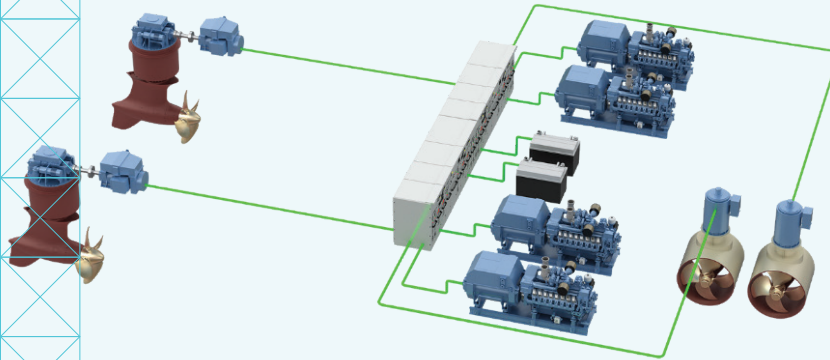


# DC HYBRID SOLUTIONS FOR YACHTS



KONGSBERG

KONGSBERG

## DC hybrid solutions

The demand for green solutions in the maritime industry is driving an increased use of clean electrical power systems that utilize flexible energy producers. KONGSBERG DC Solution is a scalable energy solution for conventional power systems as well as complex systems.

### About

Our mission is to help our customers lower the lifetime cost and maximising return on investment in power systems. Our DC solution offers significant fuel efficiency gains, reduced emissions and an economically beneficial step towards a greener and cleaner environment.

KONGSBERG offers the latest generation system design with an integrated drive line-up for the whole vessel. All frequency convertors, drives and switchboards are housed in a drive lineup for a significantly smaller footprint. A combined drive lineup is simpler to cool and has less yard connections than a conventional AC power plant. It is therefore much easier to install, in addition more tests and verifications can be done in advance.

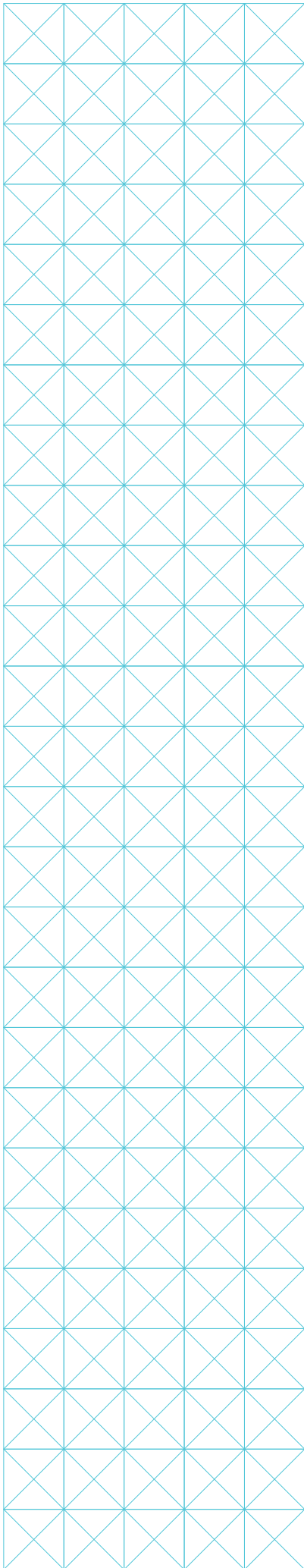
Our DC Solutions allows the engines to run at variable speed for increased fuel efficiency at each load level. And, the DC Solution enables full flexibility in combining energy sources, including renewables. Additional energy storage is available for spinning reserve, slow speed transits in harbour or for peak power load smoothing.

Core components of the DC Solution includes well proven components like AC generators, inverter modules, AC motors, etc. All main AC MSB's and transformers are however no longer needed and you have the most flexible power and propulsion system to date. The main benefits of this is a reduction of the fuel consumption due to variable speed operation. In addition, the system allows for considerably weight and space savings thus leading to increased cargo capacity.

### The advantages of variable speed gensets

Compared to traditional, constant speed genset, variable units can offer several advantages, such as up to 15% reduction in fuel consumption, up to 20% increase in time between overhauls, lower noise emissions and increased power density with less installation space.

Variable speed units are particularly useful in operating modes with a high percentage of low loads – which is normally occurring for yachts.



## Comparison of fuel consumption between a variable speed and constant speed engine

The aspect of fuel economy is a vital part of the lifecycle cost (LCC) of such a ship, as figure 1 illustrates.

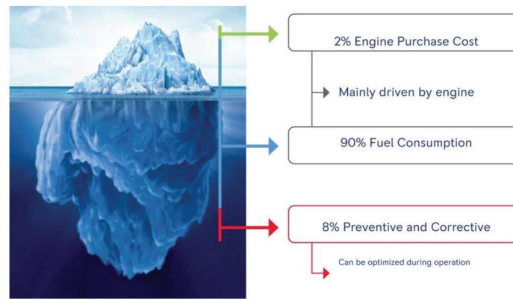


Figure 1. Average distribution of the operating costs compared to the investment costs for the engine

In addition to the diesel engine and the generator, the electrical power conversion through various electrical components such as converters must be considered. Examination of another evaluation case has shown that efficiency advantages of up to 5% are possible with the generator at partial load.

The main difference compared to a traditional AC power system is an internal common DC distribution. As well as the usage of AC/DC and DC/AC converters between the DC switchboard and generators, and low power AC grid on board the vessel.

## Implementation of Energy Storage

In a DC Solution the Energy Storage is designed and implemented to increase peak loading capabilities on energy producers and avoid running of redundant energy producers.

KONGSBERG focus on cost and efficiency optimisation, in that essence we can design our DC-solutions for floating main DC voltage operation. For application where energy storage is used for more than peak shaving and spinning reserve, we normally eliminate power conversion against the energy storage. By providing a more advanced energy control we can eliminate DC/DC converters in our DC solutions reducing cost and power losses to ensure our customers get the best possible CAPEX and OPEX out of their investment.

## Extended TBO

An additional advantage of variable speed units is that the reduced speed enables the maintenance / time between overhauls (TBO) to be extended by approximately 20%, which results in lower costs. However, it must be noted that this contrasts with additional costs for the electrical components and increased programming effort of approximately 15% for the variable speed units.

## Quiet operation

An additional benefit of a variable speed unit that is especially noticeable is the reduction of sound emissions. This plays an important role, especially in terms of comfort.

Comparison of surface noise (sound pressure level) at a power of 500 kW (about 20% load):

- MTU 16V 4000 M63L (variable speed) at 1,135 rpm  $\diamond$  approx. 95 dB (A)
- MTU 16V 4000 M43S (constant speed) at 1,800 rpm  $\diamond$  approx. 101 dB (A)

## Proven DC Hybrid Solutions

KONGSBERG has 45+ DC Hybrid solutions in operation or in projects in multiple segments.