PLATFORM SCHEEPSEMISSIES

LNG Seminar

27 september 2012

Stichting De Noordzee · KVNR · Port of Rotterdam · TNO innovation for life · Scheepsbouw Nederland · MARIN

PLATFORM SCHEEPSEMISSIES

Programma

13.00 – 13.30	Ontvangst	
13.30 – 13.40	Opening	Jacco van der Tak
13.40 – 14.05	Overzicht regelgeving	Roel Hoenders
14.05 – 14.30	Ontwerpen of retrofitten	Guus van der Bles
14.30 – 14.55	Technische aspecten retrofit	Bram Kruyt
14.55 – 15.20	LNG levering	Piet van den Ouden
15.20 – 15.35	Pauze	
15.35 – 16.00	LNG bunkeren in 2014	Maurits Prinssen
16.00 – 16.25	Technologische uitdagingen	Leon Sluiman
16.25 – 16.50	Green Deal	Willem Kuipers
16.50 – 17.30	Forum Discussie	
17.30	Netwerk gelegenheid	

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LNG expertmeeting

- Brede vertegenwoordiging uit de sector
  - Ontwikkelingen IGF code
    - Redundancy eisen
    - Bunker infrastructuur
    - Financiering
    - Opleidingseisen
- Besproken punten meegenomen in IGF overleg.

European Maritime Safety Agency

Overzicht regelgeving LNG ontwikkelingen

Is een level playing field in de maak?

Roel Hoenders

Project officer for environmental protection

EMSA B3 - Marine Environment, Training and Statistics

Platform Scheepvaartemissies

Delft, 27 September 2012

Contents

- Introduction to EMSA
- EMSA and environmental protection
- Revision of the Directive 1999/32 on the sulphur content of certain liquid fuels
- Sustainable Waterborne Transport Toolbox
- Developing the Sustainable Waterborne Transport Toolbox
- EMSA's involvement in developing the Sustainable Waterborne Transport Toolbox
- Addressing regulatory framework of LNG bunkering

Introduction to EMSA

Following the mandate laid down in EU law, **EMSA** supports the **European Commission** and the **EU Member States** (27) in ensuring a high, **uniform** and effective level of **maritime safety**, maritime security as well as prevention of and **response to pollution** by ships within the Community

Introduction to EMSA – legal mandate

- 12 December 1999 off the coast of Brittany

Erika sinks

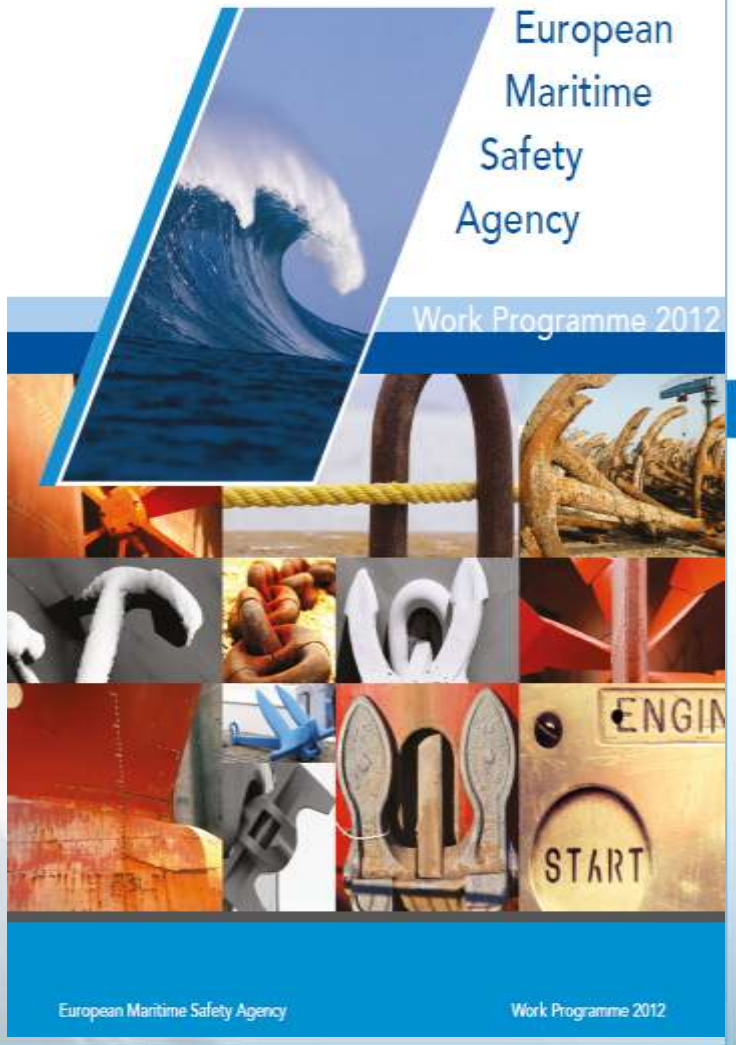
Decision to reinforce the EU maritime legislation

- Erika I maritime safety legislation package
- Erika II maritime safety legislation package

- EMSA established in 2002

Regulation EC 1406/2002

Introduction to EMSA – main tasks



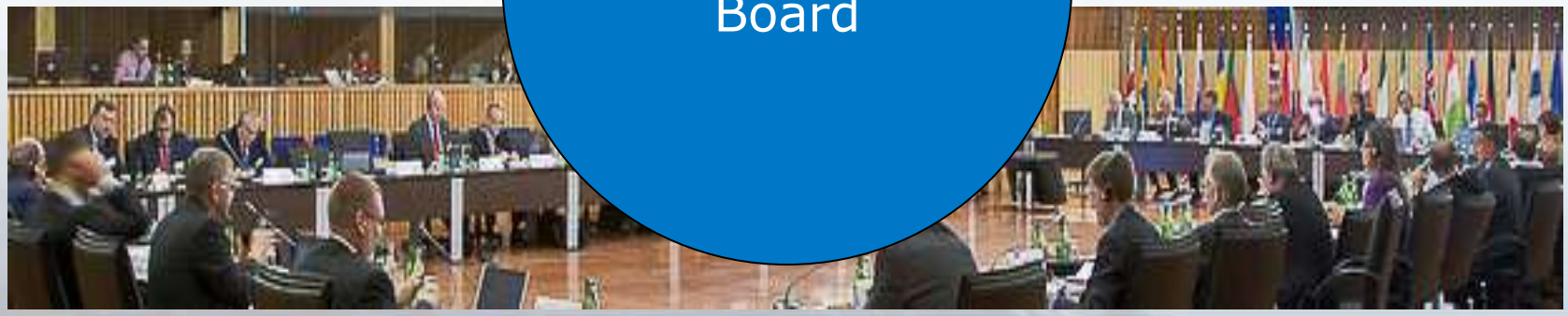
Introduction to EMSA – stakeholders & voting rights

EU Member States (1)
Norway & Iceland (x)

EU Commission (4)

4 Sectors most concerned (x)

Administrative Board



EMSA

European Maritime Safety Agency

Introduction to EMSA – organigram

European Maritime Safety Agency

September 2012

- Executive Director — *Markku Mylly*
  - Accountant — *Michel Metzger*
  - Internal Auditor — *Tom van Hees*
  - Bureau of the Executive Director — *Manuela Tomassini – Policy Advisor f.f.*; *Andrea Tassoni – Communication Advisor, incl External communications*
  - Head of Corporate Services Department A — *Manuela Tomassini*
    - Budget Planning and Monitoring
    - Finance, Procurement and Contracts
    - Unit A.1. Human Resources — *Cristina Romay Lopez*
      - A.1.1. Human Resources
      - A.1.2. Events and Missions support
    - Unit A.2. Legal & Financial Affairs — *Joachim Menze*
      - A.2.1. Legal Affairs
      - A.2.2. Budget and Financial Affairs
      - A.2.3. Facilities & Logistics
    - Unit A.3. Operations Support — *Steve Deighton*
      - A.3.1. ICT operations
      - A.3.2. Project delivery
  - Head of Implementation Department B — *Theresa Crossley*
    - Financial support
    - Horizontal Analysis
    - Unit B.1. Safety Assessments & Inspections — *Michael Hunter*
      - B.1.1. Visits to Member States
      - B.1.2. Assessment of Classification Societies
      - B.1.3. Training of Seafarers
      - B.1.4. Maritime Security
    - Unit B.2. Ship Safety — *Mario Mifsud*
      - B.2.1. Ship Safety and Marine Equipment
      - B.2.2. Port State Control
      - B.2.3. Accident Investigation
    - Unit B.3. Marine Environment, Training & Statistics
      - B.3.1. Environmental Protection
      - B.3.2. Training and Cooperation
      - B.3.3. Equasis and Statistics
  - Head of Operations Department C — *Leendert Bal*
    - Coordination & Support — *James Wood*
    - Unit C.1. Pollution Preparedness & Response — *Bernd Bluhm*
      - C.1.1. Co-ordination Cooperation & information
      - C.1.2. Contract & Fleet Management: N & W Europe
      - C.1.3. Contract & Fleet Management: S & E Europe
    - Unit C.2. Vessel traffic & Reporting Services — *Lazaros Aichmalotidis*
      - C.2.1. SafeSeaNet
      - C.2.2. Maritime Support Services
        - LRIT
        - SSN
        - Incident Alerts
    - Unit C.3. Satellite Based Monitoring Services — *Marin Chintoan-Uta*
      - C.3.1. Integrated Maritime Data
      - C.3.2. CleanSeaNet
      - C.3.3. LRIT Services
      - C.3.4. Maritime Monitoring Services

EMSA and marine environmental protection

Technical and scientific assistance to the European Commission and Member States:

- Development of new EU legislation and guidelines
- Monitoring and inspection of transposition in Member States of EU legislation
- Trainings and workshops for EU Member States
- Dedicated studies
- Participation in IMO Committees, Working Groups, Correspondence Groups
- Developing guidance for compliance with EU legislation

Topics:

- Ballast water
- Ship recycling
- Port reception facilities
- Air pollution
- Green House Gases
- Places of refuge
- Illegal discharges of oil pollution
- AFS
- …

Revision of the Sulphur Directive

Commission proposal to amend Directive 1999/32 on the sulphur content of certain liquid fuels was published on 15 July 2011

Background (Commission Impact Assessment)

- Air pollution caused by ships at berth is major concern for many harbour cities when it comes to their efforts to meet EU air quality limit values

- Formation of acid rain and particulate air pollution is major risk factor for cardiovascular & respiratory diseases

- Emissions of SO2 and NOx from maritime transport expected to exceed total of these emissions of land based sources in 2020 (SO2 for road vehicles cannot exceed 0,001%)

Revision of the Sulphur Directive

Background (cont.)

- IMO adopted in 2008 new standards for sulphur content of marine fuel (revised Marpol Annex VI). EU legislation needs to be revised to reflect new international requirements

- Requested review of Directive 1999/32 by European Parliament and Council highlighted need for improvement of implementation (provisions of sampling of marine fuels, their analysis and reporting of results by Member States needs to be improved and harmonised)

Revision of the Sulphur Directive

Main elements of proposal

- Directive will be aligned with IMO Marpol Annex VI;
  - 1/1/2015: 0.1% sulphur content in SECAs (1% until 31 December 2014)
  - 1/1/2020: 0.5% for all other EU waters (down from 3.5%)

- Directive will be adapted to IMO provisions on alternative compliance methods & emission abatement methods (exhaust gas cleaning systems, averaging,…)

- Improved implementation of the Directive by harmonising and strengthening provisions on monitoring and compliance

Revision of the Sulphur Directive

Status of legislative procedure and compromise

- A first reading agreement was reached between European Parliament and Council during Danish Council Presidency (23 May 2012)

- European Parliament confirmed and adopted the agreement in Plenary session on 11 Sept. 2012. Council is likely to follow on 29 Oct. 2012 (TTE Council).

- Compromise:
  - Emission limits entirely in line with Marpol Annex VI
  - IMO non-availability assessment and possible postponement of 2020 emission limit not included
  - Commission to assess impacts of applying 0.1% fuel standard in all EU MS territorial waters as part of 2013 air quality review
  - Strengthening provisions on sanctions

'Sustainable Waterborne Transport Toolbox'

Accompanied the legal proposal - Commission Staff Working Paper – SEC(2011)1052 final of 16/9/2011

- Commission's proposal for sulphur reduction to be **flexible** and **neutral** as regards achieving compliance with new limits: leaving choice of most appropriate technology to the operators

- But, compliance has to be achieved on time and therefore Commission considers **short term measures** to seek solutions for reducing compliance costs

- A 'toolbox' should **assist** the sector to achieve further sustainability in the long run by 'working out' a set of **medium to long term measures**

'Sustainable Waterborne Transport Toolbox'

Identified measures:

1. Short term measures: exploring possible financing instruments under **current** EU policy framework and financial perspectives (i.e. TEN-T and Motorways of the Seas, Marco Polo, EIB, State Aid, international dialogue and technical cooperation)

2. Regulatory measures: create adequate regulatory framework that facilitates safe & secure implementation and use of green ship technologies and alternative fuels, as well as development of **necessary standards**

3. Non-regulatory measures: Commission to develop platform gathering relevant public and private stakeholders to facilitate dialogue, sharing of best practice and technical co-operation amongst all interested parties

'Sustainable Waterborne Transport Toolbox'

3. Non-regulatory measures: Implementing the results of research, development and innovation activities, and promotion clean ship technology and alternative fuels

4. Development of green infrastructure and superstructure: Develop a sustainable alternative fuels strategy including also the appropriate green transport infrastructure/superstructure and ensure guidelines and standards for refuelling infrastructures

Policy-makers and industry each have their responsibilities in terms of implementing these measures

Developing the 'Sustainable Waterborne Transport Toolbox'

Possible EMSA's general involvement:

- Consider 'maritime safety' & 'marine pollution' aspects when implementing the Toolbox
- Acting as technical secretariat for the stakeholder groups / platform under the Toolbox
- **Addressing regulatory framework of LNG bunkering**
- Closely monitoring operations of exhaust gas cleaning systems (SOx emissions & wash water criteria)
- Support to developing common reporting and enforcement methods for revised Sulphur Directive
- Support to analysing use of alternative fuels contributing to reduce GHG emissions from transport and optimise ship energy efficiency

'Sustainable Waterborne Transport Toolbox'

Addressing regulatory framework of LNG bunkering:

Toolbox, p. 6:

'The absence of common rules for the distribution and bunkering of LNG to ships would need to be addressed. The Commission services, in co-operation with **EMSA** and other interested parties will assess whether the adoption of common EU wide guidelines and standards are justified.'

Developing the 'Sustainable Waterborne Transport Toolbox'

Addressing regulatory framework of LNG bunkering:

EMSA's activities so far:

1. Commission & EMSA expert group meetings with ports and ship owners (April and June 2012) to identify operational/technical gaps on LNG bunkering
2. EMSA procured a study on standards and rules for bunkering of gas fuelled ships
3. Follow-up of relevant international and European developments

Developing the 'Sustainable Waterborne Transport Toolbox'

Ad 1. Outcome of the Commission & EMSA expert group meetings with ports and ship owners on LNG:

- Exploring possibilities of LNG bunkering in different ports is rapidly evolving (also consider inland shipping)
- No harmonised definition for 'bunkering' (yet), and large variety of local bunkering and safety rules may be the result
- Accreditation mechanisms of bunkering companies to be defined
- Need to develop training requirements for personnel
- Further clarity needed regarding bunkering while loading cargo/passengers & bunkering by placing LNG tanks on board
- Possible harmonised approach for risk assessments & permit processes
- Assess necessity/scope of European framework for safe LNG bunkering to embed different national/local rules

Developing the 'Sustainable Waterborne Transport Toolbox'

Ad 2. EMSA procured a study on standards and rules for bunkering of gas fuelled ships:

- Tender notice was published in May 2012 and the contract was awarded to Germanischer Lloyd in August 2012 (€ 51.000)

- Objective: to study **possible** common-wide EU guidelines for LNG bunkering, to be presented to the industry and Member States

Developing the 'Sustainable Waterborne Transport Toolbox'

Ad 2. EMSA procured a study on standards and rules for bunkering of gas fuelled ships:

Contents of the study:

- Task 1: Provide a detailed description of the existing standards/regulations/guidelines related to LNG bunkering and those currently under development
- Task 2: Provide a gap analysis identifying, documenting and comparing the differences between requirements of current/on-going LNG related rules
- Task 3: Provide a consolidated version of possible common EU-wide guidelines or standards for LNG bunkering
- Task 4: Consultation with stakeholders and Member States

Developing the 'Sustainable Waterborne Transport Toolbox'

Ad 2. EMSA procured a study on standards and rules for bunkering of gas fuelled ships:

Current status of the study:

- Collection of information and desk-top work for the gap analysis is on-going
- Different meetings with Commission and stakeholders
- Consultation of stakeholders is on-going (questionnaire was sent out by mid-September, to be followed-up by phone interviews)
- First draft results expected for October 2012
- Stakeholder consultation foreseen for 5 December 2012
- Possible finalized study by the end of December 2012

Developing the 'Sustainable Waterborne Transport Toolbox'

Ad 3. Follow-up of relevant international and European developments

- EMSA participates – on behalf of the European Commission - in IMO correspondence group on the **IGF code**
- Presentation at EMSA LNG expert group meeting by the chair of the **ISO group** on the development of Guidelines for systems and installations for supply of LNG as fuel to ships (ISO TC 67/WG 10)
- EMSA follows the work done in other **international and EU initiatives** (WPCI, SIGTTO, ECSA)
- EMSA is in contact with **individual Member States**, **ports**, **ship owners, bunker companies and other stakeholders**

Dedicated LNG web-page on EMSA general website

EMSA
European Maritime Safety Agency

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  - Ballast Water
  - Greenhouse Gases
  - Liability & Compensation
  - Port Reception Facilities
  - Ship Recycling
  - Sustainable Toolbox
- Other Issues

Related Documents

- Commission Staff Working Paper on pollutant emission reduction from maritime transport and the sustainable waterborne transport toolbox
- Commission proposal for an amendment of Directive 1999/32/EC

Relevant Legislation

- Directive 2005/33/EC

Sustainable Toolbox

Support in relation to the Sustainable Waterborne Transport Toolbox

On 16 September 2011, the Commission issued a Staff Paper "Pollutant emission reduction from maritime transport and the Sustainable Waterborne Transport Toolbox" accompanying the Commission proposal and communication of 15 July 2011 amending Directive 1999/32/EC on the use of low sulphur marine fuels.

The "Sustainable Waterborne Transport Toolbox" aims at addressing the environmental challenges the shipping sector is confronted with in an integrated manner, in order to help it to achieve sustainability objectives in the long run. The proposed actions shall be flexible and neutral and minimise any possible unwanted effects. The actions will be part of a coherent action to facilitate the efficient use of energy in the field of transport, i.e. the Clean Transport System Initiative. EMSA has been requested to support the development of a number of actions identified in the Sustainable Waterborne Transport Toolbox.

LNG as fuel in ships

The Commission has expressed its intention to proceed with some of the key actions outlined in that document, among them the setting up of a platform gathering the relevant stakeholders on LNG as ships' fuel. For this reason the Commission invited to a first set of ad hoc meetings with expert from relevant parts of the industry to initiate an exchange of view, focussing on concrete technical and operational obstacles to the use of LNG. The Commission has indicated that at this stage, funding issues will not be addressed. The aim of the Commission at this stage is to develop an action plan that would specifically contribute to the use of LNG as alternative fuel in shipping.

EMSA is acting as secretariat for the groups currently working; the port- and ship-owner groups.

Other groups

The Commission has indicate that there might be a need for other expert groups to meet to discuss other issues related to the Sustainable Waterborne Transport Toolbox, such as scrubbers.

Conclusie

Is een level playing field in de maak?

- On-going op **internationaal niveau**, verder ondersteund door diverse zelfregulering/guidelines initiatieven van stakeholders/industries

- In de **EU** voornamelijk initiatieven van individuele Lidstaten, havens en Europese belangenorganisaties. Mogelijke **Commissie** initiatieven om bestaande gaps in te vullen zullen afhangen van snelheid van internationale ontwikkelingen, resultaten van EMSA studie, stakeholder consultations en positie van de Lidstaten.

THANK YOU FOR YOUR ATTENTION

Roel.Hoenders@emsa.europa.eu

Klaar voor LNG in 2014 !

Ontwerpen of retrofitten voor LNG

Kom je uit de kosten ?

Door: Guus van der Bles

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Programma

1. Introductie
2. R&D project: LNG MKB haalbaarheid
3. Vervolg R&D LNG-SSS Innovatie Contract Energy
4. Ontwerpprojecten
5. Conclusies: kom je uit de kosten ?

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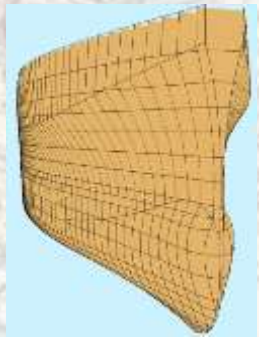
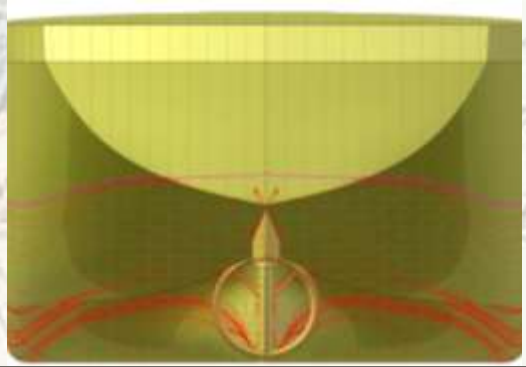
Introductie

- Guus van der Bles: Conoship + TU Delft
- Drive: innovaties toepassen in schepen
- Focus R&D: Economie & Milieu
  - Brandstof besparen door scheepsvorm + voortstuwer
  - ConoSeaBow en ConoDuctTail obv CFD
  - Windvoorstuwing units TurboSail
  - **LNG tbv voortstuwing**





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Intro Conoship

- 60 jaar ontwerpbureau in Groningen
- Specialist innovatieve ontwerpen Short Sea Shipping : alle typen 30 to 130 m Lengte
- ca. 2000 schepen van ons ontwerp gebouwd: “World Market Leader” in ‘coasters’
- Focus op toepassen van praktische innovaties, oa lekstabiliteit –> max T -> max DWT ook Retrofit

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Snelste projectladingschip < 3000 GT

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projectladingschip < 3000 GT
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2600 m3 SHZ 14 kn Golf Biskaje

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Loodsvaartuig Polaris

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Kleinste LNG tanker
Pioneer Knutsen

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R&D project: LNG toepassing MKB haalbaarheid 2011/2012

Partners:

- CMTI
- Koers en Vaart
- Cryonorm Projects
- Damen Bergum
- Cofely West Industrie
- Conoship

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MKB haalbaarheid LNG probleem- en doelstelling:

- 2015: max 0.1% S eisen Baltic SECA
- Intro LNG: iedereen wacht (2011)
- LNG varen <-> LNG bunkerstations
- Technisch haalbaar <-> regelgeving
- Nieuwbouw / retrofit: techniek & economie: kom je uit de kosten ?
- Doelen: haalbaarheid toepassen LNGbrandstof in ShortSeaShips

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MKB haalbaarheid LNG
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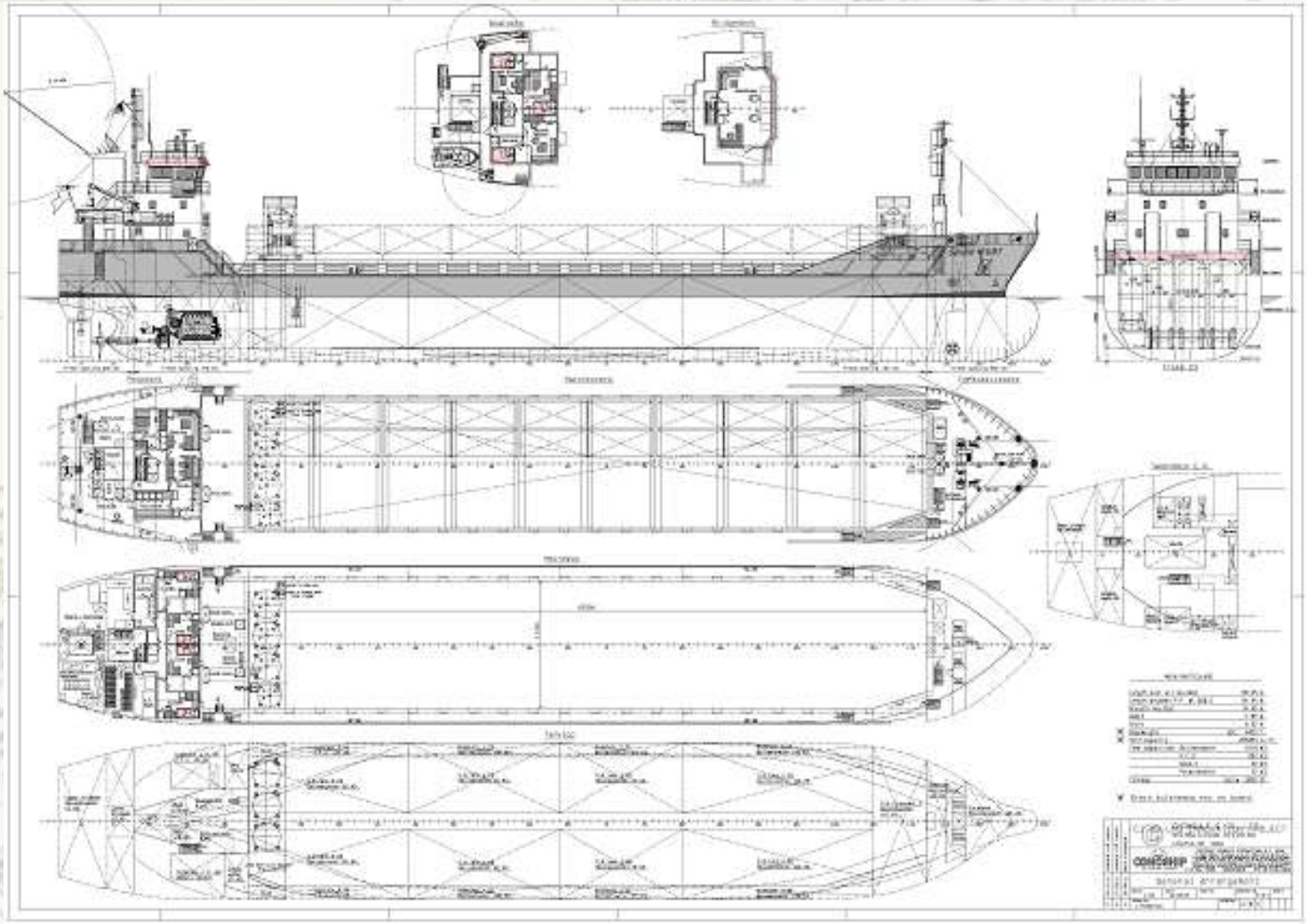

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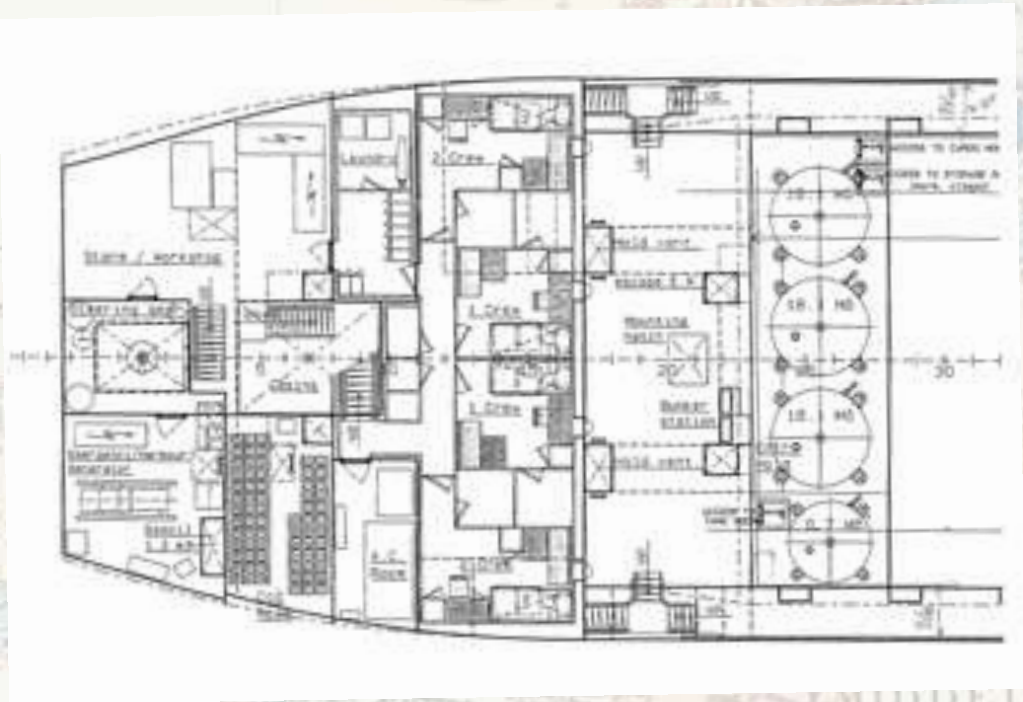
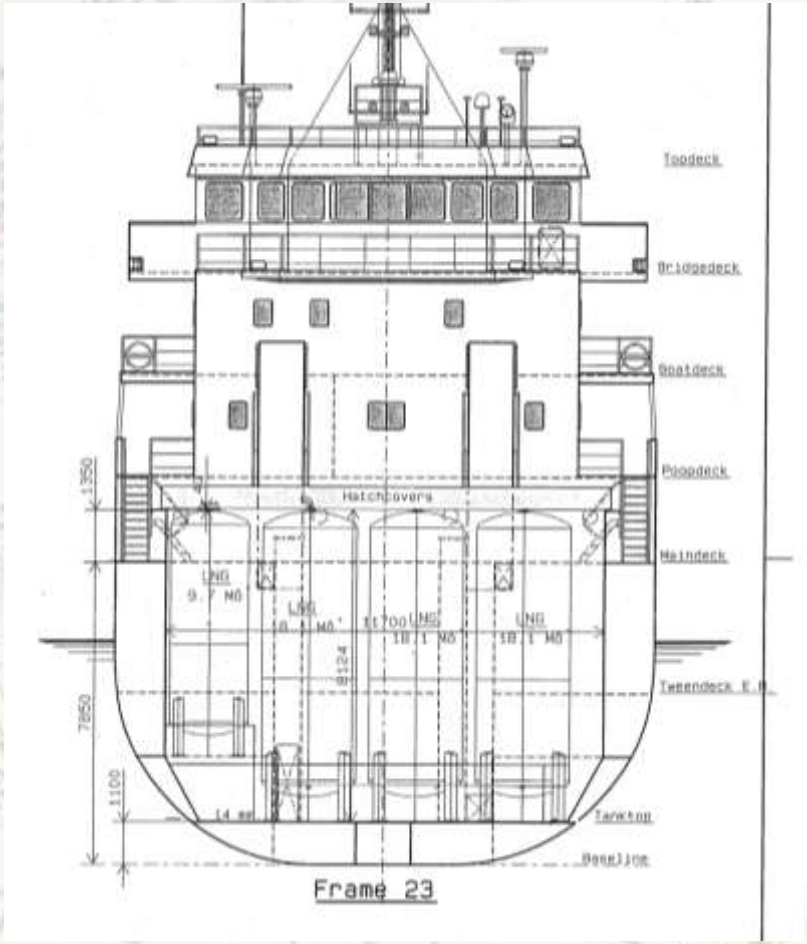
MKB haalbaarheid LNG standaard LNG tanks Cryonorm





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MKB haalbaarheid LNG
LNG Installatie:

- Cryonorm dubbelwandig RVS standaard tanks, vertikaal, bunkerstation aan dek
- Coldbox/tankroom eronder, verbonden met tanks, warmtewisselaars gasstraat
- Dubbelwandig RVS piping naar/in MK ‘Inherently Gas Safe’
- Wartsila 9L20 DF MCR Gas 1580 kW
- Verbruik LNG 8500 – 9500 kJ/kWh
- LNG ca. 180 gr/kWh, MGO ca. 195 gr/kWh

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MKB haalbaarheid LNG vaarprofiel: Rotterdam Rauma vv binnen ECA 2 x 1090 nm

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MKB haalbaarheid LNG jaarverbruik benchmark-reis

VERBRUIK LNG EN GASOLIE	ROTTERDAM - RAUMA VV		
Wartsila 9L20DF	LHV van LNG = 49,5 MJ/kg		
SNELHEID (KN)	**12,5**	**12**	**11**
VERMOGEN (Kw)	1560	1240	920
RONDREIZEN / JAAR	40	38	35
JAARVERBRUIK DIESEL (T)	2129	1670	1291
JAARVERBRUIK LNG (T)	1856	1460	1088
+ PILOTFUEL MGO (T)	13,6	13,7	15,3

MGO (T) 13,6 13,7 15,3

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MKB haalbaarheid LNG economische vergelijking

KOM JE UIT DE KOSTEN ?		**ROTTERDAM - RAUMA VV**	
GASOLIE EUR 650/ton	LNG EUR 434/ton = aan boord		
BEDRAGEN IN MILJOEN EURO			
SNELHEID (KN)	**12,5**	**12**	**11**
JAARVERBRUIK MGO (T)	2129	1670	1291
JAARKOSTEN MGO (M.EUR)	1,38	1,09	0,84
JAARVERBRUIK LNG (T)	1856	1460	1088
JAARKOSTEN DUAL FUEL	0,80	0,63	0,49
INVESTERING LNG-INSTALL	1,33	1,20	1,08
KAPITAALKOST/J LNG-INSTALL	0,13	0,12	0,10
BESPARING/J FUEL-CAPEX	0,34	0,24	0,17
TERUGVERDIENTIJD (J)	**4,0**	**4,9**	**6,4**
afschrijving 15 jaar rente 3% extra onderhoud LNG 3%			

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MKB haalbaarheid LNG aandachtspunten:

- Vergelijk MGO – LNG niet voldoende, ook:
  - HFO met scrubbers nat / droog
  - 100% gasmotoren
- Verbruik LNG 8500 – 9500 kJ/kWh , maar variaties bij bunkeren in:
  - Low Heating Value (LHV) in MJ/kg en MJ/m3
  - Methaangetal = klopvastheid=efficiency
- Prijsvorming LNG aan boord (distri-toeslag)
- Regelgeving IMO IGF-code ontwikkelt zich
- Veiligheid –regelgeving bunkeren

Conoship International BV
PO Box 6029
9702 HA Groningen
Netherlands

Phone: +31 505268822
Fax: +31 505252223
conoship@conoship.com
www.conoship.com

Bunkeren: shore to ship
ship to ship op zee/in haven ?

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vervolg R&D project: **LNG – SSS**

LNG-Innovatie Contract Partners:

– CMTI /SbNL & Koers en Vaart
– Cryonorm, Cofely, Econosto
– Conoship, Damen Shipyards
– BV, LRS, VIV
– Ballast Nedam, Wagenborg
– Wartsila, Rolls Royce
– Pon Power, Sandfirden

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LNG applications SSS probleem- en doelstelling:

- LNG-supply chain + LNG ships + LNG bunkerstations
- haalbaarheid regelgeving/techniek/ veiligheid/sociale accept/economie
- Doelen: praktische oplossingen LNG bunkeren + systemen + schepen
- 3 ontwerpen: variatie lay-out
- Dual fuel 1% / 25% + 100% gas
- Eco-analyse

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LNG-Ontwerp-projecten

- 2009 DTM-France : baggerschip 2600m3 14,5 kn LNG + Wartsila 8L34DF op prop
- Te vroeg: certificatie Wartsila + regelgeving
- MPP ship lijndienst in Baltic ECA: LNG tank + installatie integreren in ontwerp
- MPP ship veel in Baltic, basis ontwerp uitwerken met BV, tot in details
- Vergelijk: dual fuel – 100% gas
- Ook scrubbers 3 typen

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Aandachtspunten LNG in praktijk

- Regelgeving bunkeren en op de wal
- Tanksystemen en investeringskosten
- Prijsontwikkeling motoren: dual fuel, gasmotoren, scrubbers, ombouw-kits
- Echte reder met echt project: echt contract
- Prijsvorming LNG aan boord in toekomst:
  - Koppeling olieprijs ? Gasprijs in gasnet?
  - Aanlandingsprijs + distri-toeslag :
  - 10 USD/MMBTU ? = ca. 7 EUR/GJ = ca. 380EUR/ton aanlanding of aan boord ?

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Conclusie: kom je uit de kosten?

- **R&D project wel: tussen 4 en 6,5 jaar**
- Investeringskosten in praktijk : daar is uit te komen in “echt project”
- Verbruikscijfers motoren: variaties in rendement dual fuel – gasmotoren
- Variaties LHV/m3 en /kg van LNG : wat gaan we straks bunkeren ?
- Prijsvorming LNG: Echte reder met echt project kan echt contract krijgen: komt er uit!

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LNG: Kom je uit de kosten ?
Kom daar maar eens uit !

CONOSHIP
INTERNATIONAL

Dank voor uw aandacht

Vragen?

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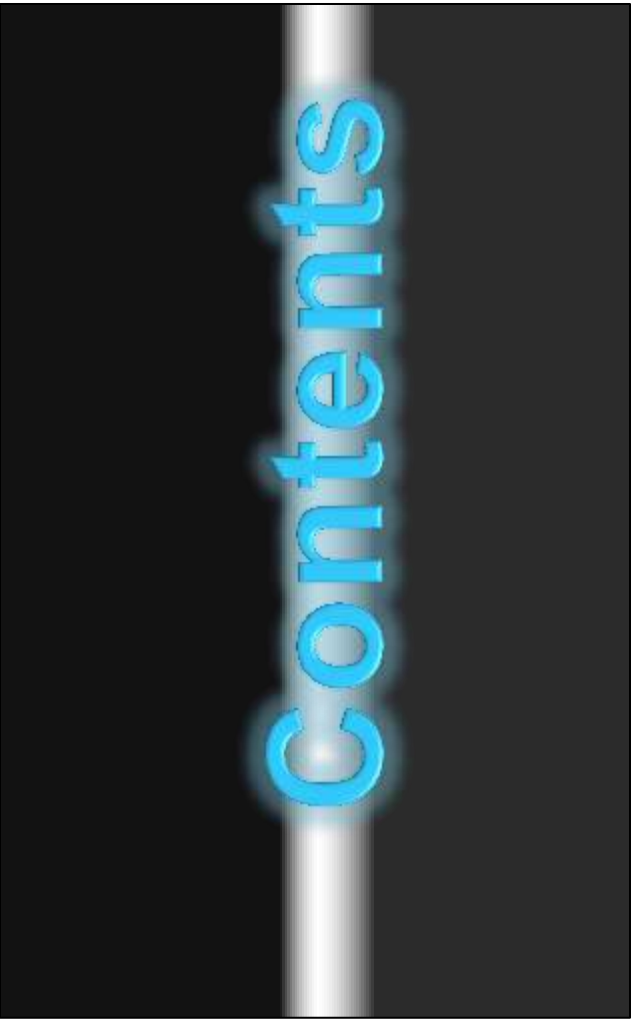
Propulsion retrofit Solutions, Technical aspects

Bram Kruyt

Contents



- Introduction
- The challenge, options to reduce emissions
- Duel Fuel, in more detail
- One size fits all?
- Propulsion system retrofit, hurdles
- Operational experience

This is Wärtsilä

Nett Sales 2011 : 4,209 million
Operating Profit : 469 million
Nbr of employees : > 16,000

Our offering covers all key shipping segments

Merchant	Offshore	Cruise and Ferry	Navy	Special Vessels
				

Our offering covers these products & solutions

Engines

Portfolio of 2-Stroke, 4-Stroke and Dual Fuel Engines

Propulsion Products

Portfolio of Gears, Propellers, Thrusters, Nozzles, Rudders, Water Jets, Seals and Bearings

Ship Design

Wärtsilä design provided for merchant, offshore and special vessels

Seals, Bearings and Stern Tubes

Wärtsilä provides advanced Seals and Bearing Solutions

Automation & Electrification

Portfolio of monitoring and power distribution systems

Systems

Standardized combinations of components

Environmental Products

Portfolio of NOx and SOx abatement systems and Oil/Water Separators

Ancillary Equipments

Portfolio of Ancillary Equipments for Engine Room

The Challenge: Reduce Emissions

The challenge: Green Shipping

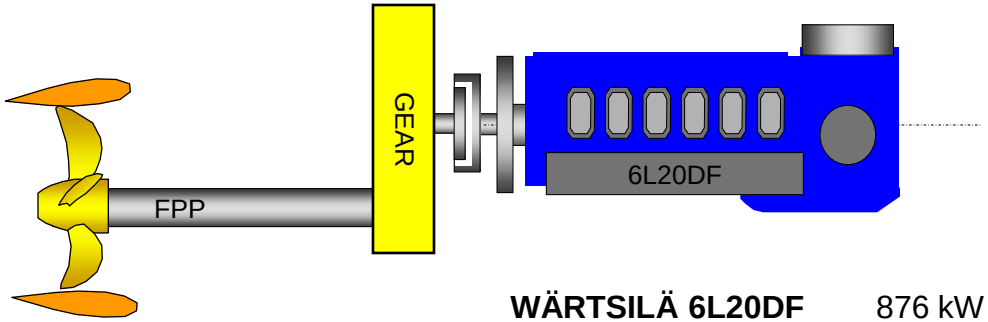
Some 12.000 Inland vessels in Western Europe need to become "green" in the upcoming 10 – 15 years !

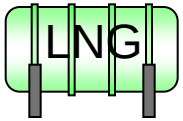
CCR4 (effective 2015/16) will set the standard for Inland Propulsion Concepts, both for newbuild and retrofit

The technology to realise this is already available but will be further developed; various options are available

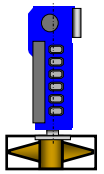
Example 1: Direct Dual-Fuel Propulsion

WÄRTSILÄ 6L20DF 876 kW at 1000 rpm

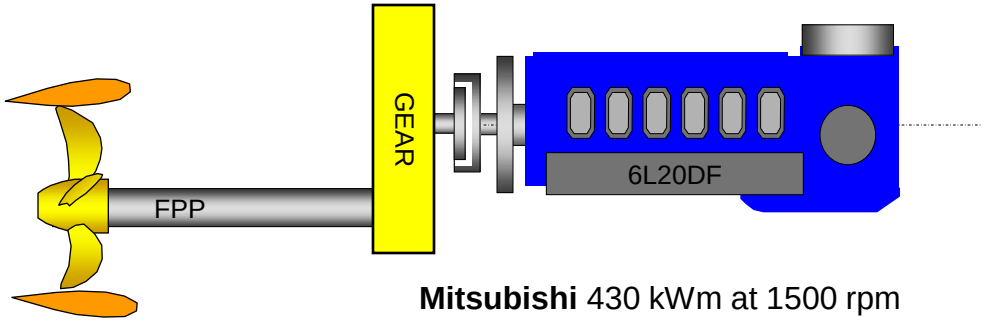




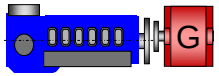
Mitsubishi 405 kW



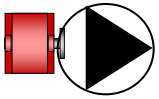
WÄRTSILÄ 6L20DF 876 kW at 1000 rpm

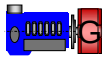


Mitsubishi 430 kWm at 1500 rpm

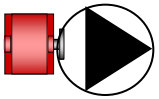


Cargo pump 200 kW



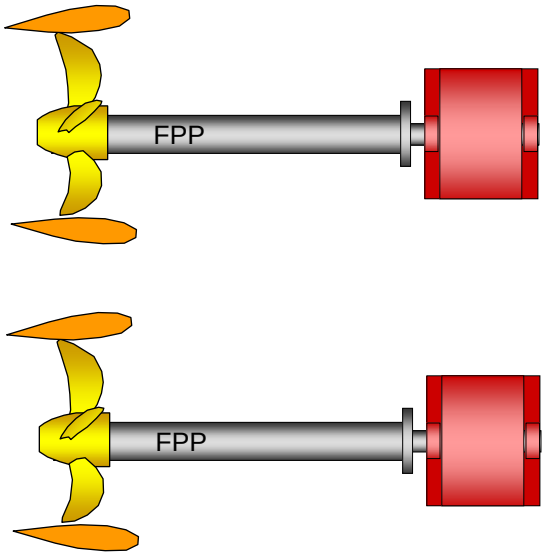


Cargo pump 200 kW

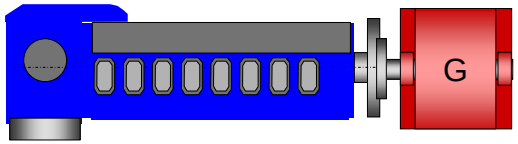


- HS after treatment
- MS after treatment
- Diesel- electric
- **DF-mechanical**
- DF-electric
- DF-hybrid
- LNG-mechanical
- LNG-electric
- LNG-hybrid
- Hydrogen additives

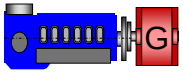
Example 2: Dual Fuel–Electric Propulsion:



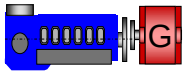
Wartsila 8L20DF 1168 kW at 1000 rpm

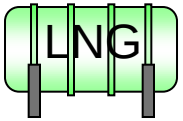


Mitsubishi S6B MPTK 257 kWm at 1500 rpm

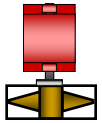


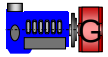
Mitsubishi S6B MPTK 257 kWm at 1500 rpm



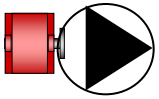


Electrical drive 420 kW

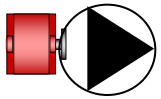




Cargo pump 200 kW



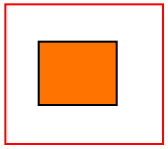
Cargo pump 200 kW



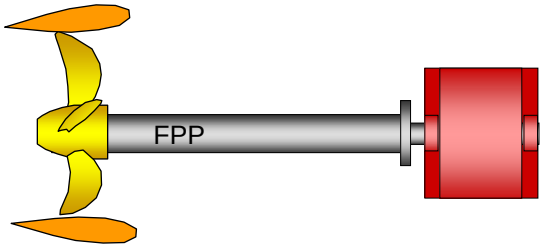
- HS after treatment
- MS after treatment
- Diesel- electric
- DF-mechanical
- **DF-electric**
- DF-hybrid
- LNG-mechanical
- LNG-electric
- LNG-hybrid
- Hydrogen additives

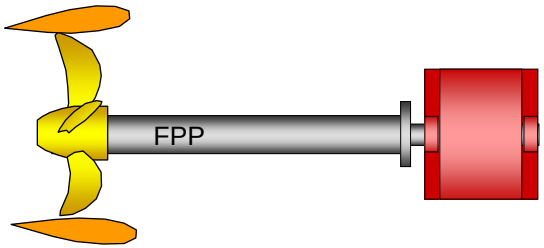
Optional: Batteries 30 kW h

(in lieu of the harbor set)

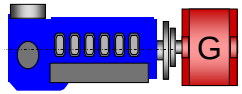


Example 3: LNG – Electric Propulsion

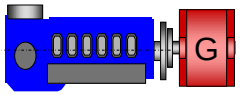


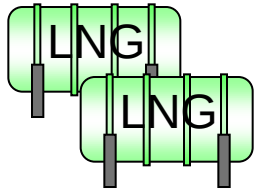


Mitsubishi GS12R MPTK – gas 686 kWm at 1500rpm

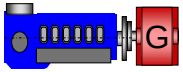


Mitsubishi GS12R MPTK – gas 686 kWm at 1500rpm

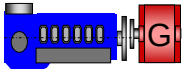




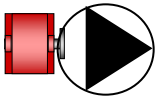
Mitsubishi S6B MPTK 257 kWm at 1500 rpm



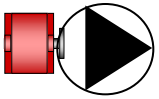
Mitsubishi S6B MPTK 257 kWm at 1500 rpm

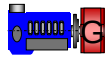


Cargo pump 200 kW



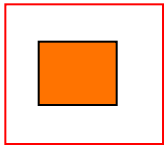
Cargo pump 200 kW





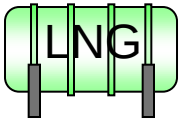
Optional: Batteries 30 kW h

(in lieu of the harbor set)

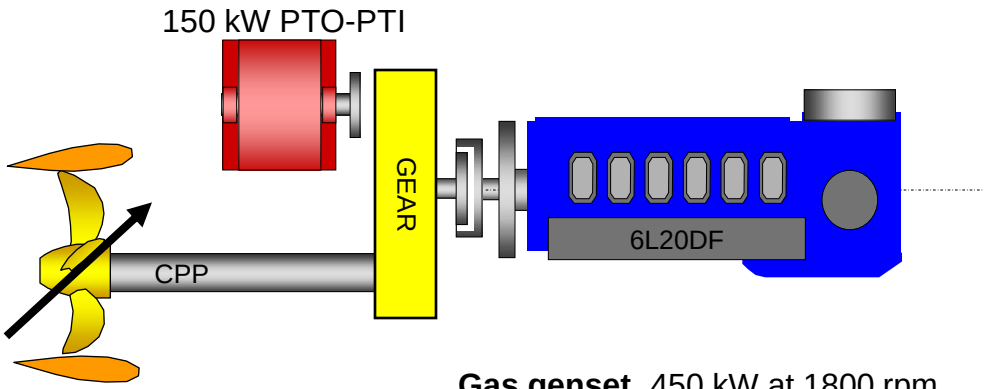


- HS after treatment
- MS after treatment
- Diesel- electric
- DF-mechanical
- DF-electric
- DF-hybrid
- LNG-mechanical
- **LNG-electric**
- LNG-hybrid
- Hydrogen additives

Example 4: Hybrid DF-Electric Propulsion

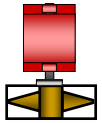


WÄRTSILÄ 6L20DF 1056 kW at 1200 rpm

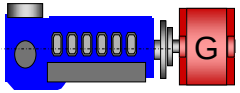


1206 kW

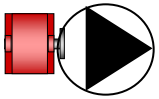
Electrical drive 400 kW



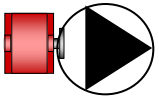
Gas genset 450 kW at 1800 rpm



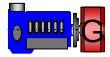
Cargo pump 200 kW



Cargo pump 200 kW



High Speed 50 kW at 1800 rpm



- HS after treatment
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- Diesel- electric
- DF-mechanical
- DF-electric
- **DF-hybrid**
- LNG-mechanical
- LNG-electric
- LNG-hybrid
- Hydrogen additives

Dual Fuel - Performance

Combustion control => Better Performance

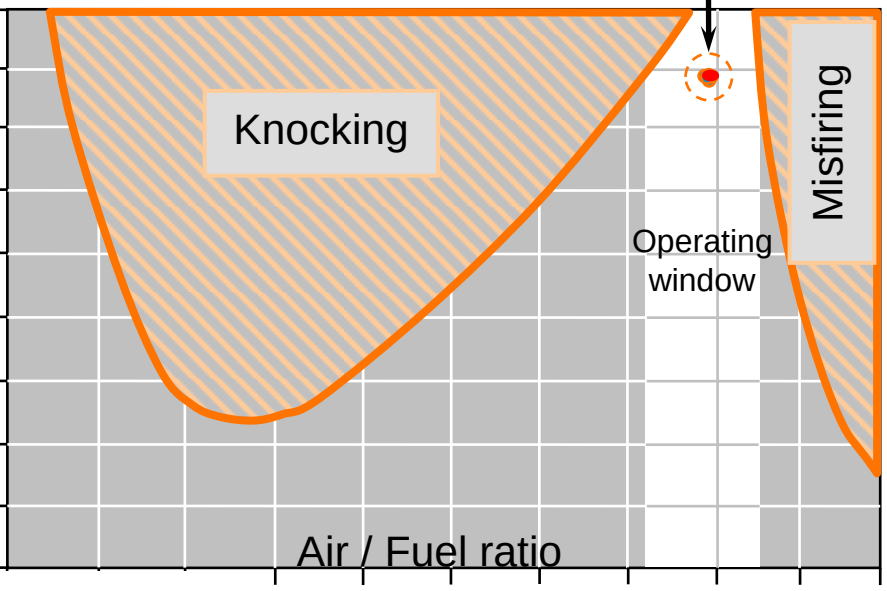
Dedicated Design:

- LNG injection per cylinder
- Load balancing between cylinders
- Extra injector / pump for pilot fuel

Converted Diesel Engine

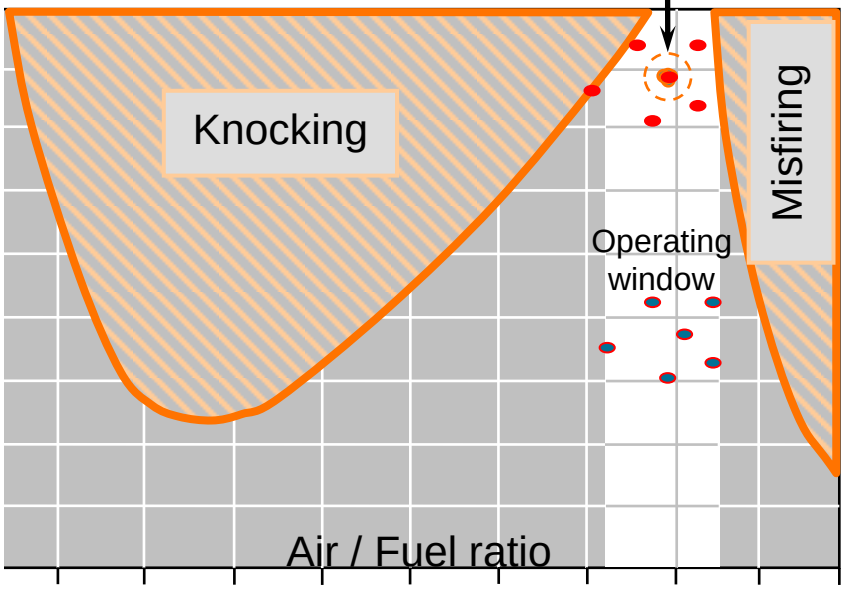
- LNG supply before turbo
- No load balancing possible
- Normal injector

Wartsila optimum performance for all cylinders
→ efficient and clean



BMEP [bar] ~power

Different performance per cylinder



Dual Fuel – Performance

Combustion control => Better Performance

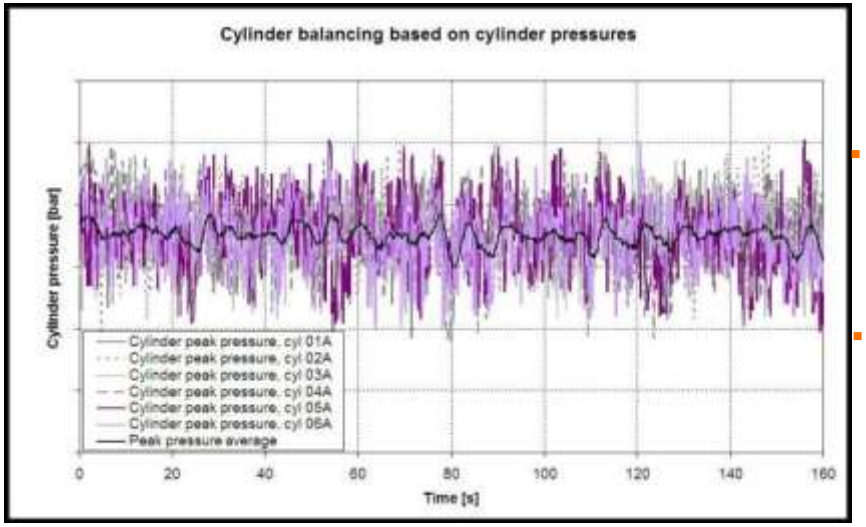
Dedicated Design:

- LNG injection per cylinder
- Load balancing between cylinders

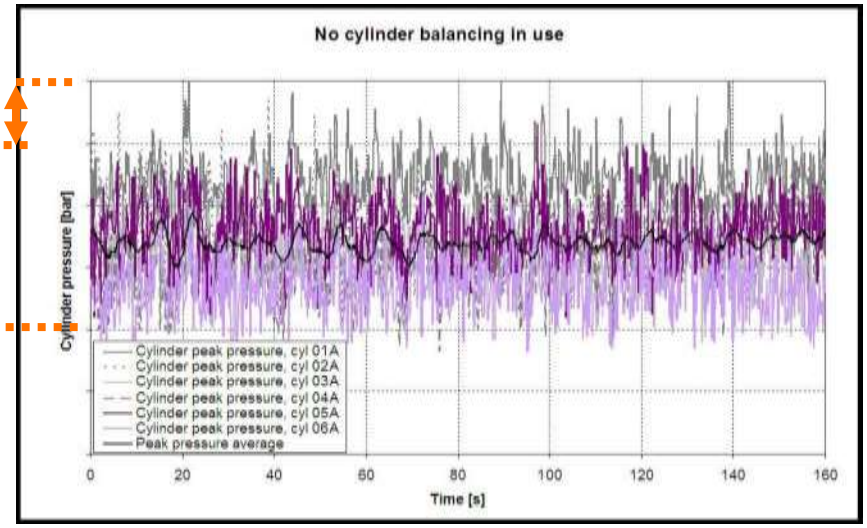
Converted Diesel Engine

- LNG supply before turbo
- No load balancing possible

• With cylinder pressure balancing – 30% lower load differences → quiet and vibration free



• No cylinder pressure balancing



Dual Fuel – Engine Life Time

Dedicated Design:

- Key components designed for higher temperatures
- Thermal loading part of design and control process → high output

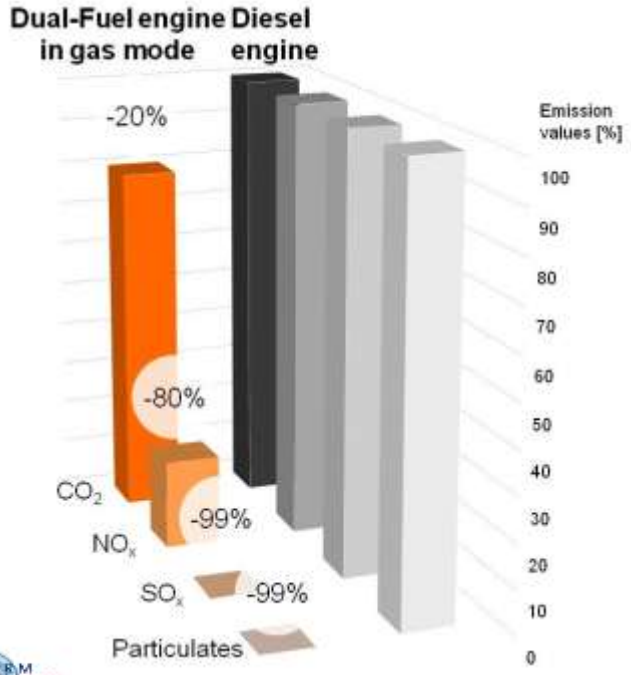
Converted Diesel Engine

- Standard components
- Limited thermal loading analysis → up to 55% reduction in output compared to diesel for same lifetime

Dual Fuel - Emissions

Dedicated Design:

- CCR4 compliance expected
- LNG / Diesel mixture 95-99/ 5-1%
- Inlet/outlet valve timing and gas admission independent → methane slip and performance optimized independently



Converted Diesel Engine

- After treatment for CCR4
- LNG / Diesel mixture 80/20 %
- Inlet / outlet valve overlap results in methane slip

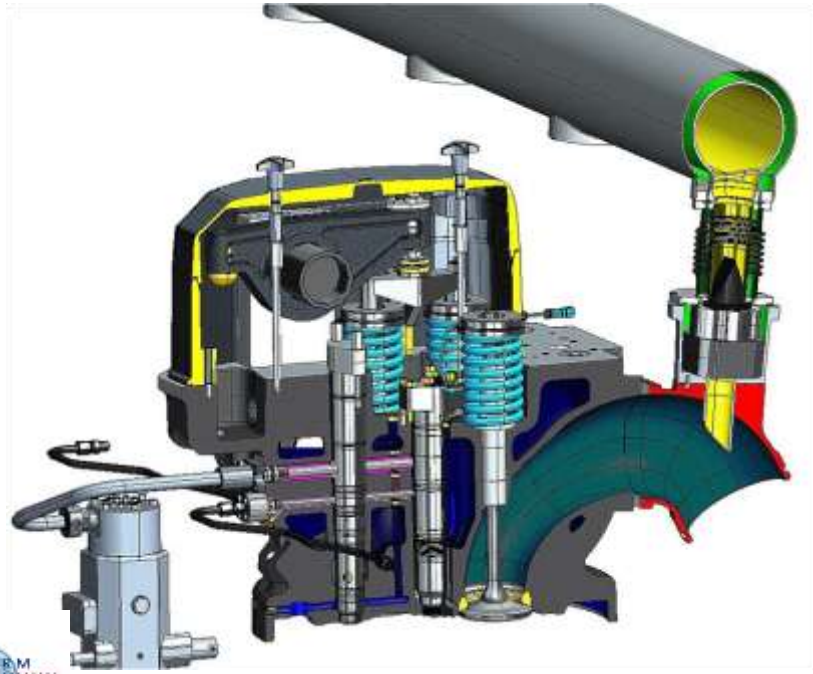
Dual Fuel – Safety

Dedicated Design:

- Double piping on engine with gas leak detection between pipes

  => Standard Engine room

- Controlled combustion process



Converted Diesel Engine

- Single wall piping on Engine, gas leak detection

  => Special Engine Room

Duel Fuel - conversion – Parts which will be exchanged

Dual-needle injection valve

Cylinder heads

Turbochargers modified for DF operation

Cylinder liner & anti-polishing ring

Camshaft pieces for DF Miller valve timing

Pistons & piston rings

Control system UNIC

Connecting rods (upper part)

Duel Fuel - conversion – Parts which will be added

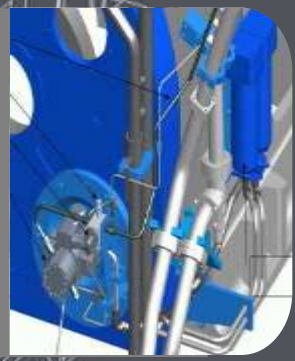
Exhaust gas waste gate

Gas rail pipe

Phase sensor

Gas admission valves

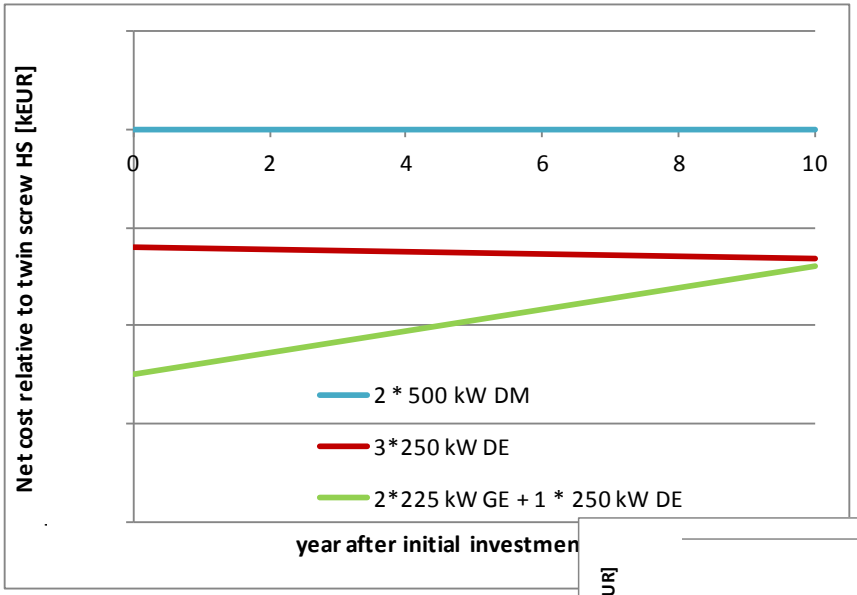
Pilot fuel system:
- Pilot fuel oil filter
- Common rail piping
- Pilot fuel oil pump

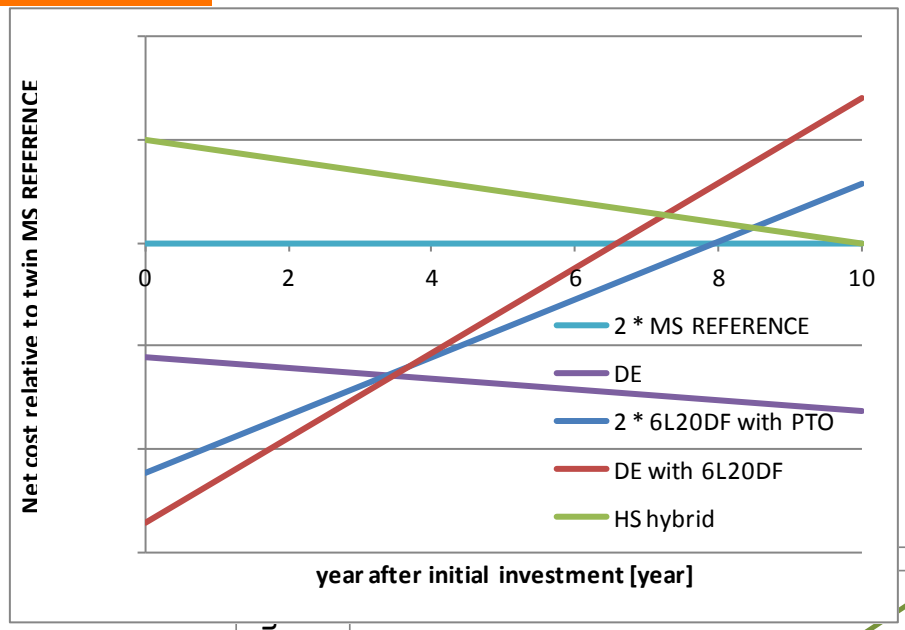


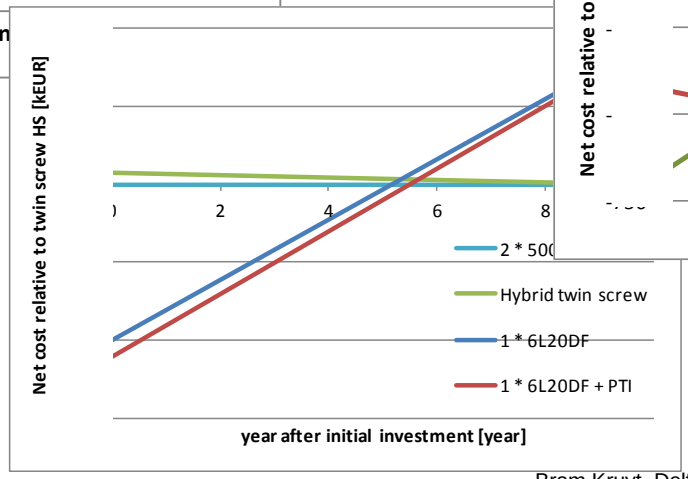
One size fits all? Certainly not!

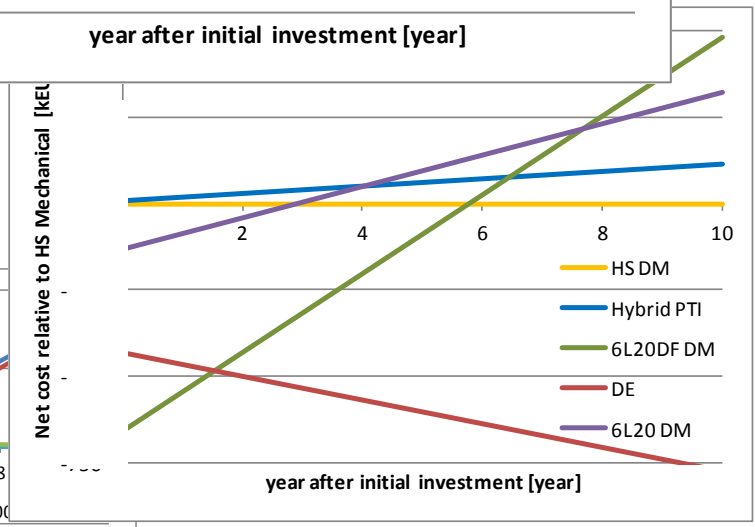
Best option very much depends on:

- **Annual sailing time**
- **Average power**
- **Ship type**
- **Sailing area**



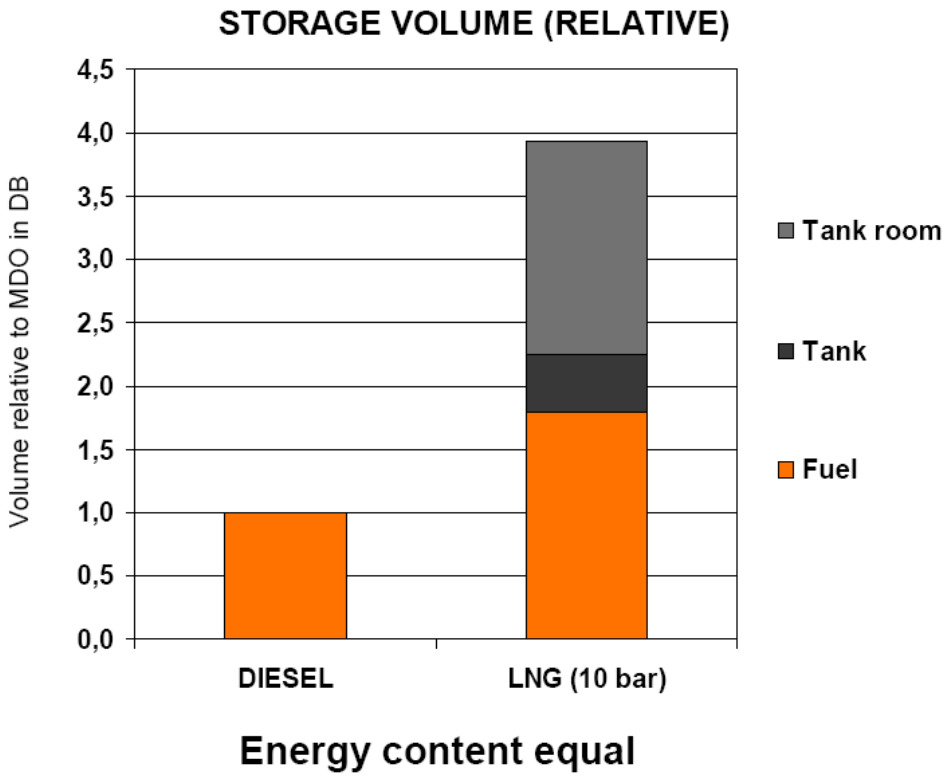




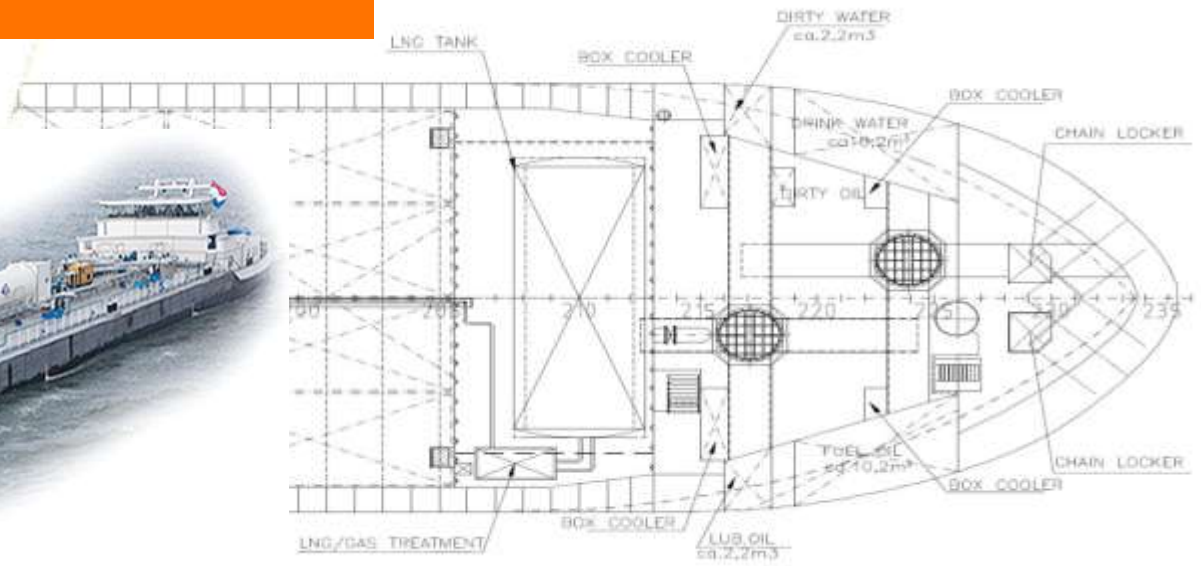


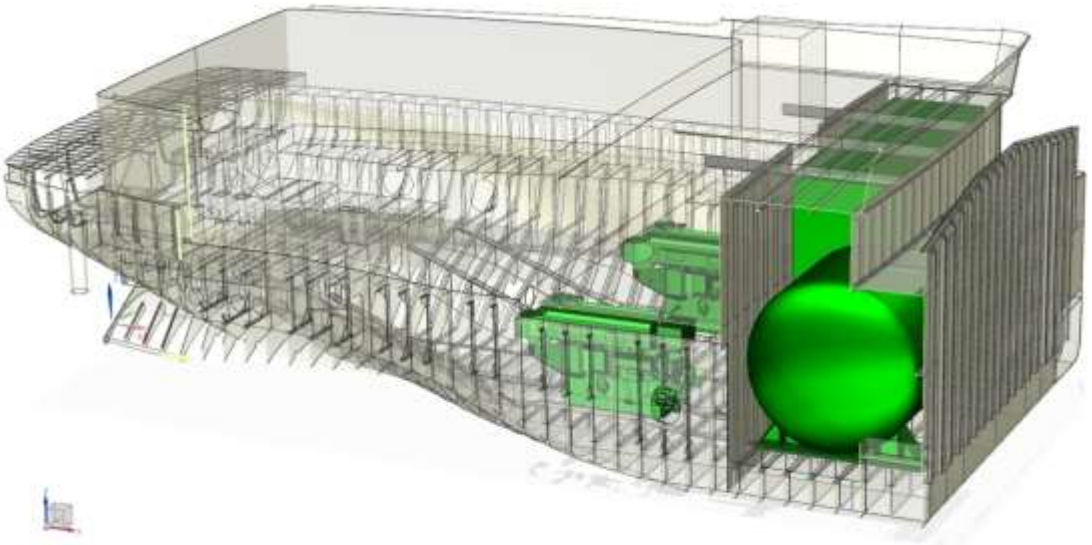
Retrofitting of vessels, hurdles to take

- Classification of vessels required
- Risk analysis (HAZID)
- **Tank & coldbox, capacity, location, space demand**
- Stability
- Existing Engine foundation
- ……

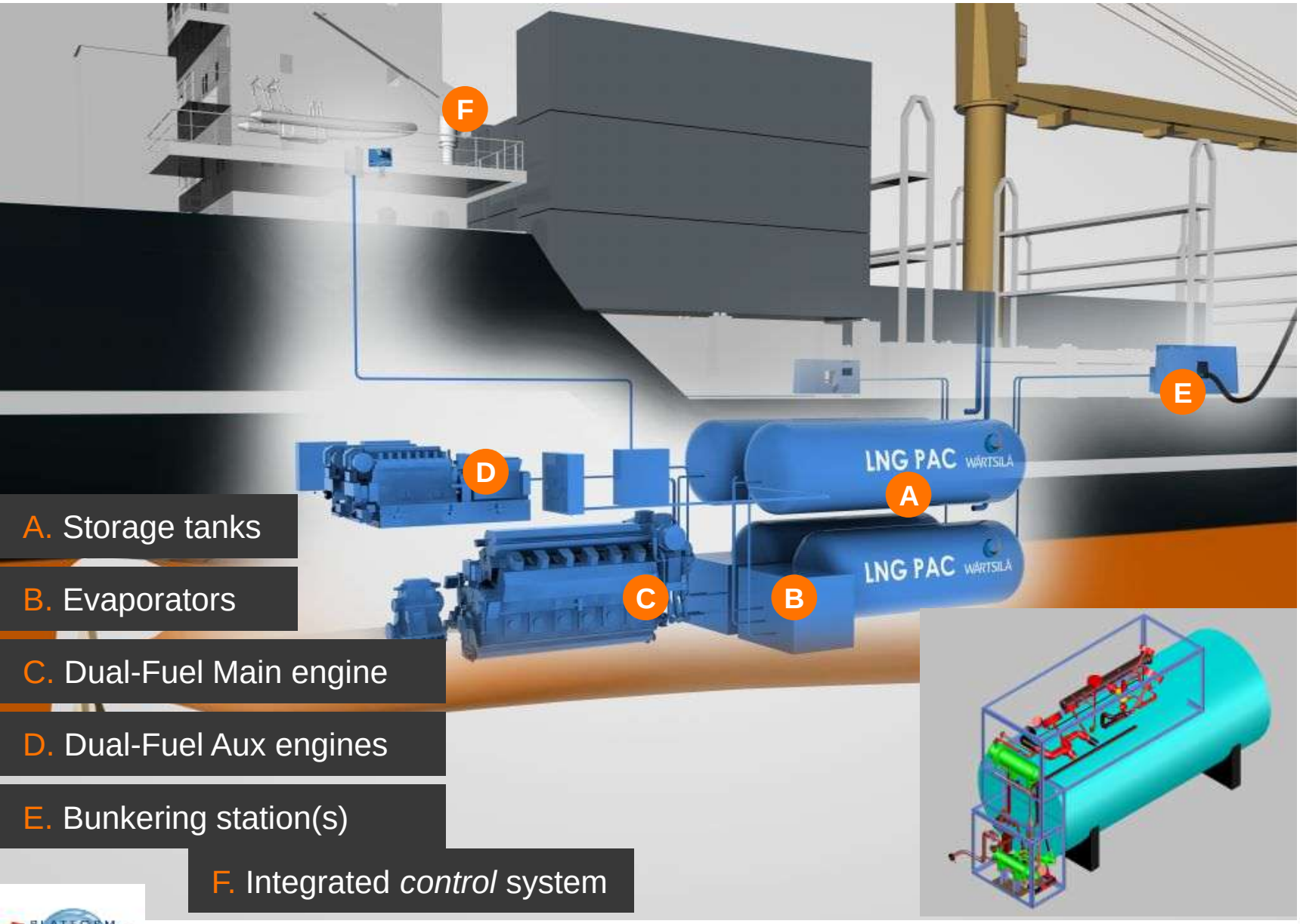


LNG Tank, possible locations





LNG Cold Box – system lay out



A. Storage tanks

B. Evaporators

C. Dual-Fuel Main engine

D. Dual-Fuel Aux engines

E. Bunkering station(s)

F. Integrated *control* system

Dual-Fuel applications - References

Power Plants

DF Power Plant
- 49 installations
- 155 engines
- Online since1997

Conversion
> 50 conversions

Merchant

LNGC
- 89 vessels
- 353 engines
- 1’000’000 rh

Conversion
- 1 Chem. Tanker
- 2 engines conv.
- Complete gas train
- Complete design

Offshore

PSVs/FPSOs
- 17 vessels
- 87 engines
- Online from 1994

New orders!
- Harvey Gulf: the first 3 LNG-PSV to be operated in the Gulf of Mexico!

Cruise and Ferry

LNG ferries
- 1+1 vessels
- 4 engines per vessels
- Complete gas train
- 2800 passengers
- In service in 2013

Navy

Costal Patrol
- Coming…

→ 4 segments → 150 installations → > 5’000’000 running hours

Viking Energy – Operational Experiences

Project MariTIM
Scope of Project

MariTIM
Maritime Technologien und Innovationen
Modellregion Deutschland/Niederlande

- Joint Dutch –German innovation project, aimed at the development of maritime technology and co-operation
- Innovative environmental friendly vessel propulsion systems
- Inland Passenger vessel with hybrid LNG- Electric propulsion
- "ECO² Inland Vessel", Selection tool for Inland vessel propulsion systems, testing different systems on up to 3 vessels
- Short Sea vessel with wind turbine propulsion
- Includes Technology, LNG infrastructure, legal and legislation aspects
- 26 project partners
- Know-how network , basis for further future developments
- Total 5,2 million subsidy by provinces and EU

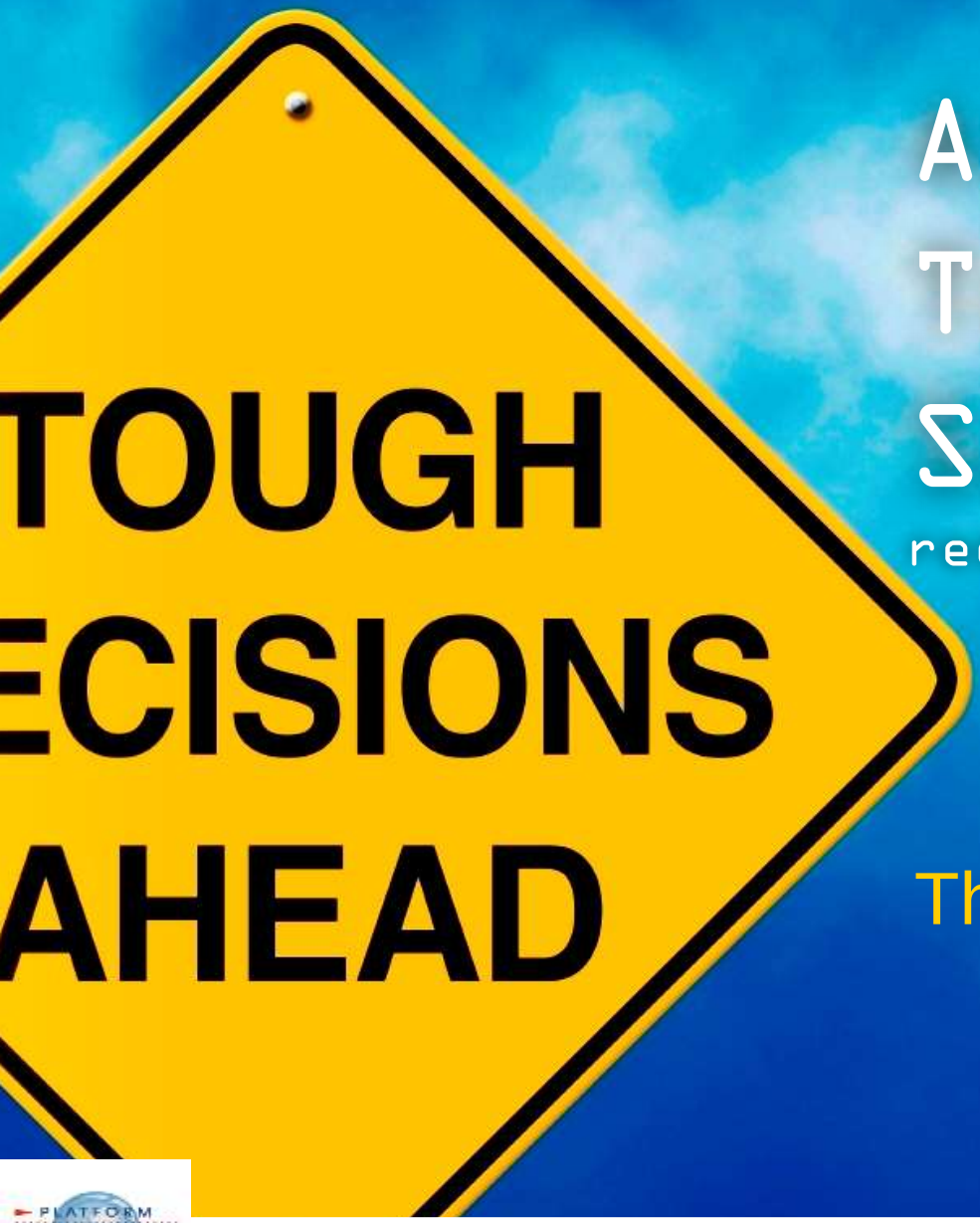
INTERREG Deutschland Nederland

INTERREG - Grenzregionen gestalten Europa
Europäischer Fonds für Regionale Entwicklung der Europäischen Union
INTERREG - Grensregio's bouwen aan Europa
Europees Fonds voor Regionale Ontwikkeling van de Europese Unie

PLATFORM SCHEEPSEMISSIES

Project "ECO² Inland Vessel"
Project partners

New Partners invited



After Treatment Or Sail on LNG

reduce emission at the source

Thank you for your attention

Fuel consumption comparison of Diesel versus Otto cycle

- LHV MGO = 42700 [kJ/kg]
- LHV LNG = 49200 [kJ/kg]

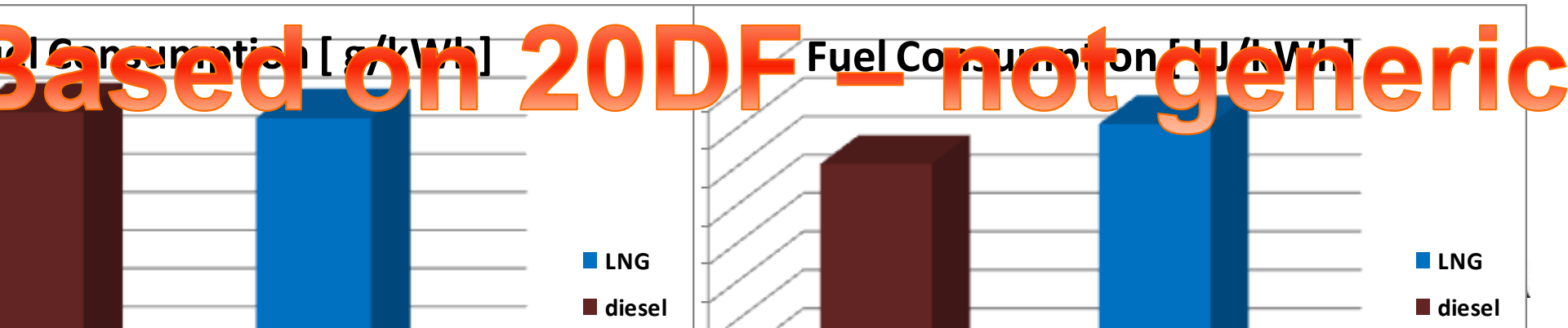
LNG contains more energy per unit mass

1 ton MGO consumption can be “converted” to roughly 1 ton LNG consumption ➔ valid for 20DF, but not for 34DF. Suggest to leave this out

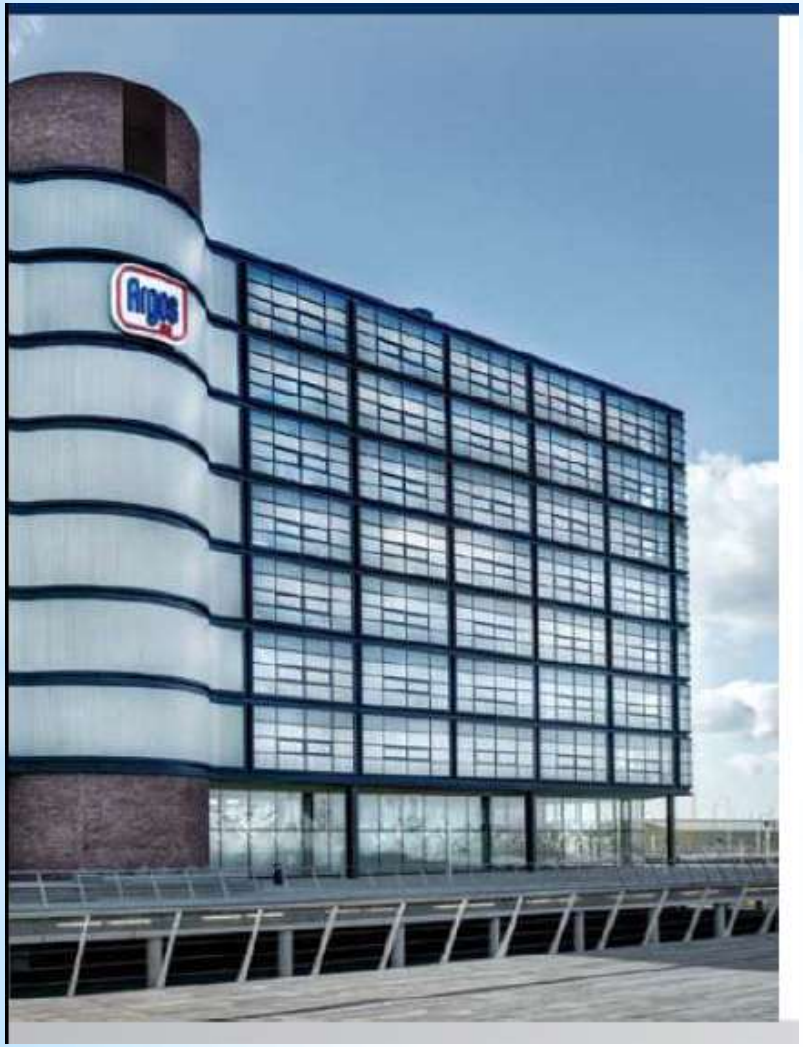
- density MGO = 850 [kg/m3]
- Density LNG = 430 [kg/m3]

LNG has a greater volume per unit mass

Comparison dependant on load considered as par load characteristic is different.



Based on 20DF – not generic



PLATFORM SCHEEPSEMISSIES

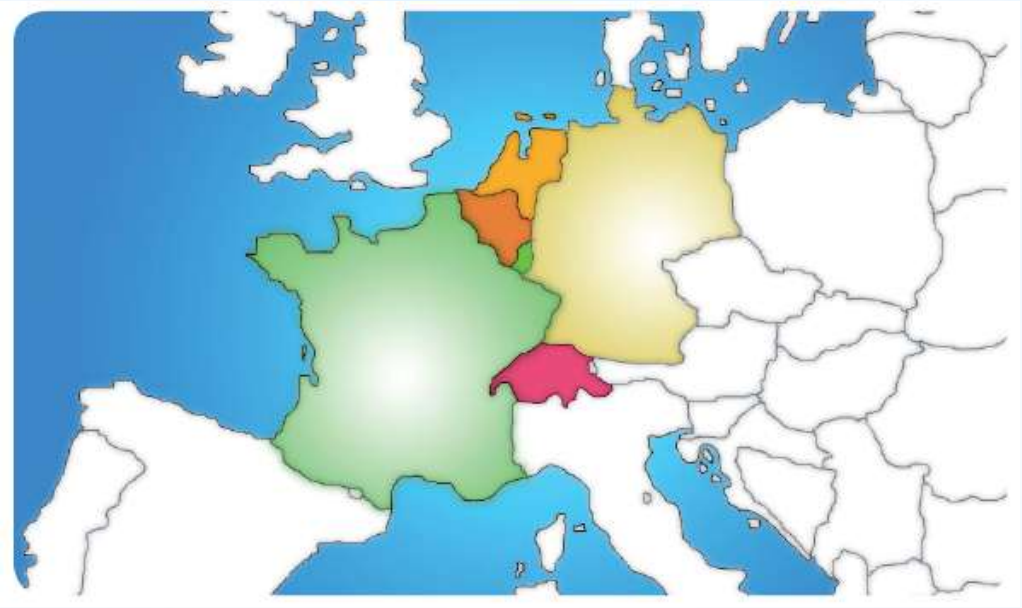
LNG presentation
27 September 2012

Argos

Piet van den Ouden
Business Development Manager

1. Introduction
2. LNG bunkering Port of Rotterdam
3. Price / market, LNG as bunker fuel
4. LNG customer
5. LNG chain
6. Conclusions

Argos



- 850 employees
- Annual turnover 13 billion euros

Largest **independent oil** and energy company with operations in North-West Europe, Netherlands, Belgium, Luxembourg, Germany, France, Switzerland, Brazil, Singapore, China and some other countries.

Argos

Argos

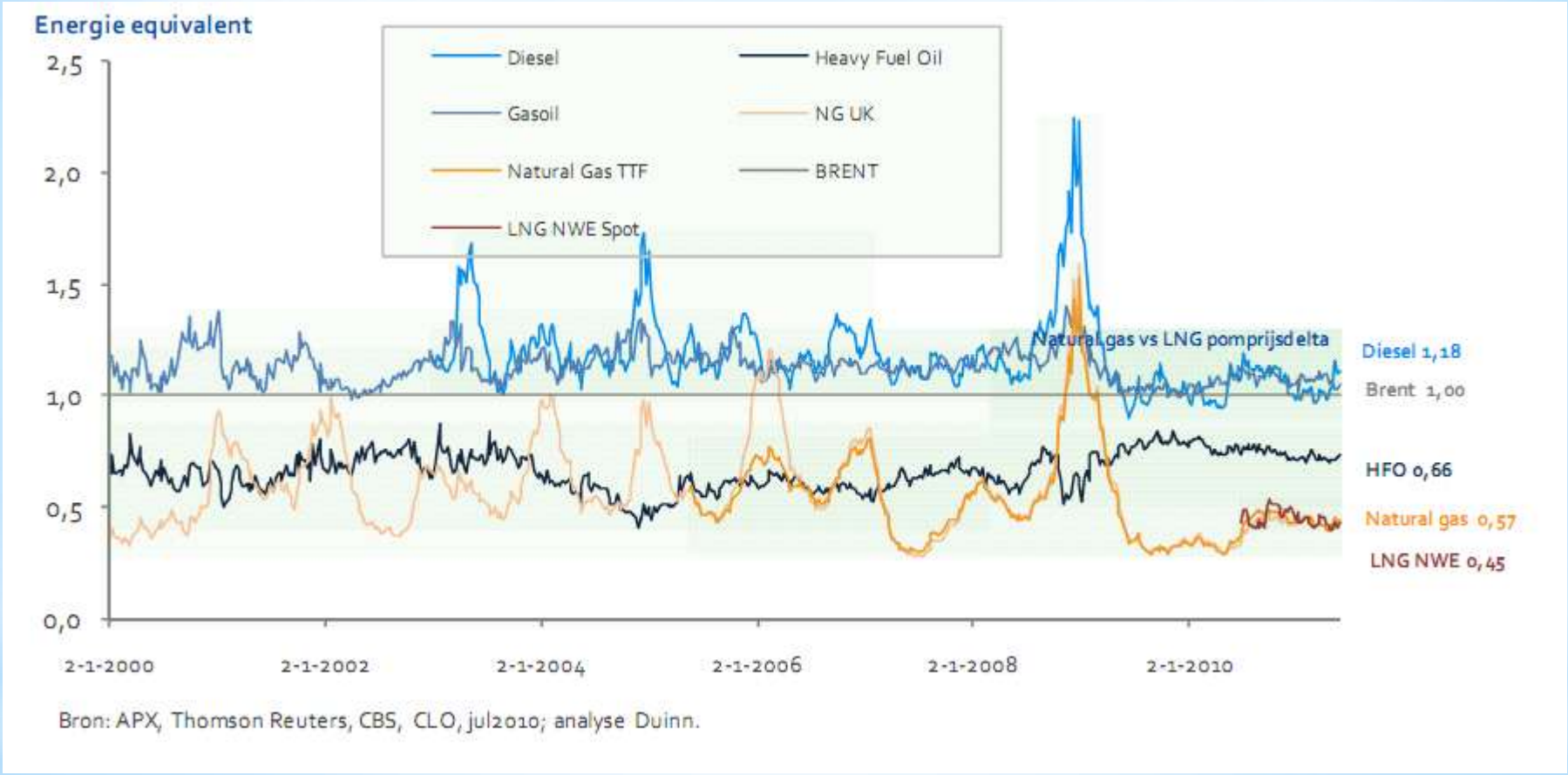
LNG bunkering Port of Rotterdam.

Argos

Price / market, LNG as bunker fuel.

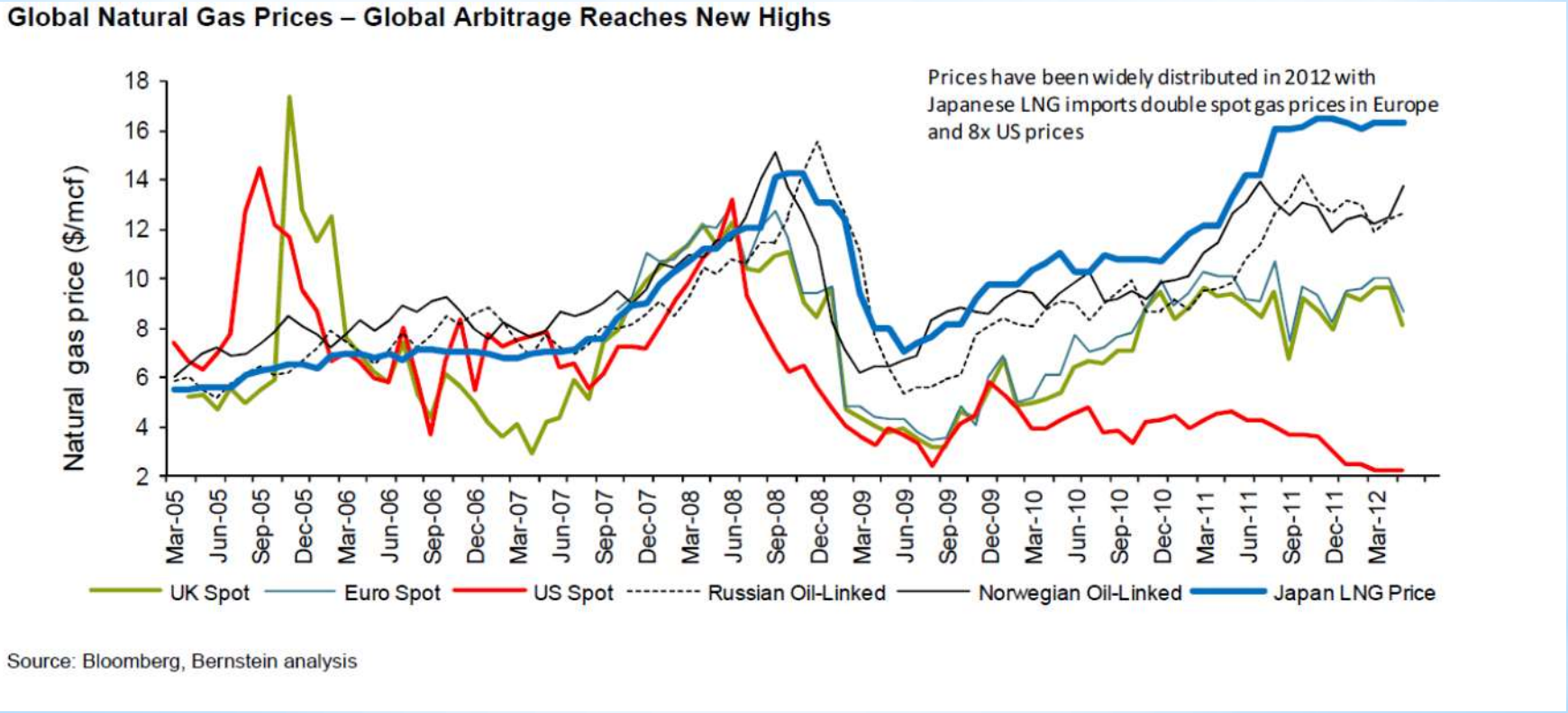
A. Historical prices
B. Crystal ball !!??
C. LNG customer

A2. Historical prices / market, Commodity.

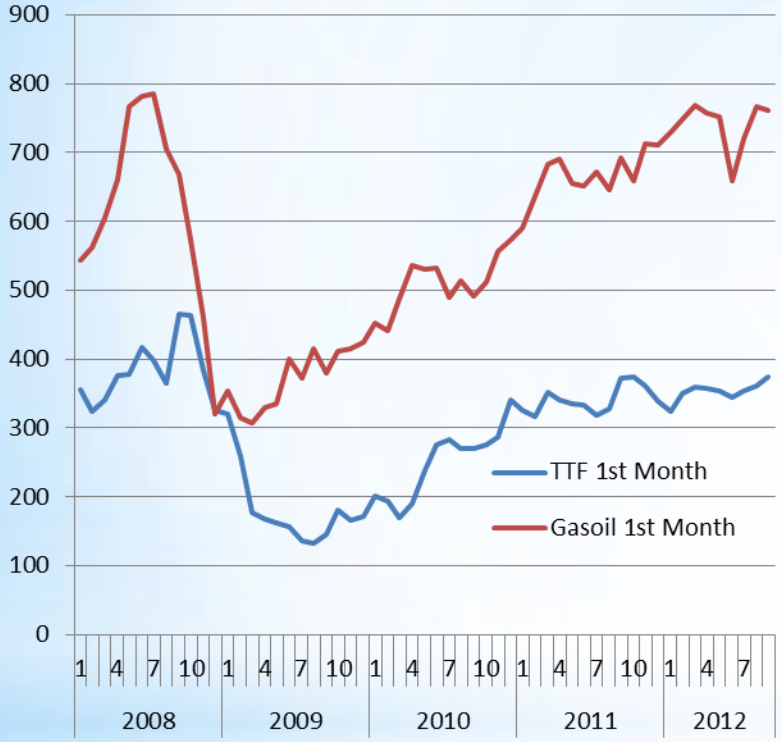


A3. Historical prices / market, Commodity.

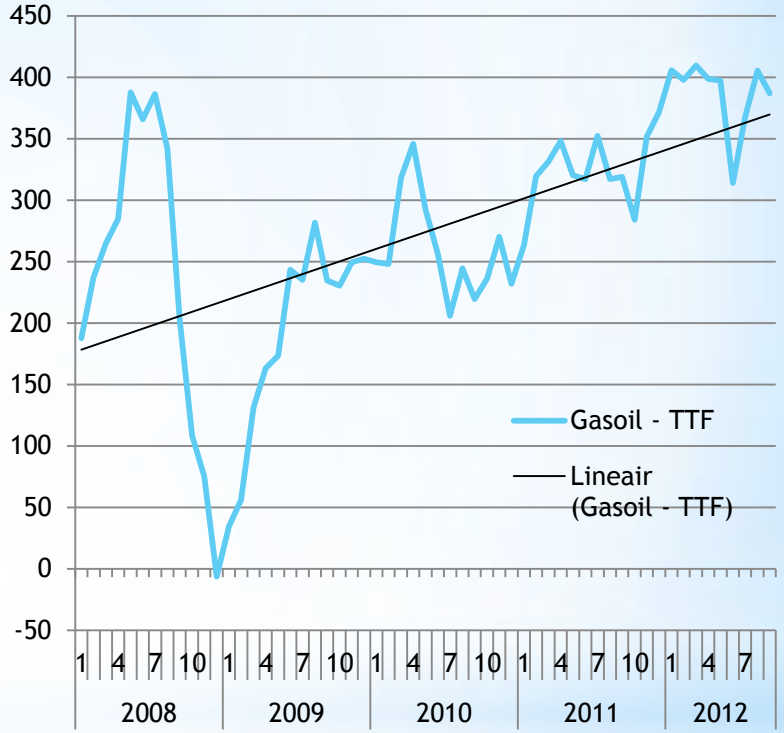
A4. Historical prices / market.



A5. Historical prices / market.



Gas Price versus Gasoil (Euro/MT)



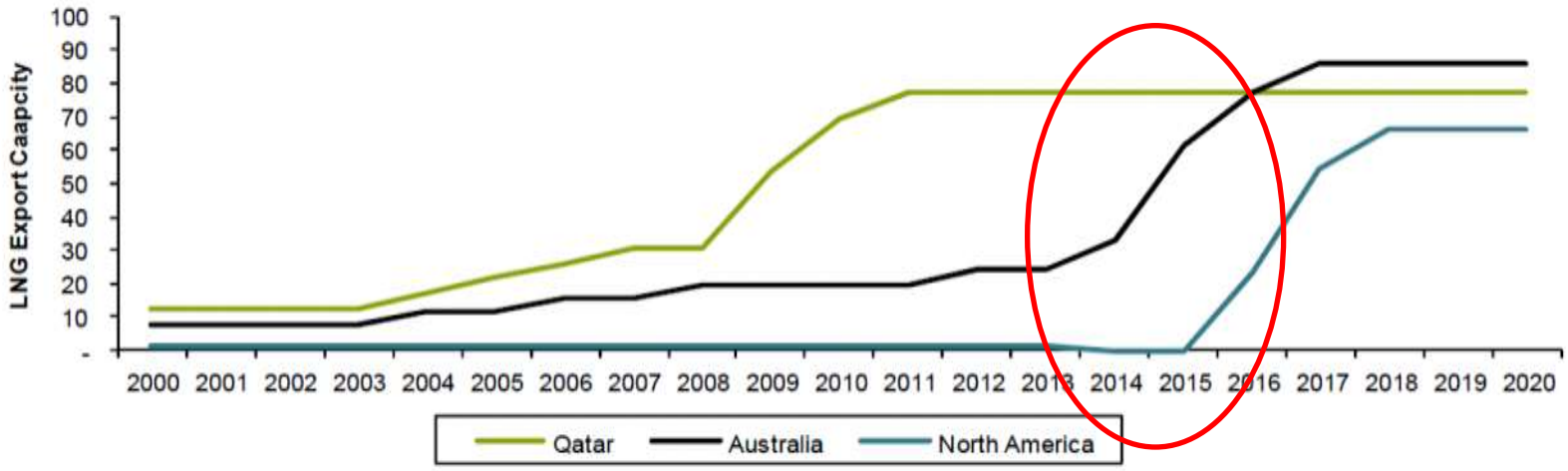
Gasoil – Gas spread (Euro/MT)

Source: Bloomberg 25/09/2012, Argos Energies

B1. Crystal ball !!??

B2. Crystal ball !!??

North America Could be The Next Wave of Global LNG After Australia



Source: Bernstein estimates

C1. LNG bunker customer.

What do they expect ?

1. LNG price **10 - 15% lower** than gasoil/diesel
2. Delivery time, day and night 24/24 hrs.
3. Delivery speed on call, in 2 hrs.
4. LNG quality in line, motor specifications
5. LNG bunker volumes 5 – 150 ton LNG per LNG bunker
6. LNG bunker/operation speed **NO** longer than usually
7. Delivery location ARA (Amsterdam, Rotterdam, Antwerp)

5. LNG value chain

Gate

LNG Break bulk terminal

Sea going vessel

Inland barges

Price / market, LNG as bunker fuel.

We believe that there will be a spread between Marine diesel and LNG.

Marine diesel Oil price 2013/2014 !??

€ 785 - € 1100 per ton

LNG bunker price 2013/2014 !??

€ 550 - € 680 per ton

Depending on:

- Gate, LNG Terminal fee
- $ <-> €
- EU gas market
- LNG distribution cost

Conclusions;

Developing a LNG bunker market, as a LNG partner.

- LNG Sales, long term contract/volume
- Optimization of logistics in relation with investments
- Standard LNG safety procedures and hardware

But we, are always “open” to discuss the opportunities with our customers.

Finally

"If the customer does not deserve at the use of LNG".

We have, as potential LNG supplier, **no** business case.

Thank you for your attention.

Piet van den Ouden
Business Development Manager

Bunkering of LNG in 2014

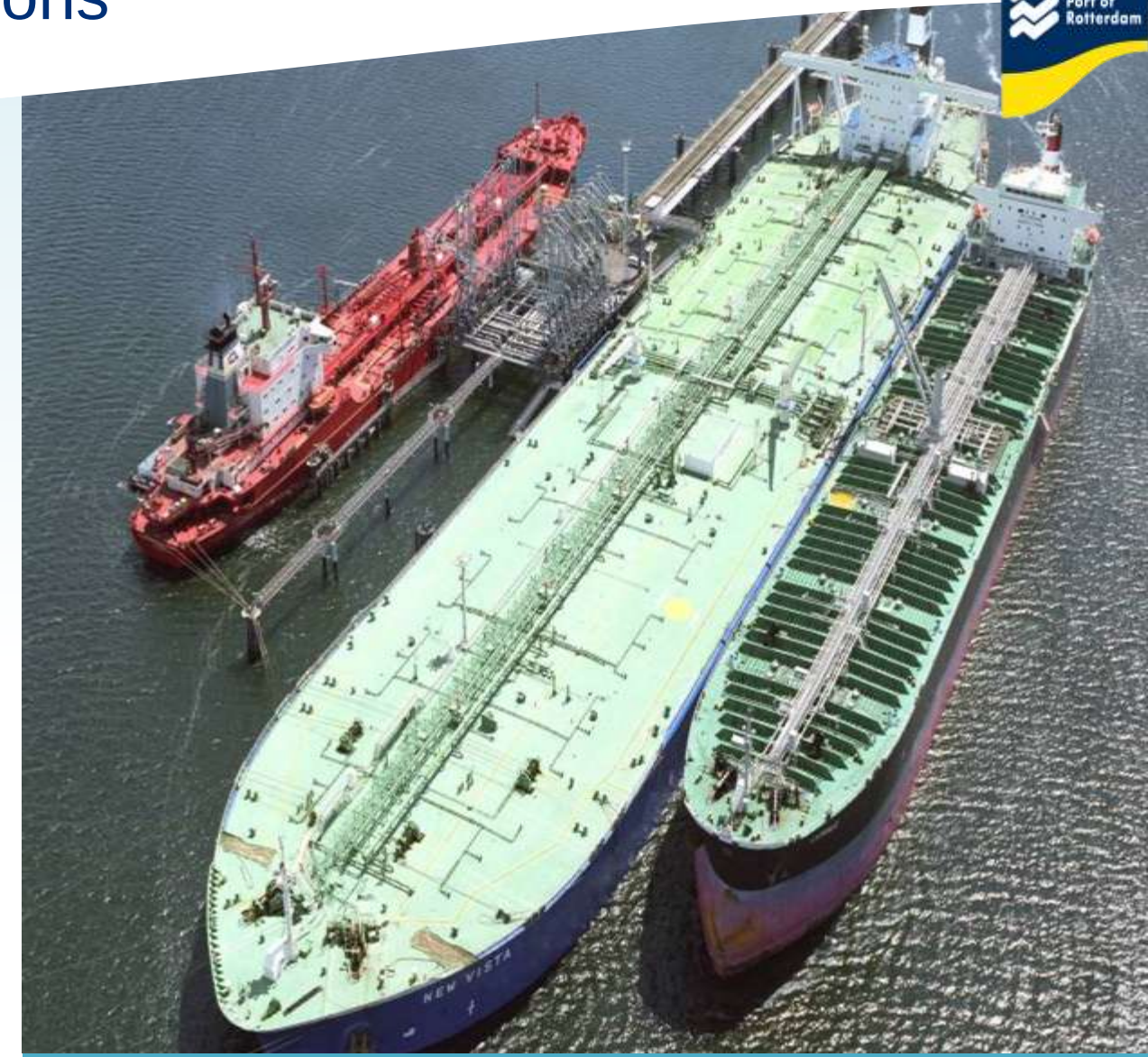
By: Maurits Prinssen MSHE, Project manager Sustainable Development

What to do till 2014…….

- Port Vision 2030
- Environmental opportunity's and challanges
- Studies
- IAPH/WPCI WG LNG
- Expert meeting 10 September 2012
- Development in the Port
- Port Bye Laws
- Bunker infrastructure
- When can we bunker LNG?

Bunkering ambitions

- Improve / optimize efficiency of the bunker process
- Keep position as most competitive bunker port in Europe
- Lead the transition to sustainable fuels



LNG story line: Environment and Safety

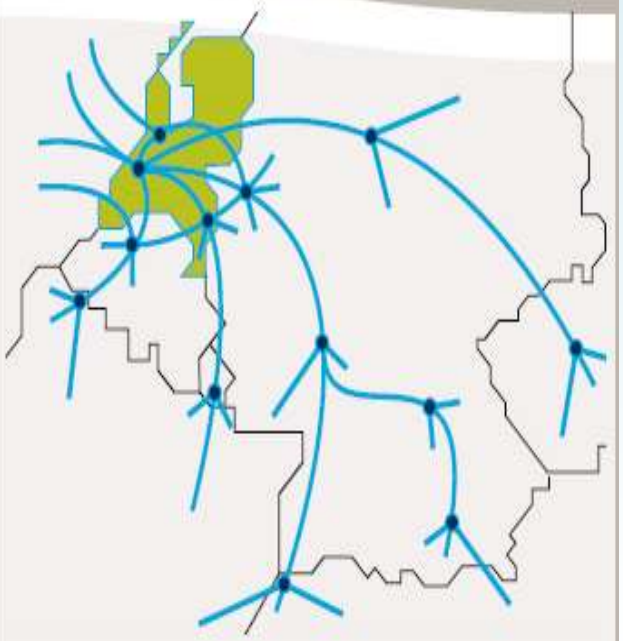
- In 2009 LNG raise on the horizon for maritime industry
- Only environmental benefits, so let’s go for it
- Some safety issues arise
- To continue this development we needed a better understanding
- We are on track
- Some work still has to be done
- We need your input and assistance in this process
- We will be ready in time

Our vision: the port in 2030

- By 2030, sustainability performance will have improved in all modes of transport, thanks partly to the use of alternative fuels like LNG for inland shipping. A shift in the modal split of hinterland transport will have taken place from road to cleaner modes. This will also have helped in keeping the port of Rotterdam easily accessible.
- One of the next steps in making shipping cleaner is the switch to cleaner fuels such as LNG. Commitment at the European level is needed for this.

Direct the Future, Start Today !

_Port networks

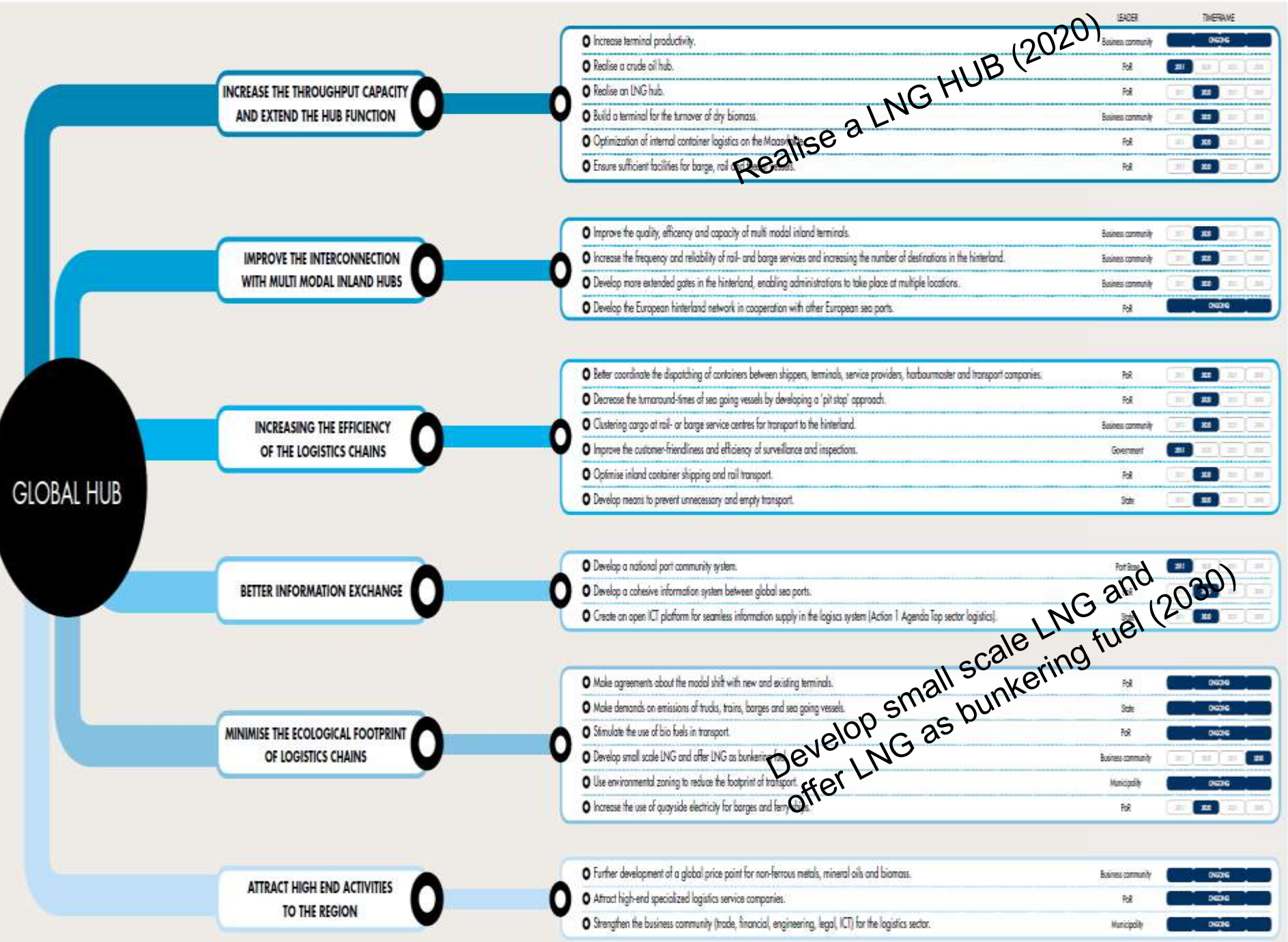


In 2011, ports have not yet formed any highly integrated global networks. Also, the different global terminal operators work relative independently of each other. A number of developments can be expected in this area, such as stronger relations between hub and feeder ports through the integration of information systems and dedicated shuttles. Hub ports too, such as Rotterdam and Singapore, will integrate their procedures. This can be done through 'green and secure lanes' between the two ports, joint development of LNG bunker facilities to effect the switch to LNG as a shipping fuel and the introduction of shuttle services between hub ports.

More reduction possibilities in Port Vision2030

By using alternative fuels for ocean and inland shipping (such as LNG) and optimising sailing times, sometimes in combination with slow steaming for ocean shipping, emissions can be reduced even further.

For LNG we will focus on 2 items…..


GLOBAL HUB
INCREASE THE THROUGHPUT CAPACITY AND EXTEND THE HUB FUNCTION
IMPROVE THE INTERCONNECTION WITH MULTI MODAL INLAND HUBS
INCREASING THE EFFICIENCY OF THE LOGISTICS CHAINS
BETTER INFORMATION EXCHANGE
MINIMISE THE ECOLOGICAL FOOTPRINT OF LOGISTICS CHAINS
ATTRACT HIGH END ACTIVITIES TO THE REGION
LEADER
TIMEFRAME
Increase terminal productivity.
Realise a crude oil hub.
Realise an LNG hub.
Build a terminal for the turnover of dry biomass.
Optimization of internal container logistics on the Maas
Ensure sufficient facilities for barge, rail
Improve the quality, efficiency and capacity of multi modal inland terminals.
Increase the frequency and reliability of rail- and barge services and increasing the number of destinations in the hinterland.
Develop more extended gates in the hinterland, enabling administrations to take place at multiple locations.
Develop the European hinterland network in cooperation with other European sea ports.
Better coordinate the dispatching of containers between shippers, terminals, service providers, harbourmaster and transport companies.
Decrease the turnaround-times of sea going vessels by developing a 'pit stop' approach.
Clustering cargo at rail- or barge service centres for transport to the hinterland.
Improve the customer-friendliness and efficiency of surveillance and inspections.
Optimise inland container shipping and rail transport.
Develop means to prevent unnecessary and empty transport.
Develop a national port community system.
Develop a cohesive information system between global sea ports.
Create an open ICT platform for seamless information supply in the logisics system (Action 1 Agenda Top sector logistics).
Make agreements about the modal shift with new and existing terminals.
Make demands on emissions of trucks, trains, barges and sea going vessels.
Stimulate the use of bio fuels in transport.
Develop small scale LNG and offer LNG as bunkering
Use environmental zoning to reduce the footprint of transport.
Increase the use of quayside electricity for barges and ferry
Further development of a global price point for non-ferrous metals, mineral oils and biomass.
Attract high-end specialized logistics service companies.
Strengthen the business community (trade, financial, engineering, legal, ICT) for the logistics sector.
Realise a LNG HUB (2020)
Develop small scale LNG and offer LNG as bunkering fuel (2030)

Environmental Opportunities & Challanges

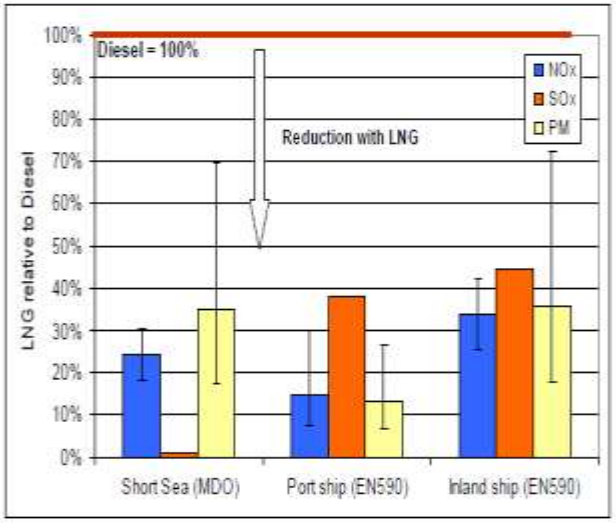


Figure 5. Comparison annual air pollutant emissions between diesel and LNG engines for 2011 – 2015.

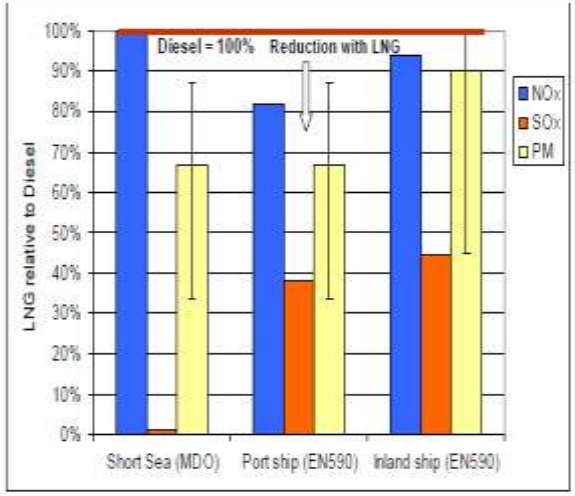


Figure 6. Comparison annual air pollutant emissions between diesel and LNG engines for 2016 and later (diesel engines are assumed to be equipped with deNOx SCR catalyst).

- The burning of LNG reduces the emissions of PM10, NOx and SOx for inland and seagoing vessels
- The LNG engines may comply with TIER III criteria (NOx seagoing)
- *During LNG bunkering and burning some methane (CH4) may escape*
- *Don't forget this environmental challenge: public perception of climate change is a risk in a sense*
- [Several calculation methods result in different Methane Numbers]
- Measurements during operation must show the expected emission reduction.

LESAS

TNO innovation for life

LNG LESAS Rotterdam project

How to deal legislation and safety?

NEN

DNV

Project proposal: Legal and safety barriers

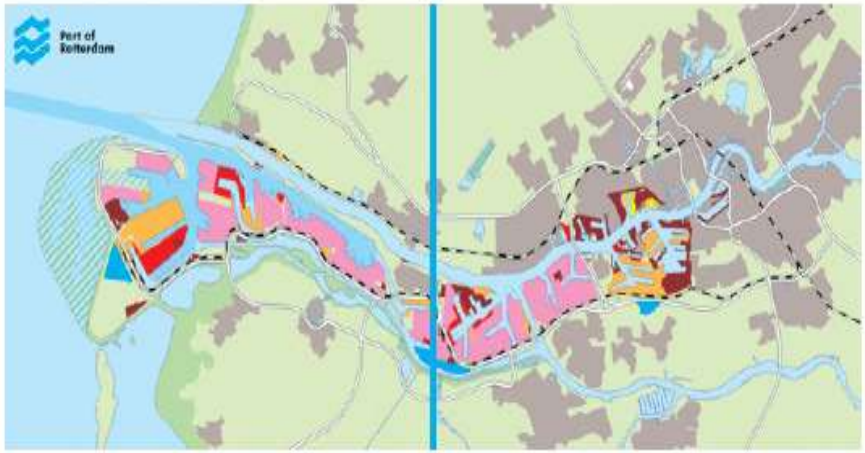
- Objective: To supply recommendations for **public authorities and industry** on legislation and safety practice.
- Role: **Enabling the development of a small scale LNG supply chain** and application of LNG as transport fuel
- Method: LNG **safety practice and evaluations of RCS (Regulations, Codes and Standards)** based on stakeholder viewpoints on how an **economical stable supply chain** should look like (Joint Industry Assessment)
- Base case: The Netherlands, Rotterdam (representative for NL)
- Project Partners: TNO, DNV, NEN

LNG LESAS Rotterdam project

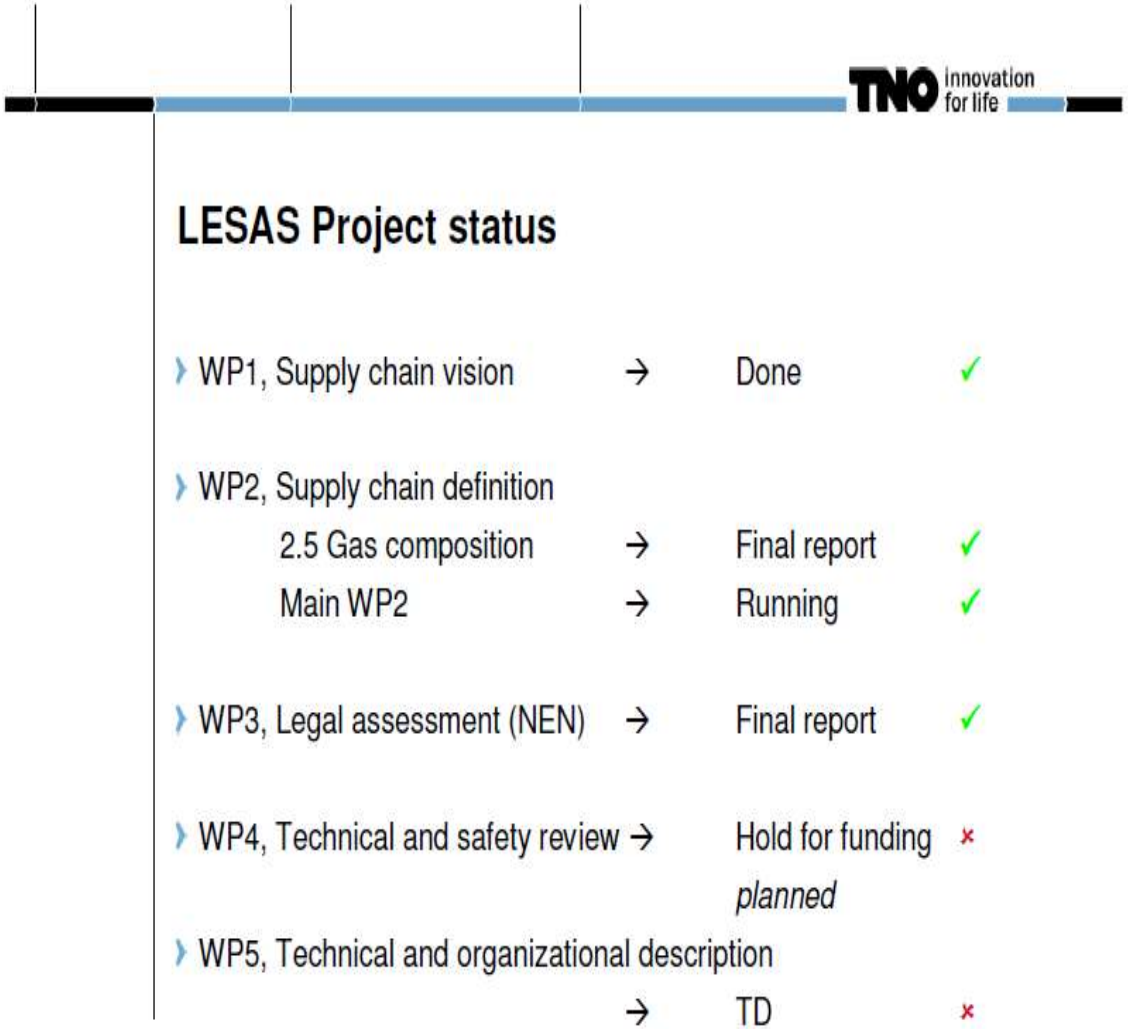
How to deal legislation and safety?

Project process steps

- WP1: Joint vision on the supply chain (Roadmap definition)
- WP2: Supply chain definition / quantification
- WP3: Legal assessment (regulation, codes and standards)
- WP4: Safety assessment (Technical and safety review)
- WP5: Technical and organisational description (locations)



LESAS



- This joint industry project started in February 2011 (Kick Off meeting)
- To be prepared for LNG fuel
- Last meeting in February 2012
- Still waiting for the MIP funding process, no progress is made since February 2012

- In March PoRA tendered a study which can be used as a toolbox for ports with bunkeractivities at the watersite

Port toolkit safety distances LNG bunkering

We identified various LNG bunker activities our port area. Those activities can be grouped in five different categories:

1) LNG bunkering from small inland bunker vessel to small vessels

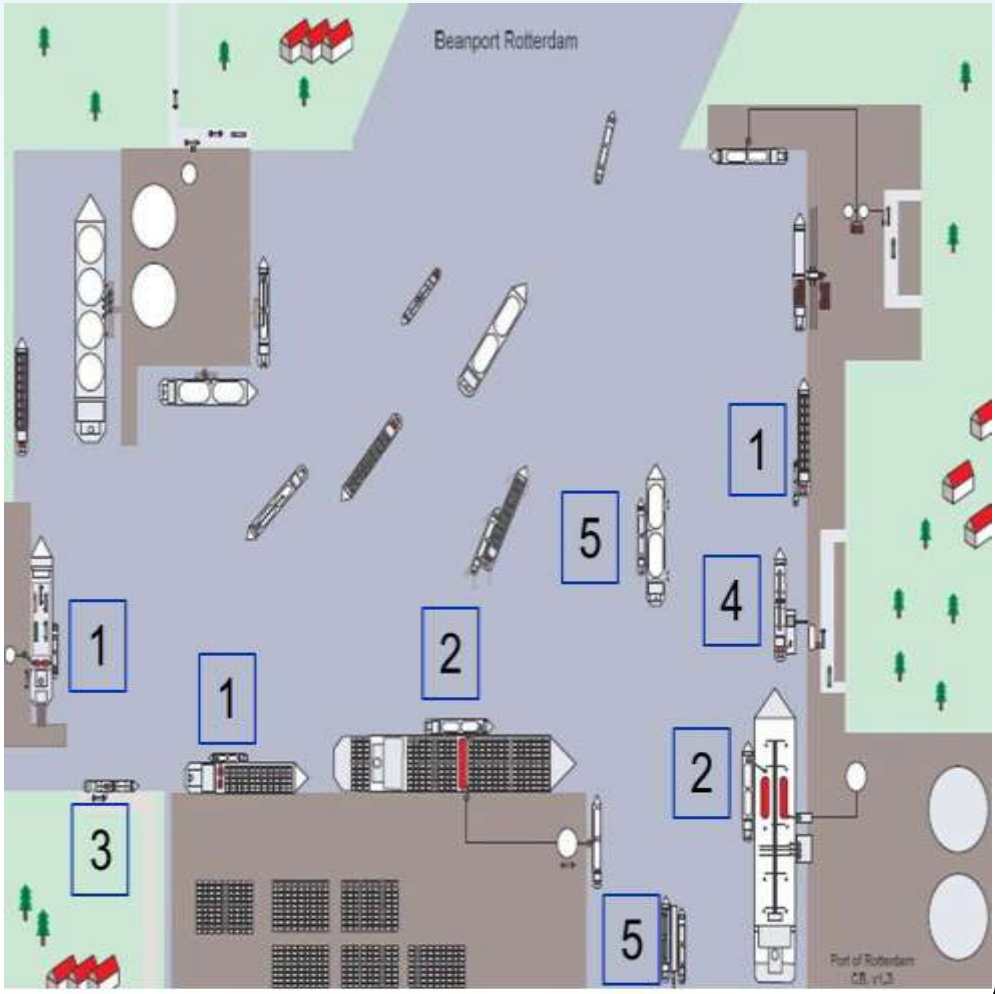
2) LNG bunkering from large bunker vessel to seagoing vessels

3) LNG bunkering from trucks to small vessels

4) LNG bunkering from bunker pontoons to small vessels

5) LNG transfer from ship to ship

Bunkeractivities from land are excluded



Port toolkit safety distances LNG bunkering

- For successful incorporation of these activities into our current safety systems (e.g. guidelines, operational procedures), the Port of Rotterdam, the Ministery of Infrastructure & Environment, with the participation of the Ports of Antwerp, Amsterdam and Sealand Seaports asked to determine the following:
    - *Safety distances* for the determination of exclusion zones related to passing vessels during LNG bunkering activities, i.e. what is a safe passing distance for other traffic related to an ongoing LNG bunkering activity?
    - • *Risk distances* to vulnerable objects, i.e. what should be the minimum distance between an LNG bunker location and (fixed) vulnerable objects such as residential housing, offices, hospitals etc. based on the quantified risk. The purpose is to develop a risk-based toolkit, with which *suitable locations for LNG bunkering activities can be* ***identified*** in the port at any given time.
- Concerning the bunkering of LNG *a significant amount of uncertainties exist*, e.g. related to ship designs (both for bunker vessel and recipient vessel), vessel types, bunkering equipment, process parameters etc. In this study considerable effort has been made to make *defendable assumptions* but in case *choices needed* to be made the conservative option have been chosen in an attempt *not to underestimate the risks* related to LNG bunkering.

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World Port Climate Initiative: mission

International Association of Ports and Harbors

GREENING THE MARITIME INDUSTRY

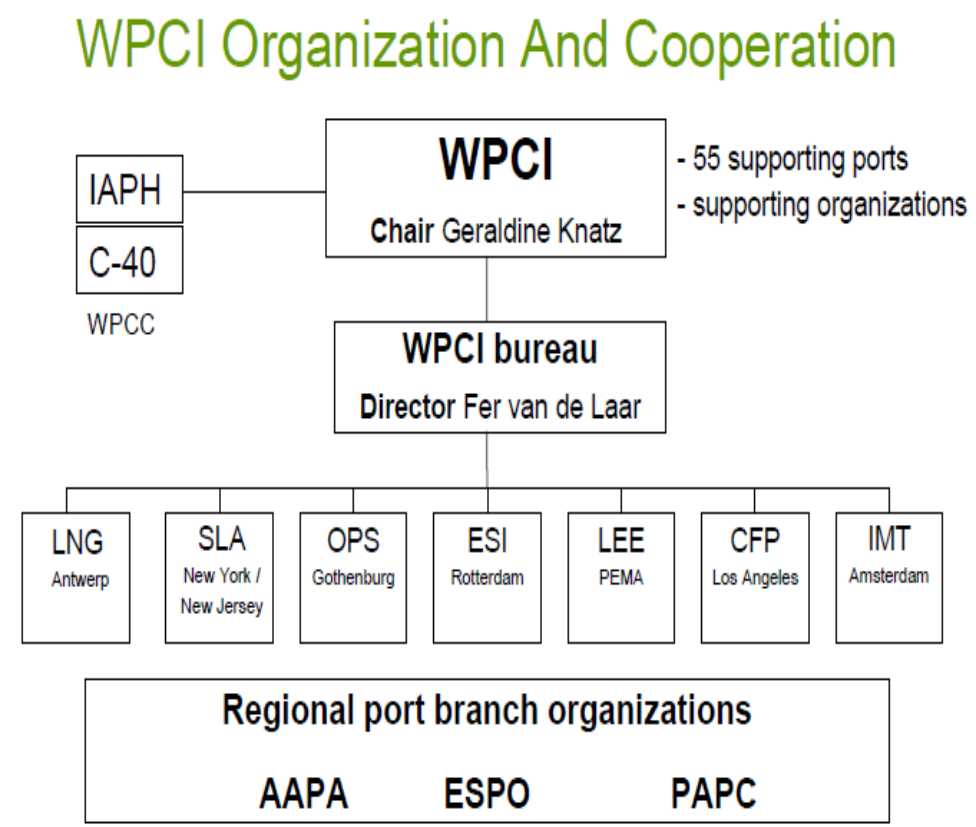
WPCI World Ports Climate Initiative

World Ports Climate Initiative

The mission of the World Ports Climate Initiative is to:

- raise awareness in the port community of need for action
- initiate studies, strategies and actions to reduce GHG emissions and improve air quality
- provide a platform for the maritime port sector for the exchange of information thereon
- make available information on the effects of climate change on the maritime port environment and measures for its mitigation

WPCI: Organisation and why



Why ports care about ship emissions:

- Responsibility for local quality of life
- Air quality as a limiting factor for port development
- Implications of the climate change (CO_2 mainly but also methane as a GreenHouseGas)
- Incorporate sustainability in port, license to operate and grow

WPCI and LNG

Current Projects

- Carbon Foot Print
- On-shore Power Supply
- Environmental Ship Index
- Intermodal Transport
- Low Emission Yard Equipment
- Sustainability in Lease Agreements
- LNG as a fuel

Timeline

- Agreed during IAPH Port Safety & Security Committee, Busan: May 2011
- Kick off meeting in Port of Amsterdam: February 2012
- Port of Antwerp: May 2012
- Port of Rotterdam: September 2012
- Port of Stockholm: December 2012
- Participants: ports of Amsterdam, Antwerp, Bremen, Brunsbuttel, Gothenborg, Hamburg, Le Havre, Rotterdam, Stockholm and Zeebrugge
- Reference group: to be established

WPCI/WG LNG

SWG 1: Bunkerchecklists

- **Create bunker checklists to reflect the extra requirements of ports with regards to LNG bunkering operations in a port environment.**
- **Create guidance document with regards to the conditions for safe bunkering in the port**
- **Some ports might choose the method of accreditation for bunker companies based on certain conditions. A guideline for the content of these conditions will be developed in this SWG.**
- **Standardization**

SWG 2: Risk perimeters

- **Create guidance to harmonized approach of risk perimeters of the different possible LNG bunkering scenarios within a port environment.**

SWG 2: Risk perimeters

- Create guidance to harmonized approach of risk perimeters of the different possible LNG bunkering scenarios within a port environment.

SWG 3: public awareness / communication

- Make up documents per target group
- Communication approach

SWG 4: information share point

- Create website for participants and reference group

Expertmeeting 10 September 2012

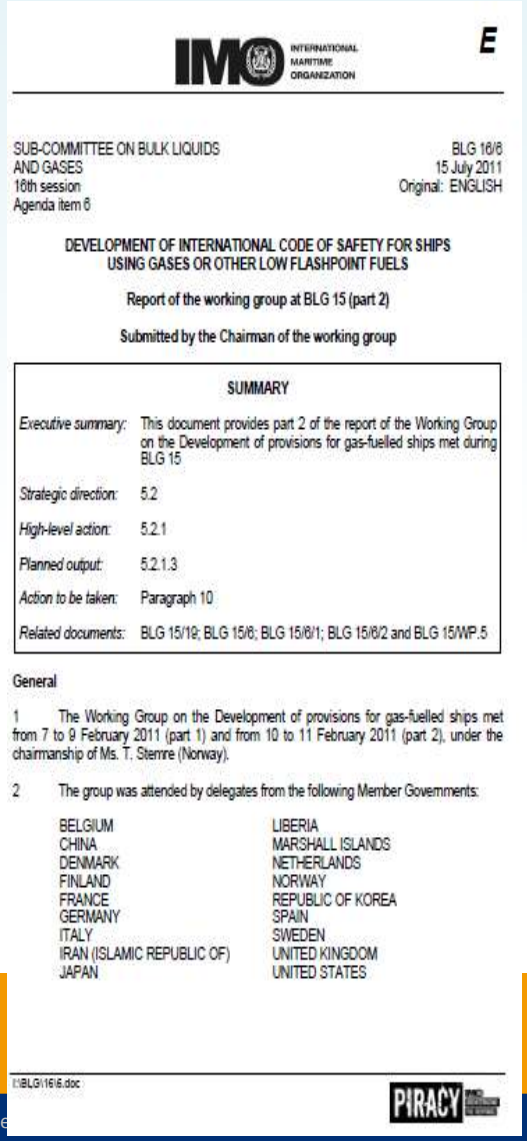
Chair: Lex Vredeveldt TNO

Participants:

- **shipowners (association)**
- **Shipbuilding industry**
- **Engine manufactories**
- **Classification bureaus**

Conclusions

- **IGF code 16-6 to be discussed 4-8 February 2013**
- **Conservative approach – proposal more pratical**
- **IGF code planned to be in place in 2015 for all Low FlashPoint Fuels.**
- **Some chapters will be empty**



IMO INTERNATIONAL MARITIME ORGANIZATION

E

SUB-COMMITTEE ON BULK LIQUIDS AND GASES
16th session
Agenda item 6

BLG 16/6
15 July 2011
Original: ENGLISH

DEVELOPMENT OF INTERNATIONAL CODE OF SAFETY FOR SHIPS USING GASES OR OTHER LOW FLASHPOINT FUELS

Report of the working group at BLG 15 (part 2)

Submitted by the Chairman of the working group

SUMMARY

Executive summary: This document provides part 2 of the report of the Working Group on the Development of provisions for gas-fuelled ships met during BLG 15

Strategic direction: 5.2

High-level action: 5.2.1

Planned output: 5.2.1.3

Action to be taken: Paragraph 10

Related documents: BLG 15/19; BLG 15/6; BLG 15/6/1; BLG 15/6/2 and BLG 15/WP.5

General

1 The Working Group on the Development of provisions for gas-fuelled ships met from 7 to 9 February 2011 (part 1) and from 10 to 11 February 2011 (part 2), under the chairmanship of Ms. T. Stemre (Norway).

2 The group was attended by delegates from the following Member Governments:

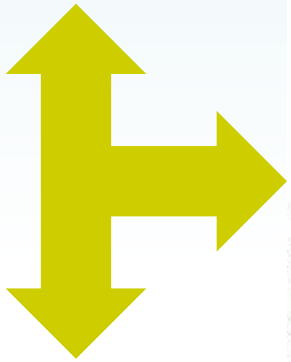
BELGIUM
CHINA
DENMARK
FINLAND
FRANCE
GERMANY
ITALY
IRAN (ISLAMIC REPUBLIC OF)
JAPAN
LIBERIA
MARSHALL ISLANDS
NETHERLANDS
NORWAY
REPUBLIC OF KOREA
SPAIN
SWEDEN
UNITED KINGDOM
UNITED STATES

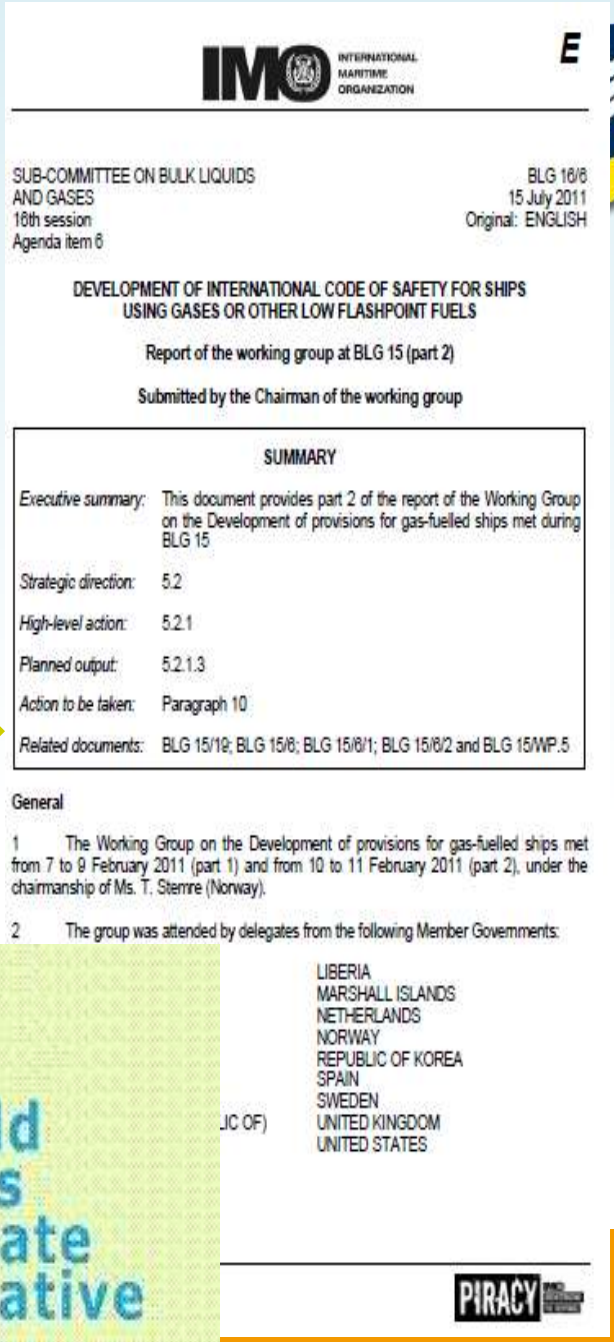
I:\BLG\16\6.doc

PIRACY

Bunkering in Rotterdam

- Based on IGF code
- ISO standards
- Guidance from WPCI
- Several QRA for bunkering in ports
- Experience in ports
- Discussion with other authorities
- Together with (un)loading





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NETHERLANDS
NORWAY
REPUBLIC OF KOREA
SPAIN
SWEDEN
UNITED KINGDOM
UNITED STATES

JC OF)

PIRACY

LNG bunkering in Rotterdam will be possible

- Nautical right location
- Not everywhere and under conditions (difference during loading or separate operation)

2012:

- Regulations (if req.) for bunkering inland vessels
- Policy for STS LNG bunkering (Seagoing vessels)

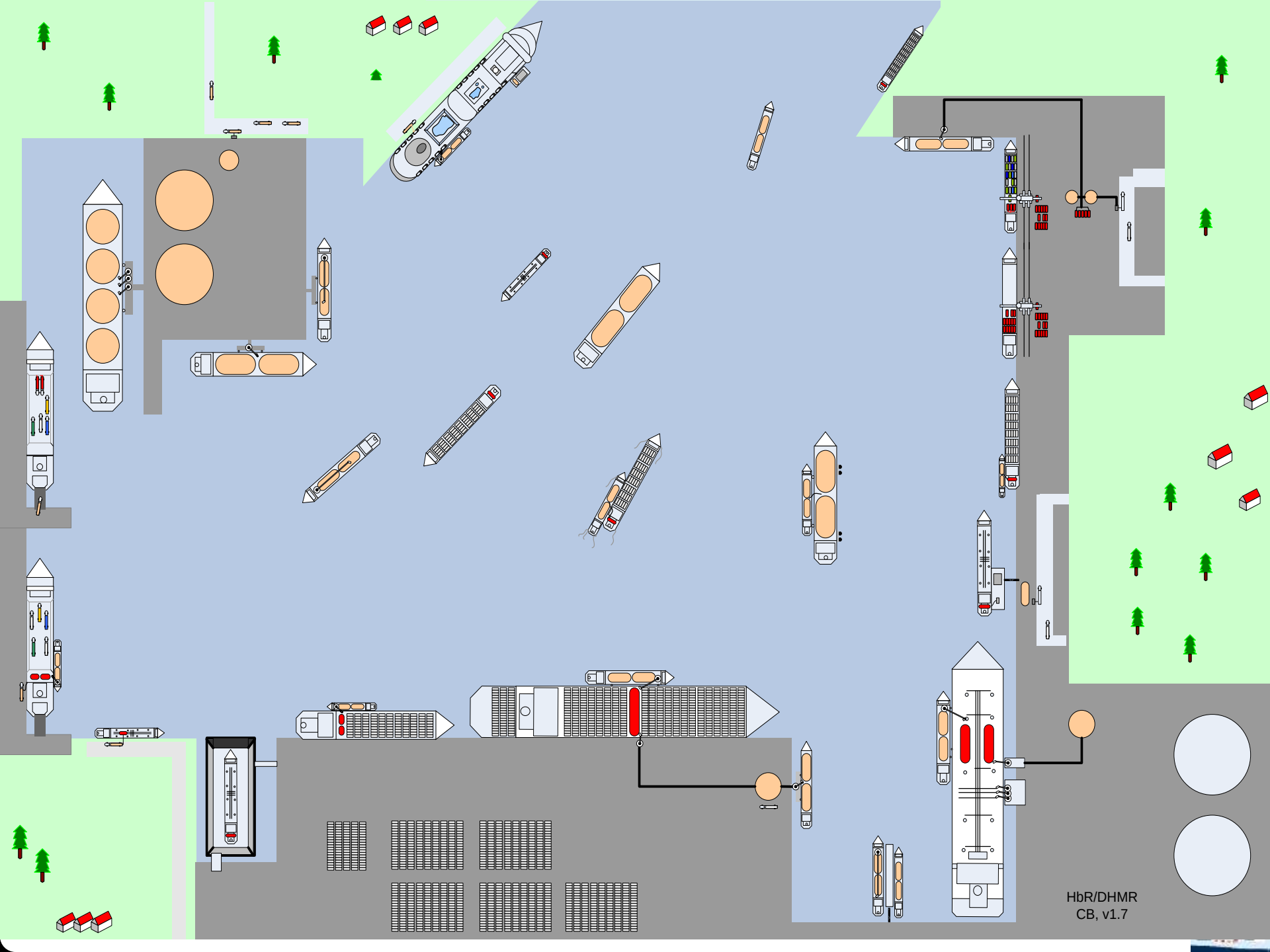
2013:

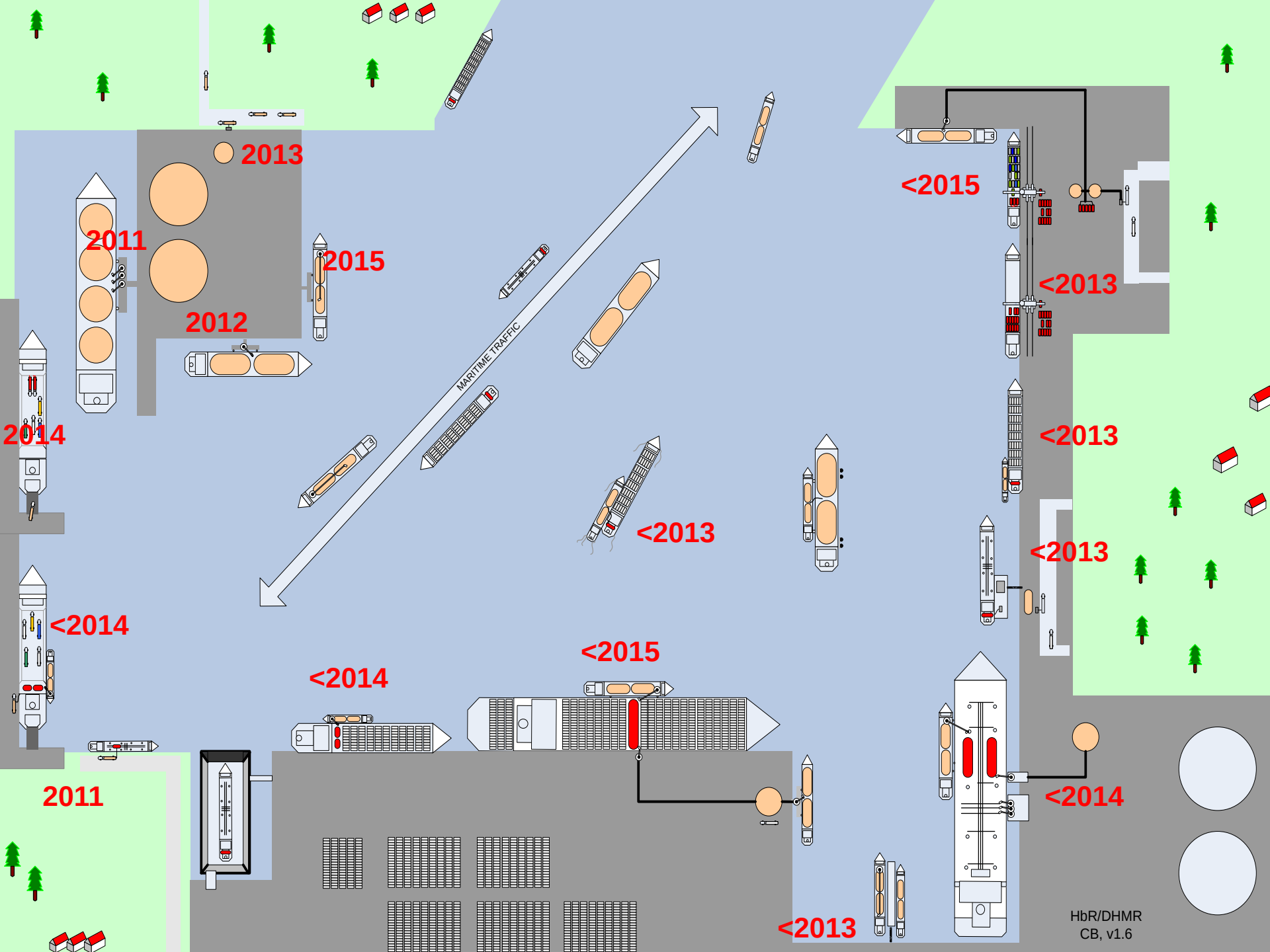
- Regulations for STS bunkering LNG

Planned bunkeractivities

- **'Seine port' for truck-barge**
- **Breakbulk terminal:**
  - 2013: BB at existing jetty
  - 2015: Start-up LNG BB terminal
- **LNG small scale infrastructure:**
  - 2013/2014: 2 LNG Bunker station initiatives
  - 2013: 2 LNG trucktankstations

ARTIST IMPRESSION BREAKBULK TERMINAL


HbR/DHMR
CB, v1.7


2013
2011
2015
2012
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2014
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MARITIME TRAFFIC
<2013
<2014
<2014
<2015
2011
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<2013
HbR/DHMR
CB, v1.6

Strategic Alliances

Hinterland

- Basel
- Discussion with ports of Duisburg and Leige

Shortsea

- Gothenburg MoU in October 2012

Deepsea

- Towergroup (NY, LA, Shanghai, Singapore) 1th meeting November 2012

Strategic Alliances

Incentives

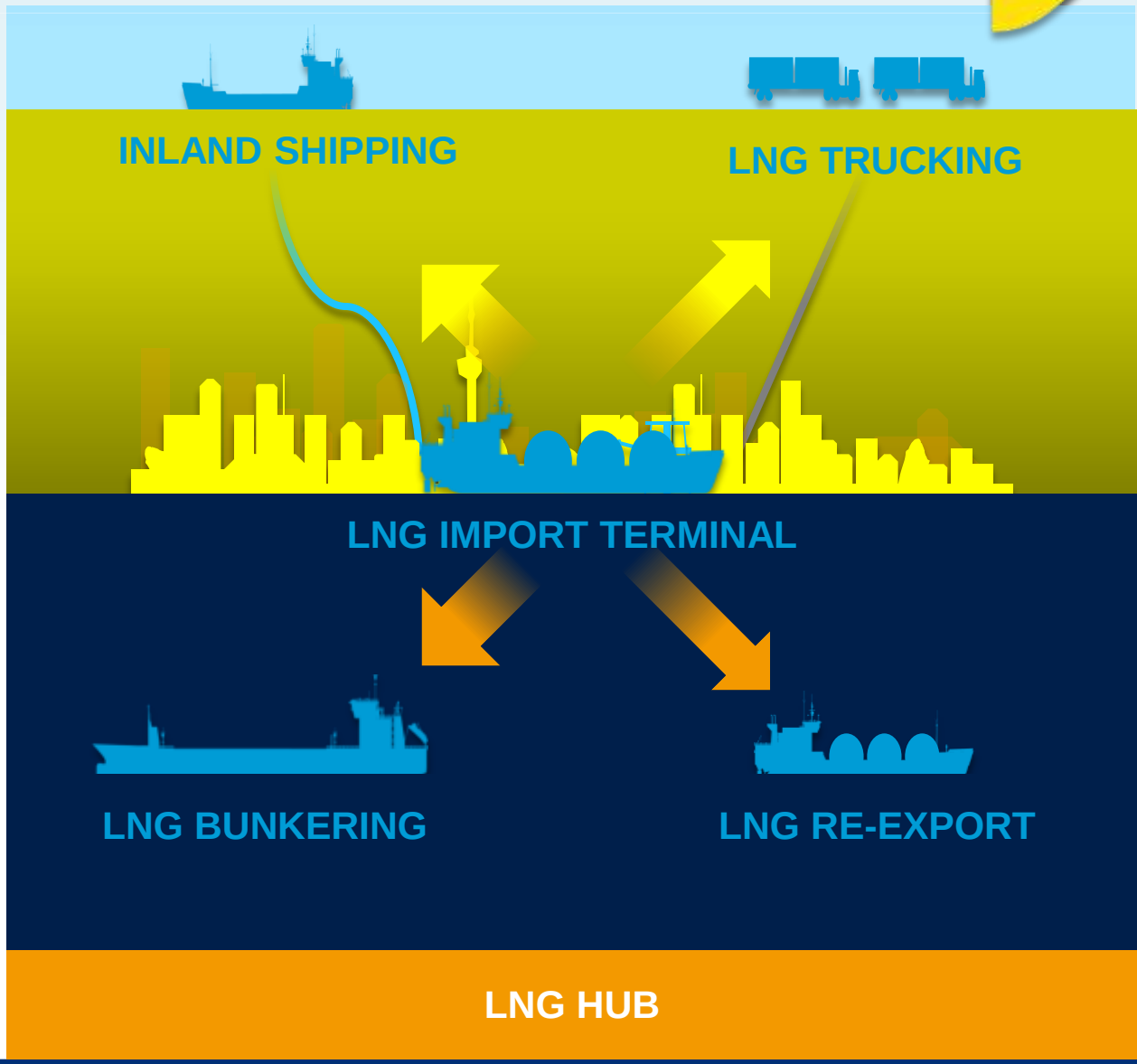
- seagoing vessel: Environmental Ship Index (ESI)
  - *www.wpci-esi.org*
- inland vessels
  - *Non compliance with CCR II emission standards*
  - *CCR II compliance*
  - *Green Award*
  - *60% below CCII emission standards for NOx en PM*

CURRENT INCENTIVES FOR CLEAN FUELS

Port of Rotterdam

Role:

- Co – investor in nautical infrastructure
- Safety and Regulations
- Incentives
- Strategic Alliances
- (Inter)national lobby



platform scheepsemissies

PLATFORM SCHEEPSEMISSIES

PLATFORM | AGENDA | CONTACT | LINKS | PROJECTEN | ENGLISH

EMISSIES

ONDERZOEK

REDUCTIE

BEHEERSEN

CLEAN SHIP

Onderzoeken LNG als brandstof

Met aanscherpen van de emissienormen voor de zeevaart en de binnenvaart, groeit de interesse voor alternatieve brandstoffen. LNG (Liquid Natrual Gas) is een van de alternatieve brandstoffen die kan bijdrage aan emissiereductie. Verschillende studies zijn uitgevoerd om de haalbaarheid van toepassing van LNG op schepen te onderzoeken. Onderzoeken kunnen via de volgende links worden gedownload:

LNG as fuel for shipping
Keten analyse: LNG als brandstof voor scheepvaart
Sailing for cleaner skies
Maritime Gas Fuel logistics
Feasable study for a natural gas fueled installation
Sustainability in inland shipping

Port of Rotterdam

SCHEEPSBOUW NEDERLAND

KVNR

Stichting De Noordzee

MARIN

TNO innovation for life


Port of
Rotterdam

GDF SUEZ

LNG as a Fuel for shipping & road transportation and industry

2

A vehicle for the future and the present

Leon Sluiman

Business Development / Operational Manager

Operational Director GDF SUEZ LNG Solutions

GDF SUEZ LNG Solutions
www.gdfsuez-lngsolutions.nl

1. Context

The Norwegian story and the NOX fund

2. What is LNG?

- Liquefied Natural Gas (LNG) is natural gas cooled down to – 162°C where it condenses into a liquid at atmospheric pressure.
- Liquefaction reduces the volume of gas approximately 600 times
- Economical to store and transport over long distances

Phisical data and composition

Chemical formula: CH4
General: Clear, Colourless, Cryogenic Liquid
Freezing Point: -183°C
Boiling point: - 162°C
Liquid Density: 450 kg/m^3
Gas specific Gravity: 0,6 (at ambient T and P
Liquid to gas expansion ratio: 1:600

Table 1. Typical chemical composition of LNG (Source: Center for Energy Economics, www.beg.utexas.edu/energyecon/lng)

Chemical	Chemical Formula	Low	High
Methane	CH_4	87%	99%
Ethane	C_2H_6	<1%	10%
Propane	C_2H_8	>1%	5%
Butane	C_4H_{10}	>1%	>1%
Nitrogen	N_2	0.1%	1%
Other Hydro-carbons	Various	Trace	Trace

Figure 1. LNG "boiling" at atmospheric pressure and temperature (Source: Osaka Gas Co. Ltd.)

3. Why LNG, Timeline of emission regulations

Timeline of Emissions Regulations

NO_x Limits

- Tier I: Global — 17,0 g/kWh - 9,8 g/kWh
- Tier II: Global for new ships — 14,4 g/kWh - 7,7 g/kWh
- Tier III: Current ECA & new ships — 3,4 g/kWh - 2,0 g/kWh

IMO SO_x Limits - Global

- 4,5% max
- 3,5% max
- 0,5% max

IMO SO_x Limits - SECAs

- 1,5% max
- 1,0% max
- 0,1% max

EU SO_x Limits

- 0,1% max For certain fuels
- 0,1% max for all types of marine gas oils for ships at berth for longer than 2 hours in EU territory

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

Source: DNV's MARPOL Annex VI Brochure, Wartsila, IMO http://www.imo.org

3. Why LNG, external Drivers

COUNCIL OF
THE EUROPEAN UNION

EN

Brussels, 23 May 2012
10034/12
PRESSE 208

Council and the European Parliament reach a provisional agreement on the sulphur content of marine fuels

The Committee of Permanent Representatives endorsed today the compromise proposal agreed between the Council and the European Parliament regarding the directive amending directive 1999/32/EC as regards the sulphur content of marine fuels

P R E S S

Rue de la Loi 175 B – 1048 BRUSSELS Tel.: +32 (0)2 281 6319 Fax: +32 (0)2 281 8026
press.office@consilium.europa.eu http://www.consilium.europa.eu/Newsroom

Global ECA's – geographical area

Existing fleet	
Requirement	Compliance option
2010: SOx < 1,0% 2015: SOx < 0,1%	• HFO + scrubber • Distillate fuels • LNG

Newbuilds	
Requirement	Compliance option
2011: NOx Tier 2 2016: NOx Tier 3	• Scrubber + SCR • LNG

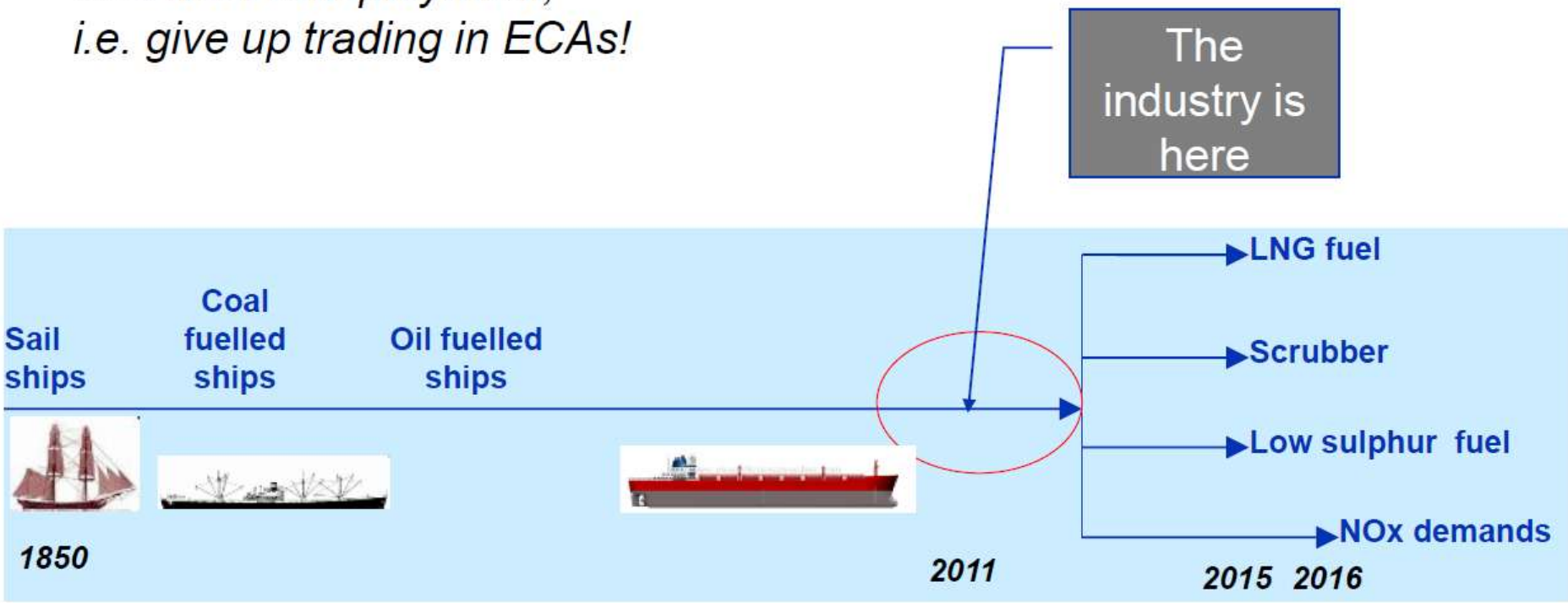
3. Why LNG, external Drivers

ECA challenges:
The risk of making the wrong choice

Basically 3 options on the table

- A LNG as fuel
- B Scrubbers for exhaust gas purification
- C Low sulphur fuel

…or fleet redeployment,
i.e. give up trading in ECAs!



3. Why LNG, external Drivers

Basically 3 options available:

A LNG as fuel

B Low sulphur fuel

→ Continuously

→ Switch in ECA

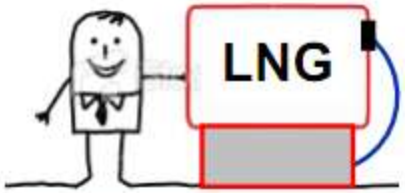
C Scrubbers + HFO

…or fleet redeployment, i.e. give up trading in ECAs…

MANAGING RISK

LNG is one of the ECA Keys.
LNG fuel: The technology is proven - it is time for growth!

Available technology

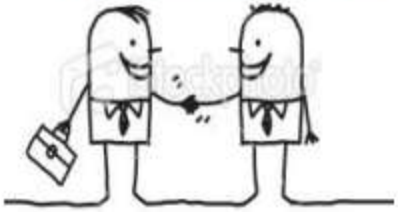


Emerging LNG bunkering

Normally no increased safety risk with LNG

IMO and regional regulations impose emission reduction

Strategic partnerships



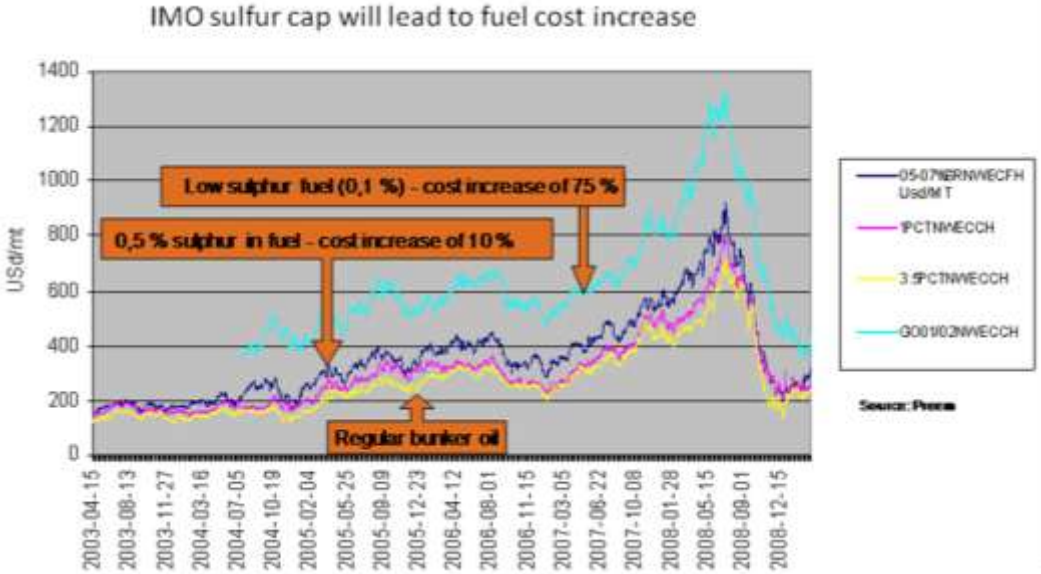
HFO overtakes LNG fuel prices

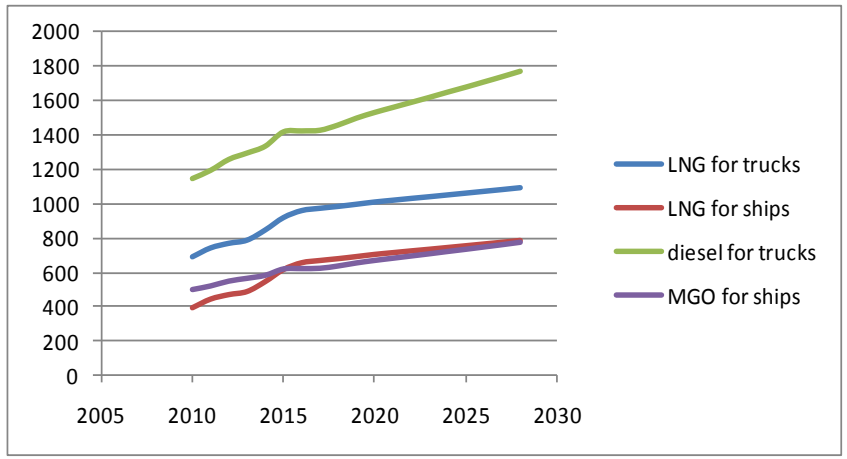
A financially viable solution

MANAGING RISK DNV

3. Why LNG, External drivers (financial)

As Heavy Fuel Oil (HFO) no longer allowed in 2015, LNG can compete with Marine Gas Oil and Road Diesel





State incentives, lower taxes in favor of LNG will boost the conversion of the industry

B Low sulphur fuel: Areas of challenge

The main issues are:

- Low viscosity (MGO)
- Lubricity (MGO/MDO)
- Acidity (MGO/MDO/HFO)
- Flashpoint (MGO/MDO/HFO)
- Ignition and combustion quality (HFO)*
- Increased catalytic fines (HFO)*

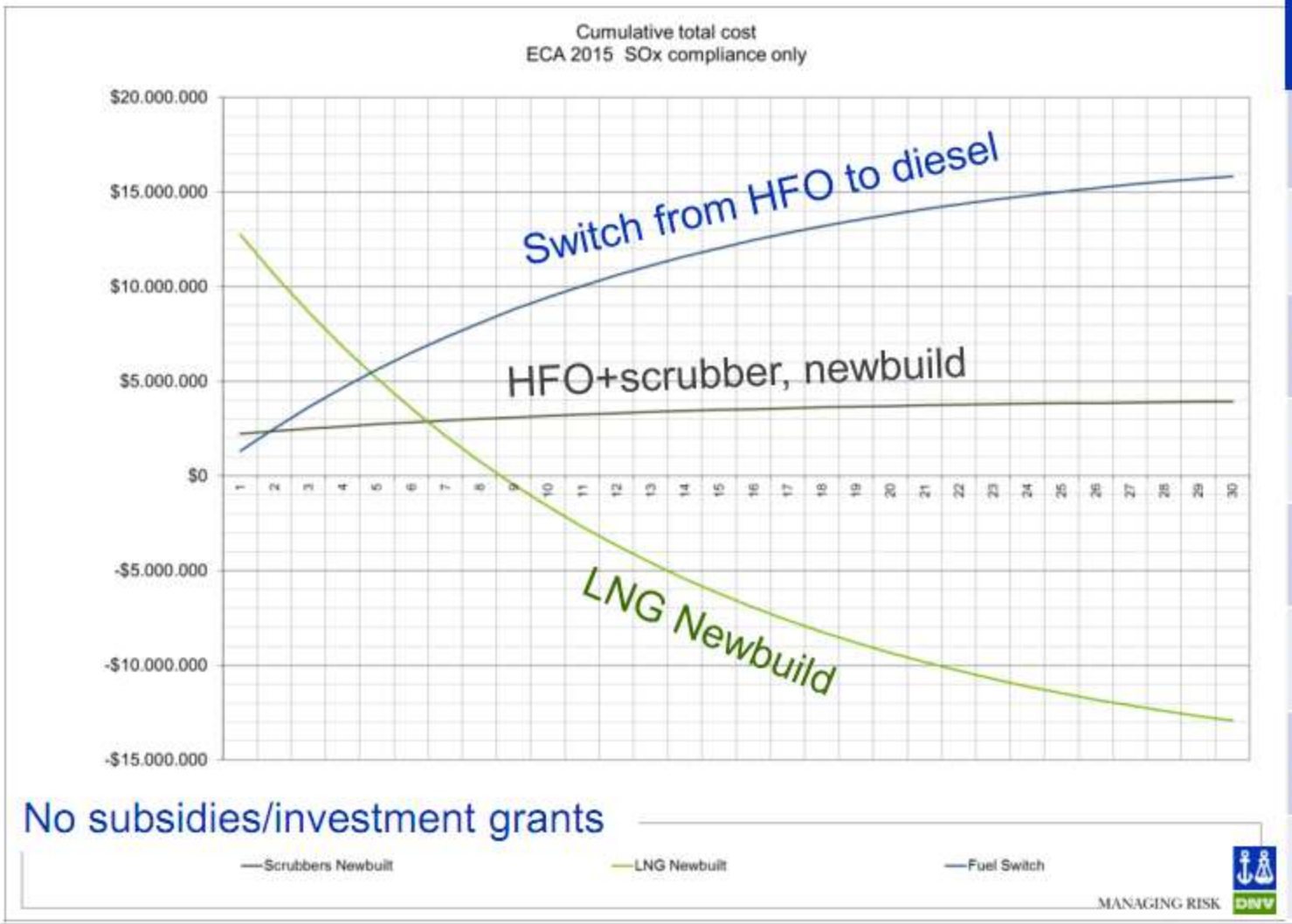
* May be affected through blending with some "Cutter Stocks"

Low Sulphur fuel area of challenge

B Flashpoint

- Low sulphur fuels may be manufactured by mixing a fuel with a normal sulphur grade with one that has a very low sulphur content.
- These lighter fractions often have a flashpoint which is lower
- The lower limit for DMX grade fuel, is 43°C.
- The flashpoint of a mixture will often be lower than that of the original fuel.
- It may even drop below the minimum allowable limit, 60°C, for fuels used on board ships.
- **Ref. is made to req. for flashpoint SOLAS II-2 reg.15.**

Additional cost for meeting SO_X requirements in ECA for newbuild with 7000kW installed, 100% ECA operation



Compliance conditions:	
Abatement tech.	SO_X
Retrofit / New-build	New-build
Gas price	European level
Diesel price	European level
Ship type	Reefer
Installed power	ca. 7000 kW
Time in ECA	100%
Base Case	HFO

27 LNG fuelled ships in operation worldwide (April '12)

27 Ships in operation

Year	Type of vessel	Owner	Class
2000	Car/passenger ferry	Fjord1	DNV
2003	PSV	Simon Møkster	DNV
2003	PSV	Eidesvik	DNV
2006	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2007	Car/passenger ferry	Fjord1	DNV
2008	PSV	Eidesvik Shipping	DNV
2009	PSV	Eidesvik Shipping	DNV
2009	Car/passenger ferry	Tide Sjø	DNV
2009	Car/passenger ferry	Tide Sjø	DNV
2009	Car/passenger ferry	Tide Sjø	DNV
2009	Patrol vessel	REM	DNV
2009	Car/passenger ferry	Fjord1	DNV
2010	Patrol vessel	REM	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Patrol vessel	REM	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Car/passenger ferry	Fjord1	DNV
2010	Car/passenger ferry	Fosen Namsos Sjø	DNV
2011	PSV	DOF	DNV
2011	Chemical tanker	Tarbit Shipping	GL
2011	Car/passenger ferry	Fjord1	DNV
2011	PSV	Solstad Rederi	DNV
2012	Car/passenger ferry	Fjord1	DNV
2012	PSV	Eidesvik	DNV

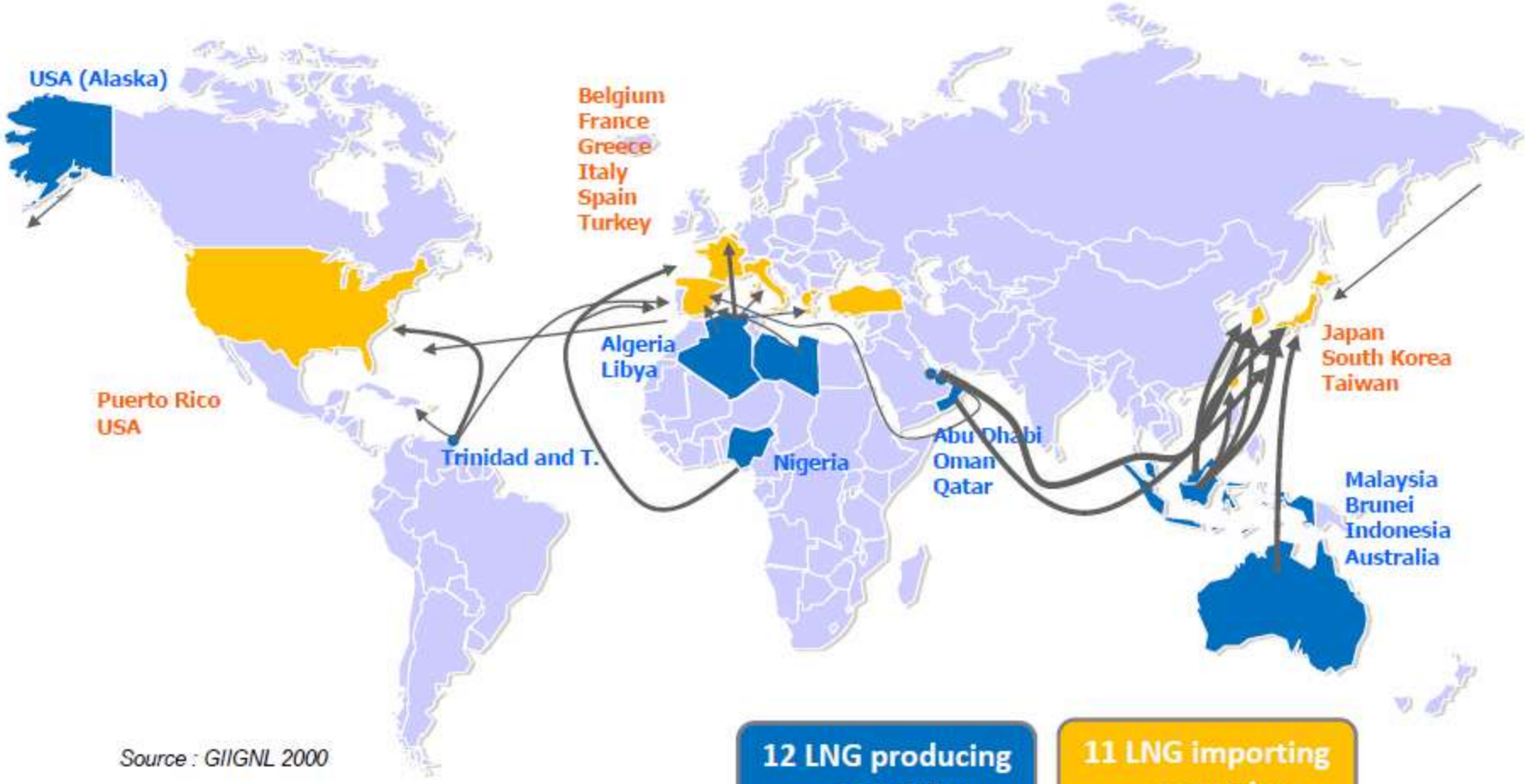
Confirmed orderbook (29 ships)

Year	Type of vessel	Owner	Class
2012	General Cargo	Nordnorsk Shipping	DNV
2012	PSV	Eidesvik Shipping	DNV
2012	PSV	Olympic Shipping	DNV
2012	Ro-Ro	Sea-Cargo	DNV
2012	Ro-Ro	Sea-Cargo	DNV
2012	High speed RoPax	Buquebus	DNV
2012	PSV	Island Offshore	DNV
2012	PSV	Island Offshore	DNV
2012	PSV	REM	DNV
2012	Car/passenger ferry	Torghatten Nord	DNV
2012	Car/passenger ferry	Torghatten Nord	DNV
2012	Car/passenger ferry	Torghatten Nord	DNV
2012	Car/passenger ferry	Torghatten Nord	DNV
2012	Guideship	Incheon Port Authority	
2013	General Cargo	Eidsvaag	
2013	Car/passenger ferry	Norled	
2013	Car/passenger ferry	Norled	
2013	Ro-Ro	Norlines	DNV
2013	Ro-Ro	Norlines	DNV
2013	RoPax	Viking Line	LR
2013	Tug	Buksér & Berging	DNV
2013	PSV	Harvey Gulf Int. Marine	ABS
2013	PSV	Harvey Gulf Int. Marine	ABS
2013	Patrol vessel	Finish Border Guard	GL
2013	Car/passenger ferry	Society of Quebec ferries	
2014	Car/passenger ferry	Society of Quebec ferries	
2014	Tug	Buksér & Berging	DNV
2014	PSV	Harvey Gulf Int. Marine	ABS
2014	PSV	Harvey Gulf Int. Marine	ABS

GDF SUEZ

LNG producing and importing countries

Main Flows in 2000



Source : GIIGNL 2000

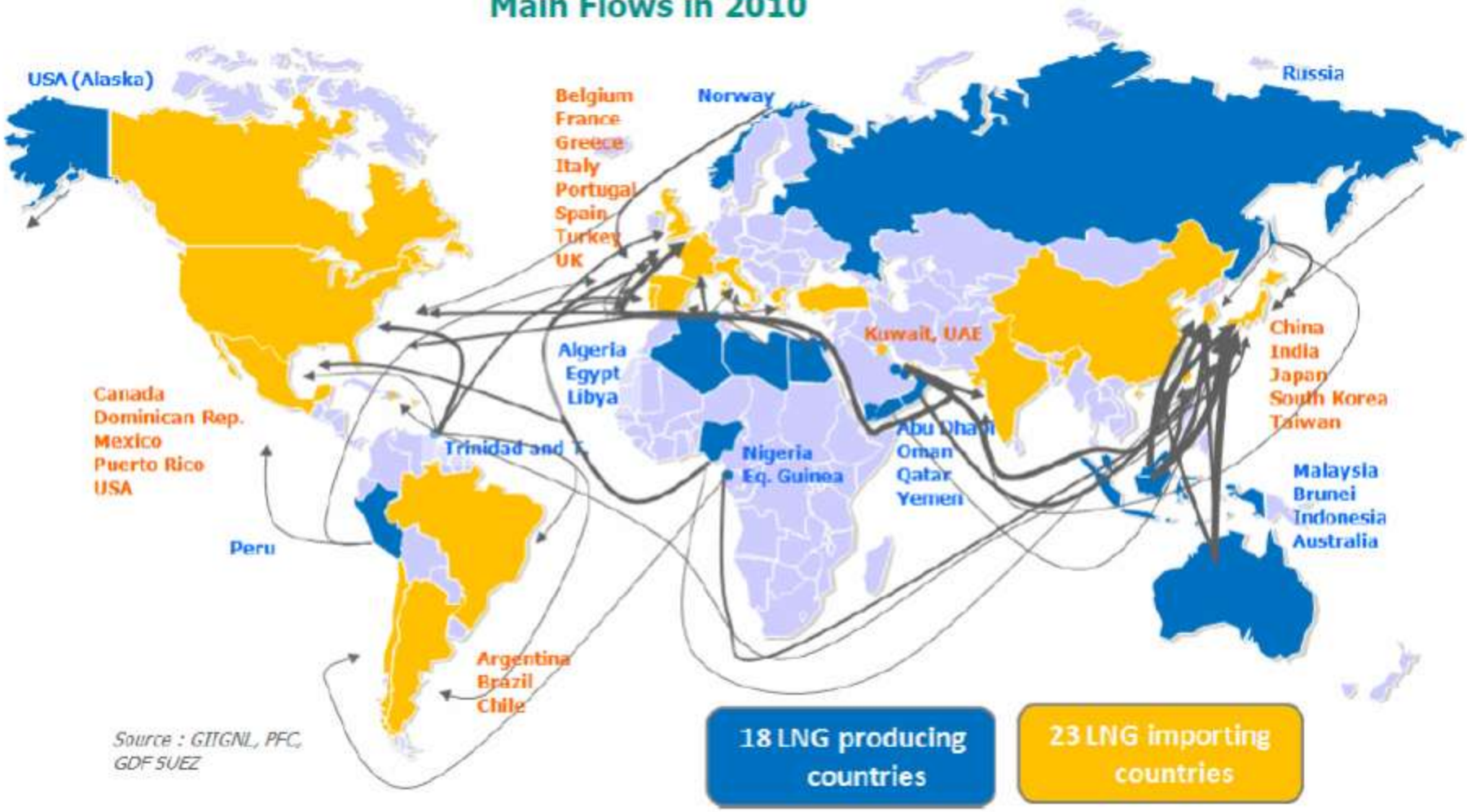
12 LNG producing countries

11 LNG importing countries

Gas & LNG markets

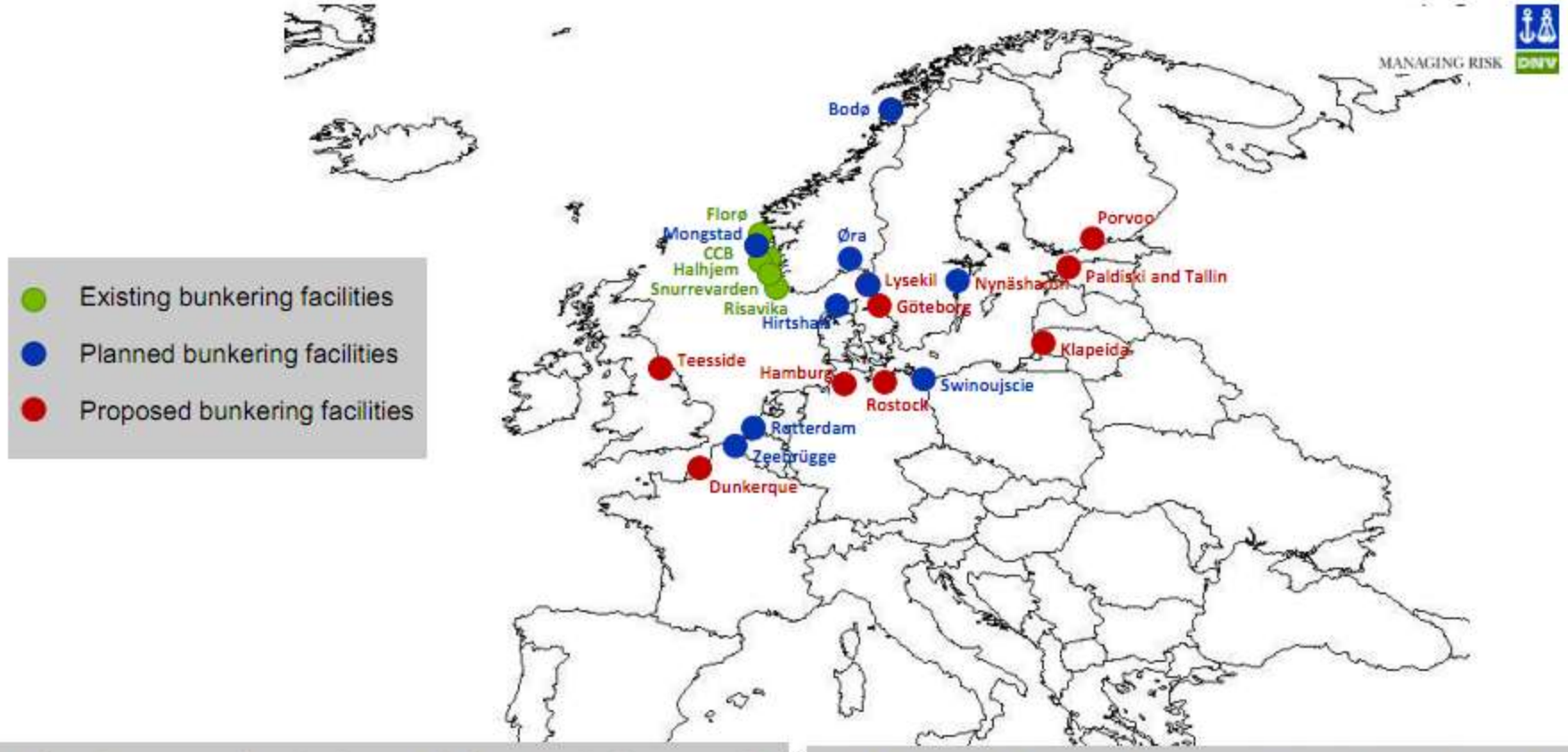
LNG flows are driven by the different markets

Main Flows in 2010



Source : GIIGNL, PFC, GDF SUEZ

A The European LNG bunkering grid



LNG bunker can be delivered by truck for small volumes of LNG supply to any remote area (ref Oslofjorden, Boknafjorden etc). Ship to ship bunkering is a more permanent solution

LNG bunkering being established beyond Norway! (Sweden, The Netherlands, Belgium, USA, Argentina, Singapore…)

4. Market development - Retail LNG distribution chain

Extent of implementation – Pilot case Doeksen

1) Start a pilot project in the Waddensea area (Doeksen) based on the full value chain (included sales to end-users)

➔ high visibility due to World heritage zone

➔ funding & local support from the government

➔ a landmark on the North sea

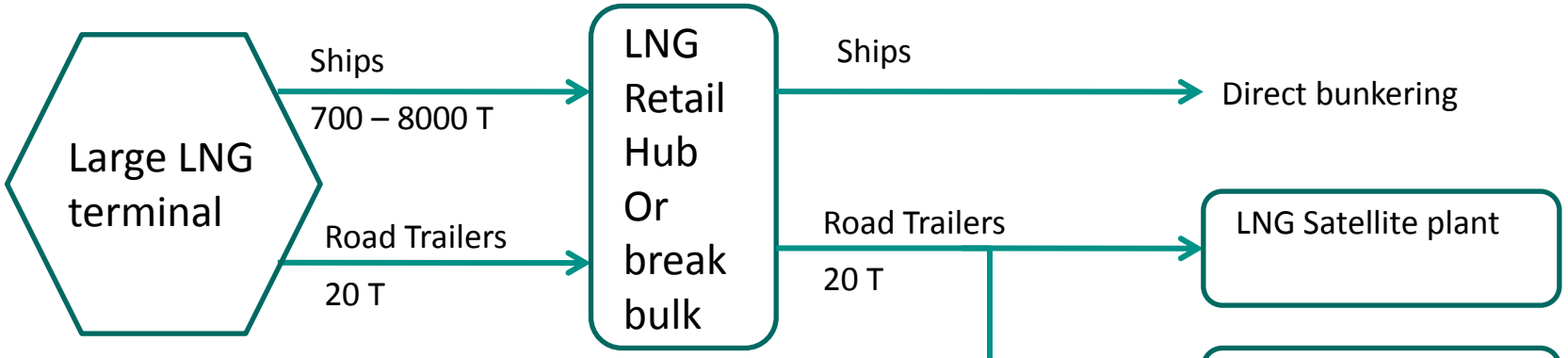
REDERIJ DOEKSEN

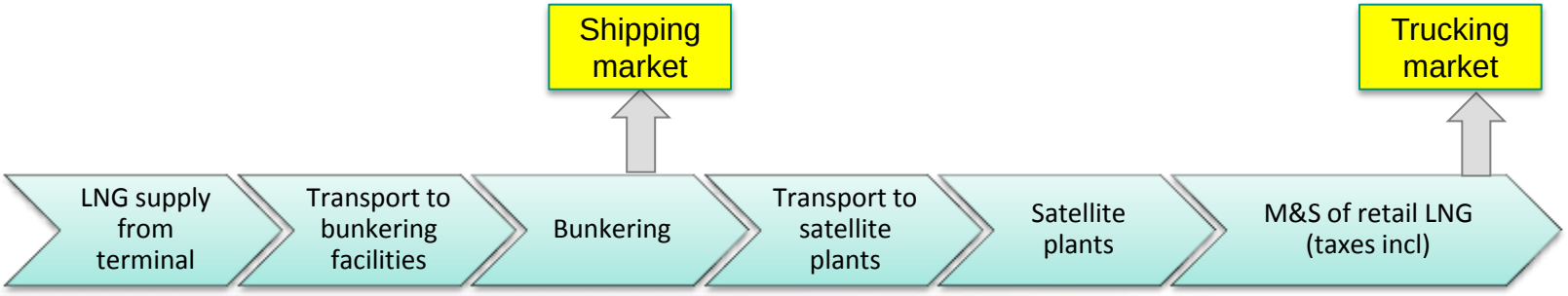
2) Develop a volume – margin strategy in the important (European) harbors

Waddensea harbors
Rotterdam
Antwerp
Hamburg
Marseille

MariTIM

5. Retail LNG distribution chain





5. Concept Retail LNG Market

LNG bunkering facilities/hub

Fixed line (dedicated quay)

Size ?

(FSU)

Tugs, coast guards

LNG Feeder vessel

LNG/LCNG Refueling station

Truck loading station

5 000 m^3

LNG bunkering vessel/barge

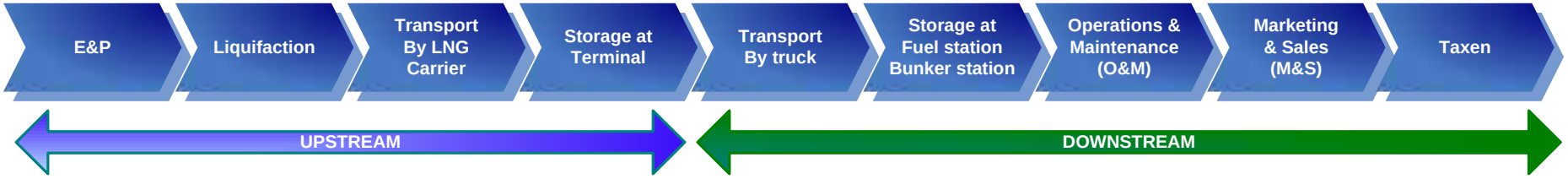
LNG trailer

LNG powered trucks

LNG/LCNG Refueling station

LNG satellite plant industrial application

6. Economical LNG chain development



Sourcing Cost (Zeebrugge); XX €/ton

Transport by Truck → Storage Fuel station → Operations & Maintenance → Marketing & Sales → Taxen

Customer end price LNG for Road Sector;

- Truck; XX + T €/ton (including tax)

Trucking Costs;	Storage Costs;	O&M Costs;	M&S Costs;	Tax Costs;
A € /ton	B € /ton	C € /ton	D € /ton	E € /ton

Total Cost LNG Distribution;
T= A+B+C+D+E € /ton

Sourcing Cost (Zeebrugge); XX €/ton

Transport by Truck → Storage Bunker station → Operations & Maintenance → Marketing & Sales → ~~Taxen~~

Customer retail price LNG for Maritime Sector;

- Ship; XX + T €/ton (no tax)

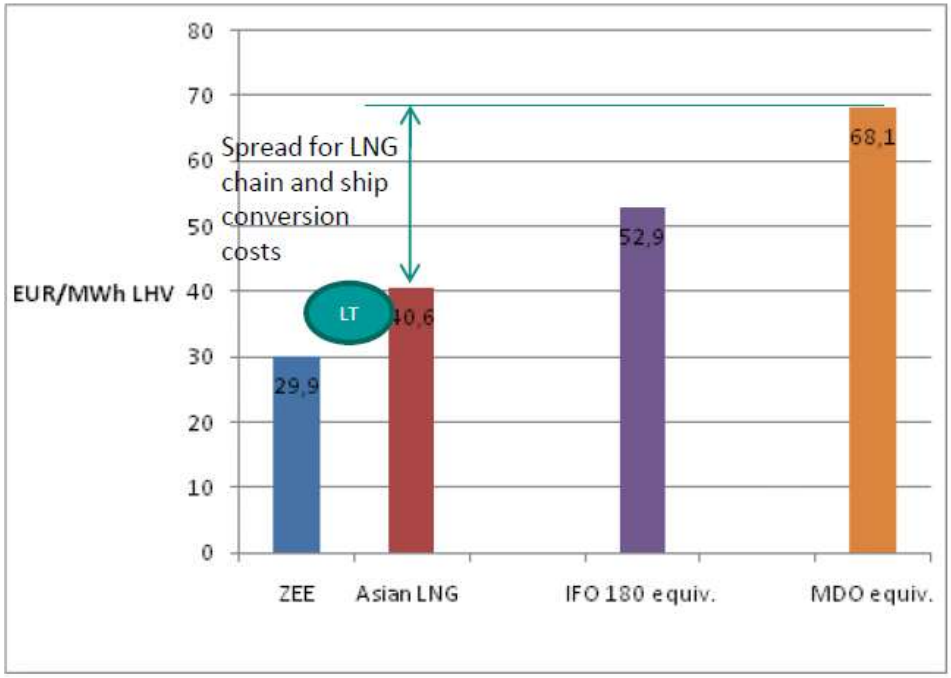
Trucking Costs;	Storage Costs;	O&M Costs;	M&S Costs;	Tax Costs;
A € /ton	B € /ton	C € /ton	D € /ton	0 € /ton

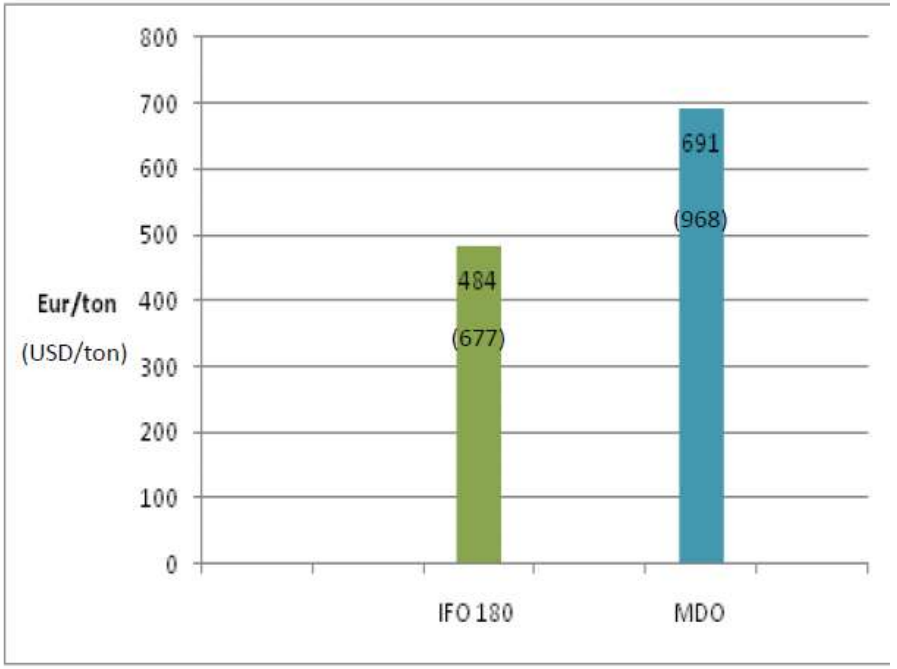
Total Cost LNG Distribution;
T= A+B+C+D € /ton

LNG retail price customer is different than a LNG ex terminal price

6. Economical /Technical chain development

Fuel Prices for same energy content



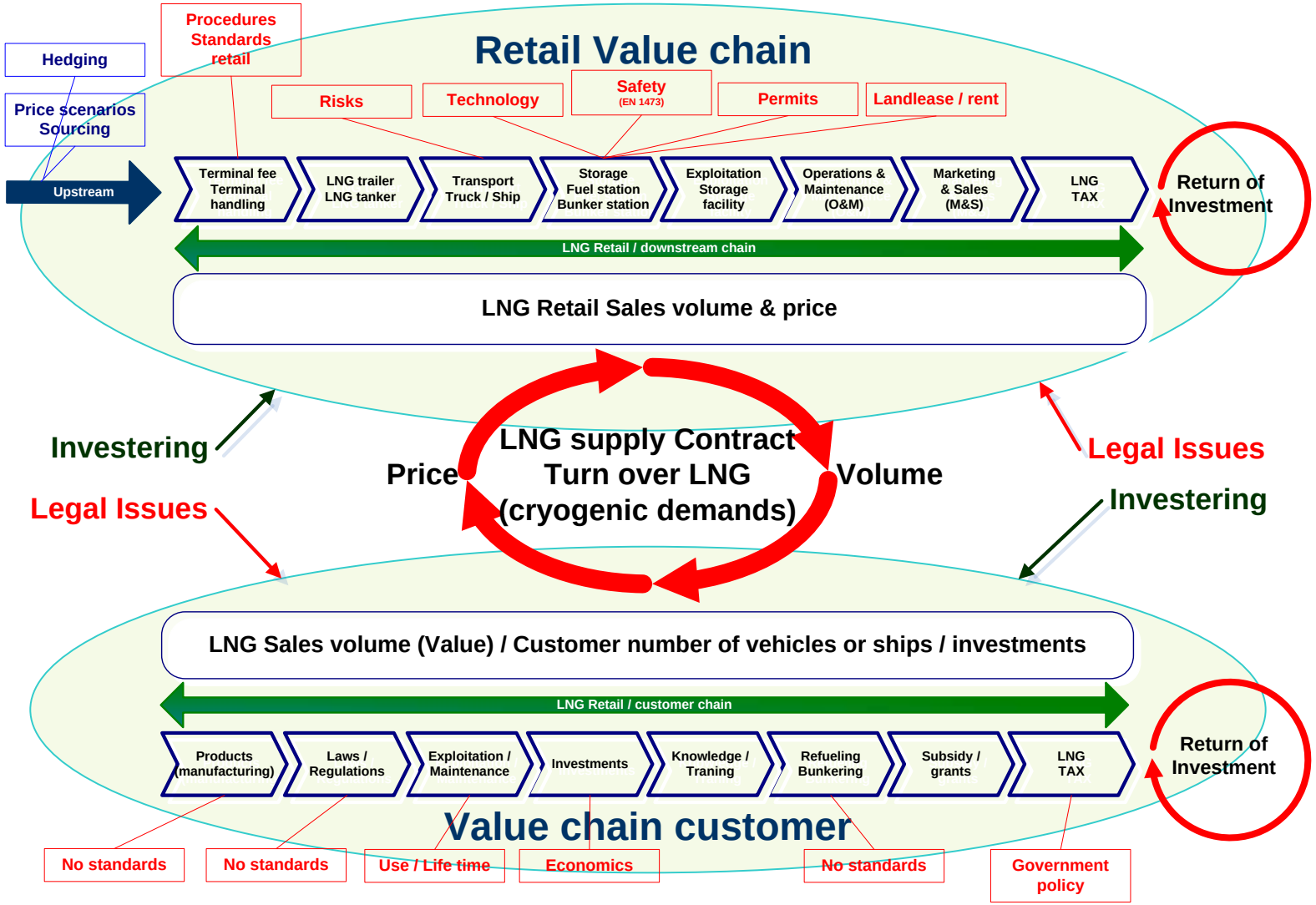


31.08.11 prices

Zee is a spot gas market price

- is today not a valid reference for LNG price
- not reflecting the long-term LNG contract prices

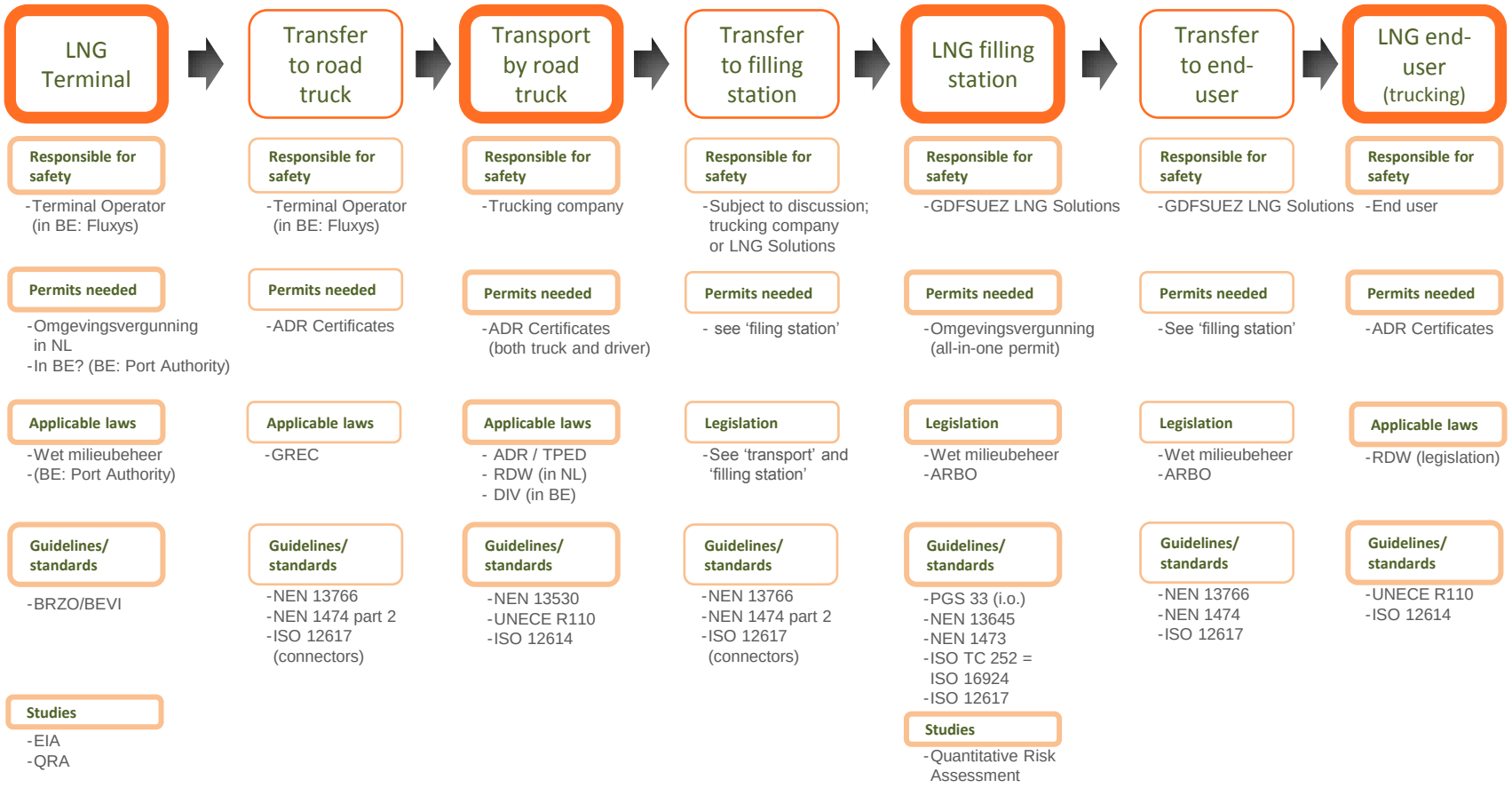
6. Economical /Technical LNG chain development



The LNG fuel chain has totally different dynamics as traditional fuel chains

7. Safety and Quality

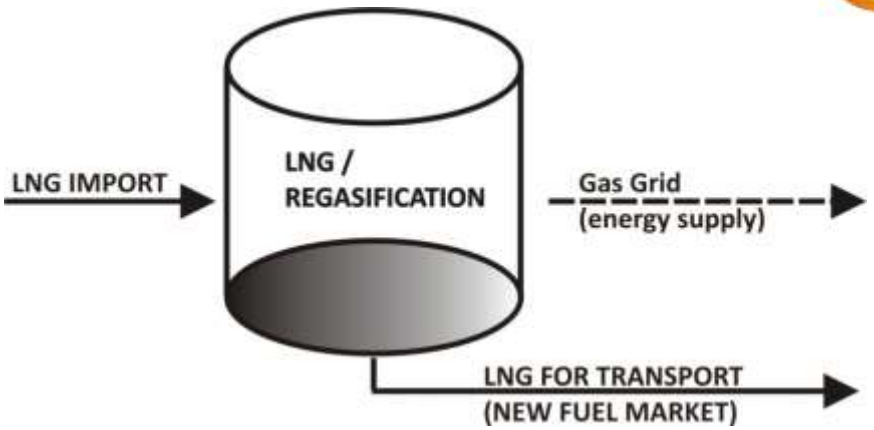
LNG Legislation for downstream applications (heavy road transportation)



Overall gaps:

- Lack of experience among authorities with LNG
- Lack of experience among industries with permitting processes
- Lack of educational programs for LNG operations (maintenance, filling, etc.)

7. Safety and Quality (Legal research)

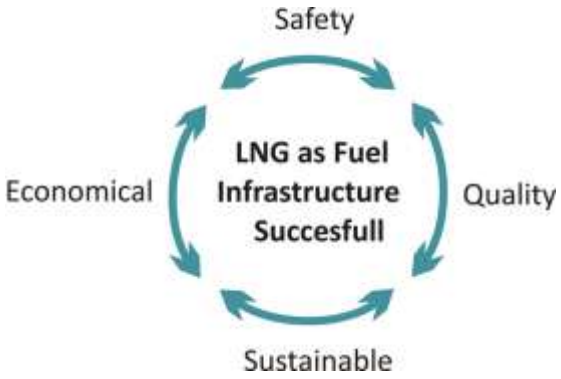


- Investigate the white spots in existing legislation and permits for the use of LNG as fuel in the down stream chain
- Provide advise for adjustments necessary to change or add in permitting & legislation to assure safe and unambiguous operation for clients and government throughout the whole LNG chain.
- What are the risks & possible liabilities for the use of LNG as fuel in the down stream value chain

Conclusie

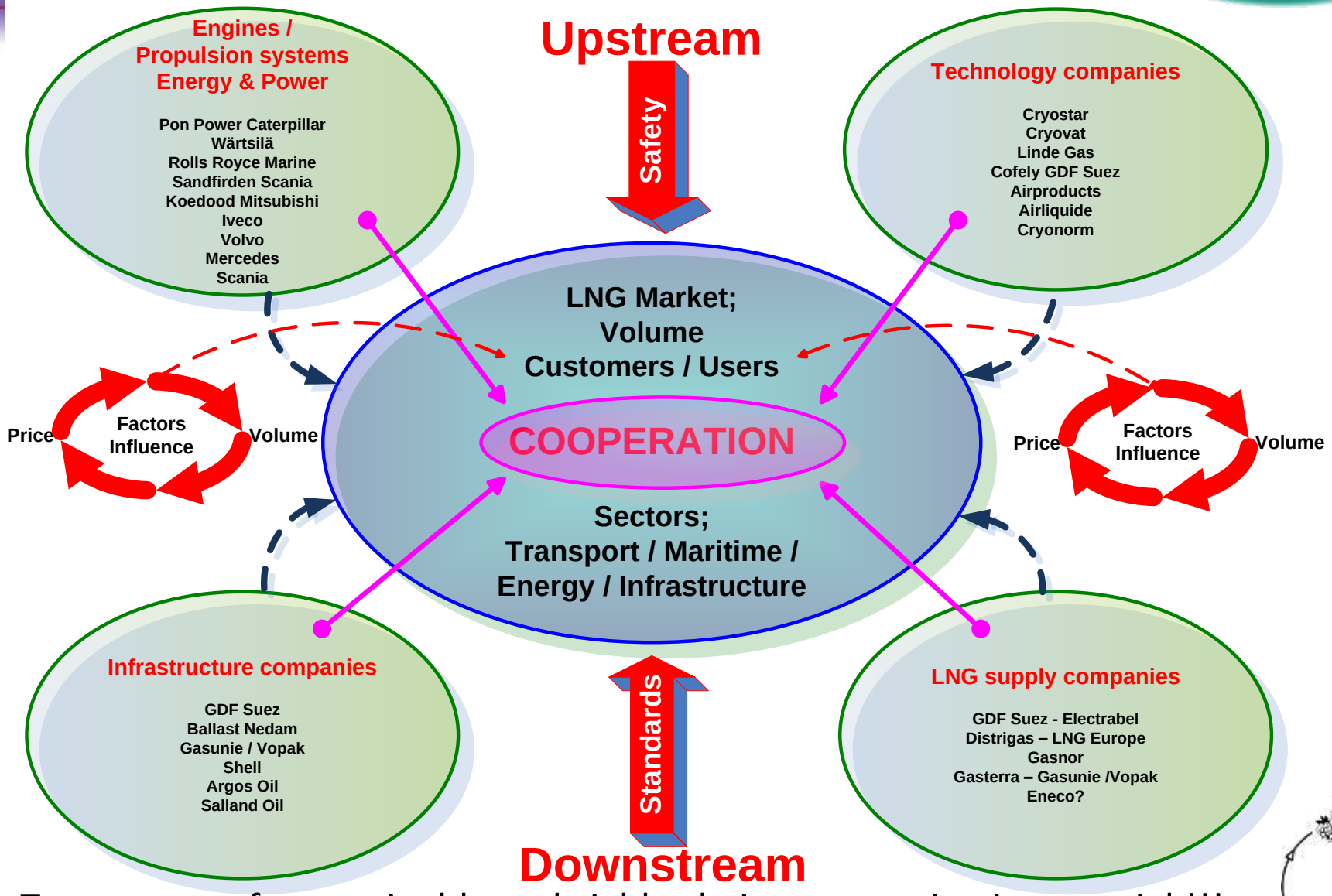
- **De Nederlandse wetgeving is (nog) niet toereikend om LNG te implementeren als brandstof.**

GDF SUEZ focus on Safety, Sustainability, Quality and Economical viability



Cooperation between market parties is essential

Market Approach from four directions



To create a safe, sustainable and viable chain cooperation is essential !!!

6. Economical /Technical chain development

Current GDF SUEZ Expertise

- LNG Sourcing : access to products and slots in terminals
- LNG Shipping & LNG carriers
- LNG Ship loading/unloading technologies
- LNG overland transportation – trucking activities
- LNG Truck loading stations
- Research & innovations programs
  - Ship-to ship transfer
  - Gas carburation – LNG-c
- LNG operating experience

6. Economical /Technical chain development
Current GDF SUEZ Expertise

- **Overland Transportation - Trucking of LNG**

Everett, Boston , USA

- 4 loading bays
- 10 000 trucks loaded/year
- Cryogenic flexible hoses
- 18 tons (40m3) trucks
- Truck loading time : ~ 45 min
- Could represent up to 10% of the terminal send-out

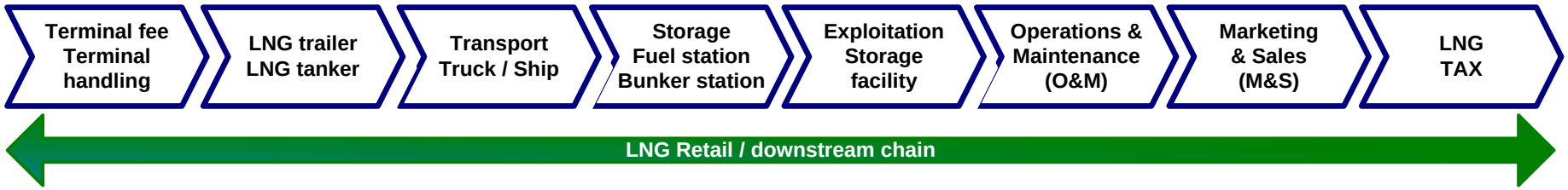
6. Economical /Technical chain development

COFELY GDF SUEZ

GDF SUEZ Energie Nederland

GDF SUEZ LNG Solutions

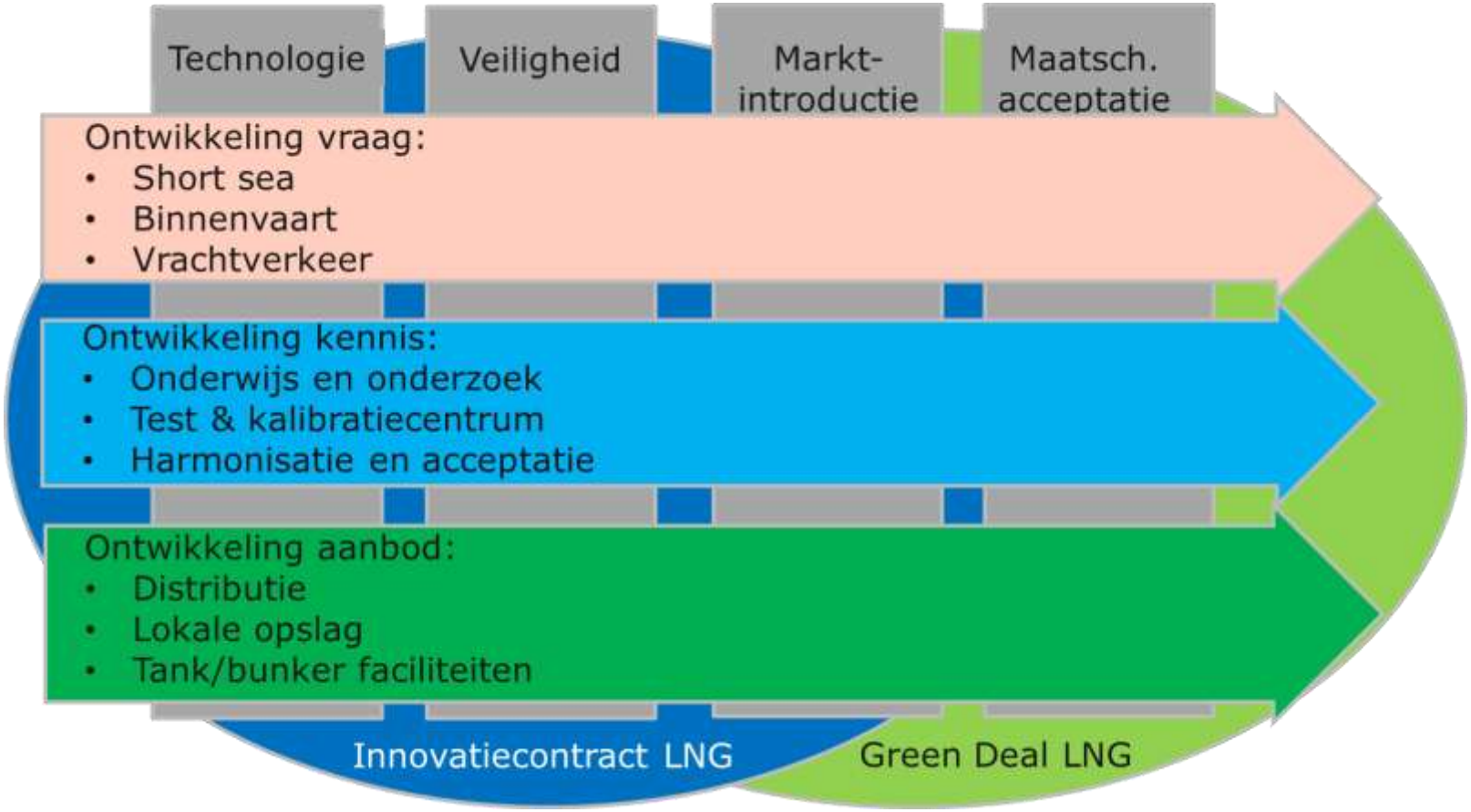
- We sell LNG but also provide an integral solution
- Take responsibility in every part of the retail value chain
- Build infrastructure on LNG, insert and develop to Bio LNG
- Connect to green gas lobby and network
- Lead the way for safety, sustainability and viability (TKI IC Gas) LNG, top sector Energy



Joint forces also in our group to secure availability of knowledge and expertise

6. Economical /Technical chain development

Top Sector Energie, TKI gas (thema LNG) Innovatiecontract LNG. Focus op implementatie van LNG als brandstof



8. Relation LNG & Bio LNG, Green Gas

- LNG and Bio LNG have the same chemical composition
- LNG is made of fossil gas, Bio LNG is made of upgraded bio gas or green gas
- Green gas commonly used for compressed fuel applications
- LNG & Bio LNG have the same energy content
- LNG is generously available, Bio LNG is limited available
- LNG is a economically viable product (liquefied upstream, large volumes)
- Bio LNG: upgrading & locally liquefied, smaller volumes

➢ **Build infrastructure with LNG and prepare an economically basis for bio LNG**

➢ **LNG retail chain development pushes green gas and bio LNG development as well**

➢ **Realization of a GREEN (bio)LNG infrastructure for Maritime and road sector**

9. Conclusions

LNG as a fuel is a sustainable and viable option versus MDO and Diesel

Provided

- optimization of the LNG chain (scale/volumes effect)
- adequate LNG contract duration
- Development of LNG retail market price structure
- optimization of the ship conversion costs
- Safety standards upstream to be implemented downstream
- No venting policy in the whole LNG supply chain

State incentives, lower taxes in favor of LNG will boost the conversion of the industry

Environmental taxes if applicable will reinforce the tendency in favor of LNG.


Bridge to the future

BY PEOPLE FOR PEOPLE

LNG Solutions

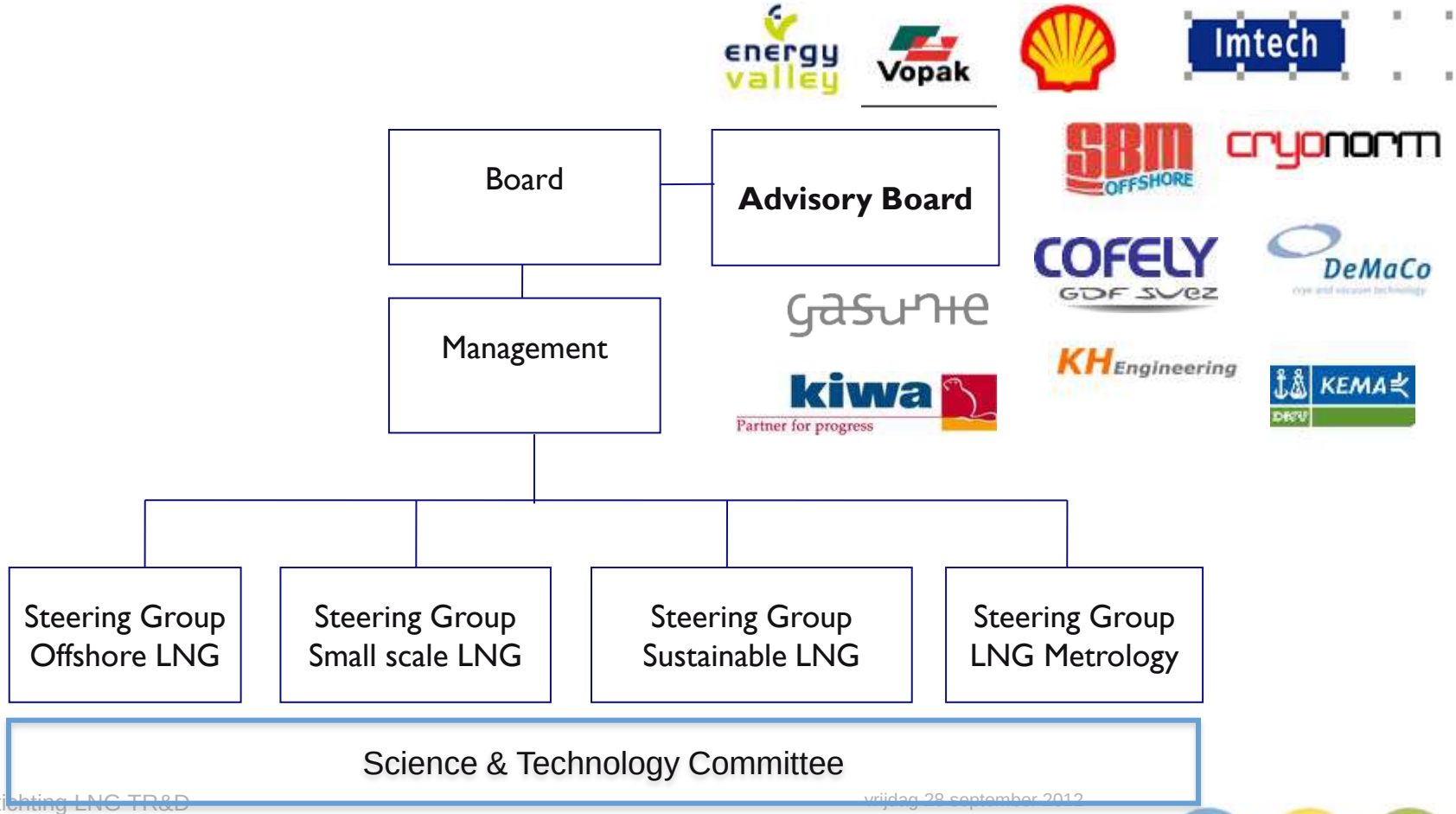
www.gdfsuez-lngsolutions.nl

Innovation Contract LNG 2012

27th of September 2012
Delft

Willem Kuipers
Managing Director, LNG TR&D
LNG Line Manager, TKI Gas

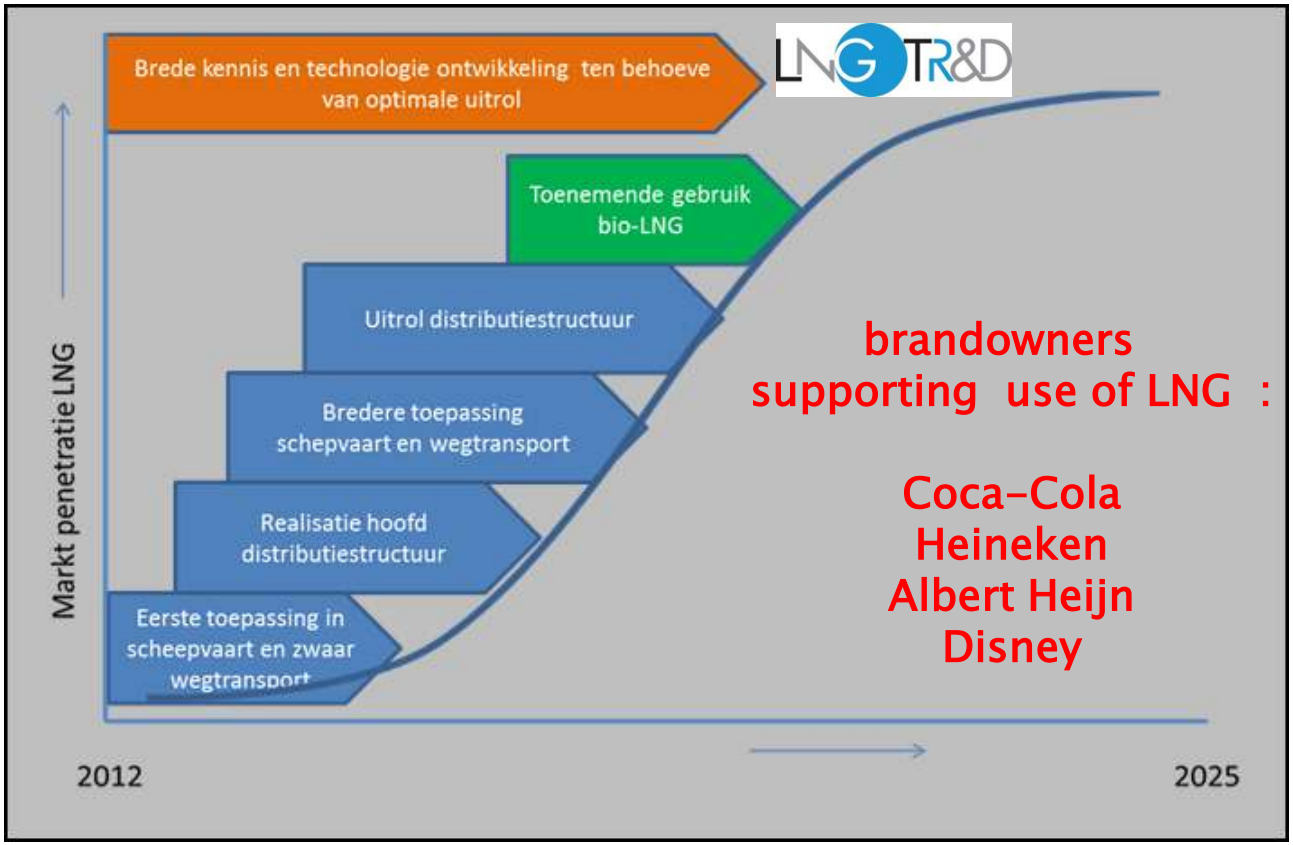
LNG TR&D Organisation Structure



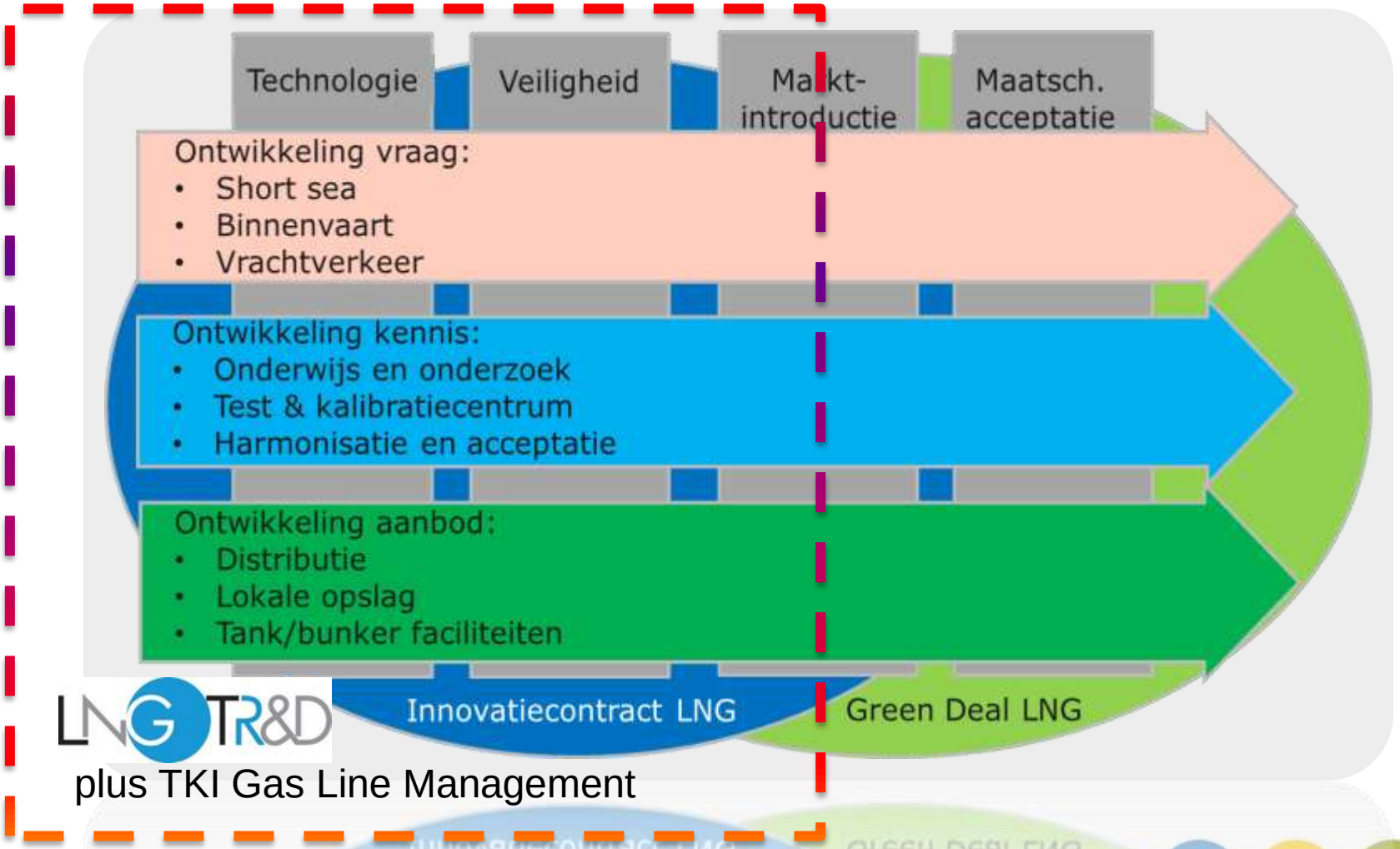
Innovation Contract LNG 2012 : Market pull

- **NOV 2011** : LNG Roadmaps determined by LNG TR&D with focus on implementation of LNG in the market ;
- **FEB 2012** : 40 mio Euro of Letter of Commitment by 30 large companies 10 SME's, branche-org., & knowledge institutes ;
- **FEB 2012** : Program-lines and Projects : Market Pull = Industry decided
- **MAR 2012** : LNG TR&D requested to define with " the golden tri angle" the LNG Program as basis for the Innovation Contract LNG 2012 ;

Technologies needed to support distribution of LNG



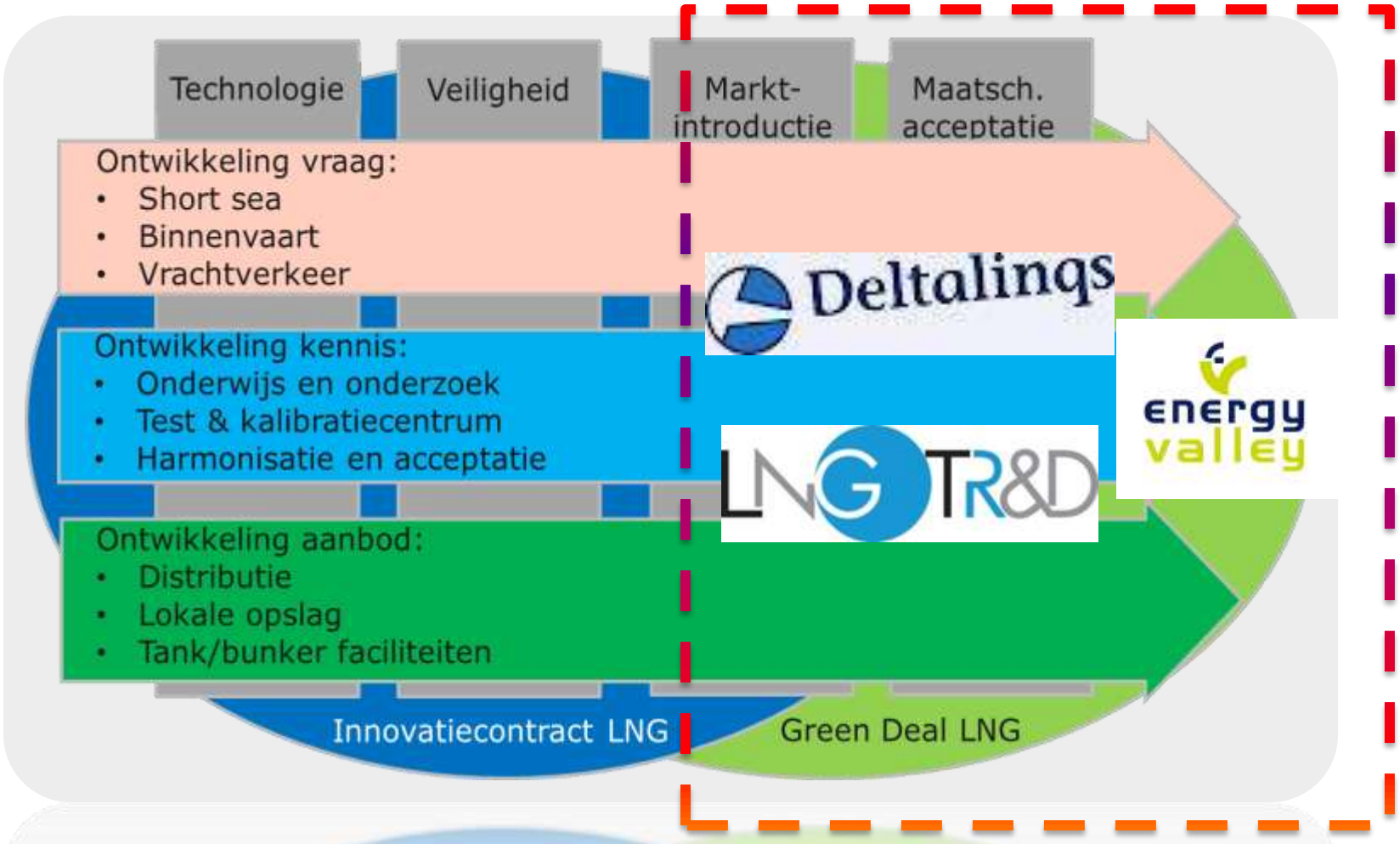
INNOVATION CONTRACT LNG 2012 : Program Lines



LNG TR&D

plus TKI Gas Line Management

Green Deal LNG / Nationaal LNG Platform



Program Lines and Projects 2012 (1)

Project Examples	Program Lines
Advanced LNG Training Program	Education
LNG applications for Short Sea Shipping	Market Intro
Retrofitting an existing seagoing gas carrier to dual-fuel LNG technology	Market Intro
Development of calibration facilities to support reliable custody transfer of LNG as a transport fuel	Market Intro / Technology
High Efficiency MultiFuel Engine Management System	Market Intro / Technology
Standards, specifications and input for regulations for Small-scale LNG Filling Stations	Market Intro /Technology
Avoiding Methane Emissions in the LNG supply chain.	Technology
Safety in LNG fuel bunker	Safety
Discovery of a small-scale LNG composition sensor principle	Technology
Controlled Crystallisation of Impurities in Pre-processing & Liquefaction.	Technology

21 submitted project proposals requested 8.9 mio Euro IC LNG funding

whereas 3 mio Euro is available

12 high quality proposals via LNG TR&D have been awarded by the TKI Gas

Program Lines and Projects 2012 (2)

- Focus on Small Scale LNG

- Fits in Vision & Objectives of “Hoofdlijn LNG in Innovation Contract Gas” presented to Topteam Energy on 15 February, 2012.

- Q2 2012 : projects-ideas clustered

- Discovery = 763 kE subsidy
- Development = 911 kE subsidy
- Deployment = 1.317 kE subsidy

- Industry cash = 1.400 kE
- Industry in-kind = 2.300 kE

Balanced program
6,6 mio Euro

Focus on Implementation &
with many SME’s

Participants : **31 Large companies (also foreign)**
22 SME's
5 Knowledge Institutes
4 Branche Organisations

organisations mentioned below are an indication

Outlook towards the IC LNG 2013

- **High quality project proposals are left, which are the basis for request of 6 mio Euro subsidy in the Innovation Contract LNG Tranche of 2013**

12 mio Euro in IC LNG Program 2013

- **LNG TR&D Steering Groups will make an iteration step in October on the existing project proposals, which did not make it in the 2012 Tranche ;**

- **LNG TR&D Steering Groups are open towards new project ideas from stakeholders in and outside the steering groups ;**

- **Procedure, criteria, program lines and submission date for proposals will be communicated in October**

Thank You !

Questions ?

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