HOLISTIC DESIGN CONSIDERATIONS TO THE GREEN MARINE OPERATIONS

Ulstein Lucy Lu

ULSTEIN

- More than 100 years' experience in the maritime industry
- Innovator in maritime equipment, designs and ships
- Family-owned, third generation

450
People

4
Countries

Norway
Main office Ulsteinvik

Established 1917

ADAPTING TO NEW SEGMENTS

Transport
RoPax

Energy
Offshore oil and gas

Recreation
Yacht

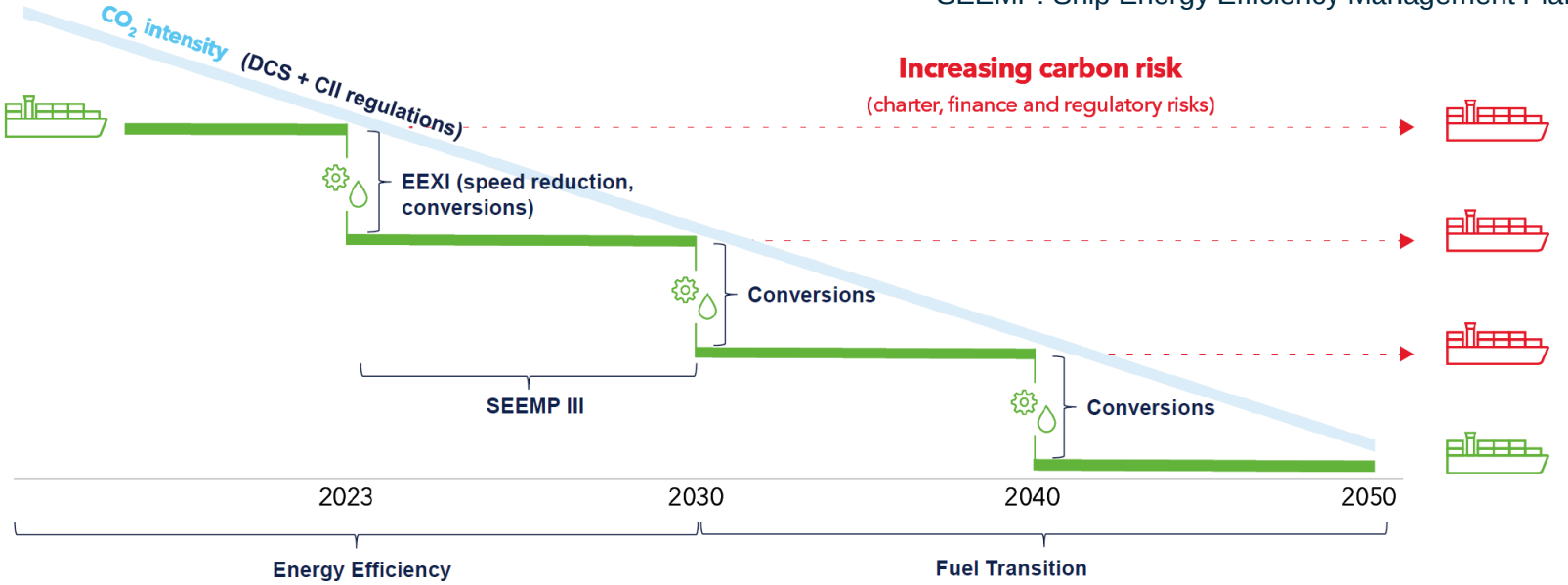
Recreation
Expedition cruise

Renewables
Offshore Wind

Seafood
Coastal to ocean-going

PATHWAYS

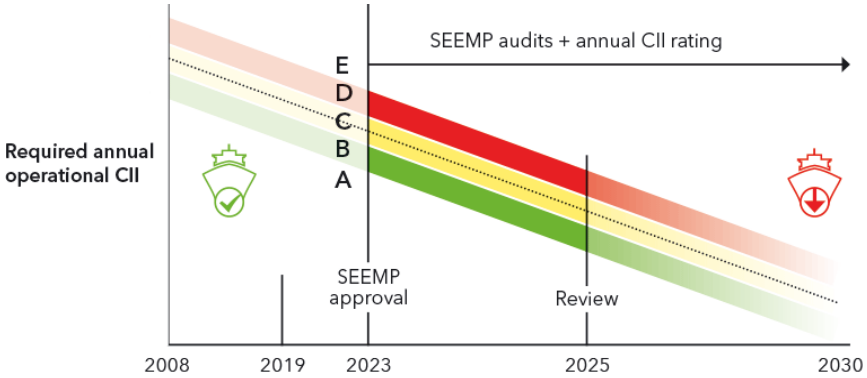
DCS: Data Collecting System
CII: Carbon Intensity Indicator
EEXI: Energy Efficiency Existing Ship Index
SEEMP: Ship Energy Efficiency Management Plan



Source: DNV 2021

CARBON INTENSITY

Attained CII based on received planned itinerary and estimated energy demand (MGO), repeated for each scored year

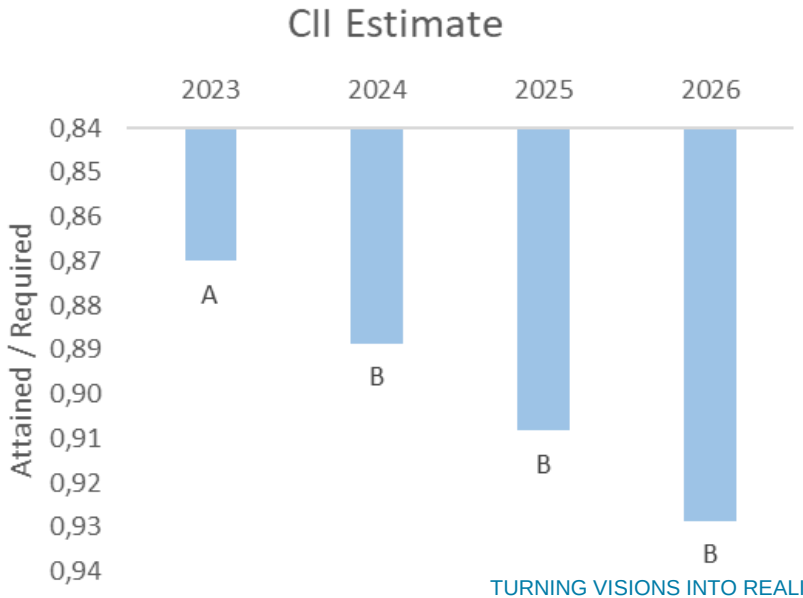


Calculation of annual CII:

$$CII = \frac{\text{Annual fuel consumption} \bullet CO_2 \text{ factor}}{\text{Annual distance travelled} \bullet \text{Capacity}} \bullet \text{Correction factors}$$

To be developed

GT	21420
Distance	78900 nm
CO2 emissions	28505 t
Attained CII	16,87



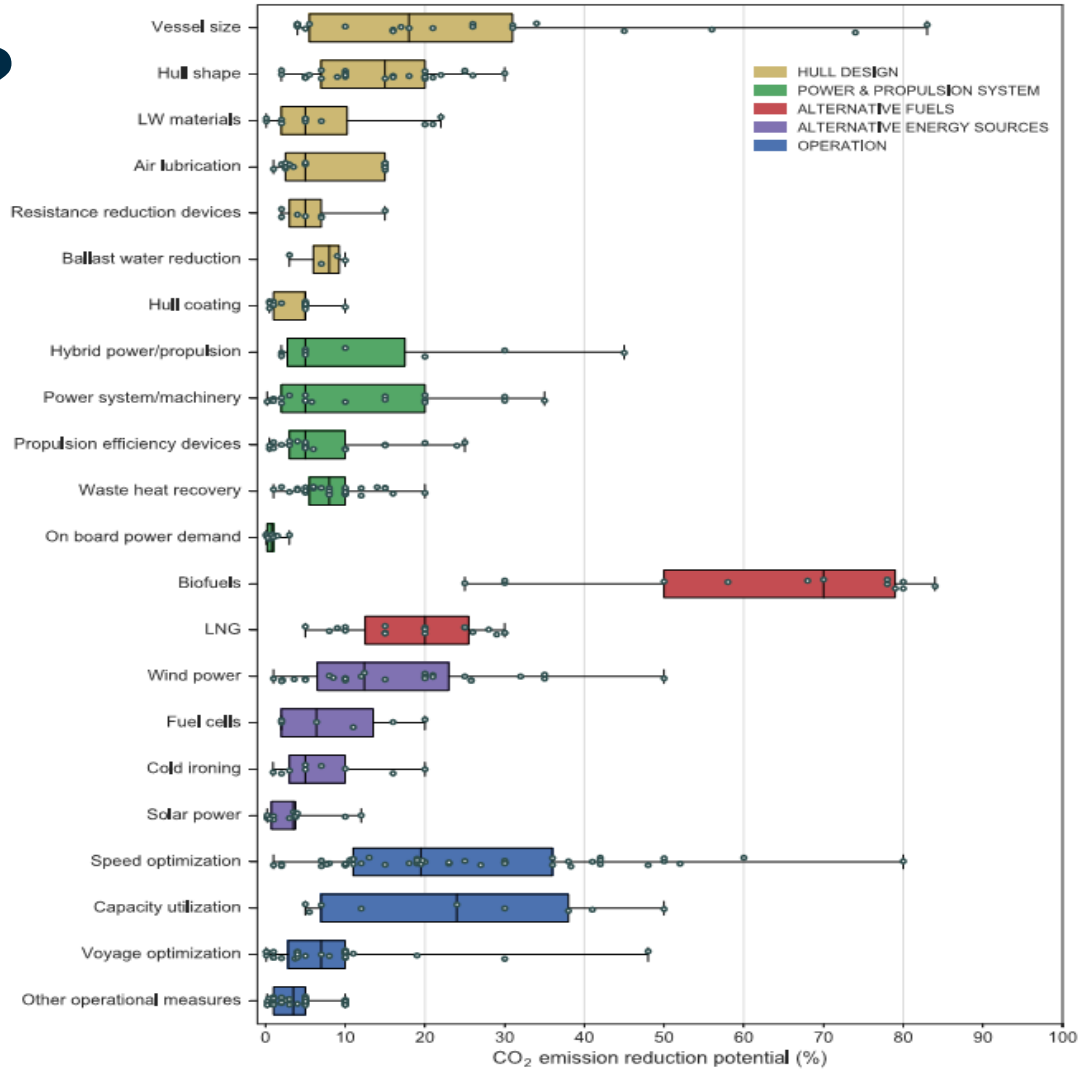
WHAT CAN WE DO?

There are many alternatives to reduce the emissions of shipping.

Over the years, ship design practitioners and researchers have proposed and tested different alternatives. Yet, many of these alternatives have a limited effect on the level of emissions as a single action to take, typically below 10%, while they can have substantial consequences to the operational and commercial exploitation of the vessel.

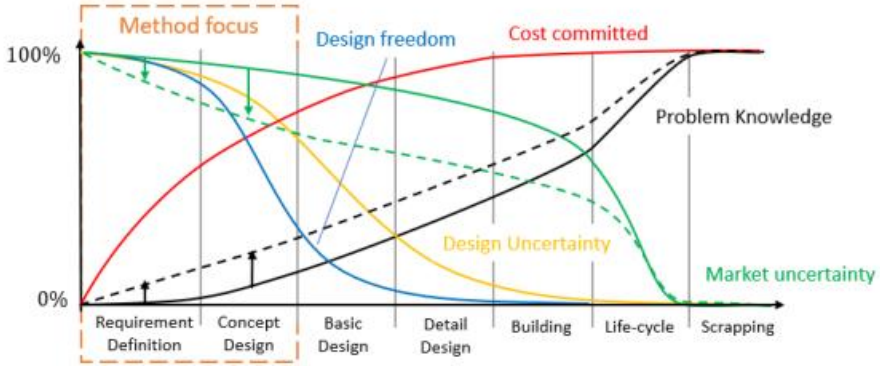
Ship design is a systematic engineering process.

Source: Bouman et al. (2017) Transportation Research Part D, 52, 408-421



ULSTEIN BLENDED DESIGN METHOD

- Market Model
- Ship Model:
  - Scaling
  - Weight estimate
  - Power and Propulsion
  - Mission of the ship
  - Cost & Income
- Uncertainty Model
  - Regulation development
  - New technologies
  - Market distortions
  - Life-time financial performance
- Verification & Validation:
  - Internal consistency
  - Justification of knowledge claims
  - Competitiveness analysis



Design freedom over the design process, adapted from (Nam and Mavris, 2008)

RIGHT-SIZING ENABLES ZERO-EMISSION OPERATIONS

- Ulstein Twin X-Stern to have the energy reducing benefit, as well as to keep DP flexibility;
- Optimized deck space to ensure the supply need but also avoid unnecessary power consumption;
- Remote operation, reduce accommodation and vessel size;
- Battery system and offshore charging solutions;

ULSTEIN U-STERN

- 25 % reduction in motions, increase operability;
- 50% power reduction in DP (Dynamic Positioning) operations due to weather vaning;
- Safer lifting operations offshore;

STRATEGIES TOWARDS GREENER OPERATIONS

ULSTEIN®

Capacity utilization
Optimized routing
Lower speeds
Digitalization

1. More effective vessel operations

2. Reduce energy consumption

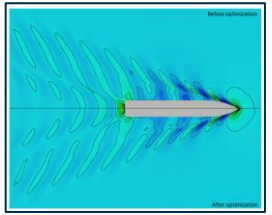
3. Smarter use of energy onboard

4. Use of greener energy sources

Compact design
System efficiency
LED lighting
Hull coating
Foils
Hybrid propulsion
Ballast-free designs
Lower hydrodynamic and aerodynamic resistance
Air cavity lubrication

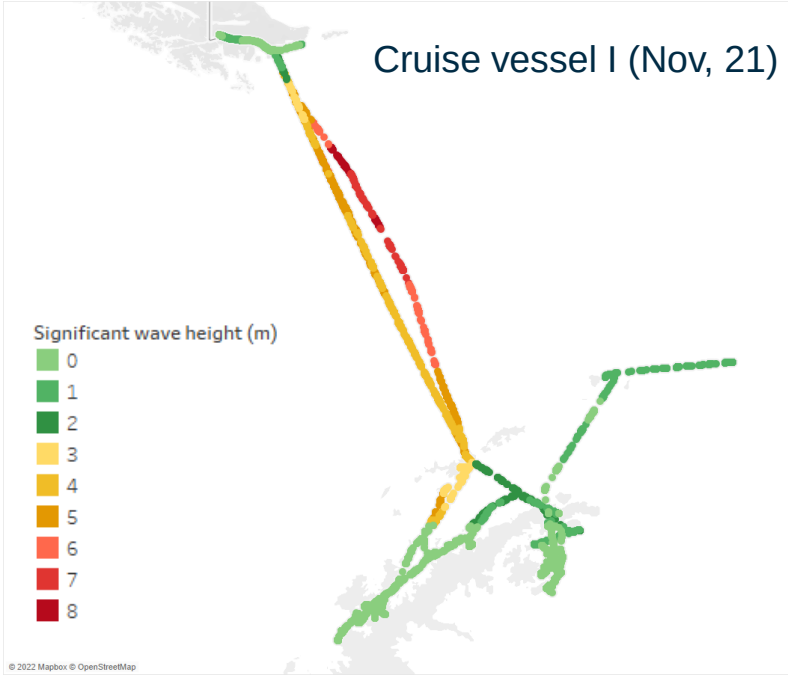
Heat recovery
Energy management
Energy storage

Wind energy
Solar energy
Hydroelectric energy
Hydrogen (H_2)
Biofuels
Methanol (CH_3OH)
Natural gas (LNG/CNG)
Ammonia (NH_3)
Nuclear power

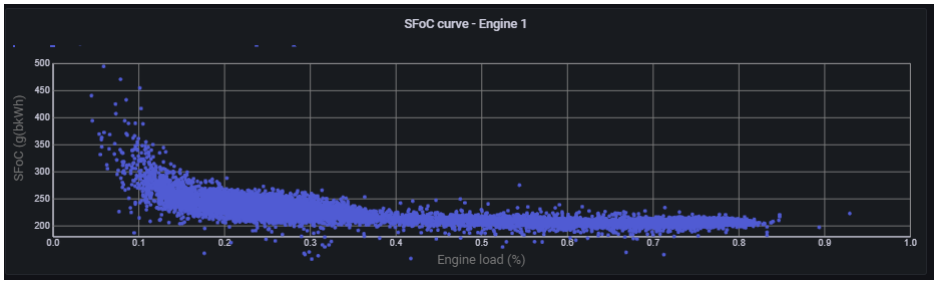


CLOSE LOOP BETWEEN DESIGN AND OPERATIONS

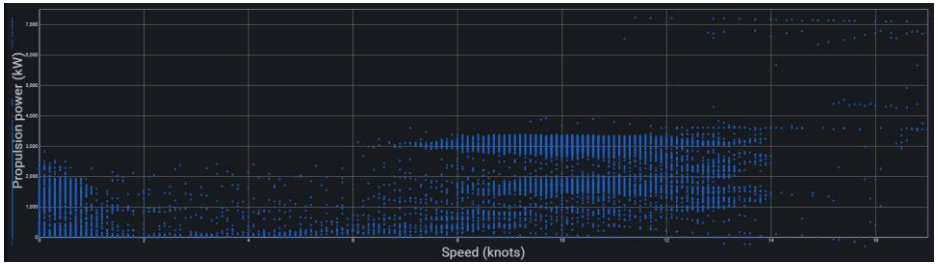
Design based on extensive feedback from operations



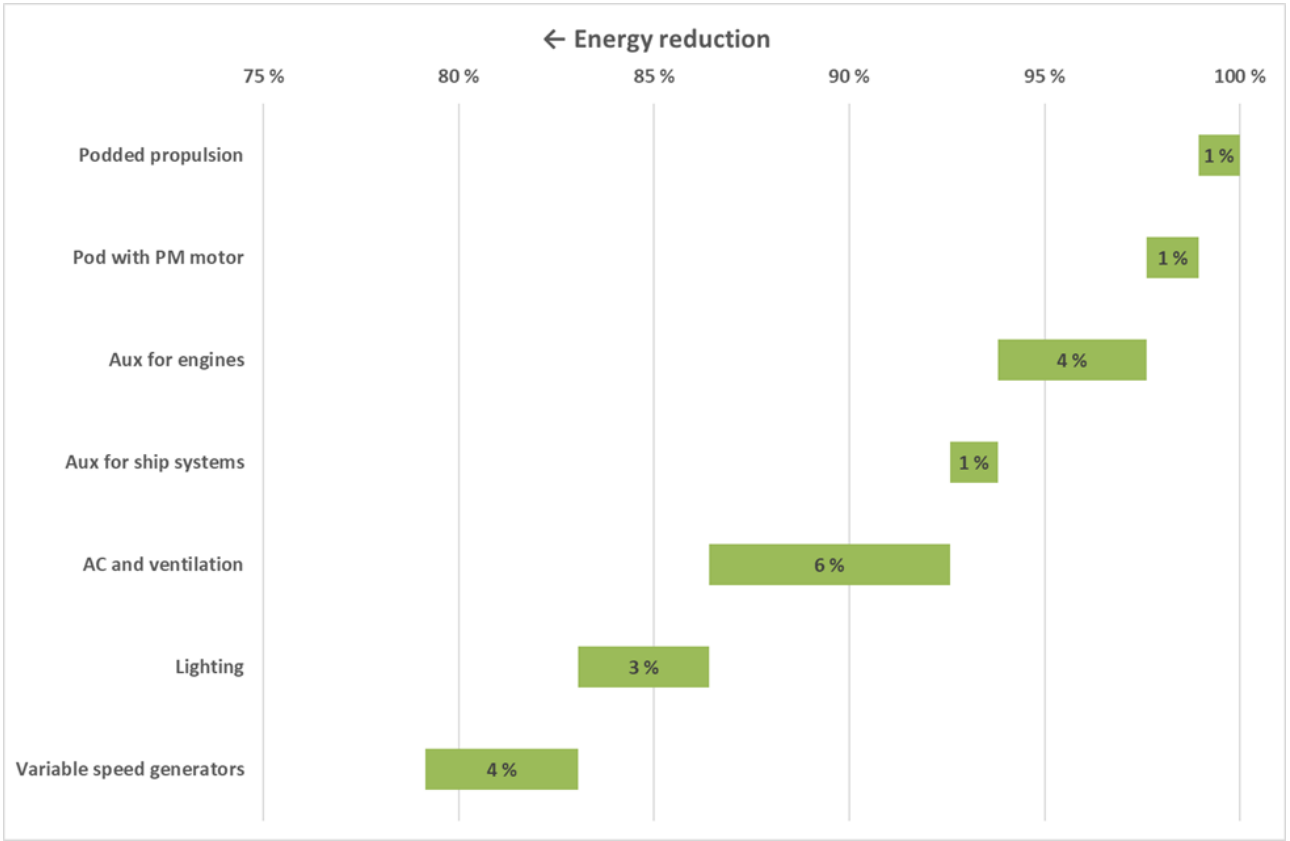
Specific fuel consumption of engines



Speed power curve



REDUCE ENERGY CONSUMPTION



Application of various technologies relative to no measures taken.

Indicated energy reduction in relation to the vessel's total energy requirement.

SMARTER USE OF ENERGY ONBOARD

- Controlled Waste Heat Energy System
- Utilize waste heat from:
  - High temperature cooling water
  - Exhaust gases
  - Low temperature cooling water
- Combined with:
  - Boilers
  - CO2 heat pumps
  - Hot water calorifiers
  - Rack coolers

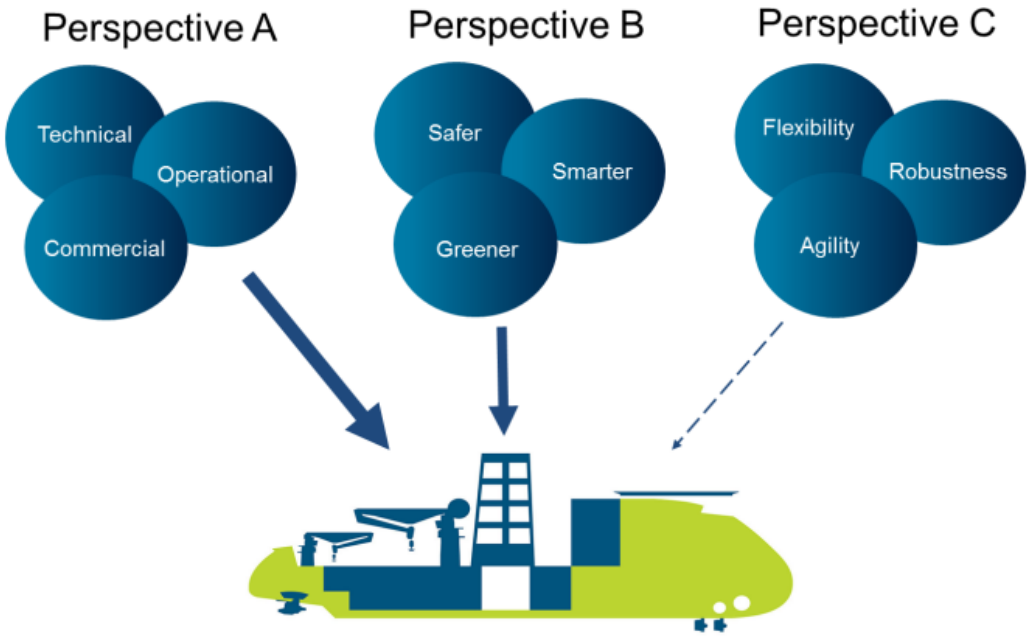
- Waste Heat Energy consumers:
  - Pre-heating of HVAC units
  - Heating of sanitary water
  - Fresh water production
  - Tank heating
  - De icing
  - Ballast water treatment
  - Heat to power units

USE OF GREENER ENERGY SOURCES AND MATERIAL

- We have seen more and more alternative fuel ships coming to live.
  Like Methanol.
- Class rules are present.
- Design process buleprint.

- Battery as hybrid power:
  - 4,5 MWh for the world's largest hybrid ferry.

  - 1,130 kWh for fish factory trawler ECOFIVE



Ship design is dancing between complexities and uncertainties.

Turn unknowns into knowledge.


ULSTEIN®