Alternative Fuels and Marine Transportation





16th Biennial National Harbor Safety Committee Conference

September 2016



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Shipping is on the verge of a fueling transformation



CleanMarineEnergy

Building first fully integrated LNG supply facility in US

120,000 GPD liquefaction plant



- Plant sits on a 36 acre lot on St. John's River
- Up to 360,000 LNG gallons per day capacity
- 2 million gallons storage tank on site
- Built to FERC standard
- Project includes plant, storage, jetty and barge
- Plant operations will begin in 2018 (LNG currently supplied via truck)



2,200 cbm bunker barge

- "Clean Jacksonville" will be the first LNG bunker barge in North America
- Under construction at Conrad Shipyard
- Bristol Harbor desing and GTT membrane tank
- LOA: 222', Beam: 49', Draft: 8'
- Barge will transfer fuel at a rate 500 cbm /hour, total fueling time to TOTE is ~3 hours
- Barge is expected to be delivered in 2017



JAXLNG to supply TOTE Maritime in Jacksonville, FL

- JV between CME and Pivotal LNG
- First shoreside LNG plant dedicated to bunkering in North America
- First LNG bunker barge in North America (2,200 m3 capacity)
- TOTE Maritime as 'anchor tenant'





FIRST LNG Bunker Barge to Facilitate Initial Supply

• Bunkering services to TOTE's new 3,100 TEU Marlin-class LNG-fueled containerships





Best-in-class JAX LNG project consortium

CleanMarineEnergy Project Development	 Clean Marine Energy Established in 2012 HQ in South Norwalk, CT www.CleanMarineEnergy.com 	•	Affiliate of Mid Ocean Marine, 30 year US Jones Act ship owner Ordered the first North American LNG bunker barge, in operation Q3 16 Offer a proprietary Emissions Compliance Service Agreement (ECSA) to solve ship owner's capital dilemma of funding LNG conversion
Project Manager	 Northstar Midstream Established in 2008 HQ in Houston, TX www.NorthstarMidstream.com 	•	Flexible midstream crude and natural gas services for North America's rapidly developing shale plays, with an expertise in small-scale project execution. Portfolio company of Oaktree Capital
EPC Contractor	 Saulsbury Established in 1967 HQ in Houston, TX www.si-tx.com 	•	Saulsbury is a national leader in providing engineering, construction, fabrication and services to heavy industrial clients across a wide range of industries: Gas Processing & Treatment; Refining; Petroleum / Petrochemicals; Power (Fossil & Nuclear); Mining; Manufacturing; and, Terminals / Logistics. One of the preeminent records for incident-free operations in the construction industry
audubon Sub-contractor	 Audubon Companies Established in 1997 HQ in New Orleans, LA www.AudubonCompanies.com 	•	EPCM services for the oil & gas, petrochemical, refining, and power generation markets. With 10 offices and over 1,000 employees, the company offers a full-range of engineering, consulting, and field services to an extensive portfolio of clients across the globe.
Plant Manufacturer	 Cosmodyne Established in 1958 HQ in Murrieta, CA www.Cosmodyne.com 	•	Cryogenic plants including natural gas liquefiers (5,000 to 500,000 gallons per day). Cosmodyne has designed, manufactured and successfully commissioned 450+ plants in every climatic zone in the world.
Pivotal LNG [™] JV Owner / Plant Operator	 Pivotal LNG Established in 2006 HQ in Atlanta, GA www.PivotalLNG.com 	•	LNG supply services to companies and industries throughout the United States Wholly owned subsidiary of AGL Resources (NYSE: GAS) More than four decades of experience in LNG production, delivery and transportation
OAKTREE JV Owner / Capital Provider	 Oaktree Capital Established in 1997 HQ in Los Angeles, CA www.OaktreeCapital.com 	•	Private equity firm with \$97B assets under management and the largest single investor in shipping assets worldwide. Believes in the short window of opportunity to effectively put 'steel in the ground' to serve the future of marine fueling with LNG Other fund investments: Kinder Morgan, Ports America, and GWF Power



First LNG bunker barge in North America





GTT membrane technology

- Membrane systems proven across LNG carrier markets
- LNG carrier orders by containment type:

TANK TYPES	# on Order	# in Service*
MOSS	26	98
SPB	4	2
GTT MEMBRANE	107	297
KC-1	2	0

• In Service Fleet:









Barge to be delivered in 2017

- Hull is completed and Barge launched in February 2016
- Containment system installation in progressing well
- Equipment integration & piping to follow



Pictures : courtesy of CONRAD SHIPYARD



















































CME develops solutions in all links of the value chain



<u>Flexibility</u>: CME / Oaktree can participate in just one or all links of the value chain, including vessel financing, liquefaction, bunkering, etc.

<u>Partnership</u>: CME / Oaktree are very partnership oriented if there are other partners that offer solutions for any link in the value chain, to offer the absolute best solution to customers

Track Record: CME / Oaktree are the owners of the first fully-integrated LNG marine fueling facility in North America (liquefaction/bunkering/etc.), this experience provides significant learnings to be leveraged in new projects (USCG WSA, HazID, HazOp etc.)



New infrastructure requires large capital providers





CME finances LNG-fueled vessels, as well	Oaktree is the majority funder of CME
as develops, owns and operates LNG	developed projects and has allocated
infrastructure in select locations to serve	significant capital to the development of
major high horsepower transportation	LNG infrastructure for marine and
hubs, guaranteeing LNG supply	transportation purposes
 Founded in 2012, based in South Norwalk, CT Geographic emphasis on North America, focusing on sourcing demand ships with LNG fueling, by building LNG liquefaction facilities, storage and transportation First-mover in developing LNG distribution infrastructure, with the first LNG bunker barge in North America under construction Projects can be customized and located to meet specific customer requirements Capital investment and operational costs are paid through a mid- to long-term tolling arrangement 	 \$96 billion AUM private equity firm founded in 1995 based in Los Angeles, CA The largest single investor in shipping assets worldwide Believes in the short window of opportunity to effectively put 'steel in the ground' to serve the future of marine fueling and investing in the first phase of infrastructure projects Other well-known portfolio companies include Kinder Morgan, Ports America, and Southern Star Has committed \$300 million to fund CME developed projects



CME develops solutions in all links of the value chain







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Principle of "Path of Least Resistance"

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Principle of "Least Execution Risk"



Bunkering options

Image courtesy of DNV GL



Key to emerging market is using scalable solutions

- Currently bunkering TOTE's 3,100 TEU vessels with interim trucking solution until plant is operational
- Partnered with Applied CryoTechnologies (ACT) to build bunkering system with four-truck manifold





Main features of the 2,200 m3 bunker barge

- Based on conceptual design fully developed by GTT
- Single cargo tank of Mark III Flex technology with BOR 0.38%/day
- Equipped with the REACH4 Bunker Mast for safe, reliable LNG transfer
- Cold LNG delivery ensured by 6 Stirling StirLNG-4 cryocooler units
- Lightweight of ~1350 LT and achieves speed up to 8 knots
- Dimensions 232' L x 49' B x 16' D x (8.2' d)





Intermodal LNG bunker barge



Courtesy of Argent Marine



Anthony Veder 7,500 cbm Bunker/Feeder Design



- AV is a pioneer and market leader in offering small to midscale LNG shipping and bunkering solutions, with the leading track record in small-scale ship-to-ship transfers
- Bunker / Feeder vessel design
 - 7,500 cbm net cargo capacity
 - 15 knot design speed
 - High maneuverability
 - Can discharge up to 1200 cbm per hour
 - Dual fuel, highly fuel efficient, main propulsion and subsystems
 - BOG is used as fuel; low fuel consumption during service speed and low boil-offgas during port operations
 - Hose handling cranes and re-liquefaction plant to perform bunker operations serving a wide range of vessel types



Schulte 7,500 & 13,000 cbm Gas Supply Vessel (GSV)



- 7,500 cbm or 13,000 cbm net cargo capacity
- 12 knot design speed
- Shallow draft; 15 feet
- High maneuverability (bow thrusters and 360° azimuth drive propulsion)
- Can deliver 6.5 MW of 'cold ironing' electric power service
- Ice class bow design, can be fully ice classed
- Can discharge up to 1250 cbm per hour
- Can hold LNG without power for 40 days
- Dual fuel, highly fuel efficient, main propulsion and subsystems "zero emissions"
- BOG is stored in CNG tanks (not re liquefied), and used as fuel
- Ownership would be 33% CME, 33% Schulte. 33% Babcock LGE



Asset summary table – 40 designs

Vessel Size (cbm)	Count	Туре	Designer	Availability
1,000	1	River Barge	Jensen	24-30 months
1,515	1	River Barge	Resolve	18-24 months
1,800	1	River Barge	Argent	18-24 months
1,976	1	OSV	Bristol Harbor	18-24 months
2,200	1	Bunker Barge	GTT	8-30 months
2,272	1	Bunker Barge	Resolve	18-24 months
3,000	4	Bunker Barge/Vessel	Wartsila, Jensen, MES	24-30 months
3,030	1	Bunker Barge	Resolve	18-24 months
3,409	1	ISV	Argent	24 months
3,750	1	Bunker Vessel	Schulte	18-24 months
4,000	1	Bunker Barge	Jensen	24-30 months
4,200	1	Bunker Barge	GTT	24-30 months
5,000	1	Bunker Vessel	GTT	27-30 months
6,200	1	Bunker Vessel	Jahre	24-30 months
6,500	3	Bunker Vessel	Wartsila, Anthony Veder	16-30 months
7,500	5	Bunker Vessel	Wartsila, Schulte, MES, Kanfer	18-30 months
10,000	3	Feeder Vessel/ATB	GTT, Waller, Skaugen	27-30 months
12,000	2	Feeder Vessel	Wartsila, Skaugen	27-30 months
13,000	1	LNG Carrier	Schulte	18-24 months
20,000	1	LNG Carrier	Wartsila	27-30 months
26,230	1	FSRU	Exmar	12 months
28,000	1	LNG Carrier	Kanfer	24-30 months
30,000	4	LNG Carrier	Anthony Veder, Schulte, GTT, Waller	27-30 months
32,000	1	LNG Carrier	GTT	27-30 months
40,000	1	LNG Carrier	MES	27-30 months



1,000 – 2,000 cbm Inland River Barges

Assets for inland river to fuel river tugs in midstream operations

Owner / Designer Lead Time	Size (m3)	Туре	LOA Breadth Draft (m)	Speed (knots)
Jensen 24-30 months 	1,000	Inland River Barge	91, 30.5, 6	8
Resolve18-24 months	1,515	Inland River Barge	64, 15, 1.5	8
Argent18-24 months	1,800	Intermodal River Barge	56, 16, 2	8
M&O Shipdevmt18-24 months	1,870	LNG/MGO River Barge	110,13.5,	
Bristol Harbor18-24 months	1,976	OSV	91, 30.5, 6	13





2,000 – 5,000 cbm Bunker Barges

Local transportation, for harbors and rivers, typically pushed by harbor tugs

Owner / Designer Lead Time	Size (m3)	Туре	LOA Breadth Draft (m)	Speed (knots)
TOTE / GTTJul 2016 delivery	2,200	Bunker Barge	68, 15, 2.5	8
Resolve18-24 months	2,272	Bunker Barge	73, 22, 2	8
Wartsila 24-30 months 	3,000	Bunker Barge	87, 24, 2.8	8
Jensen 24-30 months 	3,000	Bunker Barge	80, 23, 2	8
Resolve18-24 months	3,030	Bunker Barge	91, 22, 2	8
Jensen 18-30 months 	4,000	АТВ	91, 18	8
GTT • 24–30 months	4,200	Bunker Barge	91, 19, 2.7	10





3,000 – 5,000 cbm Bunker Vessels

Self propelled vessel with faster steaming speeds for greater range

Owner / Designer Lead Time	Size (m3)	Туре	LOA Breadth Draft (m)	Speed (knots)
Bristol Harbor Group18-24 months	3,000	Offshore Supply Vessel*	80, 18, 4.5	12
Wartsila 27-30 months 	3,000	Bunker Vessel	85, 5, 4.5	12
Jensen 24-30 months 	3,000	Bunker Vessel	89, 18	12
MES • 24-30 months	3,000	Bunker Barge	91, 15, 6.5	14.2
Argent24 months	3,409	Intermodal Supply Vessel	116, 32.2	10
Schulte 18-24 months 	3,750	Bunker Vessel	84, 18, 5.5	12-15
GTT • 27-30 months	5,000	Bunker Vessel	105, 20, 6	13
Jahre 27-30 months	4,200	Bunker Vessel	93, 24, 7	12









5,000 – 10,000 cbm Bunker Vessels

Intermediate to long haul transits fueling vessels and offloading to shore facilities

Owner / Designer Lead Time	Size (m3)	Type Name	LOA Breadth Draft (m)	Speed (knots)
Wartsila 27-30 months 	6,500	Bunker Vessel	100, 19, 6	13
Anthony Veder27-30 months	6,500	Bunker Vessel	108, 22, 5.5	13.5-14
Anthony Veder • Q1 2017	6,500	Feeder Vessel Coral Anthelia	115, 16.8	15
Anthony Veder27-30 months	7,500	Bunker Vessel	100, 18, 5.7	13.5-14
Schulte 18-24 months 	7,500	Bunker Vessel	110, 18, 5.3	12-15
MES • 24-30 months	7,500	Bunker Vessel	118, 18.6, 6	13
Kanfer / LMG Marin24-30 months	7,500	АТВ	113, 19.6, 6.5	14.5
Kanfer24-30 months	7,500	FSRU	103, 20, 3.6	NA





10,000 – 15,000 cbm Feeder Vessels

Larger size for intermediate to long haul transits to shore facilities

Owner / Designer Lead Time	Size (m3)	Туре	LOA Breadth Draft (m)	Speed (knots)
GTT • 27-30 months	10,000	Feeder Vessel	68, 15, 2.5	8
Waller 18-24 months 	10,000	Feeder ATB	122, 22, 5	15
Skaugen 30 months 	10,000	Feeder Vessel	137, 20, 11.5	14
Wartsila 27-30 months 	12,000	Feeder Vessel	137, 22.5, 6.2	14.5
Skaugen 30 months 	12,000	Feeder Vessel	152, 20, 11.5	16
Schulte 18-24 months 	13,000	Feeder Vessel	120, 24, 5.5	12-15





15,000 – 40,000 cbm LNG Carriers

Mid size LNG carriers for long haul and export

Owner / Designer Lead Time	Size (m3)	Туре	LOA, Breadth, Draft (m)	Speed (knots)
Wartsila 27-30 months 	20,000	LNG Carrier	147, 25, 7.8	115
Exmar • Q4 2016	26,230	FSRU Barge	120, 33, 8	NA
Kanfer • 24-30 months	28,000	LNG Carrier	176, 28, 8	14
Anthony Veder27-30 months	30,000	LNG Carrier	145, 26, 6.9	15
Schulte 18-24 months 	30,000	LNG Carrier	187, 29, 6.5	15
GTT • 27-30 months	30,000	FSRU Barge	175, 30, 6	NA
Waller 18-24 months 	30,000	LNG Carrier	122, 22, 5	14
Deltamarin27-30 months	31,000	LNG Carrier	150, 21, 7	15
GTT • 27-30 months	32,000	LNG Carrier	176, 29, 7.5	16.5
MES • 27-30 months	40,000	LNG Carrier	190, 30, 8.5	16





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Port NY/NJ Emissions

Criteria Pollutant Emissions Summary by Source Category, Percentage

Source Category	Nox	PM10	PM2.5	VOC	CO	SO2
Ocean-Going Vessels	35%	50%	45%	33%	16%	100%
Cargo-Handling Equipment	18%	16%	17%	24%	25%	0.07%
Heavy-Duty Diesel Vehicles (Truck)	38%	28%	31%	35%	54%	0.14%
Railroad Locomotives	4%	2%	2%	5%	3%	0.08%
Harbor Craft	6%	4%	5%	4%	3%	0.10%
Total PANYNJ Emissions, Tons per year	7,096	501	441	433	1,632	1,735



Vessel type	50 Hz	60 Hz
Container vessel (< 140m)	63 %	37 %
Container vessel (> 140m)	6%	94 %
Container vessel (total)	26 %	74 %
RoRo / RoPax vessel	30 %	70 %
Oil and product tankers	20 %	80 %
Cruise Ships (< 200m)	36 %	64 %
Cruise Ships (> 200m)		100 %
Cruise Ships (total)	17 %	83 %

Source: Shore side electricity, A feasibility study and a technical solution for an on-shore electrical infrastructure to supply vessels with electric power while in port, Chalmers University





^{*}Federal Environment Agency - Energymix Germany











^{*} Federal Environment Agency - Energymix Germany

Data based on the electrical power !





2 x 40 ft. LNG Container Typ C, Capacity < 30 t







Shore Junction Box & Cable Channel





Cable Handling Units





Regulations

Rules

k

Bureau Veritas NR 557 High-Voltage Shore Connection System

IEC/ISO/IEEE 80005-1

Utility connections in port - Part 1 High Voltage Shore Connection (HVSC) Systems General requirements



1. MOVER BUTLET FACE DIRF NOT MENTING

P1 PROFILME I HARD FOR DRIVEN PROFILE

KEY.

C.4.1 System description





Figure C.4 - Shore power connector pin assignment

Figure C.1 - General system layout





Project start 02/2012 + + + Keel laying 01/2014 + + + Launching 09/2014 + + + Arrival Hamburg 10/2014



THANK YOU

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