



The use of biofuel in the marine sector or Methanol, the marine fuel of the future

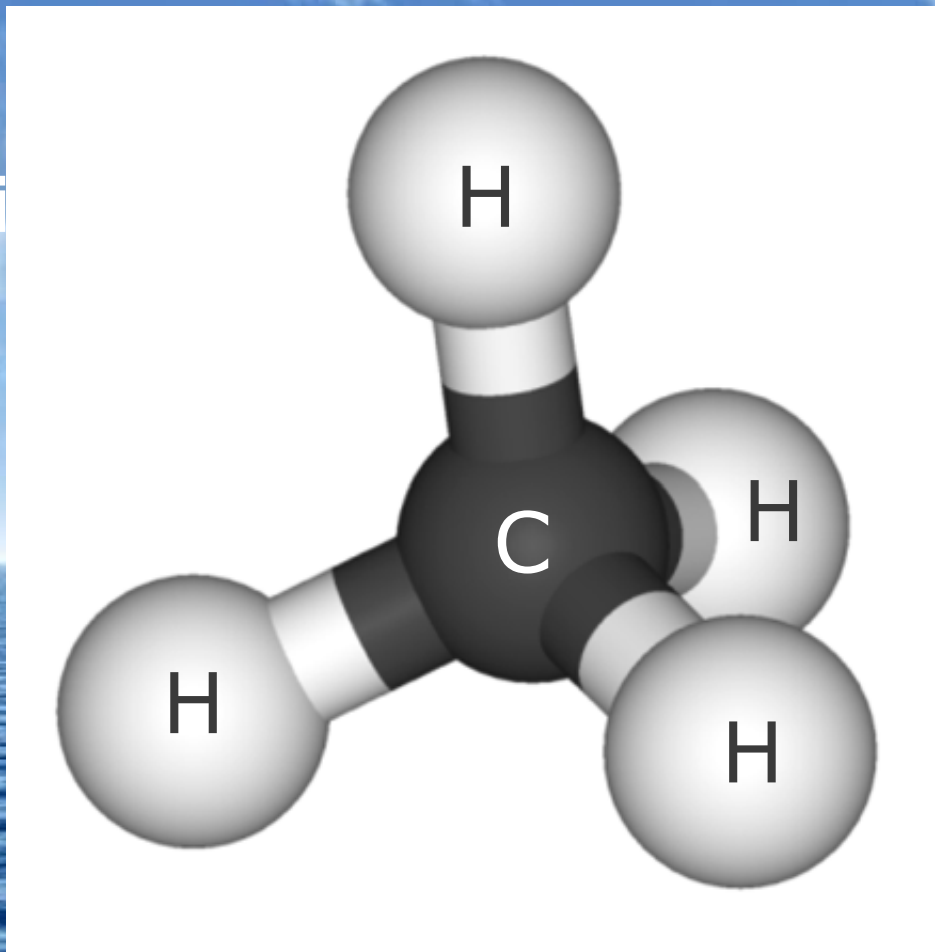
European Biofuels Technology Platform
Brussels 15 October 2014

Per Stefenson, Stena Teknik

The Challenge - SECA Sulphur Emission Control Area



What is



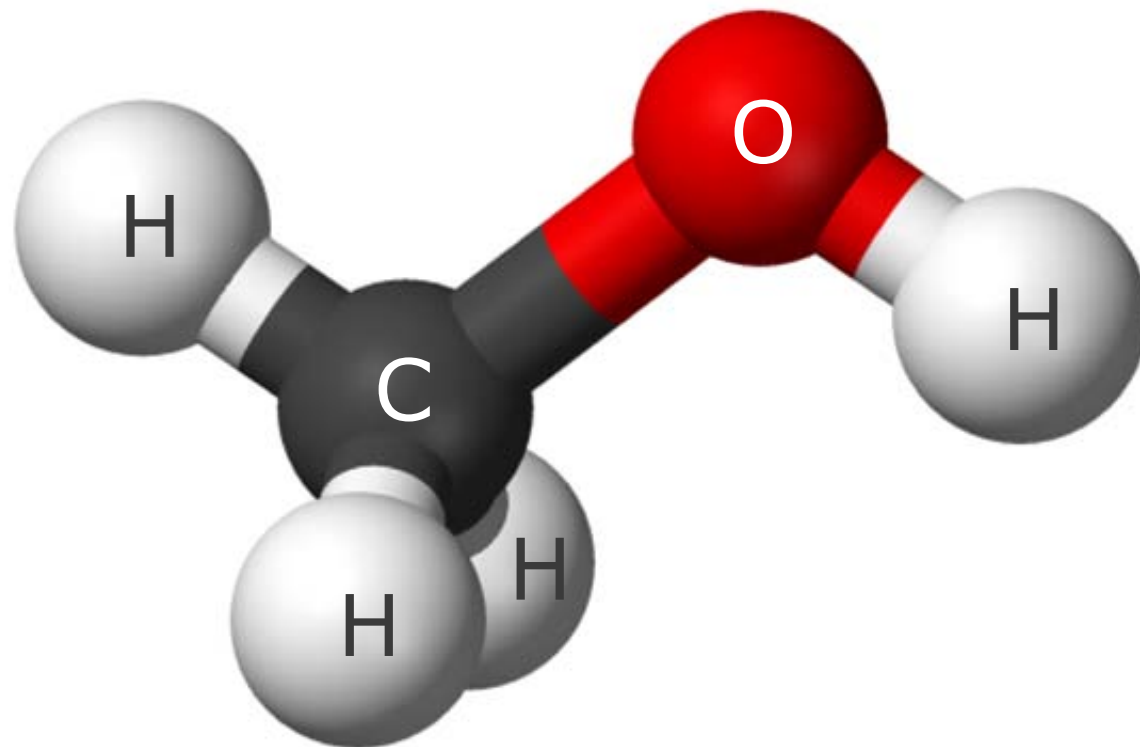
(Natural Gas)

-163° C



Volume -600 times
=
Liquefied

Methanol
The fuel of

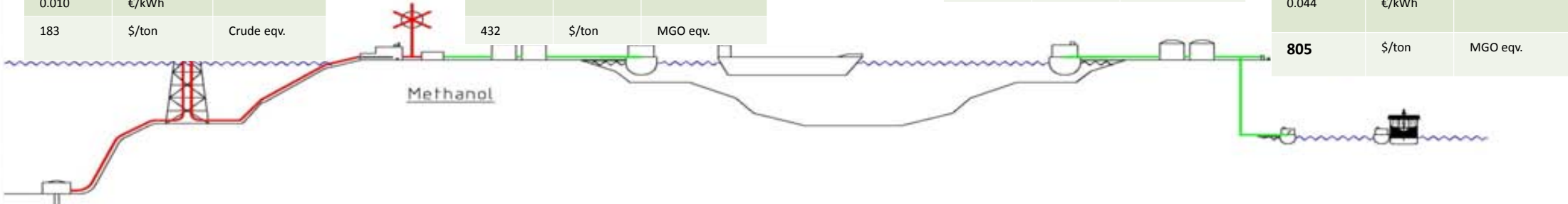


Natural gas well head price		
0.010	€/kWh	
183	\$/ton	Crude eqv.

Methanol cost ex works		
0.025	€/kWh	
432	\$/ton	MGO eqv.

Methanol produced from forest products		
0.072	€/kWh	
1244	\$/ton	MGO eqv.

Methanol along side Göteborg		
0.044	€/kWh	
805	\$/ton	MGO eqv.

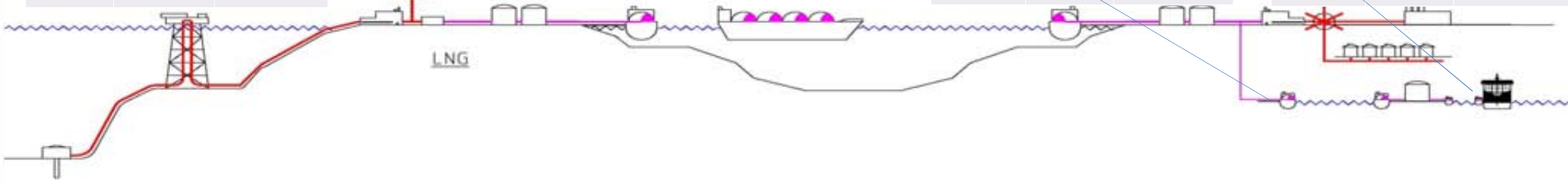


Natural gas well head price		
0.010	€/kWh	
183	\$/ton	Crude eqv.

LNG cost ex works		
0.02	€/kWh	
345	\$/ton	MGO eqv.

LNG FOB Zeebrugge		
0.03	€/kWh	
518	\$/ton	MGO eqv.

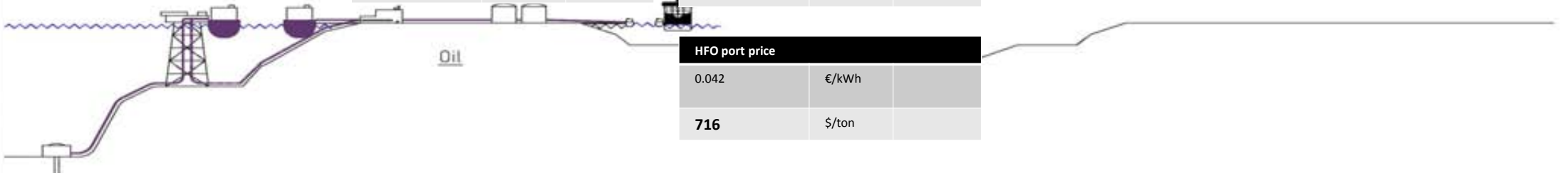
LNG along side Göteborg		
0.046	€/kWh	
845	\$/ton	MGO eqv.



Crude oil well head price		
115	\$/bbl	
843	\$/ton	

Crude landed (WTI/Brent approx)		
119	\$/bbl	
872	\$/ton	

MGO port price		
0.062	€/kWh	
1070	\$/ton	



HFO port price		
0.042	€/kWh	
716	\$/ton	

Methanol

Conversion cost; 350 Euro/kW

Comparable with Scrubber



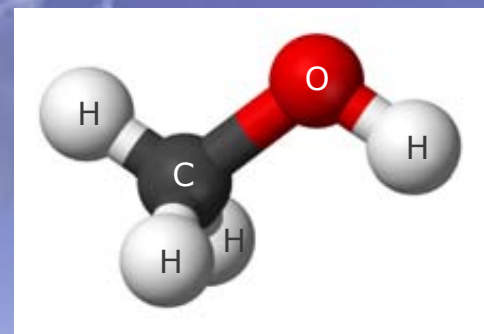
Conversion from HFO to LNG.



BIT VIKING.

Conversion cost; 1000 EURO/kW





Methanol

The marine fuel of the future



Conversion of Stena Germanica, Gothenburg - Kiel

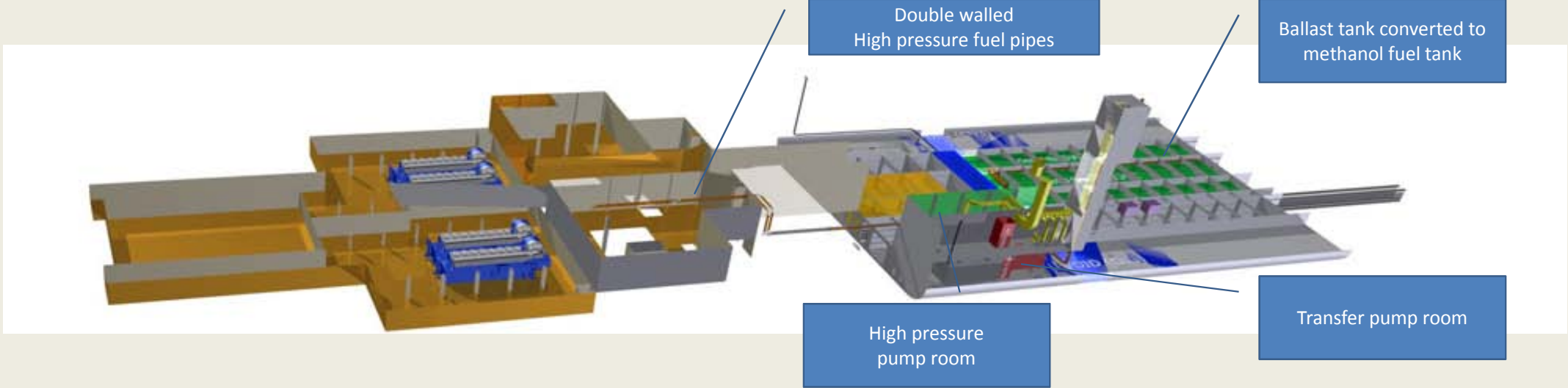


45.000 Cars
45.000 Lorries

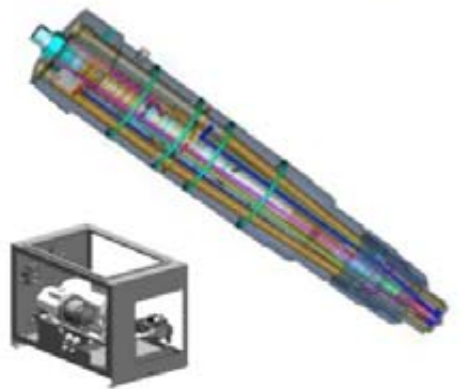


Lifted from the road
every year





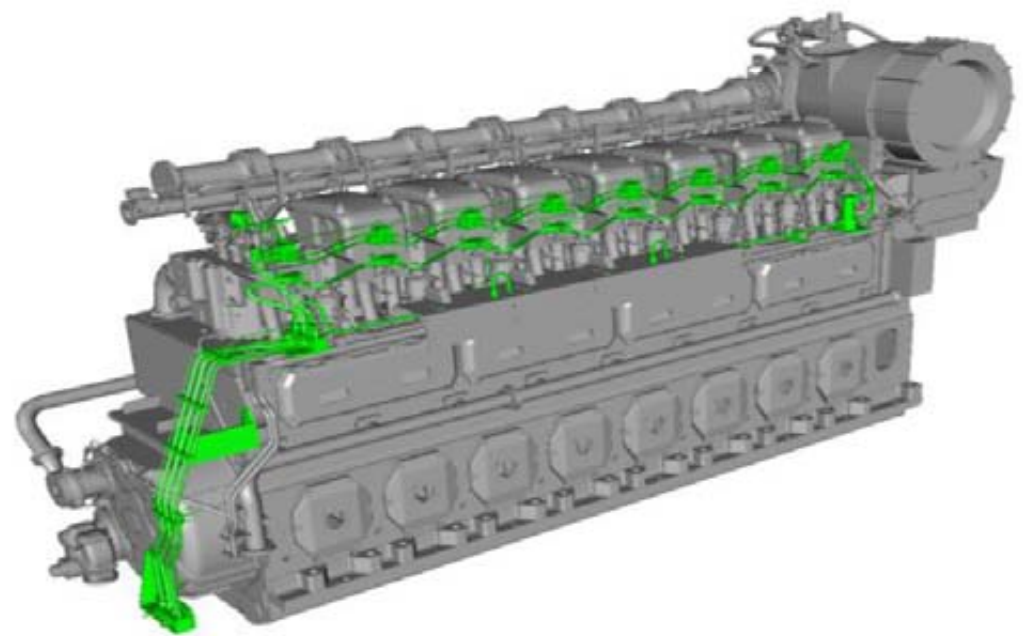
Methanol Engine Conversion Scope



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.

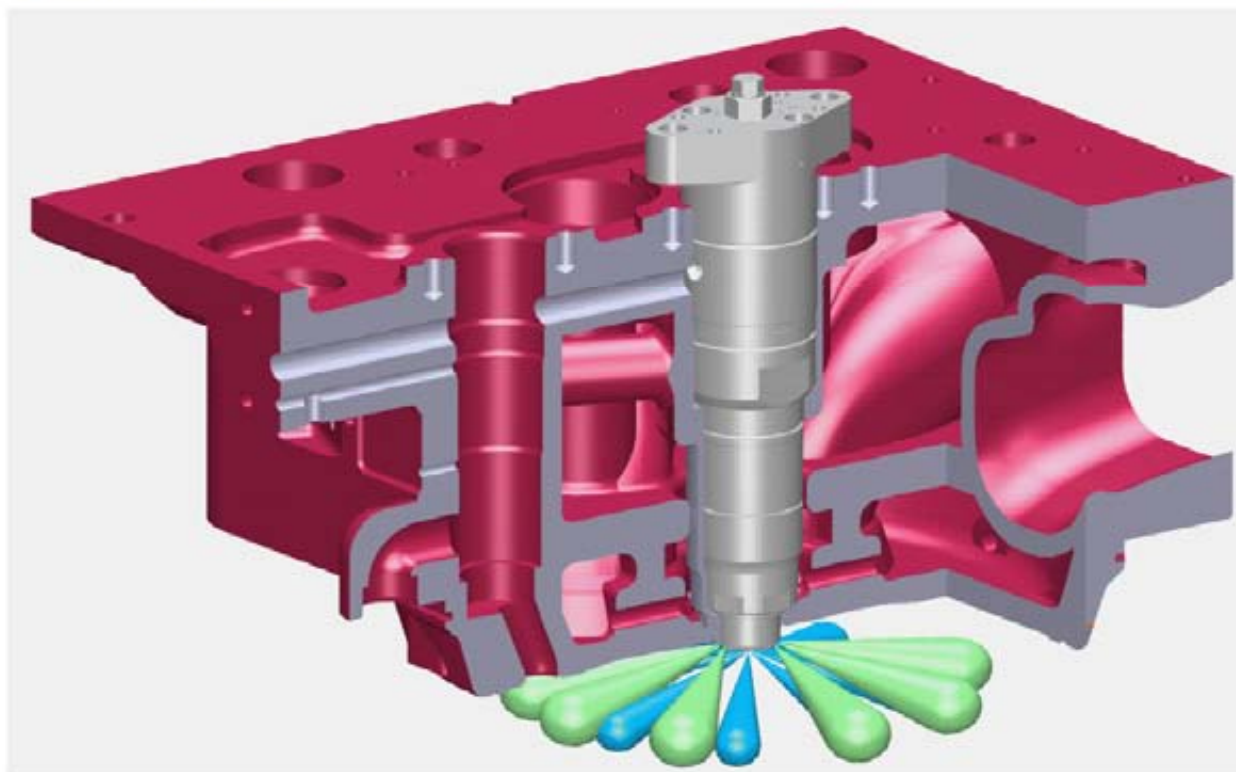


In addition to the Engine related conversion includes the conversion kit a stand-alone high pressure methanol pump with belonging oil unit for supply of sealing oil and control oil to the fuel injectors.
A UNIC C3 solution will be used for engine control.



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.



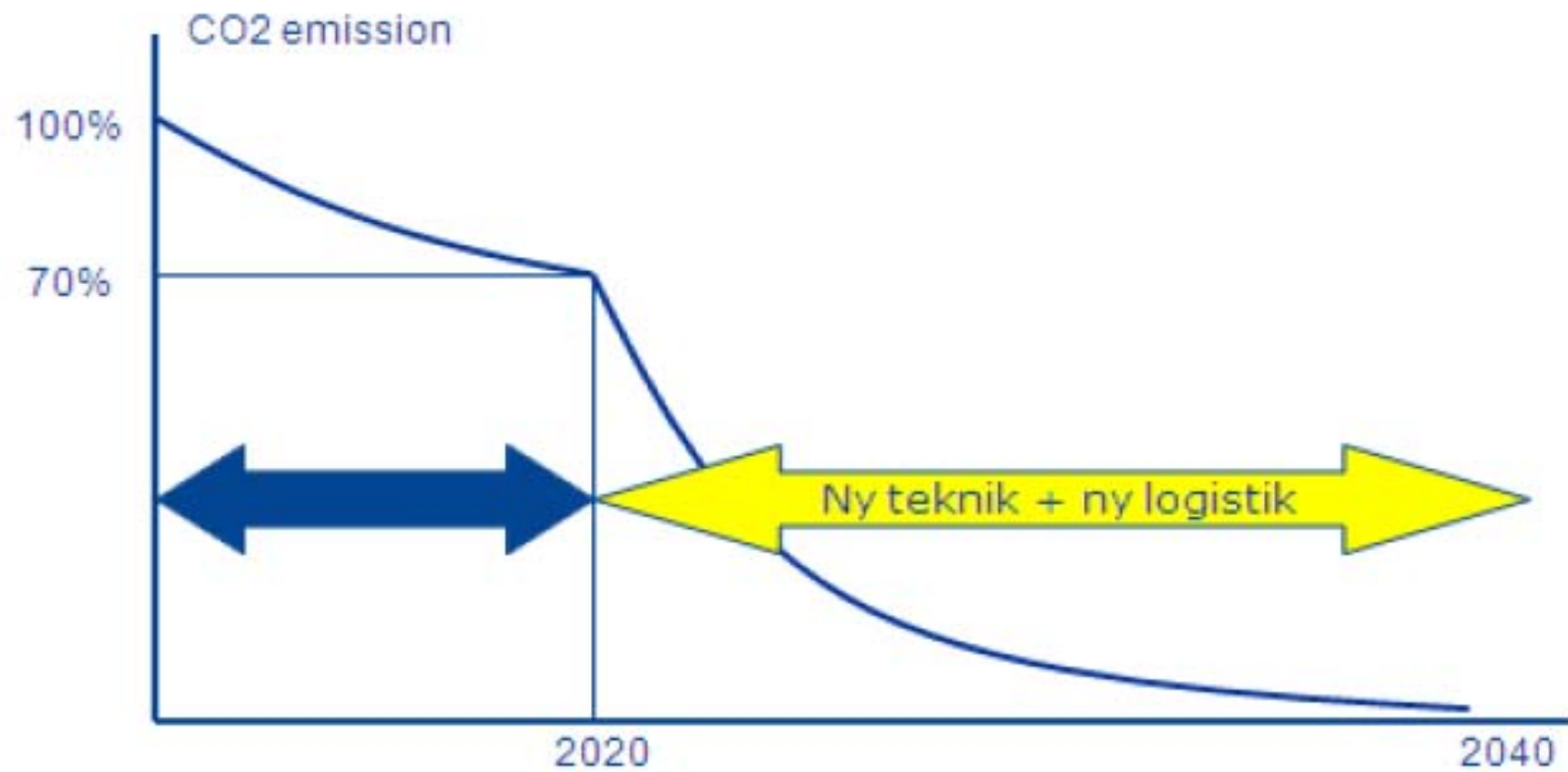
Summary test results

- NO_x acceptable (Low Tier II values)
- CO acceptable (< 1 g/kWh)
- THC (Total Hydro Carbon) acceptable (< 1 g/kWh) and no “methane slip”
- Very low PM (FSN ~ 0,1 with HFO as pilot)
- Formaldehyde emissions low ~ 10-15 ppm (limit for shore industry 25 ppm)
- Efficiency slightly higher with methanol....compared to diesel
- No Formic acid detected in exhaust gases

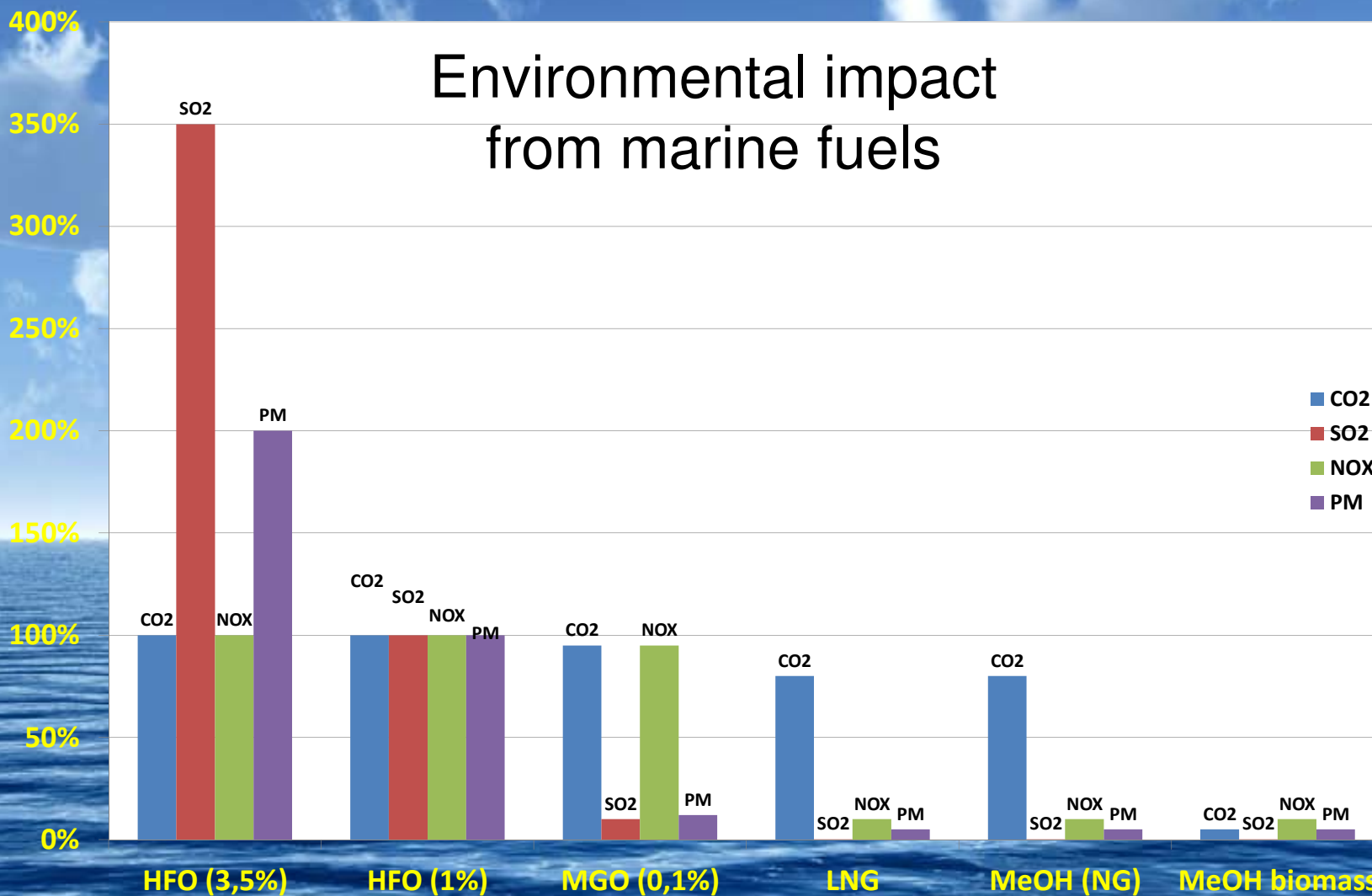


IGF code, International code for gas fuel and other low flashpoint fuels

Methanol leads towards the zero vision

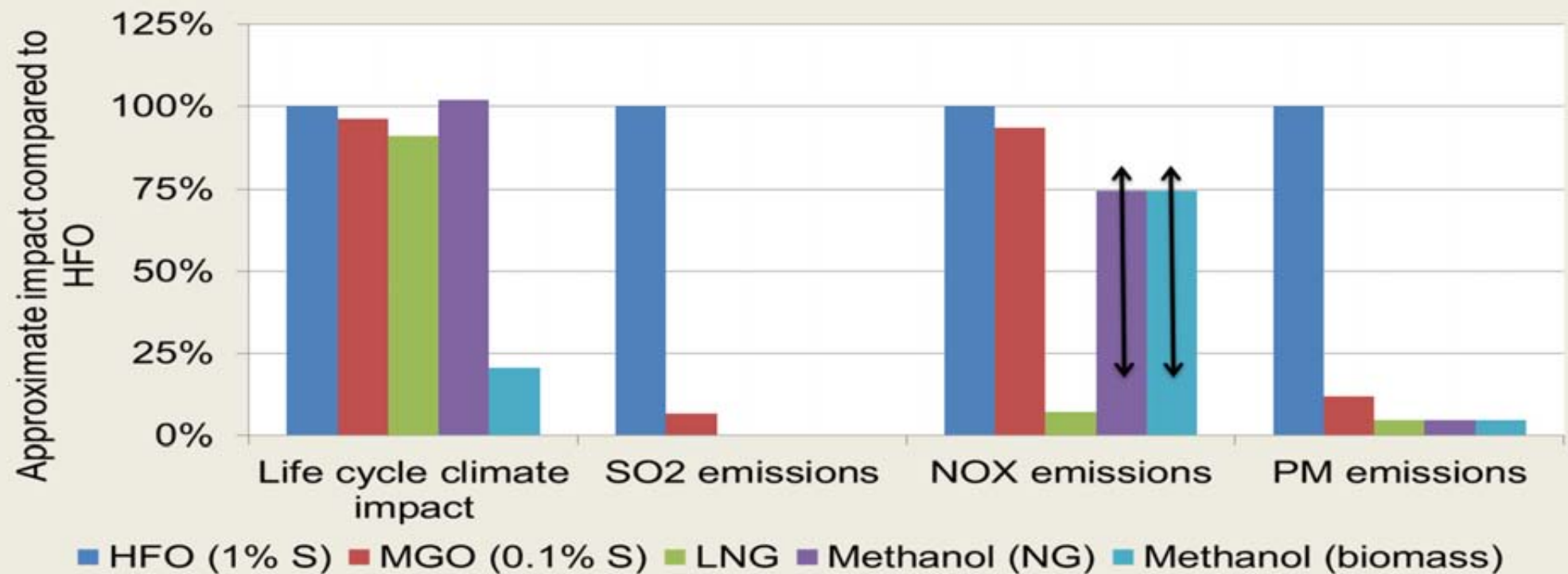


Environmental impact from marine fuels



Zero Vision

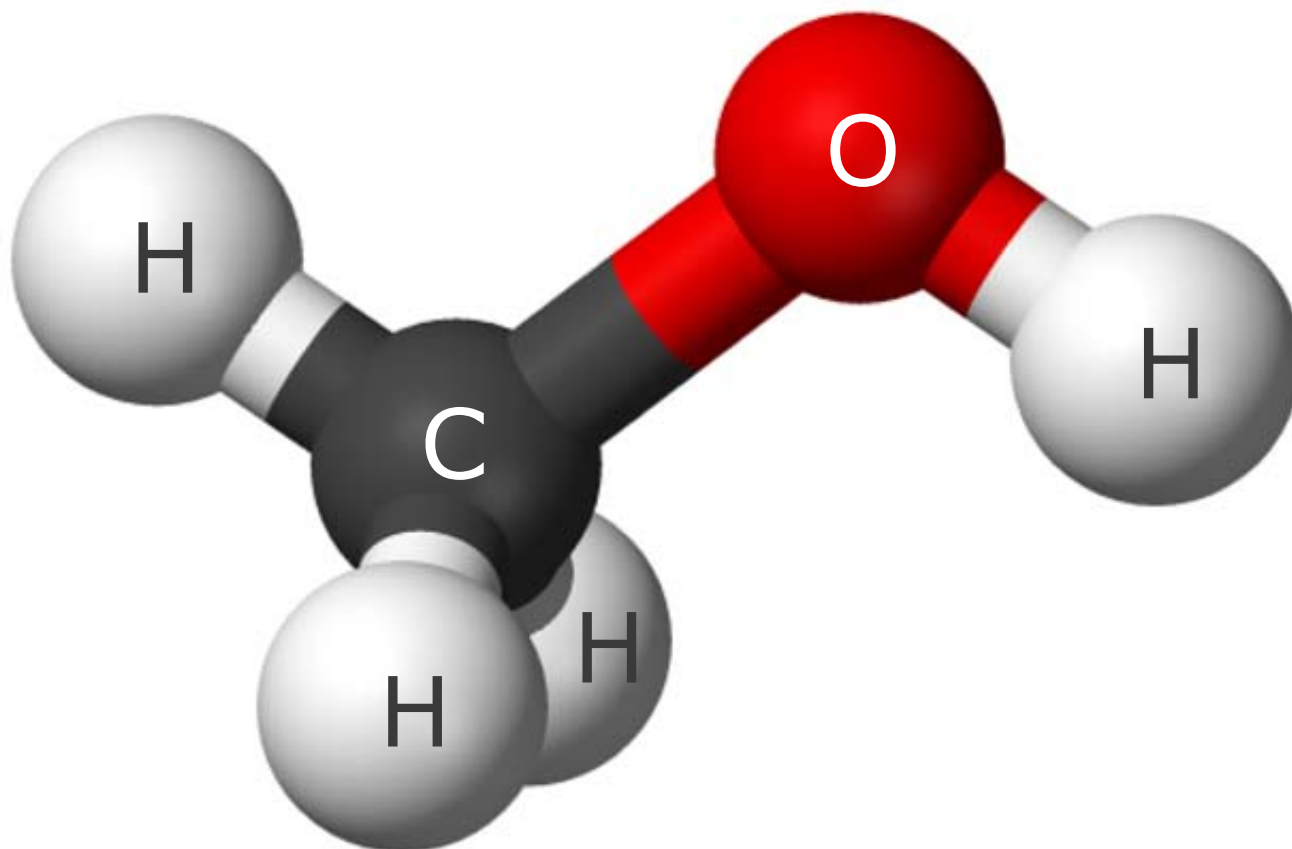
Comparison of the environmental performance of different marine fuels



*Approximate values compiled by Selma Brynolf, PhD student at Shipping and Marine Technology at Chalmers University of Technology. Methanol-diesel engine complying with NOX Tier II is assumed for methanol. PM emissions are only indicative. More information on this can be found in the thesis "Environmental assessment of present and future marine fuels" to be published in May 2014.

CO

H₂





Thank You