MARITIME

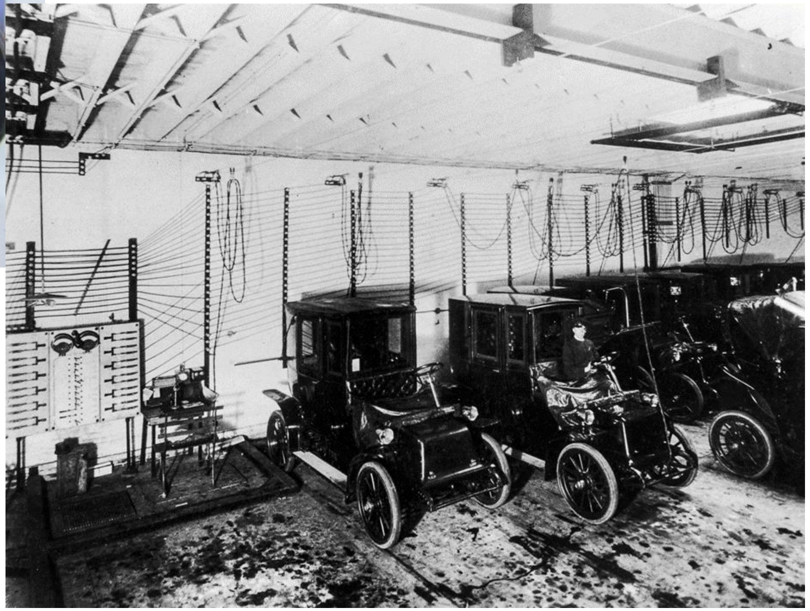
Are batteries an option in shipping?

An intro to batteries in maritime

Dr Gerd Wuersig

22 January 2019

Batteries are a revolutionary new tech that has just been invented...?



- Detroit Electric
  - Produced by Anderson Electric Car Company
  - Nickel-iron battery
  - Range advertised: 130 km
    - Record one charge: 340 km
    - (top speed abt 32 km/hr ☺)
  - Year: 1911 – 1916
    - Produced until 1939

Alternative Fuels Insight
LNG
afi.dnvgl.com

DNV·GL

Alternative Fuels Insight

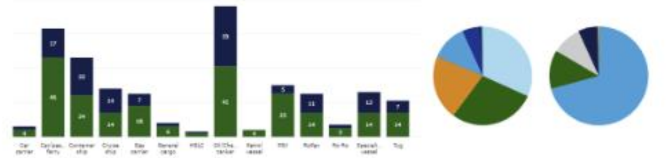
Home | Map | Statistics | Fuel Finder | Fuel Selector | Encyclopedia | Supporters | Contribute | Contact us

Welcome to DNV GL's Alternative Fuels Insight platform

Map

Explore the development of bunkering infrastructure for alternative fuels. You can also see where ships using alternative fuels and technologies are already operating.

Statistics



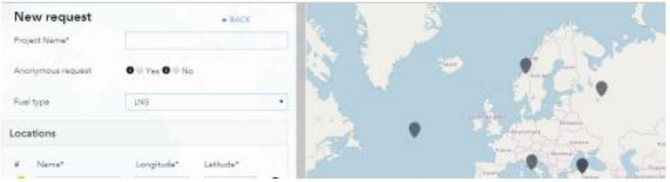
Get detailed insights to the uptake of alternative fuels and technologies on ships. Filter on ship types, region, technology and more to create your own graphs.

Supporters

The AFI platform is made possible by co-funding from our supporters.

They include industry pioneers and market leaders who see the importance of alternative fuels in the maritime industry. Here you can learn more about them and get in touch with their experts.

Fuel Finder

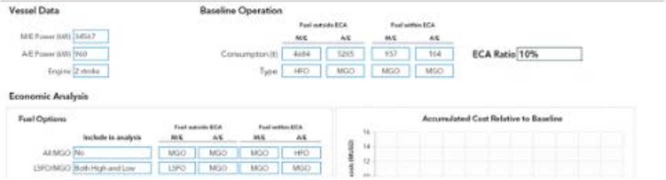


Connect instantly with suppliers of alternative fuels by submitting your own bunker request.

Encyclopedia

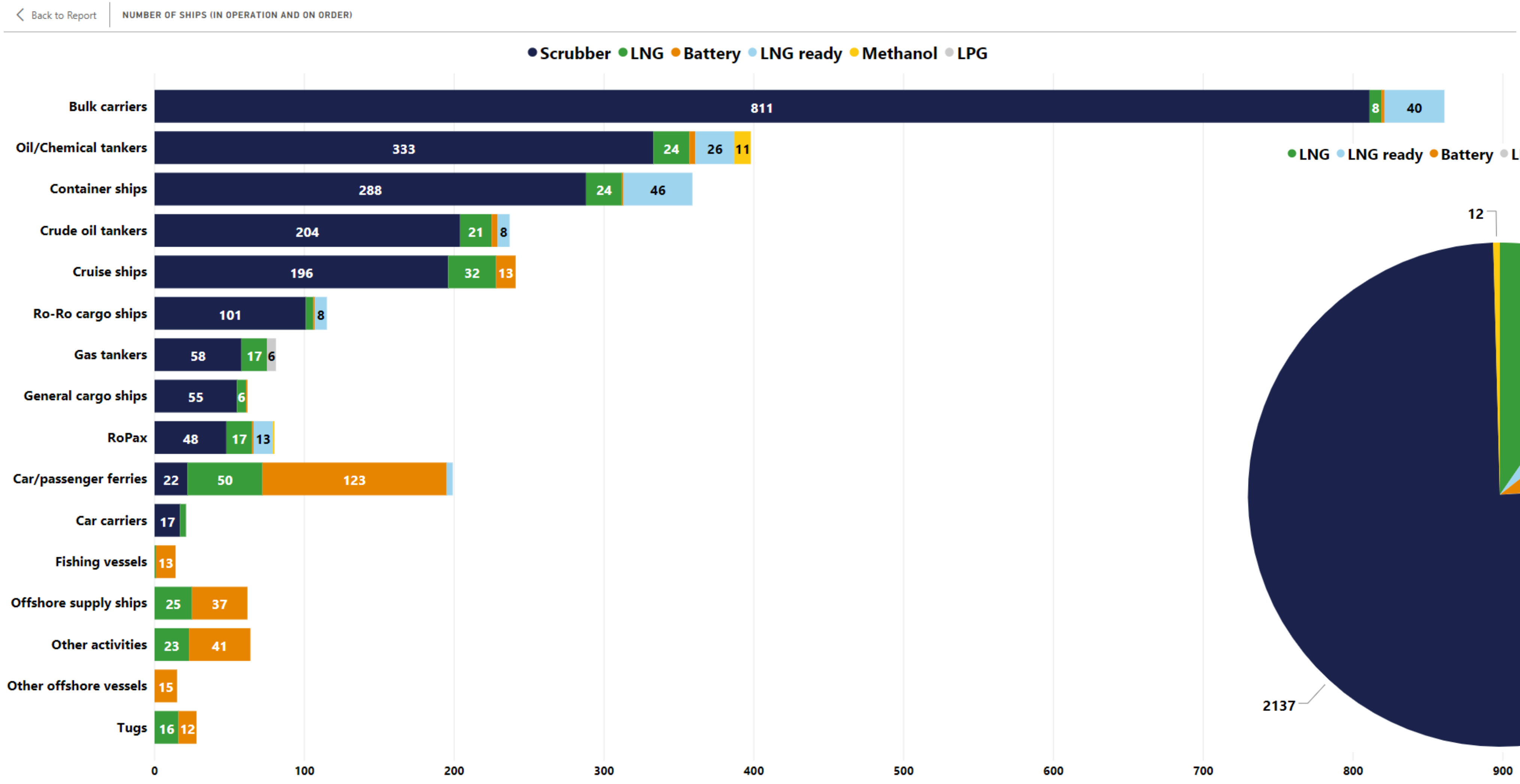
Learn more about the properties of a wide range of alternative fuels and technologies.

Fuel Selector



Compare the financial performance of LSFO, HFO with scrubber, LNG, LPG and methanol for your ship. Use DNV GL's assumptions or apply your own to calculate lifecycle costs, payback time and

Continuously updated statistics showing uptake



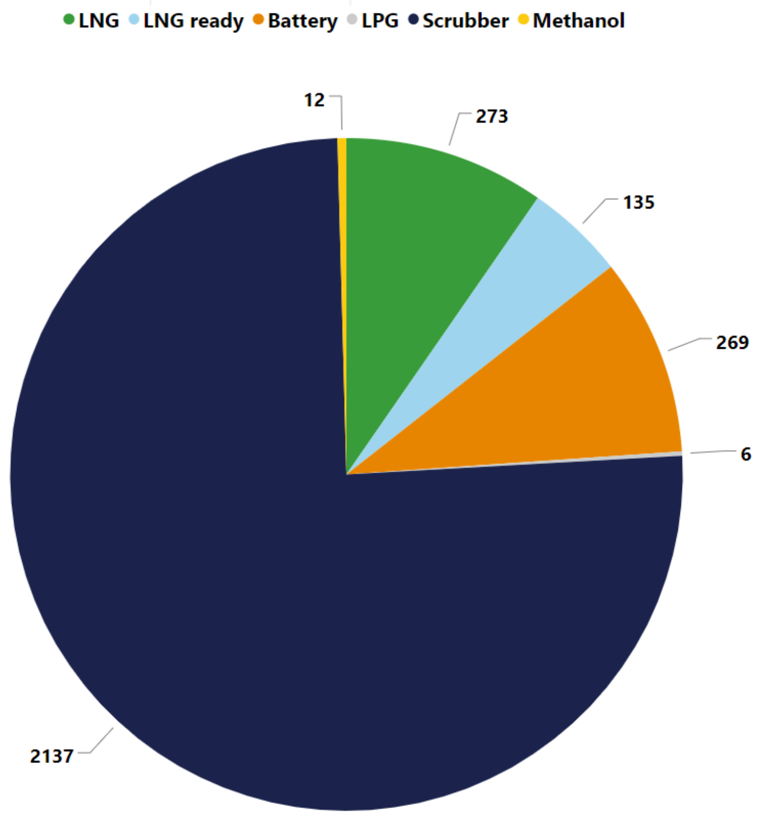


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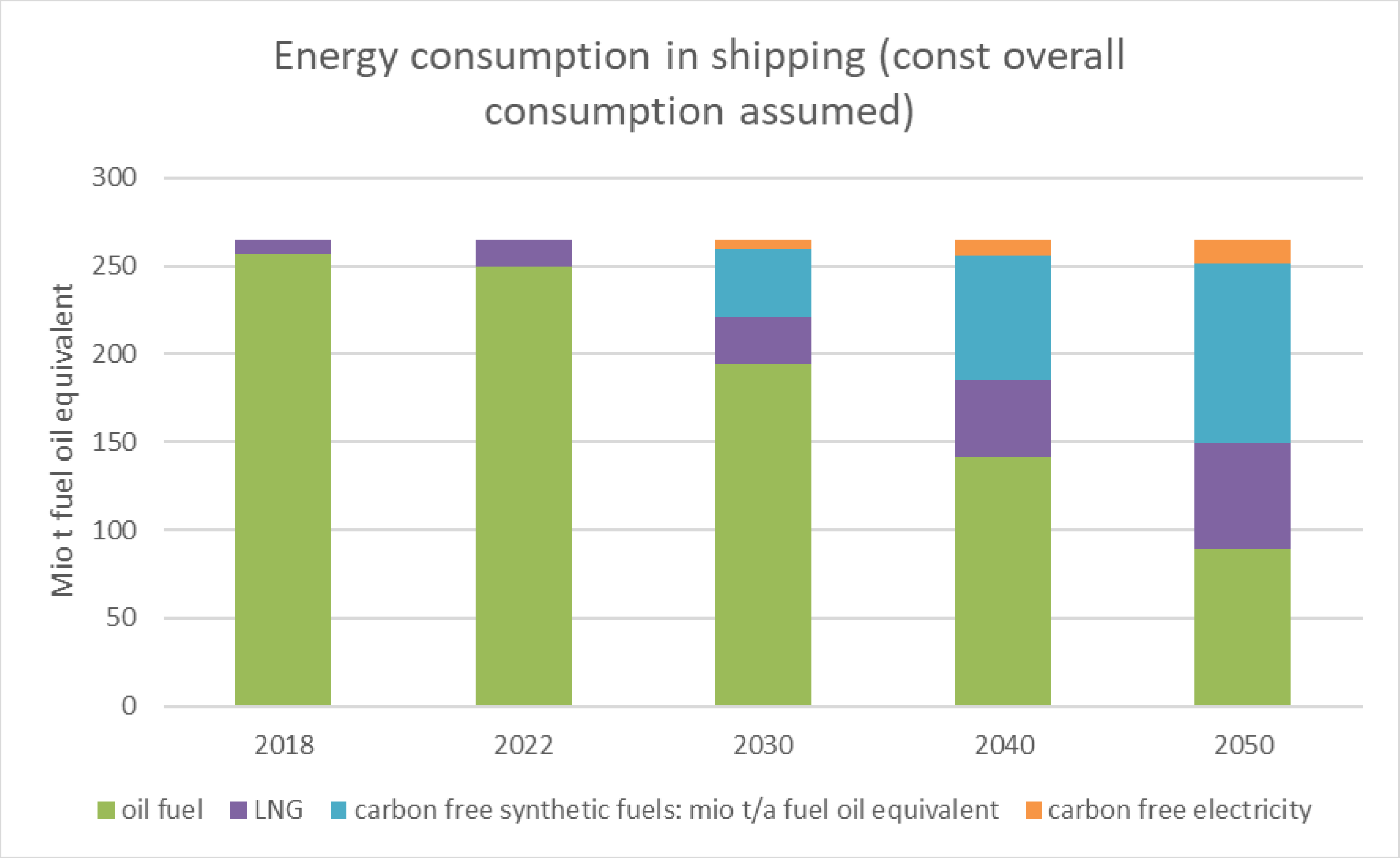
Fig. 1. Consumption figures for substitution of 50% oil fuel by PtoF

- Efficiency increase compensates growth in fleet only.
- Fuel supply for shipping: comp DNV GL ETO 2018
- Assumed: PtoF application starts "today"
  - PtoF: In 2030 approx. 38 mio t/a fuel oil equivalent might be needed!



Source: DNV GL, ETO 2018

Batteries and hybrid systems represent a new way of providing power and propulsion

Spinning reserve

- Backup for running generators
- Fewer generators needed online

Peak shaving

- Act as a buffer
- Level power seen by engines

Optimise load

- Optimise the operating point of the generators
- Reduce maintenance

Harvest energy

- Recover energy from cranes, drilling equipment, etc.
- Accommodate energy from renewables

Immediate power

- Instant power in support of generators

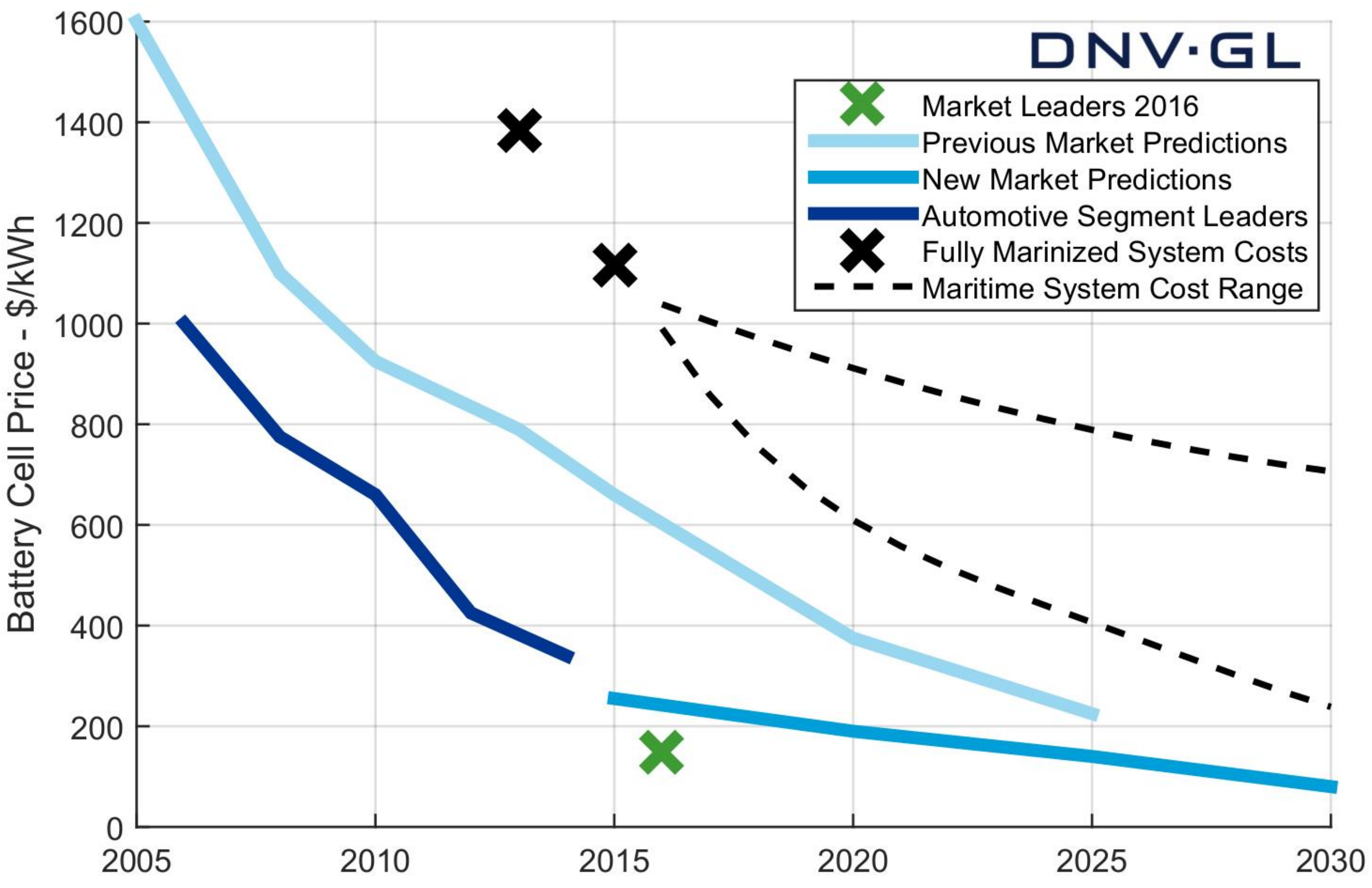
Backup power

UPS

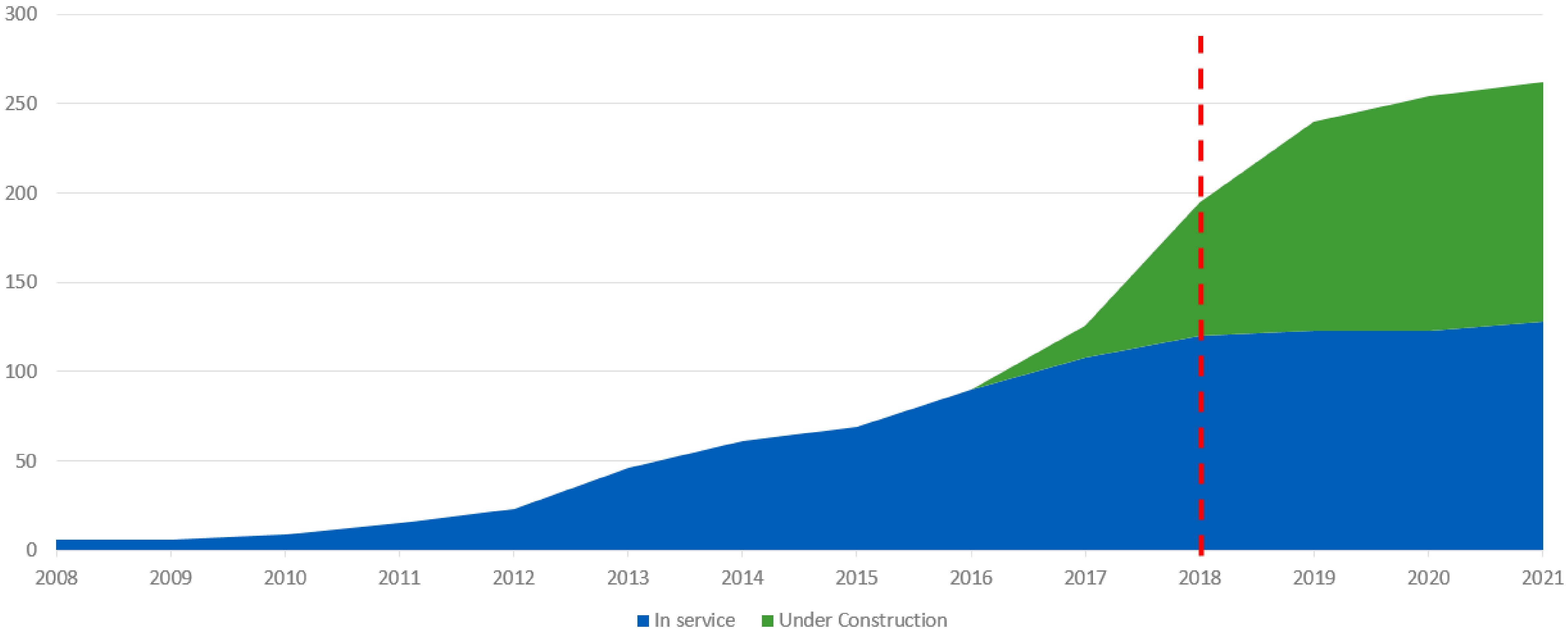
- Battery system provides backup power, UPS like functionality

Lithium ion battery price trends

- 1 t of fuel oil: approx. 11500 kWh
- 2030: Batteries
  - System:
    200 $/kWh → 11500 kWh
    approx. 2,3 Mio $
  - Cell:
    50 $/kWh → 11500 kWh
    approx. 0,6 Mio $



Development in ships
Based on year battery is installed



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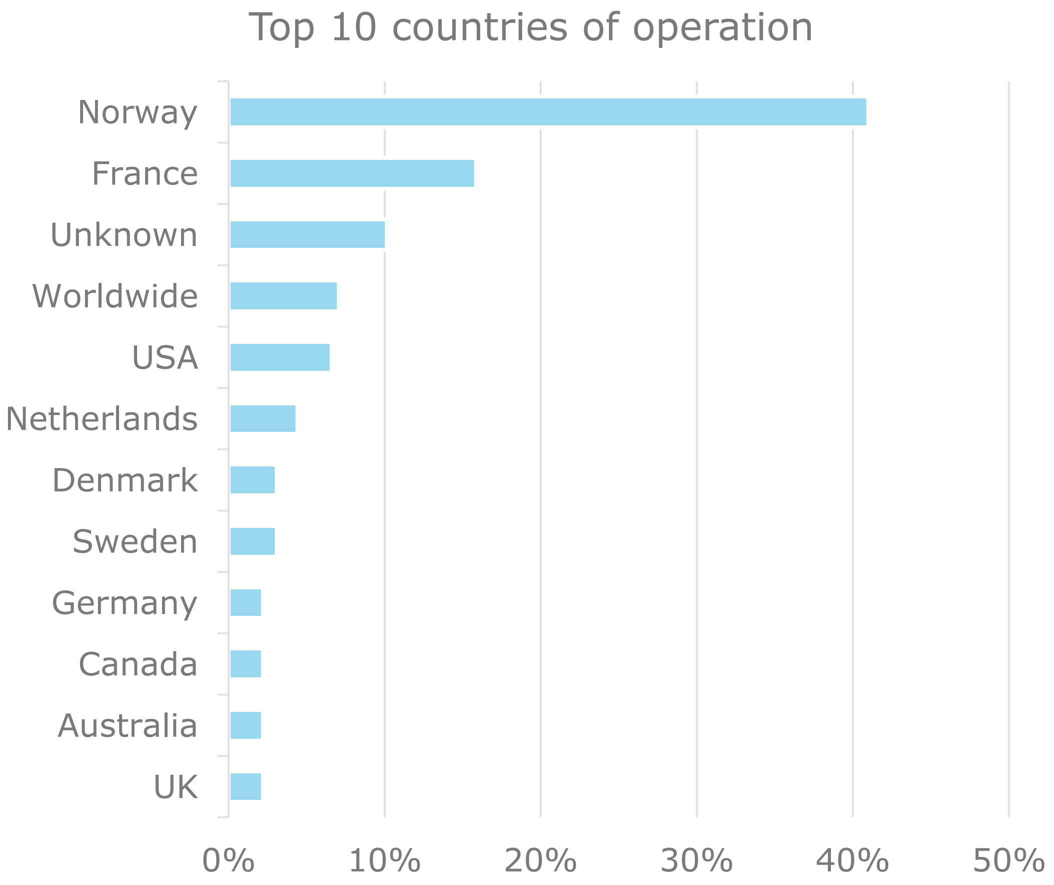
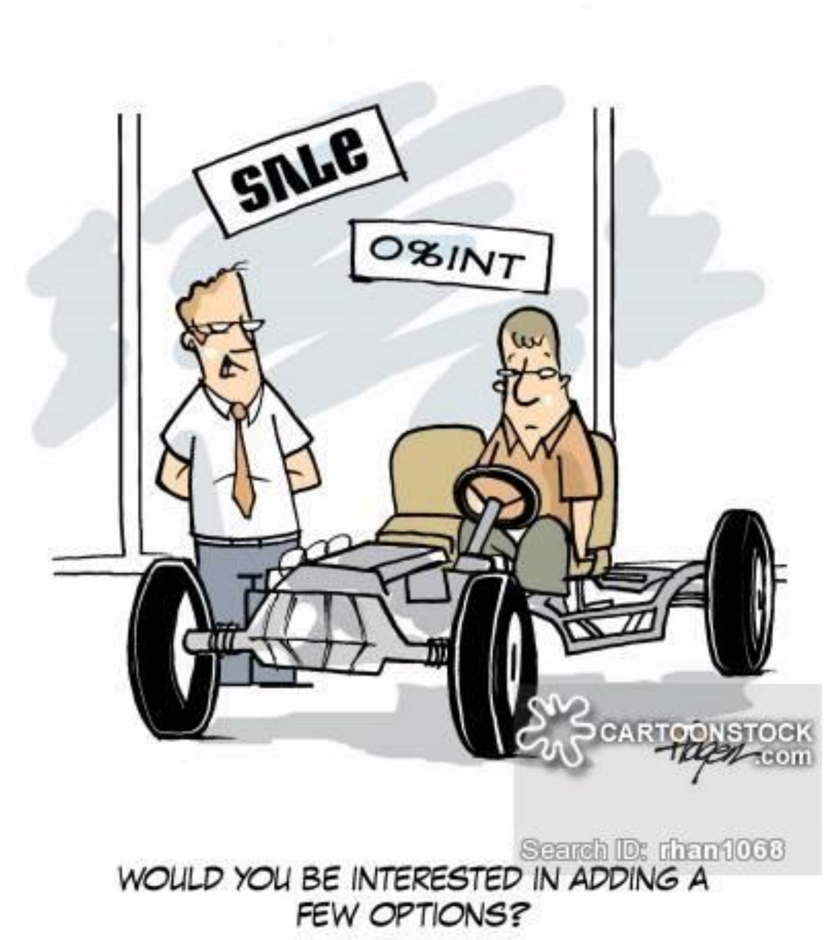
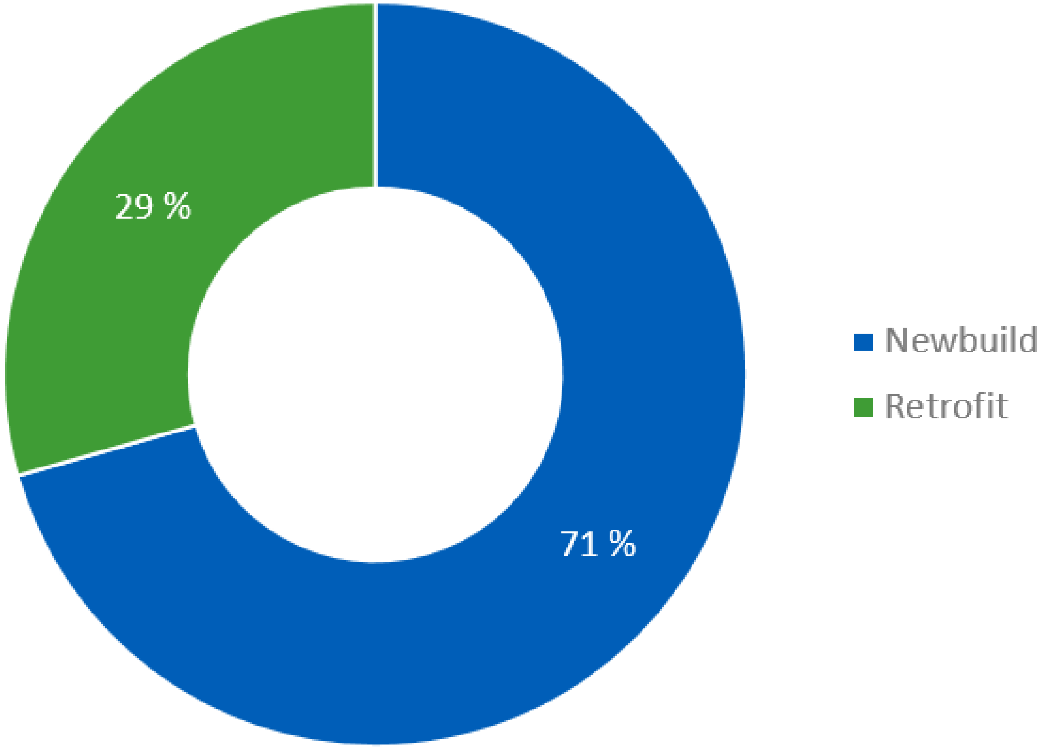
Country of operation



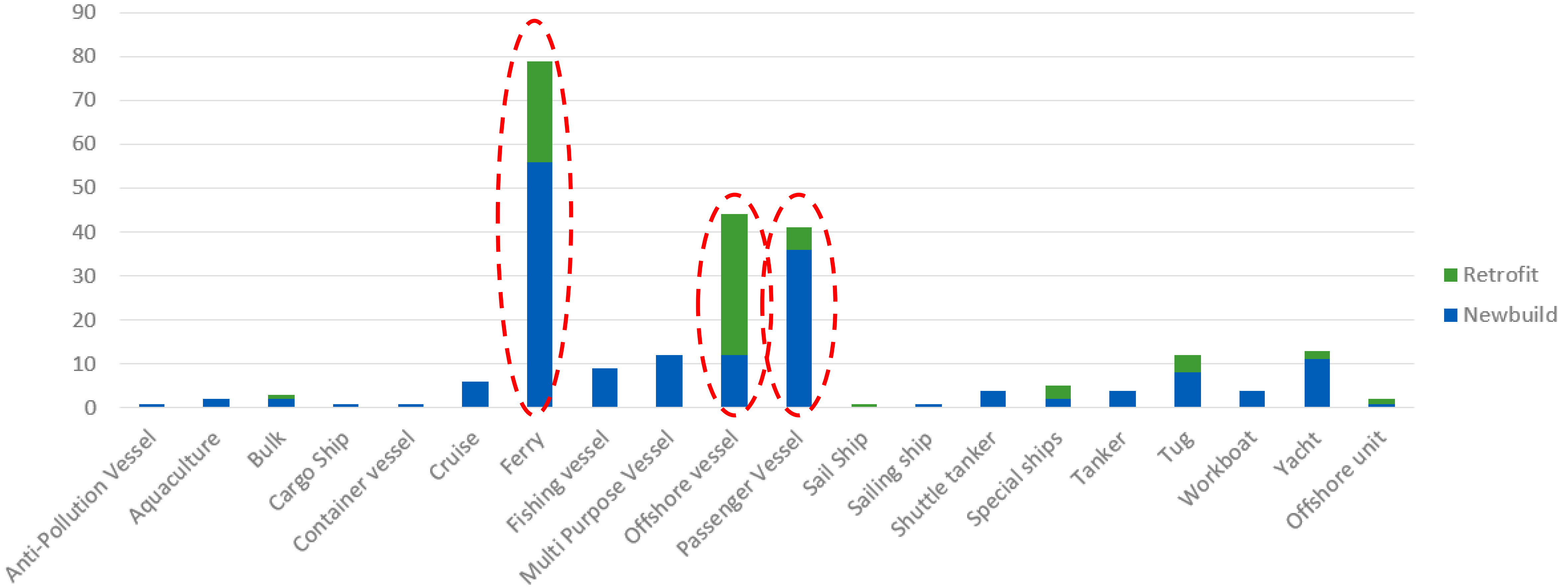
Newbuild or retrofit?



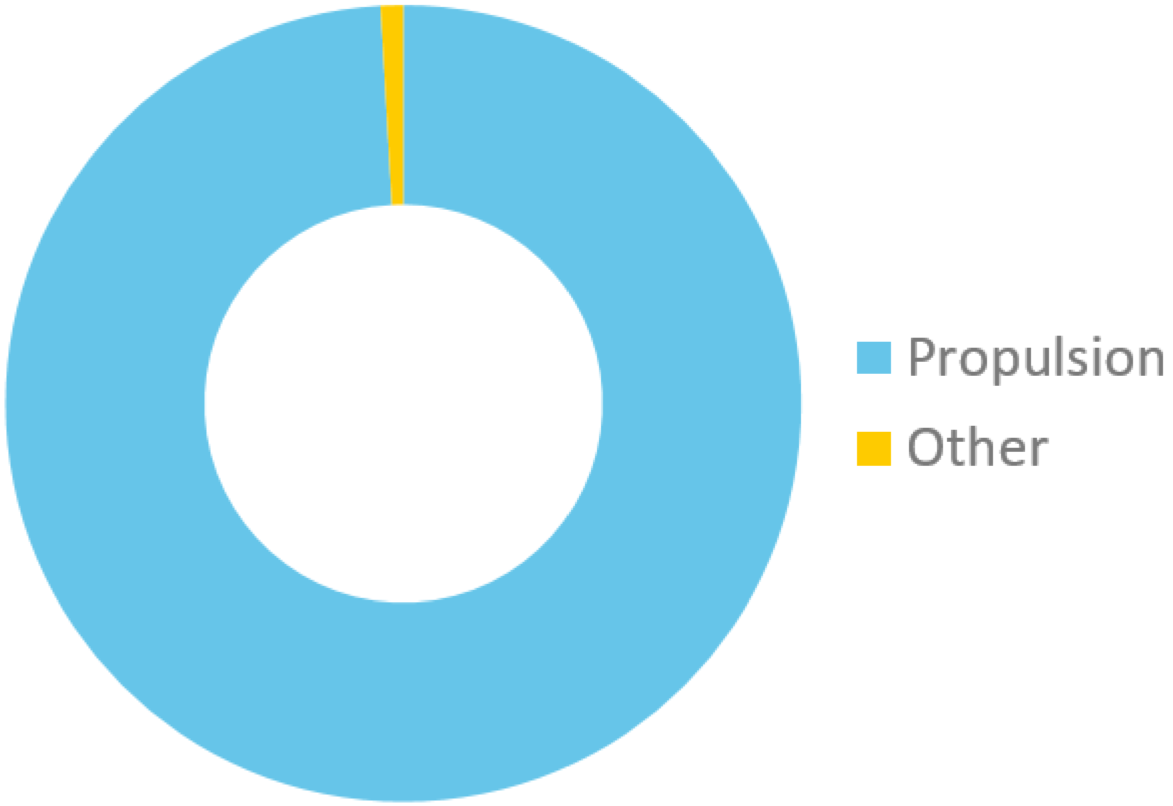


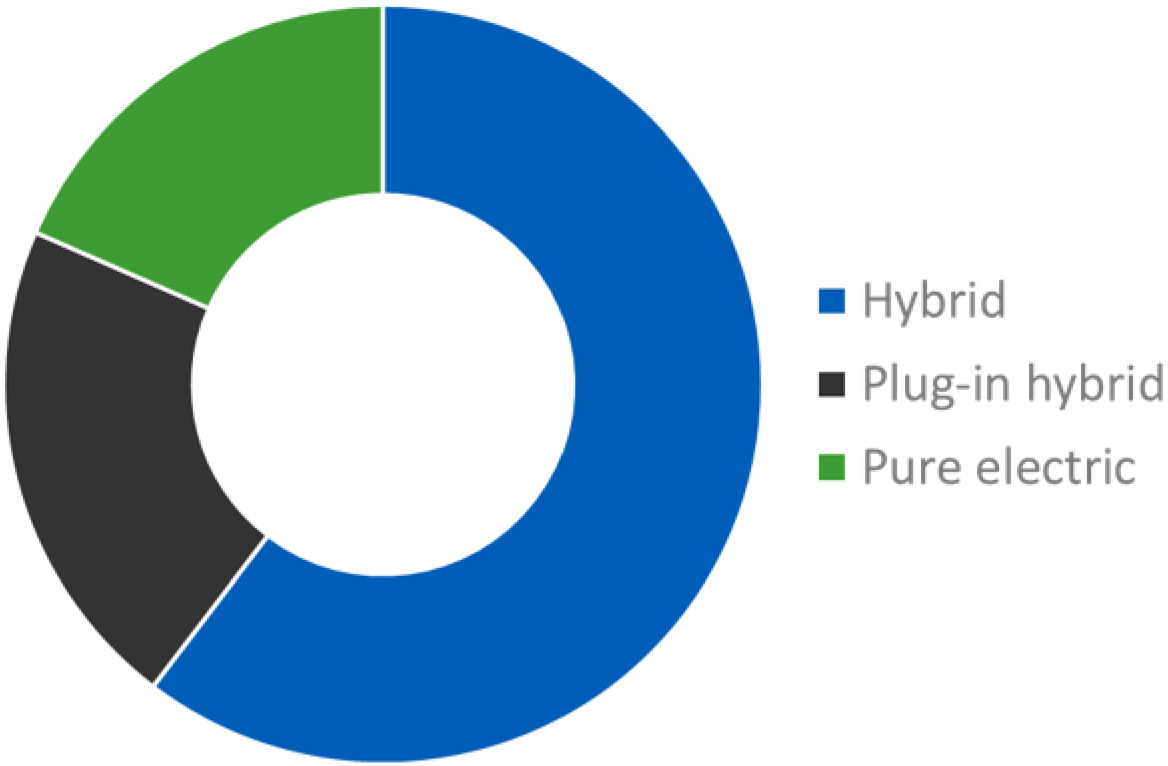

DEEPOCEAN
NORLED
VIKING LADY

Newbuild or retrofit?



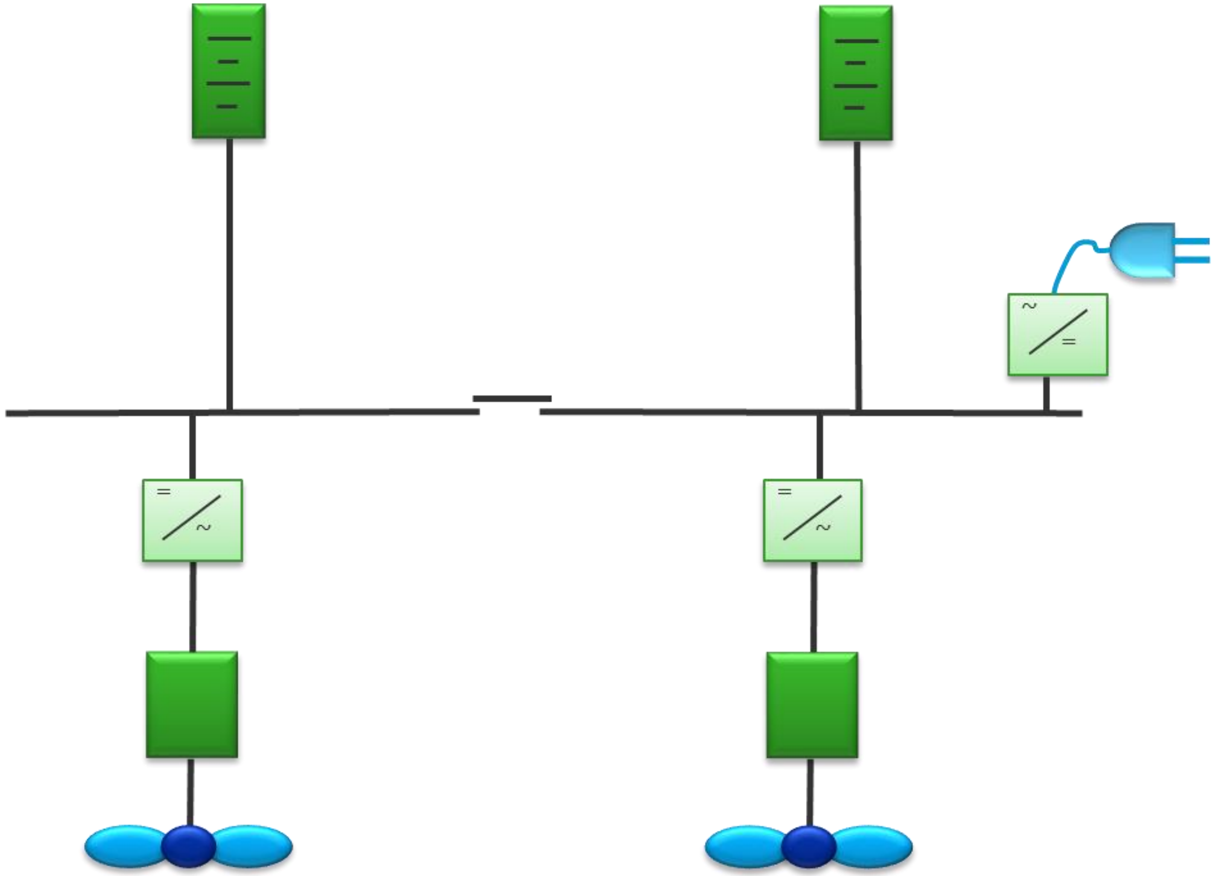
Technology



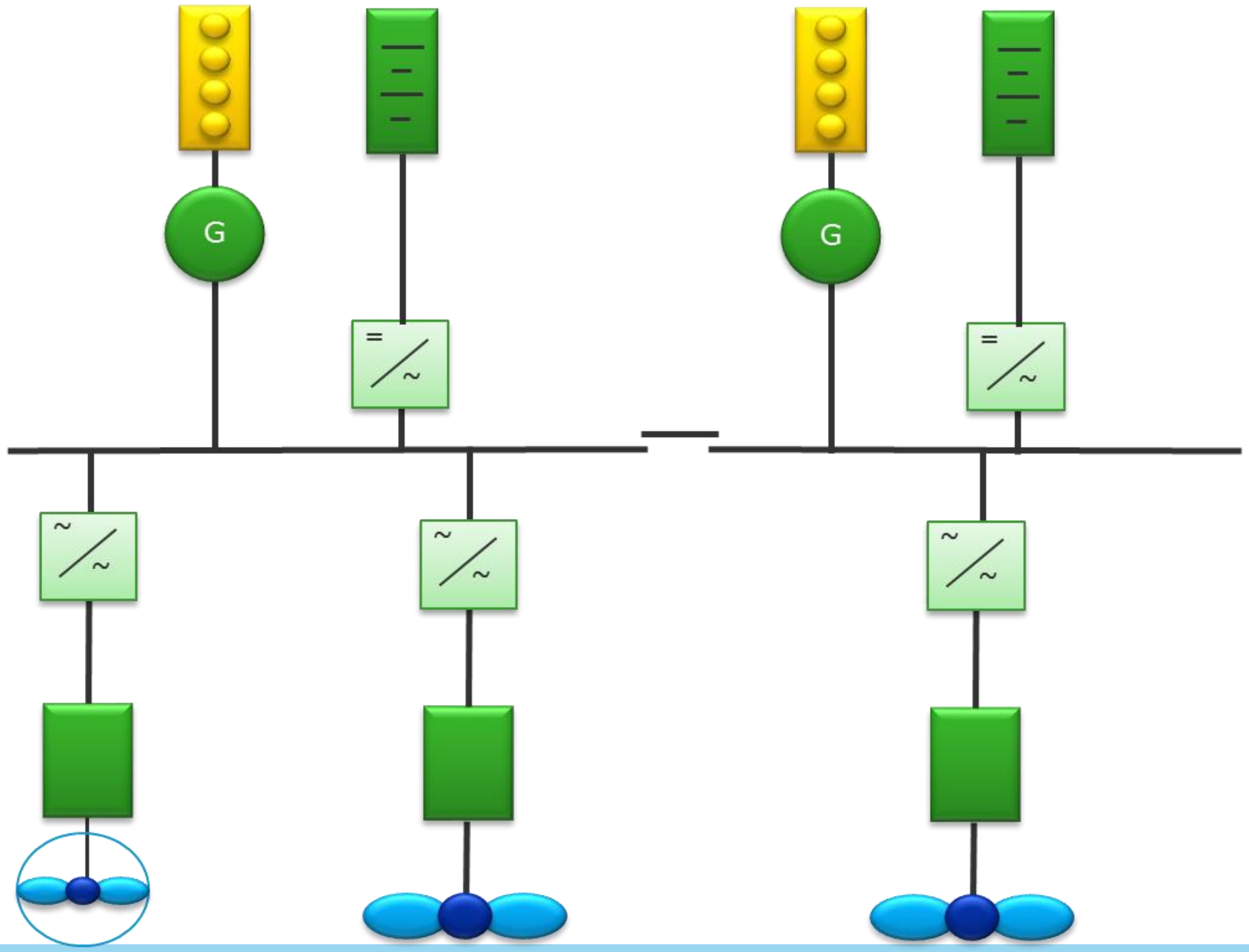


Note! Figure indicative as not all projects state if they are plug-in or not

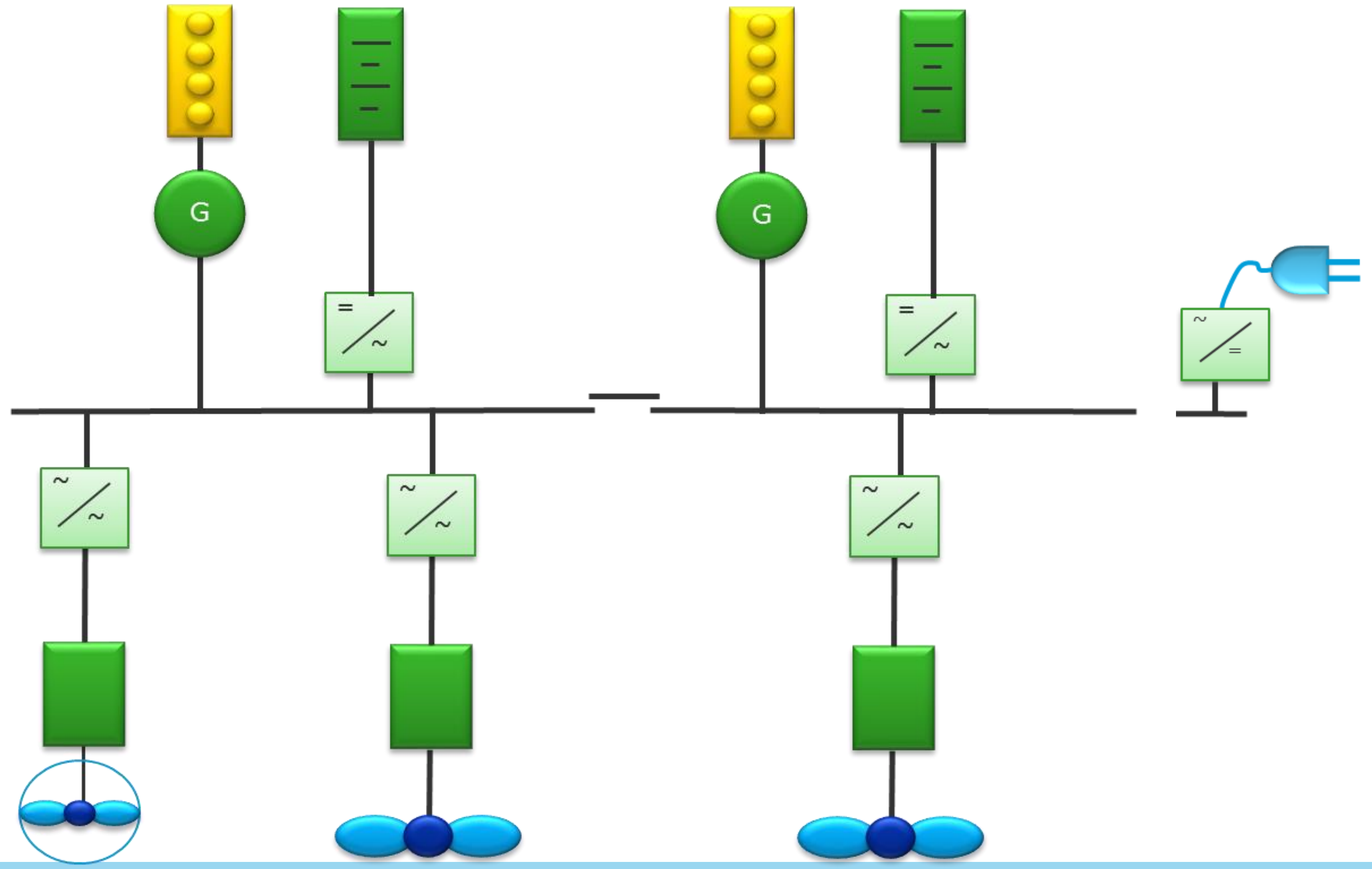
Battery Propulsion



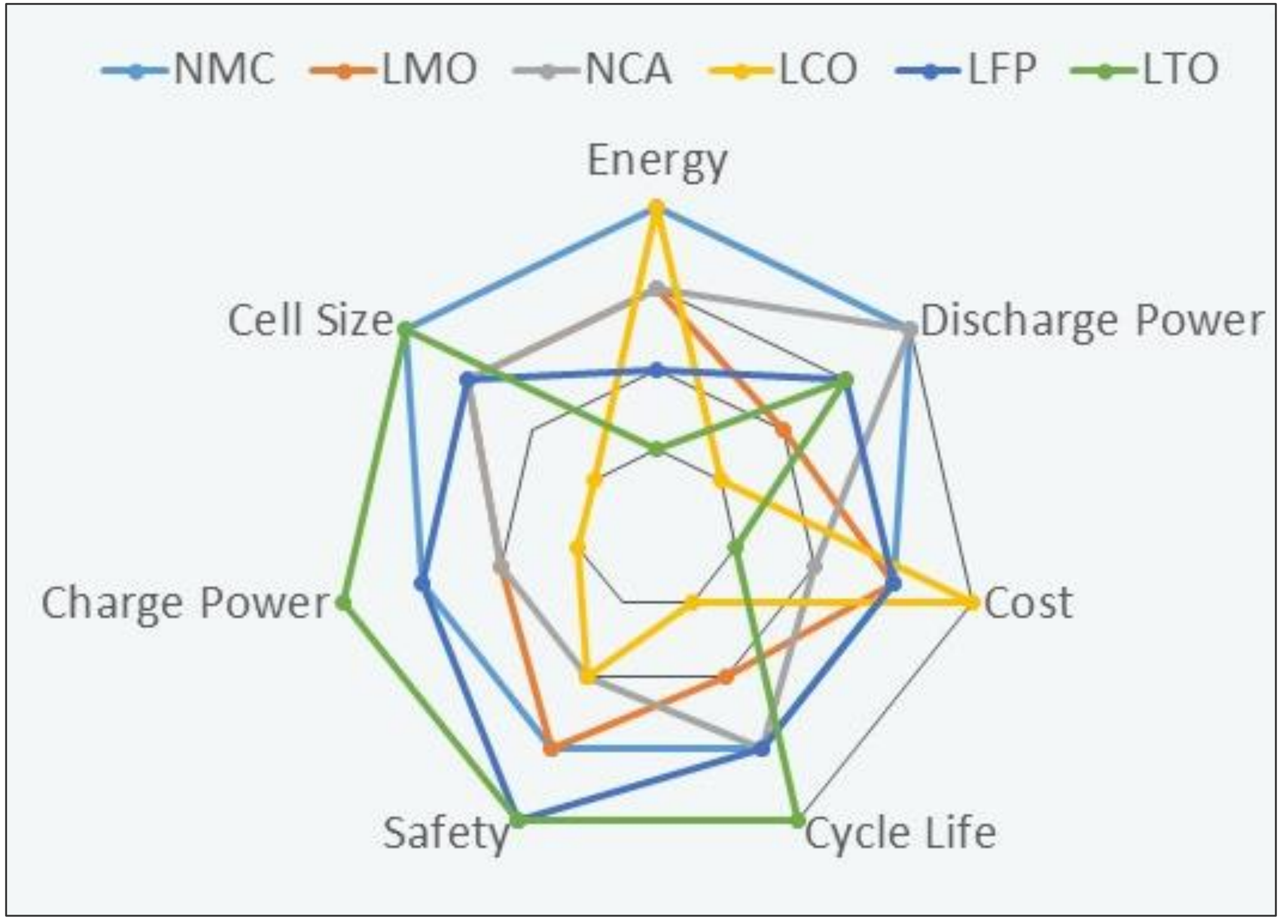
Hybrid Battery Propulsion



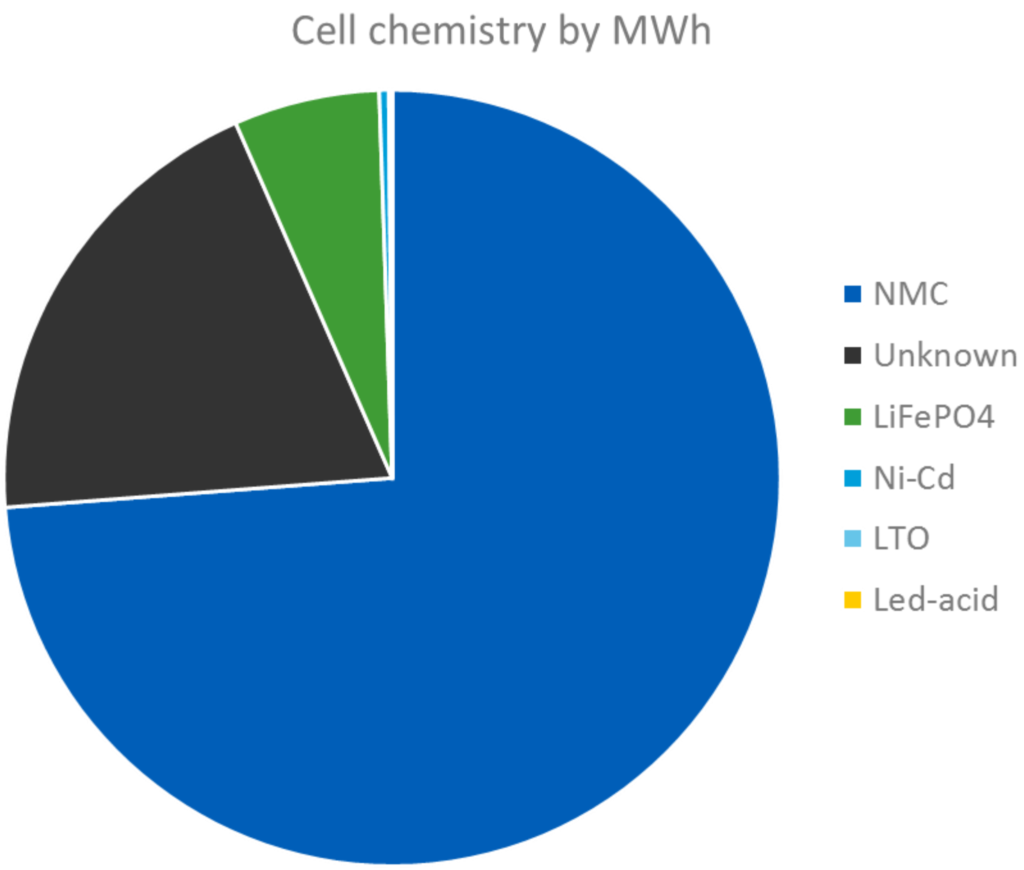
Plug-in Hybrid Battery Propulsion

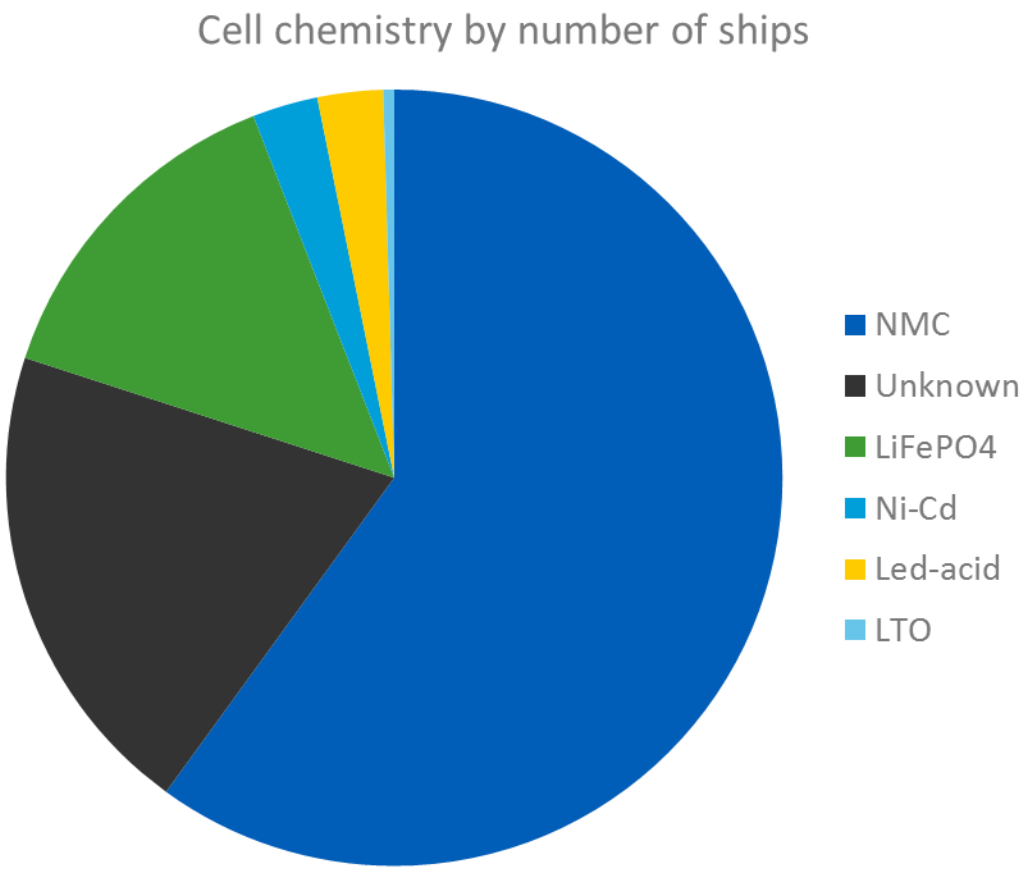


Technology Selection: Cell Chemistry Matters



Which batteries are being used?





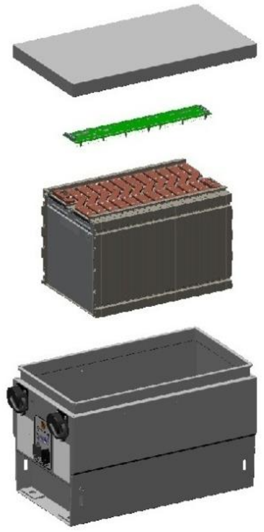
For a traditional generator, power and energy are separate considerations

Sizing a diesel engine

- What is the maximum power required?
  - Pick engine with slightly higher power
- Energy?
  - How long it will run
  - Not a concern, determined by fuel tank

Battery sizing is different

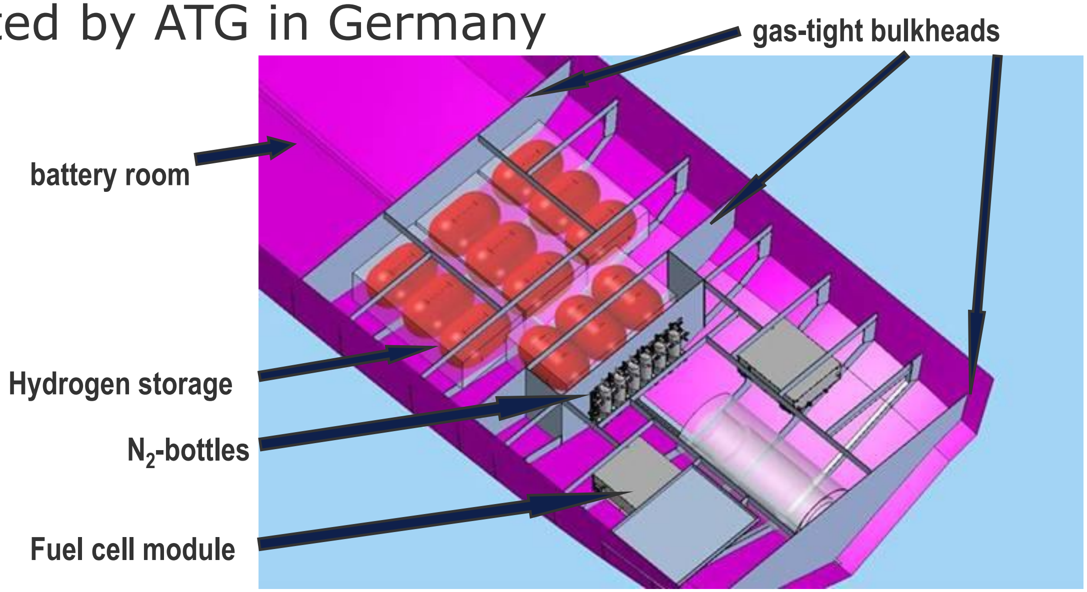
- Batteries are not used in the same way
  - Help coordinate loads and generators
  - Help the system operate at peak efficiency
  - Charge and discharge
- Power and energy are related



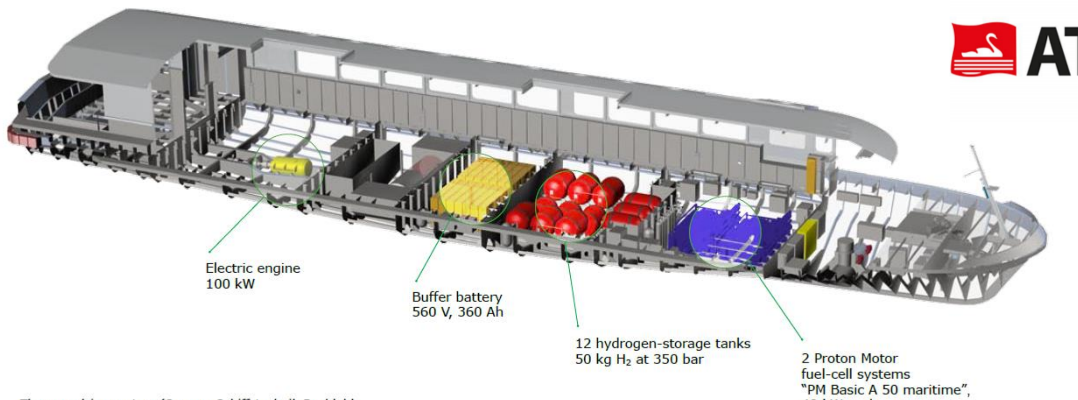
Technologies applied

MS ALSTERWASSER – operated by ATG in Germany

- 100 Passengers
- 25,46m x 5,36 m (L,W)
- 100 kW propulsion motor
- 2 Fuel Cell systems from Proton Motor, each 50 kW
- 360 Ah lead-gel batteries
- Hydrogen storage tanks, 350 bar, 50 kg
- Separation of gas storage room, Fuel Cell space and battery space
- Duration: 2006 - 2013

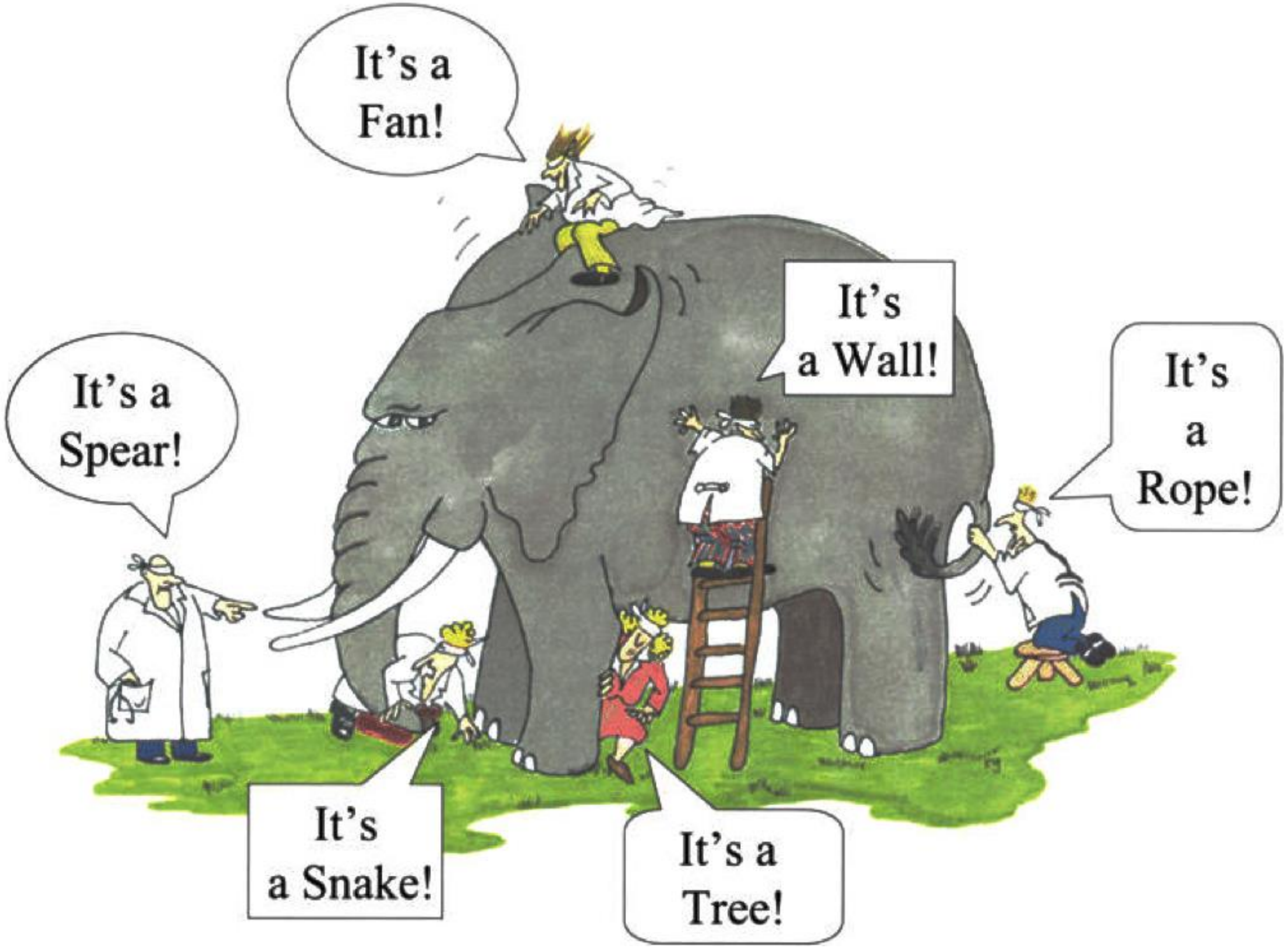


ATG



The propulsion system (Source: Schiffstechnik Buchloh)

To make it simple – consider the system as a whole



Thank you

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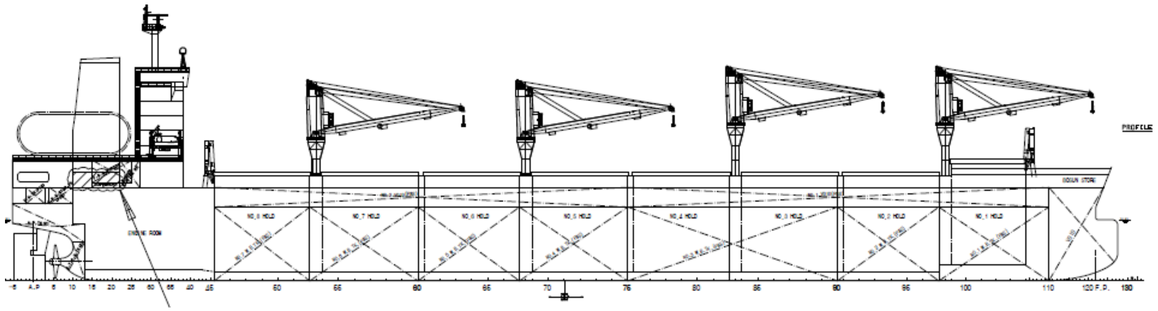
SAFER, SMARTER, GREENER

Case study

Feasibility Study: 64k Bulk Carrier – 4 Cranes

- To ensure the best solution, the system should be looked at under one and early in design
- Not all operations have same benefit of a battery
- What is the most relevant factors for the owner/ operator?
  - Emissions?
  - OPEX?
  - Noise?
  - Maneuverability?
  - Backup power/ safety?
  - Energy recovery?
  - Running hours?
  - Peak shaving/ engine ramp-up?

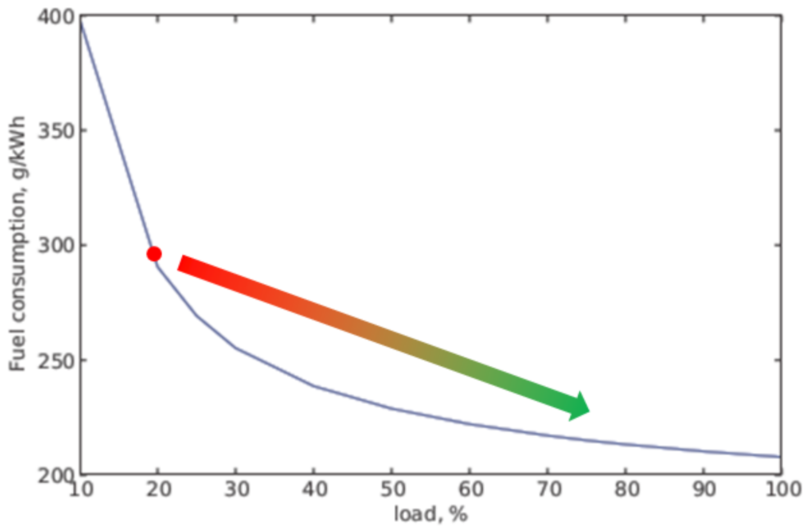


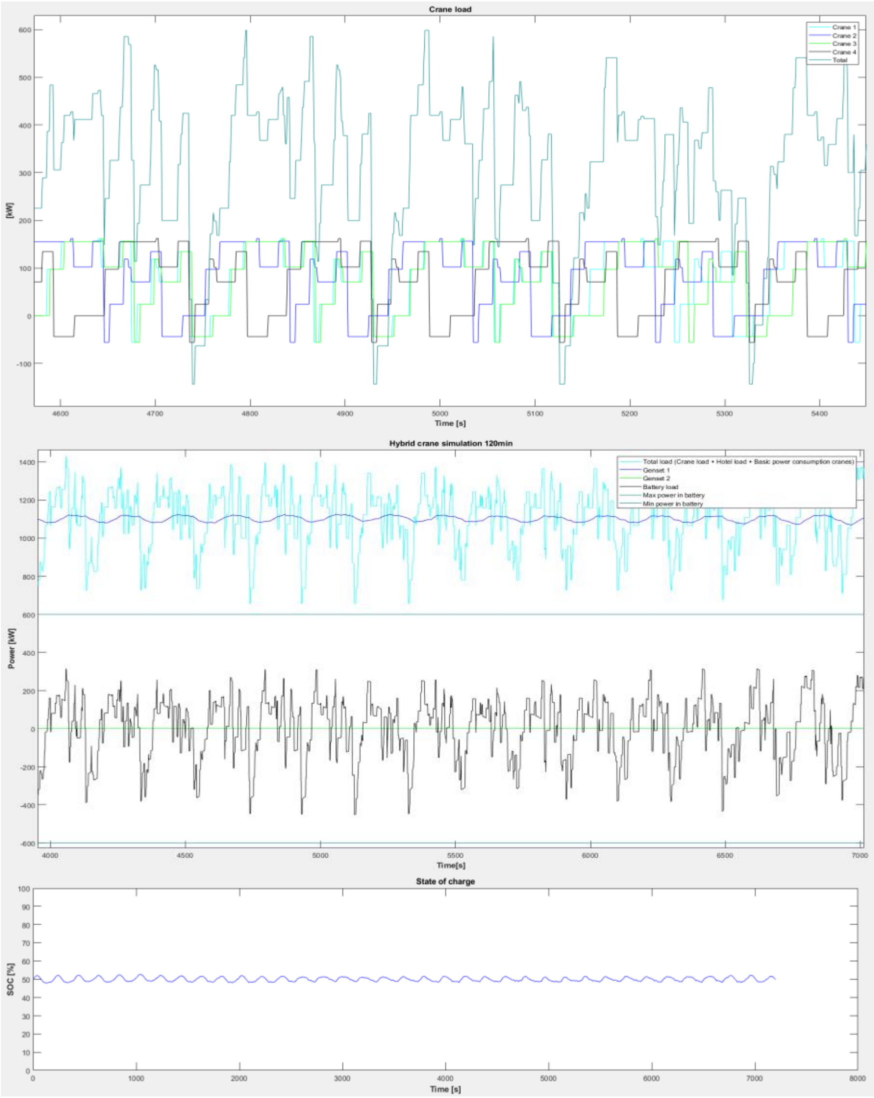
Feasibility Study: 64k Bulk Carrier – 4 Cranes

- A; crane operation:
  - what are potential savings?
  - What size and cost of battery?
  - What size and number of gensets?
- B; other operations:
  - How can the same battery be utilized?
  - What are potential savings?
  - What other advantages can be found?

Crane Operations: Analysis

- Simulate the crane operations with and without battery
- Let battery take peaks and gensets take average load
- Ensure sufficient energy to handle both discharging and charging
- Regeneration of energy while lowering
- Look at running hours for gensets





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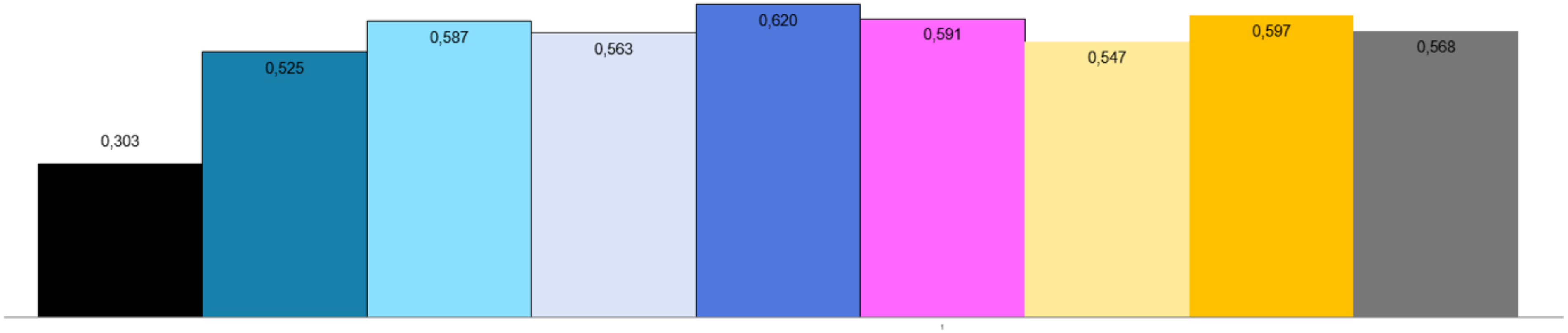
Crane Operations: Findings

- About 20% fuel saving
- About 50% running hours on gensets
- Around 5 year payback time for batteries

Additional potential for other operations

- Looking at different concepts for main propulsion
  - Direct 2-stroke
  - 2-stroke with PTO/PTI
  - 2-stroke DF with PTO/PTI
- Generate weighting for parameters
- Look at potential for savings and benefits
- Ranking
- Parametric study



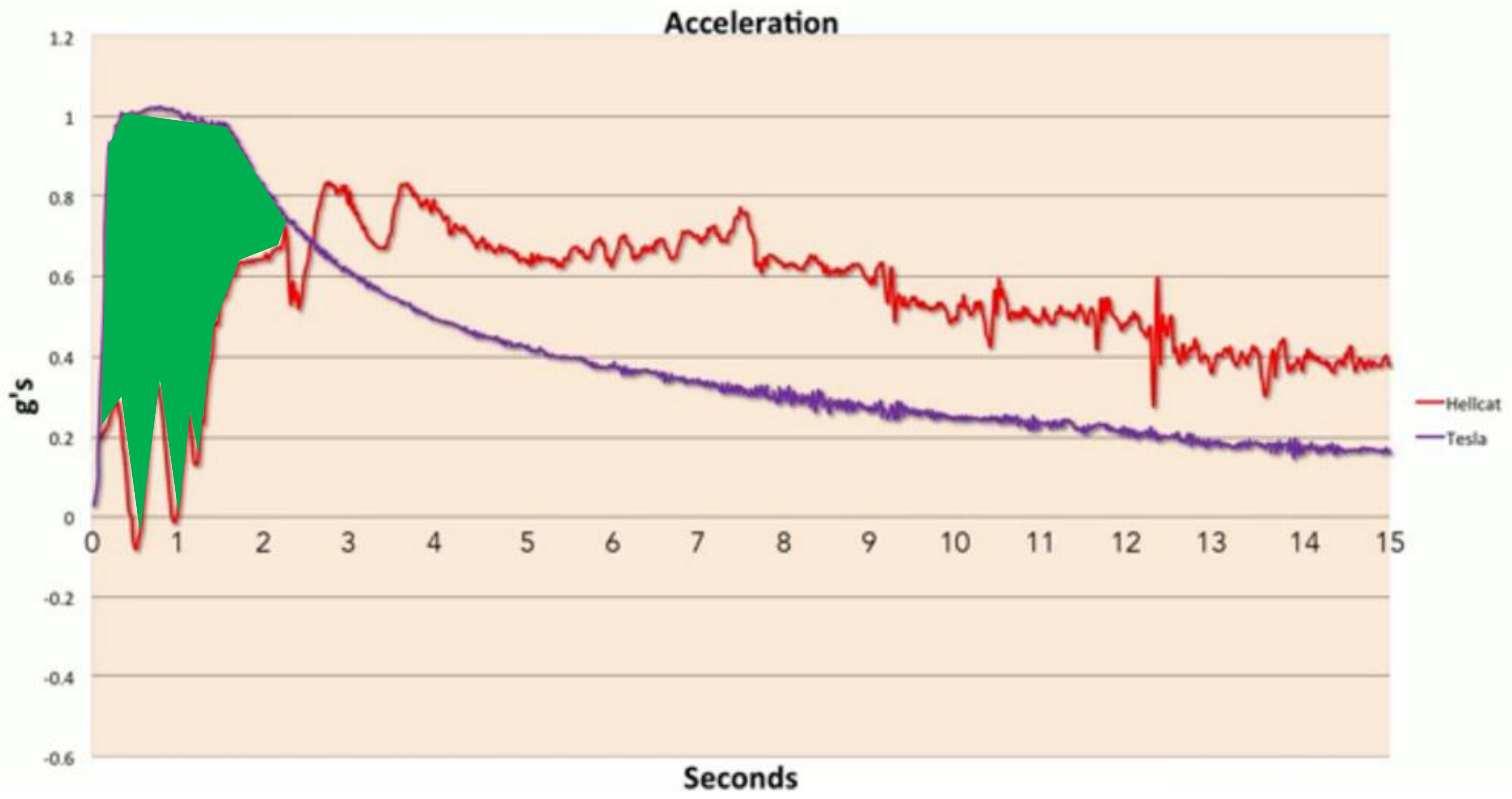
Summary – Maritime Batteries are a success

- About 30 % CAGR over the past 5 years
- Mostly ferries, passenger vessels and offshore so far, but many segments involved!
- Norway is the leader, and many are following
- More newbuilds than retrofits
- Increasing number of plug-in hybrids

Yet..

- You have to look at the whole system
- Use them smart and focussed
- There is no “one size fits all”

Backup slides



NB: figure is unofficial, however, it illustrates the benefit of “instant Torque”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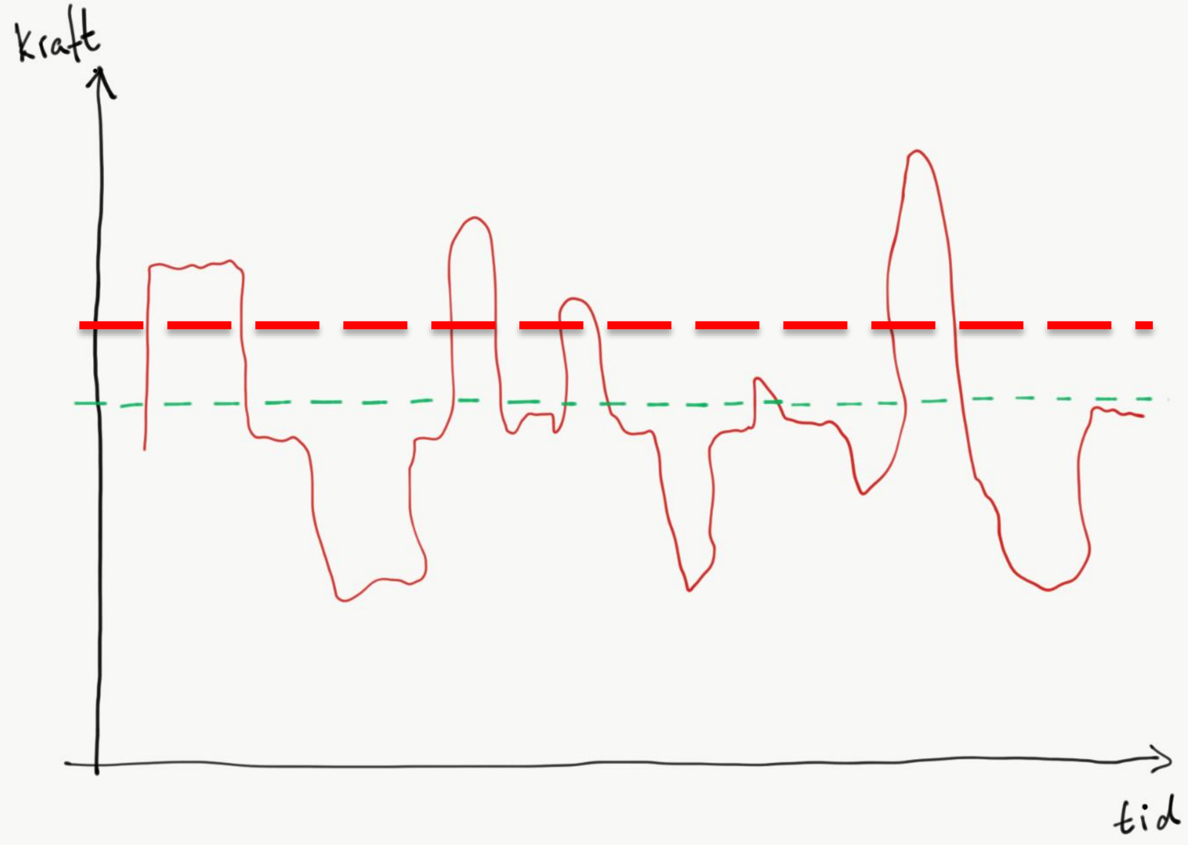
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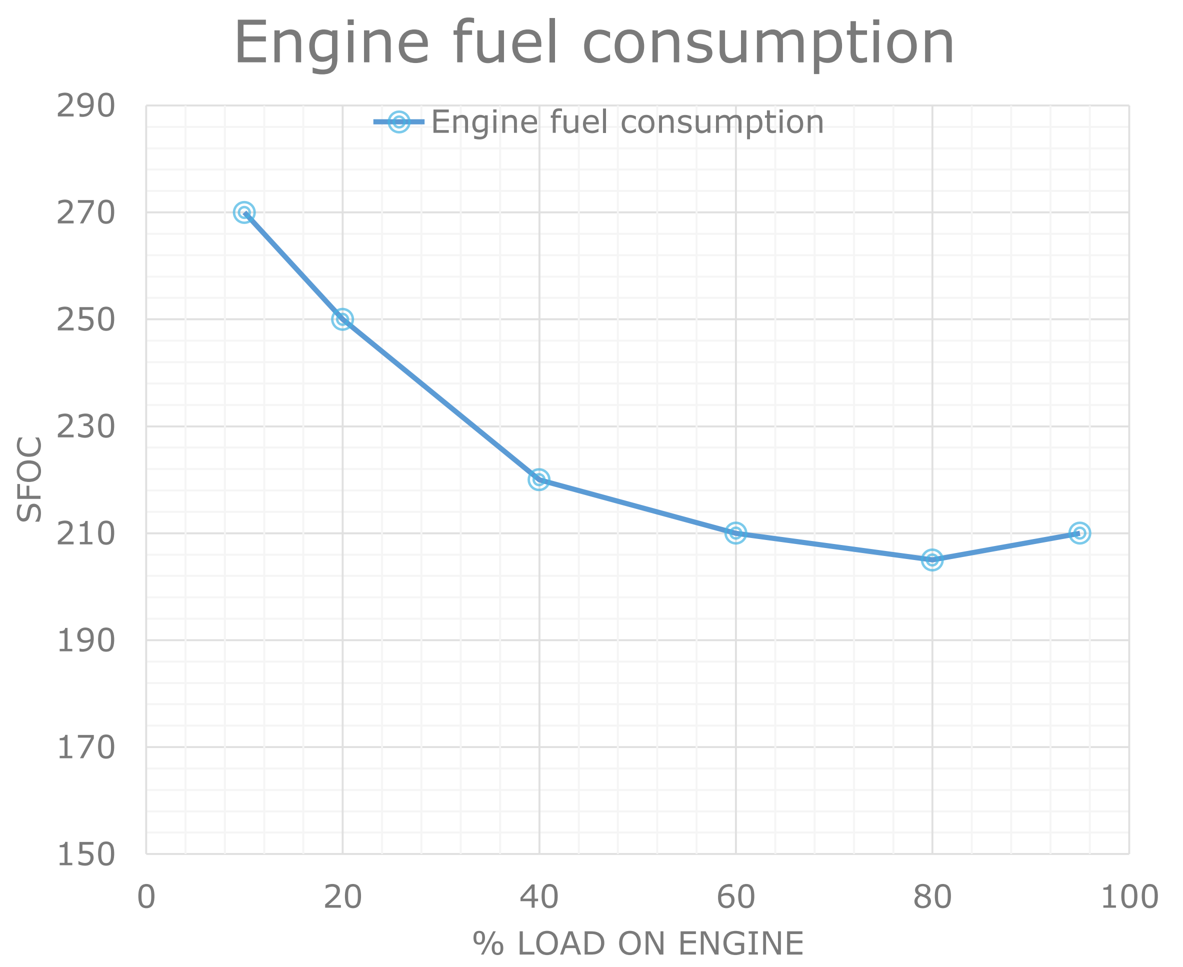
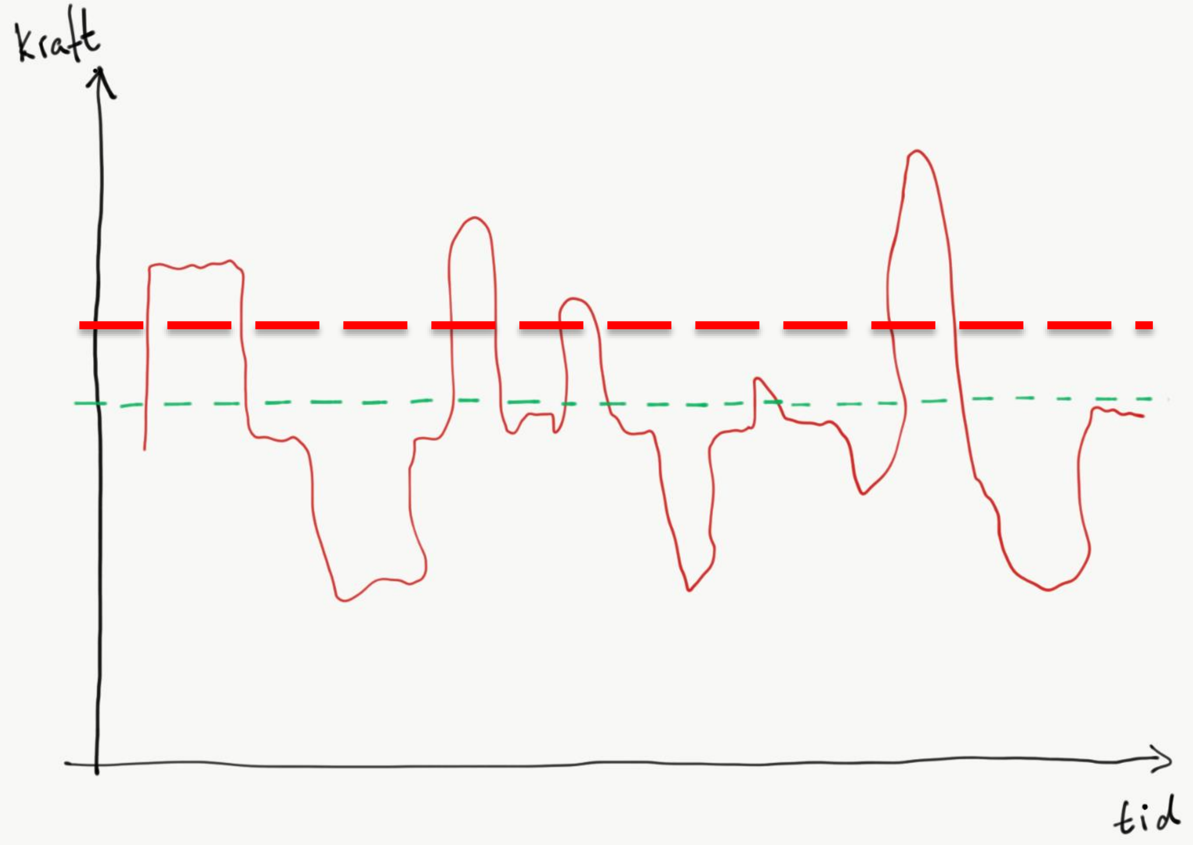
Spinning Reserve – calculation example



The figure is a typical engine fuel curve for 4-stroke engine (2-stroke has the same shape)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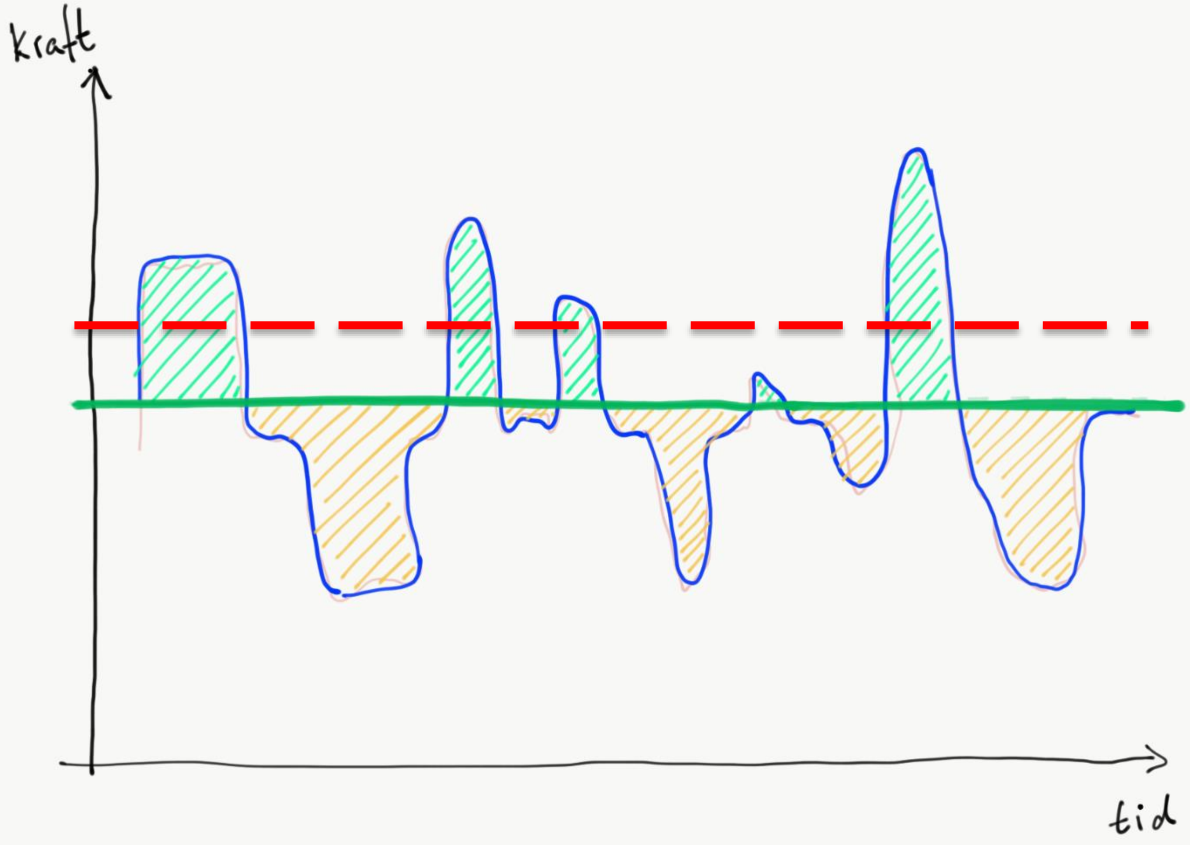

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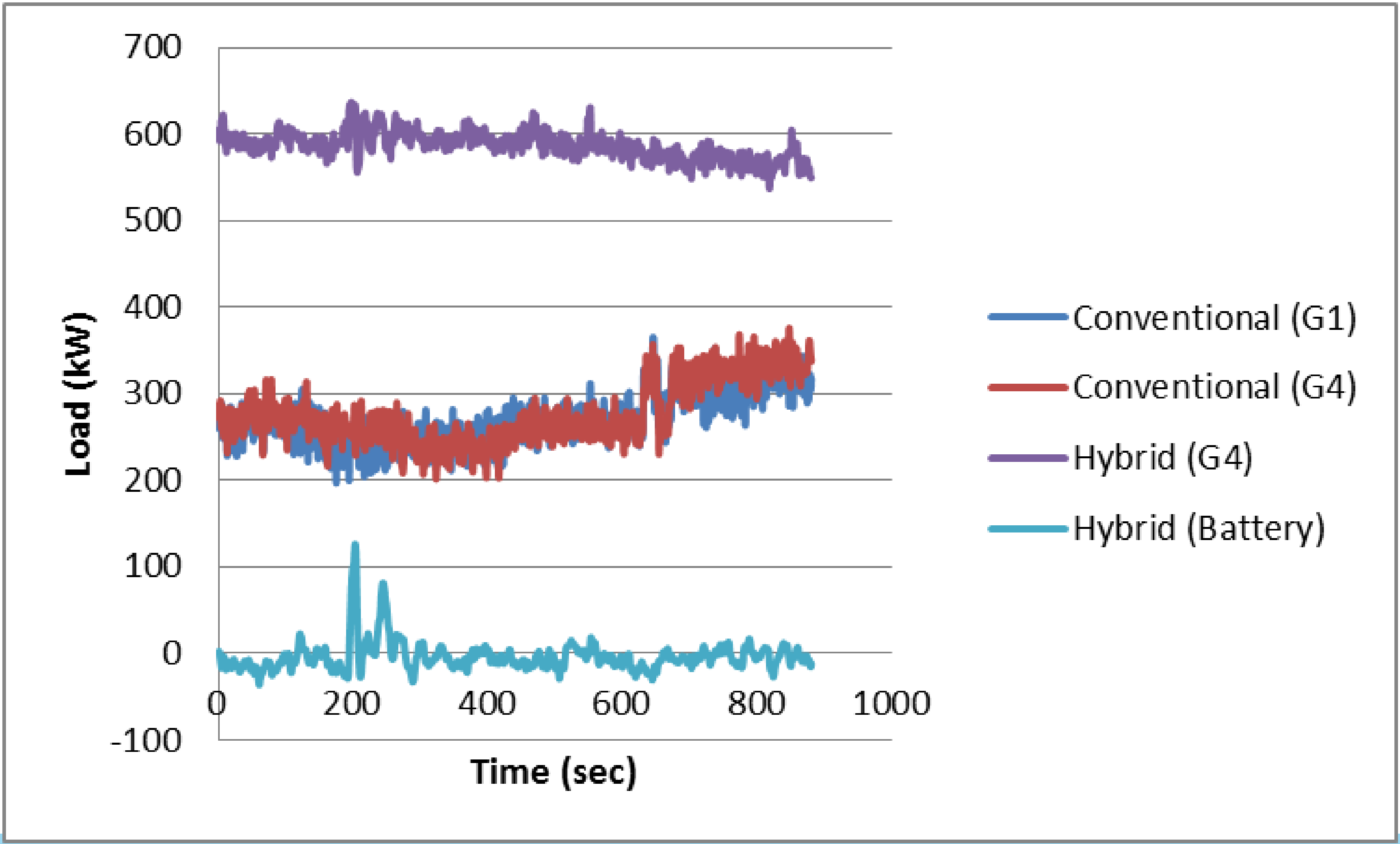
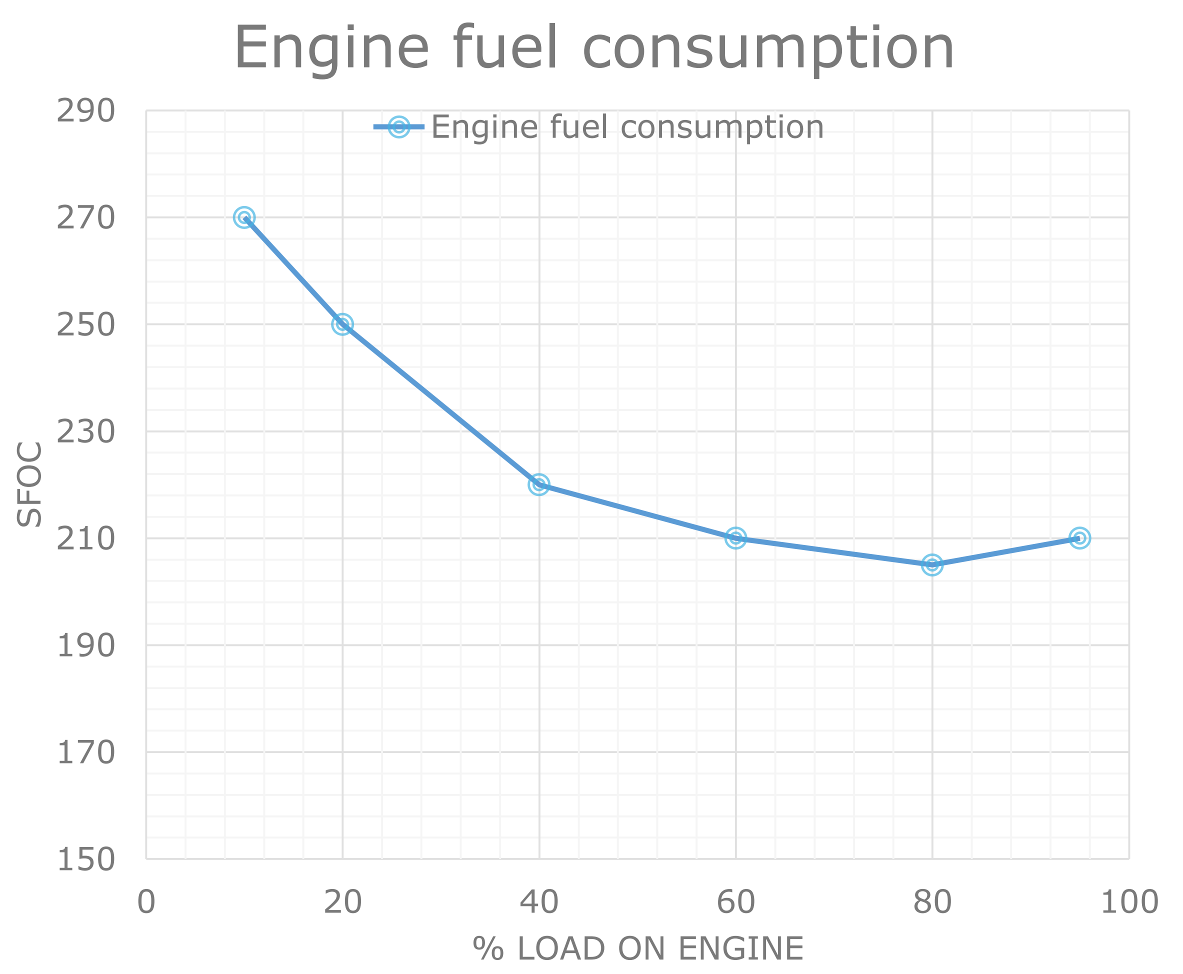
In real life



700
600
500
400
300
200
100
0
-100
Load (kW)
0
200
400
600
800
1000
Time (sec)
Conventional (G1)
Conventional (G4)
Hybrid (G4)
Hybrid (Battery)

Spinning Reserve – calculation example

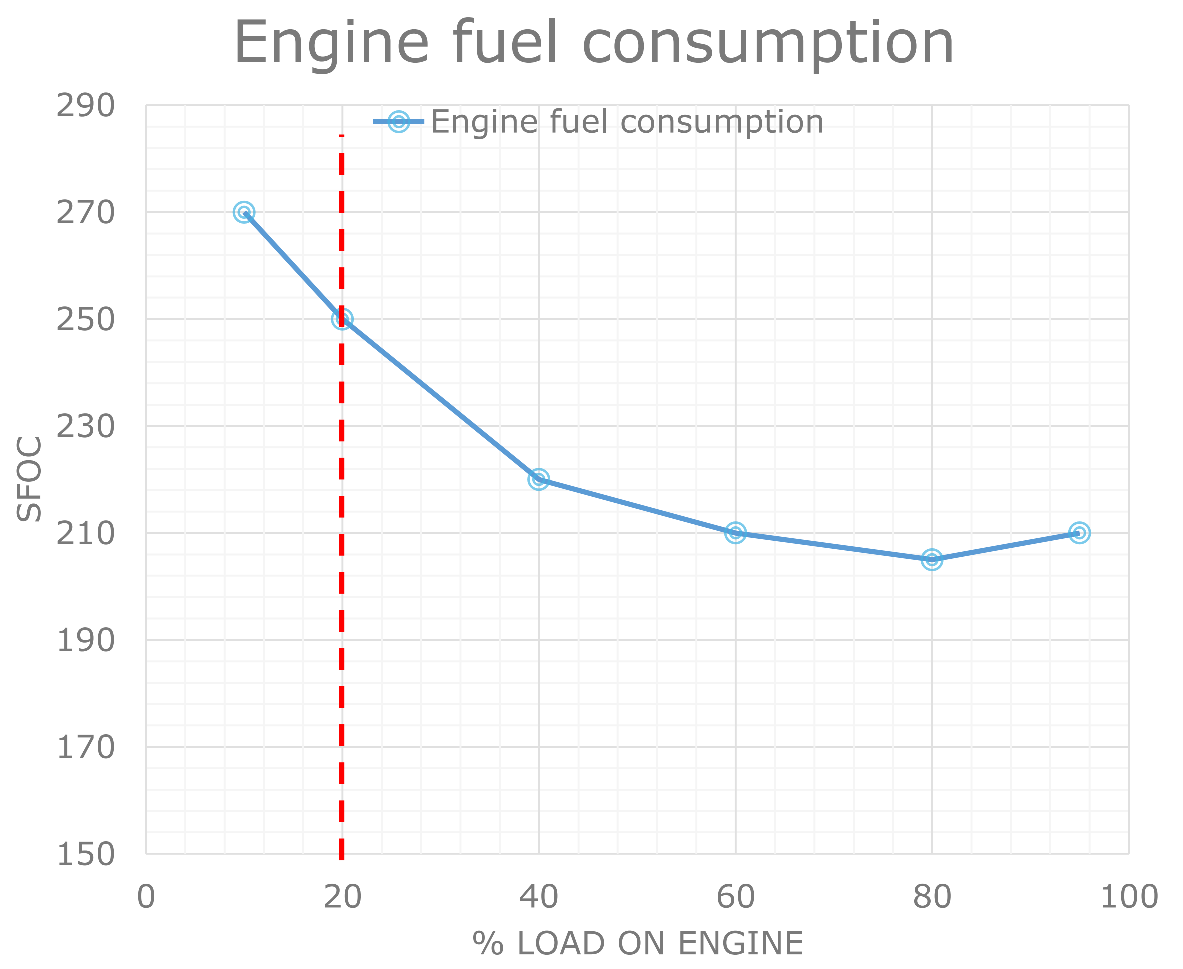
- Engine MCR: 1875 kW
- Average power demand: 1500 kW (80 % of MCR)



The figure is a typical engine fuel curve for 4-stroke engine (2-stroke has the same shape)

Spinning Reserve – calculation example

- 4 engines 20 %:
- 250 g/kWh
- 1500 kW
- 24h
  - Fuel consumption 9 tonnes
  - 96 hours operation
    - i.e. maintenance costs

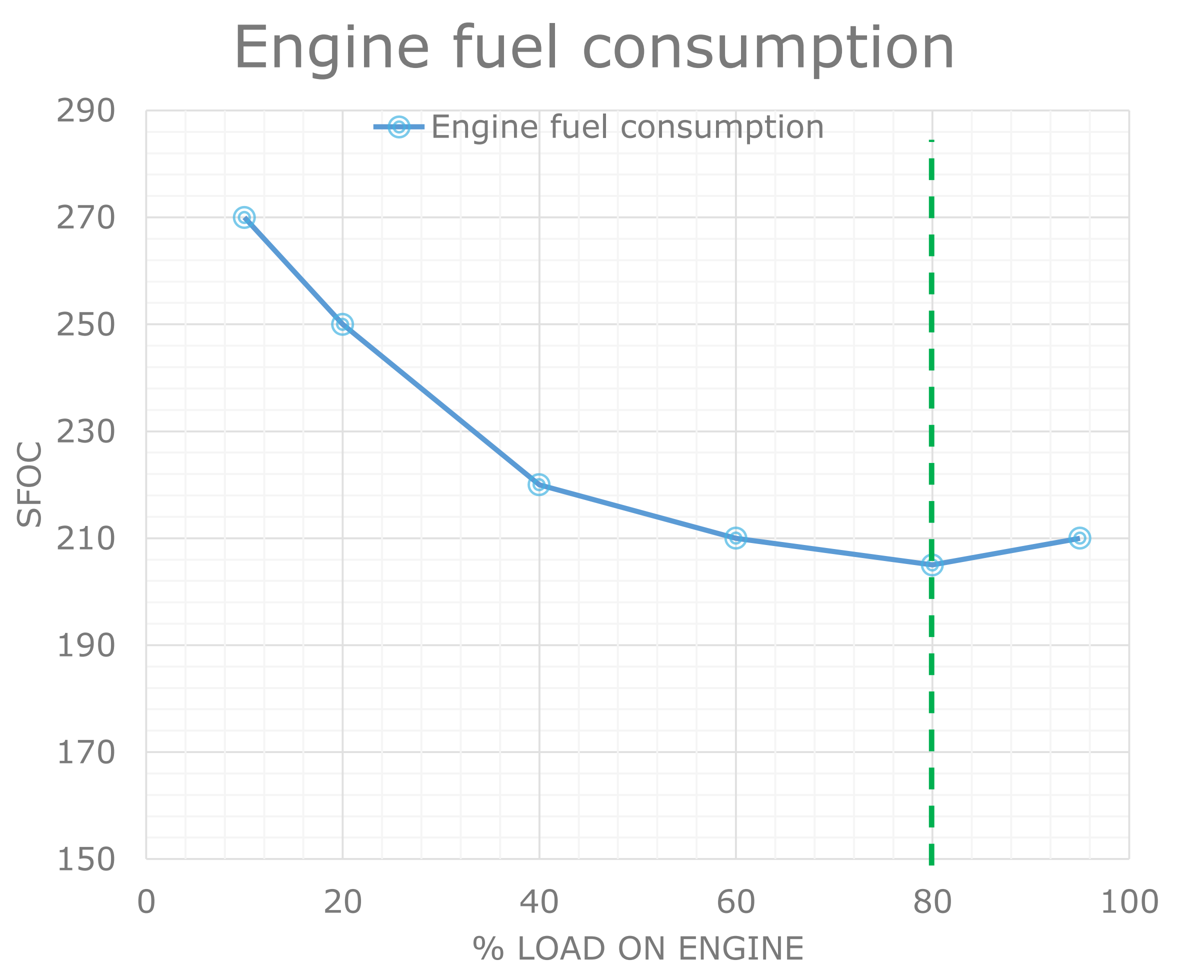


The figure is a typical engine fuel curve for 4-stroke engine (2-stroke has the same shape)

Spinning Reserve – calculation example

- 1 engine 80 %:
- 205 g/kWh
- 1500 kW
- 24h

- Fuel consumption 7,38 tonnes
  - 82 %
- 24 hours operation
  - 25 % of maintenance!



The figure is a typical engine fuel curve for 4-stroke engine (2-stroke has the same shape)

An example of a battery system from Corvus