

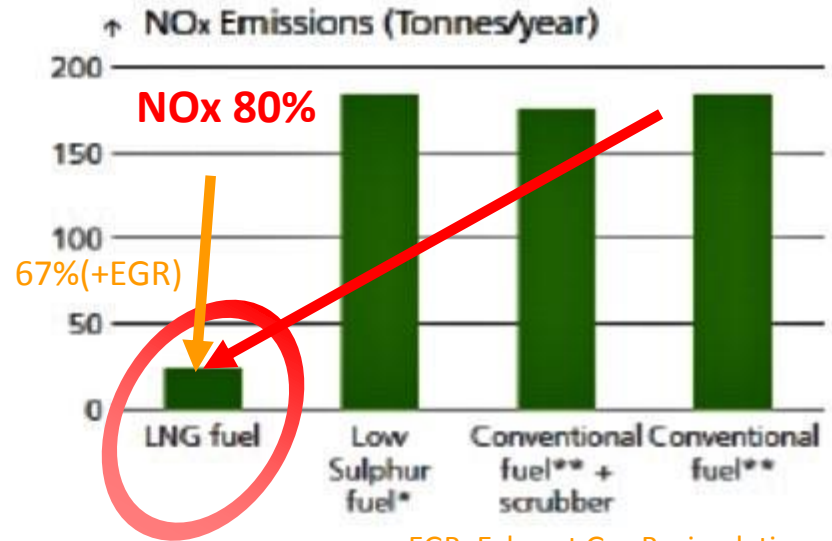
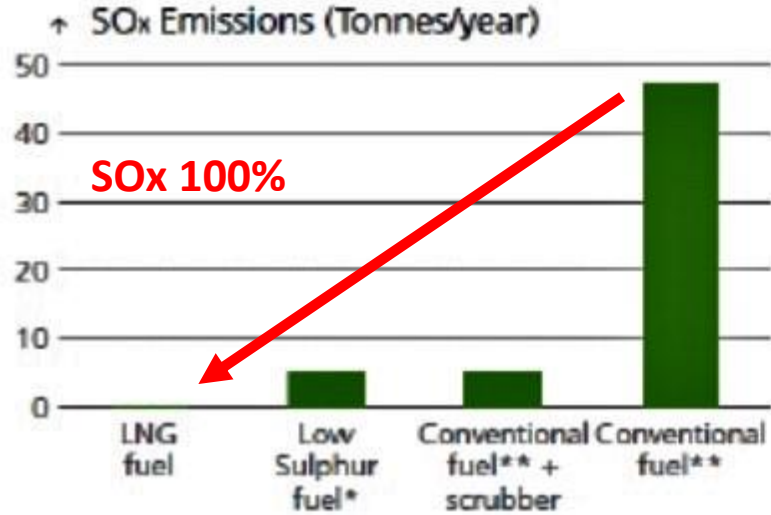
NYK's Activities in Pursuing LNG Fuel Supply

February 20th, 2020

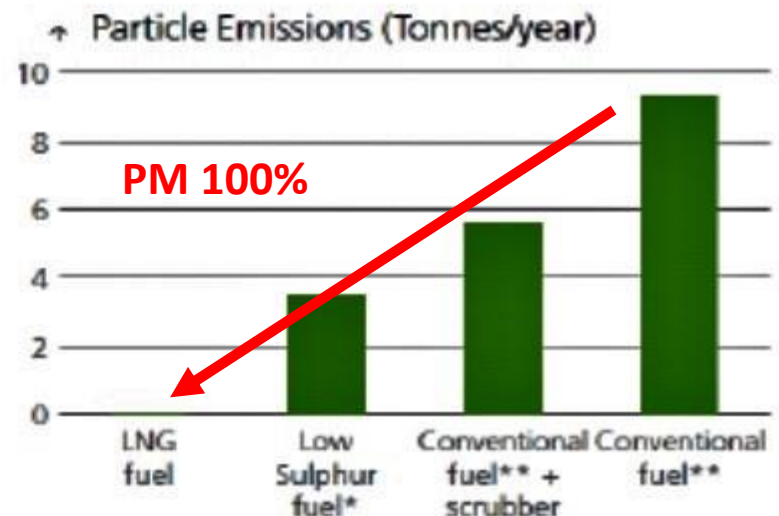
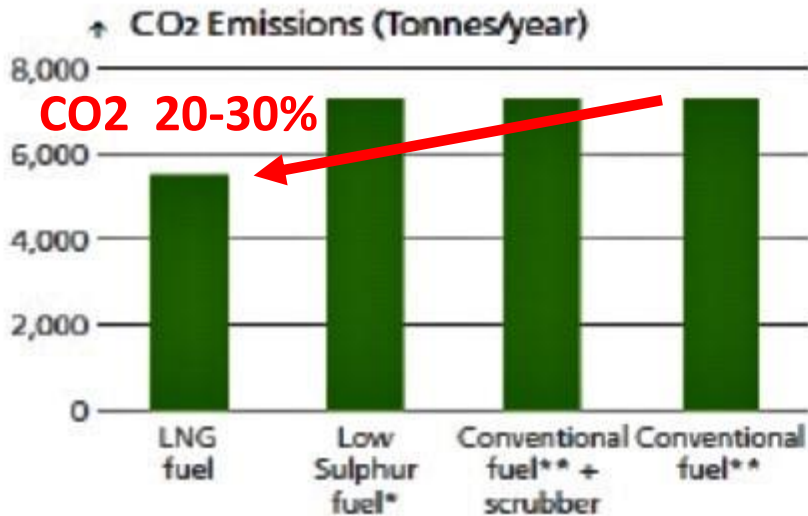
NYK ENERGY TRANSPORT (USA) INC.

- 1. Trends in Environmental Regulations**
2. NYK's View of the LNG-Fuel Market
3. NYK's Activities in the LNG-Fuel Market

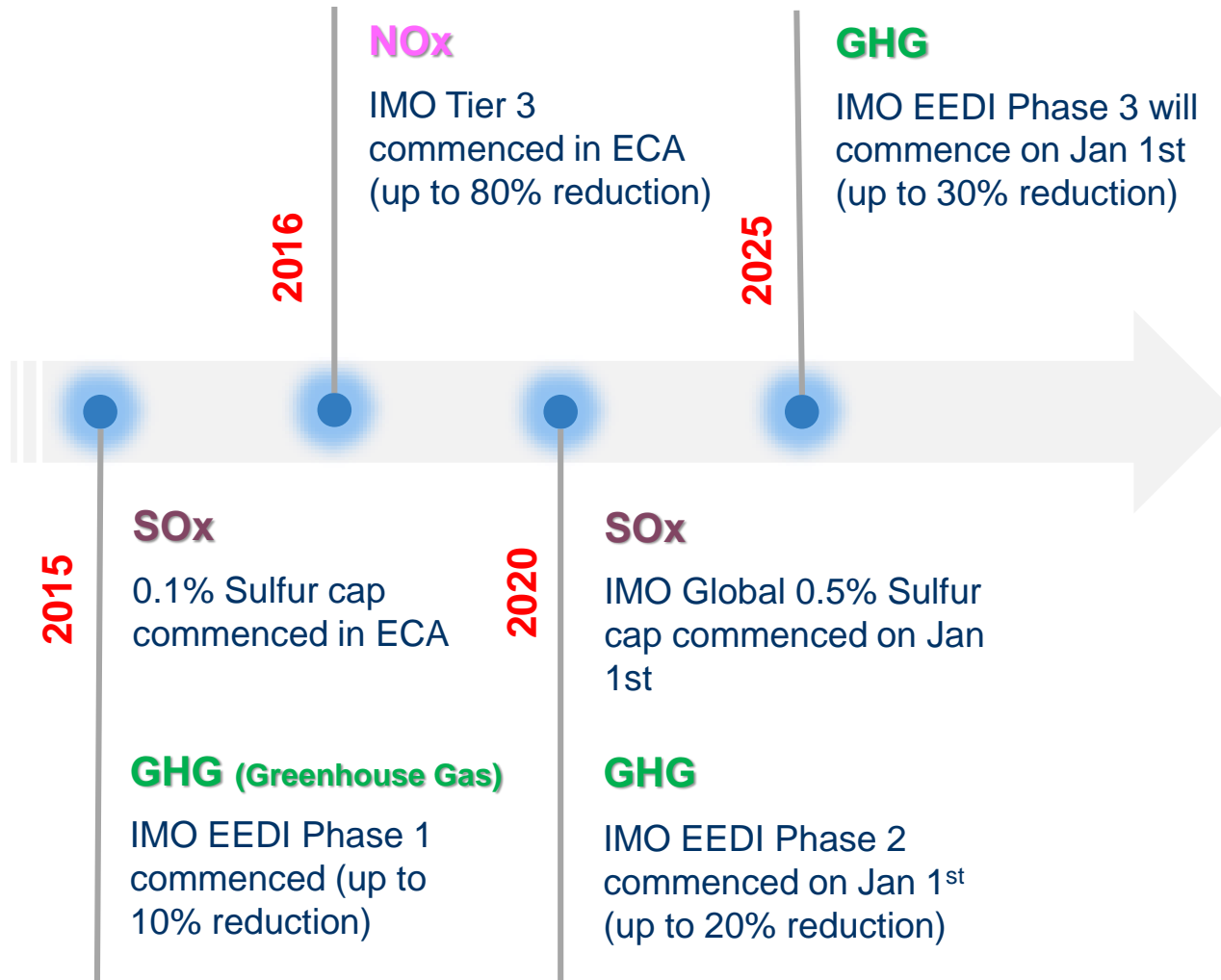
Environmental Merit of LNG fuel



EGR: Exhaust Gas Recirculation



Environmental Regulation in Shipping



ECA: Emission Control Areas
EEDI: Energy Efficiency Design Index

MEPC: Marine Environment Protection Committee

Agreed in IMO MEPC 72 (Apr 2018)

- To reduce **CO2** emissions per transport work by 40% by 2030, pursuing efforts towards 70% by 2050.
- To reduce the total annual **GHG** emissions by 50% by 2050

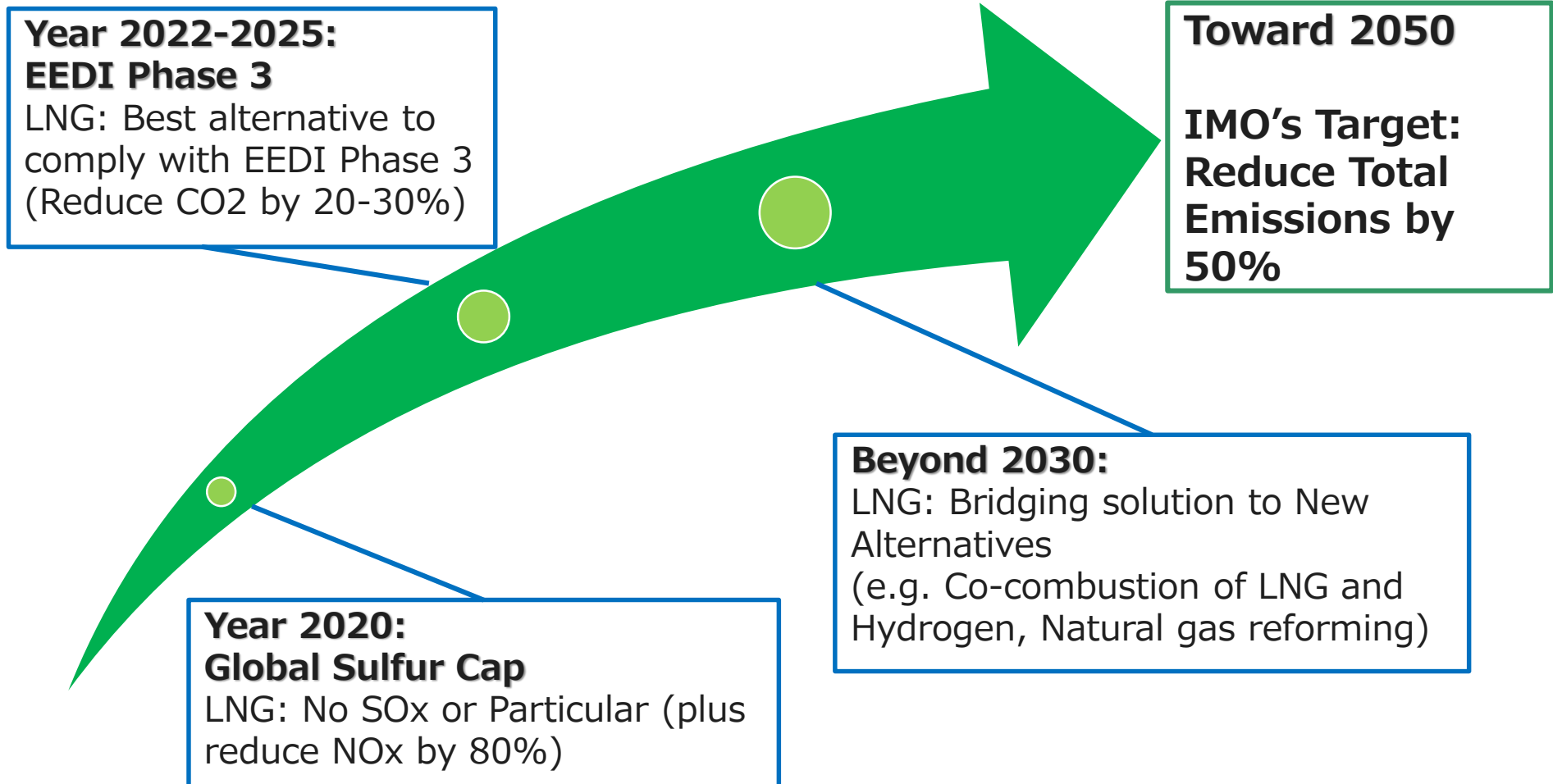
Proposed in IMO MEPC 73 (Oct 2018)

- To accelerate application of **EEDI Phase 3** to Jan 2022 for general cargo ships and container ships
- To increase the threshold of **EEDI Phase 3** to 40% for container ships

Agreed in IMO MEPC 74 (May 2019)

- To accelerate application of **EEDI Phase 3** to Jan 2022 for general cargo ships and container ships
- For larger container ships, the EEDI reduction rate is enhanced to max. 50%.

LNG Fuel is a Valuable & Long-lasting Option for the Maritime Industry



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Ship to Ship LNG Fuel Supply Projects (including Planning Stage)



Supply side is ready to cover major ports by 2020-2021



List of LNG Bunkering Vessels



In Operation – Total 12 vessels

Year	Vessel Name	Operator	Main Port	Tank (M3)
2013	Seagas	Nauticor	Stockholm	180
2017	Engie Zeebrugge	Gas4Sea	Zeebrugge	5,100
2017	Cardissa	Shell	Rotterdam	6,500
2017	Coralius	Gasum	Baltic Sea	5,800
2018	Oizmendi	Cepsa	Bilbao	600
2018	Coral Methane	Shell	North Sea	7,500
2018	Clean Jacksonville	JAX LNG	Jacksonville	2,200
2018	Kairos	Nauticor	Baltic Sea	7,500
2018	FlexFueller 001	Titan LNG	Amsterdam Rotterdam	1,480
2019	LNG London	Shell	Rotterdam	3,000
2019	Jeju LNG 1	KOGAS	Busan	7,500
2020	FlexFueller 002	Titan LNG	Antwerp	1,480

Source: Made by NYK based on public information

*ARA: Amsterdam, Rotterdam, Antwerp

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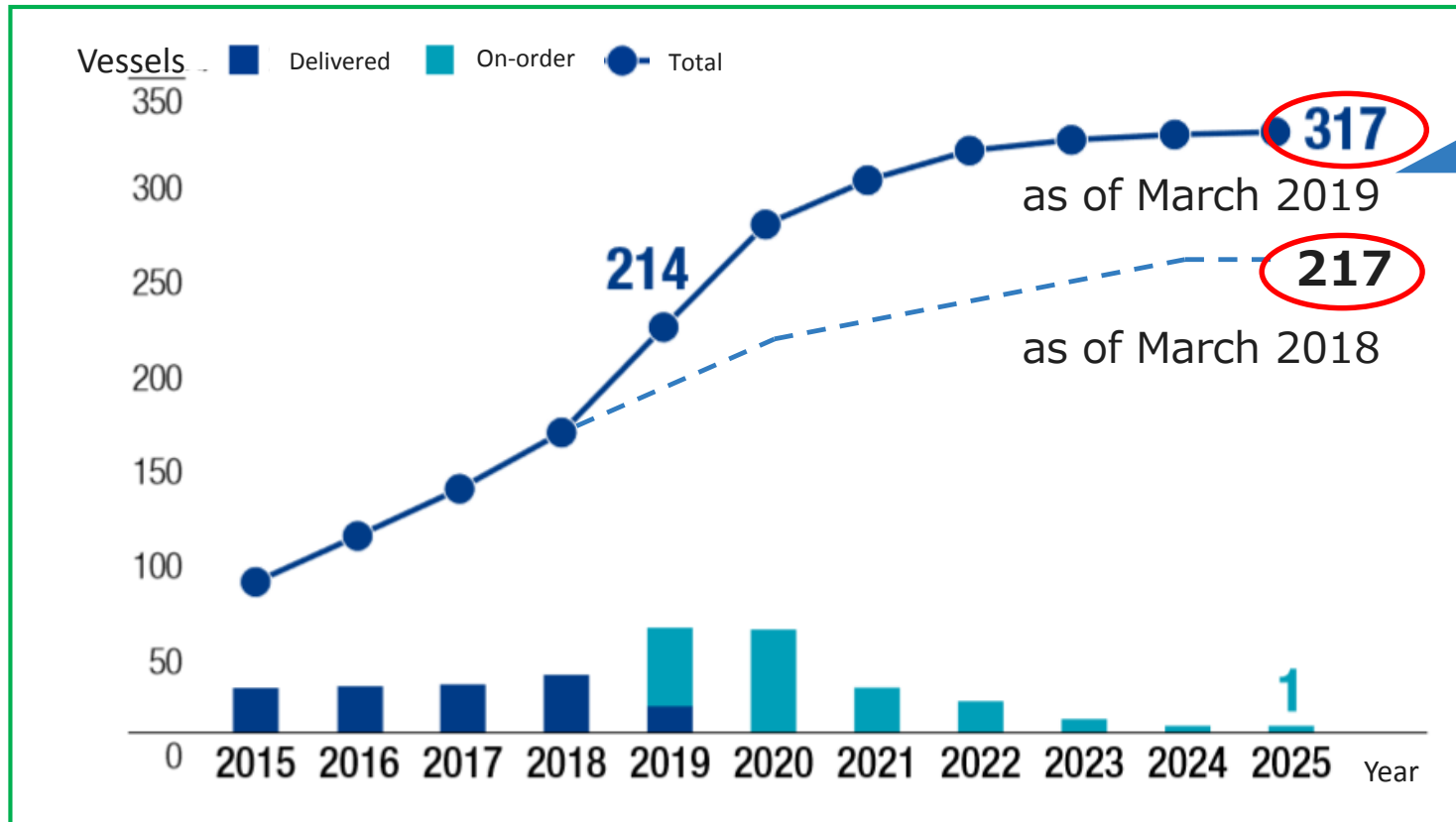
Under Construction – Total 16 vessels

Year	Vessel Name	Operator	Main Port	Tank (M3)
2020	Q-LNG 4000	Q-LNG / Shell	Elba-Florida	4,000
2020	TBN	TOTAL	*ARA	18,600
2020	TBN	Gazpromneft	Baltic Sea	5,800
2020	TBN	ENN	Zhoushan	8,500
2020	TBN	Central LNG	Nagoya, Japan	3,500
2020	TBN	Ecobunker	Yokohama, Japan	2,500
2020	TBN	Eesti Gas	Baltic Sea	6,000
2020	TBN	Petronas (from Avenir)	Pengerang	7,500
2020	TBN	FueLNG	Singapore	7,500
2021	TBN	Pavilion/TOTAL	Singapore	12,000
2021	TBN	Avenir LNG	Oristano	7,500
2021	TBN	CNOOC	China	6,000
2021	TBN	CNOOC	China	12,000
2021	TBN	TOTAL	Marseille	18,600
2021	TBN	Titan LNG	ARA	8,000
2022	TBN	Shell	Med Sea	18,000

LNG-fueled Vessels Delivered or On Order



100 new ships have been added over the 2018 year



Source: Japan Marine Science Inc.

+ 140 "LNG Ready" Ships (as of March 2019)

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Consumer: Buying fuel for more than 700 ships



Supplier: Developing LNG-fuel supply projects since Oct. 2011


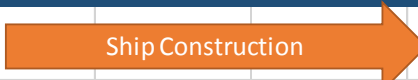



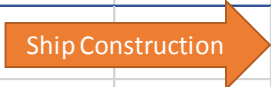





Pursuing LNG Fuel Supply is in line with NYK's Corporate Strategy:
Expanding new businesses and implementing Digitalization and Green Initiatives

LNG-Fuel Project Development Timetable

Two Regions are the Basis for the Next Step

- ✓ **North Europe:** Launched a project in Zeebrugge, Belgium together with Mitsubishi Corporation and Engie, capturing the demand in the market for LNG as a marine fuel
- ✓ **Japan:** The first LNG-fuel-supply project in Nagoya, starting operation in 2020

Area	Projects	2013	2014	2015	2016	2017	2018	2019	2020	2021
North Europe	Zeebrugge Project 									
			Established JV		UECC's Carriers delivered	Engine Zeebrugge delivered				Start LNG supply to Equinor
										
Japan	1. LNG Fueled Tug "Sakigake" 2. Nagoya Project									
				1. LNG Fueled Tug "Sakigake" delivered			2. Start New Project in Nagoya		Nagoya Project Start Operation	

World's 1st LNG-fueled Pure Car and Truck Carriers (PCTC)



- 1st Vessel Name: AUTO ECO
- 2nd Vessel Name: AUTO ENERGY
- Owner: United European Car Carriers
(Owned by Wallenius Lines and NYK)
- Delivery: 2016 from NACKS shipyard in China
- LNG Tank: 800m³ (Type-C)
- LOA: 181m
- Beam: 30m
- Depth: 30.22m
- Draft: 9.6m
- GRT: 42,424ton
- Car Capacity: 3,985 units



- United European Car Carriers (UECC), jointly owned by Wallenius Lines and NYK, has signed a contract to construct two new generation PCTC with China Ship Building Trading Co., Ltd and Jiangnan Shipyard Group Co. Ltd. The new building contract also has options for two additional vessels, and the first vessel is planned for delivery in 2021. (March, 2019)

- UECC goes for third battery hybrid LNG PCTC

Close on the heels of their call for two new battery hybrid LNG PCTCs, UECC has confirmed an option with China Ship Building Trading Co., Ltd and Jiangnan Shipyard Group Co. Ltd. for a third battery hybrid LNG vessel, this time slated for UECC's Atlantic short sea trade. (October, 2019)

LNG Bunkering Vessel - ENGIE ZEEBRUGGE



ENGIE ZEEBRUGGE is jointly owned by ENGIE, Mitsubishi Corporation, Fluxys and NYK. With an LNG capacity of 5,000 m³, she services all types of shipping customers in Northern Europe from her home port of Zeebrugge, under the brand **GAS4SEA**.

- **Delivery:** February 2017
- **Yard:** Hanjin Heavy Industries
- **Port of Registry:** Zeebrugge
- **Flag:** Belgium
- **Classification:** Bureau Veritas



Principal Particulars

Length o.a: 107.6 m
Breadth: 18.4 m
Draft: 4.7 m
Gross Ton: 7,403 ton

Main Propulsion

Engines: 2 x Wärtsilä 9L20DF
2 x controllable pitch propellers
2 bow thrusters

Cargo

2 IMO type C LNG tanks for a **total capacity of 5,100 m³**
LNG pumps : 2 per tank
Max. discharge rate : 600 m³/h





LNG Transfer System

- 2 sets of manifolds (midship and fore parts) with a L-V-L configuration to avoid crossing lines in any configuration
- 2 cargo hose handling cranes
- Flexible hoses : 6" liquid and vapor return lines, with ERC (Emergency Release Coupling) and QCDC (Quick Connect / Disconnect Couplings)
- Max bunkering rate is 600 m³/h, but it is highly dependent on the client vessel piping and conditions
- Redundancy of the pumps (2 per tank)

Zeebrugge Project

As of 2020: Start LNG Fuel Supply to Equinor Vessels

October 2017: Gas4Sea selected by Equinor for LNG bunkering in Rotterdam



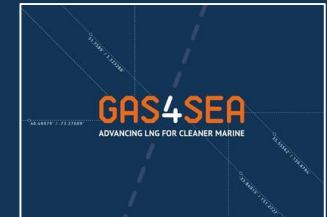
As of 2017: Start of ship-to-ship operations for UECC vessels in the port of Zeebrugge (Belgium)



February 2017: Delivery of LBV



September 2016: Launch of Gas4Sea Brand



June 2014: Order of first purpose-built, 5,000 cm capacity LNG bunkering vessel (LBV) from Hanjin Heavy Industries & Construction Co. Ltd. (Korea)



LBV under construction in HHIC (Korea)

2014: "Framework Agreement" between Engie, Mitsubishi Corporation, and NYK Line for LNG bunker supply business development



Japan's 1st LNG-fueled Tugboat "Sakigake"



The project is subsidized by the Japanese Government (*MLIT) and Class NK

- ▶ Built : 31st August 2015
- ▶ Yard : Keihin Dock K.K. (an affiliate company of NYK)
- ▶ Engine : Niigata Power Systems Dual Fuel engine
- ▶ Operator : Wing Maritime Service K.K. (an affiliate company of NYK)
- ▶ Operating Area : Yokohama, Kawasaki
- ▶ Bunkering Operation : Half-monthly, Truck to Ship

*MLIT: Ministry of Land, Infrastructure, Transport and Tourism



Nagoya Project – History



NYK and partner companies established Central LNG Marine Fuel Japan and Central LNG Shipping Japan in 2018.



Joint Study

26 Jan 2018

Commenced joint study of ship-to-ship bunkering biz in Chubu area of Japan

Foundation

10 May 2018

Founded two JVs, Central LNG Marine Fuel, Central LNG Shipping

Shipbuilding Contract

6 July 2018

JV signed a shipbuilding contract with Kawasaki Heavy Industry (“KHI”)

Business

**Commencement
Sep–Dec 2020**



Nagoya Project – LNG Bunkering Vessel

This LNG Bunkering Vessel, which is scheduled to be delivered around September to December 2020, will become the first to be operated in Japan.

- LOA: 81.7 m
- Beam: 18 m
- Depth: 7.8 m
- Draft: 4.8 m
- GT: 4,100
- Registration: Japan
- Tank Capacity: **3,500 m³**
- ME Power: 770 kw
- Transfer Rate: 500m³/h



Presented by Kawasaki Heavy Industries

Nagoya Project – Bunkering Image

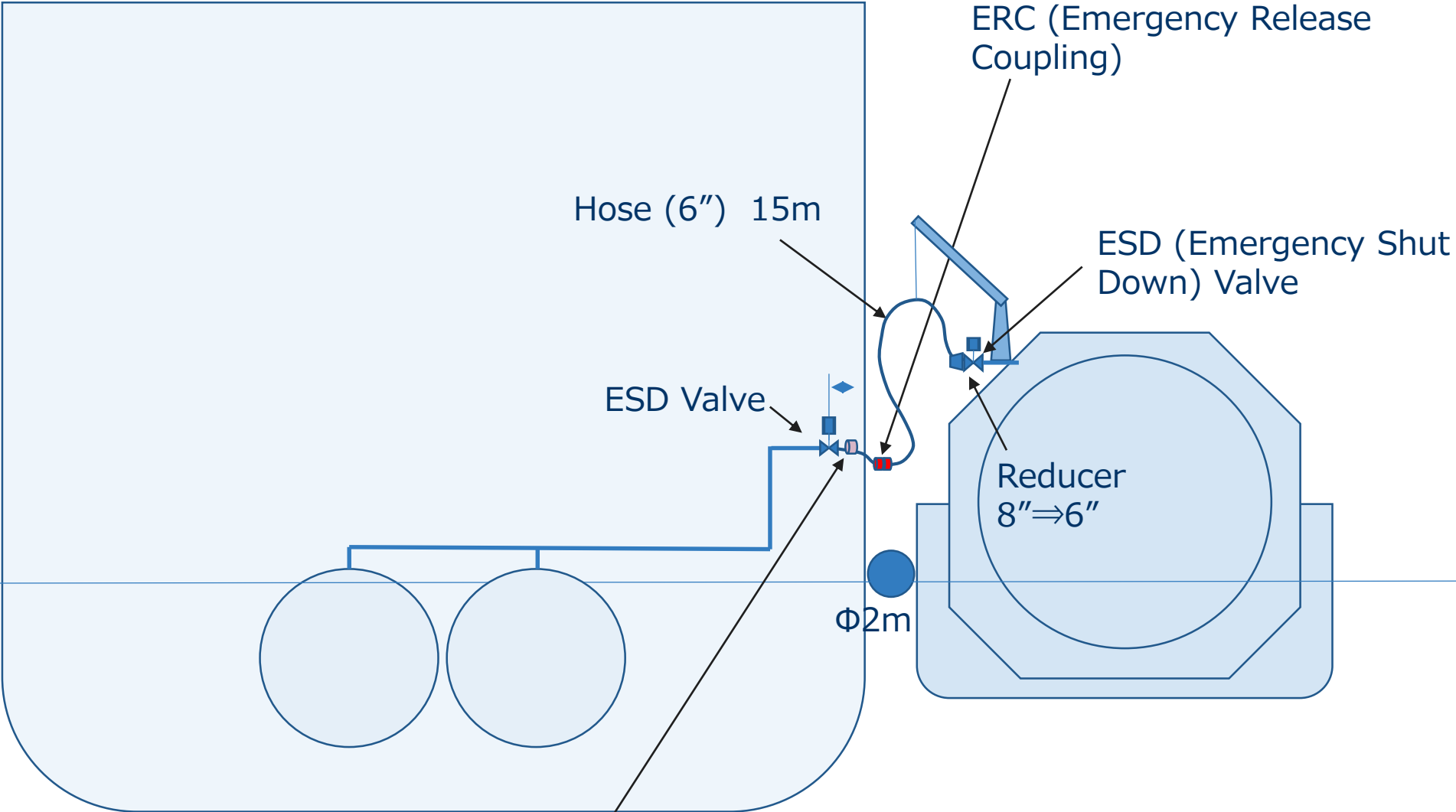


- ① LNG Loading at JERA Kawagoe Plant
- Takes around 7 hours including cool down

- ② Navigation from Kawagoe to client vessels
(④ From client vessels to Kawagoe)

- ③ Ship-to-ship bunkering during loading/discharging of client vessels

Nagoya Project – Bunkering Image



QCDC (Quick Connect / Disconnect Couplings)

NYK Places Order for World's Largest LNG-fueled PCTC

Sep. 24, 2019

[“NYK has placed an order for the world’s largest pure car and truck carrier \(PCTC\) capable of navigating oceans with only LNG as the main fuel. A keel laying ceremony was held on September 20 at Shin Kurushima Toyohashi Shipbuilding Co. Ltd. The ship is scheduled to be **delivered in 2020 and will be the first large LNG-fueled PCTC to be built in Japan.**](#)

To minimize a reduction in vehicle loading capacity caused by the installation of LNG fuel tanks, in addition to optimizing major items such as ship width, several designs for maximizing the cargo loading space will be implemented, and [the new vessel will be able to transport approximately 7,000 units](#) (standard vehicle equivalent) per voyage.



The First LNG-fueled Large Coal Carrier in the World



Kyuden signs agreements with NYK for the World's First LNG-fueled Large Coal Carrier

Dec. 25, 2019

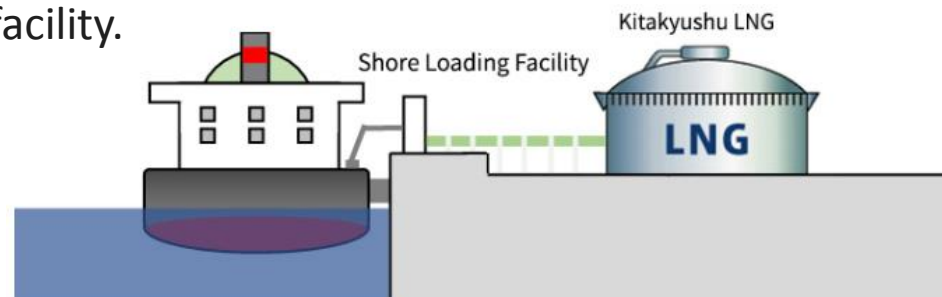
Kyushu Electric Power Co., Inc. ("Kyuden") has engaged in long term transport agreements by deploying [the world's first LNG-fueled large coal carriers with NYK](#) to import coal to Kyuden's coal-fired power plants

The LNG used for Kyuden's thermal power plants will be supplied to the vessels as fuel at Kyuden's loading facility, in other words on a shore-to-ship basis



<LNG fuel supply overview>

The LNG will be supplied using shore LNG loading facility.



Thank You!

Please send your inquiries about LNG Fuel to:

NYK Line

Green Business Group, Clean Fuel Business Team

Email: NYKJP.Green.Business-G.Clean.Fuel.Business-T@nykgroup.com