

Bureau Veritas S.A. Hamburg/Germany

Prime Mover / Are there alternatives to the diesel engine?

STG Conference on Ship Efficiency Hamburg, 09.10.2007

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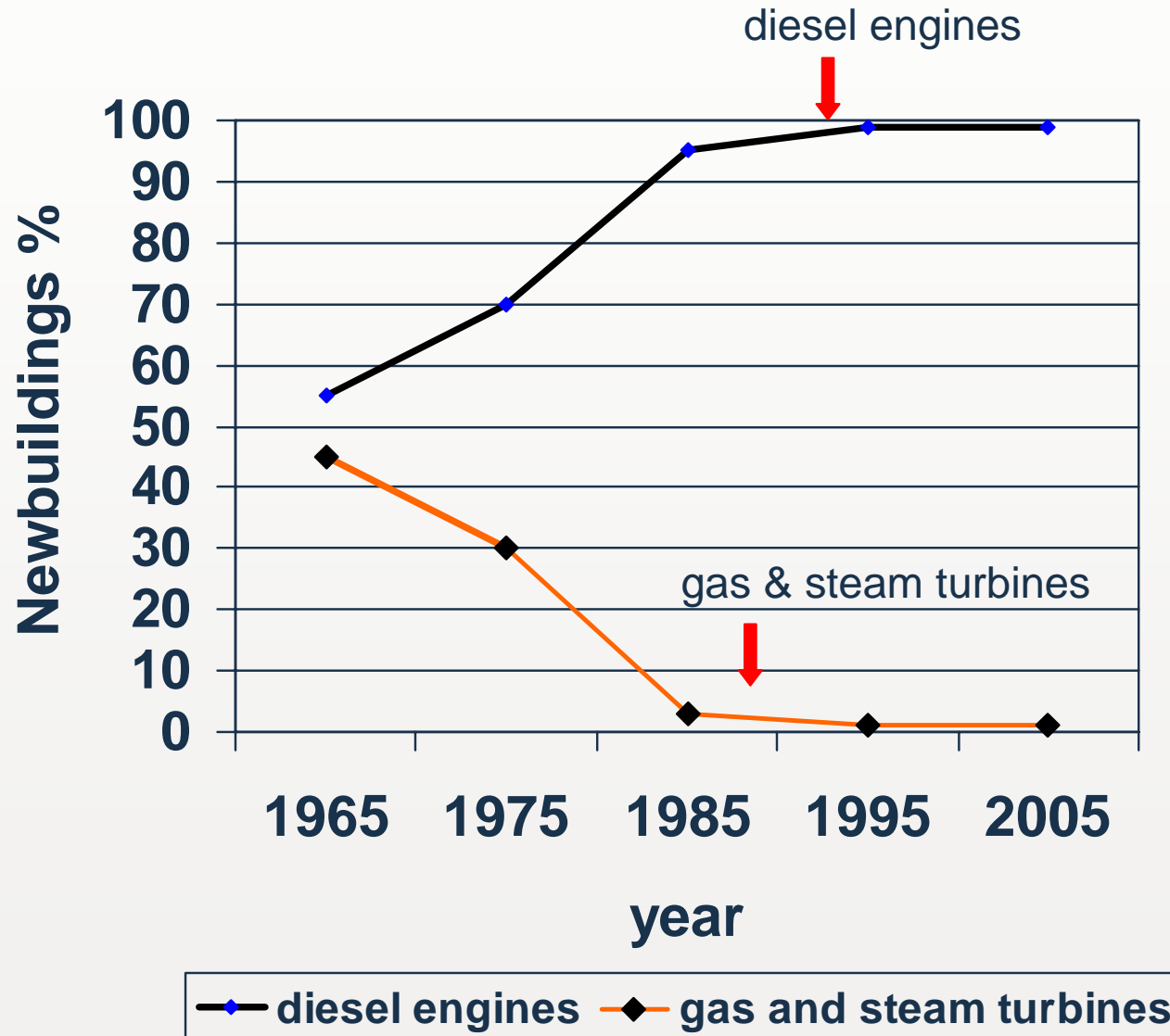
Move Forward with Confidence

owner:

➤ **Income – (CAPEX+OPEX+fuelcost+fees)**

➤ **owner of a timechartered vessel:
charterrate-(CAPEX + OPEX)**

➤ **equity provider:
return on capital investment**



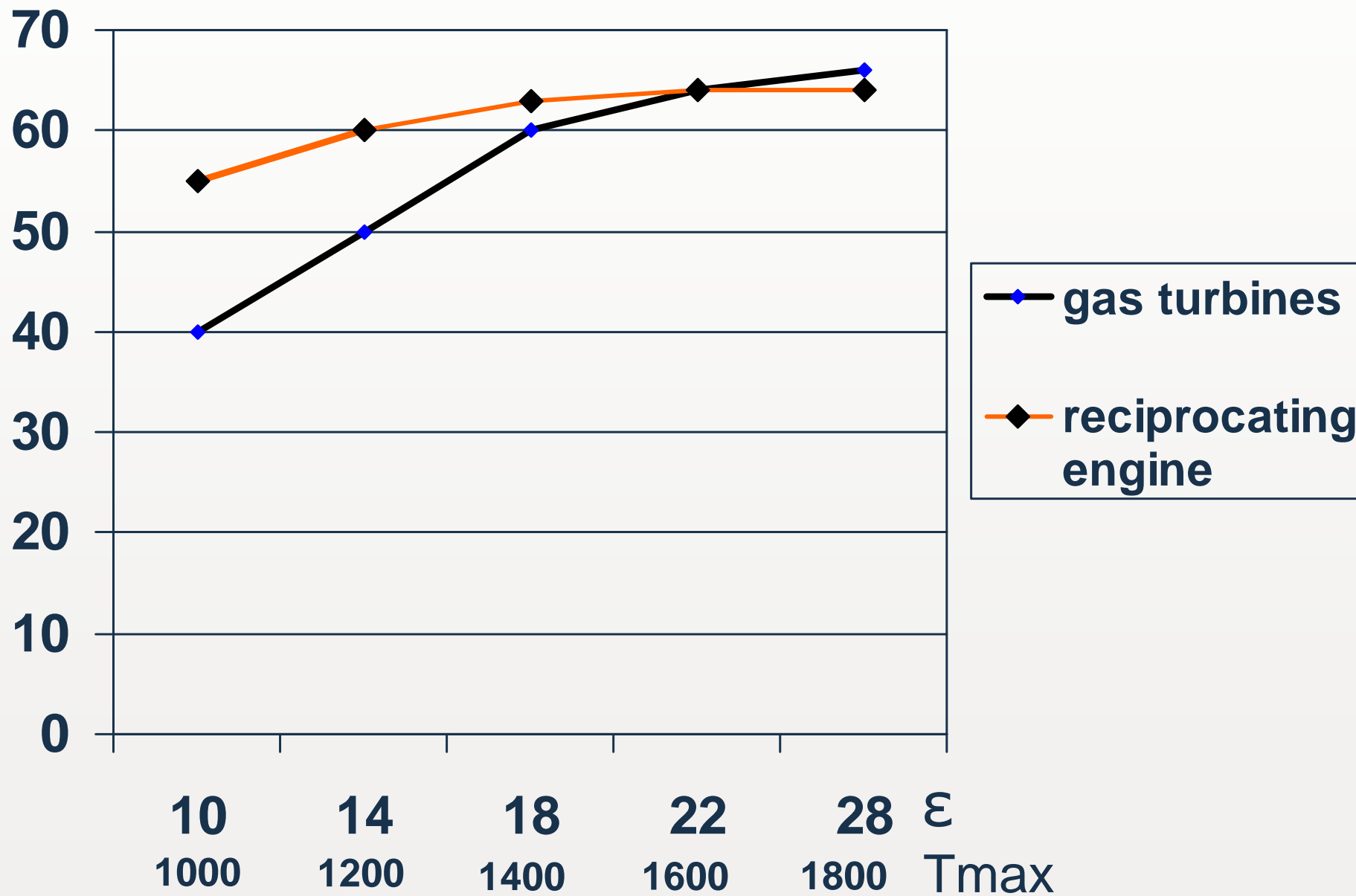
Gas turbines

$$\eta_{th} = 1 - \frac{T_{min}}{T_{max}}$$

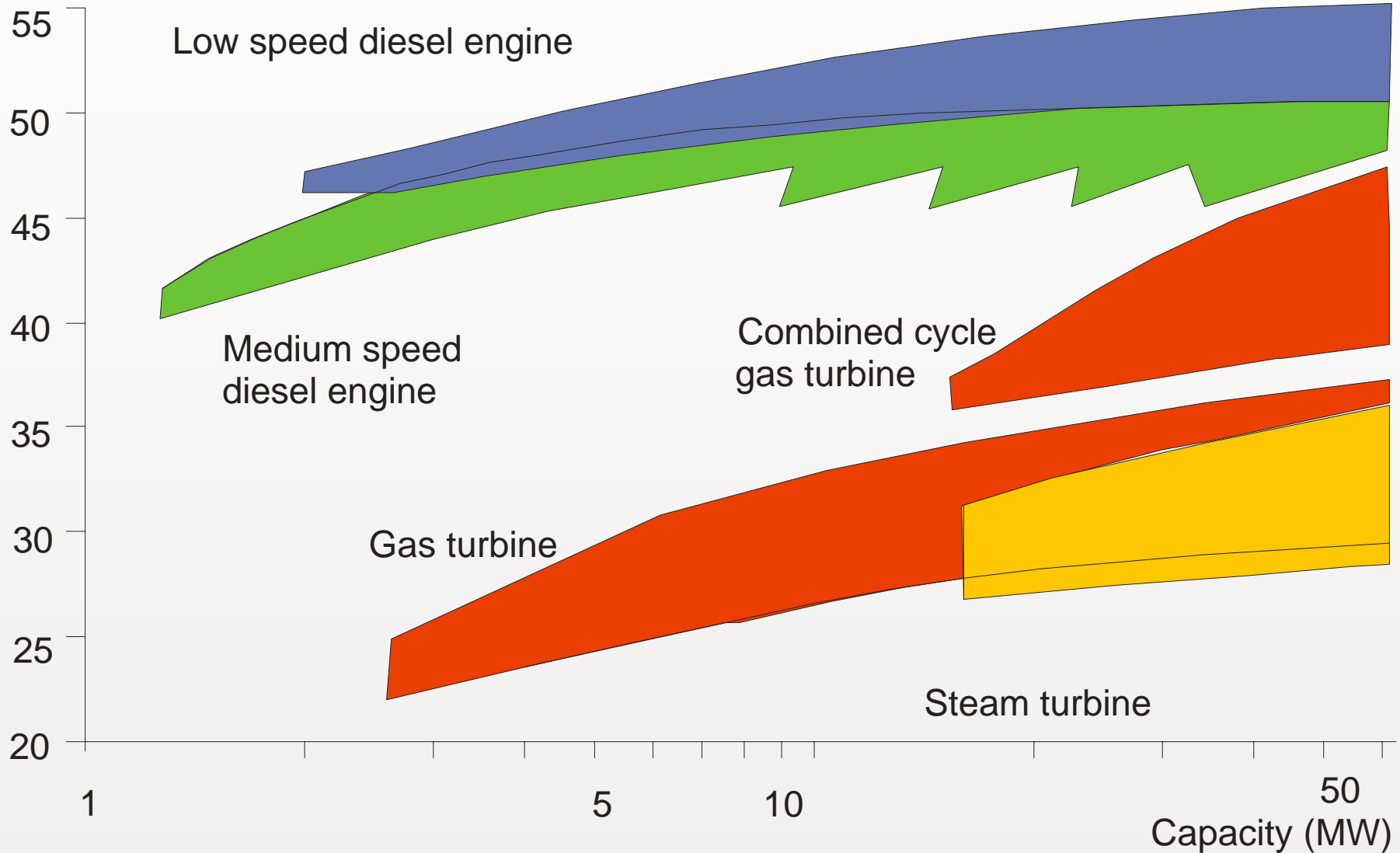
Reciprocating Engine (Otto)

$$\eta_{th} = 1 - \frac{1}{(\epsilon)^{(\kappa-1)}}$$

Comparison Theoretical Efficiency



Thermal efficiencies %



Source: MAN

- advanced cycle steam turbine
- 70 bar, 560 °C
- intermediate superheating
- developed 30 years ago
- reintroduced by Japanese manufactures for LNG carriers

Main Advantages

- nearly every fuel can be used
- low maintenance cost
- low noise and vibration

Main Disadvantages

- efficiency below other plants
- limited experienced crew available

- realized on some passenger vessels

Main Advantages

- high efficiency for large plants
- low noise and vibration level
- low exhaustgas emissions

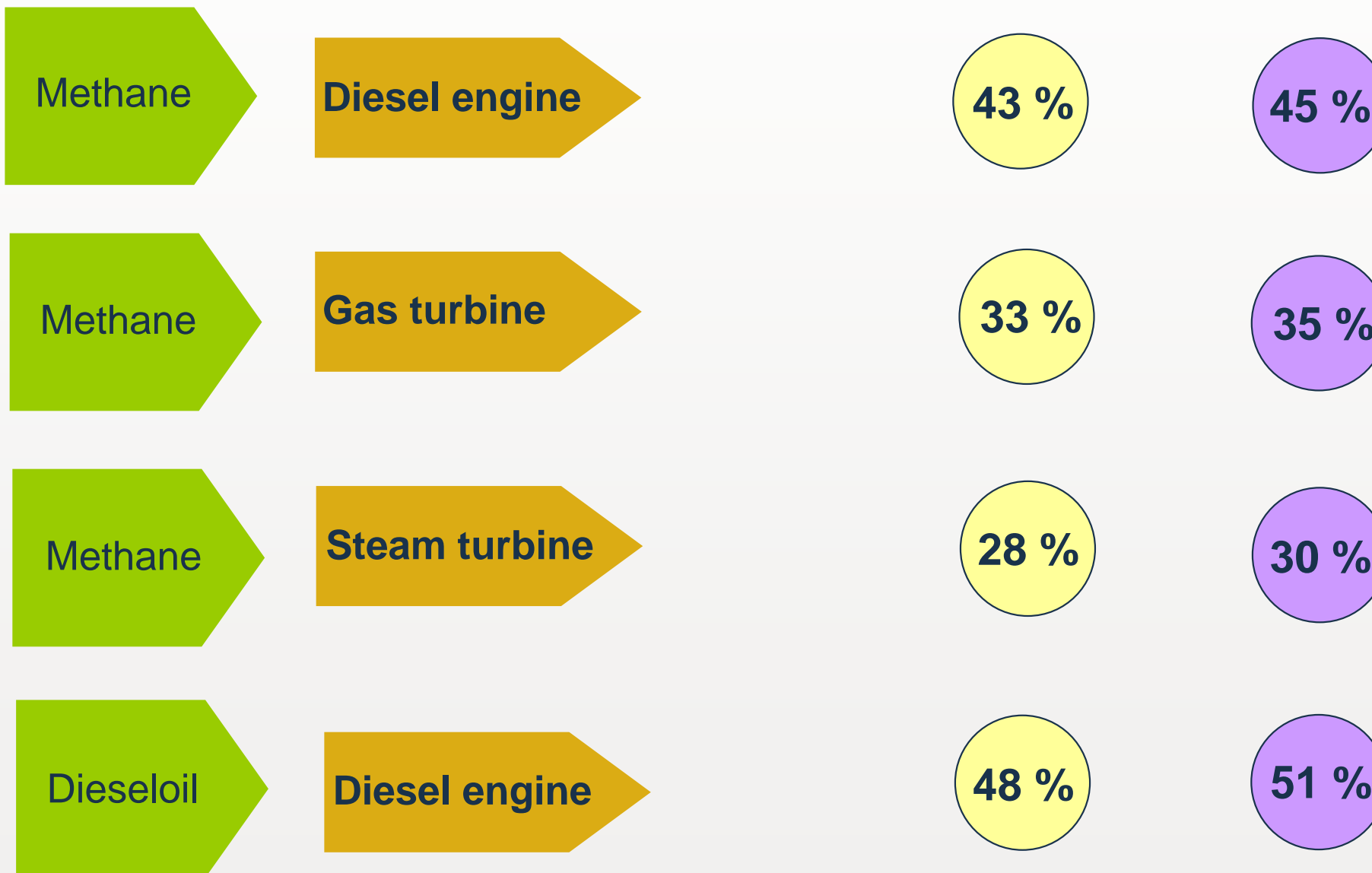
Main Disadvantages

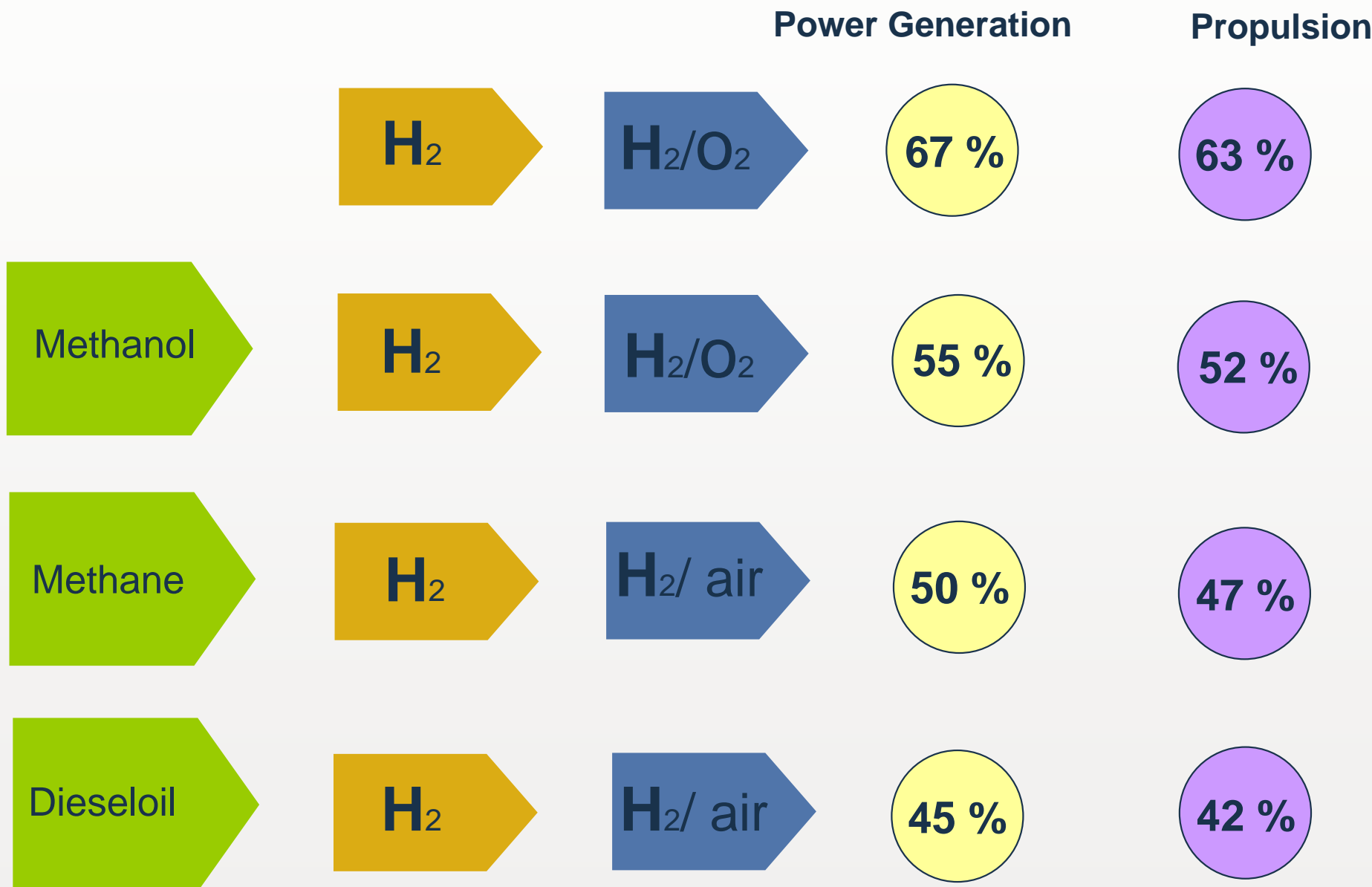
- „clean fuel“ to be used
- complexity of plant

Thermal Engines

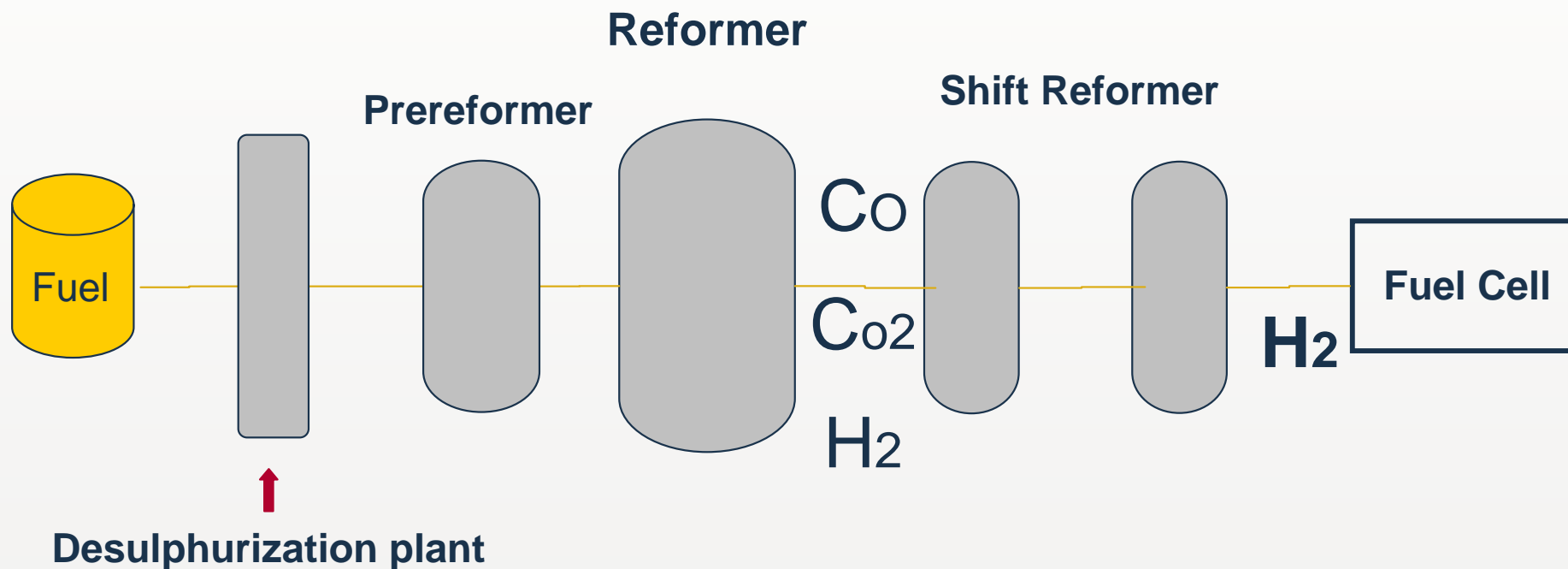
Power Generation

Propulsion





Reformerplants for Fuel Cells



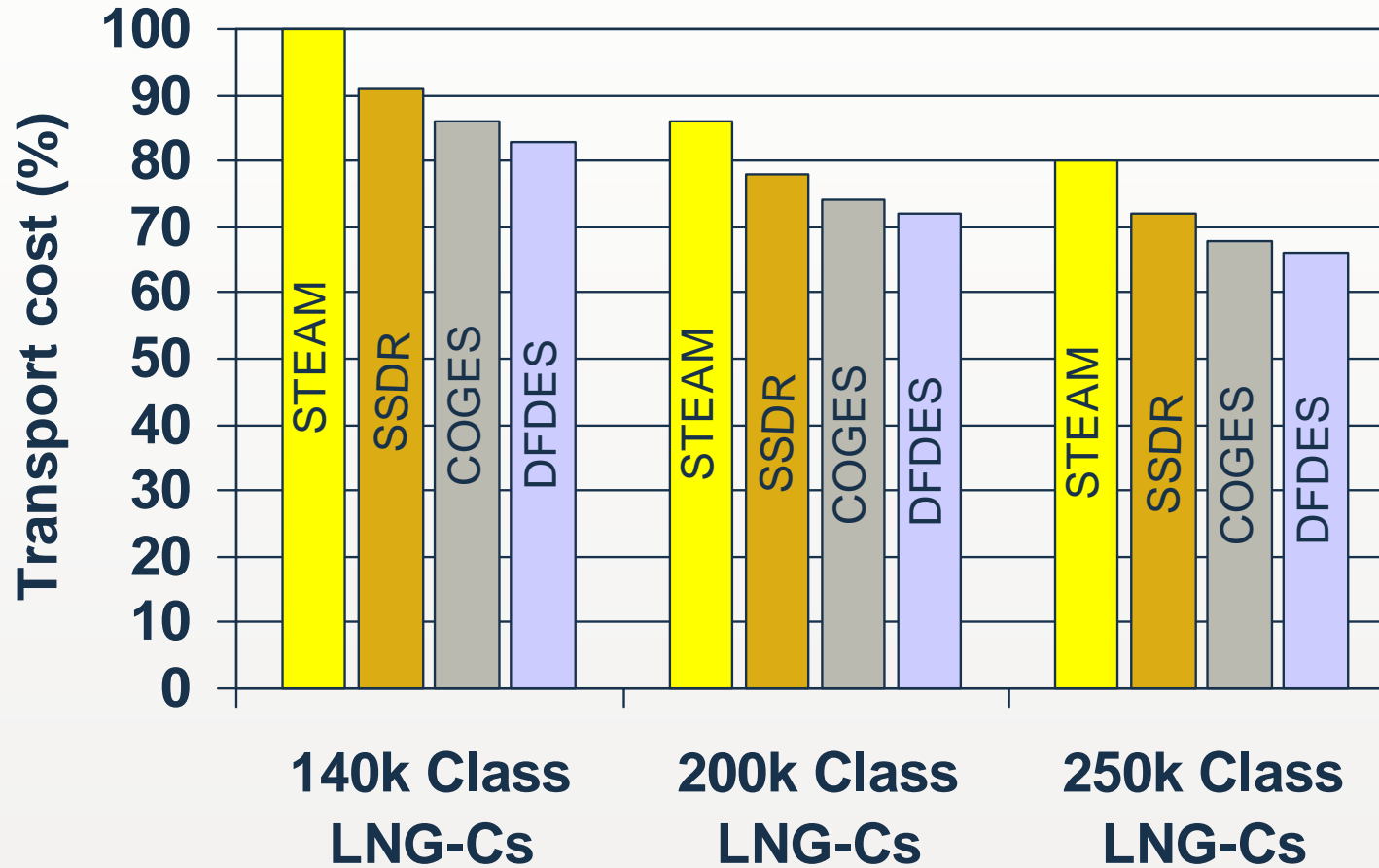
- **high speed ferries:** gas turbines

- **navy vessels:** gas turbines
combined gas turbine / diesel engine

- **passenger vessels:** combined gas turbine / steam turbine

- **LNG-carriers:** steam turbines
dual fuel diesel electric
slow speed diesel / reliquefaction
slow speed diesel gas injection
combined gas turbine / steam turbine

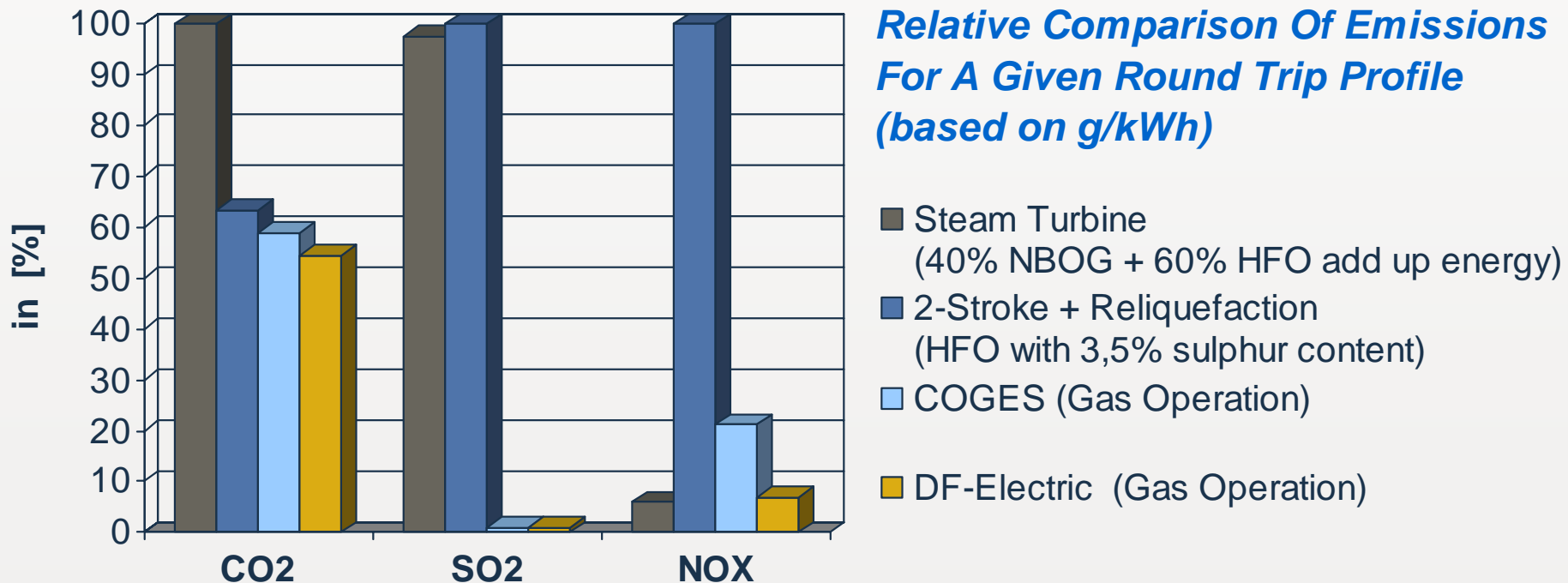
Results of Transport Cost Calculations LNG carriers



Transport cost in percent for a 6.500 nm trade for different ship sizes and propulsion systems

Source: Marine Service

- Kyoto Protocol: Trade with CO₂ emissions (presently not applicable to mobile sources) → Penalty Savings
- More regions with stricter future regulations (NO_x, SO_x, etc.) → Oper. Flexibility
- Company Policy & Public Image → „Soft“ Economics



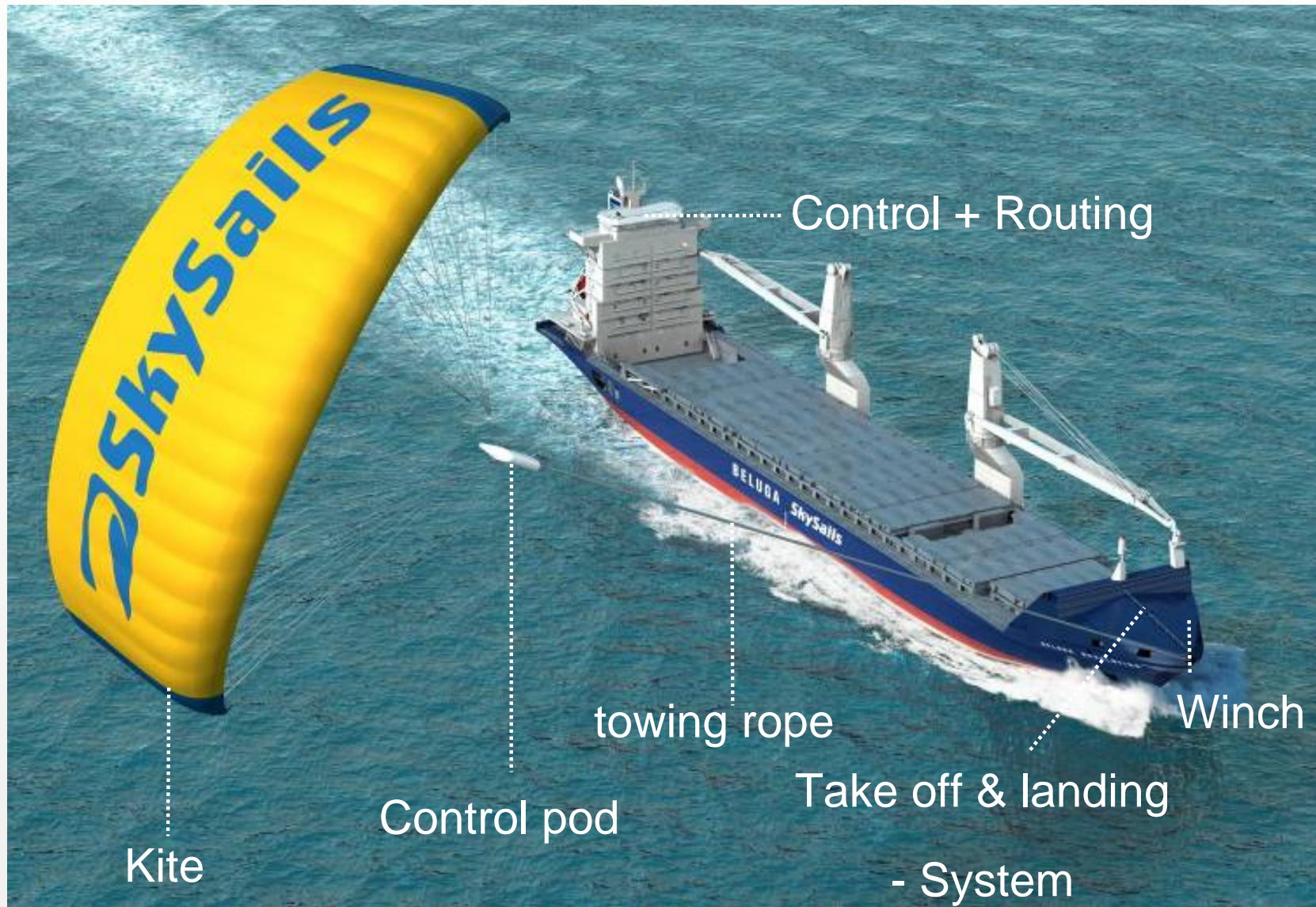
Source: MAN

- **oil:** **abt. 40 years** **diesel engine**
- **gas:** **abt. 60 years** **diesel / otto engine**
- **coal:** **> 200 years** **steam turbine**

Alternatives

- **bio fuels** **diesel engines**
- **nuclear energy** **steam turbines**
- **solar energy**
- **wind**

„Sky Sails“ System-Components



Thank you
for your kind attention.



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SHIP EFFICIENCY

by STG

