

Methanol as a Marine Fuel

Symposium on Evolution of Marine Fuels

Los Angeles July 21st 2014

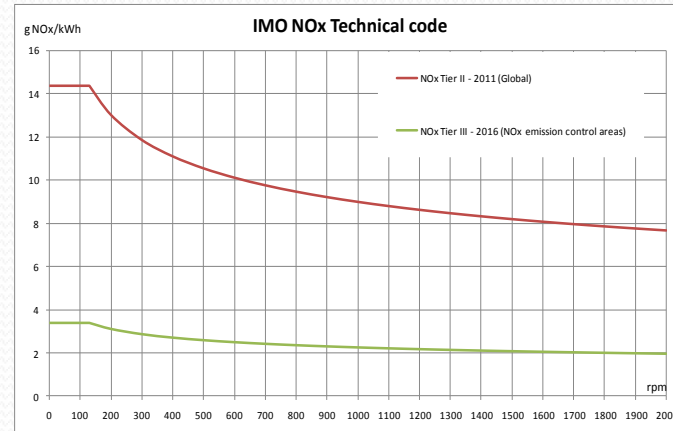
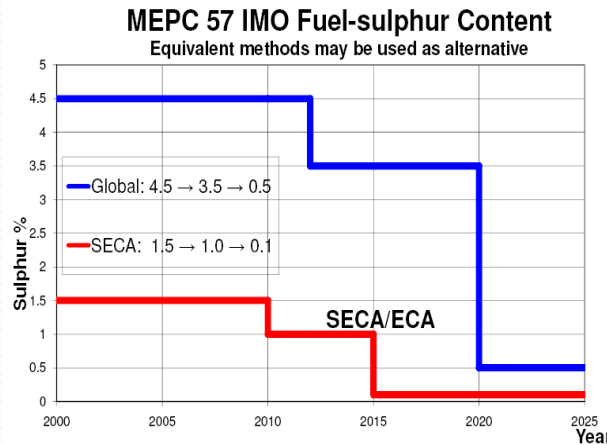
Per Fagerlund

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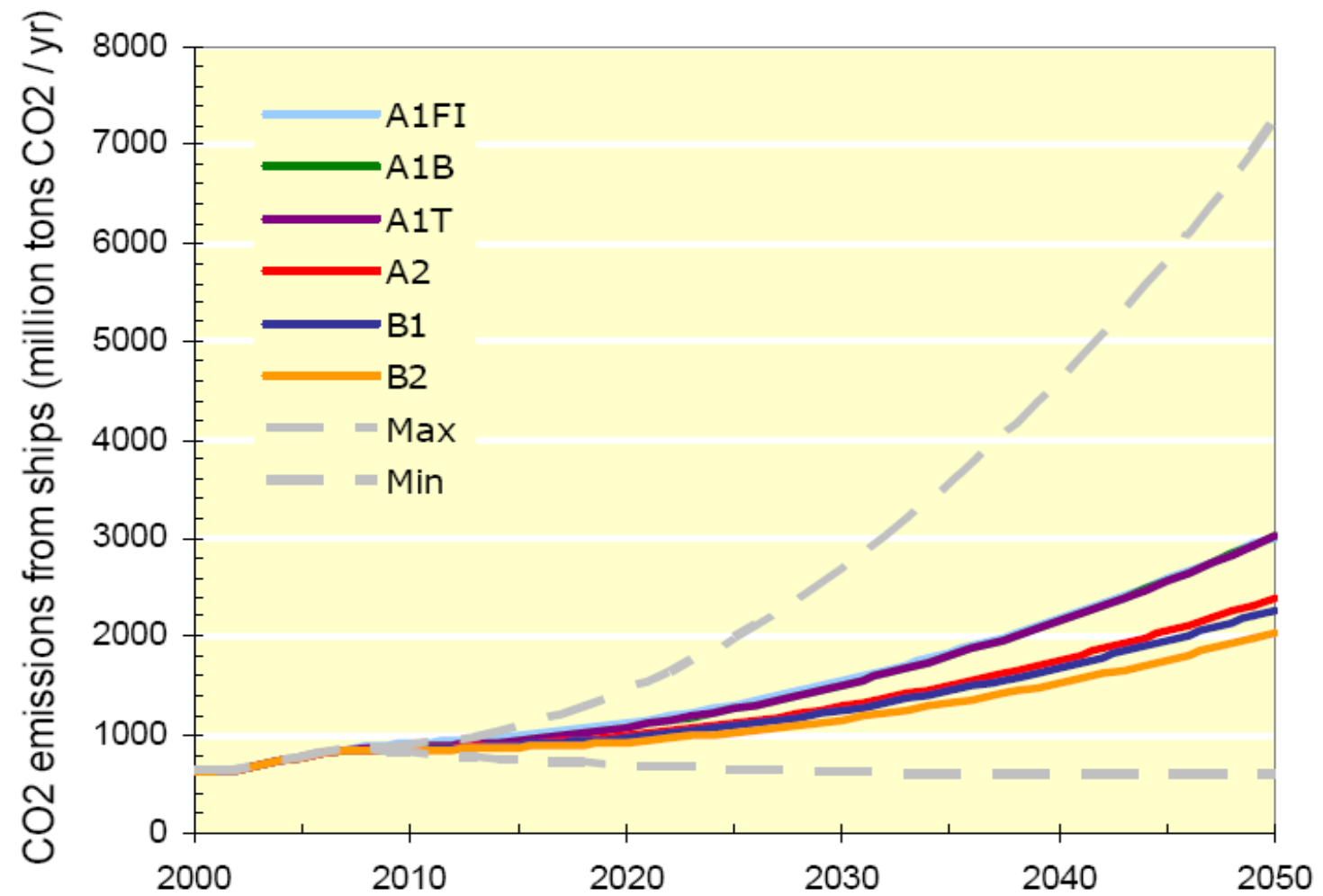


ScandiNAOS AB

Emission legislation



International shipping CO₂ emission scenarios



Perspectives

- Short term 2015/2021
SO_x, NO_x
- Medium term 2020/2030
SO_x, NO_x, PM, GHG
- Long term 2050 and beyond
SO_x, NO_x, PM, GHG, Renewable fuels

Alternatives

- Heavy Fuel Oil + Scrubber or
- Marine Gas Oil max 0.1% Sulphur or
- LNG or Methanol



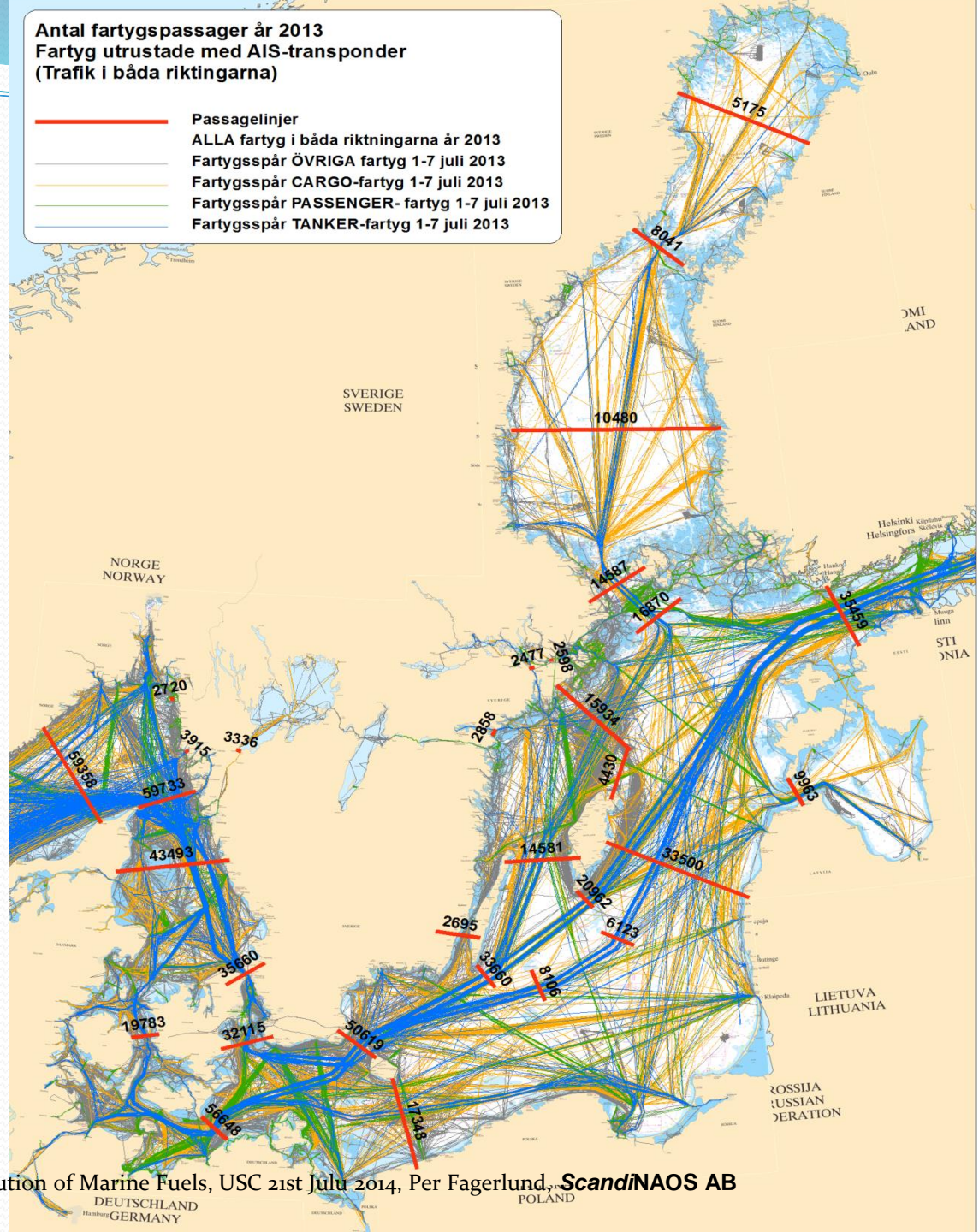
Stena Line operations in North Europe



Antal fartygspassager år 2013
Fartyg utrustade med AIS-transponder
(Trafik i båda riktningarna)

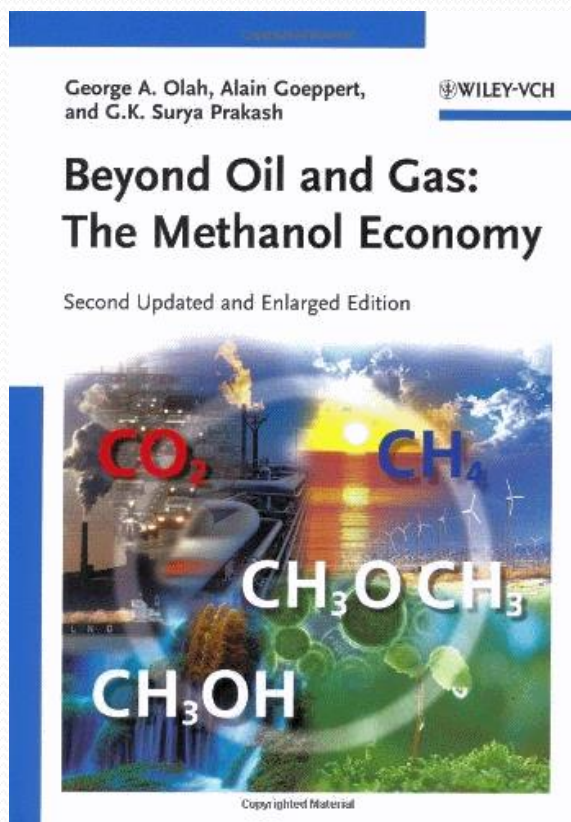
- Passagelinjer
- ALLA fartyg i båda riktningarna år 2013
- Fartygsspår ÖVRIGA fartyg 1-7 juli 2013
- Fartygsspår CARGO-fartyg 1-7 juli 2013
- Fartygsspår PASSENGER-fartyg 1-7 juli 2013
- Fartygsspår TANKER-fartyg 1-7 juli 2013

Marine traffic in the baltic sea



Professor Georg A. Olah

Nobel Price Chemistry 1994



EffShip

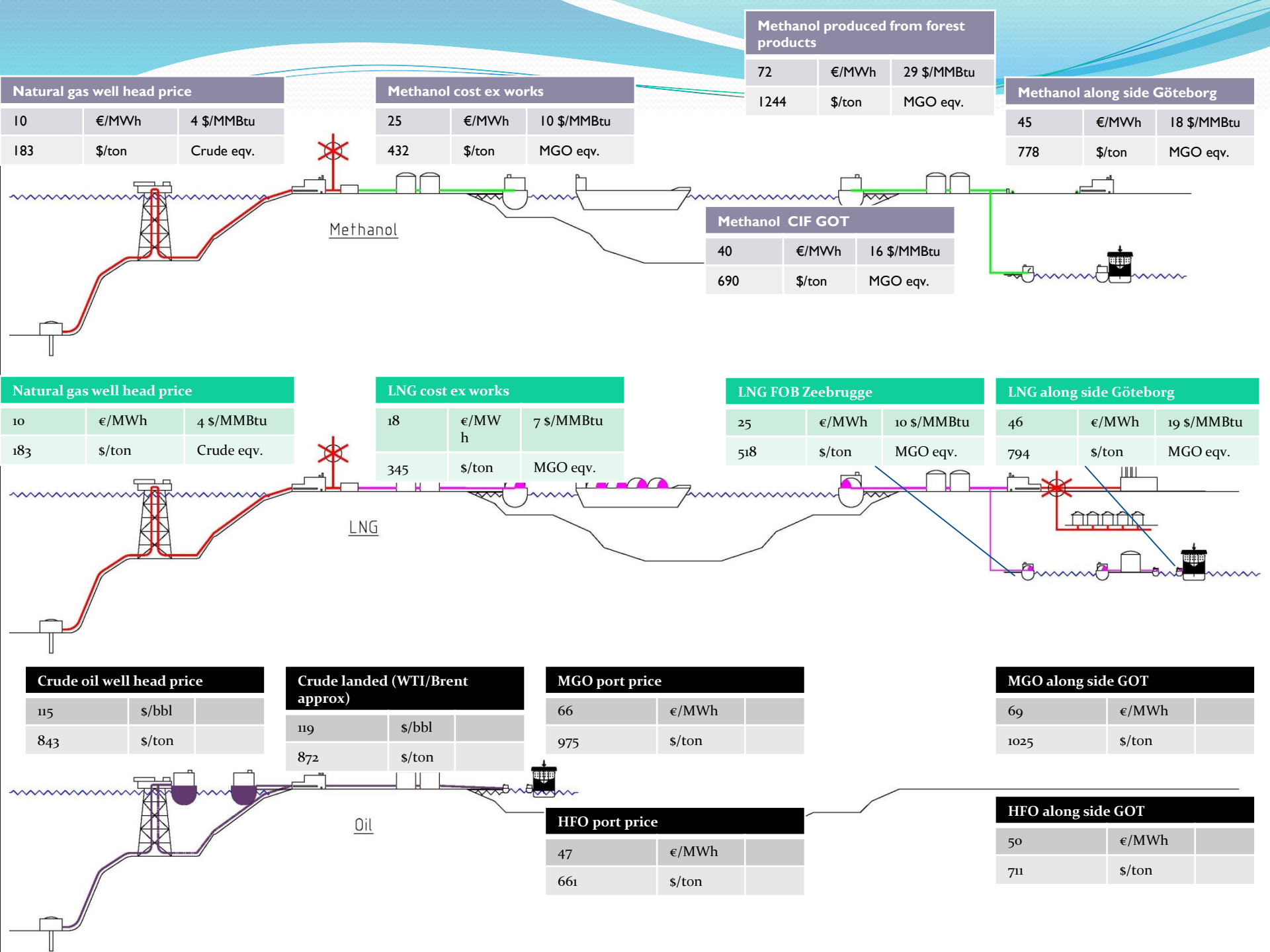
Efficient Shipping with Low Emissions

CHALMERS



Göteborg Energi





Natural gas well head price

10	€/MWh	4 \$/MMBtu
183	\$/ton	Crude eqv.

Methanol cost ex works

25	€/MWh	10 \$/MMBtu
432	\$/ton	MGO eqv.

Methanol produced from forest products

72	€/MWh	29 \$/MMBtu
1244	\$/ton	MGO eqv.

Methanol along side Göteborg

45	€/MWh	18 \$/MMBtu
778	\$/ton	MGO eqv.

Methanol CIF GOT

40	€/MWh	16 \$/MMBtu
690	\$/ton	MGO eqv.

Natural gas well head price

10	€/MWh	4 \$/MMBtu
183	\$/ton	Crude eqv.

LNG cost ex works

18	€/MWh	7 \$/MMBtu
345	\$/ton	MGO eqv.

LNG FOB Zeebrugge

25	€/MWh	10 \$/MMBtu
518	\$/ton	MGO eqv.

LNG along side Göteborg

46	€/MWh	19 \$/MMBtu
794	\$/ton	MGO eqv.

Crude oil well head price

115	\$/bbl	
843	\$/ton	

Crude landed (WTI/Brent approx)

119	\$/bbl	
872	\$/ton	

MGO port price

66	€/MWh	
975	\$/ton	

MGO along side GOT

69	€/MWh	
1025	\$/ton	

HFO port price

47	€/MWh	
661	\$/ton	

HFO along side GOT

50	€/MWh	
711	\$/ton	

Methanol related spin-off projects

SPIRETH

Alcohol (Spirit) and Ether as Marine fuel

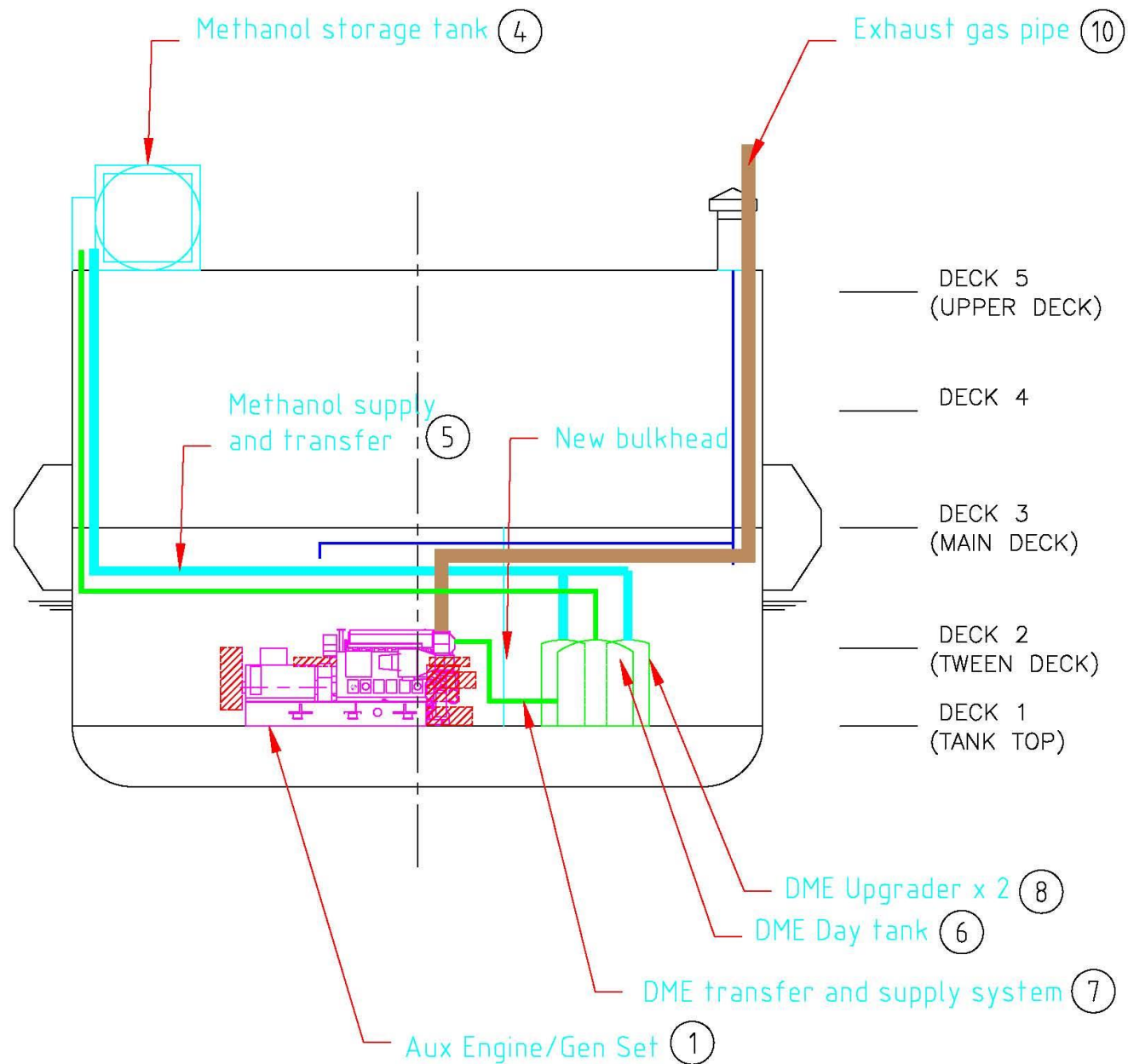
Stena Germanica

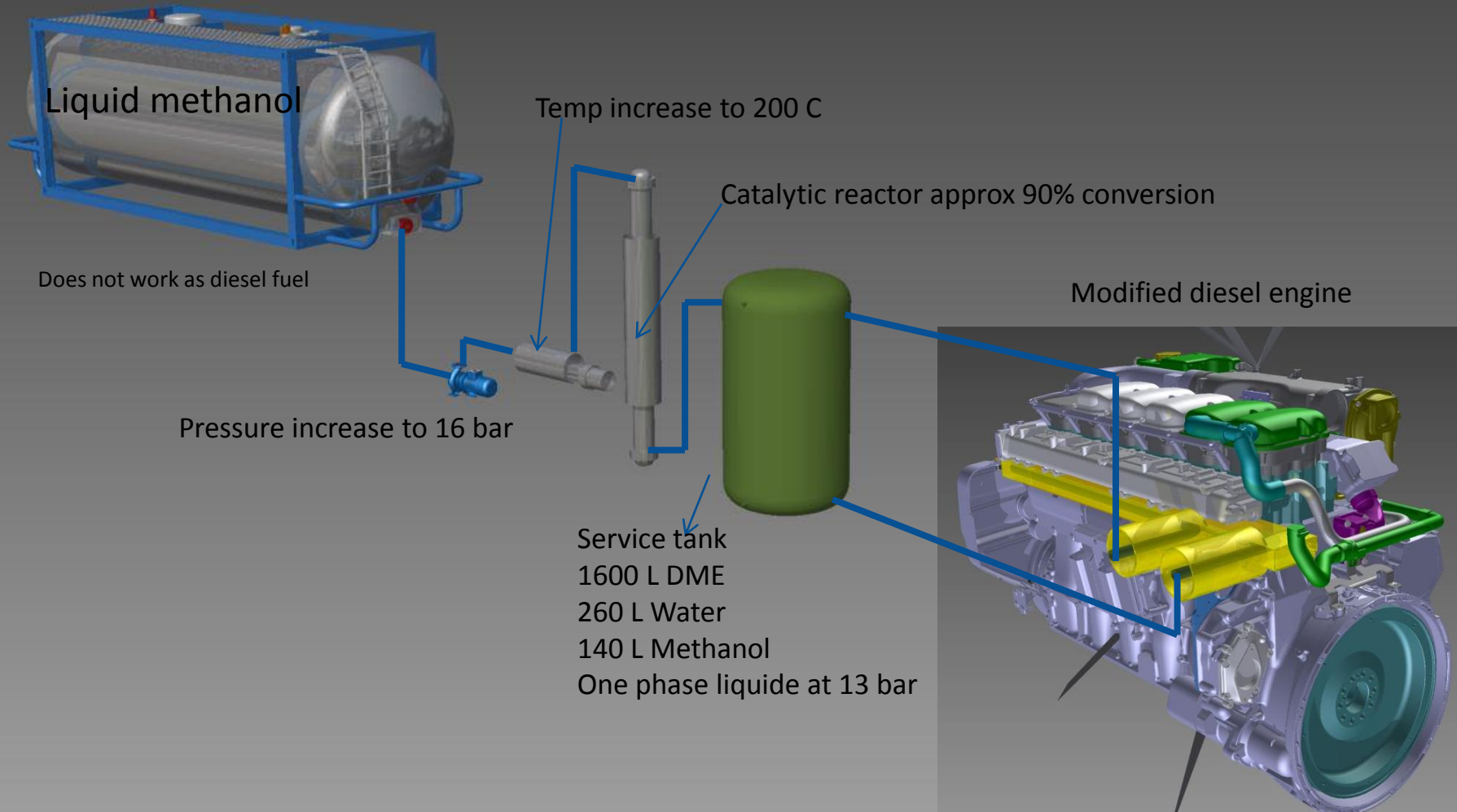
Methanol Conversion

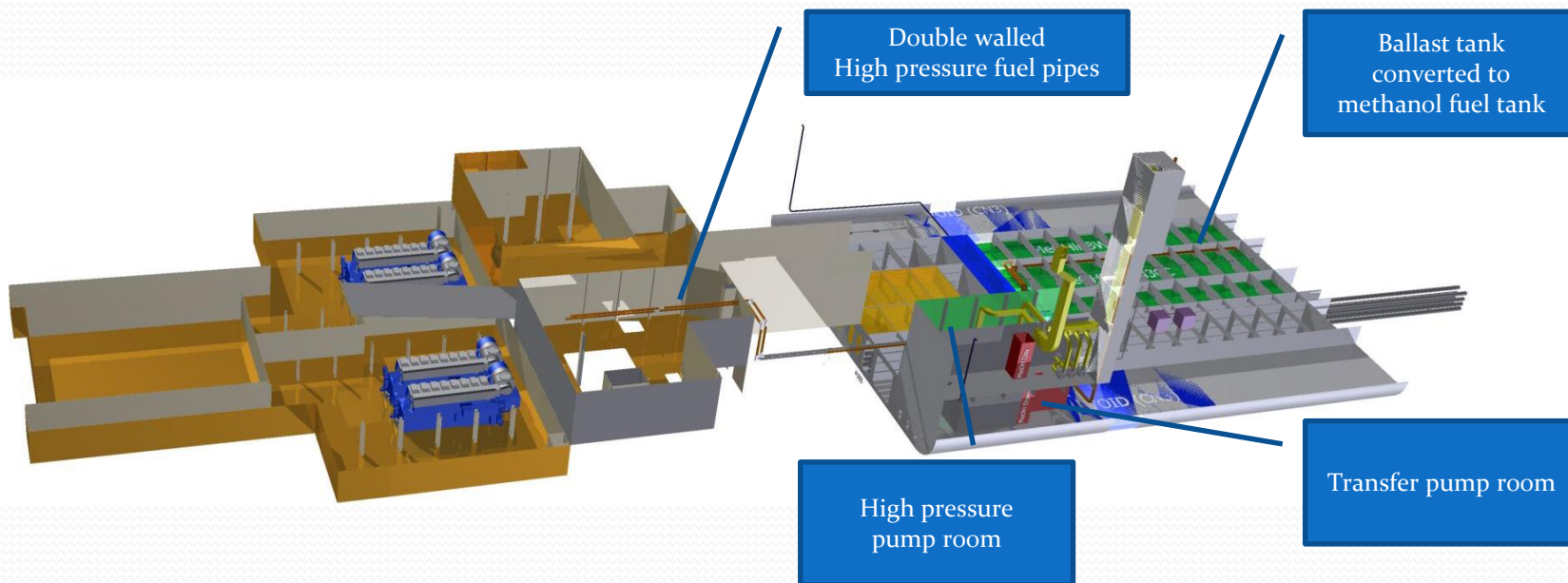


Stena Scanrail







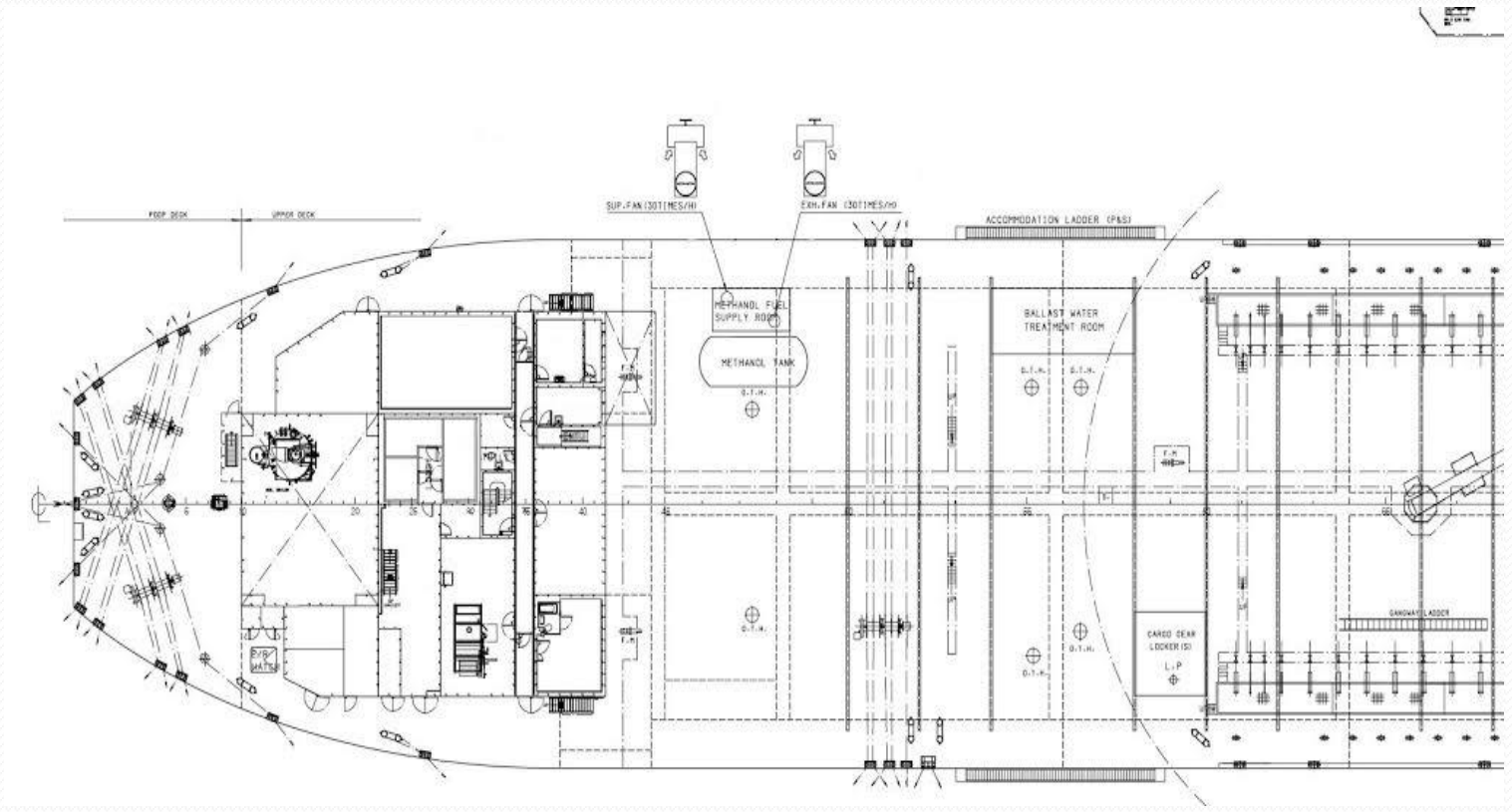


MS MARINEX. Tanker for Oil Products and Chemicals.



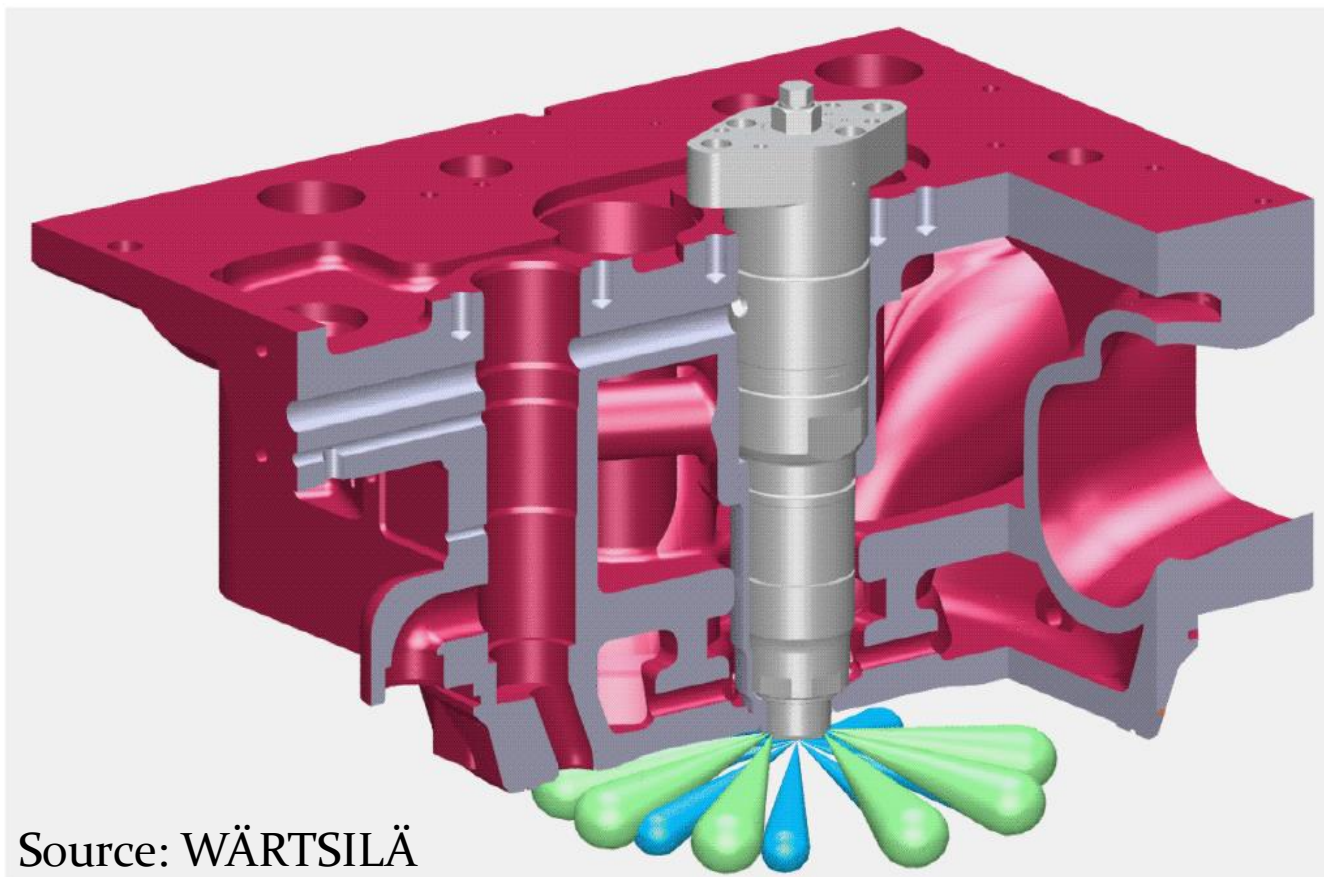
Fuel consumption (methanol) per day around 50 ton
Source: MARINVEST

Methanol in integral tanks and service tank on deck



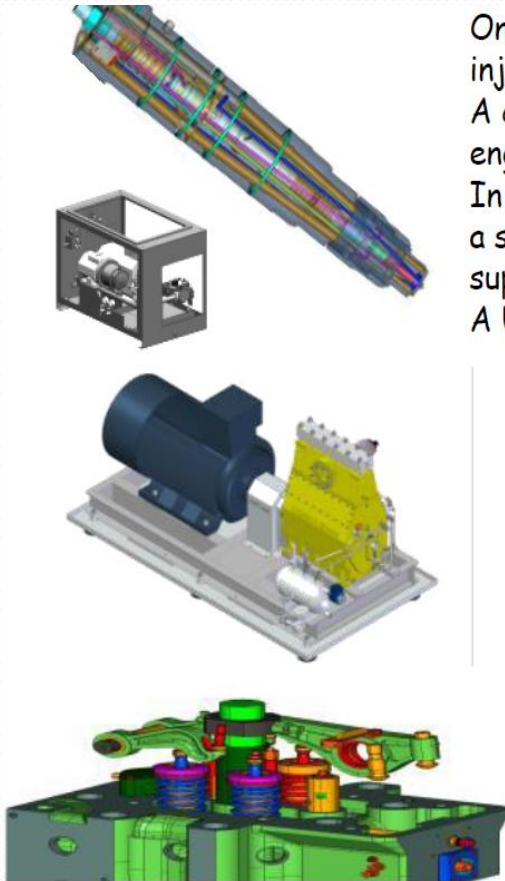
Wärtsilä 4-stroke combustion concept

Methanol is combusted according to the diesel process. The methanol is injected close to TDC and ignited by a small amount of pilot fuel - in this case traditional diesel fuel.



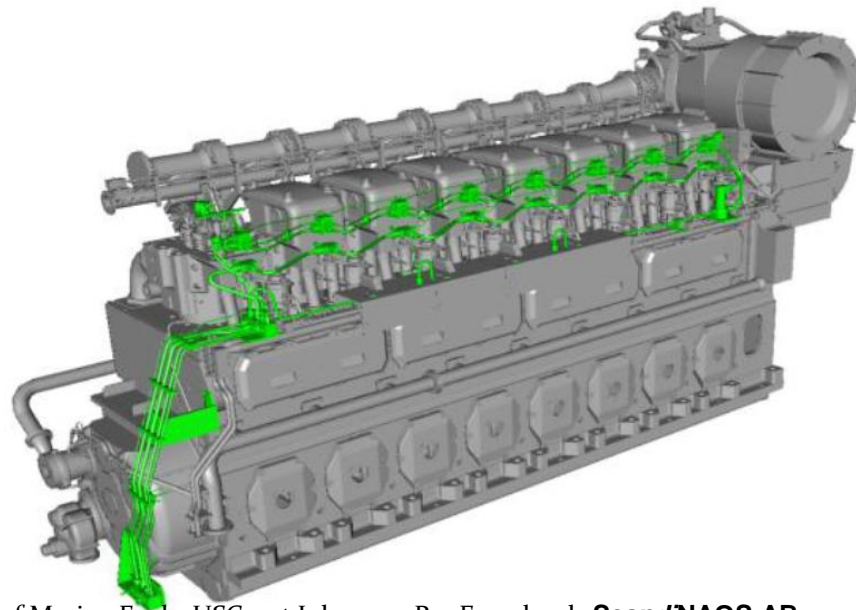
Source: WÄRTSILÄ

Wärtsilä 4-stroke Methanol engine conversion scope



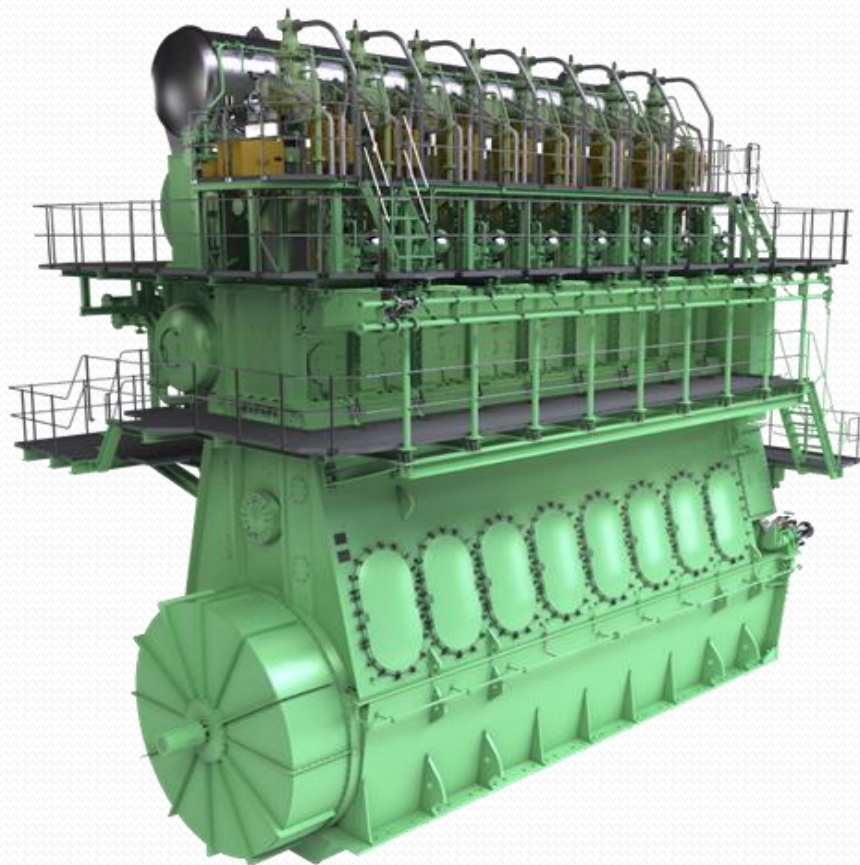
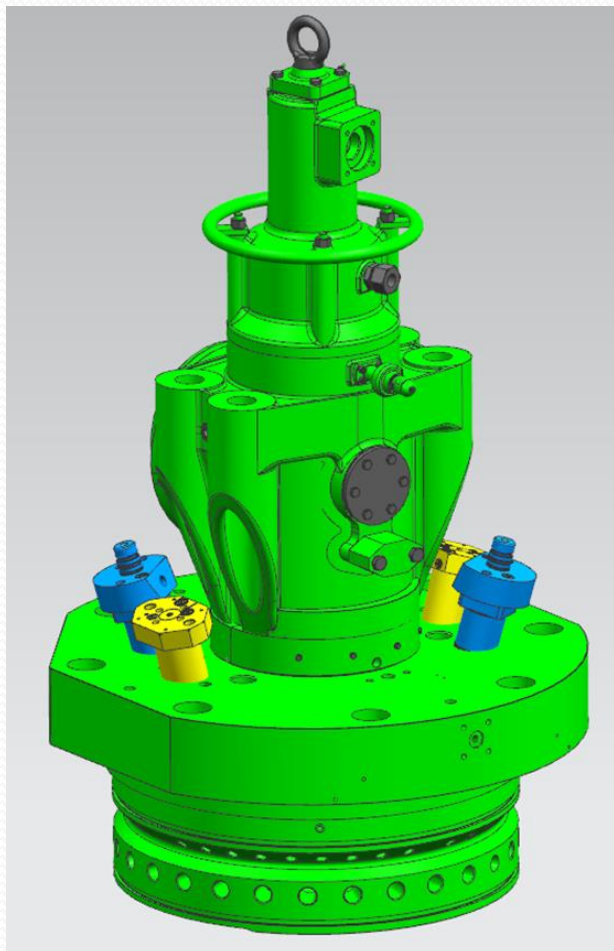
On-engine scope is limited to exchange of cylinder heads, fuel injectors and fuel plungers in existing fuel pumps.
A common rail system for methanol injection will be added on the engine.

In addition to the Engine related conversion includes the conversion kit a stand-alone high pressure methanol pump with belonging oil unit for supply of sealing oil and control oil to the fuel injectors.
A UNIC C3 solution will be used for engine control.

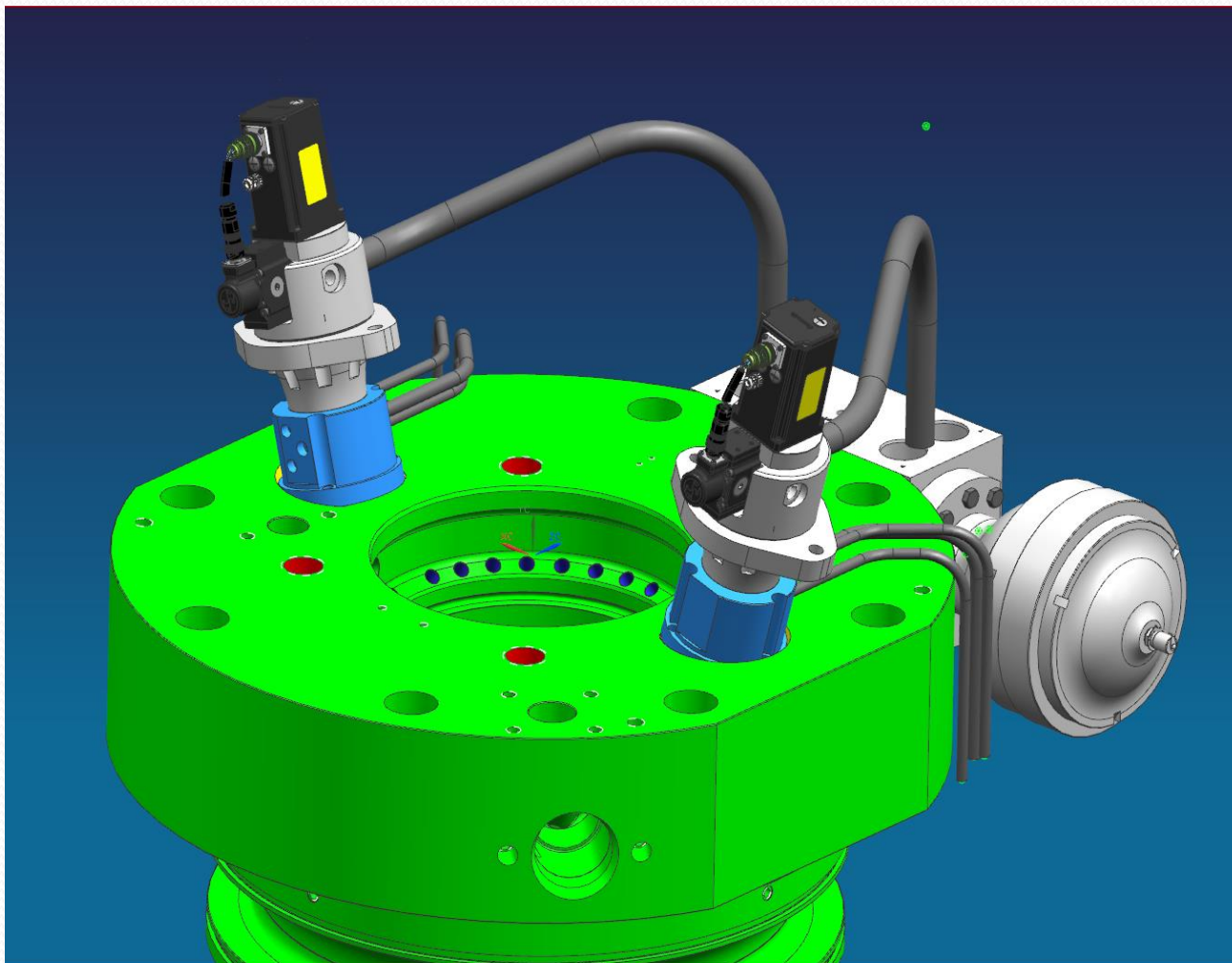


MAN 2-stroke engine

High pressure liquid gas (methanol) engine



MAN ME-LGI



Inland waterways



Road ferries



Commuter ferries



Inland waterways vessels



Diesel vs methanol

	Diesel	Methanol
Fuel cost per ton \$/ton	\$ 1 000	\$ 370
€/ \$	1,3532	
Fuel cost per ton €/ton	€ 739	€ 273
Energy content kJ/kg	42700	19900
Fuel cost per energy unit €/kWh	0,062	0,049
Typical operation		
Engine power kW	400	
Average part load	75%	
Fuel consumption g/kWh	200	429
Running hours per year	6000	
Fuel consumption per year ton	360	772
Fuel cost per year €	€ 266 036	€ 211 211
Fuel cost difference		€ 54 825
Market price conversion €/kW engine power		€ 200
Market price conversion €		€ 80 000
Pay back time years		1,5
Number of conversions per year		50
Estimated turn over for conversion		€ 4 000 000

Additional value

- An opportunity to approach a profitable marine service market
- Land based markets can also be exploited

Market, smaller marine engines

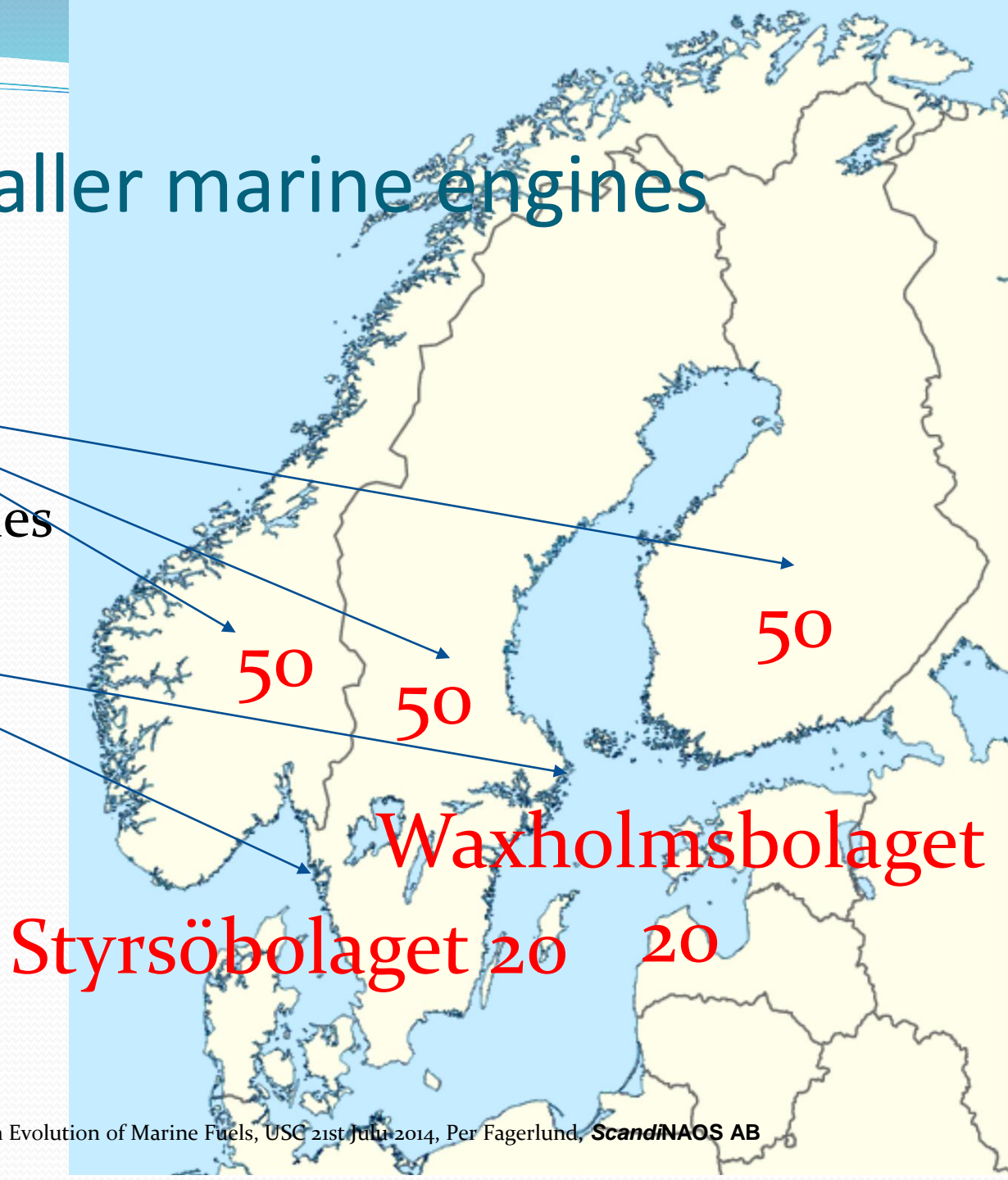
- Road ferries



- Commuter ferries



- Tour boats



Western European Inland Waterway Fleet

Approx 10 000 vessels

Standard Inland Shipping Waterway vessel	
L	110
B	11,4
Draft	4
Dwt	3000
TEU	200
Typical power	4 x 400 kW



Thank you