DANISH MARITIME AUTHORITY

TEN-T Motorways of the Sea

The North Europe LNG Infrastructure study and deployment in ships

- Deliveries and experiences
- The sub-group on LNG (ESSF)

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Outline

Introduction – the overall project

The Pilot part

The Infrastructure part

The sub group on LNG (ESSF)

Conclusions

Background

The new sulphur regulation in North Europe

•Competitiveness of shipping and regions

Distribution, storage and use as fuel of natural gas - LNG

The project

•A pilot part

•An infrastructure part - study

The full project

An EU TEN-T Motorways of the Sea project

- LNG as fuel for international short sea shipping
- Total costs 26 mill. Euro (original estimate!)

A pilot part – Fjord Line Danmark A/S

- 9.0 mill. euro from TEN-T
- 2 new built cruise ferries

An LNG infrastructure part

- 0.6 mill. euro from TEN-T

A combined top-down and bottom-up approach

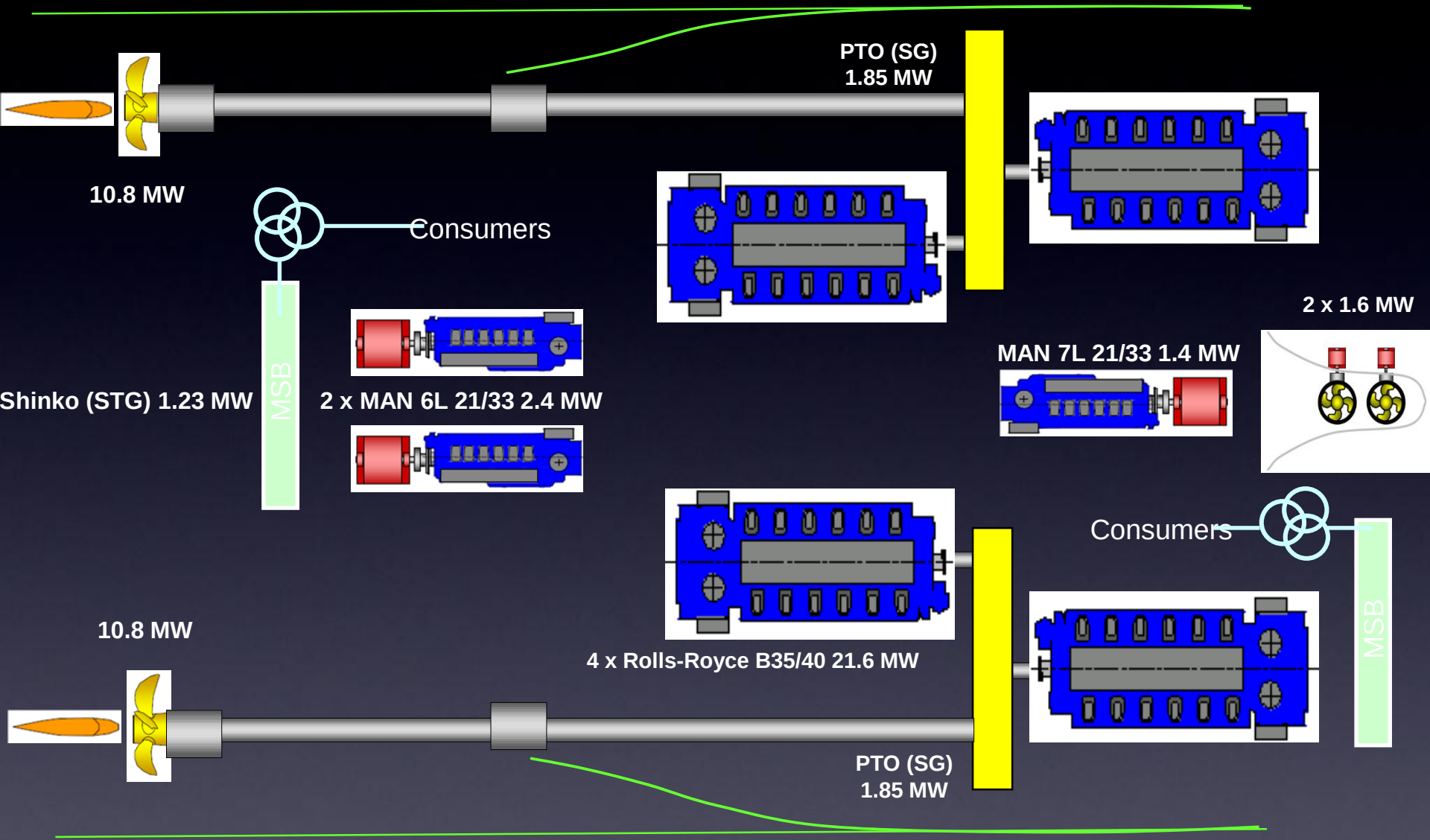
Modern fleet of 4 vessels
Operation @ 7 ports in NO, DK & SE

Vessel data

- Yard: Bergen Group Fosen Yard
- Length: 170 meter
- With: 27,5 meter
- Main engines: 4
- Engine output: 21,600 KW
- App. 30,000 HP
- Powered by LNG
- Single Fuel engines
- LNG capacity 3x 316 m3
- Cruise speed: 21.5 nots
- Max speed: 25 knots
- Max passengers: 1500
- Crew cabins 67 (100 beds)
- Passengers cabins 306 (1188 beds)
- DWT: 3500
- Cargo lane meter: Up to 1600
- (4.5 meter free hight – reefer capacity 30)
- Cars/trailers capacity 550/90
- Conference capacity: Approx. 350 persons (488 m2)
- Shopping area 600 m2
- Café, Skybar, Cafeteria, Restaurants & lounge

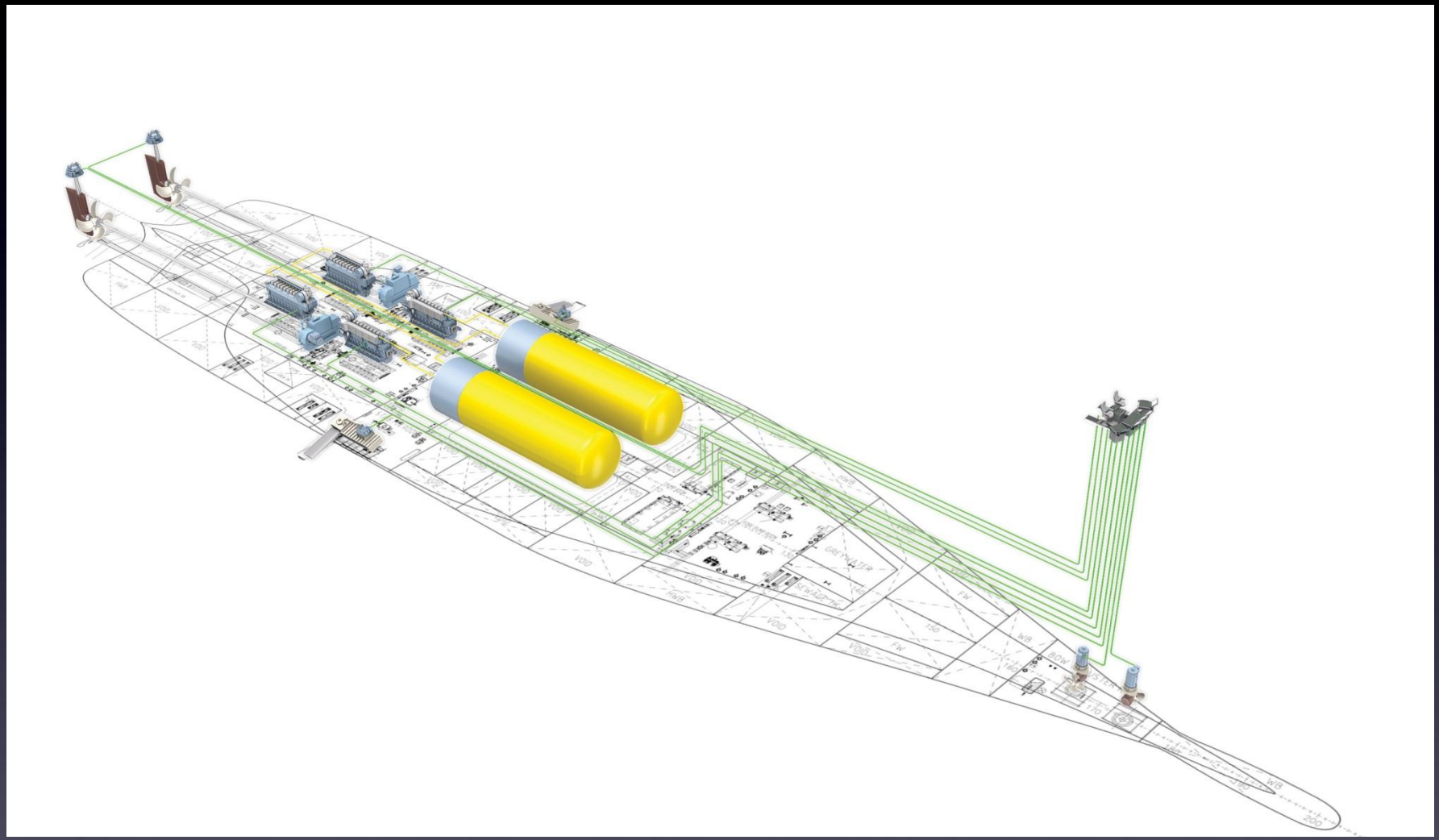
Concept basic propulsion solution

2 x GAS Mechanical shaft line 10.8 MW each.



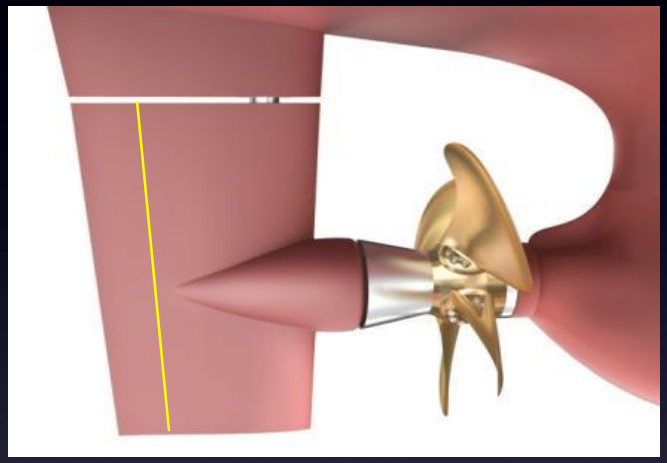
Concept 2 x 316 m3 LNG tanks

Cross over system – one system runs 4 M/E @ 85%MCR



Other fuel/gas saving & environmental installations

Rolls – Royce Promas Twisted flap rudder with hub-cap
Propeller blades and aft hull optimized



Tank tests performed at Marintek Trondheim

Waste Head recovery 1.250 kW Shinko steam generator
CPP/Shaft generators with variable frequency for optimized PTO
Ballast Water Threatment System installed
Food Waste System installed
Recycling of plastic, glasses, metals, oils and cartoon.

Bunkering

Short turn around time in port

•For saving fuel

Bunkering issues

•Passengers on board

•Passengers embarking and disembarking

•Cargo operations – trucks and cars

Bunkering

•Tank truck filling in Hirtshals

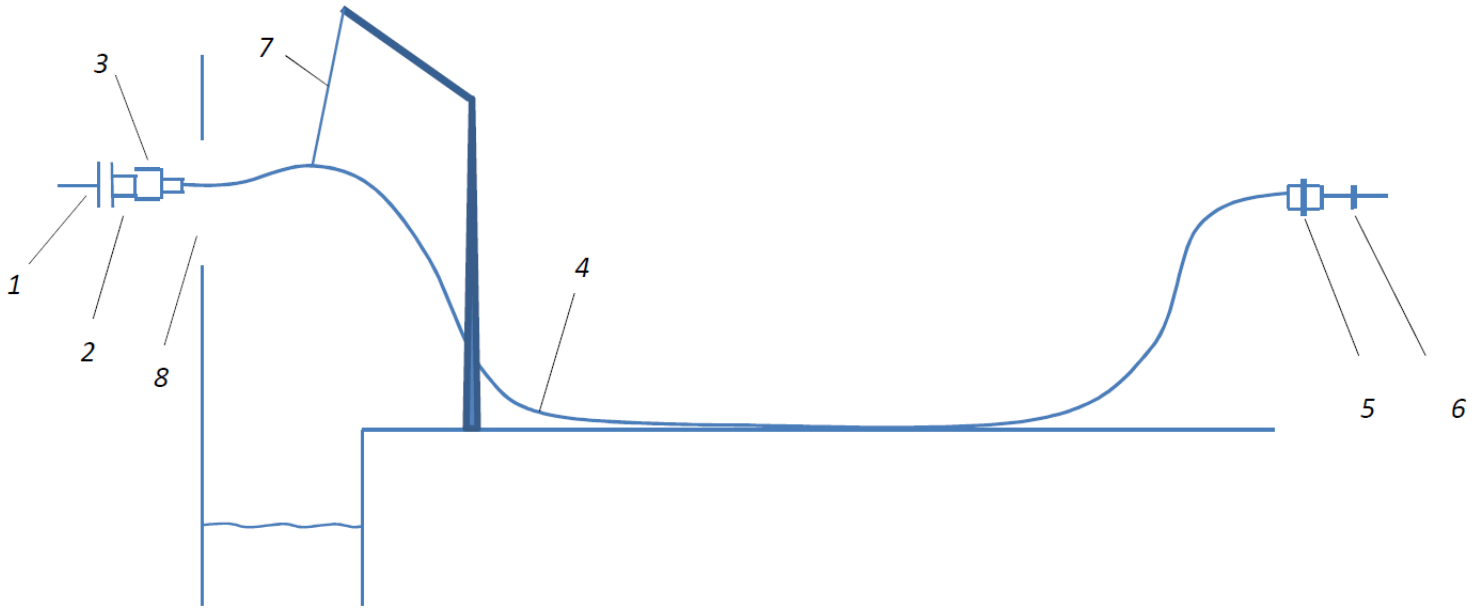
•Tank truck filling in Risavika (Stavanger)

•Direct filling (fixed pipe) in Risavika from Q1 2015

•Direct filling (fixed pipe) in Hirtshals from Q1/Q2 2015

Tank truck filling - schematic

The design of the bunkering line in Risavika, Norway is shown in the schematic picture below:



1	Bunker presentation flange
2	DCC tank unit
3	DCC hose unit
4	Bunker hose
5	Cryogenic Safety Break Away Coupling (CBC)
6	Pipe line flange
7	Crane wire (handling support)
8	Bunker port

LNG Bunkring Fixed Pipe/Loading Arm Port of Risavika

6’’ pipe from factory storage tank
Capacity of 350m3/hour
Ready for operation Q1.2015

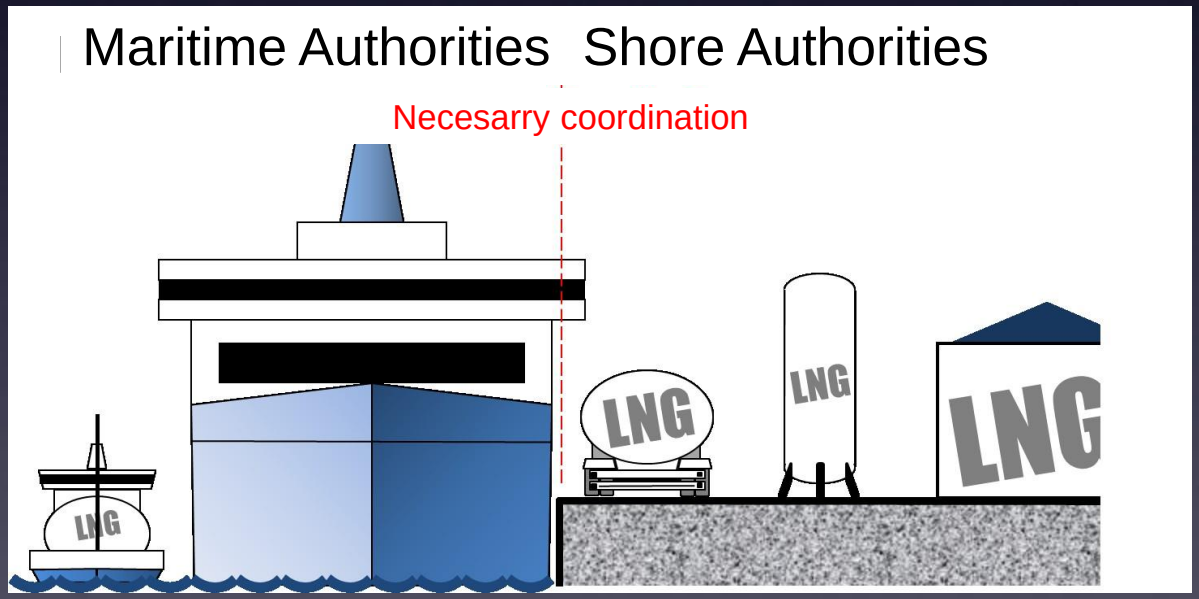
LNG Bunkring small tank Port of Hirtshals, Denmark

200 tonnes/445m3 tank capaity
Capacity of 200m3/hour
Ready for operation Q1/Q2.2015.

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

Class & Authorities @ sea/land

-Rules still under development – especially on sea we have a basis!
-Design of ship bunker stations – in respect of working environment, structure and positions of equipment as detectors, cameras and why not temperature sensors?
-Closing time of valves
-ESD automatically and/or manually?
-Common cross border rules
-Focus on time



Incurred LNG problems

- Stronger bunker Pressure Built Up Unit (PBU) needed
- Incorrect basic engine adjustment for ship nr. 1
- Bunkering incident - needed adjustments in progress
- Bunkering permits

Operational experience with LNG

MS Stavangerfjord

-Start service 14.07.2014
-> 300 bunker operations
-PBU capacity / Splashing

MS Bergensfjord

-Start service 17.03.2014
-> 150 bunker operations
-One bunker incident

Very good course keeping, manouvrebility incl. Response time, steering, sea keeping & low LNG consumption with no smoke !

Operational experience with LNG cont.

LNG features

-Nox (90%) & Nox tax reduced
-No Sox & PM
-CO2 reduced (23%)
-50% lube oil consumption compared to ME/HFO
-Sludge more or less ”0”
-Longer service interval on ME components (50%)
-Clean exhaust boilers
-More energy per kg/fuel
-Better environment in enginerooms
-80% Lesser use of chemicals for cleaning

Fjord Line LNG Experience – sum up

Operational succes

Recognitions

- Nor-Shippings Energy Efficiency Award
- Two Shippax Rewards – ”Best shipdesign” and ”Biggest LNG ferry”
- Maritime Denmark – The Danish Ship of the Year

Capacity utilization

- Expectations surpassed

The infrastructure project

Distribution, storage and use as fuel of natural gas - LNG

From the LNG import terminal to LNG used as fuel in ships

The LNG supply chain

- ”Hard” on maritime filling stations/infrastructures
- ”Soft” on regulations, industry standards, etc.

The business case as a horizontal issue

How can we create this infrastructure?

- Recommendations to central stakeholders

22 partners representing the LNG supply chain

Recommendations

Grouping of 22 recommendations

- Bunkering solutions
- Economic and financial aspects
- Safety
- Technical and operational aspects
- The permit process

The ESSF sub-group on LNG 1/2

Assist the ESSF to advance:

•The ”LNG Action Plan – Actions towards a comprehensive EU Framework on LNG for shipping”

The LNG supply chain represented

Regulation, industry standards and best practices etc

•EU

•IMO

•Industry organizations

The Clean Power for Transport Package

•Development of an LNG/CNG infrastructure

•Land, sea and inland waterways

The ESSF sub-group on LNG 2/2

Work packages

1.Hoses and connections

2.Simultaneous bunkering while

- Loading/unloading cargo
- Embarking/disembarking passengers
- Safety distances

3.Training

4.Gas quality, heating value and CO2 reduction potential

Results up to now 2 IMO submissions

•Standards for connectors to be used at bunkering stations for LNG to be included in the draft IGF-Code

•Defining a standard LNG bunker delivery note and standards of gas quality

Consultancy on the way

EU framework on LNG

•Completion of an EU framework on LNG-fuelled ships and its relevant fuel provision infrastructure

•International perspective according to the Clean Power for Transport Package

LNG market development

•Analysis of LNG market development in the EU

Awareness

•Creating awareness among the general public and industry groups regarding LNG as marine fuel for shipping

Financing

•Explore financing opportunities, beyond the EU financial framework at supporting the development of marine LNG technology

Conclusions

Succesfull LNG projects

•Fjord Line and Viking Line representing international shipping

•Also on infrastructure

New projects in the pipeline according to the press

- Also without state aid and EU grants!
- However also drawbacks!

The IGF code in its finalizing stage

The Clean Power for Transport Package

The ”LNG Action Plan – Actions towards a comprehensive EU Framework on LNG for shipping” is on its way

Is the business case strong enough?

- A wait and see strategy!
- Scrubbers are chosen as retrofit!
- Up to now no game changer as the US shale gas revolution!

Thank you for your attendance