

LNG Fuelling

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Skangas completes first LNG fuel change at sea

Specialist LNG firm Skangas has completed the first synchronised cool down and bunkering operation to switch a vessel from diesel to LNG at sea, at Danafjord outside Gothenburg.

The complex procedure involved delivering 500 tonnes of LNG fuel from the supply vessel *Coralius* to the receiving vessel LEG/C *Navigator Aurora* in the middle of a voyage between Sweden and South Europe.

"The LNG cooling and bunker operation is a first for us and we spent lots of time in the planning and execution with all stakeholders to get it right. We are very happy with the result and hope to be able to use the experiences we have gained to support the industry also going forward" Tommy Hjälmås, director of Newbuilds and Special Projects at Navigator Gas, said.

To achieve this fuel switch, the receiving ship's fuel gas tanks were required to cool down from ambient conditions to minus 160 degrees, a process which can typically take a significant amount of time.

Aurora design speeds pre-cooling

To speed this process, the *Navigator Aurora*'s design allows for pre-



The *Coralius* bunkering LNG to *Aurora*

cooling of the tanks before LNG spray is introduced, reducing the cooling down period considerably and allowing the bunker operation to complete in less than 24 hours with the transfer of the main parcel taking just six hours.

"The *Navigator Aurora* is the world's largest type-c ethane/ethylene carrier and we just proved our ability to serve yet another shipping segment. We experience an increased interest from diversified ship owners to take LNG bunker directly from a bunker vessel. Due to this operation together with the team on *Navigator Aurora* we also gained

a lot of valuable experience," Gunnar Helmen, Sales Manager Marine in Skangas, said.

Ice Class 1A classified

The *Coralius* has capacity for 5,800 cubic meters of LNG and is owned by Dutch gas tanker line Anthony Veder, operated by Swedish fuel provider Sirius Rederi and was developed in partnership with Skangas and Sirius Shipping.

It operates in the southern Baltic and from the Kiel Canal in the German state of Schleswig-Holstein up to mid Norway, via the North Sea. Finnish/Swedish Ice Class 1A classification makes it equally capable of accessing the remote areas of Norway as the industrial heartlands of Northern Germany.

Skangas is a joint venture between Finnish natural energy gas expert Gasum (51%) and Norwegian electricity group Lyse Energi (49%). The firm is one of the largest LNG suppliers in the Nordic region and provides fuel for shipping, industrial and heavy-duty road transport needs.



The *Coralius* near the Swedish coast

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Shell to supply Siem Car Carriers with LNG

Energy major Shell has signed a long-term agreement with shipping line Siem Car Carriers to supply LNG for two newbuild vessels.

Under the terms of the deal Shell NA LNG and Shell Western LNG, subsidiaries of Royal Dutch Shell, will supply fuel for two new car carriers that are due to enter service in 2019.

"This agreement is an impor-

tant development for Shell's growing LNG fuels business. We are pleased to be working with SIEM Car Carriers to provide a cleaner burning fuel and look forward to future opportunities for collaboration," a Shell

spokesperson commented.

Once operational the vessels will be used to transport Volkswagen Group vehicles to North America from Europe.

Volkswagen mulls LNG switch

When they enter operation the new vessels will be amongst the first LNG-fuelled car carriers to travel intercontinentally and both Siem Car Carriers and its partner Volkswagen are keen to use them as a test-case for further adoption in LNG fuelling within its fleet.

"The possibility of changing other vehicle transport vessels chartered by Volkswagen over to

LNG operation will depend on the availability of the necessary infrastructure," Thomas Zernechel, head of Volkswagen Group logistics, said.

Siem builds on first mover status

Siem Car Carriers is a subsidiary of Cayman Islands-registered industrial company Siem which owns and operates a range of shipping and transportation businesses.

Siem's marine support vessel, the *Siem Thiima* recently became the first LNG-fuelled in the southern hemisphere will now assess the viability of further adoption of LNG-fuelling for its fleet. ■



Siem car carrier vessel

World's northernmost railway to run on LNG

Trains running on the Obskaya-Bovanenkovo railway in the Yamal Peninsula in Siberia, Russia are set to become some of the first to be powered by LNG.

The remote railway line is the world's most northerly and connects Russia's giant Yamal gas production facility to the rest of the continent. Operating in some of the most extreme conditions the locomotives on the track will face sub-zero temperatures and severe frosts.

The Obskaya-Bovanenkovo railroad is an important element in the implementation of the Yamal megaproject and is designed to provide year-round, fast, inexpensive and all-weather delivery of machinery, building materials and personnel to the Yamal fields.

Gazprom subsidiaries deepen collaboration

An agreement was signed between freight forwarding services provider OOO Gazpromtrans and Gazprom

Gas-Fuel Fuel, subsidiaries of energy firm Gazprom. The businesses will be jointly responsible for developing the LNG-fuelled transport link to the Yamal project.

"The document is aimed at using LNG as a motor fuel for rolling stock on the Obskaya-Bovanenkovo railroad and for power generation at infrastructure facilities of the road," a Gazprom spokesperson said.

Vyacheslav Tyurin, general director of OOO Gazpromtrans, and Mikhail Likhachev, general director of Gazprom Gas-Fuel Fuel, signed the deal at the 7th St. Petersburg International Gas Forum.

Facility planned near Obskaya station

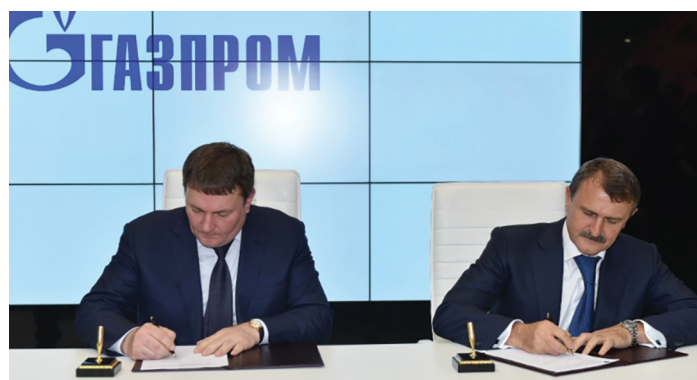
The Gazprom subsidiaries plan to create a complex for low-tonnage

LNG production in the vicinity of Obskaya station. This will include equipment for locating mobile gas filling stations, and servicing points of locomotives operated by Gazpromtrans at Obskaya, Razgad 15 and Karskaya stations.

"The production and sale of natural gas as motor fuel is the strategic direction of PJSC

Gazprom," the Gazprom spokesperson added.

The Obskaya-Bovanenkovo railroad measures 572 kilometres in length and runs from the station Obskaya to the Karskaya via five stations and 12 crossings. This route includes 70 bridges which have a total length of more than 12 kilometres. ■



Mikhail Likhachev and Vyacheslav Tyurin at the time of signing

LNG Fuelling

1st Floor, 30 Warner Street
London EC1R 5EX,
United Kingdom
www.lngjournal.com
Tel: +44 (0)20 7017 3404

Publisher

Stuart Fryer

Editor

Malcolm Ramsay
+44 (0)20 7017 3413
malcolm@lngjournal.com

Ad sales enquiries

Narges Jodeyri
+44 (0)207 017 3406
narges@lngjournal.com

Subscriptions

Elena Fuentres
Tel: +44 (0) 20 7253 2700
elena@lngjournal.com
Subscription included with LNG Journal

Production

Vivian Chee
Tel: +44 (0) 20 8995 5540
chee@btconnect.com

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Statoil selects Gas4Sea for bunkering

Maritime fuelling consortium Gas4Sea has been selected by Norwegian energy group Statoil as LNG marine fuel supplier at the port of Rotterdam, Netherlands.

The agreement will give Gas4Sea responsibility for refuelling four crude shuttle tankers that are due to come into service in early 2020. The vessels will be operated by Statoil in Northern European seas.

"Gas4Sea will supply LNG using the *Engie Zeebrugge* which started operations earlier this year," a spokesperson for Gas4Sea said.

The LNG bunker vessel *Engie Zeebrugge* completed its first re-fuelling procedure at the port at the start of this year and is one of the first such barges operating in the region. The barge is powered by dual-fuel engines that can run on either LNG, marine gas oil or marine diesel oil.

Bunkering designed for full range of shipping

Jointly-owned by Belgian gas transmission system operator Fluxys, French energy company Engie, engineering firm Mitsubishi, and shipping line NYK the *Zeebrugge* features capacity for 5,000 cubic metres of LNG and measures 108 metres in length and 18 metres in breadth.

"She is currently performing regular ship-to-ship LNG bunkering services in the port of Zeebrugge, in Belgium... [the vessel] is designed to serve a full range of shipping customers, in Zeebrugge as well as neighbouring ports," a spokesperson for Engie said.



The *Engie Zeebrugge*

The bunker barge operates from Fluxys' LNG terminal in Zeebrugge, where small carriers with capacities from 2,000 cubic metres upwards can dock at a recently commissioned second jetty. Ship management services for the *Engie Zeebrugge* are provided by NYK.

"The challenge in making LNG grow in the bunker market is to develop sufficient supply infrastructure to support the increasing number of LNG-fueled ships that are expected to come into operation. *Engie Zeebrugge*, in this respect, marks a milestone in the development of the European LNG bunkering chain," a spokesperson for Engie said.

LNG "most viable" option

Gas4Sea is a commercial brand

jointly launched by Engie, Mitsubishi Corporation and NYK in 2016 to develop the use of LNG as a sustainable, reliable, safe and cost-effective alternative to conventional oil-based marine fuels.

Since launching the consortium has expanded its international reach signing agreements with several major energy groups, including Malaysian state-owned firm Petronas.

"Gas4Sea is setting a new direction in the maritime sector by advancing LNG as a marine fuel via ship-to-ship transfer... LNG is now the most viable alternative fuel to drive emission reduction within the shipping sector," a Gas4Sea spokesperson said. ■

NEWS NUDGES

Cryonorm to deliver Liqvis LNG fuelling stations

LNG developer Cryonorm Systems has received an order from Liqvis Germany, a subsidiary of Uniper, to install two public LNG fuelling stations in Germany.

The agreement covers turnkey supply and installation of two public LNG fuelling stations that will include dual dispensers and will be capable of refuelling up to 100 vehicles per day.

"This is a milestone for both companies" Jos Glorie, business development director at Cryonorm Systems, said, adding that the new stations have been developed to meet customer requirements and all international standards as well as applicable local German regulations.

Both stations will be equipped with Cryonorm saturation on the fly units and data transfer modules based on GSM 3/4G Ethernet in order to access the control system from remote. They will be fully shop pre-fabricated and transportable.



Fluxys LNG terminal



LNG VALUE CHAIN SOLUTIONS

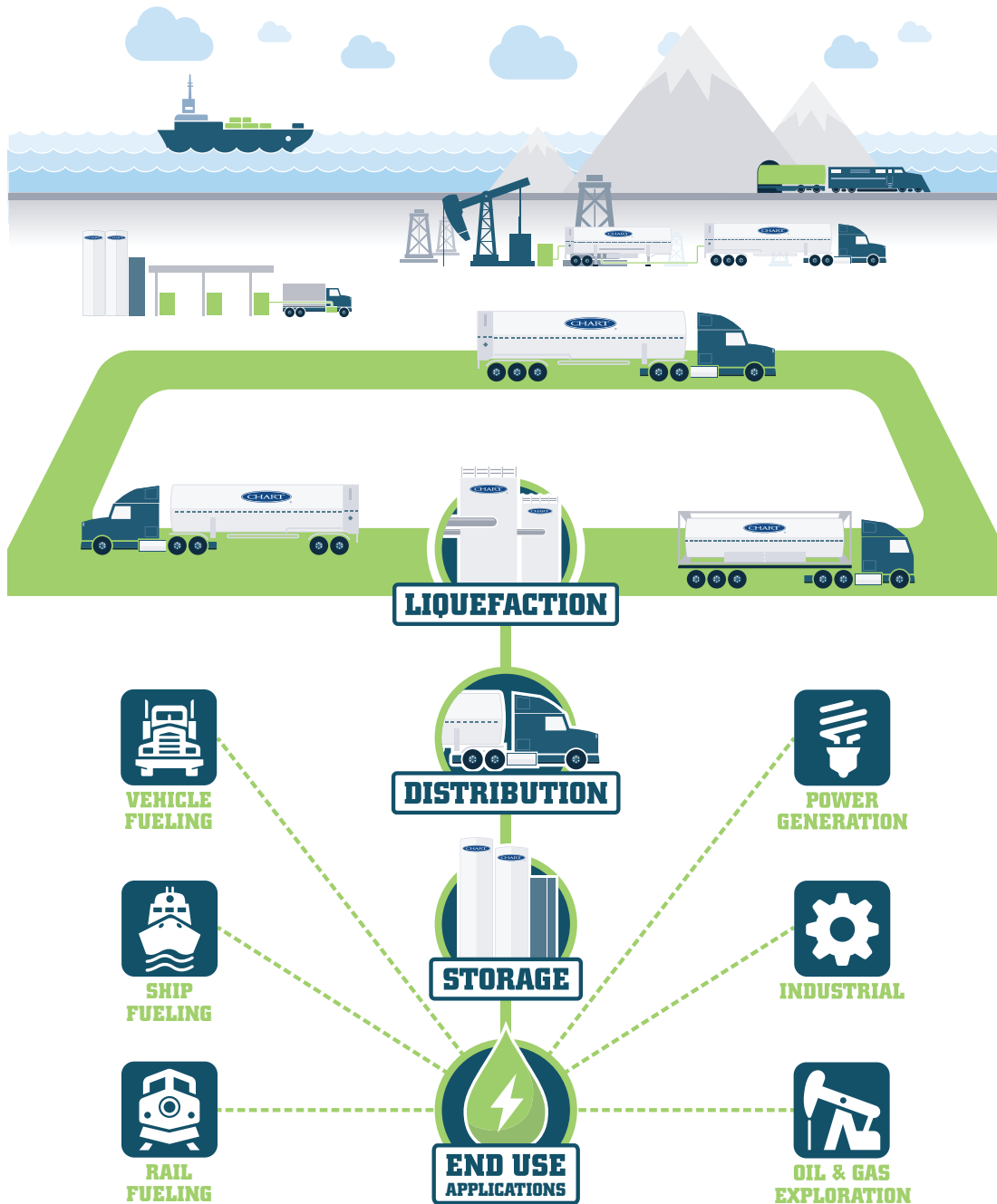


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Bakker Slidrecht to supply power packages for LNG-fuelled *Orion*

Engineering firm Bakker Slidrecht is to supply power packages for the world's first LNG-fuelled offshore installation vessel, *Orion*.

The multipurpose vessel will feature a Class 3 Dynamic Positioning (DP3) system and will be deployed by GeoSea, a subsidiary of dredging specialist DEME, for the installation of offshore windfarms, marine construction projects, oil and gas industry services and decommissioning of offshore installations.

"Our experience with Bakker Slidrecht, gained during earlier projects, and the experience of Bakker Slidrecht with delivering complex electrical systems for DP offshore installation vessels strengthens our confidence in a great project execution," Wouter Eyckmans, head of DEME's new-building and automation department, said.

Delivery scheduled for 2019

The *Orion* will be equipped with total installed electrical power of 44,180 kilowatts to drive a heavy-lift crane with lifting capacity of 3,000 tonnes at more than 50 metres. It is scheduled for delivery in 2019.

"The *Orion* will be equipped with the brand-new ABB ACS 880 liquid-cooled low voltage multidrive system. The new model of ABB has a very high power density, yielding a lot of power out of a small footprint," a spokesperson for Bakker Slidrecht said.

Finnish manufacturer Wärtsilä is to supply the dual-fuel LNG engines that will power the *Orion*. These include four 9-cylinder Wärtsilä



Artist's rendition of the OSV *Orion*

46DF dual-fuel electric propulsion engines, and two 6-cylinder Wärtsilä 20DF dual-fuel engines.

CSD order builds LNG portfolio

Earlier this year, Bakker Slidrecht was awarded a separate contract to supply similar electrical power systems for the world's first LNG-fuelled cutter suction dredger (CSD) vessel. The *Spartacus* is

under construction by shipbuilder Royal IHC and will also be delivered to DEME in 2019.

The *Spartacus* will likewise feature a 44,180 kilowatt power system for which Bakker Slidrecht will provide all engineering, delivery, and commissioning services. The vessel was designed in close cooperation with DEME, Vuyk Engineering Rotterdam, an IHC unit and IHC.

Wärtsilä combines LNG engines with battery technology

Finnish equipment manufacturer Wärtsilä has installed the world's first hybrid energy storage solution for an offshore vessel, combining a battery pack with LNG-fuelled engines.

The novel system replaces a traditional generator and was installed aboard the offshore supply vessel (OSV) *Viking Princess*. It allows the vessel to save up to up to 30% in fuel costs and reduce CO2 emissions by up to 13-18% per year.

"The Norwegian vessel is now the first ever offshore supply vessel in which batteries reduce the number of generators aboard the ship. The new energy storage solu-

tion will improve engine efficiency, generate fuel savings and reduce greenhouse gas emissions. *Viking Princess* completed sea trials and the system was handed over to customer Eidesvik Offshore on 9 October 2017," a spokesperson for Wärtsilä said.

Balancing demand peaks

Alongside a reduction in fuel required, the hybrid solution also

provides a more optimal load on the engines, improving durability and reducing the need for engine maintenance. The new energy storage solution provides balancing energy to cover the demand peaks.

The daily operation of the vessel will be managed with support from Wärtsilä's remote monitoring and operational advisory services to further ensure efficient and optimised operations.

"Eidesvik and Wärtsilä's partnership dates back to 2003 when our ship, the *Viking Energy* became the first offshore supply vessel powered by LNG fuel. Now, together, we are again introducing a world's first, with the *Viking Princess* becoming the first offshore vessel in which batteries reduce the number of generators aboard the ship. We are grateful to Wärtsilä for providing the technology to make this possible," Vermund Hjelland, President of

Technical Department at Eidesvik Offshore, said.

Wärtsilä backs small-scale LNG with RIC technology

Headquartered in Helsinki, Finland, Wärtsilä's core products include large combustion engines used in cruise ships and ferries and it is a leader in reciprocating internal combustion (IC) engines that can burn a variety of fuels, including natural gas.

"Wärtsilä's advantage lies at the most advanced level of integration related to hybrid technology for marine applications. It is a combination of expertise in both engines and electrical and automation systems, as well as digital solutions... The success of this project will impact the future of the entire shipping industry," Sindre Utne, Manager at Wärtsilä Norway, said.



The *Viking Princess*

Kosan Crisplant targets mobile LNG bunkering

Danish gas specialist Kosan Crisplant has announced a mobile LNG refuelling system designed to provide high-capacity bunkering on an ad hoc basis.

The system features a pumping capacity ranging from 40 to 210 cubic metres per hour and is based on a modular design allowing for unlimited scalability in principle.

Formed of two chassis, the system includes one forty-foot container, holding three racks in which a pump unit can be placed, and one twenty-foot container, which contains the automation, compressor and generator. Each pump unit can be connected to the tank trailer, allowing LNG to be pumped from up to six tank trailers simultaneously.

The system was first trialled in partnership with developers Q8 and Samsø Municipality who created the semi-mobile LNG bunkering system in Hou for Samsø Rederi's LNG-operated ferry Samsø.

"Two cryogenic tank trailers shuttle between Q8's LNG terminal in Rotterdam and the ferry port in Hou. Here, the trailers connect alternately to a twenty-foot container which holds the cryogenic pumps for the LNG. From here, the gas is transported in an insulated pipeline to the

"An LNG bunker barge may be introduced in one city, but it will take some time to get it to other ports as well. We would be able to bunker a large cruise ship there with just one day's notice"

- Lars Sall, Head of Group LNG at Kosan Crisplant

area with the control panel and the bunkering hose itself is connected to the ferry via an Emergency Shut-Down (EMS)," a spokesperson for Kosan Crisplant

Expedient for trans-European maritime infrastructure

Designed as a stop-gap measure until European LNG bunkering infrastructure further matures, the system is described by Kosan Crisplant as a parallel solution to serve "the constantly growing number of LNG-operated vessels."

"We believe that there will be room for both for a long period of time well into the future. The same spreading of LNG as the conventional bunker is not just around the corner. An LNG bunker barge may be introduced in one city, but it will take some time to get it to other ports as well. We

would be able to bunker a large cruise ship there with just one day's notice," Lars Sall, Head of Group LNG at Kosan Crisplant.

Triplet formation allows for scalability

The current system has capacity of up to 120 tonnes of LNG, based on six tank trailers, but if more than this quantity needs to be bunkered then the process is carried out with three tank trailers at a time. In this configuration each set of three is swapped once empty, allowing for continuous flow and thus a constant cooling down of the system as well.

Headquartered in Aarhus, Denmark, Kosan Crisplant is owned by Saudi industrial group Al-Ayuni Group for Investment & Construction and has a background in liquefied petroleum gas. The firm supplies and manufactures equip-

ment, plants and systems for filling and maintenance of gas cylinders and offers after-sales and engineering services, facility management, and supply of components for industry. ■

NEWS NUDGES

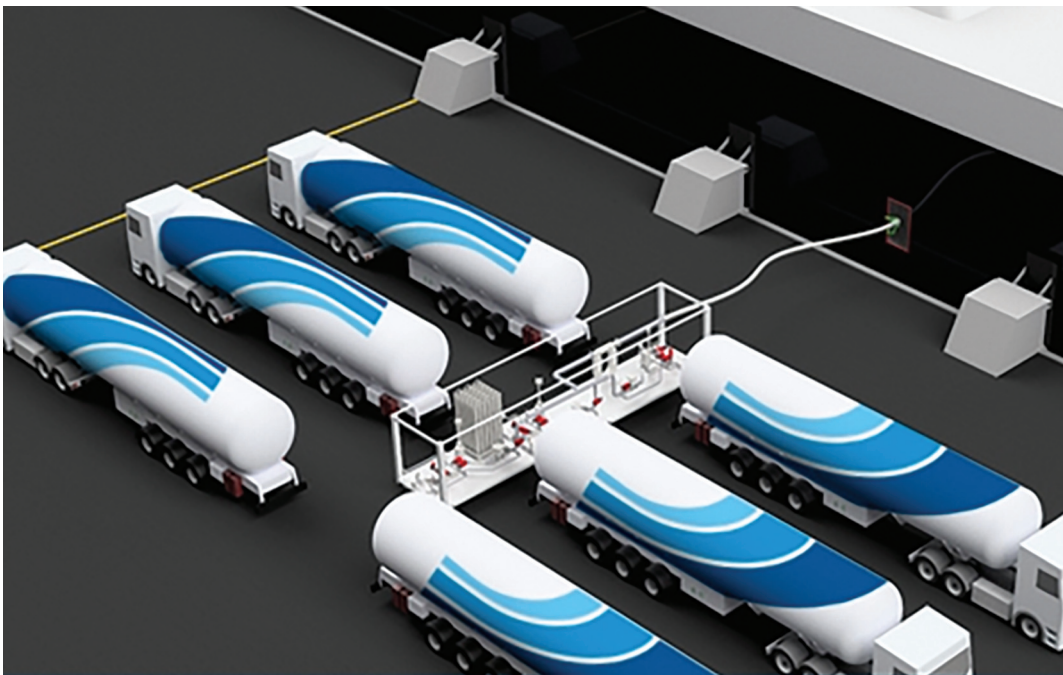
Rotterdam, Pitpoint Plan Dordrecht LNG bunkering

Authorities at the Port of Rotterdam are reportedly planning to develop a new multi-fuel bunker station at Dordrecht Inland Seaport.

The proposed facility would provide LNG, CNG, hydrogen, electricity and biodiesel, for ships, trucks and commercial vehicles and would be located on Duivelseiland, an island at the confluence of the Oude Maas, Dordtse Kil and Beneden Merwede in Dordrecht

"The realisation of a multifuel bunker station reflects the Port of Rotterdam's commitment to play a pioneering role, as the administrator of the biggest port in Europe, in energy transition within Europe. In this way, we will encourage the use of LNG as an alternative to fuel oil in shipping", believes Ronald Paul, COO for the Port of Rotterdam.

Gas infrastructure specialist Pitpoint.LNG has signed a letter of intent with the port and will now explore feasibility for the project.



Artist's rendition of Kosan Crisplant system

WORLD LNG-FUELLED CONFIRMED NEWBUILDS

Year	Type of Vessel	Owner	Class
2017	Car/passenger ferry	Society of Quebec ferries	LR
2017	Car/passenger ferry	Society of Quebec ferries	LR
2017	Tug	Drydocks World	
2017	PSV	Siem Offshore	DNV GL
2017	Gas carrier	Evergas	BV
2017	PSV	Siem Offshore	DNV GL
2017*	Ro-Ro	TOTE Shipholdings	ABS
2017	Car/passenger ferry	BC Ferries	LR
2017	Gas carrier	Ocean Yield	DNV GL
2017	Gas carrier	Ocean Yield	DNV GL
2017	Gas carrier	Ocean Yield	DNV GL
2017	Gas carrier	Navigator Gas	ABS
2017	Dredger	DEME	BV
2017	Dredger	DEME	BV
2017*	Container ship	Wessels Reederei	BV
2017	Hopper Barge	Bremenports	DNV GL
2017	HSLC	Fred. Olsen	DNV GL
2017	PSV	Harvey Gulf Int.	ABS
2017	PSV	Harvey Gulf Int.	ABS
2017	Cable layer	DEME Tideway	DNV GL
2017	Gas carrier	Evergas	BV
2017	Gas carrier	Evergas	BV
2017	Tug	Østensjø Rederi	
2017	Tug	Østensjø Rederi	
2017	Tug	Østensjø Rederi	
2017*	Car/passenger ferry	BC ferries	ABS
2017	RoPax	Rederi AB Gotland	DNV GL
2017	Car/passenger ferry	Caronte & Tourist	RINA
2017	Oil/chemical tanker	Groupe Desgagnés	BV
2017	Oil/chemical tanker	Groupe Desgagnés	BV
2017	Oil/chemical tanker	Groupe Desgagnés	BV
2017	Oil/chemical tanker	Groupe Desgagnés	BV
2017	Car/passenger ferry	BC Ferries	LR
2017	Oil/chemical tanker	Terntank	BV
2017	Container ship	Crowley Maritime Corp.	DNV GL
2017	Container ship	Crowley Maritime Corp.	DNV GL
2017	RoPax	Tallink	BV
2017	Container ship	Brodosplit	DNV GL
2018	Container ship	Brodosplit	DNV GL
2018	Bulk ship	ESL Shipping	DNV GL
2018	Bulk ship	ESL Shipping	DNV GL
2018	Tug	Keppel Smit Towage	ABS
2018	Tug	Maju Maritime	ABS
2018*	Car/passenger ferry	BC ferries	ABS
2018	PSV	Harvey Gulf Int.	ABS
2018	Container ship	Brodosplit	DNV GL
2018	Container ship	Brodosplit	DNV GL
2018	Car/passenger ferry	Royal Doeksen	LR
2018	Car/passenger ferry	Royal Doeksen	LR
2018	Car/passenger ferry	CHFS	LR
2018	Car/passenger ferry	CHFS	LR
2018*	Ro-Ro	TOTE Shipholdings	ABS
2018	RoPax	Rederi AB Gotland	DNV GL
2018	General cargo ship	Nordnorsk Shipping	DNV GL
2018	Container ship	Containerships	ABS

Year	Type of Vessel	Owner	Class
2018	Container ship	Containerships	ABS
2018	Container ship	GNS Shipping	ABS
2018	Container ship	GNS Shipping	ABS
2018	Container ship	GNS Shipping	ABS
2018	Container ship	GNS Shipping	ABS
2018	Heavy lift vessel	Heerema Offshore	LR
2018	Oil/chemical tanker	Furetank Rederi	BV
2018	Oil/chemical tanker	Furetank Rederi	BV
2018	Oil/chemical tanker	Furetank Rederi	BV
2018	Dredger	DEME	BV
2018	Bulk ship	POSCO	KR
2018	Dredger	van der Kamp	DNV GL
2018	Car/passenger ferry	Torghatten	
2018	Car/passenger ferry	Torghatten	
2018	Car/passenger ferry	Torghatten	
2018	Car/passenger ferry	Torghatten	
2019	Car/passenger ferry	Torghatten	
2019	Cruise ship	Carnival Corporation	RINA
2019	Cruise ship	Carnival Corporation	RINA
2019	Oil/chemical tanker	Älvtank	BV
2019	Oil/chemical tanker	Älvtank	BV
2019	Oil/chemical tanker	Thun Tankers	BV
2019	RoPax	Baleària	BV
2019	Car carrier	Siem Car Carriers	
2019	Car carrier	Siem Car Carriers	
2019	Emergency response ship	German Transport Ministry	
2019	Emergency response ship	German Transport Ministry	
2019	RoPax	Brittany Ferries	
2019	RoPax	Baleària	
2019	RoPax	Baleària	
2019	Oil/chemical tanker	Rosneft	
2020	Oil/chemical tanker	Rosneft	
2020	Oil/chemical tanker	Rosneft	
2020	Oil/chemical tanker	Rosneft	
2020	Research ship	German Transport Ministry	
2020	RoPax	Viking Line	
2020	Cruise ship	Carnival Corporation	RINA
2020	Cruise ship	Carnival Corporation	
2021	Cruise ship	Carnival Corporation	
2021	Cruise ship	Carnival Corporation	
2022	Cruise ship	Carnival Corporation	RINA
2022	Cruise ship	MSC Cruises	
2022	Cruise ship	RCCL	
2024	Cruise ship	MSC Cruises	
2024	Cruise ship	RCCL	

Excluding LNG carriers and inland waterway vessels. For more information please visit www.dnvgl.com

Data last updated : 15 February 2017

* = conversion projects

LNG-FUELLED SHIPS IN OPERATION WORLDWIDE

Year	Type of Vessel	Owner	Class
2000	Car/passenger ferry	Fjord1	DNV GL
2003	PSV	Simon Møkster	DNV GL
2003	PSV	Eidesvik	DNV GL
2006	Car/passenger ferry	Fjord1	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL
2008	PSV	Eidesvik Shipping	DNV GL
2009	PSV	Eidesvik Shipping	DNV GL
2009	Car/passenger ferry	Tide Sjø	DNV GL
2009	Car/passenger ferry	Tide Sjø	DNV GL
2009	Car/passenger ferry	Tide Sjø	DNV GL
2009	Patrol vessel	Remøy Management	DNV GL
2009	Car/passenger ferry	Fjord1	DNV GL
2010	Patrol vessel	Remøy Management	DNV GL
2010	Car/passenger ferry	Fjord1	DNV GL
2010	Patrol vessel	Remøy Management	DNV GL
2010	Car/passenger ferry	Fjord1	DNV GL
2010	Car/passenger ferry	Fjord1	DNV GL
2010	Car/passenger ferry	Fosen Namsos Sjø	DNV GL
2011	PSV	DOF	DNV GL
2011*	Oil/chemical tanker	Tarbit Shipping	DNV GL
2011	Car/passenger ferry	Fjord1	DNV GL
2011	PSV	Solstad Rederi	DNV GL
2012*	Car/passenger ferry	Fjord1	DNV GL
2012	PSV	Eidesvik	DNV GL
2012	PSV	Olympic Shipping	DNV GL
2012	PSV	Island Offshore	DNV GL
2012	General Cargo	Nordnorsk Shipping	DNV GL
2012	PSV	Eidesvik Shipping	DNV GL
2012	PSV	Island Offshore	DNV GL
2012	Car/passenger ferry	Torghatten Nord	DNV GL
2012	Car/passenger ferry	Torghatten Nord	DNV GL
2012	Car/passenger ferry	Torghatten Nord	DNV GL
2013	PSV	REM	DNV GL
2013	RoPax	Viking Line	LR
2013	Car/passenger ferry	Torghatten Nord	DNV GL
2013	Tug	Incheon Port Authority	KR
2013	General Cargo	Eidsvaag	DNV GL
2013	RoPax	Fjordline	DNV GL
2013	High speed RoPax	Buquebus	DNV GL
2013	Tug	CNOOC	CCS
2013	Tug	CNOOC	CCS
2013	Car/passenger ferry	Norled	DNV GL
2014	Car/passenger ferry	Norled	DNV GL
2014	Tug	Buksér & Berging	DNV GL
2014	RoPax	Fjordline	DNV GL
2014	Patrol vessel	Finish Border Guard	DNV GL
2014	Tug	Buksér & Berging	DNV GL
2014	Gas carrier	Anthony Veder	BV
2014	Gas carrier	Anthony Veder	BV
2014	PSV	Remøy Shipping	DNV GL
2014	General Cargo	Egil Ulvan Rederi	DNV GL
2014	General Cargo	Egil Ulvan Rederi	DNV GL
2014	PSV	Siem Offshore	DNV GL
2015	PSV	Harvey Gulf Int.	ABS
2015	Ro-Ro	Norlines	DNV GL
2015	Car/passenger ferry	Samsøe municipality	DNV GL
2015	PSV	Simon Møkster Shipping	DNV GL
2015	PSV	Siem Offshore	DNV GL
2015	Ro-Ro	Norlines	DNV GL
2015*	Oil/chemical tanker	Bergen Tankers	LR
2015	Car/passenger ferry	Society of Quebec ferries	LR

For more information please visit www.dnvgl.com

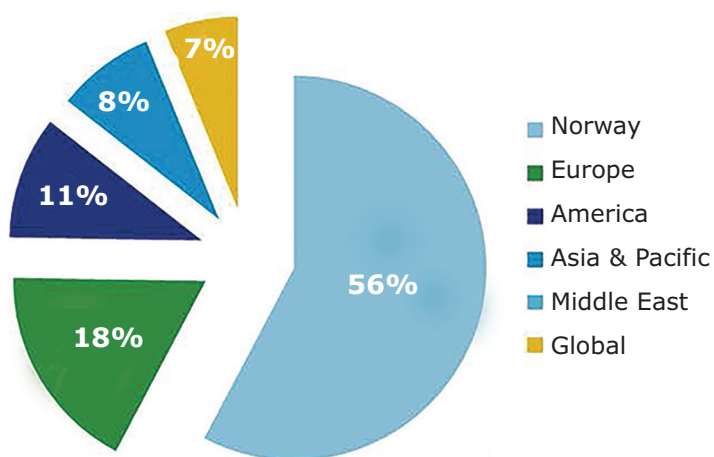
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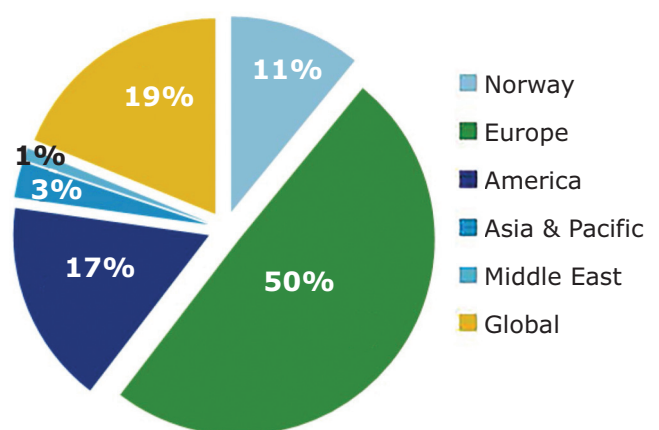
Year	Type of Vessel	Owner	Class
2015	Gas carrier	Evergas	BV
2015	Gas carrier	Evergas	BV
2015	Tug	CNOOC	CCS
2015*	Car/passenger ferry	AG Ems	DNV GL
2015	Tug	NYK	NK
2015	Gas carrier	Chemgas Shipping	BV
2015	Gas carrier	Evergas	BV
2015	PSV	Harvey Gulf Int.	ABS
2015	Container ship	TOTE Shipholdings	ABS
2015	Car/passenger ferry	AG EMS	DNV GL
2015	Bulk ship	Erik Thun	LR
2016	Container ship	TOTE Shipholdings	ABS
2016	Gas carrier	Evergas	BV
2016	PSV	Harvey Gulf Int.	ABS
2016	Bulk ship	Erik Thun	LR
2016	Oil/chemical tanker	Terntank	BV
2016	Gas carrier	Navigator Gas	ABS
2016*	Oil/chemical tanker	Furetank Rederi	BV
2016	Icebreaker	Arctica Shipping	LR
2016	Car/passenger ferry	Boreal Transport Nord	DNV GL
2016	Car/passenger ferry	Boreal Transport Nord	DNV GL
2016	Tug	CNOOC	CCS
2016	Gas carrier	Chemgas Shipping	BV
2016	Car carrier	UECC	LR
2016	Oil/chemical tanker	Terntank	BV
2016	Oil/chemical tanker	Terntank	BV
2016	Car/passenger ferry	BC Ferries	LR
2016	Gas carrier	Evergas	BV
2016	PSV	Siem Offshore	DNV GL
2016	Car/passenger ferry	Seaspan Ferries Corp.	BV
2016	Gas carrier	Navigator Gas	ABS
2016	Ro-Ro	Searoad Holdings	DNV GL
2016	Car carrier	UECC	LR
2017	Gas carrier	Navigator Gas	ABS
2017	Car/passenger ferry	Seaspan Ferries Corp.	BV
2017*	RoPax	Baleària	BV

AREA OF OPERATION OF LNG-FUELLED SHIPS

Operating area
ships in operation



Operating area
confirmed orderbook



Updated 15 February 2017
Excluding LNG carriers and inland waterway vessels

WORLD SMALL SCALE LNG FLEET*

Built	Name	CBM	Cargo Type	Trading area	Trading in LNG?	Ship Owner / Operator
1974	Seagas	187	LNG	Sweden	Yes	AGA
1988	Kayoh Maru	1,517	LNG	Japan	Yes	Daiichi
1993	Aman Bintulu / Lucia Ambition	18,928	LNG	Malaysia - Japan	Yes	Perbadanan/NYK
1996	Surya Aki	19,475	LNG	Indonesia - Japan	Yes	MCGC
1997	Aman Sendai	18,928	LNG	Malaysia - Japan	Yes	Perbadanan/NYK
1998	Aman Hakata	18,800	LNG	Malaysia - Japan	Yes	Perbadanan/NYK
2000	Tripura (ex Surya Satsuma)	23,096	LNG	Indonesia - Japan	Yes	MCGC
2003	Pioneer Knutsen	1,100	LNG	Norway	Yes	Knutsen
2003	Shinju Maru No.1	2,540	LNG	Japan	Yes	Shinwa
2005	North Pioneer	2,500	LNG	Japan	Yes	Japan Liquid Gas
2007	Sun Arrows	19,531	LNG	Malaysia - Russia - Japan	Yes	Mitsui
2008	Kakurei Maru	2,536	LNG	Japan	Yes	Hogaki Zosen
2008	Shinju Maru No.2	2,540	LNG	Japan	Yes	Shinwa
2009	Coral Methane	7,551	LNG/LPG/Ethylene	Northwest Europe/Baltics	Yes, sometimes	Anthony Veder
2010	Norgas Creation	10,000	LNG/LPG/Ethylene	Worldwide	No	Norgas Carriers
2010	Norgas Innovation	10,000	LNG/LPG/Ethylene	Worldwide	No	Norgas Carriers
2011	Akebono Maru	3,556	LNG	Japan	Yes	Chuo Kaiun
2011	Norgas Bahrain Vision	12,000	LNG/LPG/Ethylene	Worldwide	No	Norgas Carriers
2011	Norgas Conception	10,000	LNG/LPG/Ethylene	Worldwide	No	Norgas Carriers
2011	Norgas Invention	10,000	LNG/LPG/Ethylene	Worldwide	No	Norgas Carriers
2011	Norgas Unikum	12,000	LNG/LPG/Ethylene	Worldwide	No	Norgas Carriers
2012	Coral Energy	15,600	LNG	Northwest Europe/Baltics	Yes	Anthony Veder
2013	Coral Anthelia	6,500	LNG/Ethylene			Anthony Veder
2013	JX Energy TBN	2,500	LNG	Japan	Yes	JX Energy
2013	Kakuyu Maru	2,500	LNG	Japan	Yes	Tsurumi Sunmarine
2014	LNG-Oil combi**	2,000	LNG	Germany	Yes	Veka
2014	Short Sea LNG Tanker **	4,000	LNG	Germany	Yes	Veka
2015	10 small carriers TBN**	5,000	LNG			Bimantara Group
2015	Jahre TBN**	6,200	LNG	Norway	Yes	Donsotank/Jahre Marine
2015	JS Ineos Ingenuity	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2015	JS Ineos Insight	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2015	JS Ineos Intrepid	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2015	LNG Barge TBN	3,000	LNG	US Coast	Yes	LNG America
2015	LNG bunker barge 1†	2,250	LNG	China	Yes	Anhui Huaqiang Natural Gas
2015	LNG bunker barge 2†	2,250	LNG	China	Yes	Anhui Huaqiang Natural Gas
2015	LNG bunker barge 3†	2,250	LNG	China	Yes	Anhui Huaqiang Natural Gas
2015	LNG Inland bunker**	800	LNG	Germany	Yes	Veka
2015	Norgas TBN**	17,000	LNG/LPG/Ethylene	Worldwide		Norgas Carriers
2015	Norgas TBN**	17,000	LNG/LPG/Ethylene	Worldwide		Norgas Carriers
2015	PetroChina TBN	30,000	LNG	China		PetroChina
2015	TBN	14,000	LNG	China	Yes	Zhejiang Huaxiang
2015	TBN 1	27,500	LNG	China?		Danyang?
2015	TBN 2	27,500	LNG	China?		Danyang?
2015	TBN 3	27,500	LNG	China?		Danyang?
2016	Clean Jacksonville	2,200	LNG	US Coast	Yes	CME
2016	Dalian TBN	28,000	LNG	China	Yes	Dalian Inteh Group
2016	Hai Yang Shi You 301	30,000	LNG	Bali FSU	Yes	CETS (CNOOC)
2016	JS Ineos Indepence	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2016	JS Ineos Innvation	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2016	JS Ineos Inspiration	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2016	LNG Prime	2,250	LNG	Northwest Europe	Yes	Veka Deen LNG
2016	Navigator Aurora	35,000	Ethane/Ethylene	Markus Hood - Stenungsund	Ethane, for Borealis	Navigator
2016	Gaschem Beluga	36,000	Ethane/Ethylene	US - Teeside	Ethane, for Sabic	Gaschem Services
2016	Gaschem Orca	36,000	Ethane/Ethylene	US - Teeside	Ethane, for Sabic	Gaschem Services

For more information please visit <http://small-lng.com>

*Includes multi-gas, ethylene and LNG bunker ships with 40,000 cubic metres LNG cargo capacity or less

TBN = To Be Nominated indicates ships are still at construction/planning stage

** = project shelved † = Data to be verified Data last updated = 24th May 2017

Built	Name	CBM	Cargo Type	Trading area	Trading in LNG?	Ship Owner / Operator
2016	Ocean Yield TBN**	36,000	Ethane/Ethylene	US - Teeside	Ethane, for Sabic	Gaschem Services
2016	Shell Bunker Barge TBN 1	6,500	LNG	Northwest Europe	Yes	Shell
2016	Shell Bunker Barge TBN 2	6,500	LNG	Northwest Europe	Yes	Shell
2016	Shell Bunker Barge TBN 3	6,500	LNG	Northwest Europe	Yes	Shell
2016	Shell Bunker Barge TBN 4	3,000	LNG	Northwest Europe	Yes	Shell
2017	Yuan He 1	30,000	LNG	China	Yes	CSR
2017	ENGIE Zeebrugge	5,000	LNG	Northwest Europe	Yes	NYK
2017	CME TBN†	2,200	LNG	US Coast	Yes	CME
2017	CME TBN†	2,200	LNG	US Coast	Yes	CME
2017	Coral EnergICE	18,000	LNG	Northwest Europe/Baltics	Yes	Anthony Veder
2017	Coralus	5,800	LNG	Northwest Europe/Baltics	Yes, for Skangas	Anthony Veder
2017	JS Ineos Invention	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2017	JS Ineos Intuition	27,500	LNG/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2017	LNG-Gorskaya TBN	7,300	LNG	Russia	Yes	LNG-Gorskaya
2017	LNG-Gorskaya TBN	7,300	LNG	Russia	Yes	LNG-Gorskaya
2017	LNG-Gorskaya TBN	7,300	LNG	Russia	Yes	LNG-Gorskaya
2017	Navigator Eclipse	35,000	Ethane/Ethylene	US	Ethane	Navigator
2017	Navigator Nova	35,000	Ethane/Ethylene	US	Ethane	Navigator
2017	Navigator Prominence	35,000	Ethane/Ethylene	US	Ethane	Navigator
2018	Bernhard Schulte TBN	7,500	LNG	Baltic	Yes	Bernhard Schulte
2018	CME TBN†	2,200	LNG	US Coast	Yes	CME
2018	Evergas TBN	32,000	Ethane/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2018	Evergas TBN	32,000	Ethane/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2018	Evergas TBN	32,000	Ethane/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2018	Evergas TBN	32,000	Ethane/Ethylene	Markus Hook - Rafnes	Ethane, for Ineos	Evergas
2019	KLine TBN	7,500	LNG	Korea	Yes	Korea Line
2019	KLine TBN	7,500	LNG	Korea	Yes	Korea Line
2019	Stolt TBN	7,500	LNG	Mediterranean	Yes	Stolt-Nielsen Gas
2019	Stolt TBN	7,500	LNG	Mediterranean	Yes	Stolt-Nielsen Gas
2020	Stolt TBN (option)	7,500	LNG		Yes	Stolt-Nielsen Gas
2020	Stolt TBN (option)	7,500	LNG		Yes	Stolt-Nielsen Gas
2021	Stolt TBN (option)	7,500	LNG		Yes	Stolt-Nielsen Gas

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