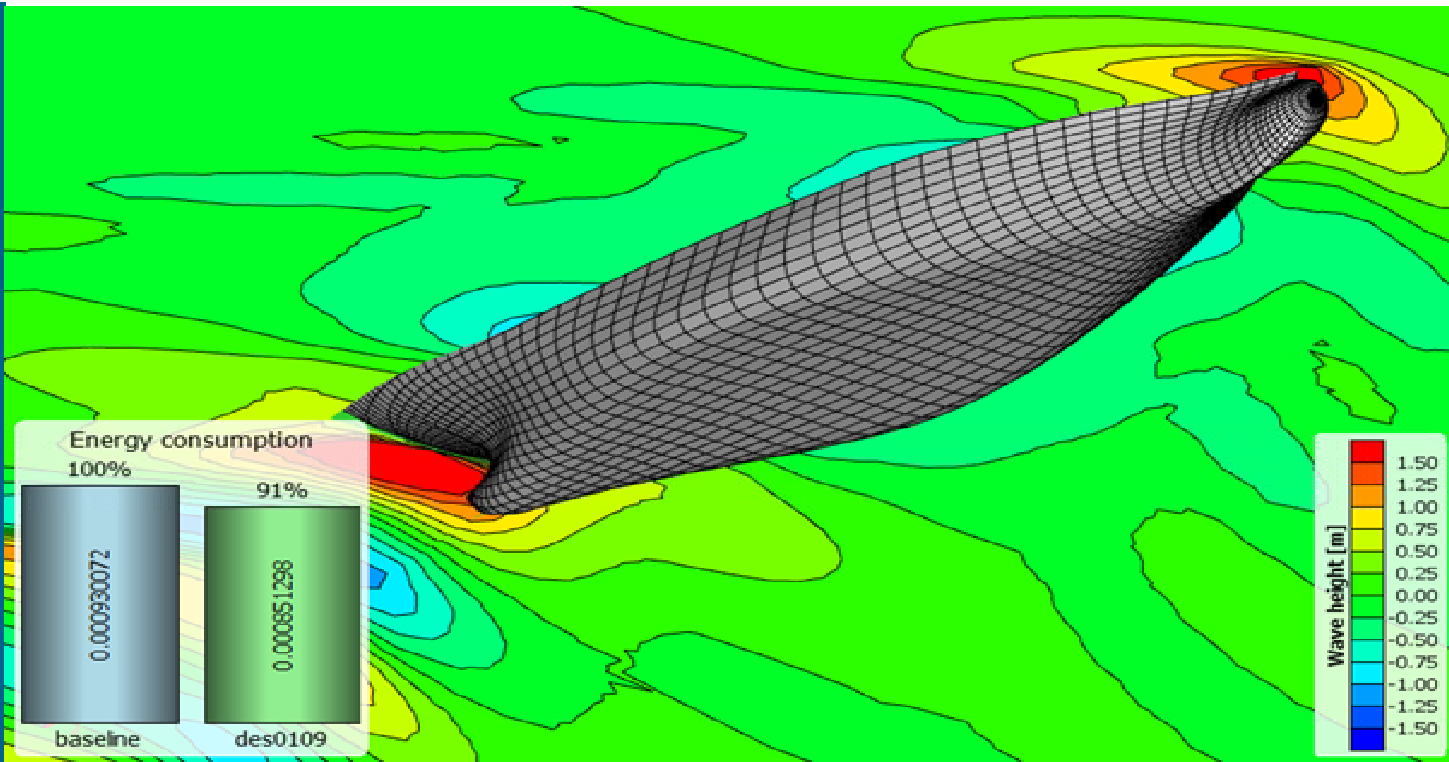


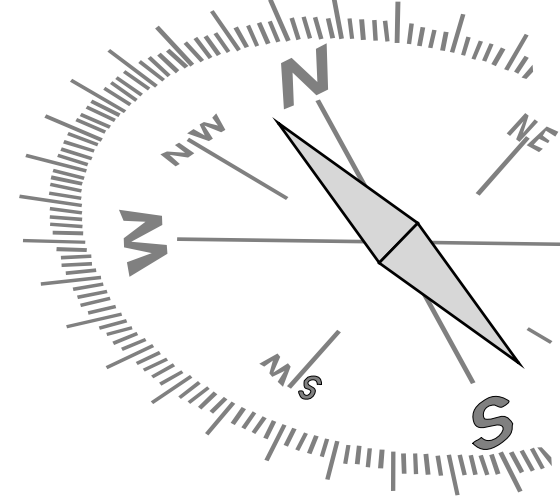
CO₂ Emissions & Propulsion

Volker Bertram



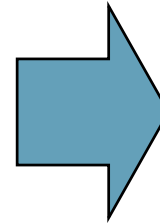
Navigator

- Global picture
- Low-Carbon fuels
- Higher engine efficiency
- Reduced required power
- Conclusion

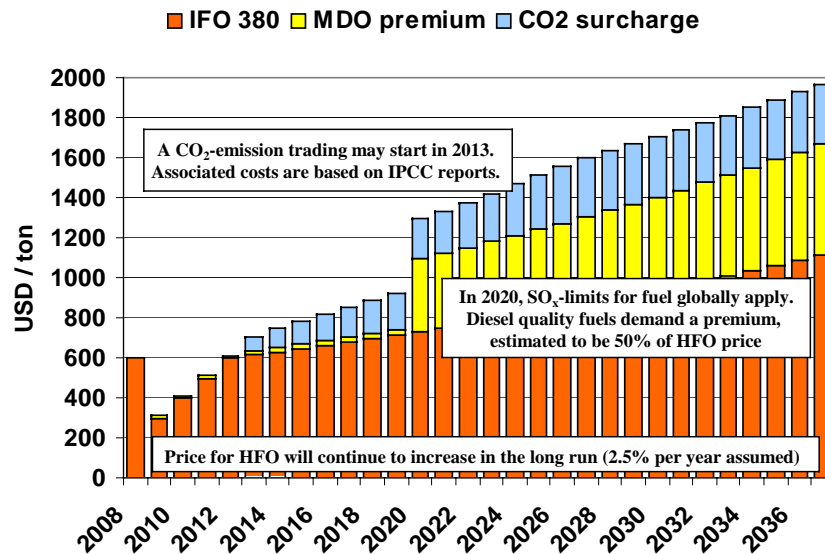


Need to tighten the (fuel) belt

- Rising fuel prices
- Stricter regulations (Emissions)



search for
fuel-efficient ship



EEDI as global measure

EEDI = Energy Efficiency Design Index

- IMO metric (CO₂ emission / transport work)
- “simple” formula
- baseline gives upper limit (as function of size & type)
 will be lowered over time, increasing pressure
- Class certifies EEDI

Like filing a tax declaration

Files and files and files...

- NO_x Technical File(s)
- (Final) Trim and Stability Booklet
- Light weight certificate (if applicable)
- Sea trial report
- Model test report/results
- ...

... need to be processed




EEDI Technical File support by FutureShip

EEDI needs to be certified

Certificate by Germanischer Lloyd

1. Receiving of all relevant data & documents (required in GL EEDI Guideline)
2. Approval of data
3. Approval of EEDI calculation and EEDI
4. Issuing EEDI certificate (and report)



The image shows a sample EEDI Certificate from Germanischer Lloyd. The certificate is for the vessel 'MS SAMPLE' and includes the following details:

- GL** logo in the top right corner.
- EEDI Certificate** title.
- Text: "This is to certify that the vessel:"
- MS SAMPLE** (Vessel Name)
- IMO No.: 05061979 | Call Sign: NOFX | GL-Reg. No.: 050679
- Port of Registry: Hamburg
- Owner or Management Company: Sample Shipping Company Ltd.
- Text: "has been assigned the"
- ENERGY EFFICIENCY DESIGN INDEX CERTIFICATE**
- Certificate No.: 58 911-08 HH
- Text: "based on the MEPC.1/Circular 681 'INTERIM GUIDELINES ON THE METHOD OF CALCULATION OF THE ENERGY EFFICIENCY DESIGN INDEX FOR NEW SHIPS' and MEPC.1/Circular 82 'INTERIM GUIDELINES FOR VOLUNTARY VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX'"
- Text: "The underlying data have been verified on 2008-05-29 in Athens/Greece."
- Text: "The CO₂-Index of the ship was assessed with a value of:"
- EEDI_{design} = 6.94 g CO₂ / (t*kilometer)
- EEDI_{design} = 12.85 g CO₂ / (t*nautical mile)
- Text: "This value is valid for one year and expires on 2010-12-31."
- Date: Hamburg, 2010-01-01
- Germanischer Lloyd** logo at the bottom.

EEDI formula

Main Engines

f_j – correction factor for ship specific design elements

P_{MEi} – 75 % ($P_{MCRi} - P_{PTOi}$) of the rated installed power

Auxiliary Engines

$P_{PTI(i)}$ – 75 % of rated power of shaft motors

$P_{AEeff(i)}$ – auxiliary power reduction of innovative electrical technologies at $P_{ME(i)}$

Innovative technologies

P_{eff} – main engine reduction due to innovative energy efficiency technologies

f_{eff} – availability factor of any innovative efficient technology

$$\left(\prod_{j=1}^M f_j \right) \left(\sum_{i=1}^{nME} C_{FMEi} SFC_{MEi} P_{MEi} \right) + P_{AE} C_{FAE} SFC_{AE}^* + \left(\prod_{j=1}^M f_j \sum_{i=1}^{nPTI} P_{PTIi} - \sum_{i=1}^{neff} f_{effi} P_{AEeffi} \right) C_{FAE} SFC_{AE} - \left(\sum_{i=1}^{neff} f_{eff} P_{eff} C_{Feff} SFC_{MEi} \right)$$

$$f_i \text{Capacity} V_{ref} f_w$$



Transport work

f_i – coefficient for technical/regulatory limitation on capacity

Capacity – depending on ship type

V_{ref} – reference speed

f_w – coefficient indicating decrease of speed due to wind and waves

Weighed and found wanting?

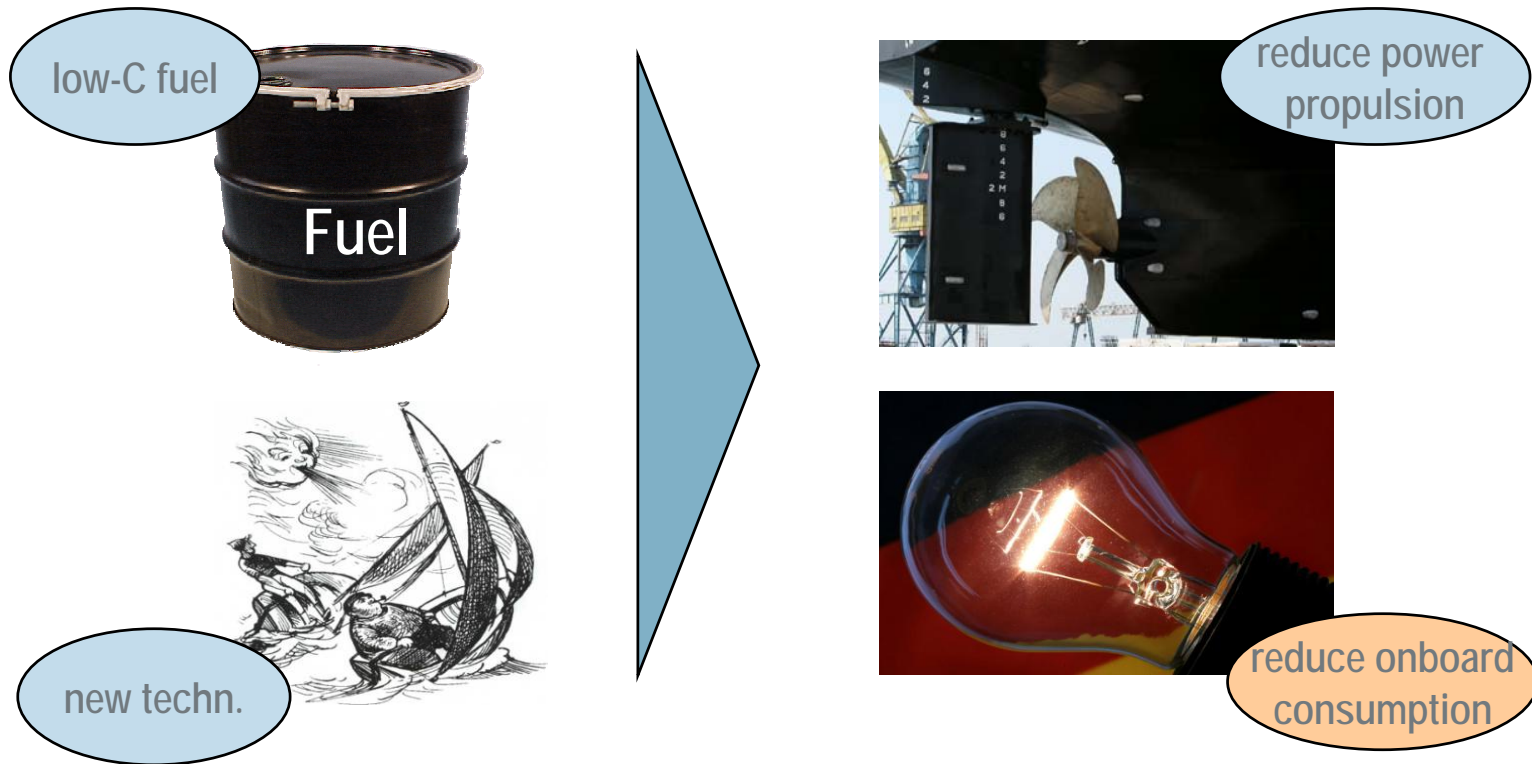
- Baseline will shift to down
- Ships must improve EEDI

Now what?



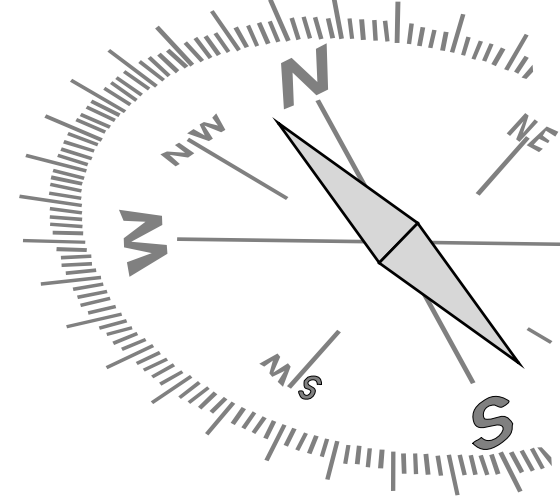
Many levers to reduce emissions

Measures to reduce CO₂ emissions



Navigator

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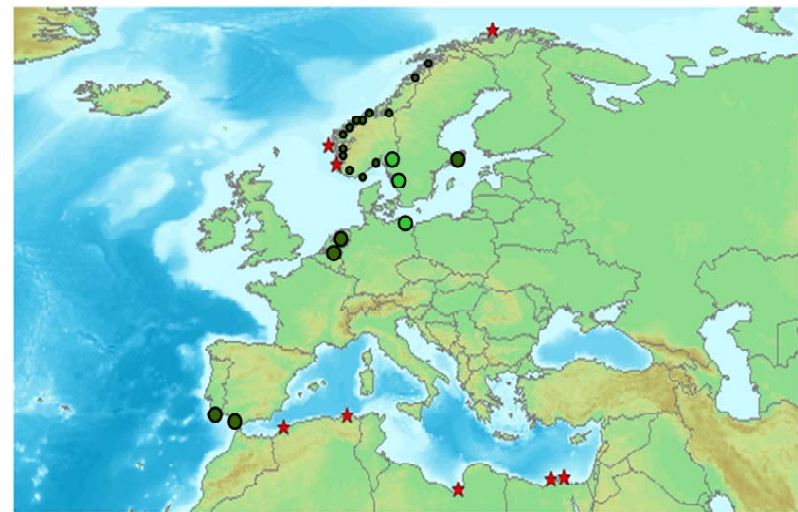
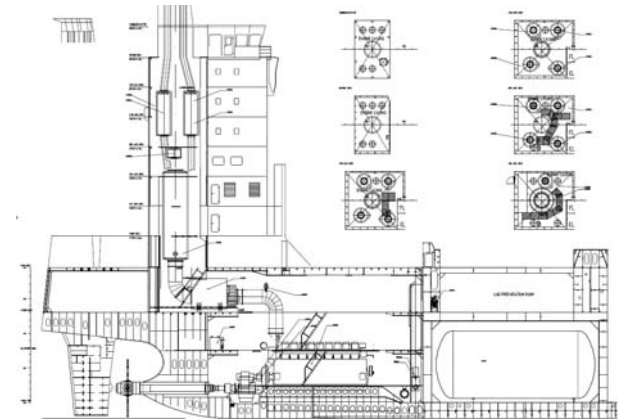


LNG as a clean fuel

LNG as a (near) future option

- 20% less CO₂
- almost no SO_x, NO_x, PM
- engines available
- operation allowed

Bottleneck:
Fuel Station



Super-Clean: Wind assistance

Kites & Flettner rotor

- 4 ships with SkySails
- 1 E-ship with Flettner rotor

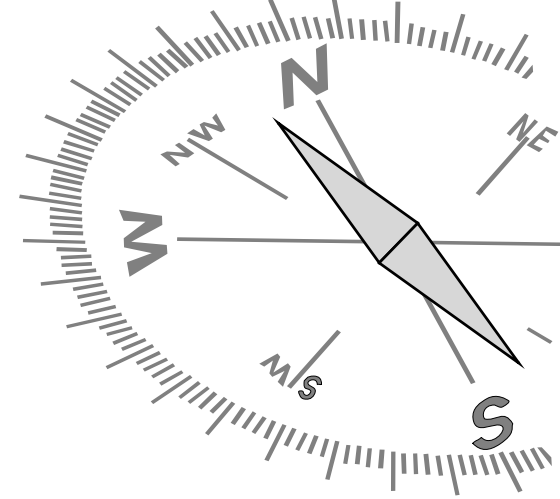
Requirements:

- slow ship speed (< 12-14 kn)
- high wind speed (e.g. Atlantic)
- controllable pitch propeller



Navigator

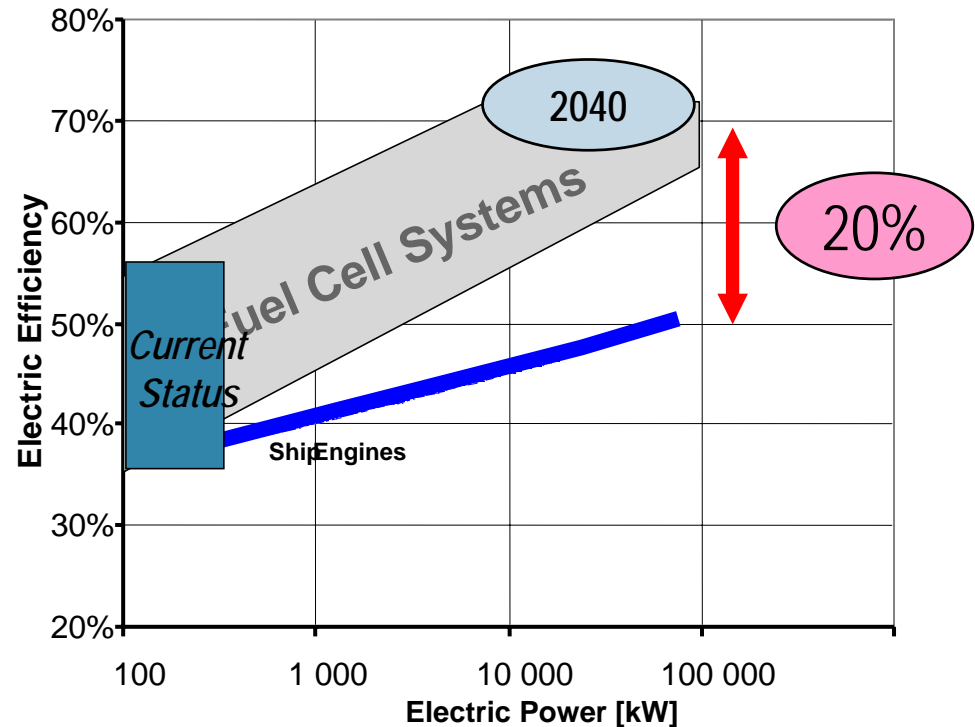
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Fuel cells much more efficient

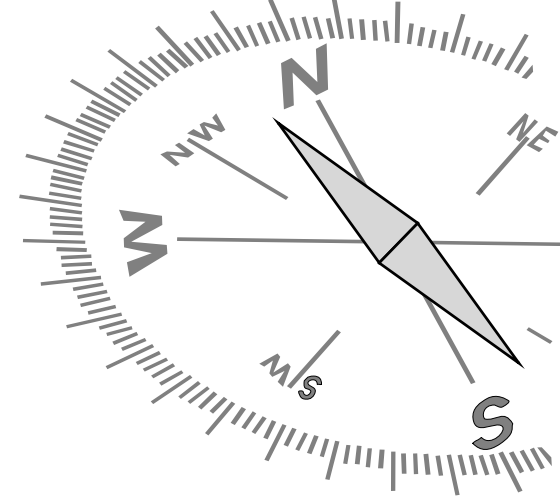
Fuel cells in a nut shell

- much higher efficiency
- need special fuel (eg LNG)
- need to evolve in size
- GL drives maritime applications



Navigator

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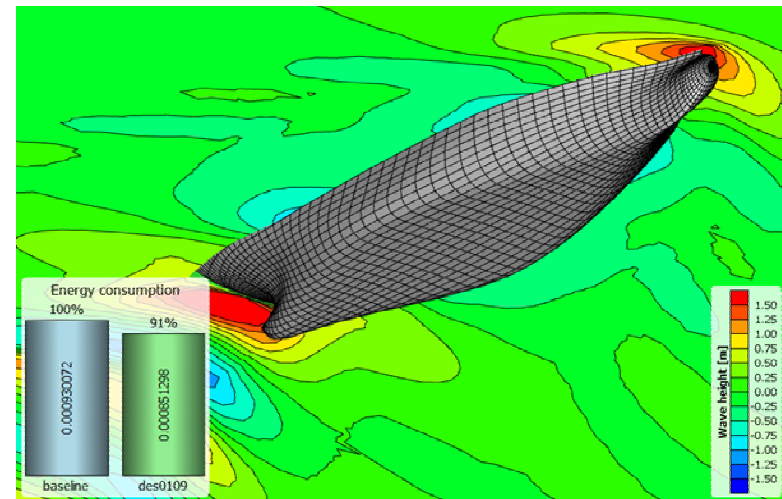


Example: Lines Optimization

Lines optimization

- 10,000 – 20,000 alternatives investigated
- typically 4-5% improvement

Same basic principles
for trim optimization





Example: “magic nozzles”

Wake equalizing nozzle

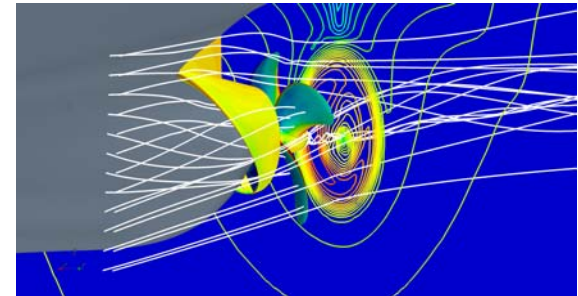
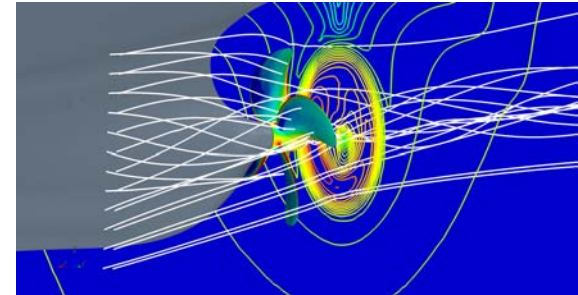
Schneekluth, Mewis, SILD, Hitachi Zosen, ...

☺ refit possible

☺ up to 7% claimed by vendors

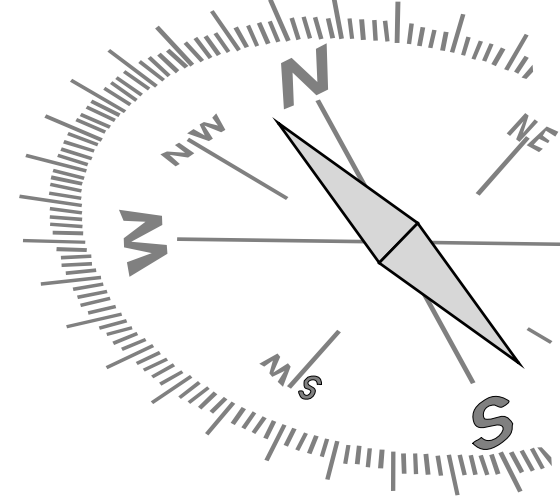
☹ not substantiated in our experience

CFD assessment recommended



Navigator

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Conclusion

- EEDI puts pressure on industry
- Preparation supported by consultants
- Compliance certified by Class
- Improvement supported by consultants

“A good plan [...] executed now
is better than a perfect plan next week”
(General George S. Patton)



How can we help you?

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