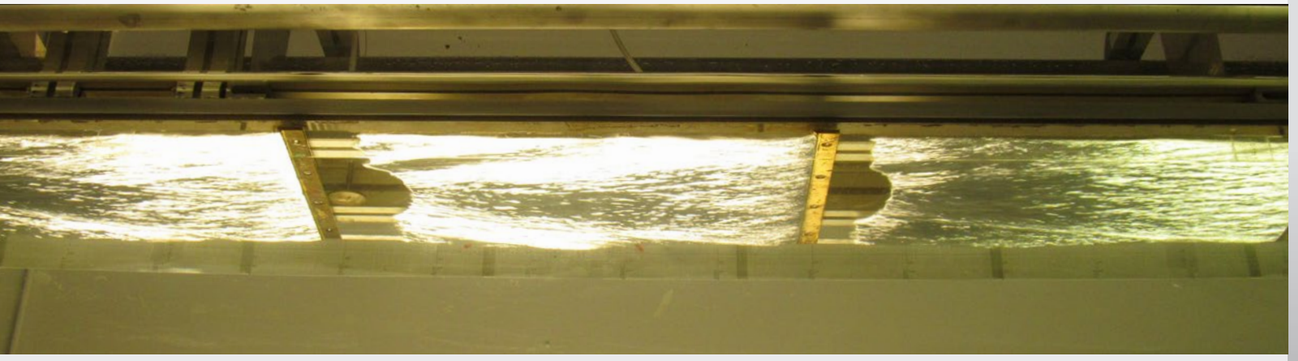
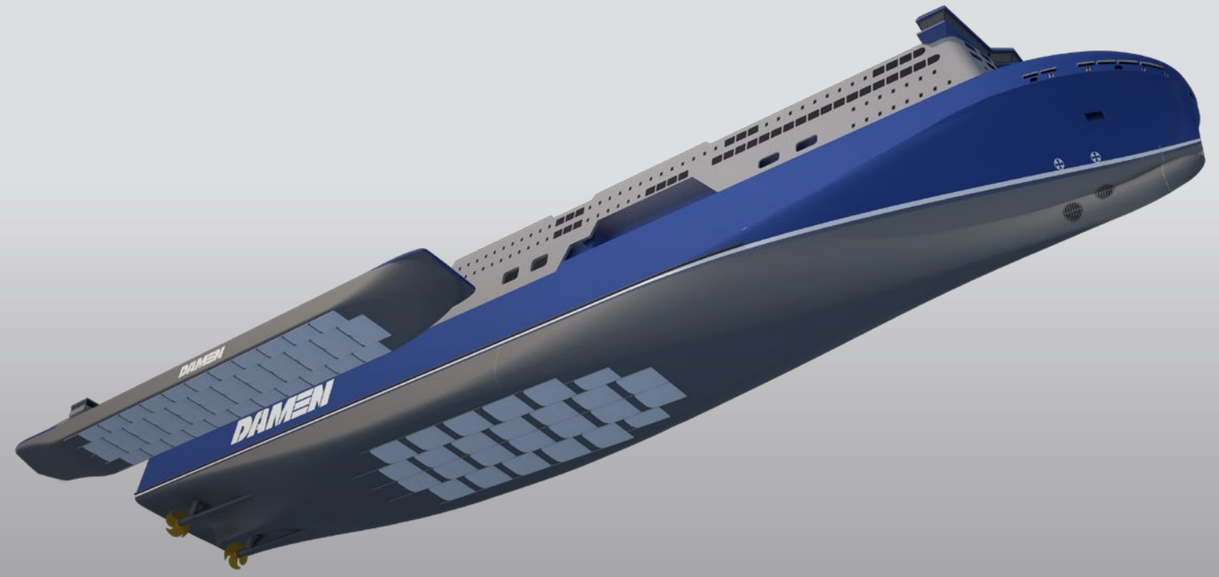
TOWARDS ZERO-EMISSION SHIPPING



Emission-free sailing is now becoming feasible for inland and short sea navigation. Electrically-driven ships use batteries or electricity generated on board from ‘clean’ fuels such as hydrogen.

Wide application of emission-free ships is currently limited by energy storage and production capacity, as well as the associated high costs. As such, energy efficiency is especially critical for such vessels. DACS, with its potential for energy consumption in ships, can reduce the size of the energy generation and storage system or extend the vessel’s range. The benefits for battery powered vessels are reduced battery size and weight, as well as charging time.



DAMEN AIR CAVITY SYSTEM

CONTRIBUTING TO LOW EMISSION SHIPPING

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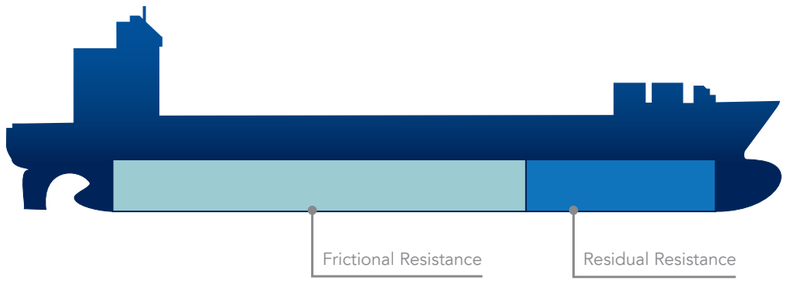
DACS

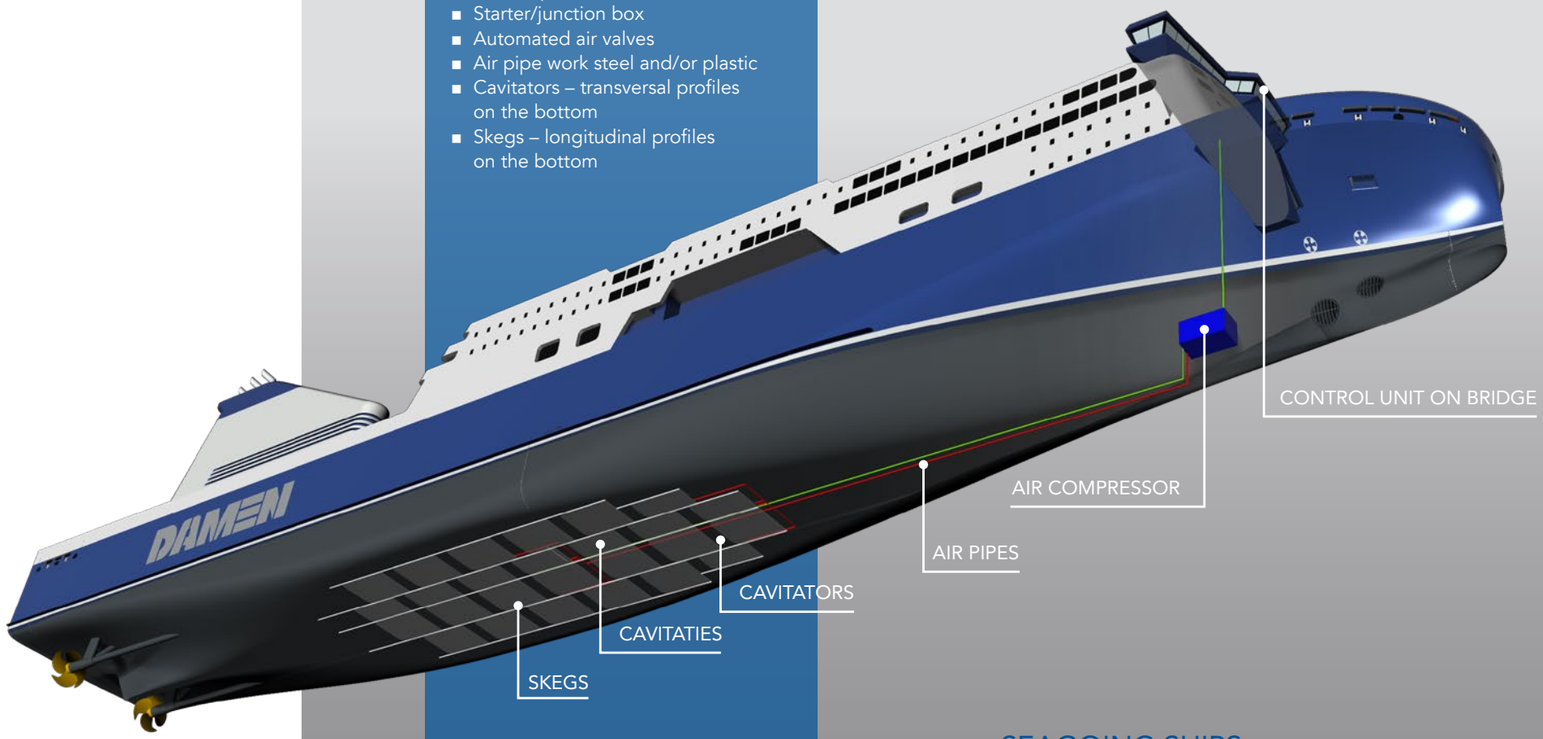
The Damen Air Cavity System (DACS) originated from a research project at the Delft University of Technology (TU Delft) in the Netherlands. Maintaining a thin layer of air over the flat bottom of a vessel's hull, DACS achieves a significant reduction in water resistance, leading to increased efficiency and a reduction of fuel consumption and, therefore, emissions.



Lowering the ship resistance results in the reduction of the fuel/energy consumption and emissions. The hull optimisation generally helps to reduce the wave making and pressure resistance whereas the frictional resistance, which is dominant, considered as given and it is proportional to the wetted area. Damen Air Cavity System DACS forms stable air cavities on the flat bottom of a ship. The system has a high overall efficiency and can be used on ships for fuel consumption and emission reduction.

DACS LAYOUT
For a successful DACS operation the following components must be integrated into the vessel structure:

- Bridge control and alarm panel
- Air compressor
- Starter/junction box
- Automated air valves
- Air pipe work steel and/or plastic
- Cavitators – transversal profiles on the bottom
- Skegs – longitudinal profiles on the bottom



BENEFITS

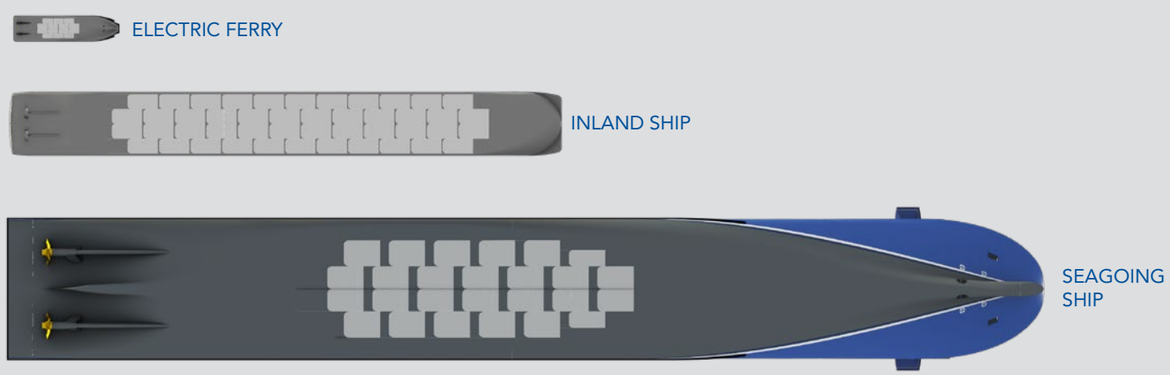
- Lowers fuel consumption
- Reduces pollutions
- Reduces negative effect of the fouling on resistance
- Qualified for Green Award
- Qualified for EIA tax reduction (for Dutch flag vessels only)
- Can be accounted in EEDI

SEAGOING SHIPS

SAVINGS ABOUT 5%

Relative efficiency of the DACS on seagoing ships is usually smaller compared to inland waterway ships. Hoverer, the seagoing ships are normally larger, sailing at higher speeds and therefore have more installed power and the absolute fuel consumption is higher, hence absolute savings on fuel and emissions on seagoing ships can be significant.

EXAMPLES OF COVERED AREA BY DACS FOR DIFFERENT SHIP TYPES



INLAND WATERWAY SHIPS

Inland waterway ships have a large flat bottom area and they sail at relatively low speeds, often in shallow water. This is why for this type of ship the relative fuel consumption reduction by DACS is the highest. The fuel savings and emission reduction is equal to between 10 and 20%.