



**SHIP EFFICIENCY 2017**

by STG

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Presentation on:

## Hybrid approaches for onboard power generation and propulsion drives

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The German Society for Maritime Technology  
Schiffbautechnische Gesellschaft e.V.

# Hybrid approaches for onboard power generation and propulsion drives

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## AGENDA

**SIEMENS**

Introduction Siemens Marine Solutions / market trends

Hybrid Solutions

BE-Solutions

Emission reduction

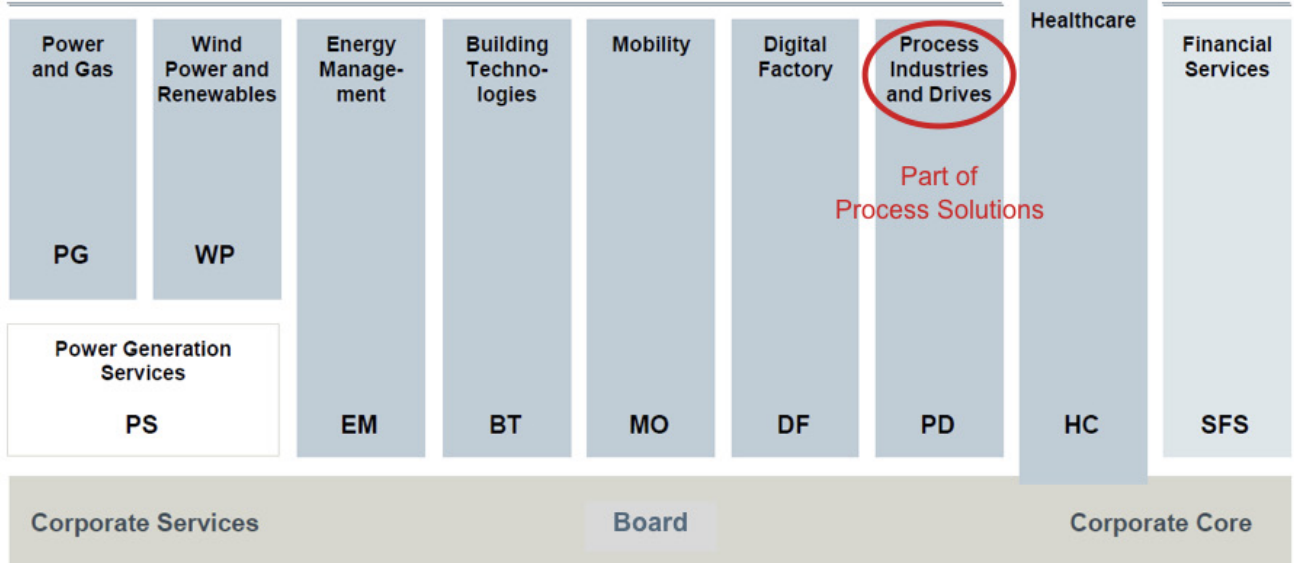
Alternative Energy sources /fuel cells /solar power

EES (electric energy storage systems)

Electric Grids of the future

# Siemens Global Organization

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## The new business unit PD SLN at a glance: Market-oriented verticals and unified execution unit (OEC)

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### Overview of the BU PD Process Solutions (PD SLN)

|           |                                  |  |                |        |   |                 |               |
|-----------|----------------------------------|--|----------------|--------|---|-----------------|---------------|
| Verticals | Drives & Automation Offshore     | Drives & Automation Onshore  | Fiber Industry | Marine | Minerals  | Water Solutions |               |
|           |                                  |  |                |        |   |                 |               |
|           |                                  |  |                |        |   |                 |               |
|           | Operation and Engineering Center |  |                |        |   |                 | Own execution |
|           |                                  |  |                |        |   |                 |               |
|           | Facts and figures                | <b>PD SLN value proposition</b> <ul style="list-style-type: none"> <li>The Process Solutions BU offers its clients comprehensive industry-specific systems, solutions and lifecycle services based on innovative products</li> <li>Technical core competencies: Automation, drives, process-critical electrification, telecom</li> </ul> |                |        | <b>Key facts</b> <ul style="list-style-type: none"> <li>Revenue with Service 2015: 1'590 EUR</li> <li>Employees with Service 2015: 5.824 FTE</li> <li>Global setup: Business in more than 40 countries</li> </ul> |                 |               |

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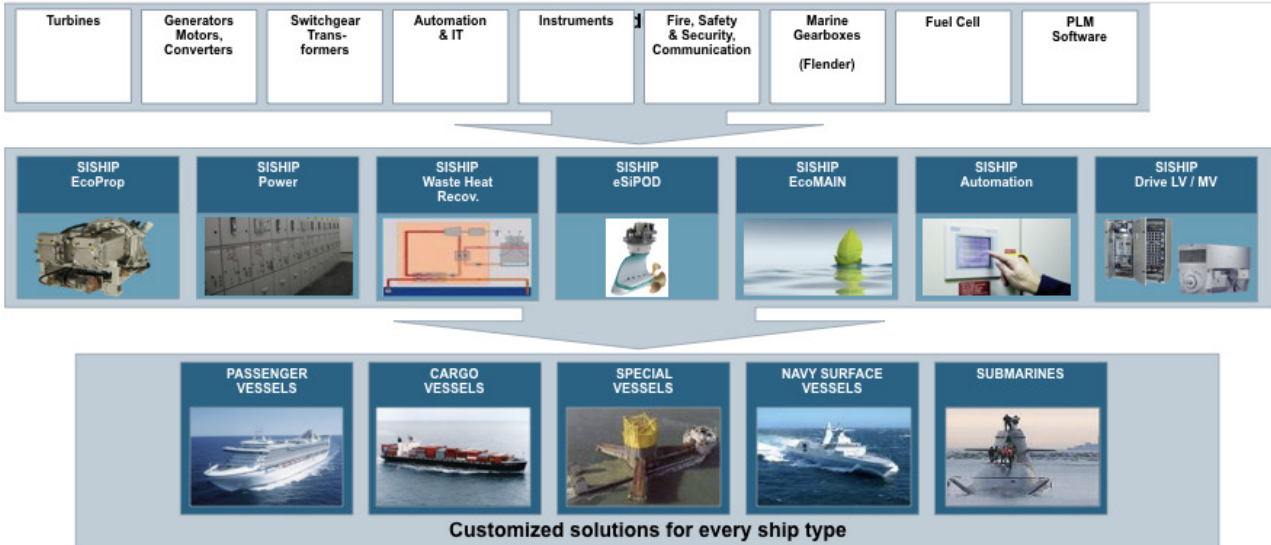


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## Unique "Products" and "Systems" Lever for Customized Solutions

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## Siemens Marine Trends of the Marine & Shipbuilding Industry

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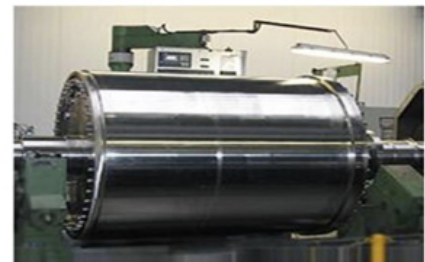
### Global mega trends

- Increased transportation
- Need for environmental care and renewable energy
- Demand for efficient transportation, thus for reliability, availability, predictive maintenance and service



### Customers & their markets

- Continuing customer consolidation
- Demand for environmental friendly solution
- Demand for offshore support, wind park installation and harsh environment operation and exploration



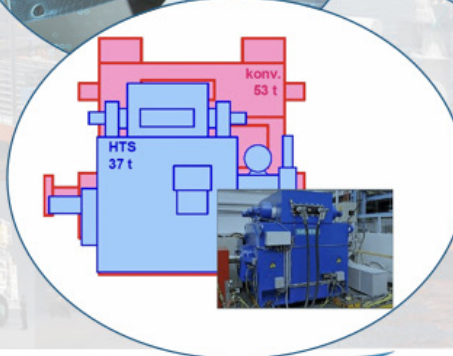
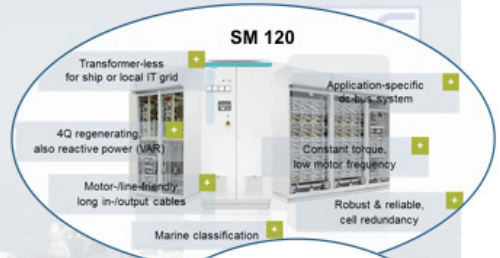
### Technological trends

- Technologies for green solutions and emission reduction
- High expectations regarding availability in operations, efficient management for ships and systems

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**Hybrid Solutions / Definition in this context**

**Hybrid Propulsion**

*Hybrid propulsion is the technical term for propulsion systems which are the combination of a mechanical, an electric propulsion and the service system – however holistically integrated.*

**Some key indicators for potential hybrid propulsion candidates:**

- Big variations in propulsion- and service power demand
- Max. power demands for prop. and service systems are not simultaneous
- The max. service power demand does not justify an all electric concept
- The propulsion power is to satisfy very different operating conditions
- Significant amount of low propulsion power demand, combined with a propulsion concept featuring a booster function

## Hybrid Solutions / Definition in this context

## Hybrid E-power generation

- Integration of different energy sources into a common grid
- Usage of renewable and environmentally friendly power sources
- Usage of shore power for supply and charging of batteries
- Integration of battery banks or ultra caps or mechanical storage devices
- Decentralized power generation (fire zones)

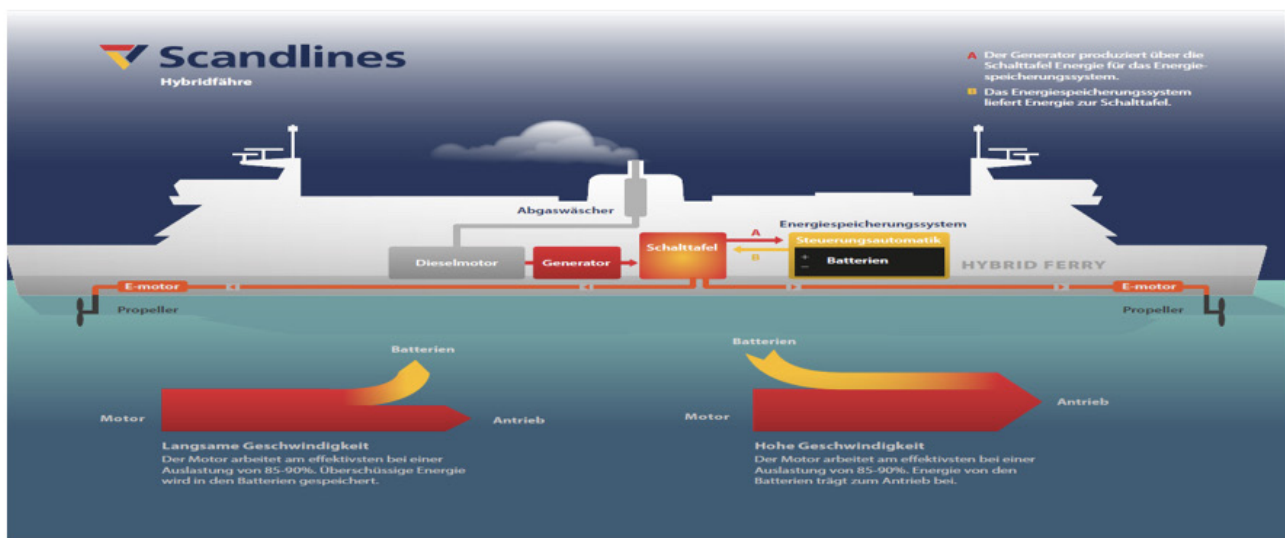
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## Prinsesse Benedikte



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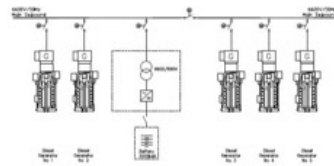


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## ESS-Scandlines fuel saving 1.2 mill kg per year

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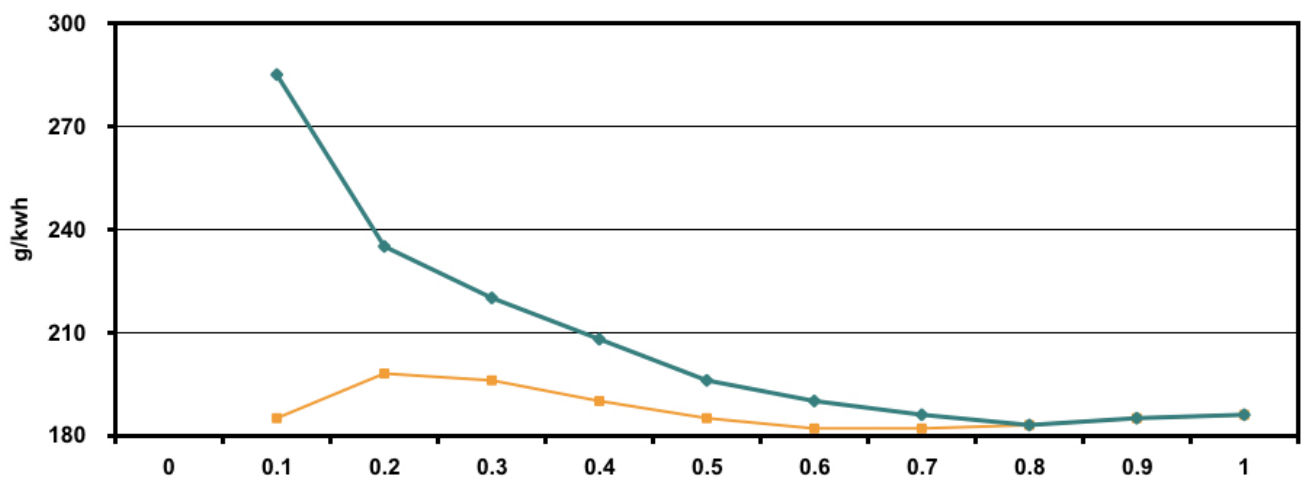


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## BLUEDRIVE PlusC Diesel with fixed speed versus variable speed

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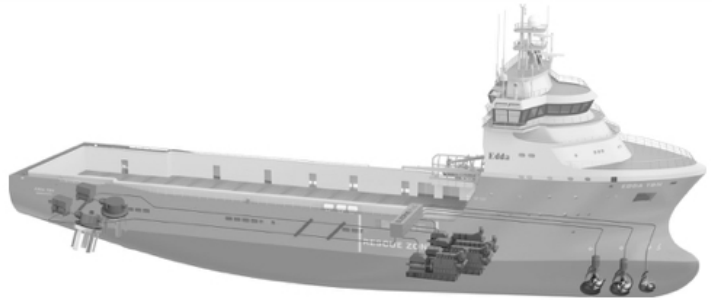
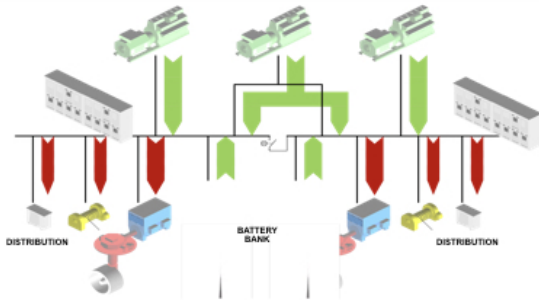
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## Solutions for medium propulsion power demands



### Key feature

- DC Power Network
- Variable Speed of Generators
- Easy Integration of alternative energy sources
- Completely Integrated Electrical System

### Customer benefit

- Improved overall efficiency
- Improved flexibility in terms of alternative energy sources
- Highest redundancy
- Extended maintenance intervals for main engines

### Scope of supply

- SINAMICS S120 LC Frequency Converter
- Power Management / Power Plant Protection
- Batteries
- LV Propulsion Motors / Generators

### Environmental benefit

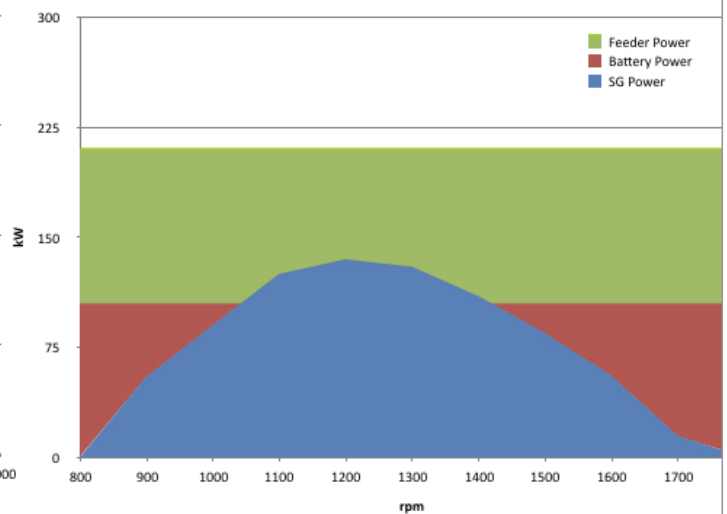
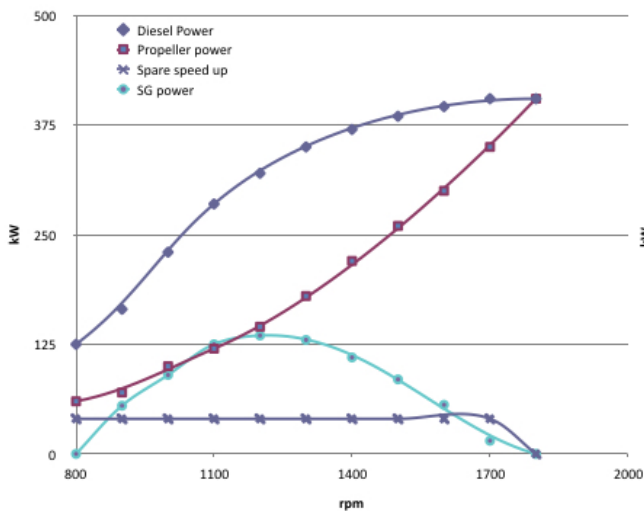
- Reduction of fuel consumption in all operating conditions
- Reduction of CO<sub>2</sub>
- Zero Emission Operation



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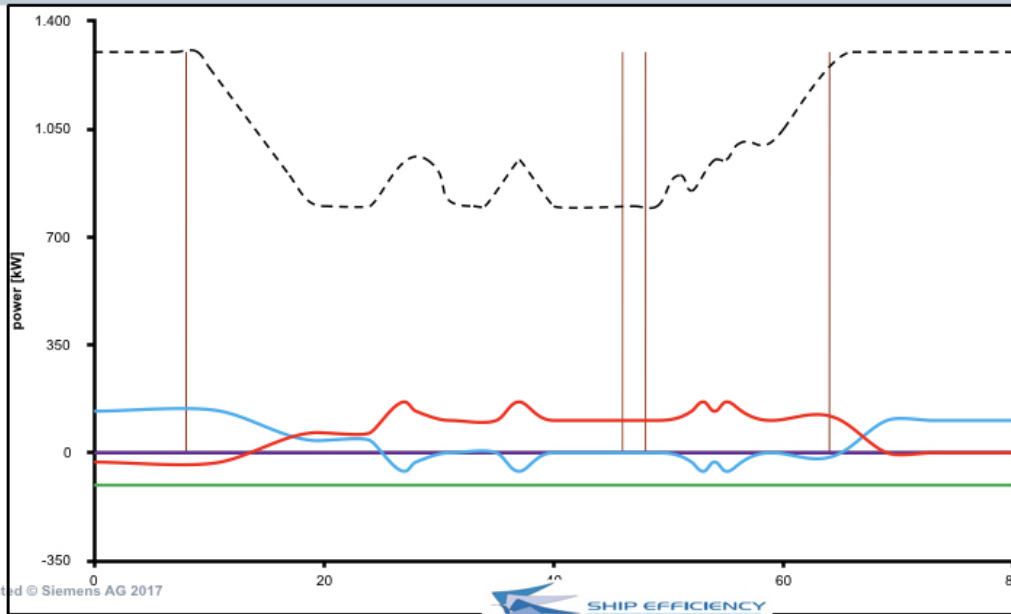
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## Diesel power and shaft generator analysis





Analysis - Scenario II - Power analysis (half system)



| Legend |  |
|--------|--|
| —      | battery [kW]   |
| ---    | propulsion diesel speed [rpm]                            |
| —      | consumer (Bordnetz) [kW]                                 |
| —      | shaft machine as -booster motor or -shaft generator [kW] |
| —      | aux diesel [kW]  |

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SISHIP WHR + Boost  
Maersk Class EEE – Class Container Ships



already more than 30 ships running with WHR



**Environmental value** • Reduction of air pollution (NOX, SO<sub>2</sub> etc.)

**Project Operator Building Yard Load capacity**

- EEE-class; 20 vessels
- AP Moeller Maersk, Denmark
- DSME / Korea
- abt. 18.330 TEU

**Scope of supply**

- Booster & Converter & Transformer: 2 x 3 MW (2 shafts)
- Power Management System
- Waste Heat Recovery Control system
- Introduction of EcoMAIN on container vessels

**Customer benefit**

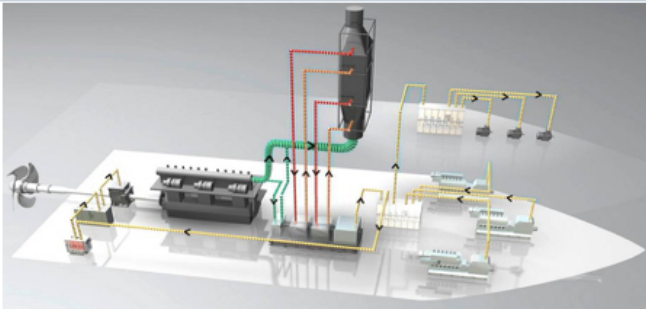
- Reduced fuel consumption
- Reduced footprint
- Excellent station -keeping and sailing performance
- High operational availability

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## Hybrid Drives and Waste Heat Recovery Systems SISHIP WHRS

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### Key feature

- Gearless Boost Motor supporting Main engine
- Boost operation during Ice condition
- Utilization of recovery energy from exhaust gas
- Emergency or take home drive
- Shaft generator function

### Customer benefit

- More efficient generation of E-power via main propulsion
- Less running hours of Gensets
- Less installed ME power
- Use of surplus power from WHRS (PTI)
- Less operating costs

### Scope of supply

- State of the art Sinamics Inverter
- Salient mounted poles on ME- shaft
- Power Management & Propulsion control system

### Environmental benefit

- Significant reduction of CO2
- Up to 12% reduction in fuel consumption
- 1% increase of overall main engine efficiency



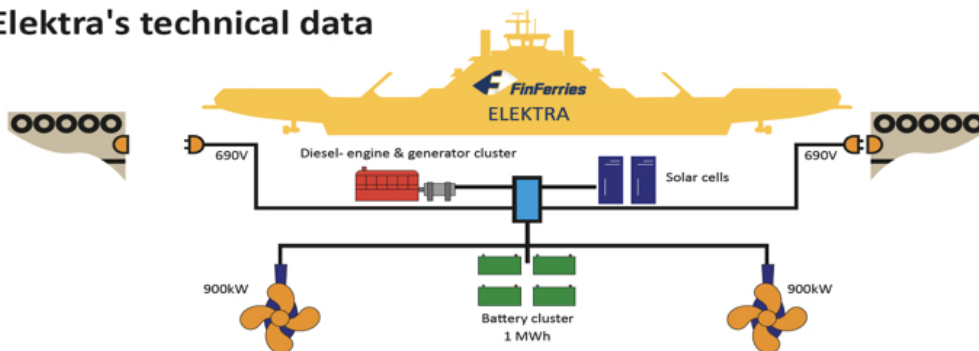
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## BE-Solution / Finn Ferries

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### Elektra's technical data



|                          |             |
|--------------------------|-------------|
| Length over all          | 97,92 m     |
| Breadth moulded          | 15,20 m     |
| Draught                  | 3,55 m      |
| 5 lanes, length of lanes | 450 m       |
| Passenger + crew         | 375 persons |

|                        |             |
|------------------------|-------------|
| DWT                    | 525 t       |
| Cars                   | 90          |
| Propulsion power       | 2 x 900 kW  |
| Batteries all together | 1 MWh       |
| Diesel generators      | 3 x 420 kWe |

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BE- solutions / Norledge



80 m Length  
120 Cars  
360 Passengers  
2 x 450 kW Propulsion

34 trips/day  
365 day/a  
20 minutes/ trip  
1 minute locking / 9 minutes charging

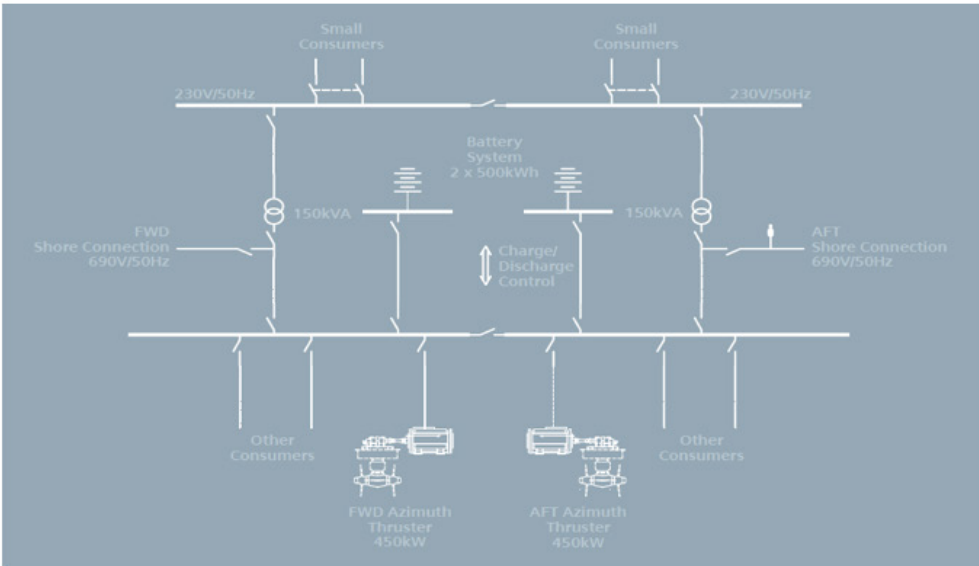
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BE-Solutions / typical single line diagram



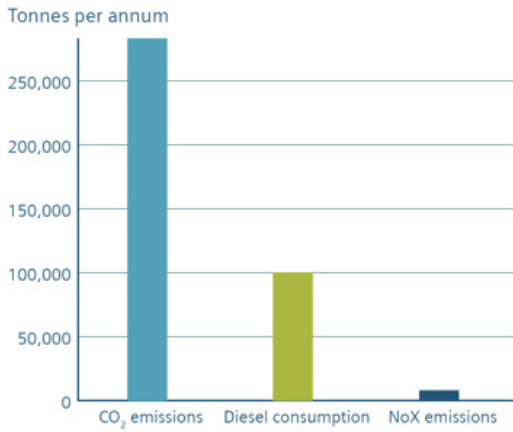
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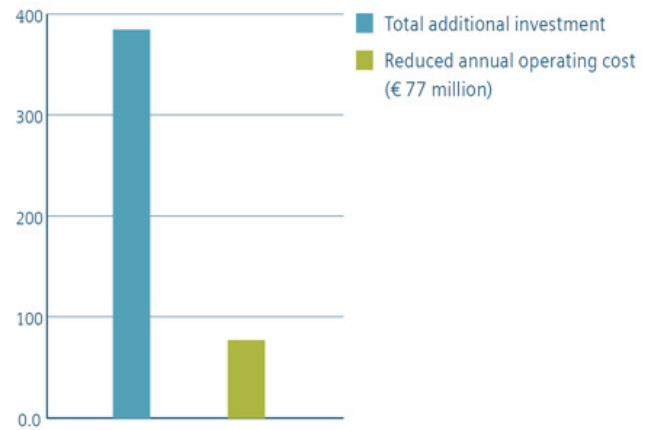
## Emission reduction

EMISSION REDUCTIONS FROM BATTERY-POWERED OR HYBRID FERRIES COMPARED TO DIESEL-DRIVEN FERRIES



ADDITIONAL INVESTMENT REQUIRED WITH BATTERY

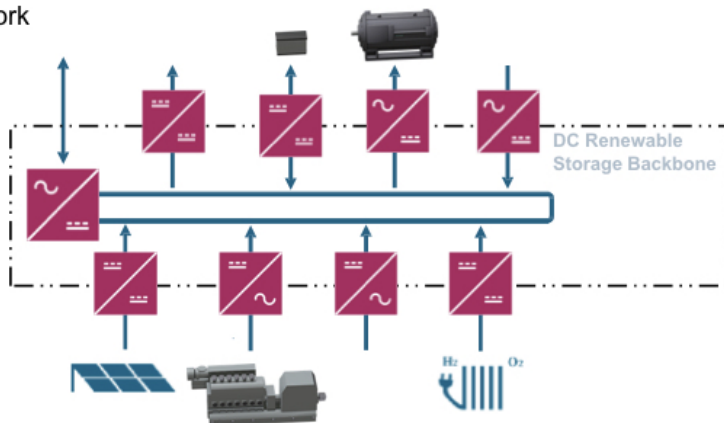
OPERATION Amounts in € (million)



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## Alternative Energy Sources / fuel cells / solar power

Ships Main-MV AC network



### DC-RSB

#### DC Renewable Storage Backbone

Combination of different sources and

Optimized energy transportation over DC Link

Bidirectional Energy-management between sources and consumers

Scalable for different functions

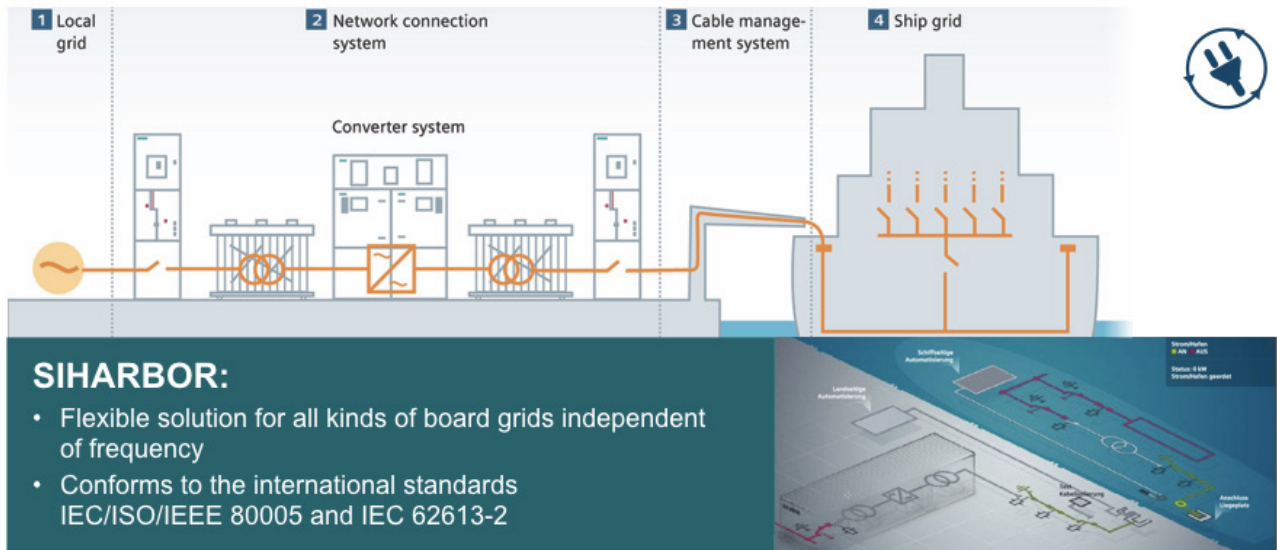
Solution based on proven industry products

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# SIHARBOR – Shore-side power supply for eco-friendly ports

## System description with frequency conversion

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### SIHARBOR:

- Flexible solution for all kinds of board grids independent of frequency
- Conforms to the international standards IEC/ISO/IEEE 80005 and IEC 62613-2

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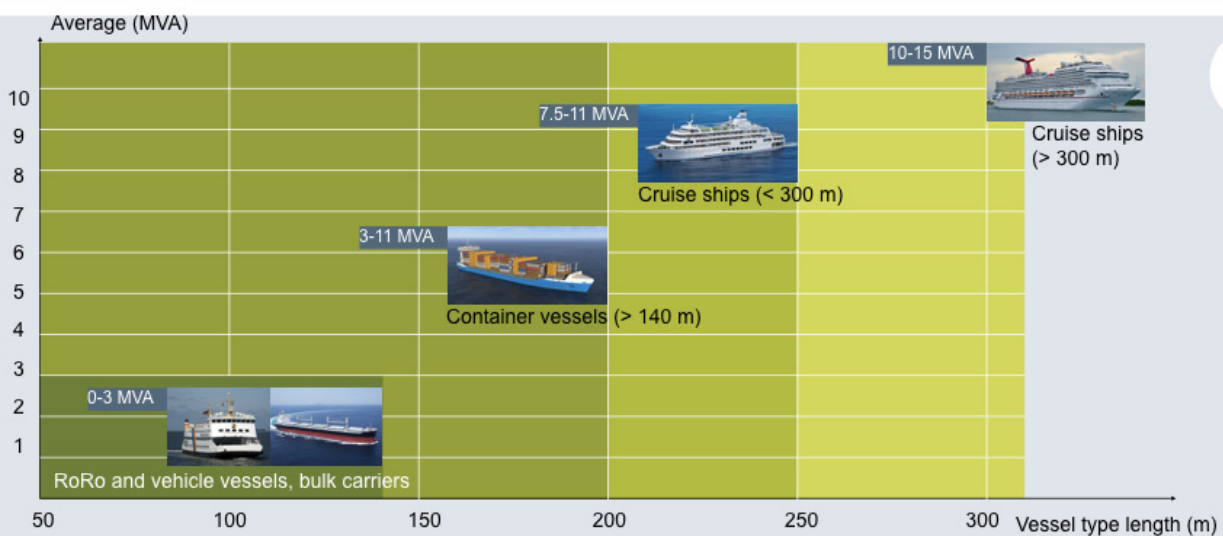
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# SIHARBOR – Shore-side power supply for eco-friendly ports

## Versatility of application for a large variety of ships

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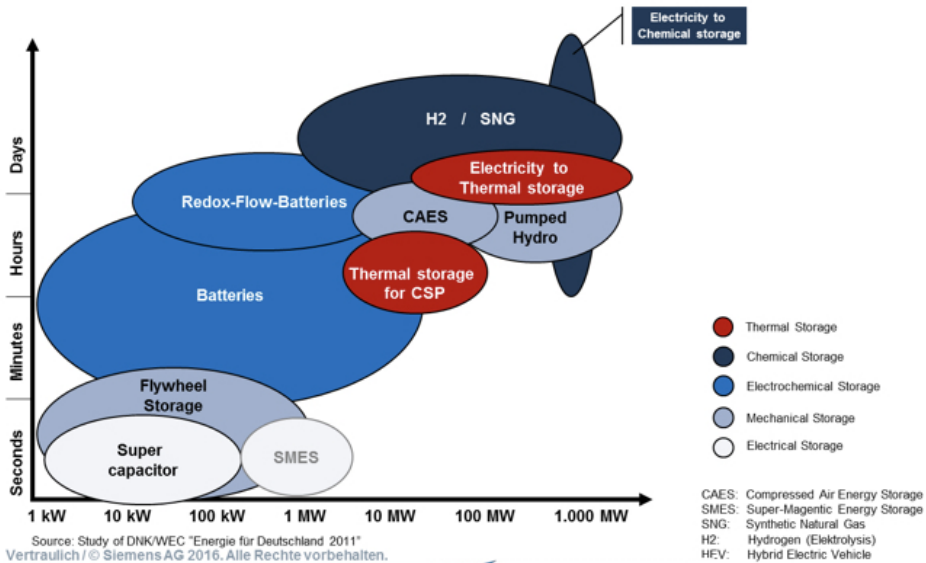
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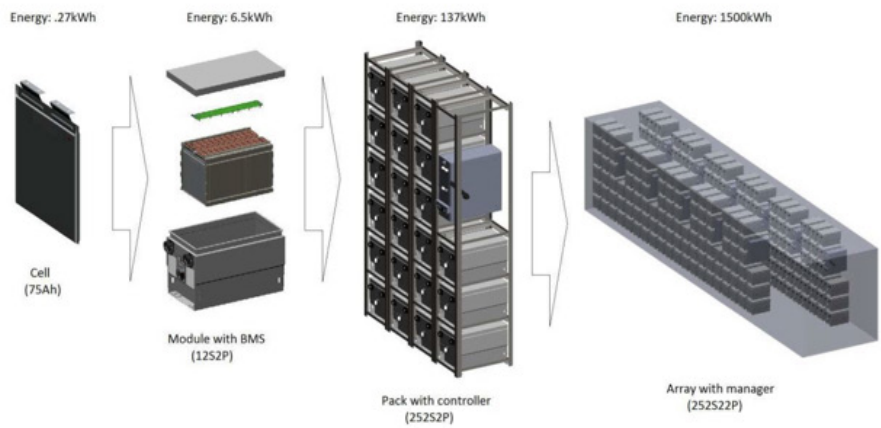
# Overview – energy storage systems



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# Battery build up

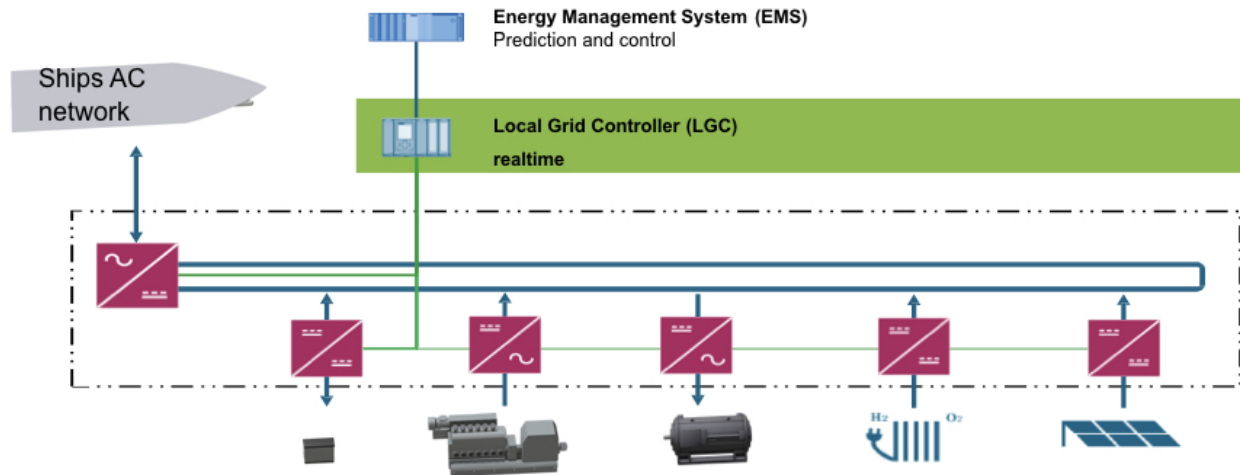


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## Electric grid of the future

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## Thank you

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