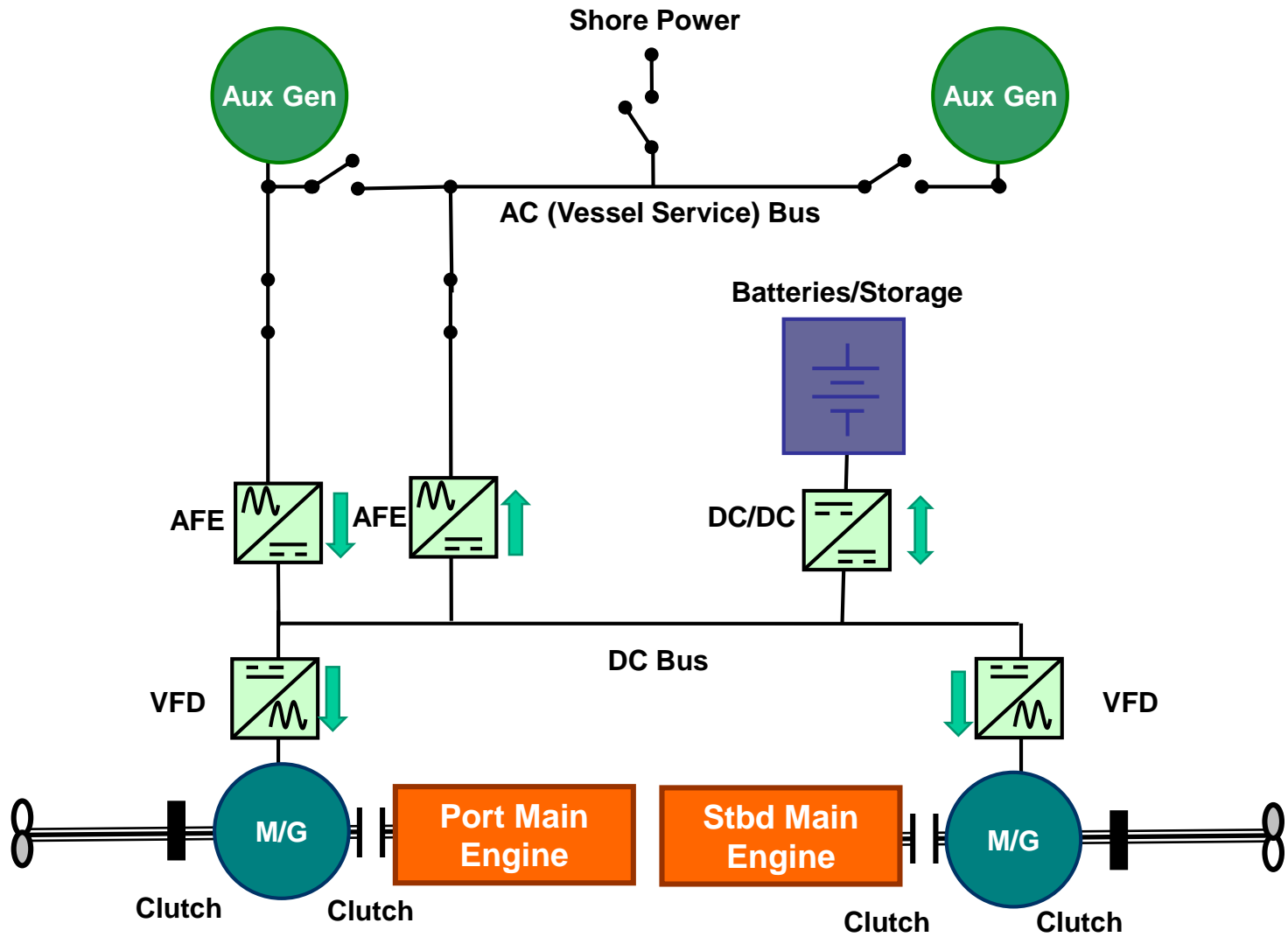
# Stop Mode



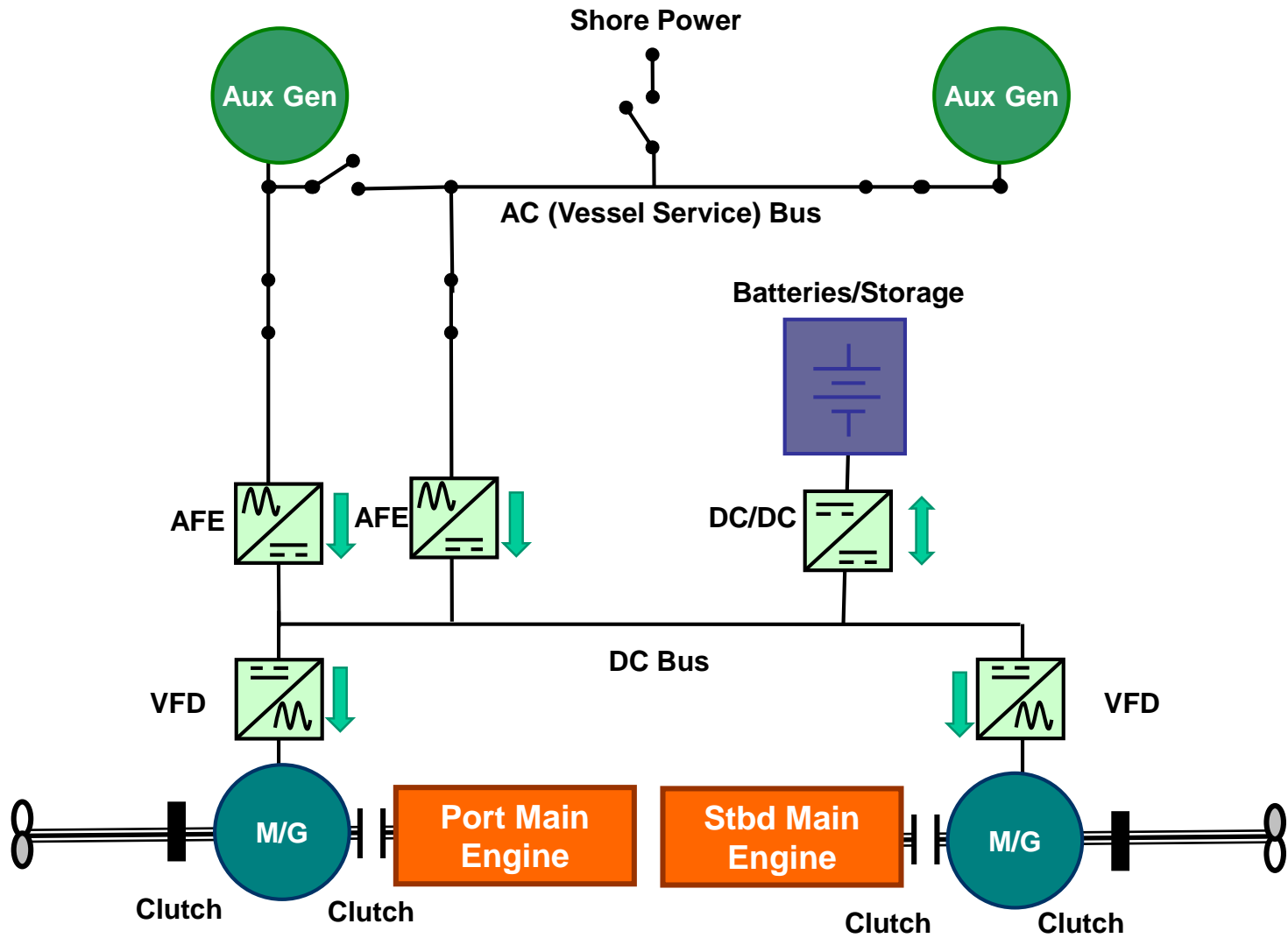
# Idle Mode



# Transit Mode 1

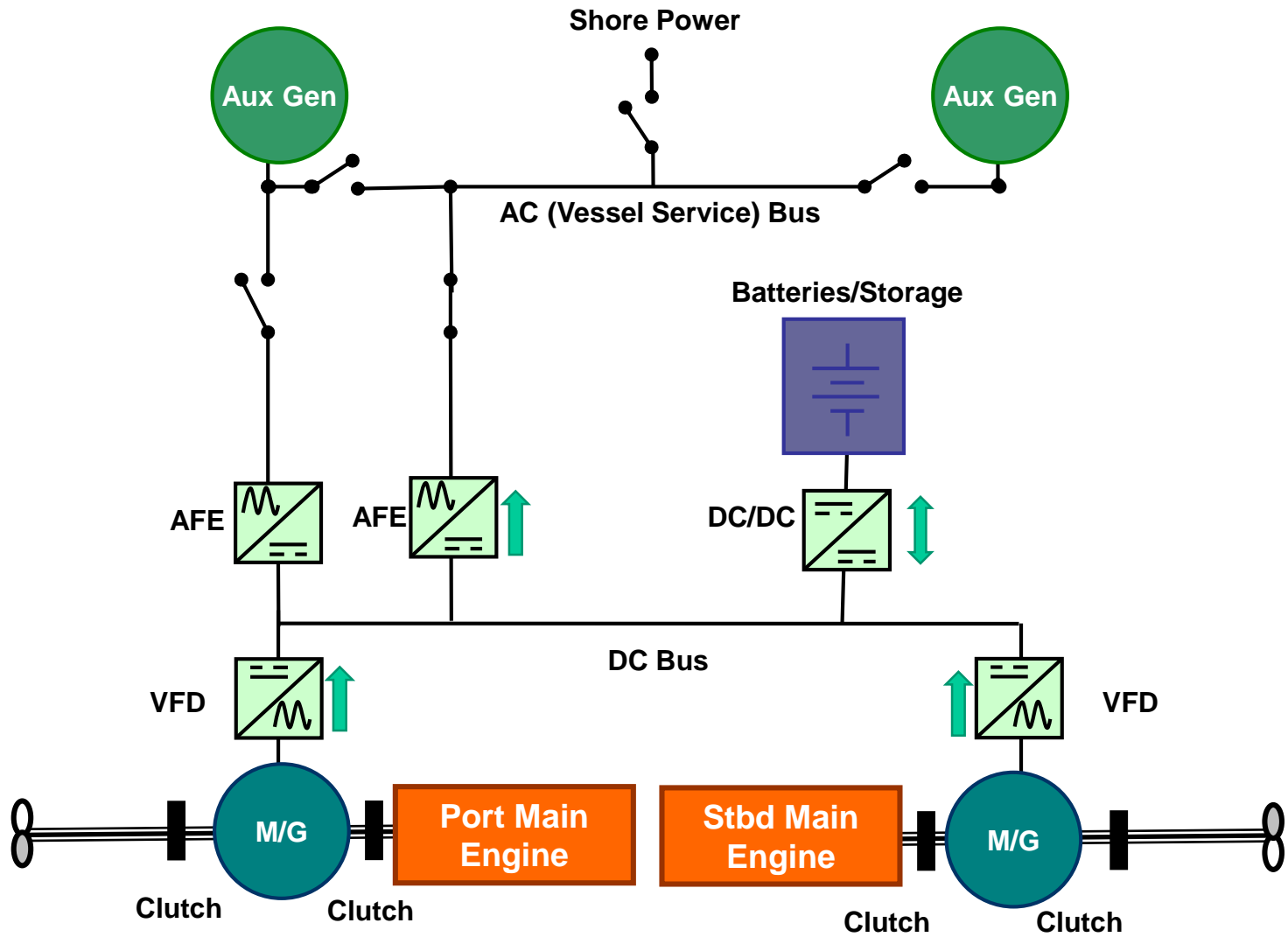


# Transit Mode 2

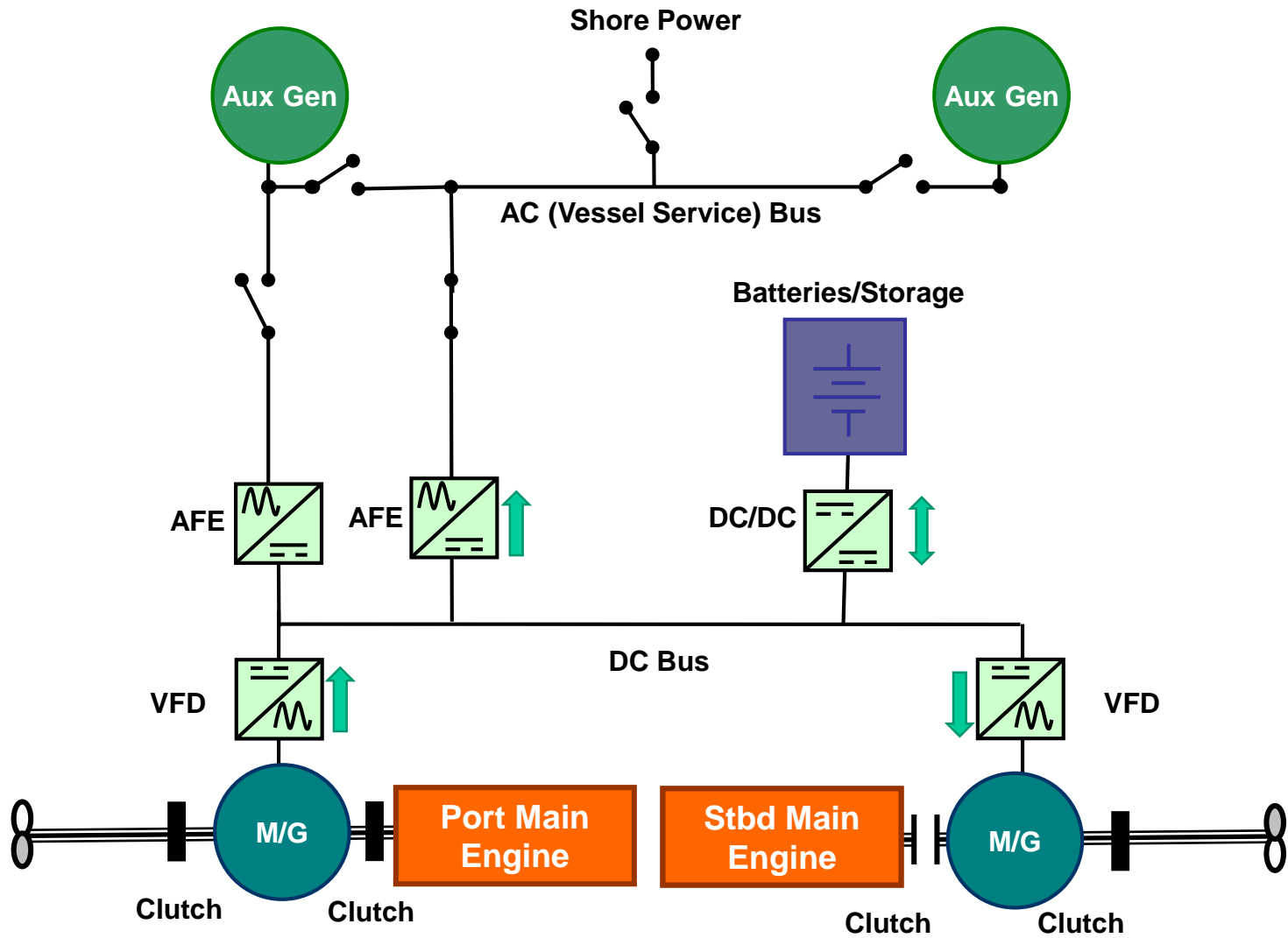




# Assist Mode



# Single Main Engine Mode



# HYBRID OVERVIEW

