Kongsberg Maritime

Technologies for sustainable oceans

Kongsberg Maritime

Global scale and technological depth, applied in real-world maritime operations

Maritime technology expertise

Deep maritime domain expertise and a large installed base, delivering complex integrated systems at scale.

Full lifecycle coverage

A broad portfolio of products, services and integrated solutions, supporting both newbuild and aftermarket.

24/7 global operations

Supporting commercial, offshore and naval operations, with strong local presence worldwide.

Driving maritime transformation

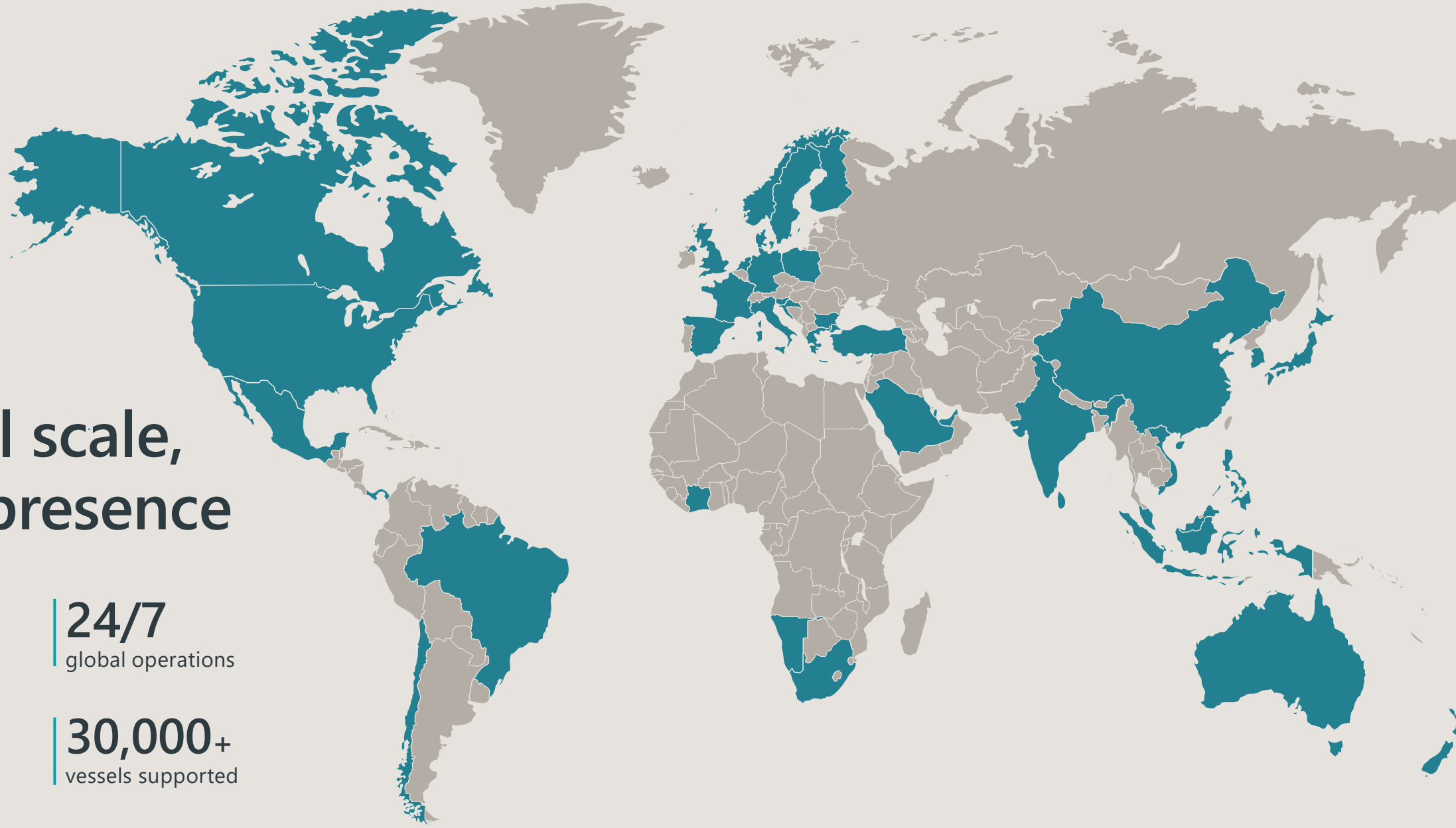
Supporting more efficient and digitalised maritime operations across the industry.

Proven performance globally

~16% average revenue growth and ~24% average order backlog growth over the past five years.

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See statement of proprietary information



Global scale, local presence

8,300
employees

24/7
global operations

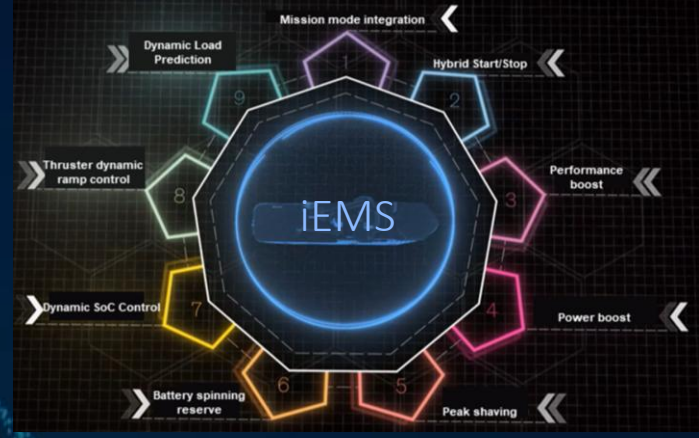
53%
engineers

30,000+
vessels supported

iEMS

Intelligent Energy Management System

Future Ready

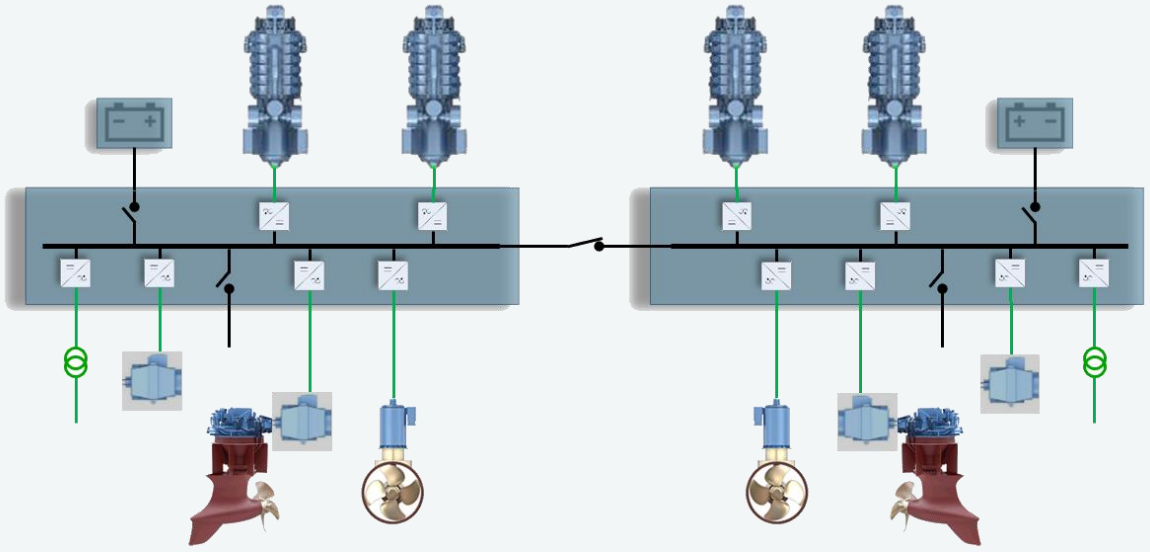


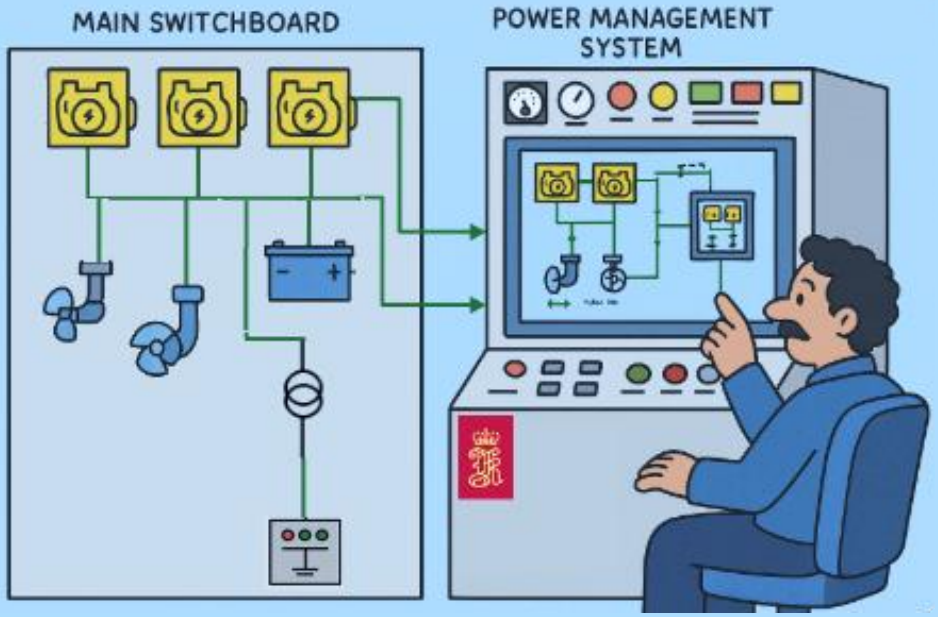
Energy



What is a Power Management System (PMS)?

The main function of the Power Management System (PMS) is to manage safely, reliably, and economically the power generation and distribution systems on various types of vessels.





Evolution of Power Management



The 60's

Automatic Generator Control

NOR CONTROL

70's and 80's

Digital Power Management System

KONGSBERG våpenfabrikk

SIMRAD

By KONGSBERG

2026

Intelligent Energy Management

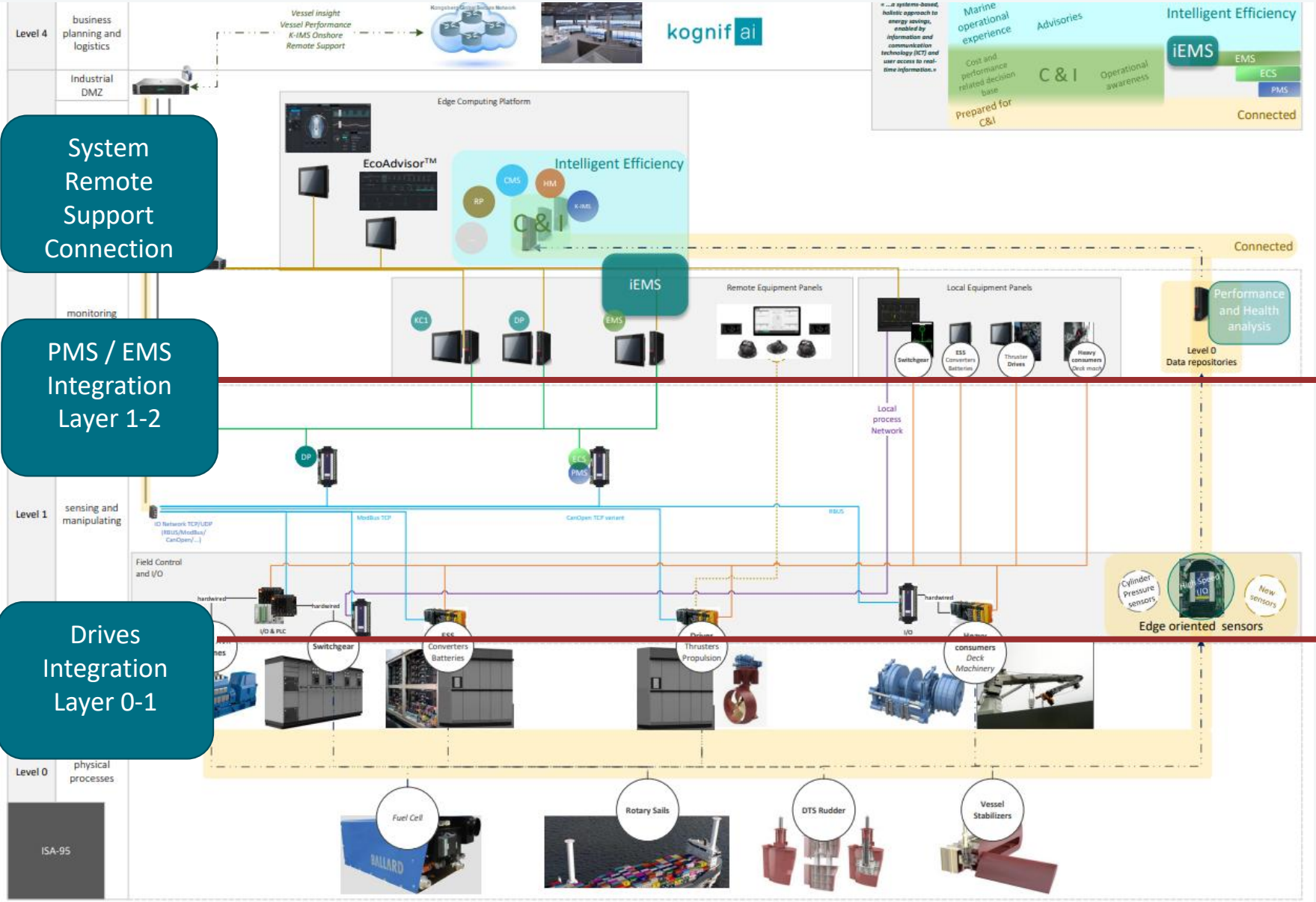
KONGSBERG

ISA95 Model & Key Competencies

Integrated Health & Performance Management

KONGSBERG

Kongsberg Maritime



System Remote Support Connection

PMS / EMS Integration Layer 1-2

Drives Integration Layer 0-1

Real-time Health & Performance Analytics K-IMS

Centralised Data Science ()

Implementation on Onboard Platform EMS / PMS

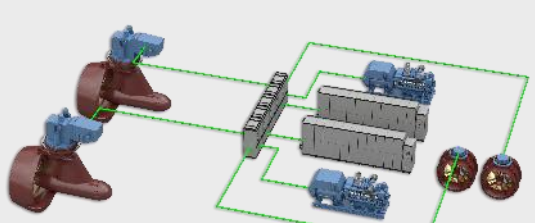
Software Development (Real time)

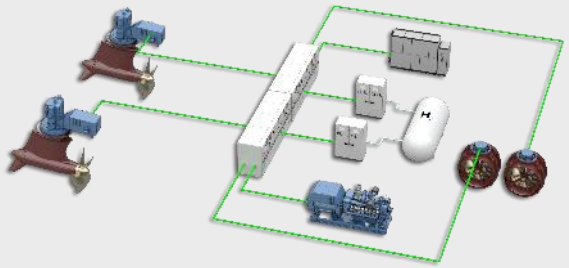
Domain Expertise on Products DC drives

Domain Expertise (Energy Systems)

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Electrification of the maritime industry





Energy Management

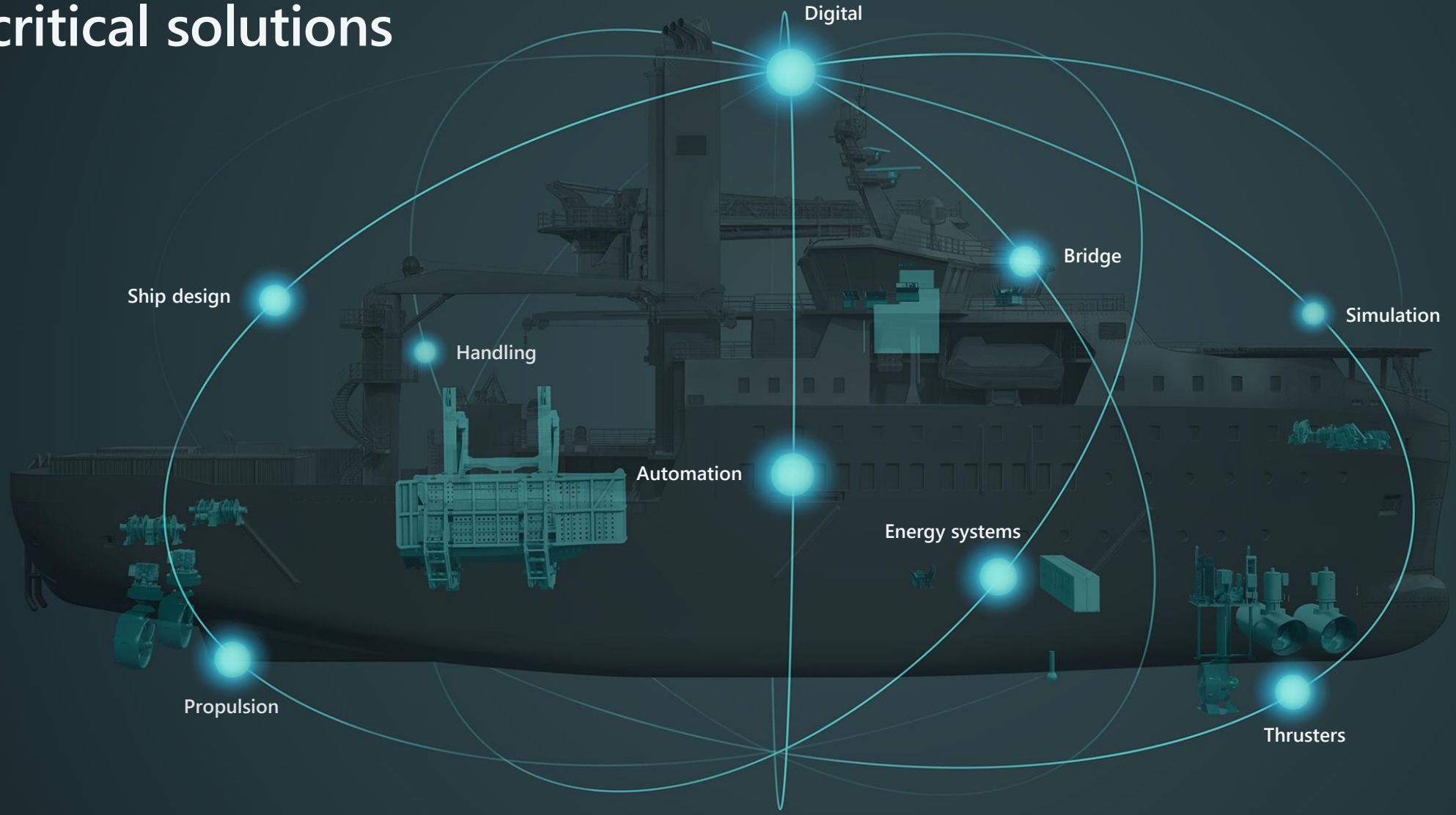
Drives

Energy Storage

Switch-boards

Rotating Machinery

Broad portfolio of unique and mission-critical solutions



Vessel Segments



Kongsberg Maritime

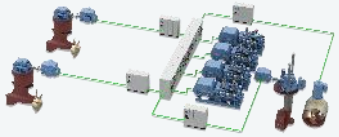
Integrated systems level

Ship design	Propulsion and Handling					Integration & Energy				Automation and Control				
	Thrusters	Propulsion	POD	Winches	Cranes	Power Components	Power distribution	Drives	Energy Storage	Automation & Control	Offshore automation	Bridge systems	Navigation/ communication	DP

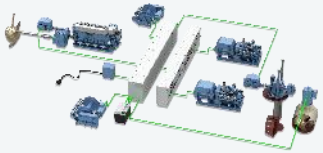


Energy system level

AC System



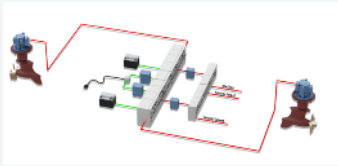
Dual Hybrid System



DC System



Zero Emission System



Energy product level

Drives



LV/HV SWBD



Energy Storage



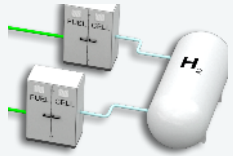
Rotating Machinery & 3rd party equipment



PMS / EMS



New Technology

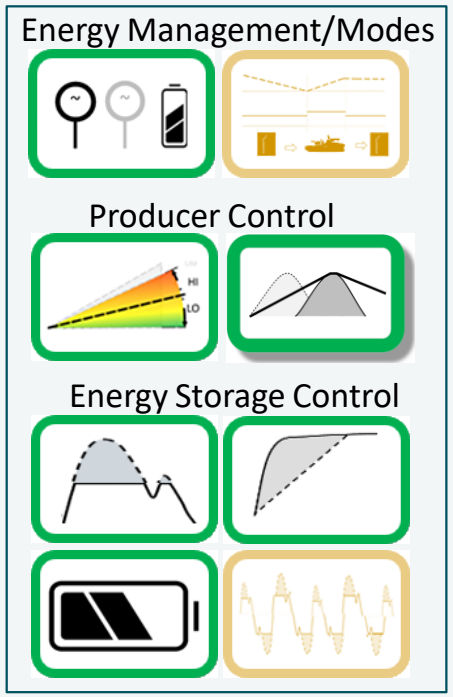


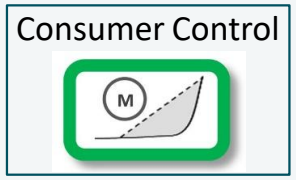
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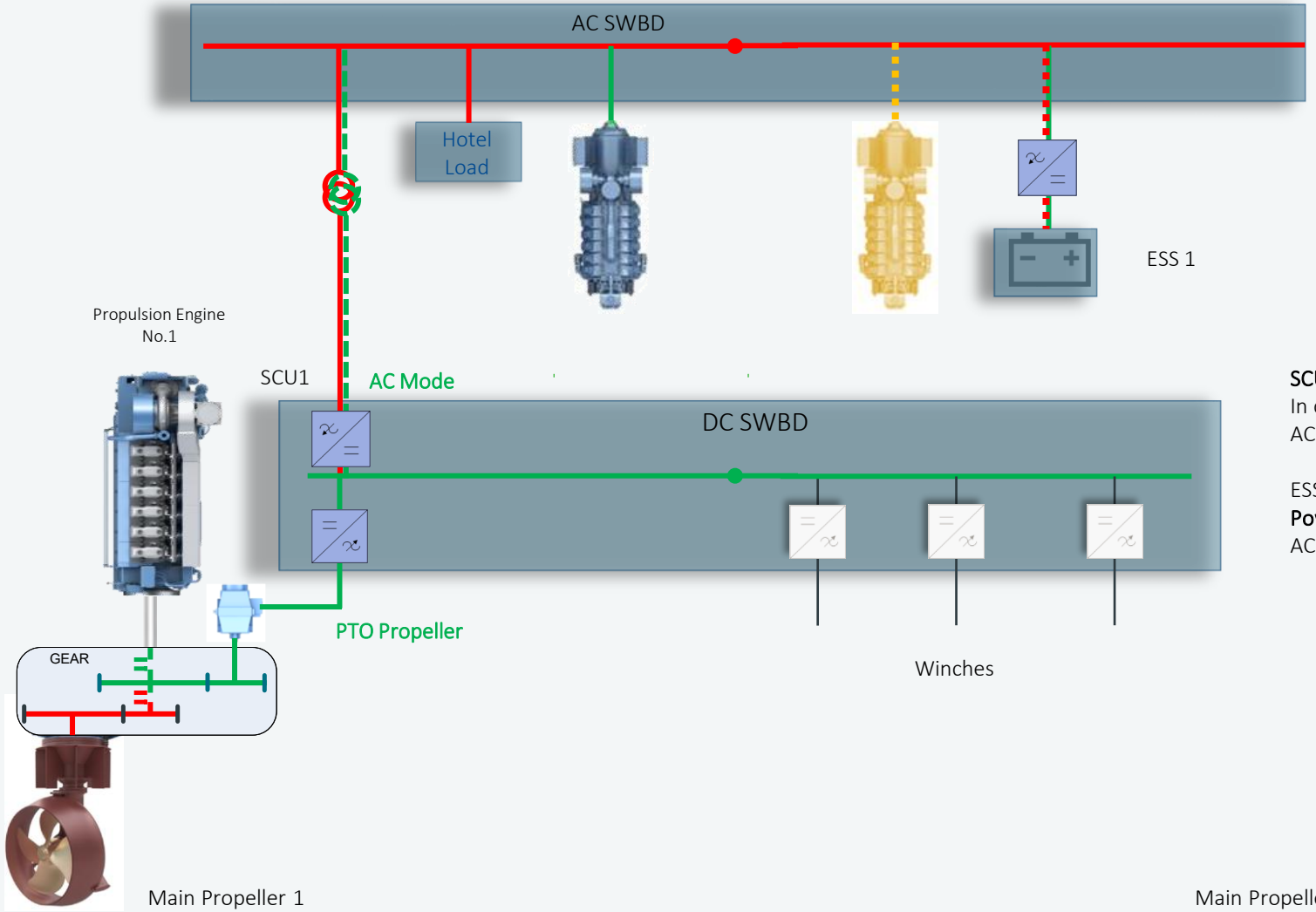
PTO Propeller + ESS + AC Gen
SCU AC Mode

Kongsberg Maritime









SCU in AC Mode
In case ESS trips, the SCU will maintain power on AC Switchboard.

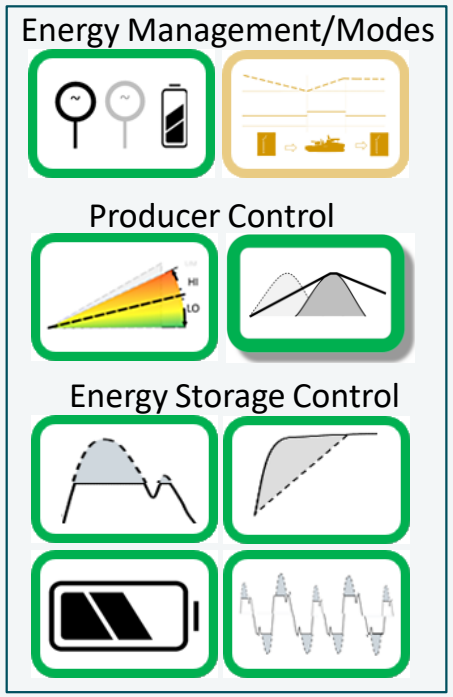
ESS will be **peakshaving** only on AC Bus
Power Boost and **Performance Boost** available on AC and DC bus.

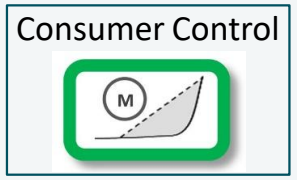
COMPANY SHARED

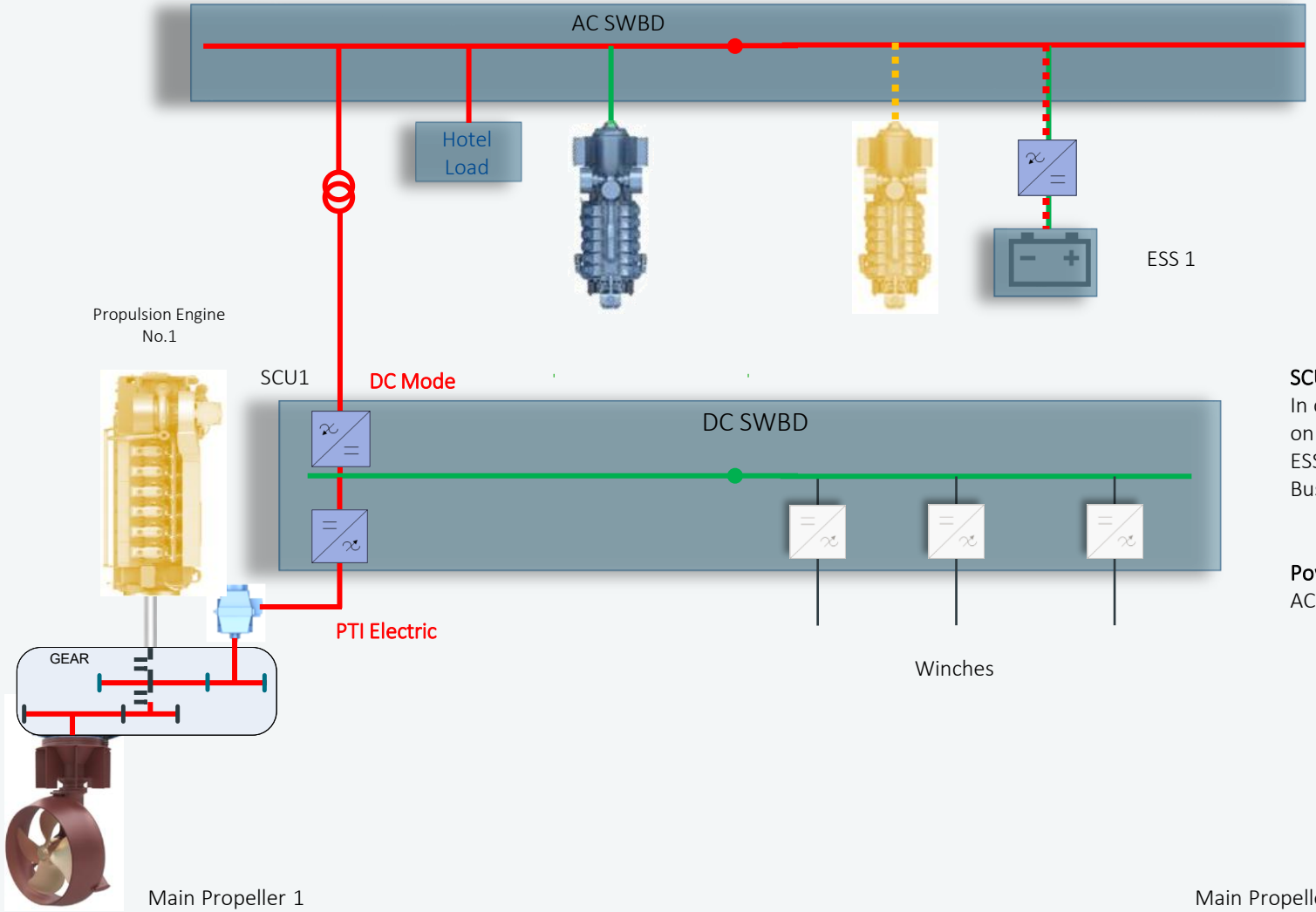
PTI Diesel Electric
SCU DC Mode

Kongsberg Maritime









SCU in DC Mode
In case AC Gen trips, the ESS will maintain power on AC Switchboard.
ESS will be **peakshaving** on AC and via SCU on DC Bus

Power Boost and **Performance Boost** available on AC Bus

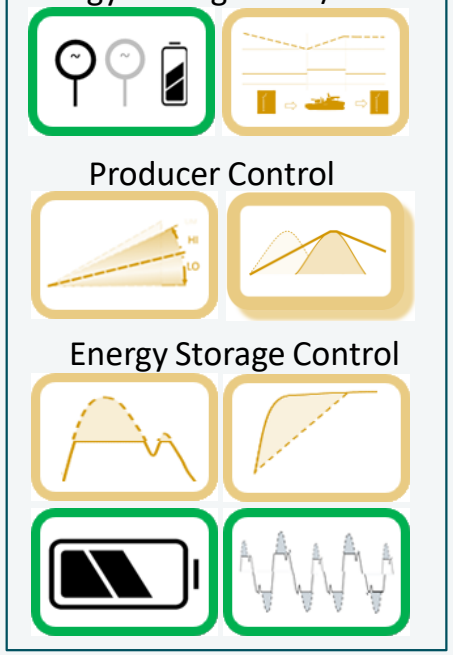
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Mechanical Assist

Kongsberg Maritime



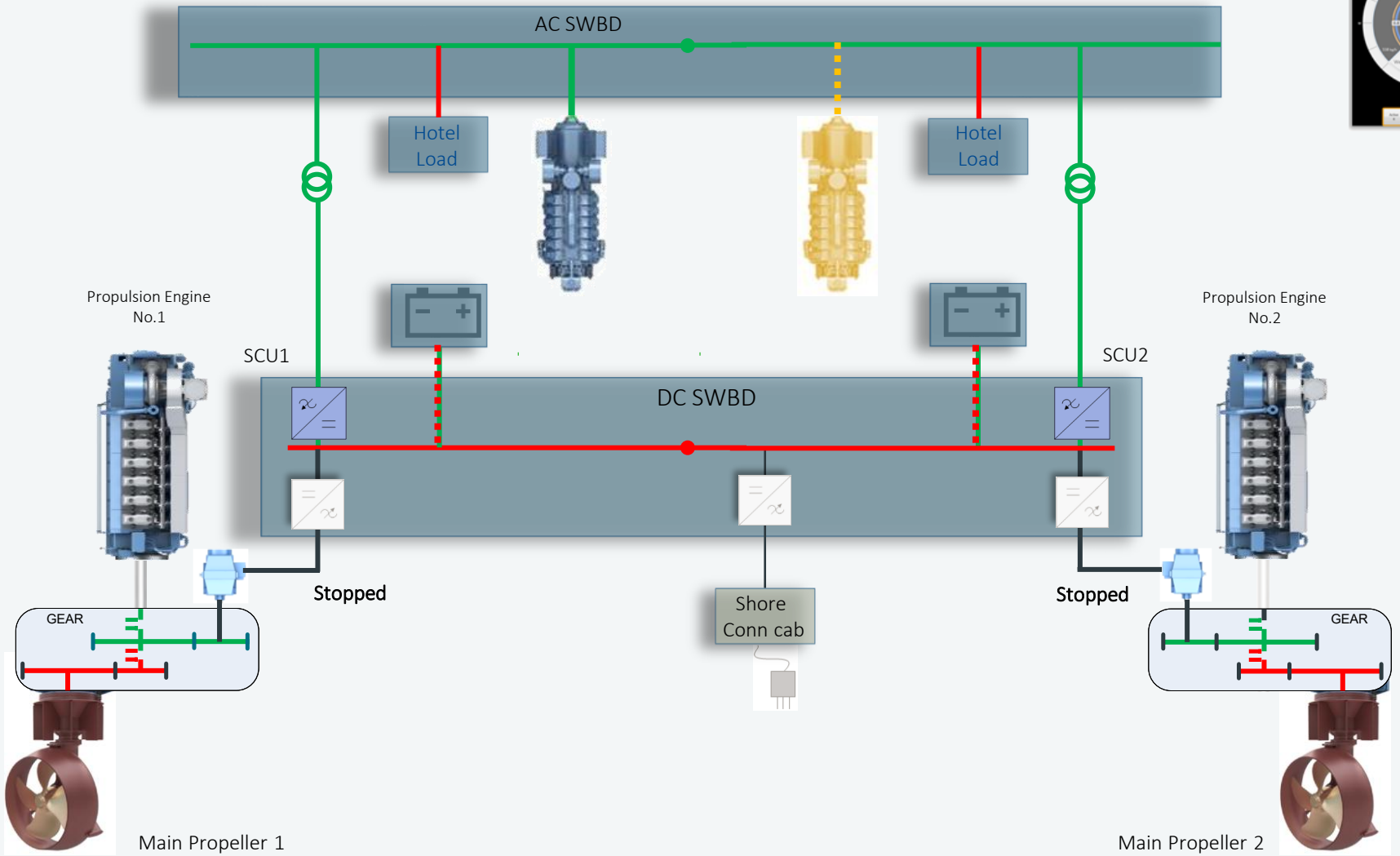
Energy Management/Modes



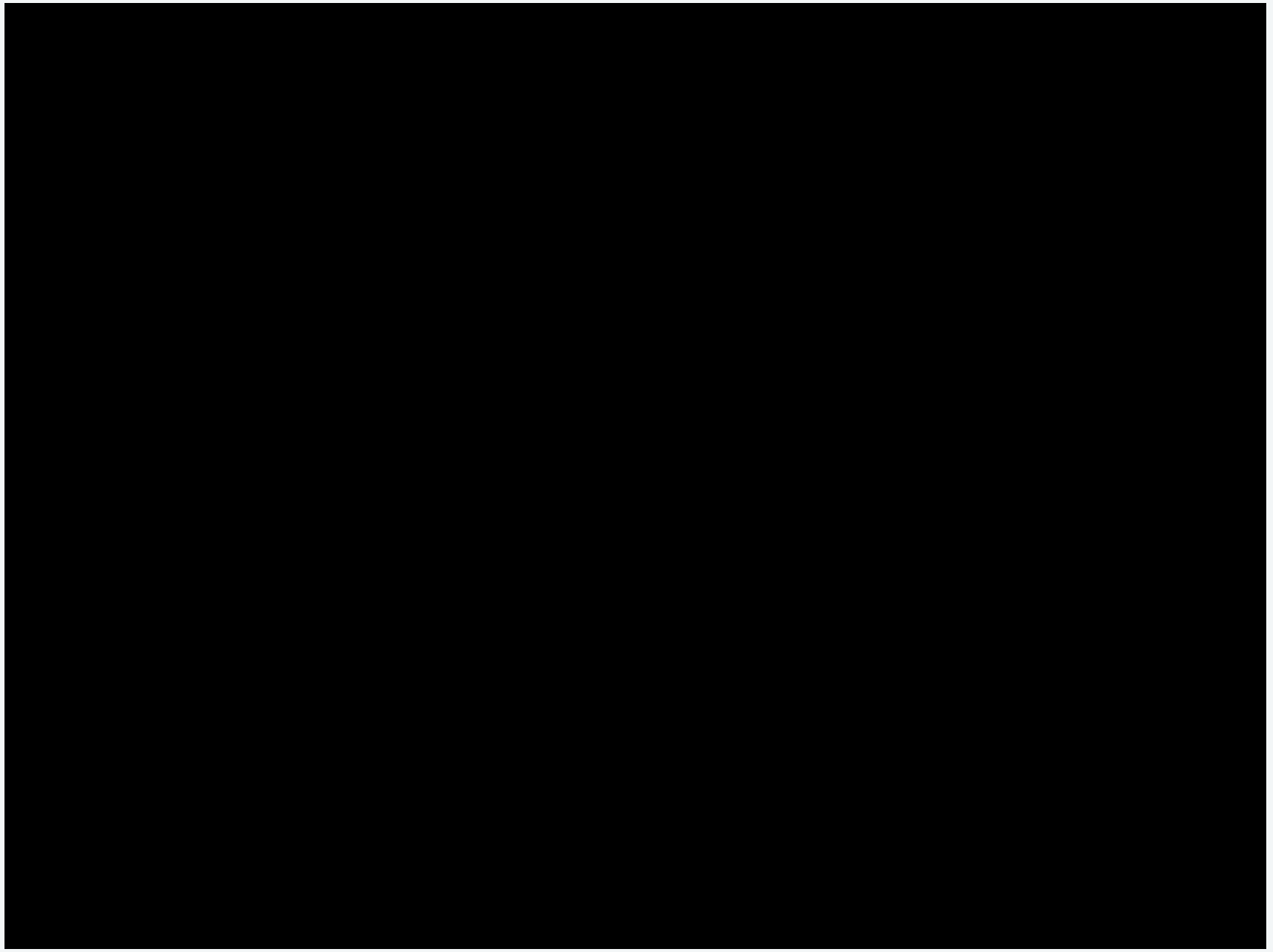
Producer Control

Energy Storage Control

Consumer Control



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Predictive energy management and control

KM's wide portfolio of Energy Storage Solutions (ESS) all utilize stored energy of batteries to increase efficiency, cost & emissions of the hybrid power plants by introducing a series of predictive Energy Control features:

Performance boost makes ESS power instantly available which enabling dynamic performance beyond engine capability

Peak shaving smoothens load fluctuations and stabilize main engines load, enabling operations with high dynamics with fewer engines online

PowerBoost™ allow the ESS to absorb high loads above engine capacity for prolonged periods without need or triggering starting surplus engines

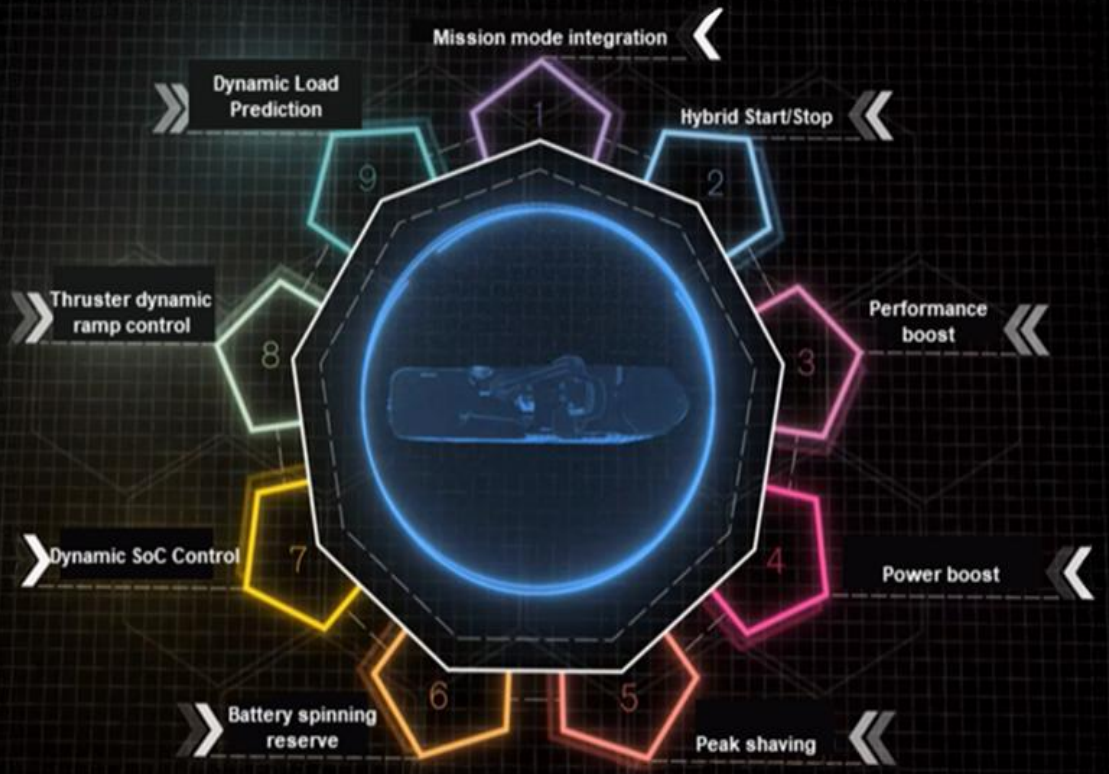
Spinning reserve – ESS contributing to the class required redundancy, thereby reducing the need of engines online (Time-To-Terminate)

Hybrid Start/Stop – Automatic start and stop of generators keeping a minimum of generators online

Dynamic ramp control – EMS calculates and adjust ramps acc. to available power and dynamic capability

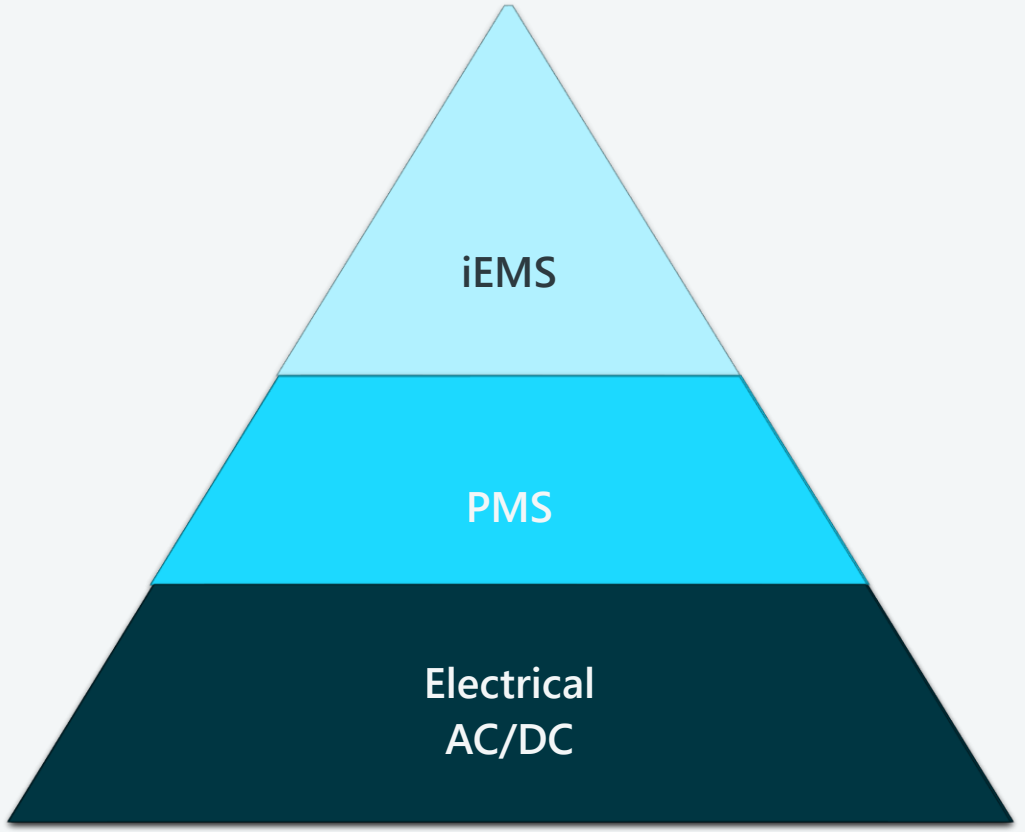
Dynamic SoC control – EMS adjust SoC limits based on prediction from DP, optimizing battery utilization and lifetime

Dynamic Load Prediction – load prediction of DP and mission systems, with feed forward to power producers. Increase efficiency and stabilize power plant



Kongsberg from electrical to iEMS

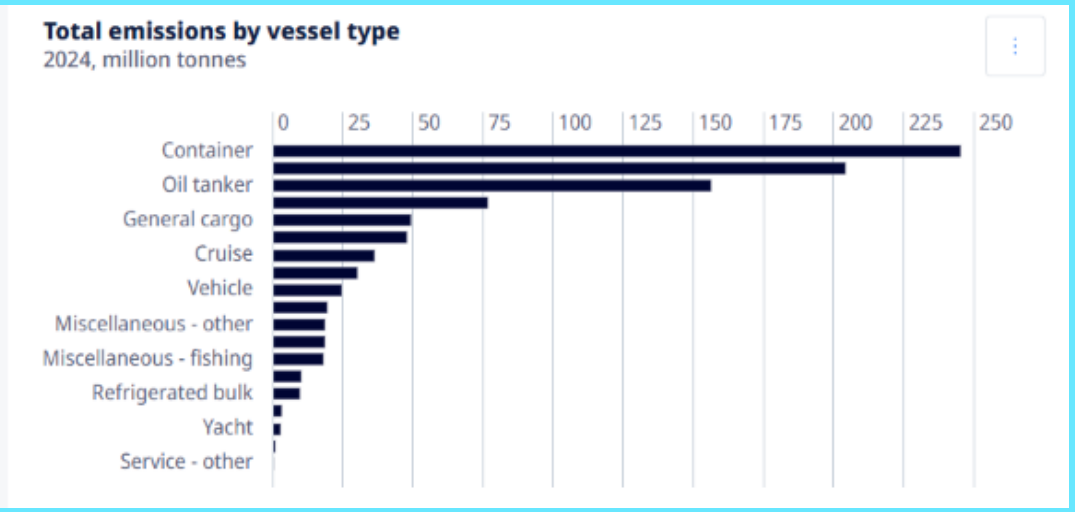




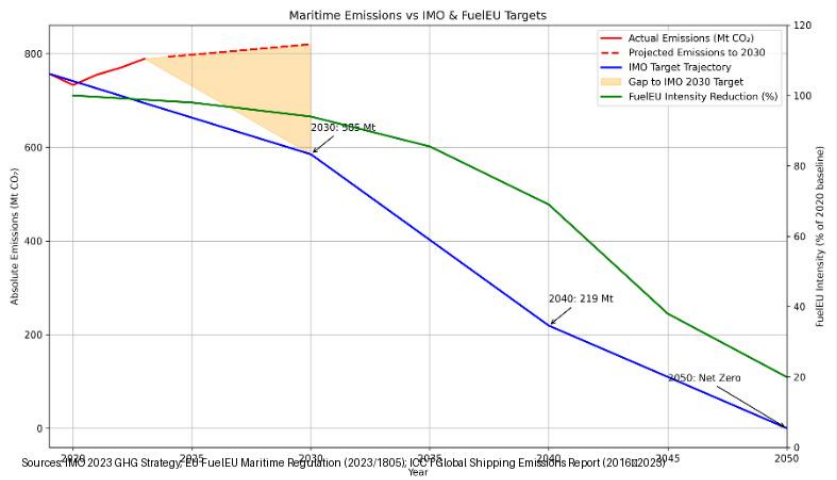
Future challenges License to operate

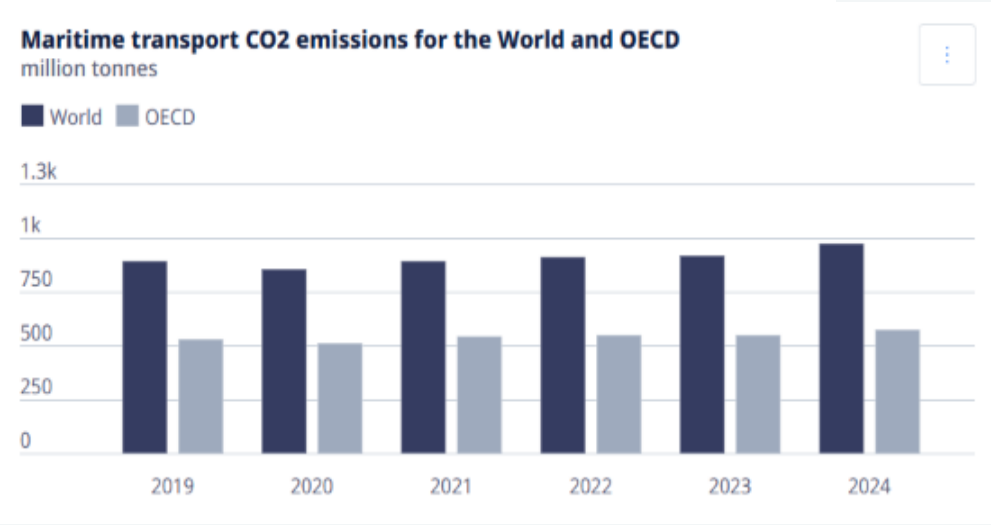
New requirements for emission reduction FuelEU & IMO

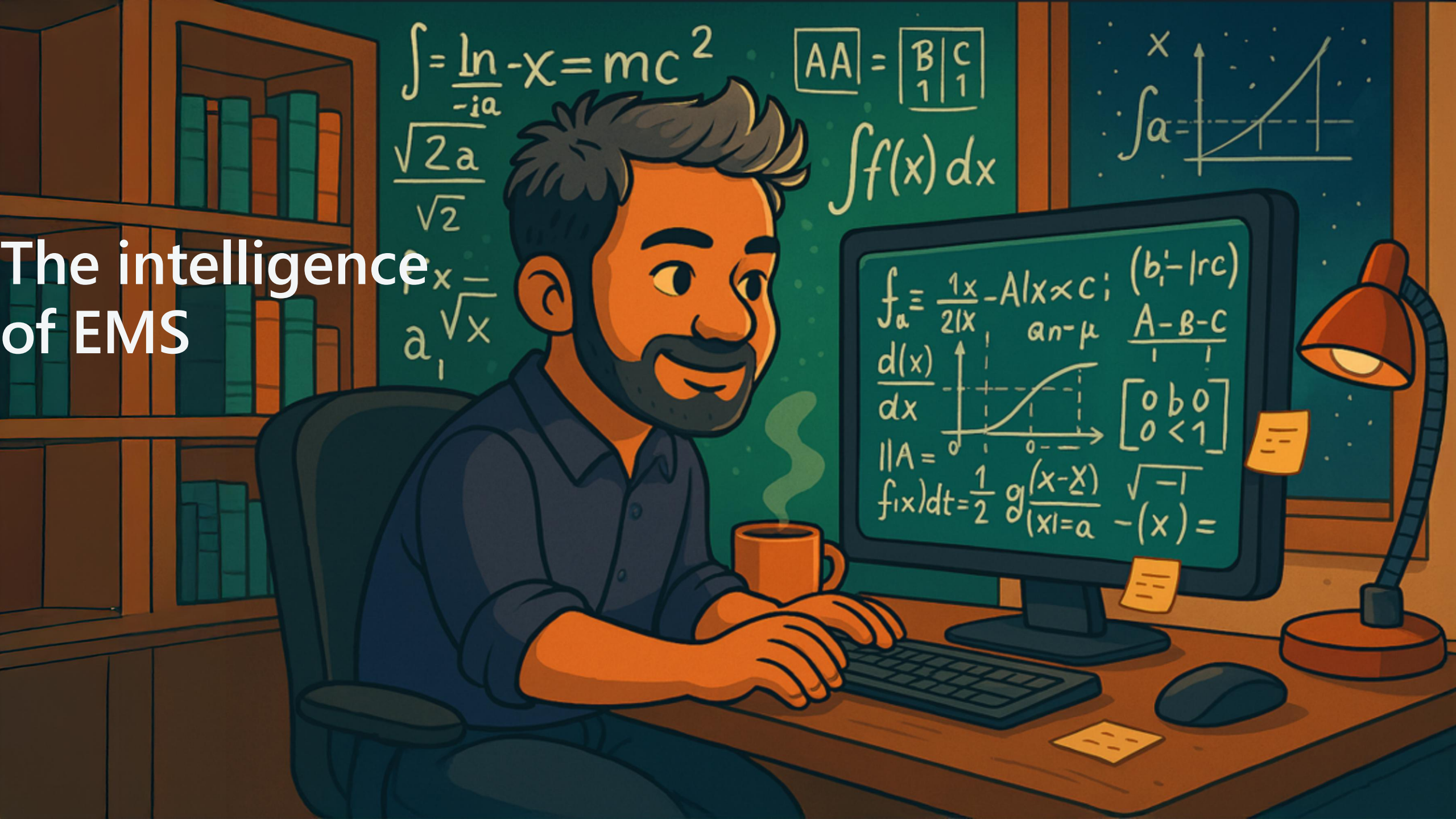




Going the wrong way






The intelligence
of EMS



How to become Heroes of our time

Fullfill the end client dreams

Deliver on a future ready platform

Collaborate with end client and be an energy transition partner

See Statement of Proprietary information

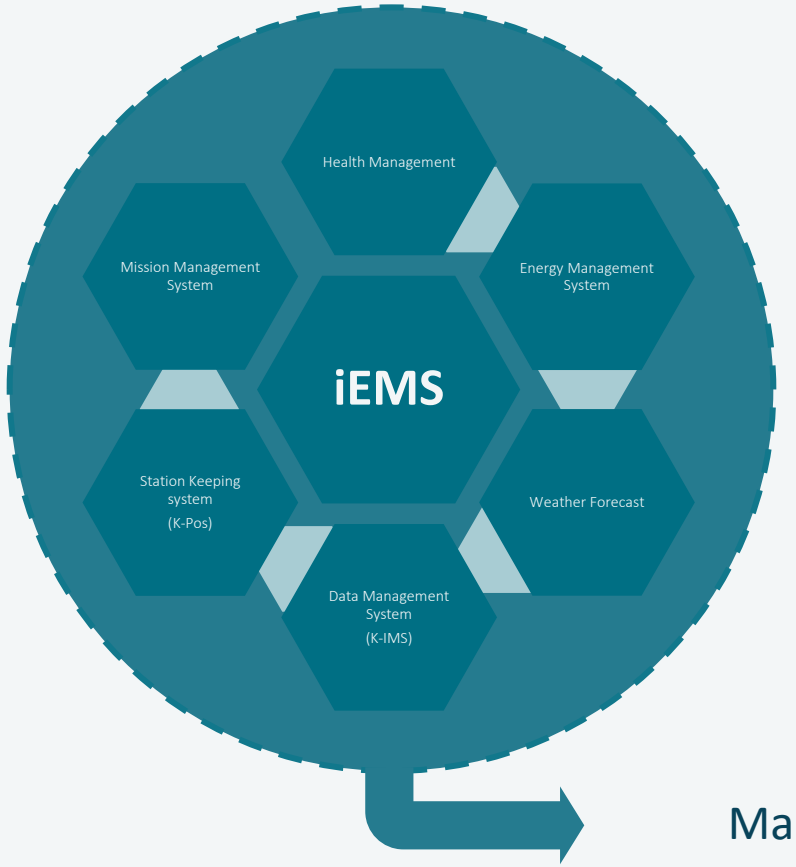
Market demand for intelligent energy management solutions



Customer statement:

"At a time when ships are equipped with batteries, shaft generators, ORC, DGs, power management optimization is beyond human brain capacity, fully automated PMS/control system should become a standard. Hybrid car automation level should be the target."

iEMS integration

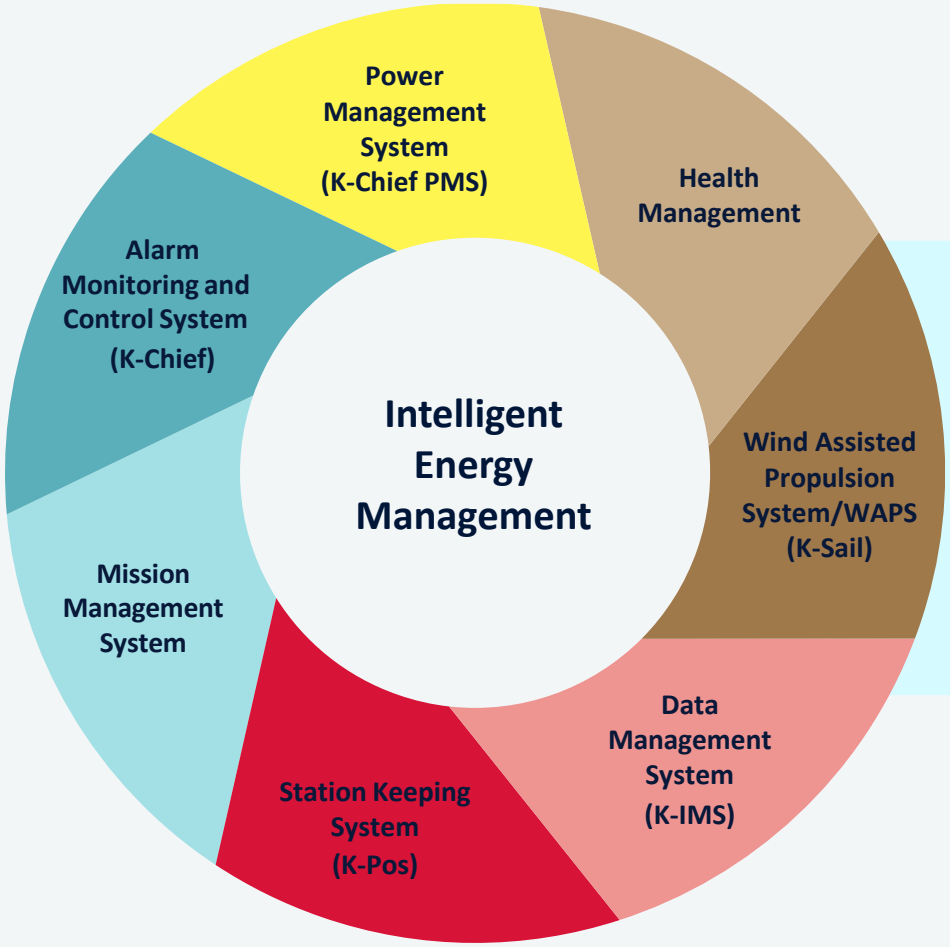


Continuous optimalisation with onboard advisory and active control based on real-time analytics

Efficiency	Safety and Redundancy
Emissions	Capability upon WCF
Energy Consumption and Equipment Utilization	Spinning Reserve Power
Number of connected consumers	Position and Heading excursion
Number of connected producers	Equipment Health and Availability

Maintain the **right balance** for the given circumstance

What will you achieve with iEMS?



Onboard advisory and active control based on real-time analytics

Continuous Optimization



Optimal use of battery



Increased safety



Environmentally friendly operation





Enhanced efficiency



Improved maintenance and health control

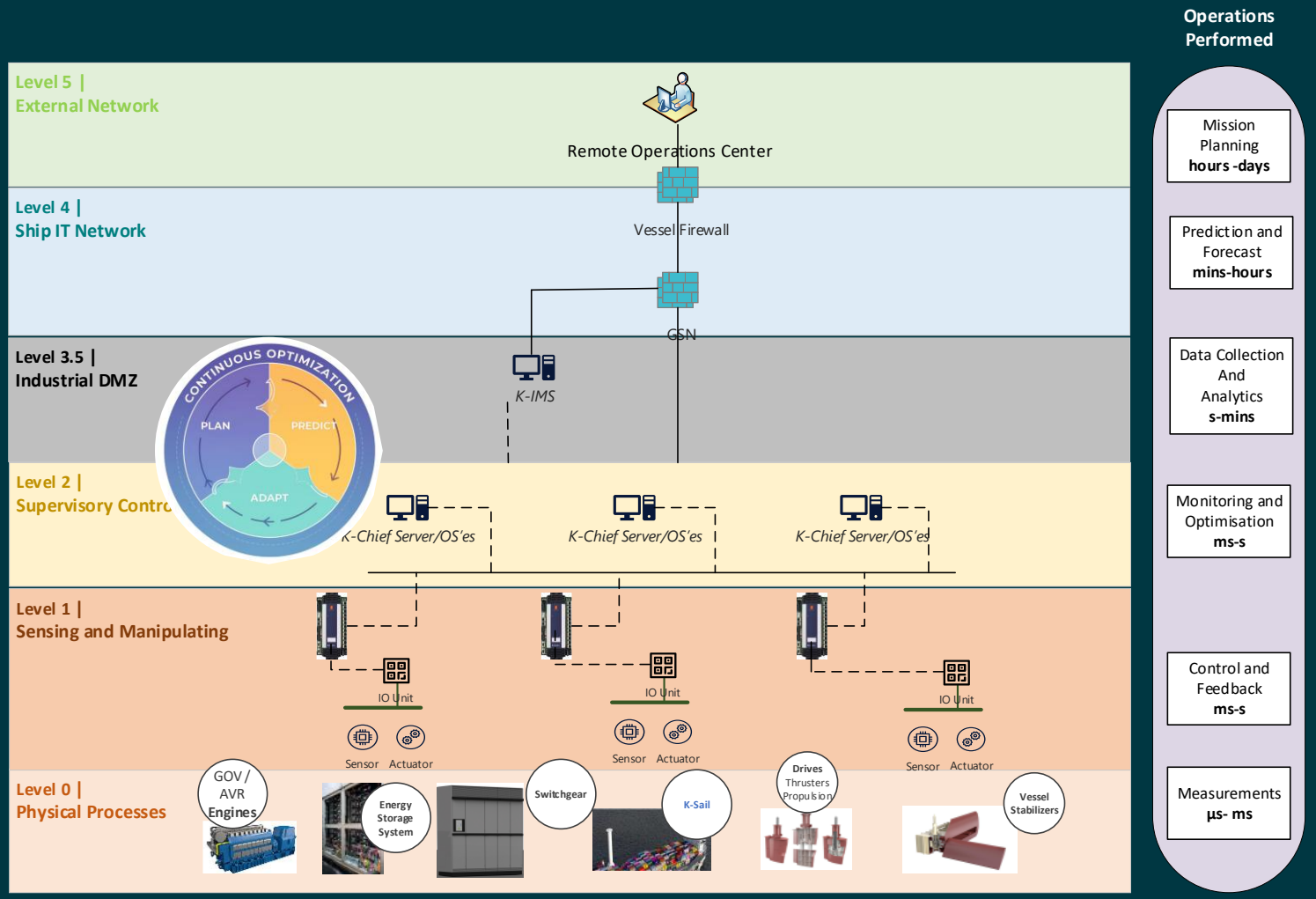


Optimal use of sail

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iEMS Features

With K-Chief, KM Electro, Digital and SAIL



Operations Performed

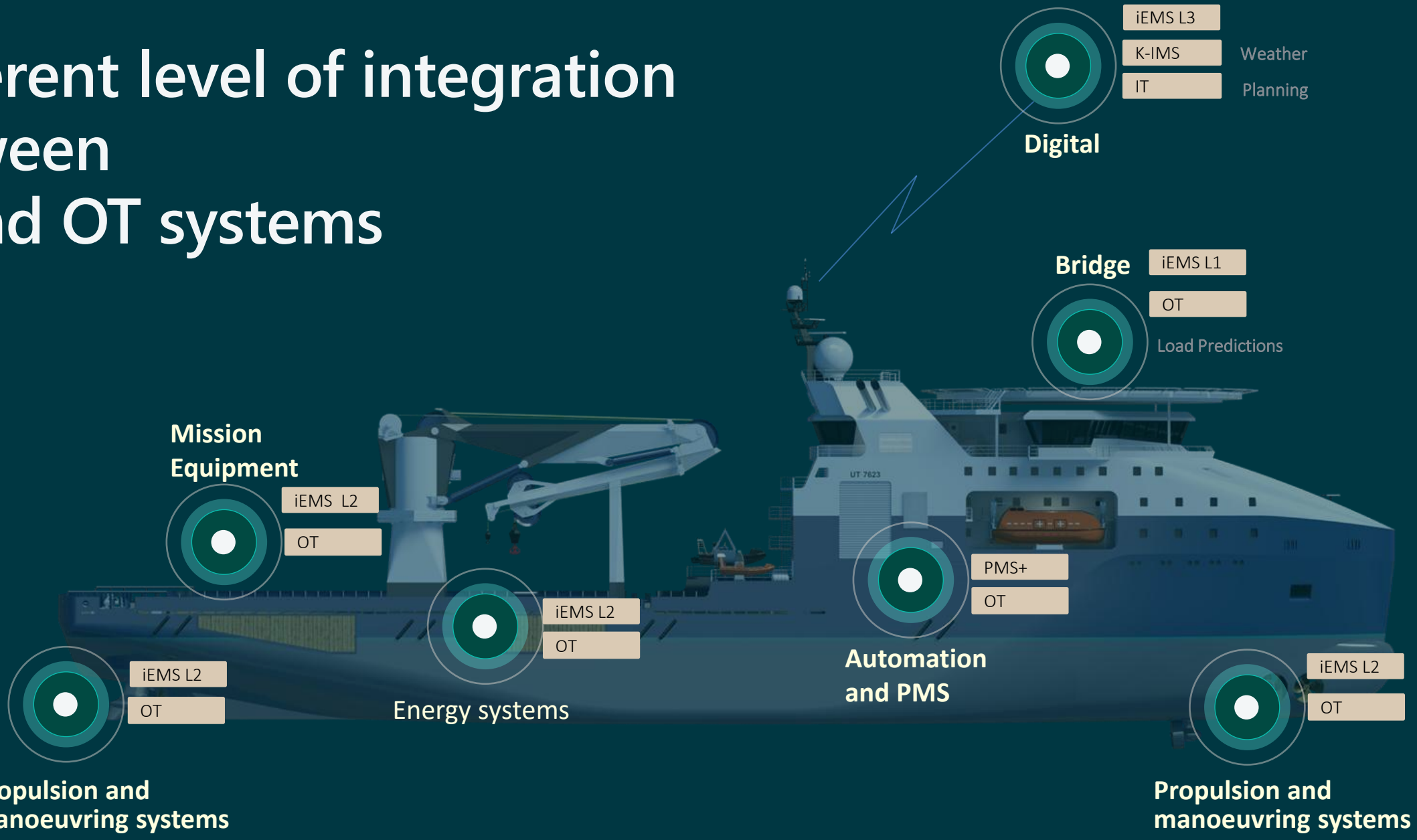
- Mission Planning **hours -days**
- Prediction and Forecast **mins-hours**
- Data Collection And Analytics **s-mins**
- Monitoring and Optimisation **ms-s**
- Control and Feedback **ms-s**
- Measurements **µs- ms**

GSN – Global Secure Network
K-IMS – Kongsberg Information Management System
K-Chief – Kongsberg Vessel Management System

Features/Functions

- Fuel Oil Consumption and Emission monitoring
- Dynamic Load Prediction
- Dynamic Ramp Control
- Dynamic Load Control and reduction
- Direct Ramp Control
- Performance/Power Boost with ESS
- Power Regeneration Control
- Continuous Optimization
- Onboard Simulation including SAIL
- Electrical Equipment Health monitoring (BESS Life+)
- Energy Planner integration with Weather forecast + Vessel Planner

Different level of integration between IT and OT systems



KM iEMS is powered by

Power Management System

Monitoring and Control of Power Producers, distributions and consumers

Perform Load dependent Start/Stop functions

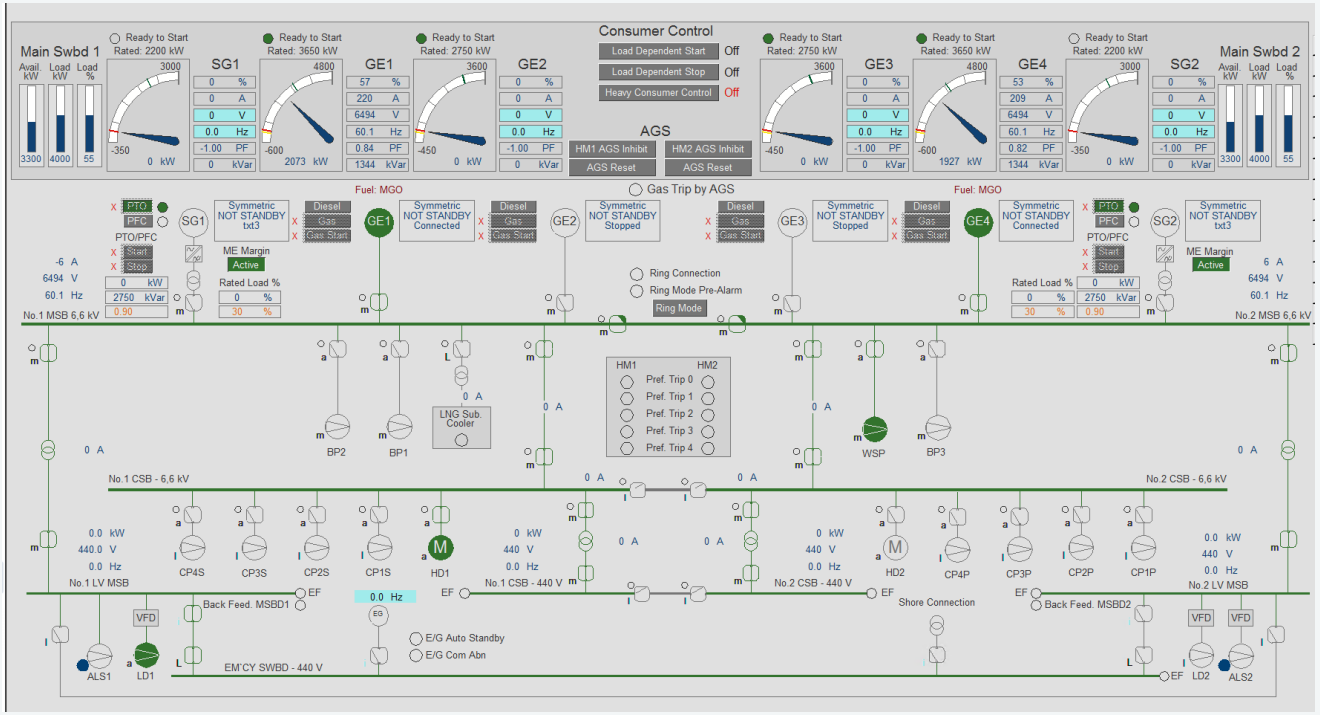
Prevent generator overload by heavy consumer start and heavy consumer control

Perform load sharing between the producers

Perform blackout recovery

Generator control and monitoring

Bus-tie breaker operation



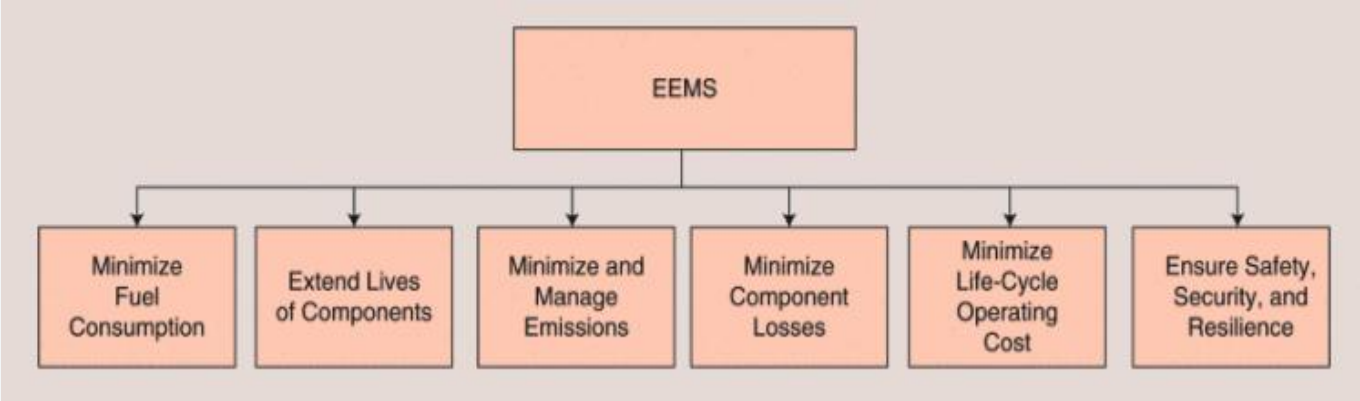
Energy and Emission Management System (EEMS)

EEMS controls dynamic behaviour of power system

Manage Energy efficiency, wear and tear of system components

Reduction of fuel consumption and emissions

Responsible for intelligently balancing the energy produced, stored and consumed



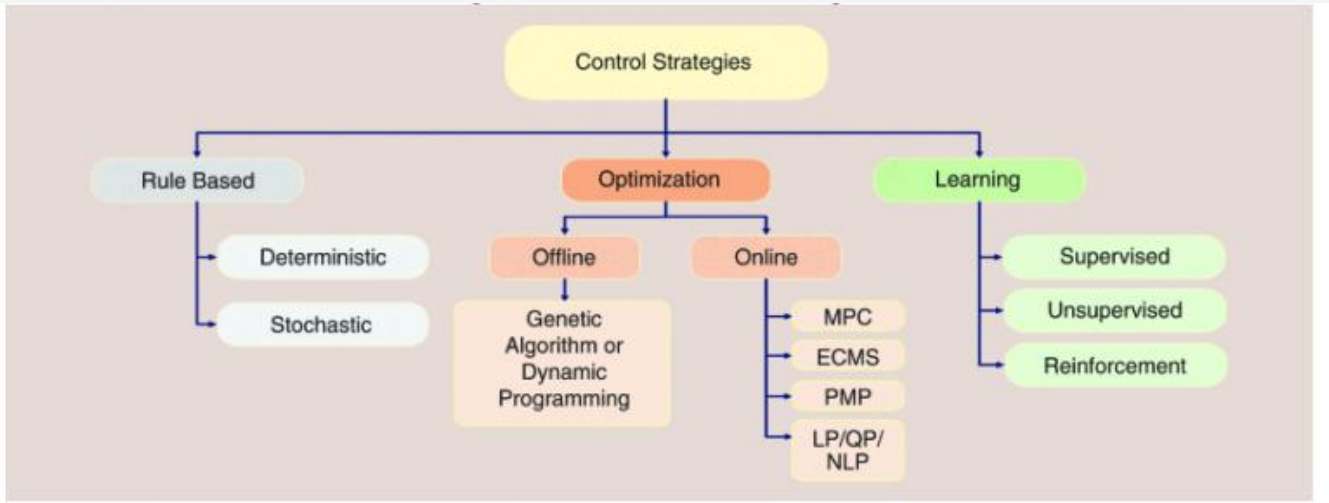
EEMS

Control Strategies

To successfully integrate the different ship components such as internal combustion engines, gas turbines, energy storage devise, fuel cells systems and various electrical loads ensuring safe and reliable operation, there is need for implementation of robust EEMS

Definition of Objectives

- Primary: Power Quality, reliability and dynamic response etc.,
- Economic: Fuel cost reduction, maintenance cost minimisation etc.,



Identify Constraints

- Limitation on charge/discharge rate of ESS,
- Power generation capacity limits of different sources,
- Operational boundaries of components,
- Thermal, electrical or regulatory restrictions

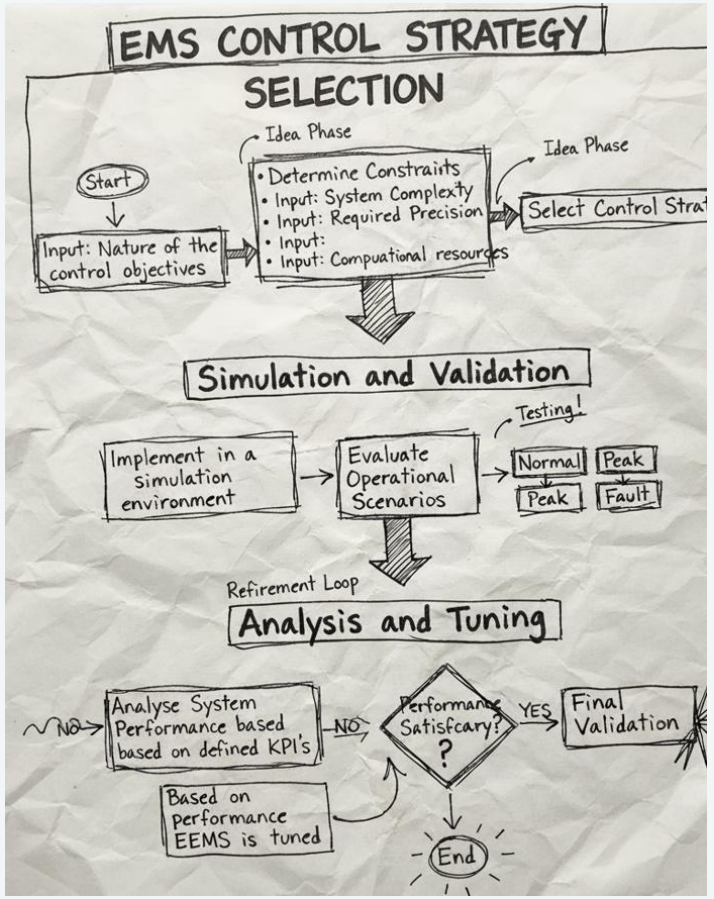
Selection of appropriate Control Strategy

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EEMS

Control Strategy Selection Criteria

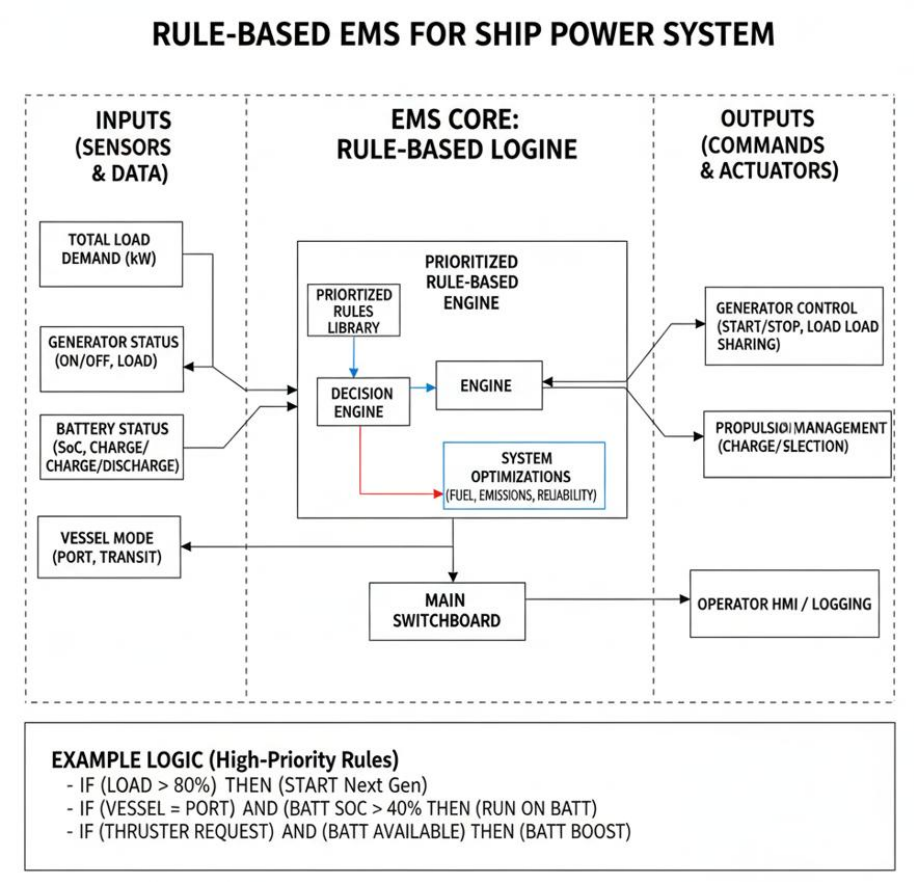
- System Complexity
- Required Precision
- Computational resources
- Nature of the control objectives
- Implement in a simulation environment for evaluating and validating the control logic under a range of operational scenarios: Normal, Peak and Fault conditions
- Analyse System Performance based on defined KPI's
- Based on performance EEMS is tuned



See Statement of Proprietary information

Rule Based

- A Rule-Based EMS uses a series of "IF-THEN" logical statements to make decisions about the operation of generators, propulsion units, and energy storage systems. Its primary goals are to:
- **Optimize Fuel Consumption:** By ensuring generators operate at their most efficient load points.
- **Reduce Emissions:** By minimizing inefficient operation and potentially enabling zero-emission modes.
- **Enhance Reliability:** By managing load sharing, starting/stopping generators, and ensuring adequate spinning reserve.
- **Extend Equipment Lifespan:** By avoiding unnecessary wear and tear.
- **Manage Energy Storage:** Effectively charging and discharging batteries (if present).



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Optimisation-based

Optimisation-based is classified as

- Global Optimisation,
- Real-time Optimisation

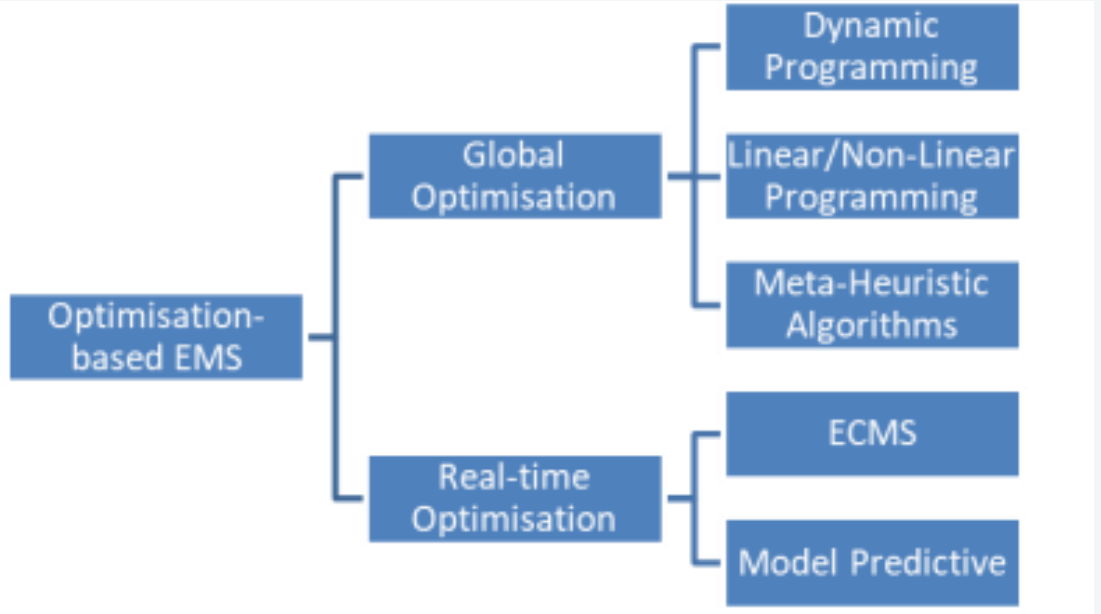
Global Optimisation: Find best way to use power sources to minimize objective function over an operating profile

Dynamic Programming,

Linear/Non-Linear Programming,

Meta-Heuristic Algorithms

Real-time Optimisation: Continuously evaluate and adjust process operating conditions based on recent information to minimize the cost function



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Learning-Based

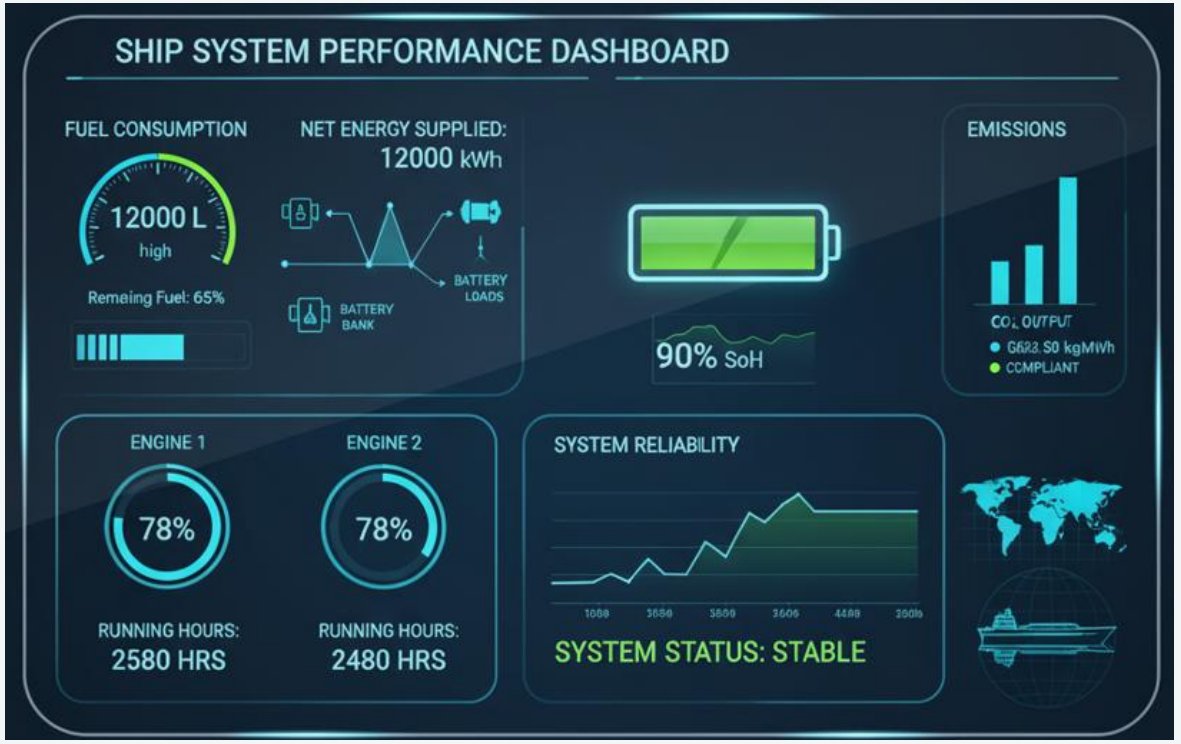
- Leverages Machine Learning techniques
- Supervised learning: Forecasting (Regression). **Application:** Predicts future **load demand**, vessel speed, and environmental inputs (wind/waves) to provide the look-ahead capability essential for Model Predictive Control (MPC) and RL.
- Unsupervised learning: **Function:** Pattern Recognition (Clustering). **Application: Anomaly Detection** for early fault warnings; automatic **Operational Mode Segmentation** (e.g., transit, maneuvering) for switching control policies.
- Reinforcement learning(RL): **Function:** Sequential Decision-Making. **Application:** The **core control agent** learns the optimal power dispatch policy (e.g., engine commitment, battery charge/discharge) to maximize long-term reward (e.g., minimum fuel cost) in real-time.

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KPI’s for evaluation

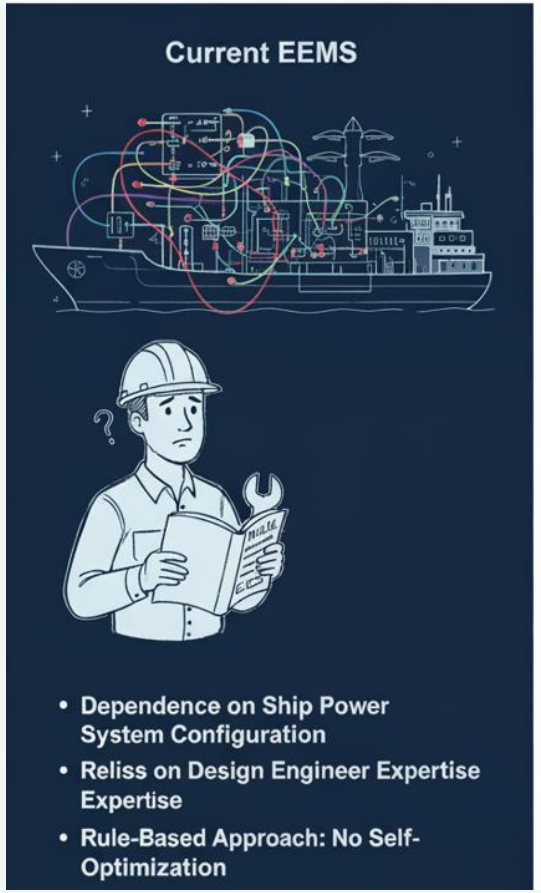
- Fuel Consumption
- Emissions
- Net Energy Supplied by producers
- Running hours of ICE’s
- ICE Efficiency
- SoH of battery
- System reliability in handling transient loads

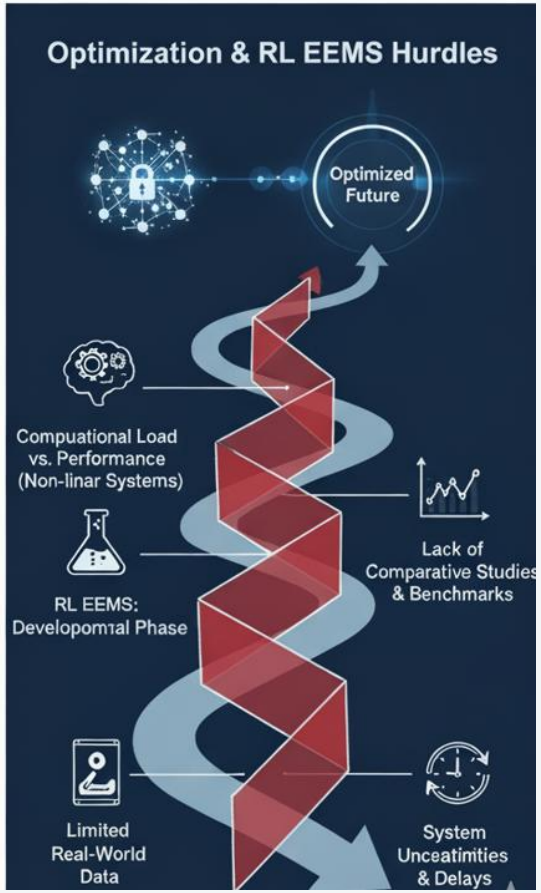


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Limitation and Challenges

- Highly dependent on Ship Power System configuration
- Depends on expertise of design engineer
- Rule-based approach do not perform any kind of optimization on their own
- Optimization-based strategies face challenge in balancing computational load with performance, especially in non-linear systems
- RL EEMS, is still in developmental phase, lack of systematic comparative studies, standardized benchmarks
- Limited real-world data
- Computational constraints
- Systems uncertainties and delays





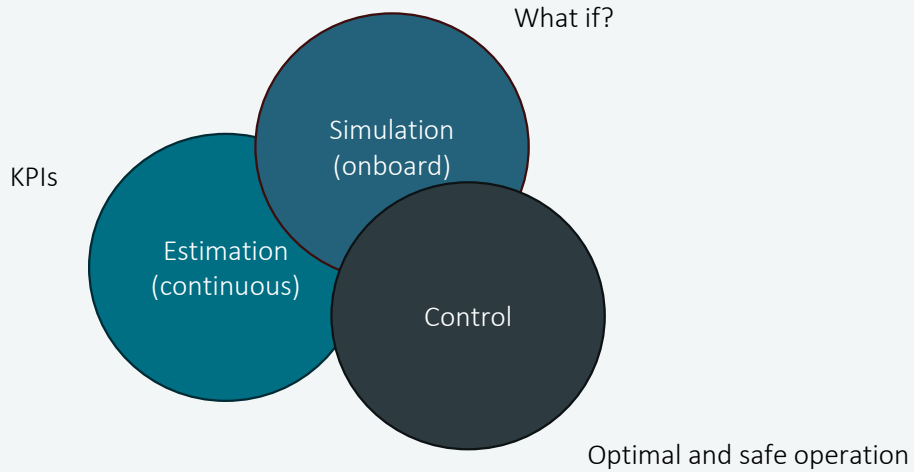
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COMPANY SHARED

iEMS

At a time when ships are equipped with batteries, shaft generators, hybrid solutions, sails, DGs, multi-fuel, energy management optimization is beyond human brain capacity, fully automated PMS/control system should become a standard. Hybrid car automation level should be the target.

- iEMS (Intelligent Energy Management System) is KM's newest addition to its legacy Power / Energy Management System.
- It aims to achieve more sustainable and environment friendly operations by continuously adapting the power systems according to the operation mode and its needs, varying weather conditions etc., for improved energy efficiency without compromising the safety of the vessel and the asset.
- It also enables operator to perform Onboard simulation of future operation to get knowledge on energy demand and potentiality for fuel savings and emissions reduction.
-
- The functionalities and components of iEMS will be realized in KCS architecture.



See Statement of Proprietary information

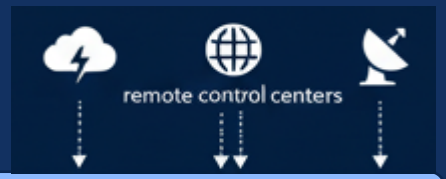
In context

iEMS scenarios

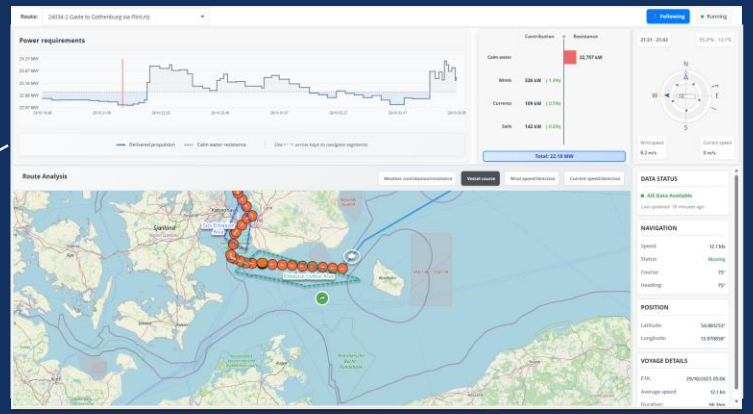
1. Energy plan with KM batterries
2. Shaft generator, Auxiliary Generators and batteries
3. Mission plan, eWSOG, and energy control (focusing offshore and advanced vessels)



Vessel in Transit Mode : DC Hybrid



Router Planner and Weather Forecast

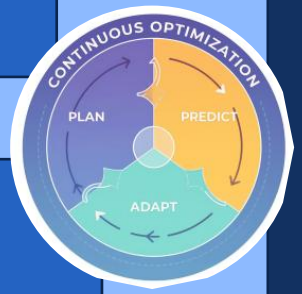


iEMS

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner



Real Time Continuous Optimization

K-Chief
(Alarm Monitoring and Control, Power Management System)

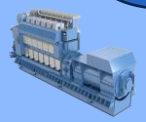
BMS

ECS

PCS

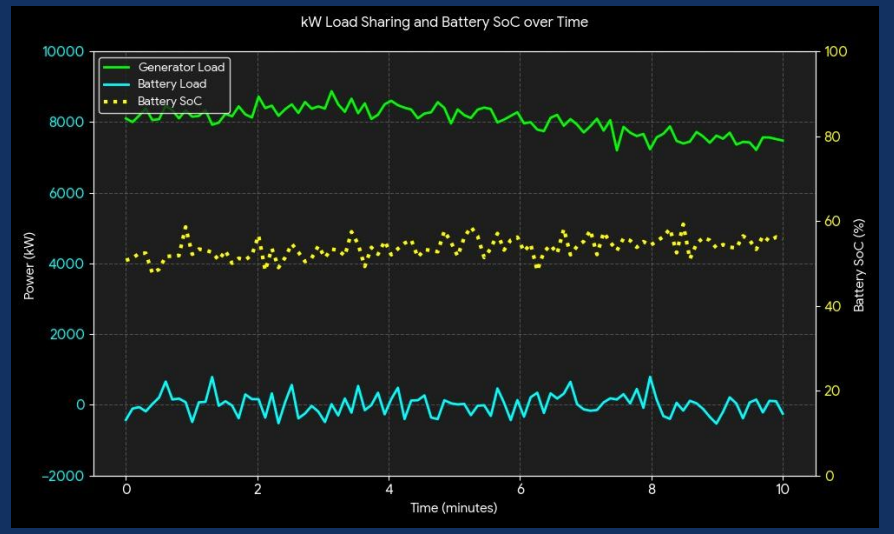


OCEON

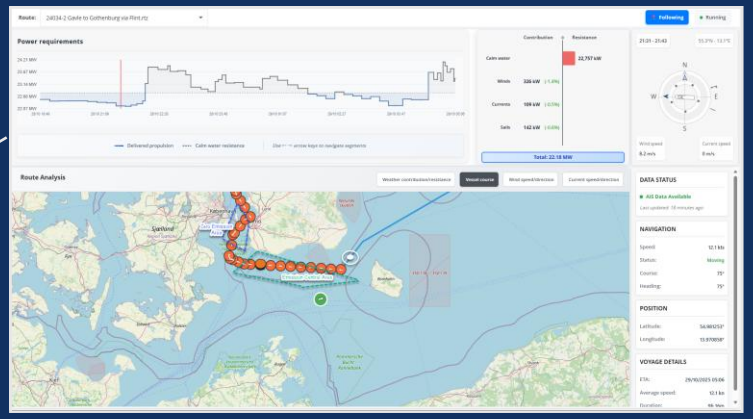


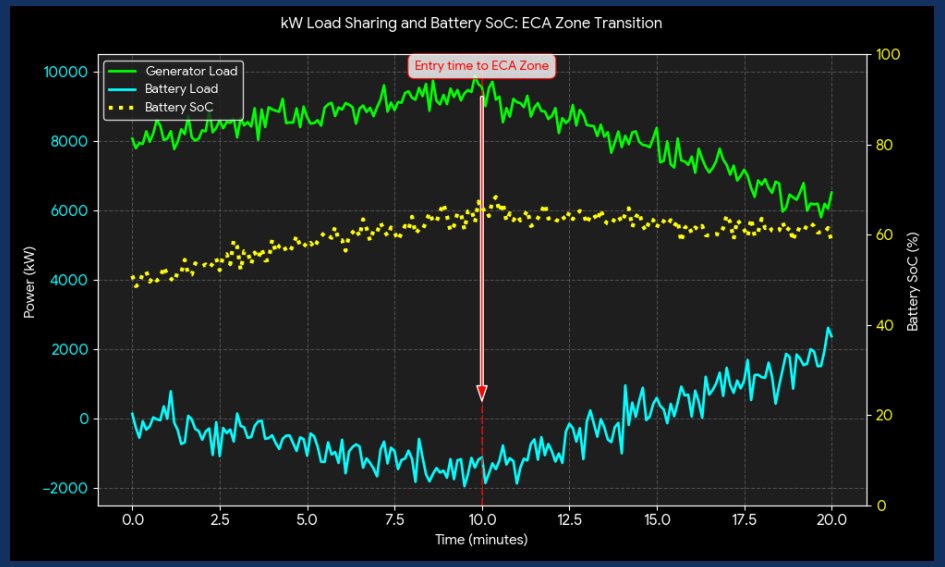


BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system



Vessel entering into Emission Control Area





remote control centers

Router Planner and Weather Forecast

Vessel Entering ECA in 10 Mins

iEMS

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner

CONTINUOUS OPTIMIZATION

PLAN

PREDICT

ADAPT

Real Time Continuous Optimization

Increase Charge Rate

Increase SoC Setpoint

K-Chief
(Alarm Monitoring and Control, Power Management System)

BMS

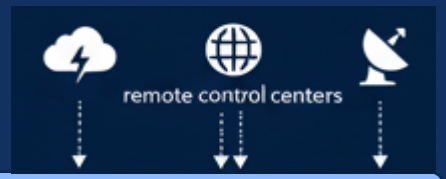
ECS

PCS

OCEON

BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system

Vessel entering into Zero Emission Area



Router Planner and Weather Forecast

iEMS

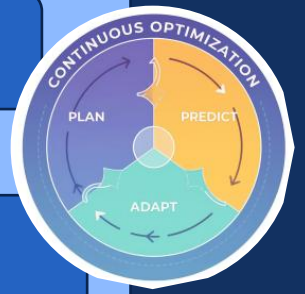
Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner



Battery-1: Health Score in Alarm State



Real Time Continuous Optimization

a. Decrease Battery 1 Discharge/Charge Rate
b. Increase Battery 2-4 Discharge Rate

Reprioritize Battery 1

K-Chief
(Alarm Monitoring and Control, Power Management System)

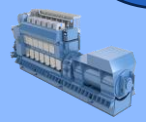
BMS

ECS

PCS

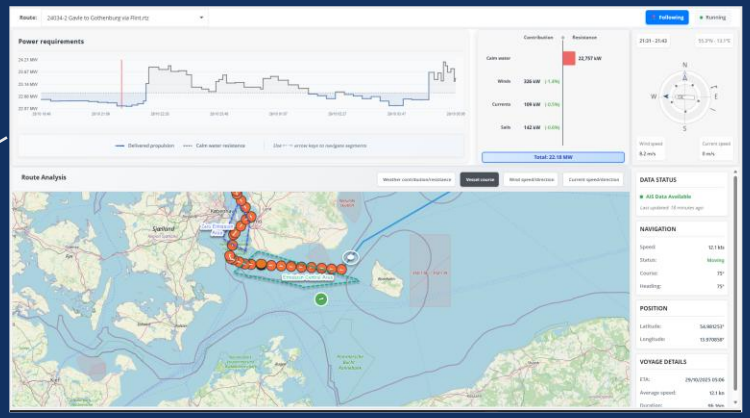


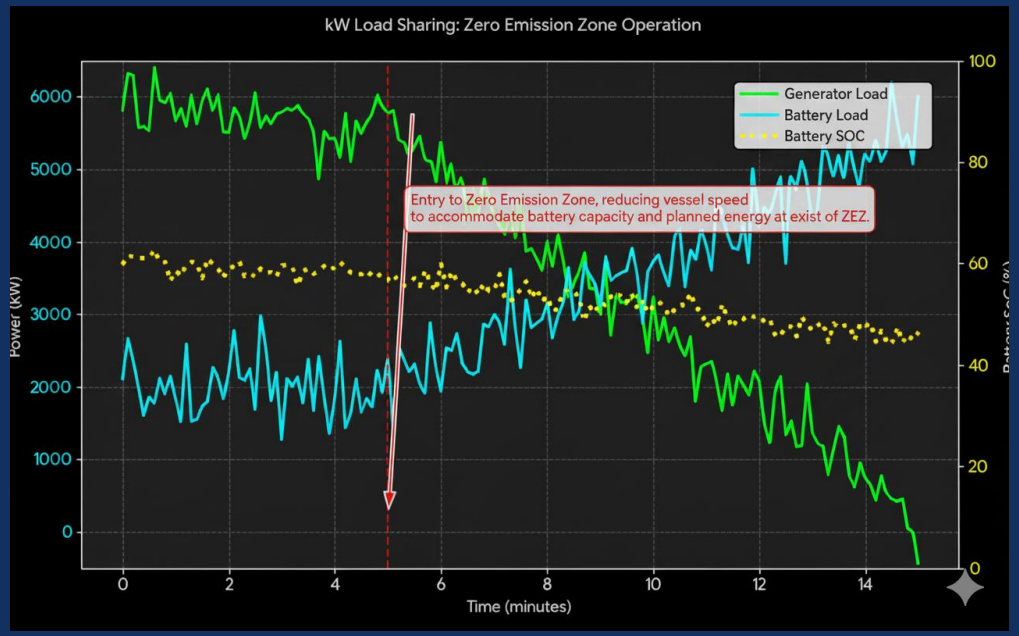
OCEON



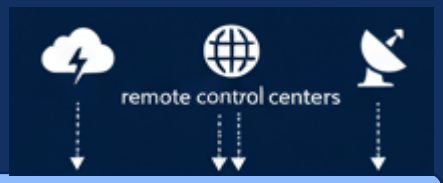


BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system





iEMS adjusting battery reference for minimizing power loss



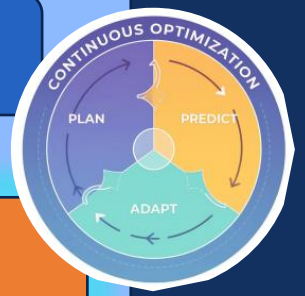
Router Planner and Weather Forecast

iEMS

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner



Real Time Continuous Optimization

Adjusting Battery Loads to minimize power loss

Actual State

Battery 1-4 Load references

K-Chief
(Alarm Monitoring and Control, Power Management System)

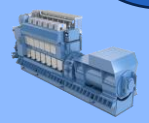
BMS

ECS

PCS

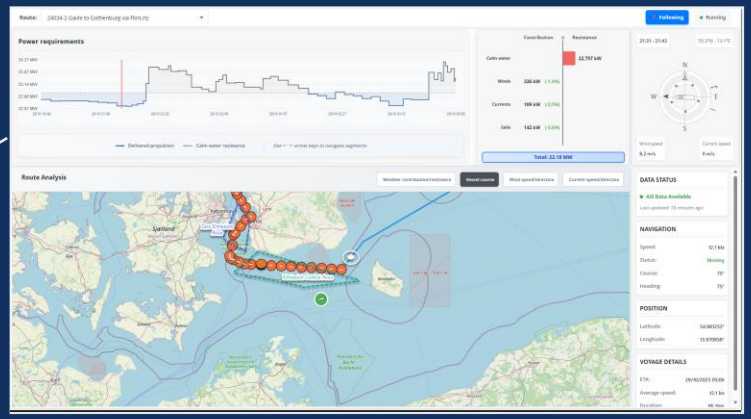


OCEON

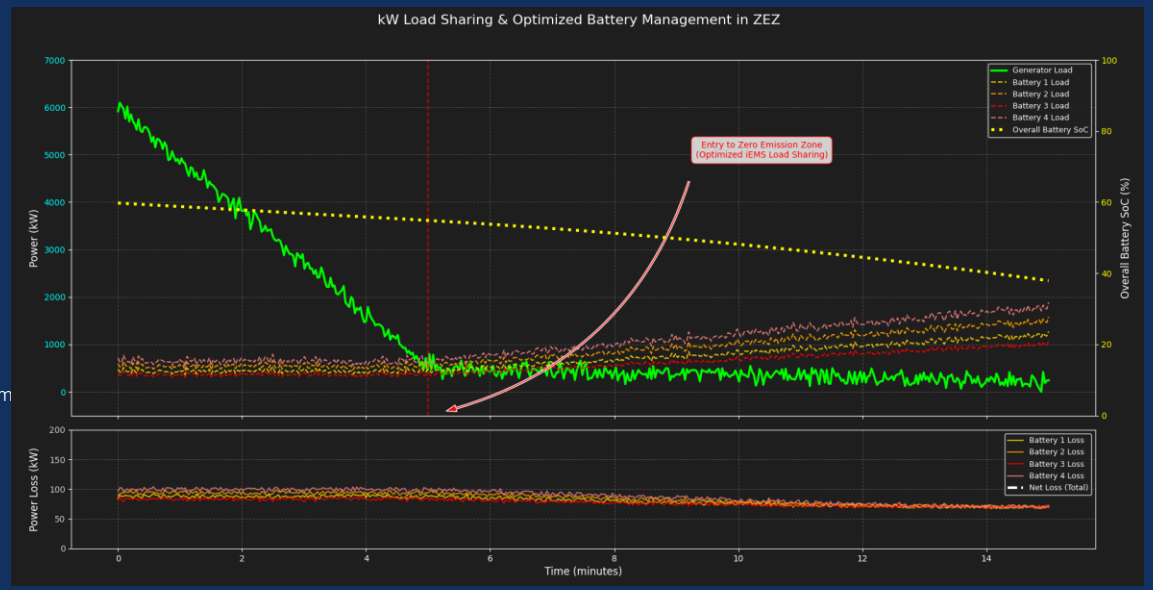




BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system



Savings : ~13% in Fuel reduction

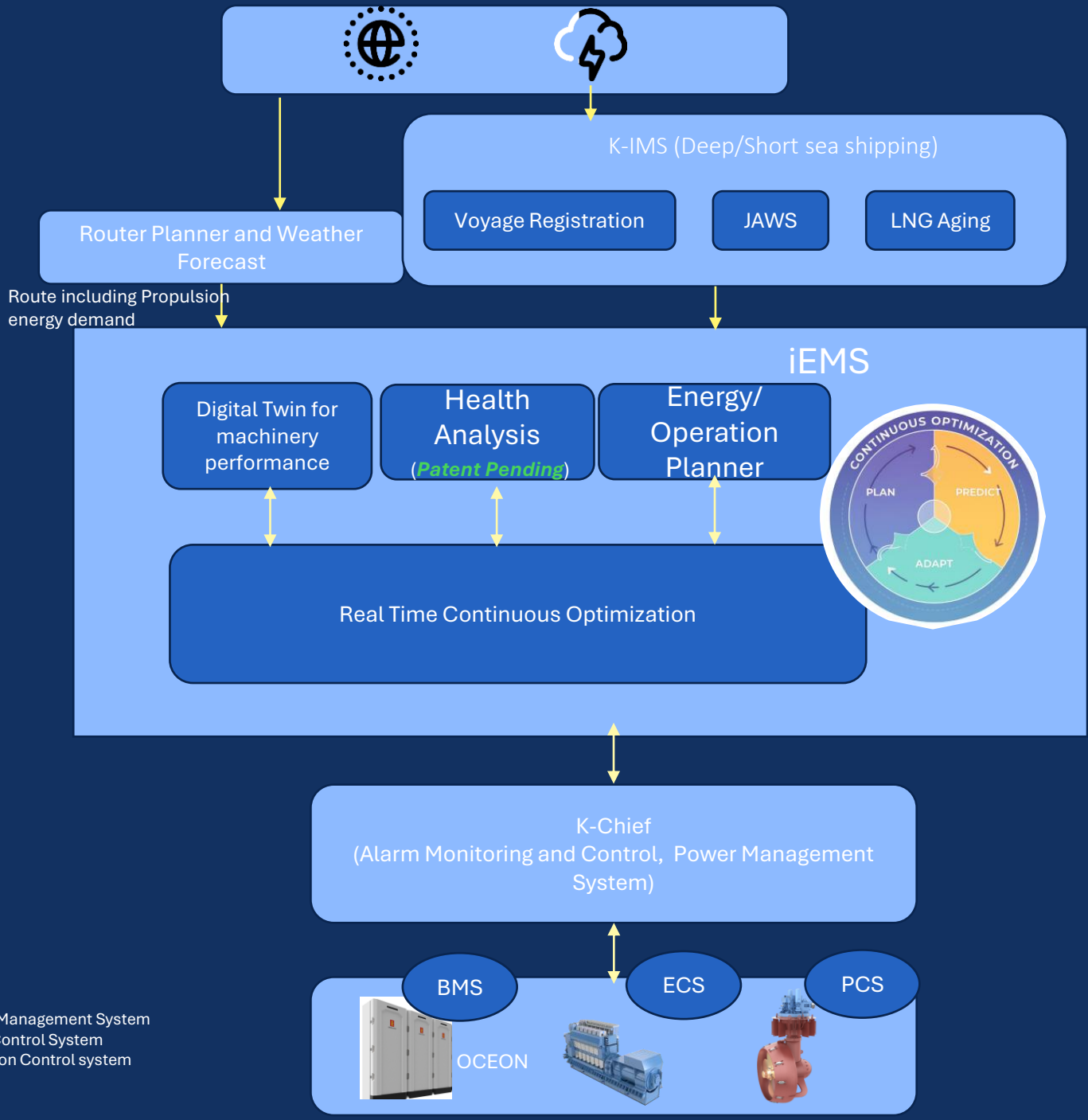


In context

iEMS scenarios

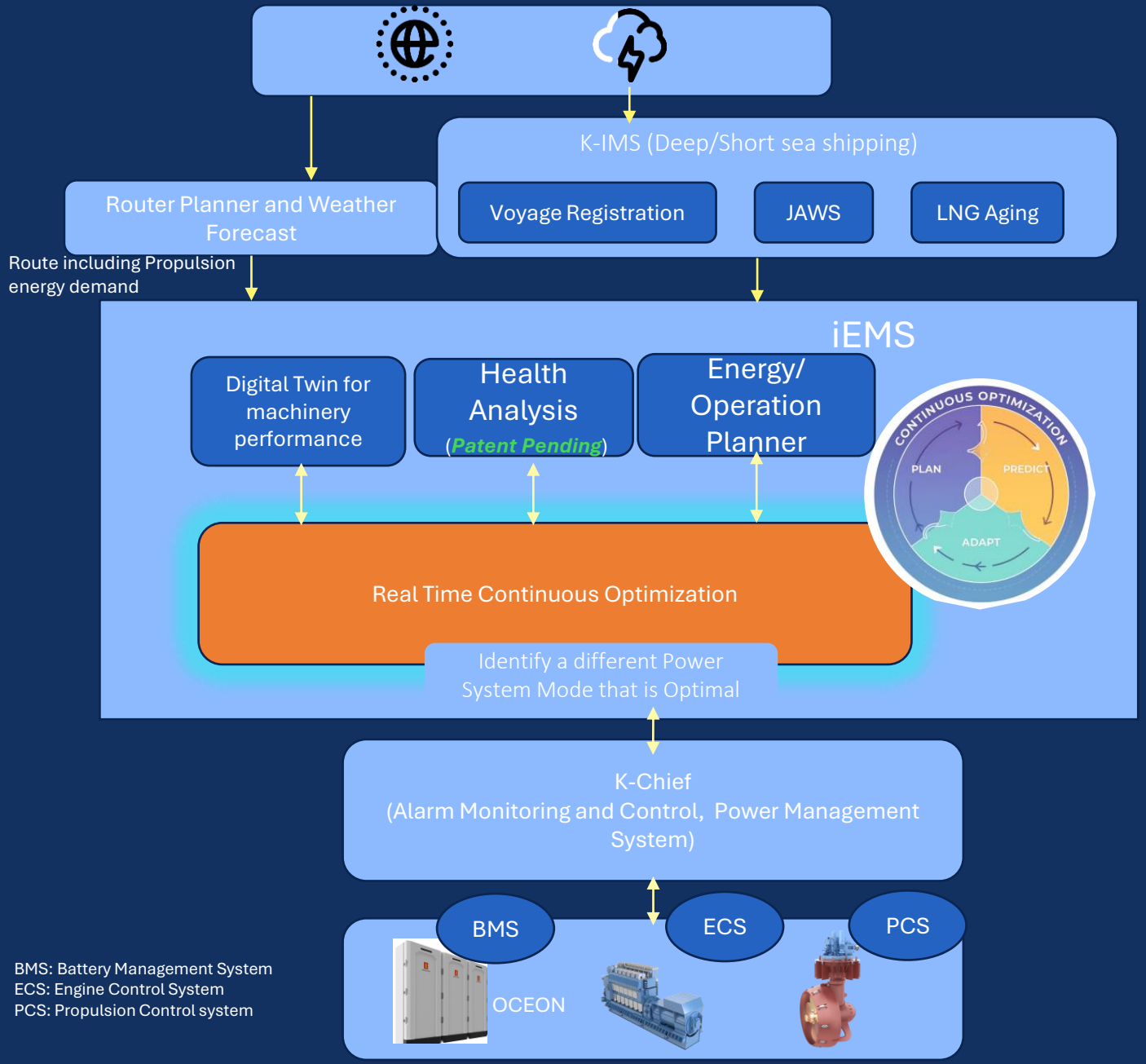
1. Energy plan with KM batterries
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3. Mission plan, eWSOG, and energy control (focusing offshore and advanced vessels)



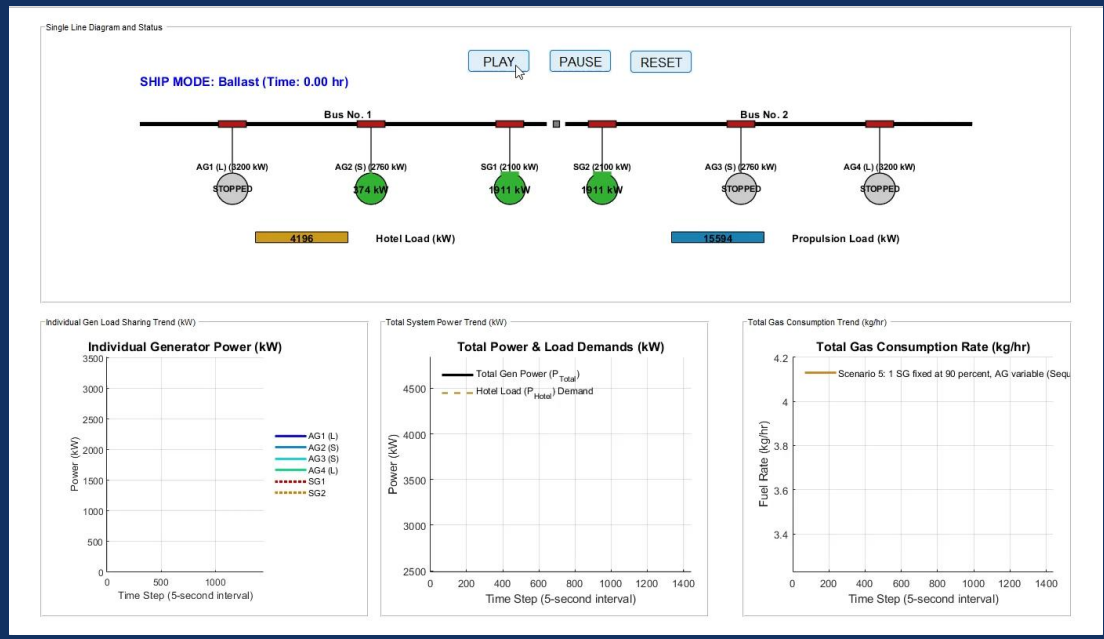


BMS: Battery Management System
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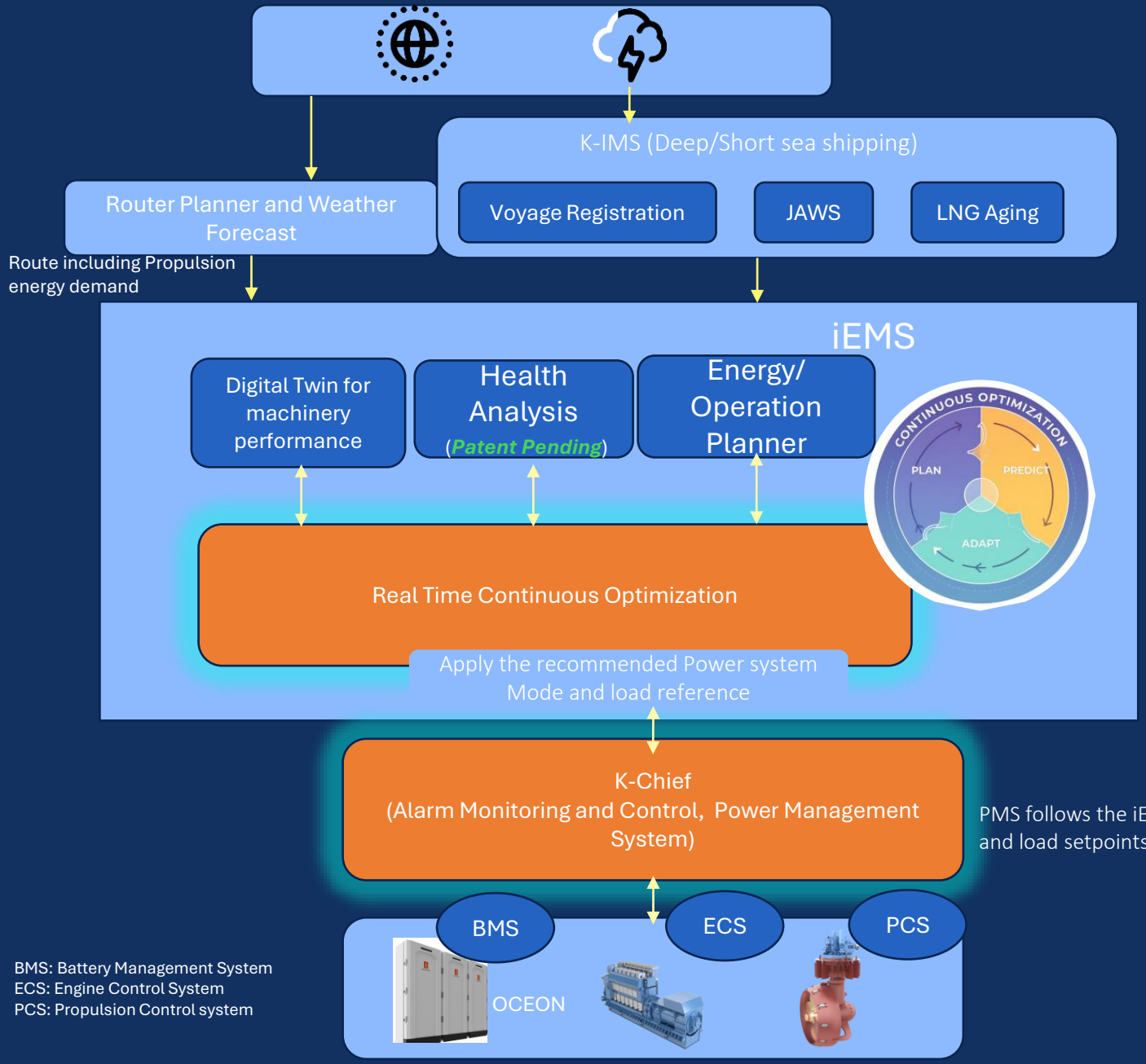
Vessel in transit mode: Shaft generator fixed and auxiliary supporting varying loads



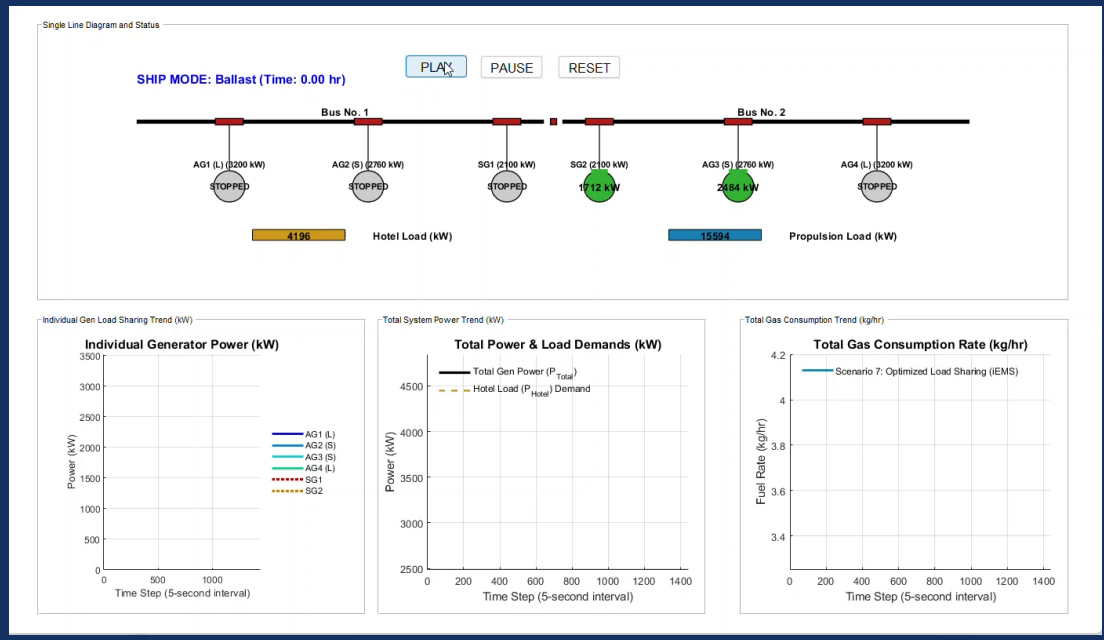
BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system



Vessel in transit mode: Optimized load sharing from iEMS



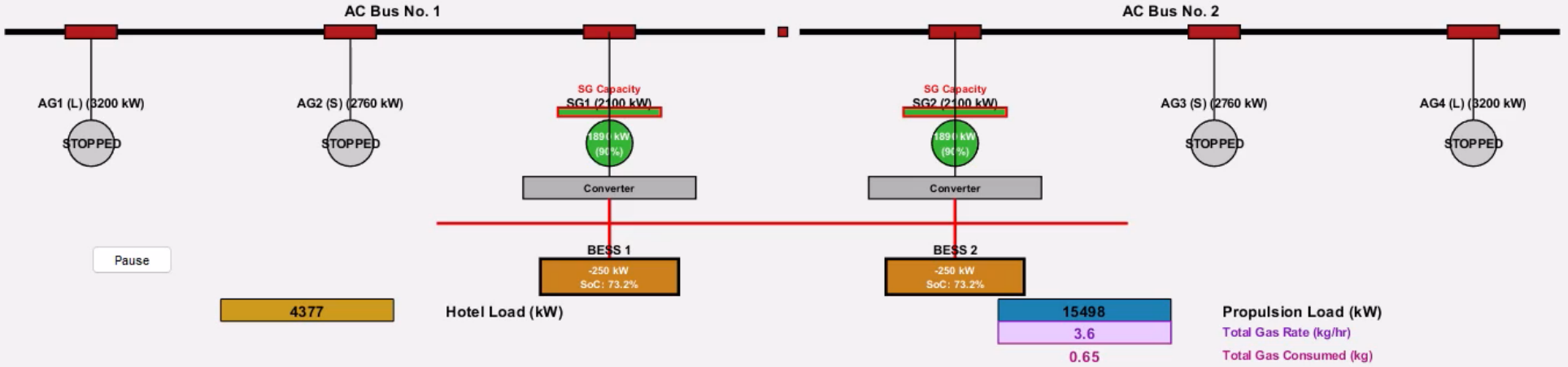
PMS follows the iEMS advice and load setpoints

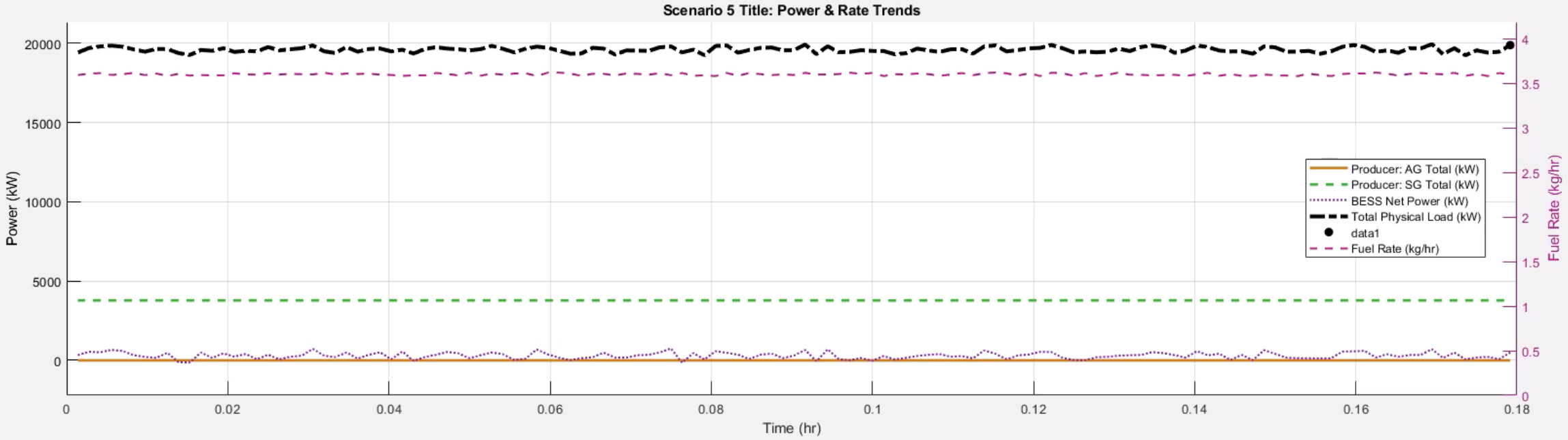


Savings : ~9% in Fuel reduction

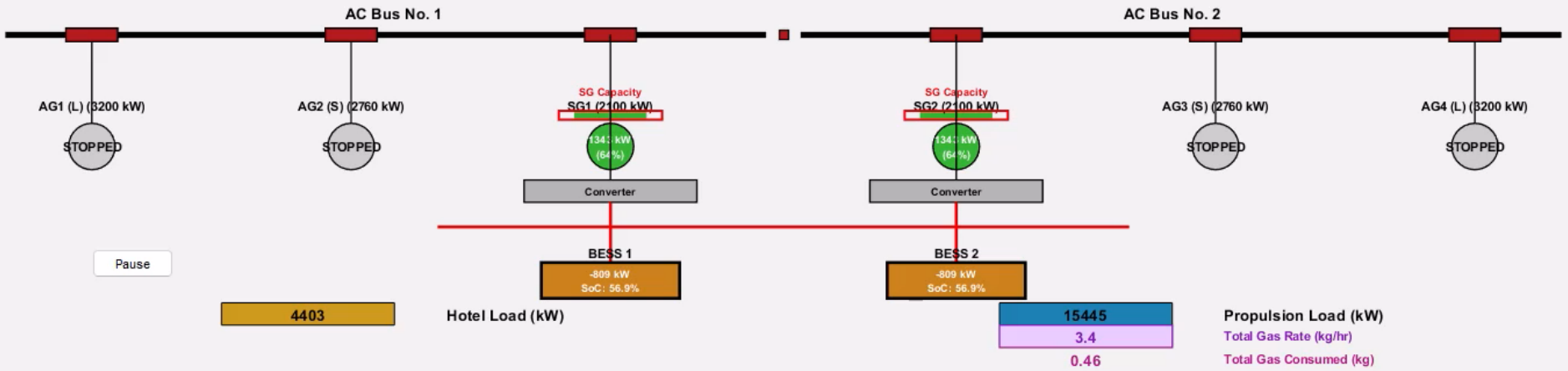
BMS: Battery Management System
ECS: Engine Control System
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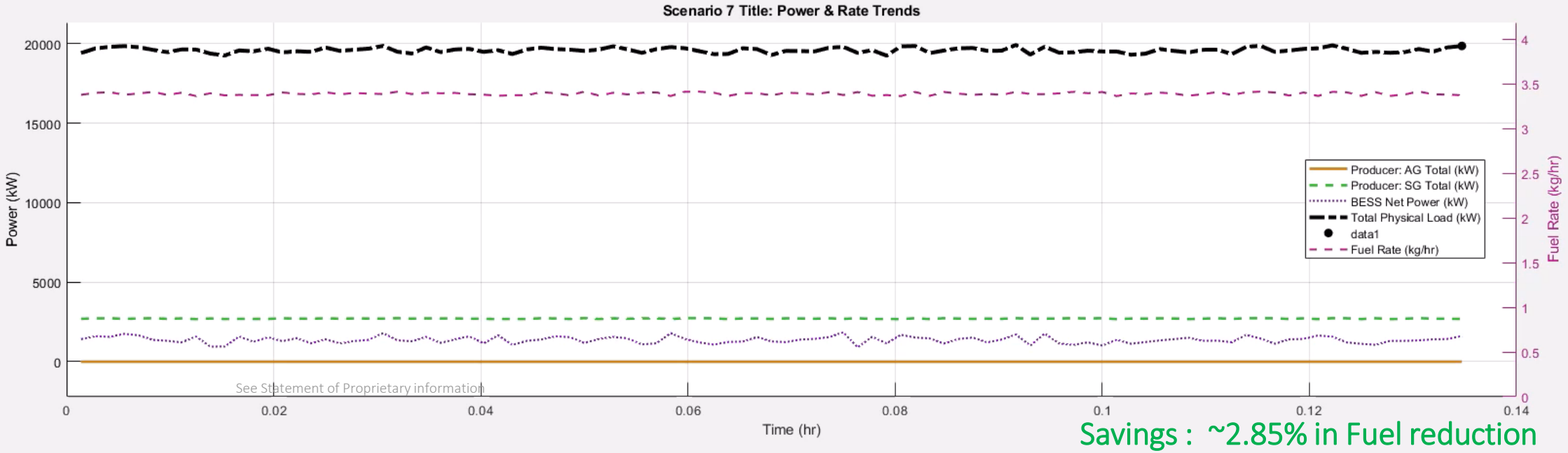
SHIP MODE: Ballast (0.18 hr)





SHIP MODE: Ballast (0.13 hr)





Savings : ~2.85% in Fuel reduction

In context

iEMS scenarios

1. Energy plan with KM batterries
2. Shaft generator, Auxiliary Generators and batteries
3. Mission plan, eWSOG, and energy control (focusing offshore and advanced vessels)





ROC

K-IMS (Offshore)

eWSOG/ eASOG

DP Operational Forecast

Gangway Operational Forecast

Router Planner and Weather Forecast

Route including Propulsion energy demand

Status: Green, Advisory, Yellow and Red

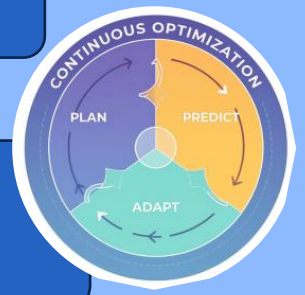
Thruster Utilization Forecast (kW)

iEMS

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner



K-Pos (Vessel Response Simulator, Power Plant Advisor)

Real Time Continuous Optimization

K-Pos (Sensors, Reference Systems status, warning and alarm limits)

K-Chief (Alarm Monitoring and Control, Power Management System)

BMS

ECS

PCS



OCEON





BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system
SOG: Specific Operating Guidelines

Vessel in DP mode: PMS set in specific ramp rate for producer and consumers. Running required number of producers for the operation.

ROC

K-IMS (Offshore)

Router Planner and Weather Forecast

eWSOG/ eASOG

DP Operational Forecast

Gangway Operational Forecast

Update Thruster demand based on latest weather forecast

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner

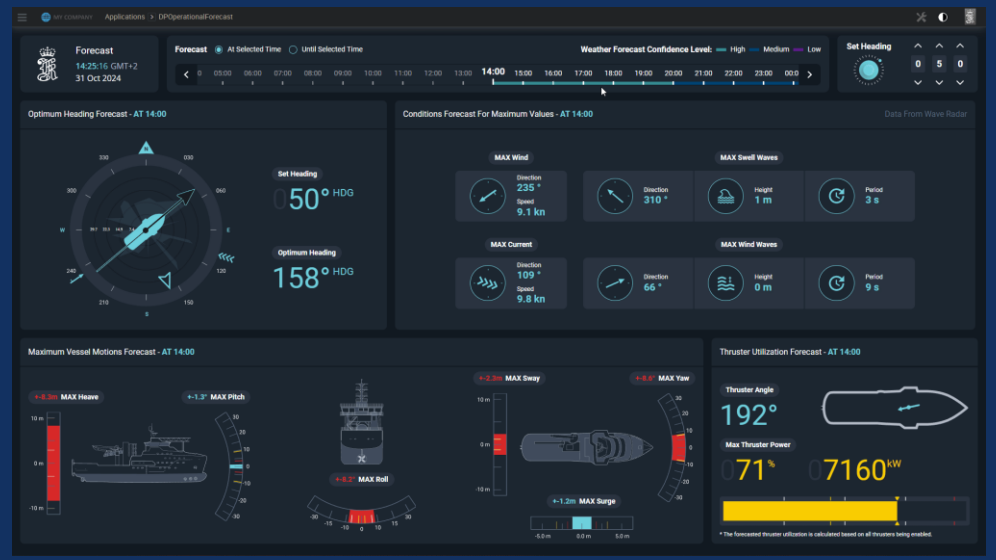
iEMS

Adjust the thruster demand for the specific time horizon



K-Pos (Vessel Response Simulator, Power Plant Advisor)

Real Time Continuous Optimization



K-Pos (Sensors, Reference Systems status, warning and alarm limits)

K-Chief (Alarm Monitoring and Control, Power Management System)

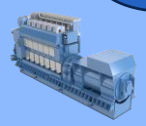
BMS

ECS

PCS



OCEON





BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system
SOG: Specific Operating Guidelines

Vessel DP Mode: PMS adjusts the ramp rate of thrusters and heavy consumers accordingly



ROC

K-IMS (Offshore)

Router Planner and Weather Forecast

eWSOG/ eASOG

DP Operational Forecast

Gangway Operational Forecast

iEMS

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner



K-Pos (Vessel Response Simulator, Power Plant Advisor)

Real Time Continuous Optimization

Adjust the consumer and producer ramp rate (kW/s) to meet demand

K-Pos (Sensors, Reference Systems status, warning and alarm limits)

K-Chief (Alarm Monitoring and Control, Power Management System)

PMS follows the iEMS advice on ramp rates

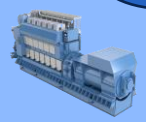
BMS

ECS

PCS



OCEON





BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system
SOG: Specific Operating Guidelines

Vessel DP Mode: PMS set a specific power and ramp limit for gangway

ROC

K-IMS (Offshore)

eWSOG/ eASOG

DP Operational Forecast

Gangway Operational Forecast

Router Planner and Weather Forecast

Update Gangway demand based on latest weather forecast

Digital Twin for machinery performance

Health Analysis (*Patent Pending*)

Energy/ Operation Planner

iEMS

Adjust the gangway demand for the specific time horizon

K-Pos (Vessel Response Simulator, Power Plant Advisor)

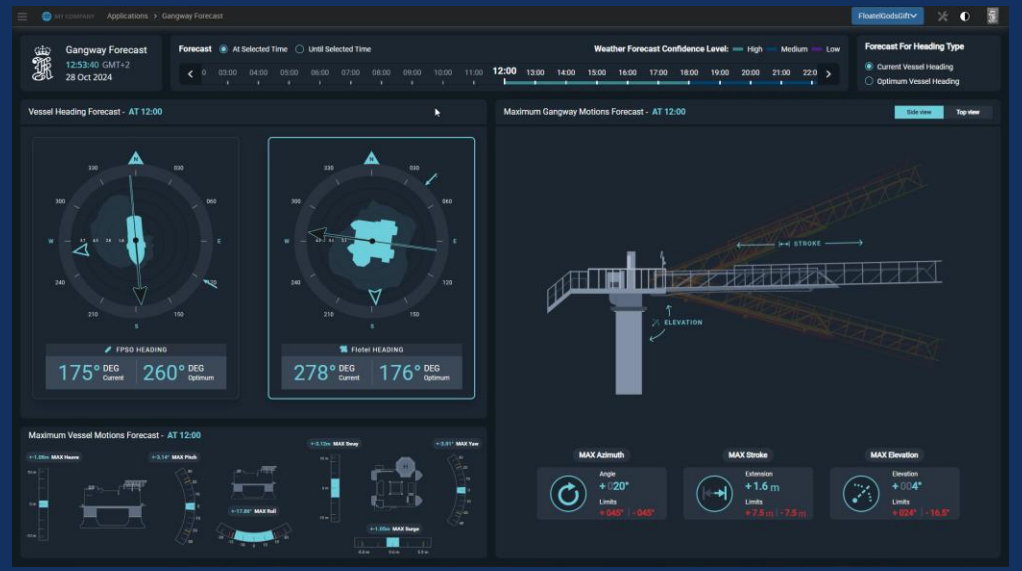
Real Time Continuous Optimization

CONTINUOUS OPTIMIZATION

PLAN

PREDICT

ADAPT



K-Pos (Sensors, Reference Systems status, warning and alarm limits)

K-Chief (Alarm Monitoring and Control, Power Management System)

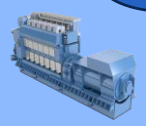
BMS

ECS

PCS



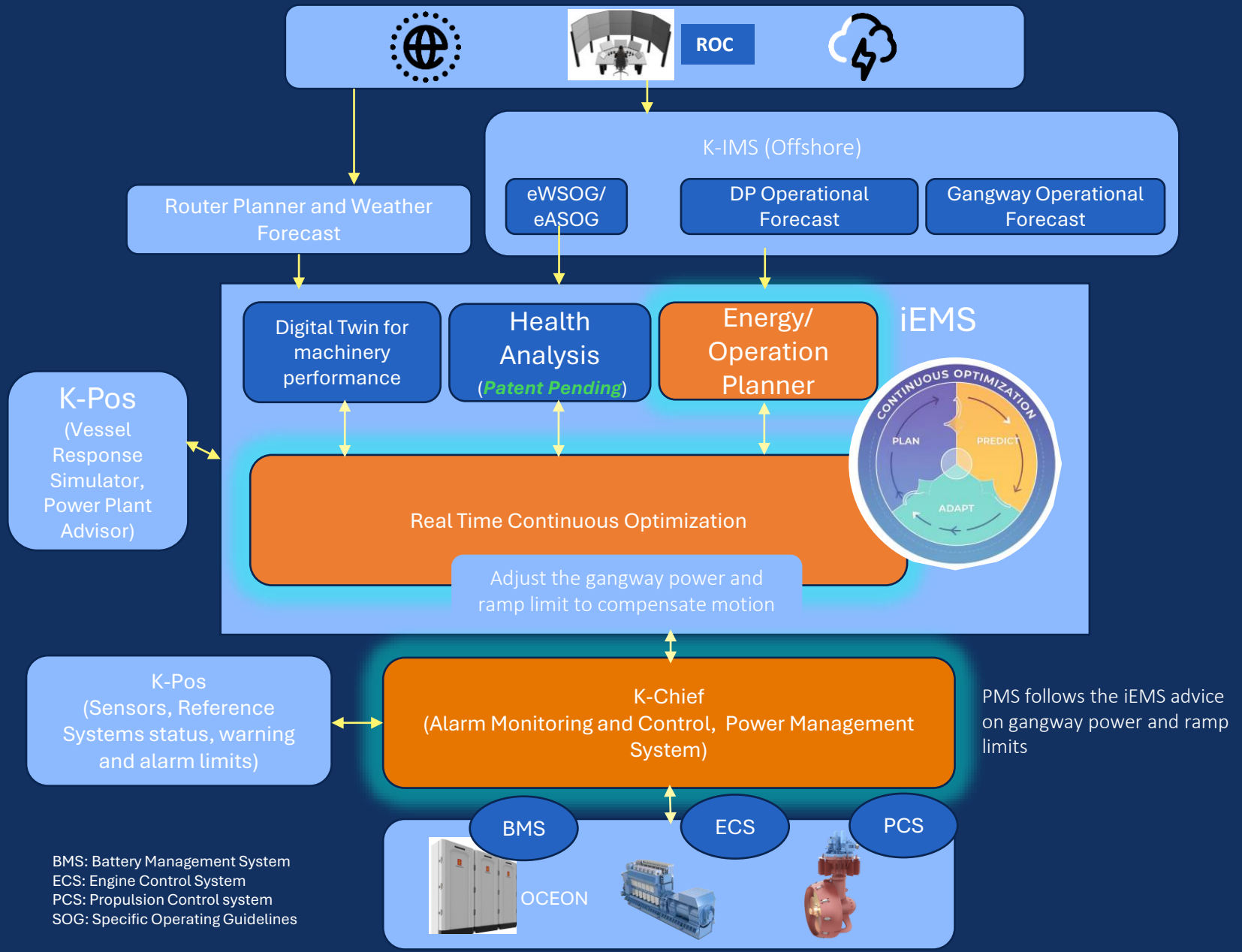
OCEON





BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system
SOG: Specific Operating Guidelines

Vessel DP Mode: PMS adjusts gangway power and ramp limits to reduce motions



PMS follows the iEMS advice on gangway power and ramp limits

Savings : ~10% in Fuel reduction

BMS: Battery Management System
ECS: Engine Control System
PCS: Propulsion Control system
SOG: Specific Operating Guidelines

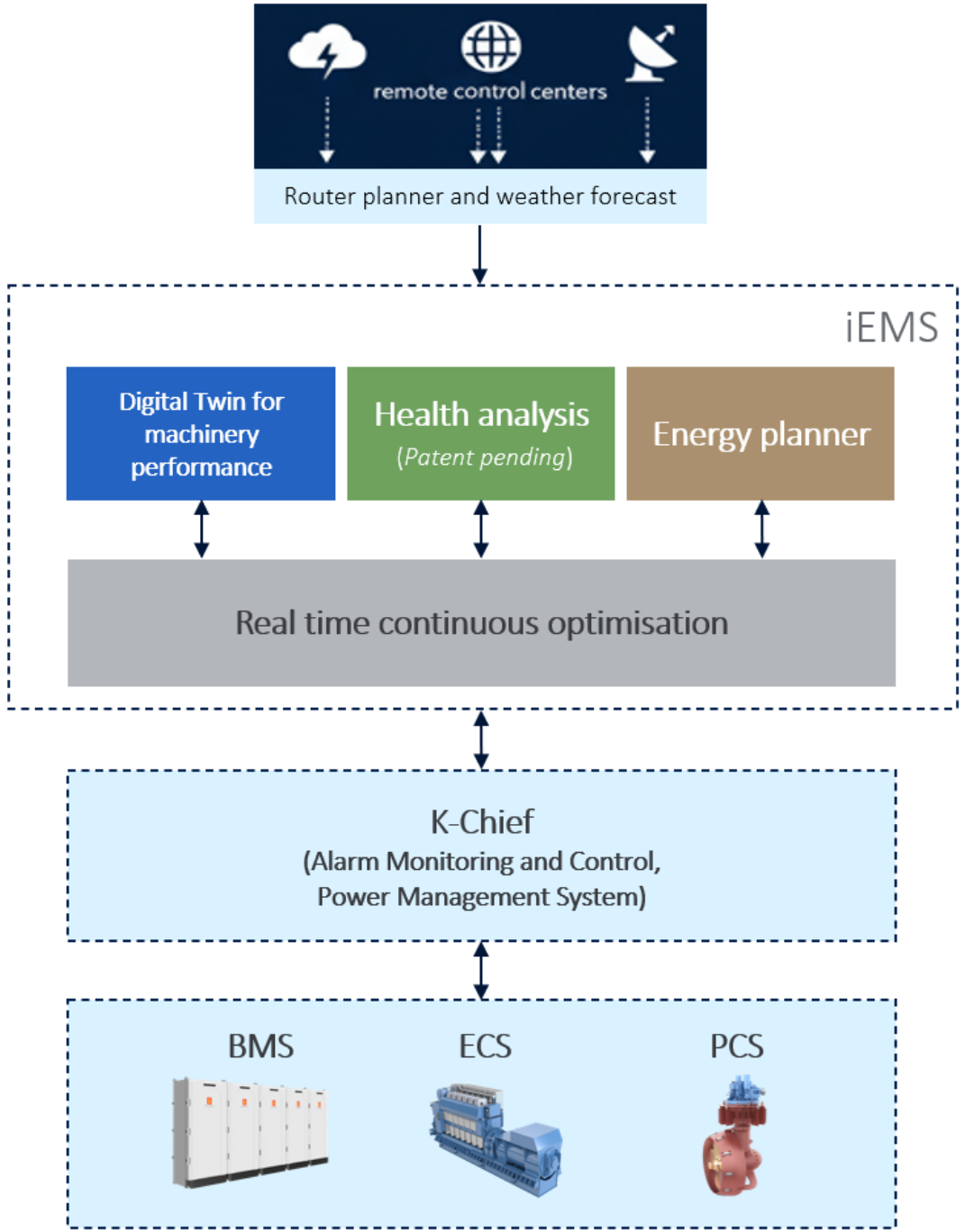
Integration

iEMS with K-Pos and K-IMS Offshore applications

- **Operational-Specific Adjustments**
  - Real-time setup changes based on eASOG/eWSOG data
  - Ensures safety and optimal efficiency
- **Forecast-Based Prioritization**
  - Thruster demand & gangway motion forecasts
  - Dynamic tuning of power limits, ramp rates, and spinning reserves
- **Dynamic Feed-Forward Prediction**
  - K-Pos thruster load feed-forward integrated
  - Stabilizes voltage/frequency and distributes load efficiently
- **Dynamic Load Compensation**
  - Inputs from mission equipment & K-Pos
  - Compensates net load increase by limiting thrusters, avoiding extra producers
- **Increased Operational Safety**
  - Complete visibility of current & future load demands
  - Enables safe, efficient planning and real-time adaptability

iEMS integration benefits

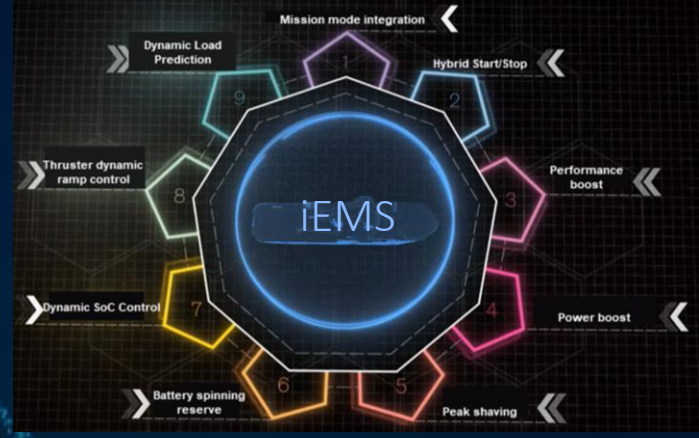
- Forecast and other predictions from Digital applications to be sent to the iEMS Energy Plan, current and planned future operations considering weather and other constraints.
- Enabling Power System to run in most efficient setup at any given time : Quantity and type of producers to run
- Providing real time visualization on KPI's : Fuel consumption and CO2 emissions compared with Optimal configuration
- Continuously adjust the load setpoints between the generators and batteries.
- Dynamic response optimalization between engines and batteries to ensure use of the cheapest electrons directly from generator when possible.
- Health optimalization on batteries and thrusters to ensure lifetime calculations and reduce mechanical stress on rotating equipment by adjusting ramps kW/s continuously.
- Optimize the power system modes based on the balancing act on how to be efficient and still be safe (also toggle drive modes to ensure fault tolerance and efficiency)
- Introducing Kongsberg Direct Drive Control on electro to ensure smooth operation, fault tolerant and linear speed / power control from bridge to propeller.

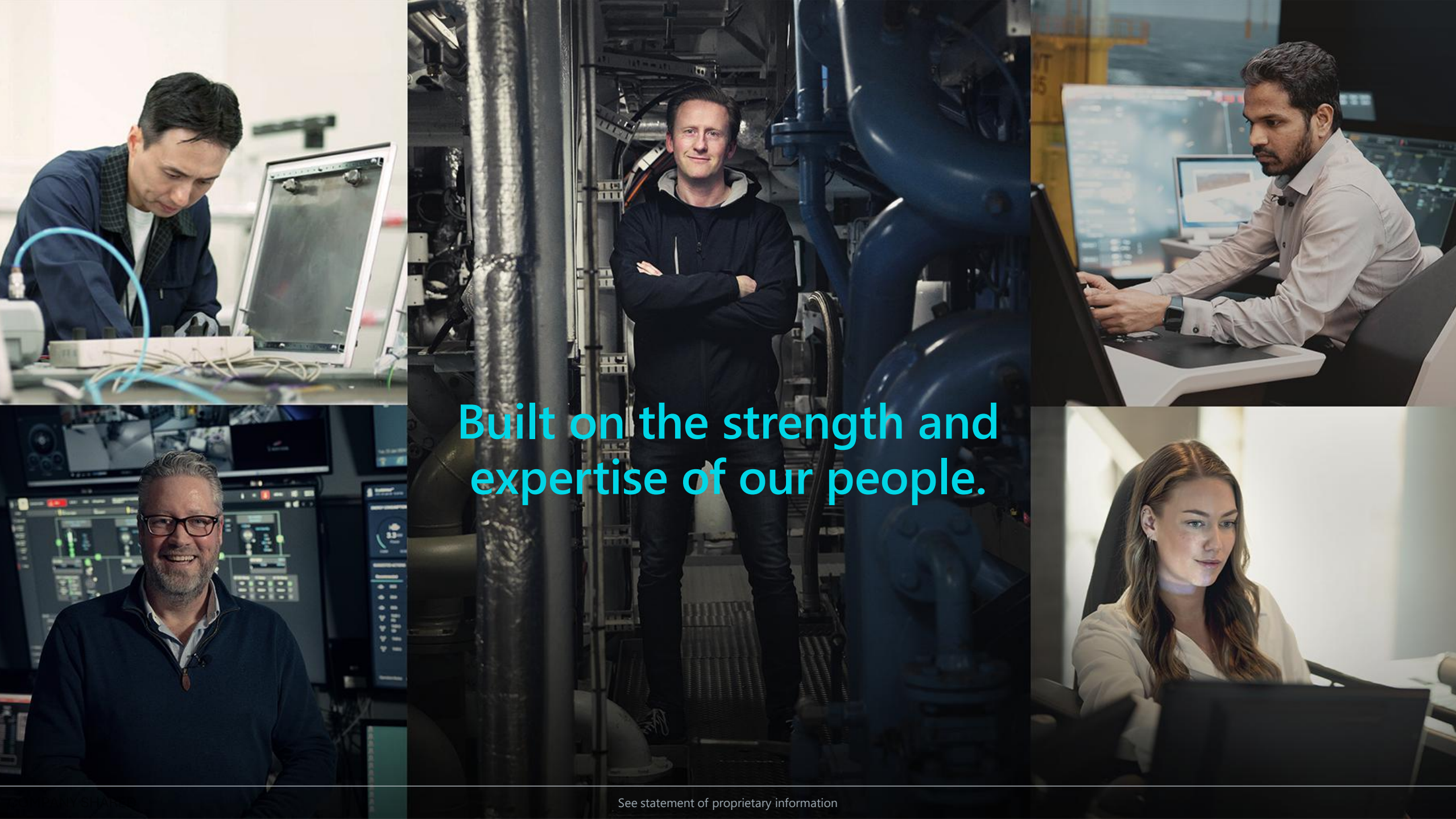


iEMS

Intelligent Energy Management System

Future Ready




Built on the strength and
expertise of our people.