



INNOVATIONS IN SMALL SCALE LNG SHIPPING

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Reserves: Our use of the term “reserves” in this presentation means SEC proved oil and gas reserves.

Resources: Our use of the term “resources” in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves excluding changes resulting from acquisitions, divestments and year-average pricing impact.

Shales: Our use of the term ‘shales’ refers to tight, shale and coal bed methane oil and gas acreage.

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PROJECTED ENERGY OUTLOOK BY 2050

RIISING ENERGY DEMAND, SUPPLY PRESSURE, CLIMATE CHANGE



Population

9 billion people,
75% living in cities
(2 billion more than today)



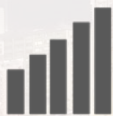
Vehicles

2 billion vehicles
(currently 800 million)



Rising standards

Many millions of people will rise
out of energy poverty; with higher
living standards energy use rises



Demand

Energy demand could double
from its level in 2000...but CO₂
emissions must be half today's
to avoid serious climate change



Efficiency

Twice as efficient, using
half the energy to produce
each dollar of wealth



Renewables

3 times more energy
from renewable sources

NO SINGLE SOLUTION FOR OIL BASED TRANSPORT



1

DRIVING LNG DEMAND



GREENSTREAM AND GREENRHINE

- 110 m long barges operating on the Rhine and on charter to Shell from 2013
- First for Shell and for the marine industry
- The first of these vessels was commissioned and filled with LNG on March 3, 2013

Shell's support helped launch Greenstream and GreenRhine, the world's first LNG-powered barges to carry goods along Europe's River Rhine.



SHELL WILL CHARTER 15 NEW LNG-POWERED BARGES OPERATING ON THE RHINE

- Shell has signed a time-charter agreement with Plouvier Transport NV and Intertrans Tankschiffahrt AG for 15 new inland dual-fuel barges.
- Built by the Dutch shipyard VEKA Shipbuilding BV
- Main engines provided by Wärtsilä
- 110m long and designed for:
 - Improved environmental performance
 - Safety
 - Optimal cargo carrying capacity in various water conditions.
 - Usage of 95- 98% LNG fuel with a small proportion of diesel used for ignition.

SHELL INTENDS TO DEVELOP A LNG SUPPLY CHAIN FOR THESE INLAND WATERWAYS BARGES

- The infrastructure deployed will:
- Provide operating coverage from Rotterdam to Basel, spanning 1,300 km of in-land waterways including Rhine and tributaries: Mosel, Main, Ruhr, and Neckar and covering three Core Corridors of the TEN-T Network in five EU Member States.
- Comprise of 2 fixed bunkering locations for bunkering shore two ship and create three additional sites for truck-to-ship bunkering
- Be studied through a real-life trial to ensure rigorous application of safety standards and optimise operating efficiency.

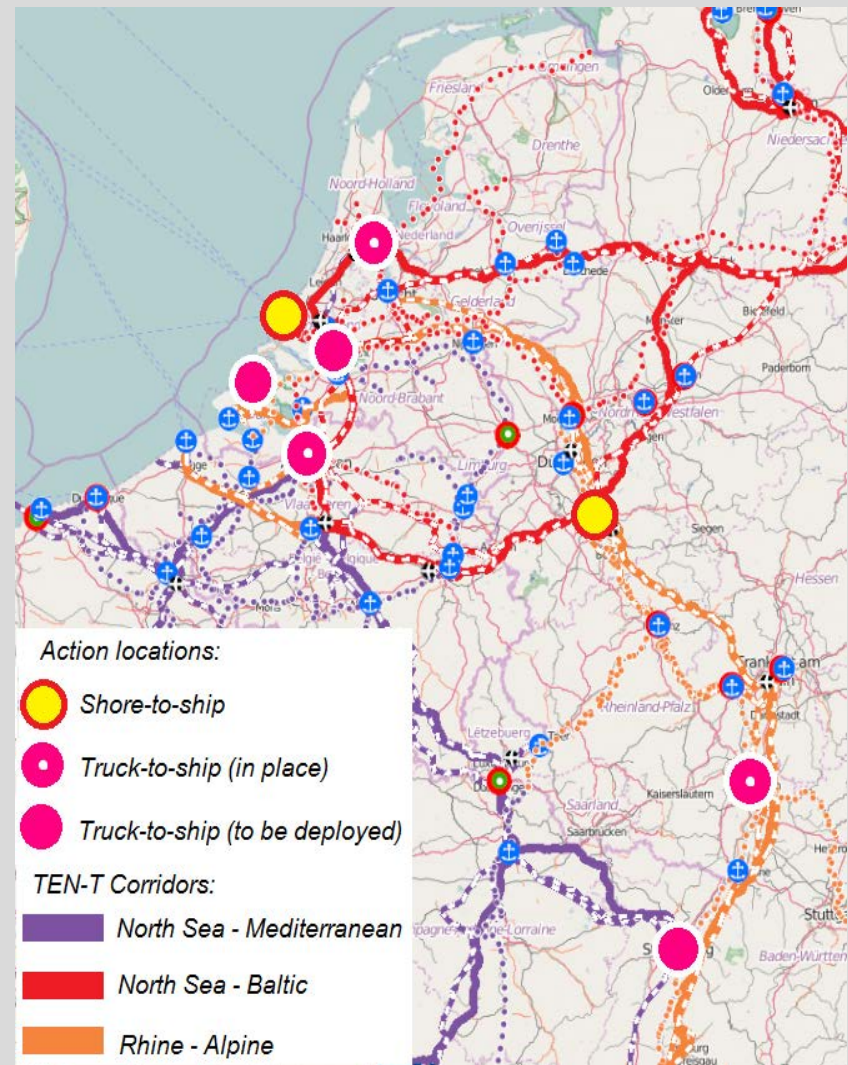


Figure 3.1. Action locations and TEN-T Core Network Corridors

NORTH SEA

- Siem LNG Fuelled Offshore Supply Vessels supporting Norske Shell's offshore activities in Norwegian Sea
 - Supply to Draugen
 - Subsea jobs for both Draugen and Ormen Lange
- Innovative Wartsila Dual Fuel Engines
 - 90% NOx reduction
 - 99% SOx/PM reduction
 - 20-30% CO2 reduction
- Gasnor awarded LNG fuel contract



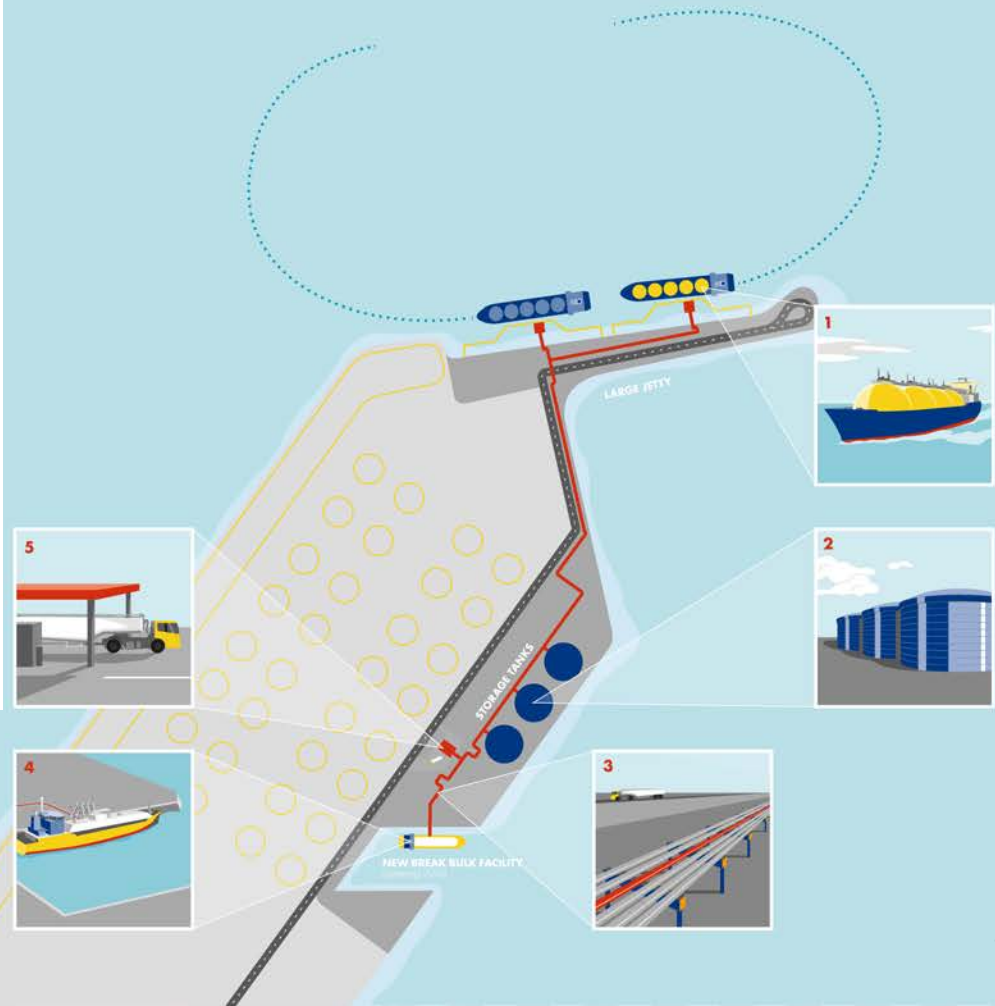
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DEVELOPING LNG INFRASTRUCTURE



GATE: LONG-TERM LNG FOR TRANSPORT

- Shell has announced investment into a break bulk jetty at the GATE (Gas Access To Europe) terminal.
- To serve marine customers in the port of Rotterdam, Shell is constructing together with STX shipyard an LNG bunker vessel facilitate ship to ship transfer operations, and also deliver LNG to secondary distribution terminals outside the port area.
- In addition, LNG will be loaded onto trucks and delivered to road customers.



AN INNOVATION IN THE LNG BUNKERING MARKET

Potential customers include container ships, coastal vessels, and ferries.

FEATURES: Cutting-edge shipping design and technology with a special loading arm for ship-to-ship transfers and sub-cooling unit to keep LNG at sub atmospheric pressure.

CAPACITY:
6,500 cubic metres

LENGTH: ~120 metres



The new vessel will be built by STX Offshore & Shipbuilding. It will be based at the port of Rotterdam in the Netherlands, and will load from the new LNG break bulk terminal and jetty to be constructed by the Gas Access to Europe (Gate) terminal. It will also be sea-going and, therefore, able to bunker customers at other locations.



Co-financed by the European Union
Connecting Europe Facility

CONSTRUCTION OF INNOVATIVE LNG BUNKER VESSEL

Sea Going
Capability

Dual Fuel
Engines

Sub cooler
Unit

High & Low
Manifold

Highly
Manoeuvrable



Transfer Arm
System

Efficient Hull
Design

Custody
Transfer

Capacity
6.500 m3

Electric
Propulsion



Co-financed by the European Union
Connecting Europe Facility

LNG BUNKER VESSEL KEY PROJECT DATES

Contract Signing
Nov 2014

Launching
Q3 2016

Ready for
Service
Rotterdam
Q2 2017

2014

2015

2016

2017

Steel
Cutting
Dec 2015

Delivery
Q1 2017



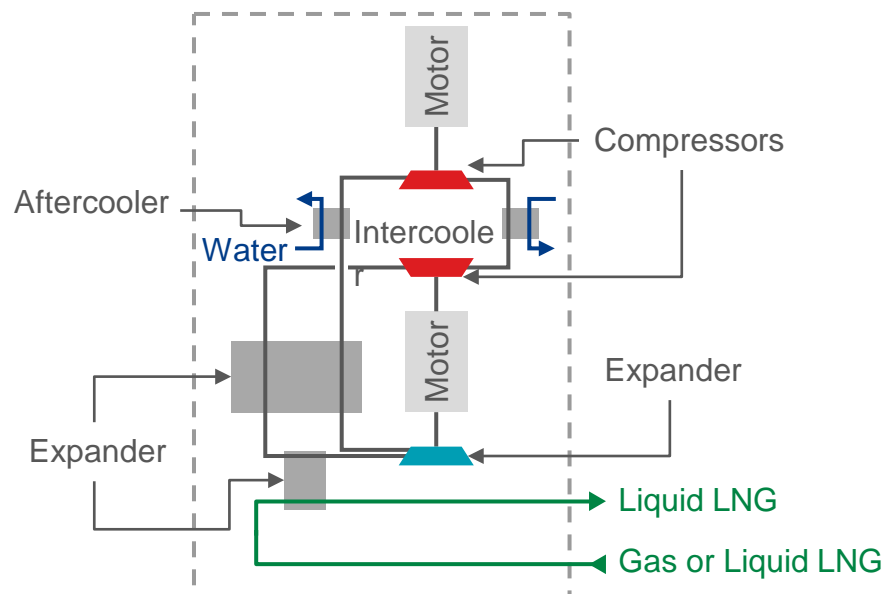
Co-financed by the European Union
Connecting Europe Facility

DESIGN FEATURES

SUB COOLER UNIT

Features

Prevention of BOG by heat extraction, taking liquid from the bottom of the tank and returning sub-cooled LNG.



Product range	TBF-175	TBF-350	TBF-700	TBF-1050	TBF-1400
LNG reliquefaction flow rate	0.15 t/h	0.5 t/h	1 t/h	1.5 t/h	2 t/h
Footprint (L*W*H)	9.5*1.7*3m	11*1.7*3m	Layout to be confirmed during the project		
Motor mechanical power	175kW	350kW	700kW	1050kW	1400kW
Weight	15T	17T	34T	51T	68T

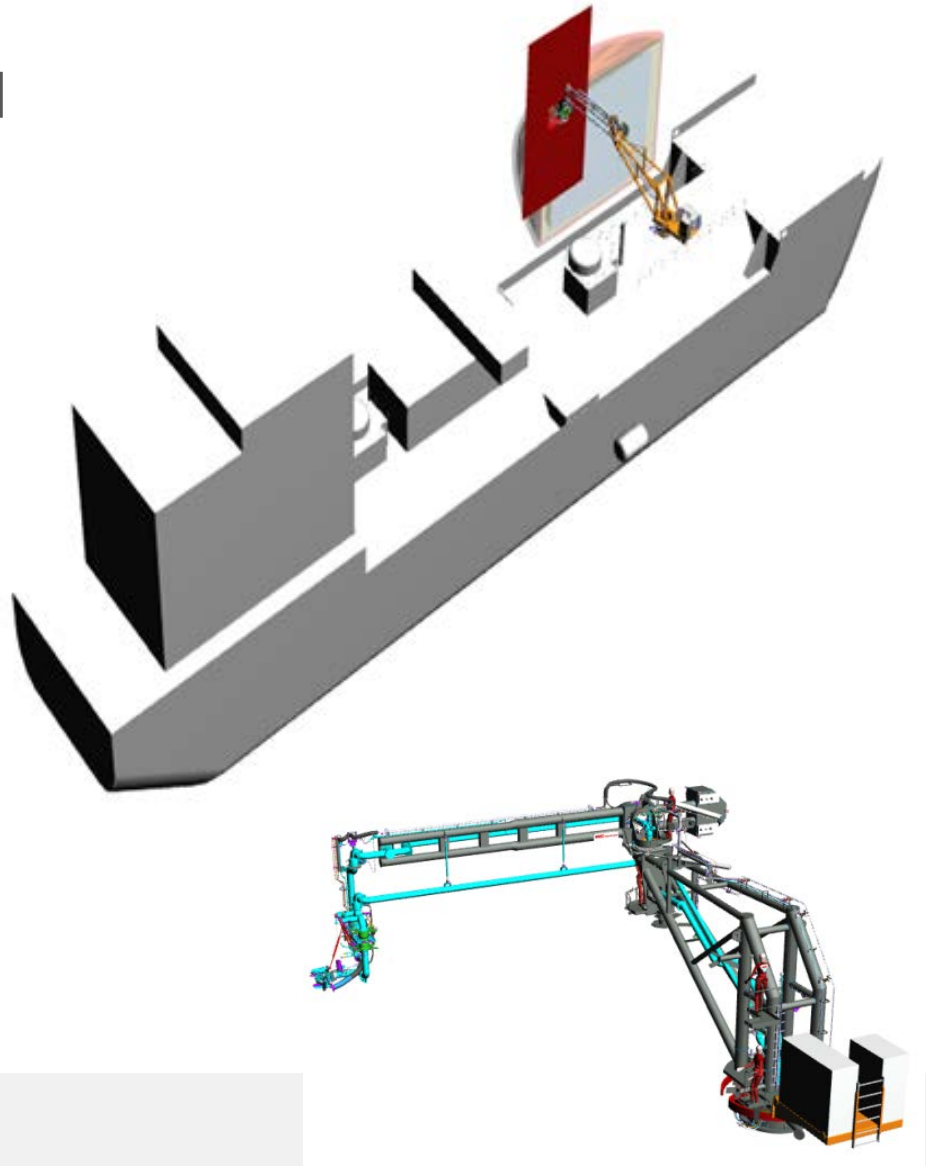


DESIGN FEATURES

TRANSFER ARM, SYSTEM

Features

- Capable of transferring LNG up to 1,100m³ per hour
- 8" liquid line, 6" vapour
- 13m height range and 16m horizontal connection range relative to LBV
- Remote operation – less manual handling than hose solutions = less personal risk exposure

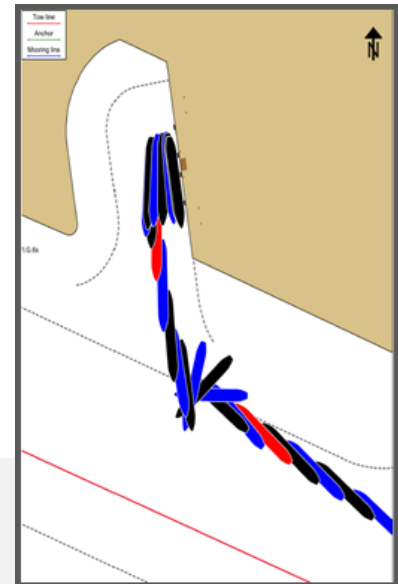
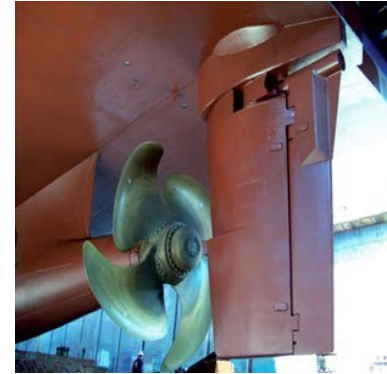


DESIGN FEATURES

HIGHLY MANEUVERABLE

Features

- Analytical maneuvering studies carried out for GATE to simulate jetty approach under various weather conditions.
- Twin screw with High Lift Rudders coupled with a bow thruster provided safe maneuvering for required conditions.
- Maneuvering model tests carried out at Sept 2015



SHIP TO SHIP BREAK BULKING (GASNOR)



- 2014-2015 Three cargos from GATE Terminal
- LNG Parcels Break bulked from 7500m³ to 1000m³
- Pressurized storage to pressurized storage

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MEETING LNG SUPPLY



AIDA PRIMA



New vessels from AIDA Cruises

- LNG used for power generation
- LNG supplied in 5 European ports in the next 5 years
- First LNG Operations April 2016

AIDA PRIMA

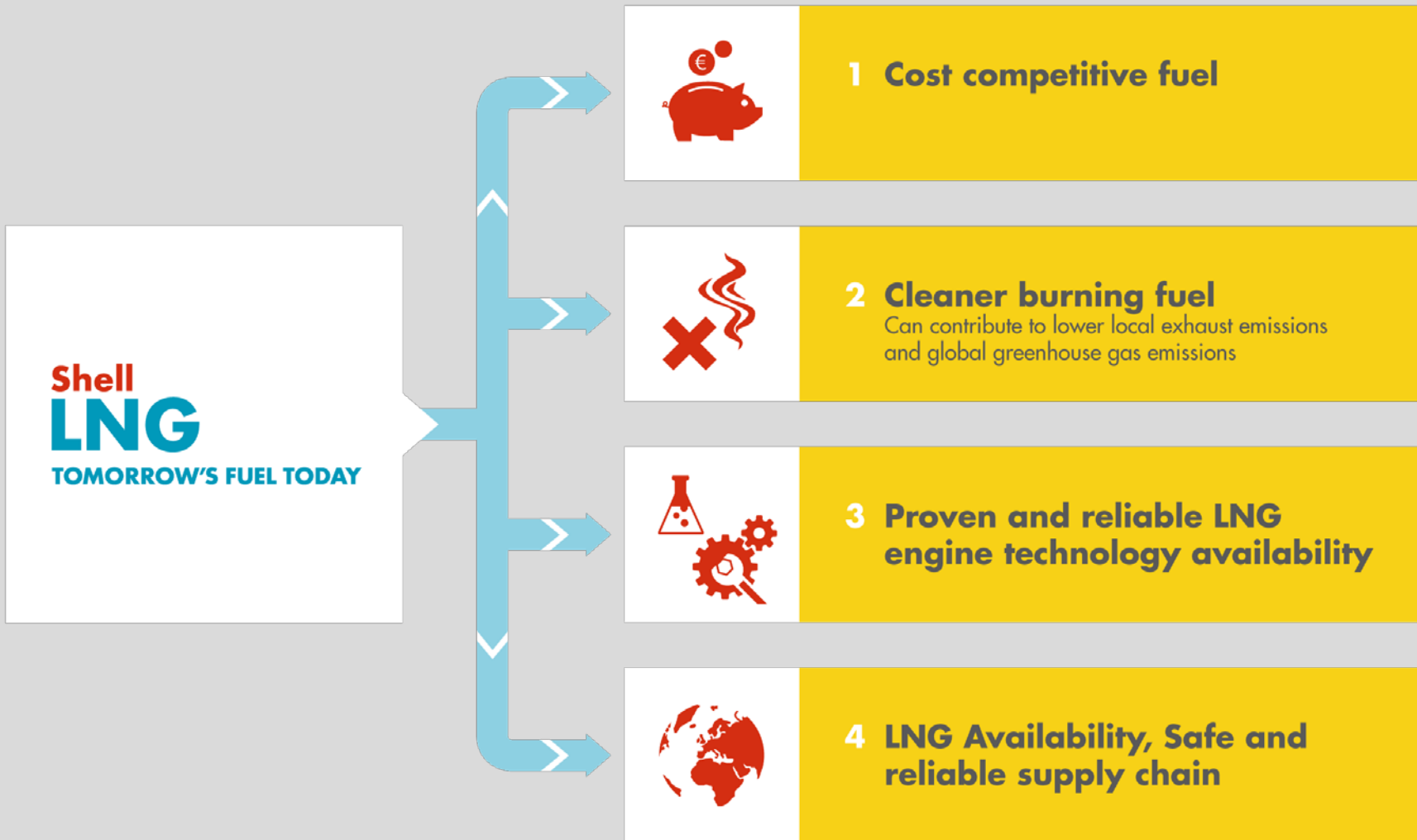


CONTAINERSHIPS

- GNS (Nordic Hamburg) is building 2+2 (1400 TEU) container vessels in China, which will be time chartered to Containerships
- These vessels will operate in the SECA area and first delivery will be in 2017/2018



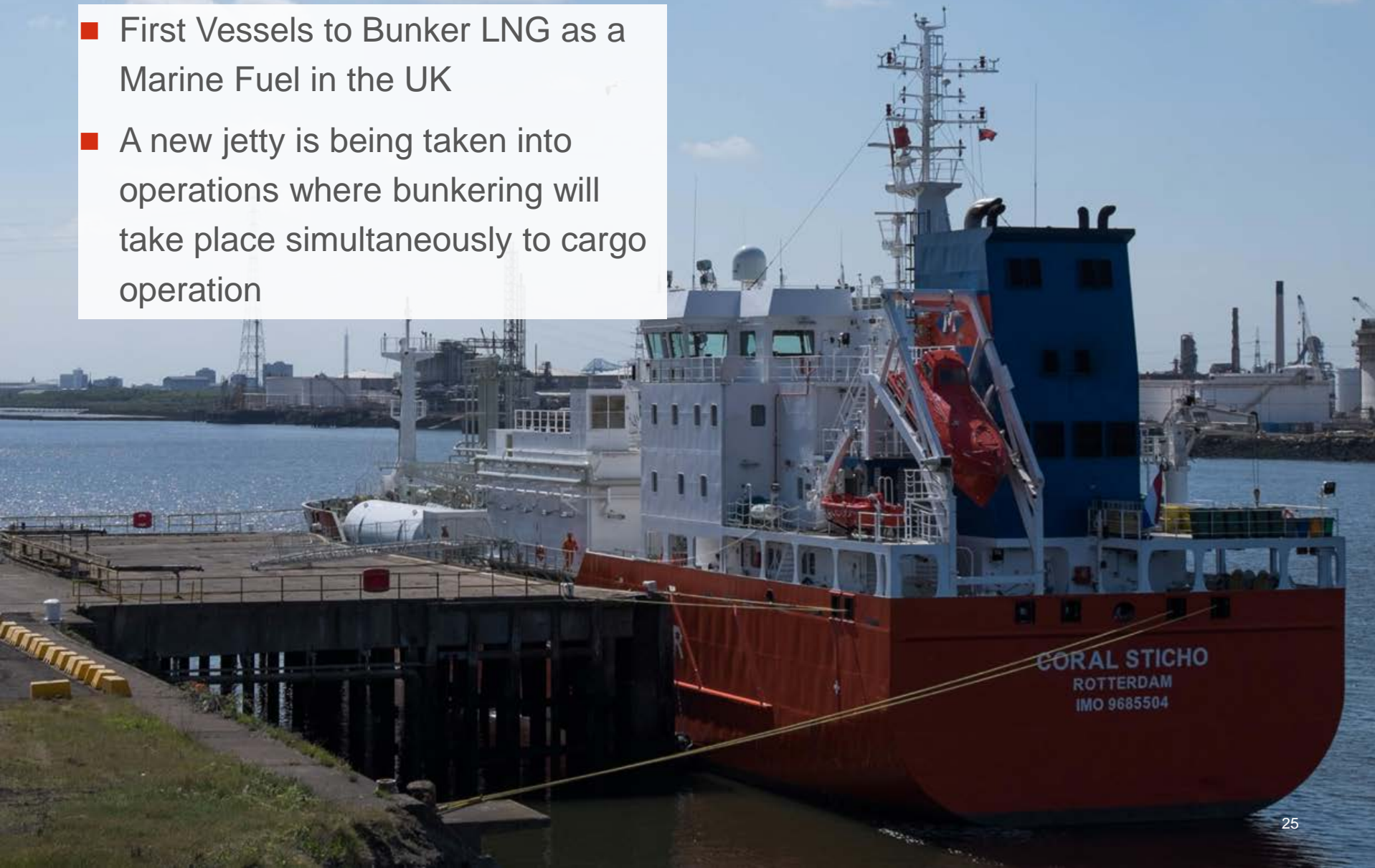
LNG CAN OFFER A COMPELLING VALUE PROPOSITION





SABIC

- First Vessels to Bunker LNG as a Marine Fuel in the UK
- A new jetty is being taken into operations where bunkering will take place simultaneously to cargo operation



GULF OF MEXICO

- The Harvey Energy is the 1st of 6 LNG-diesel dual fuel Offshore Supply Vessels (OSV's) being built by Harvey Gulf
- When delivered it was the 1st ever U.S. flag vessel to operate primarily on LNG
- The 1st 3 LNG vessels have been chartered by Shell Deep Water to support operations in the Gulf of Mexico
- The vessels will be powered by Wartsila 34 DF engines. While operating on LNG, the engines produce less emissions compared to traditional diesel engines
- Chart Industries is supplying the main 67,000 gallon (250m³) LNG fuel tanks
- The vessels are fuelled at an LNG bunkering facility operated by Harvey Gulf in Port Fourchon, LA.



CALCULATING THE COMPETITIVENESS OF THE BUSINESS CASE

