New Americas era For LNG Fuel Vessels

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Vancouver, BC
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Agenda

What ?  The Opportunities
        Target Markets

Why ?  Compelling Economic Savings
        5 Drivers set Investment Clock

How ?  Integrated Gas Solutions
        LNG Availability

Conclusions  Recent Market Signals
             The Future Decade for Gas
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Transportation Fuels

[Pie chart showing fuel percentages:]
- 61.1% Gasoline
- 23.6% Diesel
- 3.3% Jet Fuel
- 11.7% Other
- 0.2% Natural Gas

Source: Wall Street Journal, Wednesday March 6, 2013 page B1

@ 0.2% ... Natural gas has most growth potential
Annual Fuel Use: Gasoline Gallon Equivalents

Scale thousands gallons… where’s marine?

Sources: Clean Energy, Annual Report 2011, and AARR adapted by JFH
Marine Market Development Target

Scalability

A large number of small lot consumers ...

Prefer a small number of large lot consumers
Harbor Tug

Annual 268,600 Gasoline Gallon Equivalent GGE
Annual 664,000 Gasoline Gallon Equivalent GGE
Offshore Supply

Annual 1,072,000 Gasoline Gallon Equivalent GGE
Mississippi Towboat

Annual 2,058,000 Gasoline Gallon Equivalent  GGE
Great Lakes Bulker

Annual 2,866,000 Gasoline Gallon Equivalent GGE
Coastal Cruise

Annual 6,801,000 Gasoline Gallon Equivalent  GGE
Container Ship

Annual 28,090,000 Gasoline Gallon Equivalent GGE
Annual Fuel Use: Gasoline Gallon Equivalents

Sources: Industry sources, adapted by JFH

Marine... scale millions... not thousands!
Annual Fuel Use: Gasoline Gallon Equivalents

- Locomotive
- Semi Truck
- Transit Bus
- Refuse Truck
- Shuttle Van
- Taxi
- Compact Car

Scale thousands gallons... where's marine?

Sources: Clean Energy, Annual Report 2011, and AARR adapted by JFH
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LNG provides compelling savings... Business Cases demonstrate Payback screen 2... 4+ years... Strong cash flows... Higher ROA, ROE
Natural Gas Henry Price Forecasts

EIA forecasts ... prices recede... = gas bargain ...
What’s Natural Gas?

Natural gas is a mixture of hydrocarbon gases associated with petroleum deposits, principally methane.

Methane has the highest hydrogen to carbon ratio = lowest CO2.

- Methane [CH₄]: 4:1 (400%)
- Ethane [C₂H₆]: 6:2 (300%)
- Propane [C₃H₈]: 8:3 (267%)
- Butane [C₄H₁₀]: 10:4 (250%)

MGO 1.86:1 (186%)
LNG provides significant emission reductions versus traditional diesel engines.
5 US Game Changers

US centuries shale gas supply

Emissions Control Area 2012

EPA Fuel Standards

<table>
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<tr>
<th>NOx gr/kW-hr</th>
<th>Less than 130 RPM</th>
<th>130–2,000 RPM</th>
<th>Over 2,000 RPM</th>
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<tbody>
<tr>
<td>Tier 1...</td>
<td>2004</td>
<td>17.0</td>
<td>45.0 (0.25)</td>
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5 gas drivers …shale supply + bargain prices + 3

EPA mandates = set Investment Clock
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LNGPac

A. Storage tanks
B. Evaporators
C. Dual-Fuel Main engine
D. Dual-Fuel Aux engines
E. Bunkering station(s)
F. Integrated control system

Wärtsila single source…complete engineered package solutions minimize installation and operational risk for assured performance
1. Collapse the gas pressure in the tank
2. Open the main filling line
3. Inert the piping with N₂ (NOT shown)
4. Close the filling line valves
1. Open pressure control valve
2. LNG flow by the hydrostatic pressure into the vaporizer
3. LNG is vaporized and gas is returned to the tank
1. The “stop valve” and “master valve are opened (double block valves with bleed in between)
2. LNG is forced by the tank pressure through the product evaporator and instantly evaporated. Gas flows to the GVU
3 LNG plants each at 250K tons/yr
Geismar, Jumping Pond, & Sarnia…Online 2015

Supply security and price stability = certainty
…certainty breeds investment
Geismar LNG Small Scale Facility

Gulf Coast Corridor

Unbottled natural gas (LNG) is an affordable, environmentally beneficial option to meet future energy demand and reduce emissions. This is why Shell is expanding its North American LNG trading network with the development of the Gulf Coast Corridor, supplied from a LNG production facility at our Geismar Chemical Plant in Louisiana. The project will include the commissioning of a condenser LNG production facility at the plant approximately 22 kilometres (14 miles) downstream from Baton Rouge, Louisiana. The facility will include LNG offloading facilities along the Mississippi River. The facility will also supply LNG fuel to long-haul transport trucks at truck stops along the Interstate Highway.
Sarnia LNG Small Scale Facility

Sarnia...Online 2015... LNG @ 250K tons/yr
Jumping Pound LNG Small Scale Facility

Jumping Pound...Online 2015... LNG @ 250K tons/yr
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- The Opportunities
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**How?**
- History Adoption
- Integrated Gas Solutions

**Conclusions**
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6500 HP Tugs

2 @ 6L34DF LNG engines

Mechanical Drive

Twin Z Props

LNG Fuel ~ 50 m3

2 LNG tugs ordered June 2012... to work LNG Terminal Guangdong Province... Delivery 1st tug August 2013
Wärtsilä's leadership in gas engine technology enhanced - more than 2000 engines sold and 7 million running hours accumulated

Wärtsilä Corporation, Press release, 12 November 2012 at 1 pm EET

Wärtsilä, the marine industry's leading solutions and services provider, has now sold more than 2000 of its gas fuelled engines, which together have accumulated more than 7 million operational running hours in both land-based and marine applications. These achievements emphasise the leading global position that Wärtsilä holds in both gas engine and dual-fuel (DF) engine technology.

25 Year Milestone with 2,000 gas Engines...

Millions Operating Hours...Tens Millions Horsepower

= proven gas technology & LNG system
Wärtsilä gets propulsion order for the first LNG powered ferry in North America

Wärtsilä Corporation, Press release, 3 December 2012 at 12 noon EET

Wärtsilä, the marine industry’s leading solutions and services provider, has been awarded the contract to supply the gas powered propulsion machinery and corresponding gas storage and handling systems for a new passenger ferry. The

Americas early adapter… CAPEX $180 Million + 2 options

First LNG fuel ferry for Americas

be used on routes crossing the St. Lawrence River. The Wärtsilä contract was signed in October, 2012. The Wärtsilä equipment is due to be delivered in the autumn 2013.
NASSCO, TOTE: Historic Deal to Build World's First LNG Powered Containership

Historic deal in U.S. Shipbuilding, Green Ship Technology

General Dynamics NASSCO finalized a contract with TOTE, Inc., for the design and construction of two 3,100 TEU LNG-powered containerships, setting a new benchmark in green ship technology. When completed the 764-ft.-long containerships are expected to be the largest ships of any type in the world primarily powered by liquefied natural gas (LNG).

Americas early adopter … CAPEX $380 Million + 3 Options
Harvey Gulf were 4 LNG fueled supply boats ... now 5...

CAPEX $290 Million + options
LNGpac Tanks
2 @ 200m³ each

Length: 214.0 m
Breadth: 31.8 m
Speed: 22 knots
Passengers: 2800
Cabins: 880
In service: 2013
Shipyard: STX Finland Oy
Ship Owner: Viking Line

Safe, Clean, LNG Cruise Ship ... CAPEX $320 Million
STQ orders 2 Dual Fuel LNG ferries at Davies... Joins earlier larger DF ferry ordered at Fincantieri ... #2, #3 LNG ferry for No Am.
Keeping Count?

THE NUMBERS

Over $1 Billion CAPEX

1st Week December + prior during 2012...
Americas marine segment committed to LNG fuel ...
the early adopters initiated a new gas ERA
Confirmation... poised for early transition to LNG fuel...

availability supply meets owner demand
Press Release

28 May 2013

Society for Gas as a Marine Fuel (SGMF)

Launched as new non-governmental organisation

"The new industry body is a major step forward in the enhancement of safety and best practices in the use of LNG as a ship fuel."

Following a decision to proceed by the Board of Directors of the Society of International Gas Tanker and Terminal Operators (SILTTO) at its spring meeting in Houston on 16 May, the Society for Gas as a Marine Fuel (SGMF) is to be established as a new non-governmental organisation (NGO).

17 May Houston... Wartsila introduced LNG early adopters as interested guests for pre-launch....largest SIGTTO meeting ever!
Wartsila LNG Training Fort Lauderdale

**LNG as Marine Fuel**
- New LNG training course

**Gas safety training**
- New Gas safety training course

**Engine training**
- Engine training course as with "normal" Ship power project
- New LNGPac course

**Target group:**
- Shipping company management
- Ship management
- Engine crew
- Deck crew
- Ship crew

LNG as Marine Fuel

LNGPac training
Land & Sea segments... hundreds installations...
CAPEX $30 Billion... it’s real & proven gas technology
**Drivers = Decade Shift to Gas**

**Mandated Emissions & Fuel Restrictions**

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<td>Global Fuel % Sulfur</td>
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**Paradigm shift to gas 1st on economics 2nd on emissions**

**Early adopters moving ahead... soon early followers!**

**Mid decade market tipping point**

Source: US EPA web sites, Hatley capture various sources
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