SUSTAINABLE INSIGHTS:

Hybrid Power Systems in the Offshore Industry

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Hybrid Power Systems in the Offshore Industry

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Safety Moment





Hybrid Power Systems in the Offshore Industry

Journey to Sustainability

Hybrid Power Systems

ABS Solutions, Technology

Case Studies

Offshore Challenges – Journey to Sustainability

Offshore Market

- Low oil price and imbalanced oil supply and demand
- Vessel oversupply, laid up and scrapping
- Low utilization and low day rate
- Increased environmental regulations

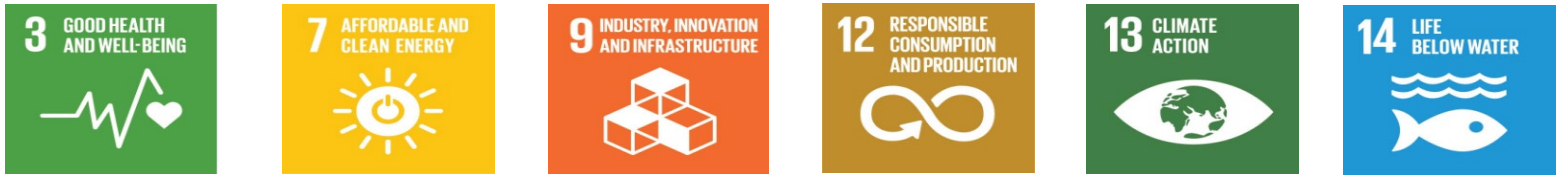
Sustainability

- Decarbonization
- New approaches to vessel design, technology and operation
- Operational efficiencies
- Other things that impact safety, security and the environment

Technology Solutions

- Alternative fuels and energy sources
- Smart to Autonomous
- Remote Survey
- Digital Solutions
- Condition-Based Survey

Sustainability



Fuels

- Alternative Fuel Adoption Strategy
- Life Cycle Cost Analysis (LCCA)
- Life Cycle Emissions Calculation and Analysis
- Fuel Outlook

Technology

- **Hybrid Electric Power**
- Techno-Economic and Feasibility Studies
- BWM Technology Evaluation
- Poseidon Principles Verification
- Vessel Human Centric Design

Operations

- Ballast Water Management
- Fleet CO_2 Benchmarking and Improvement Options
- Ship Recycling and IHM
- Operating Profile Analysis
- Sustainability Compliance Metrics

Hybrid Power Technology Enablers

Technological Advances

- Reduced cost of power electronics
- Li-Ion battery development
- DC based distribution equipment and ease of integration with ESS
- Automated energy management systems (PMS, BMS, etc.)

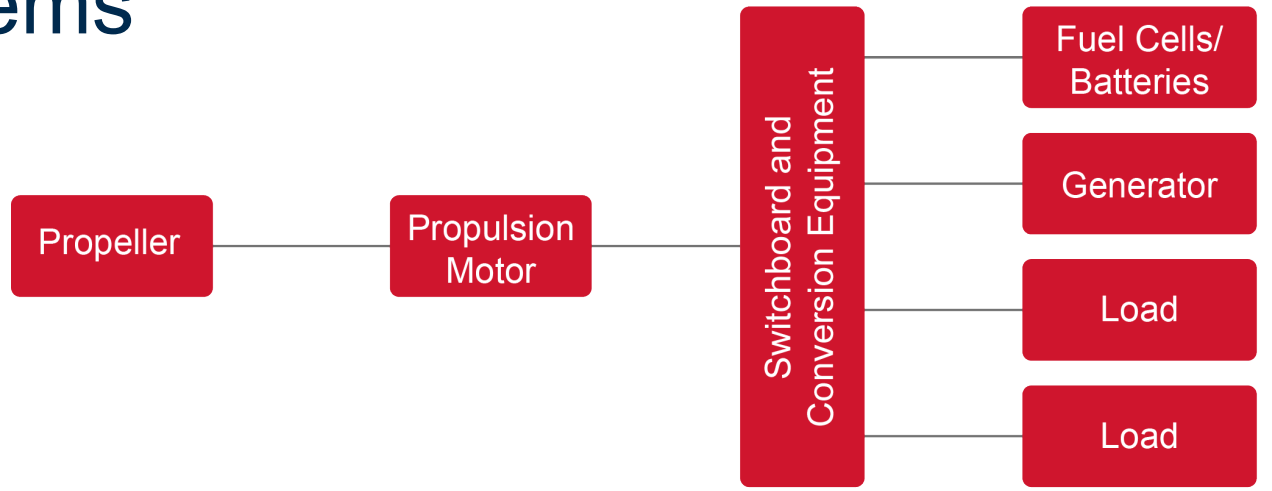
Enable

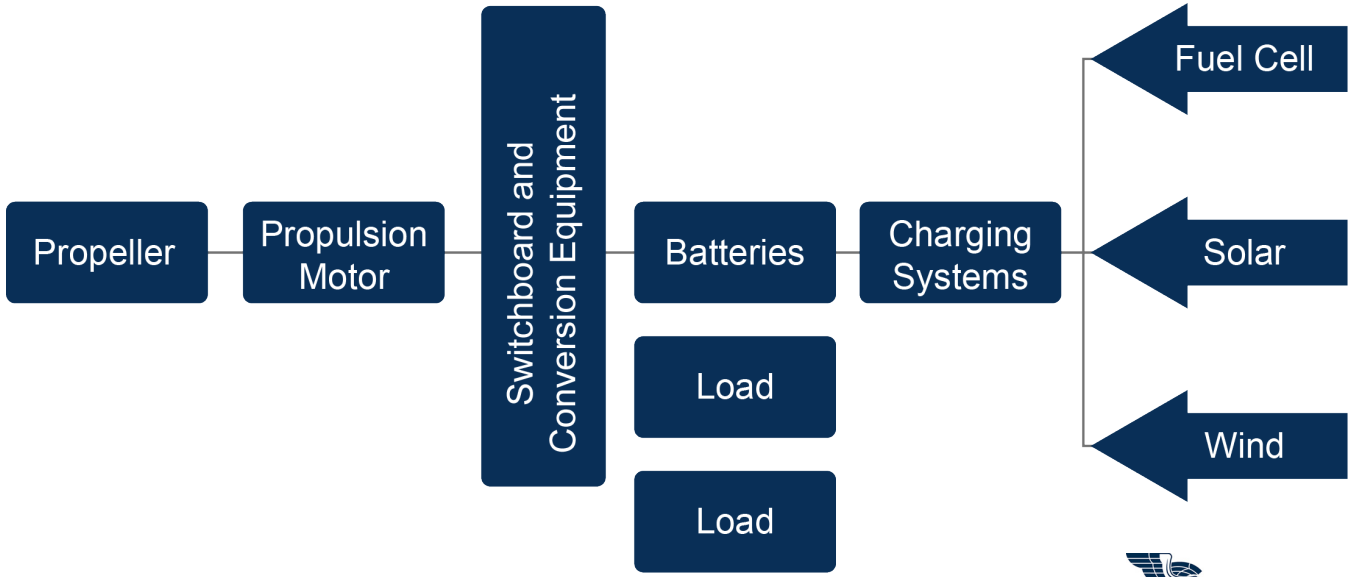
Benefits

- Fuel efficiency
- Enhanced system protection and automation
- Reduced vessel operating cost
- Improved safety and control systems
- Reduced emissions
- Weight/space savings

Hybrid Electric Power Systems

- New regulations are driving the topologies available for the operating profile of a ship
- Integration of new technologies are driving different options, including:
  - Combination of power sources: Conventional Generator, ESS, Fuel Cells, Shaft Generator
  - Energy Storage Systems: Li-Ion Batteries, Super-Capacitors





Energy Storage System (ESS) Offshore Applications

OSV

Full Integration Includes

- Energy Storage System
- Energy Control System
- Dynamic Positioning System
- Automation System

Potential Benefits

- Assisting to meet the stringent emission regulations
- Reduction in operational costs
- Improving safety

Dynamic Positioning

- Station keeping by Dynamic Positioning
- Large spinning reserve required (extra power to keep position)

Drilling Loads

- Significant power consumption for drilling system
- Maintaining continuity of power to the drilling system is critical
- Potential sources in lieu of spinning reserve

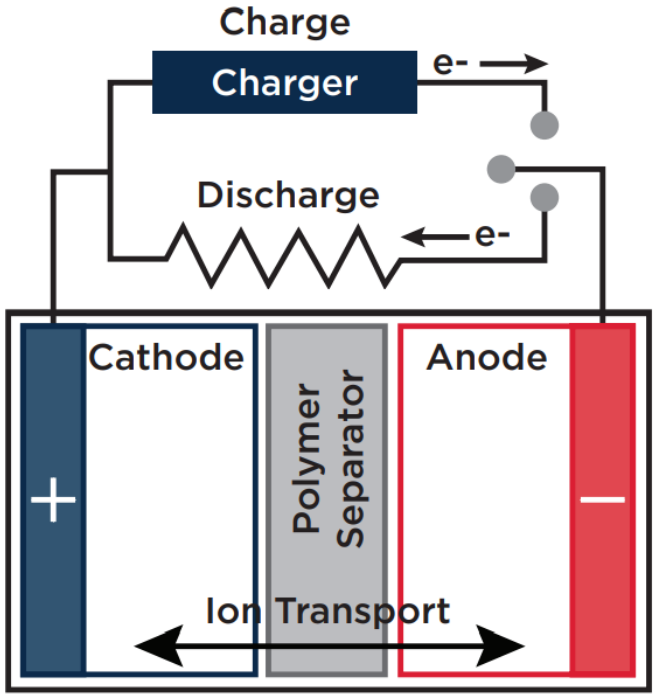
Lithium-ion Batteries

Advantages

- Higher specific energy (Wh/kg) when compared to other battery types
- Higher cycle life (impacted by depth of discharge)
- Lightweight
- Faster charging (lower internal resistance)
- Comparatively low self-discharge and maintenance
- Zero to low memory effect

Challenges

- Limited Energy Density compared to conventional fuels
- Risk of thermal runaway event
- Increased upfront cost
- Increased temperature sensitivity
- Complicated monitoring and protection circuits
- Restrictions on transportation
- Efficiency losses through recharging
- Limited Power Delivery Capacity



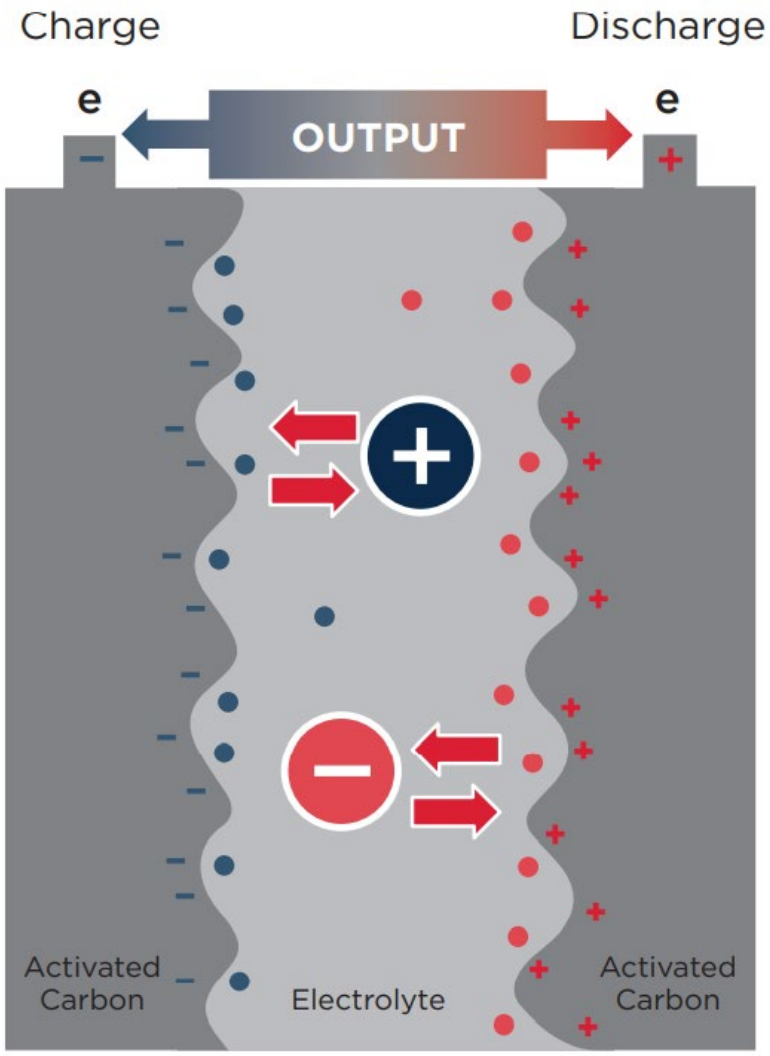
Supercapacitors

Advantages

- Cycle life
- High specific power
- Fast charging and discharging
- Easy charging without overcharge protection
- Safety
- Outstanding low-temperature charge and discharge performance
- Reduced load variations
- Improved system stability
- More fuel-efficient operations:

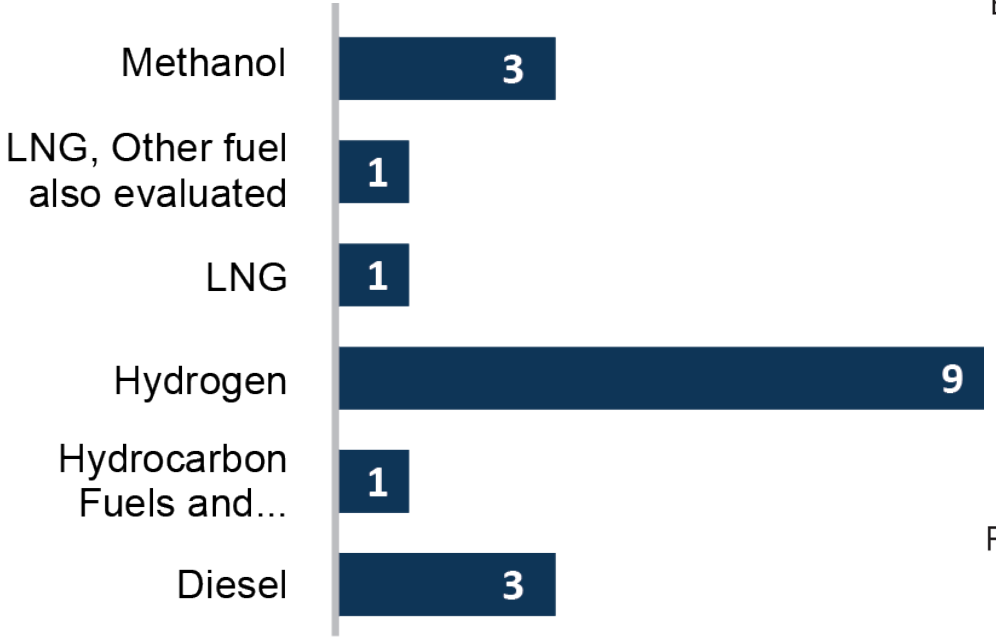
Challenges

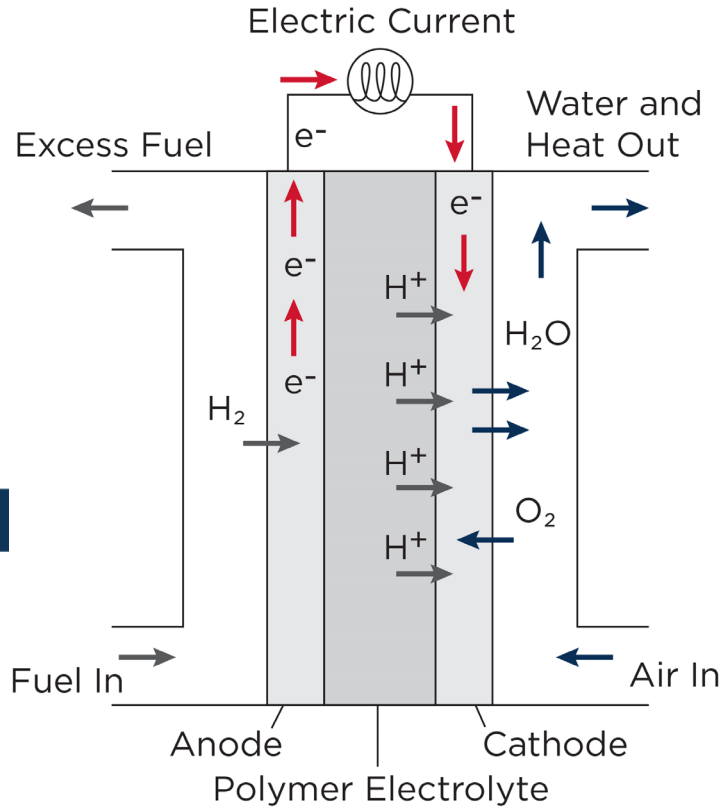
- Low energy density
- High self-discharge rate
- Low voltage/capacitor



Fuel Cells

- **Advantages**
  - Energy Efficient
  - Low to Zero Emissions
  - Refueling vs Recharging
  - Reduced Noise
- **Challenges**
  - Cost
  - Weight
  - Complexity
  - Bunkering availability and safety





Benefits of Hybrid Power Applications

Environment

- Reduce CO_2 emission
- Reduce NOx emission
- Compliance w/emission regs in SECAs

Design

- Built-in redundancy
- All-in-one power module
- Safety response to emergency scenarios (backup)

Operations

- Optimal engine loads
- Instant backup/load taking
- Less engine running hours
- Auto-optimization by EMS

Operational Costs

- Lower fuel consumption
- Lower maintenance costs

Case Studies

SEACOR Maya

- Retrofit with Hybrid Battery
- Reducing Fuel Consumption by 20%

Harvey Energy

- Dual Fuel Engine
- Modular Battery System

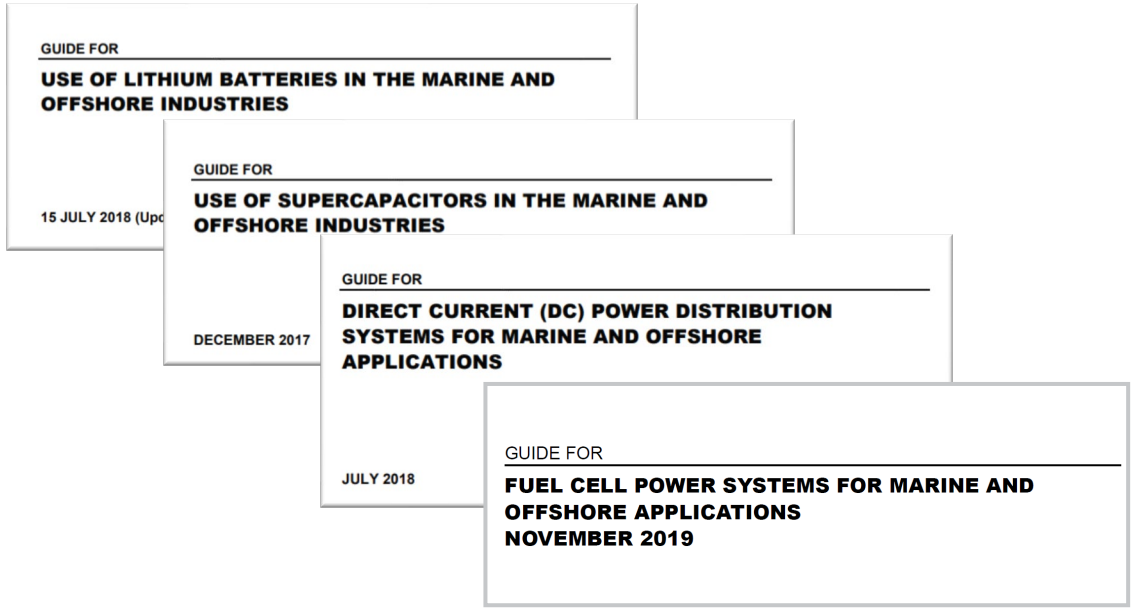
ABS Hybrid Solutions

Overview

- ABS Hybrid Advisory, 2017

Energy Storage

- ABS Lithium Battery Guide, April 2017
- ABS Supercapacitor Guide, Dec. 2017



Energy Distribution

- DC Distribution Guide, June 2018

Energy Generation

- Fuel Cell Guide, Nov. 2019
- Wind
- Solar

ABS and Sustainability

- Setting the Course to Low Carbon Shipping
  - Low Carbon Shipping Outlook
  - Pathways to Sustainable Shipping
- Current initiatives to support the industry's journey toward a sustainable future:
  - Studying the viability of alternative fuels and new energy sources in different maritime sectors
  - Analyzing decarbonization pathways, the impact of seaborne trade growth and IMO targets on new designs
  - Applying digital technology to simplify transactions and increase operational efficiency
  - Certifying, verifying and validating: EEDI, IMO DCS, EU MRV, IHM, carbon footprint and new technologies
- Safety remains a top priority as industry addresses challenges in transition to a low-carbon economy

Additional Resources

Title	Link
ABS Advisory On Hybrid Electric Power Systems	https://ww2.eagle.org/ABS_Hybrid_Advisory_17033.pdf
ABS Guide for use of Lithium Batteries	https://ww2.eagle.org/lithium-batteries-guide-aug18.pdf
ABS Guide for use of Supercapacitors	https://ww2.eagle.org/Supercapacitors_Guide_e-Dec17.pdf
ABS Guide for Direct Current (DC) Power Distribution Systems	https://ww2.eagle.org/DC_Power_Guide_e-July18.pdf
ABS Guide for Fuel Cell Power Systems	https://ww2.eagle.org/fuel-cell-nov-2019.pdf

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