Potential Growth Markets for LNG – LNG for Transportation

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Americas VP Ship Power
Wartsila North America
19 April 2013
Agenda

What ?
- The Opportunities
- Target Markets

Why ?
- Compelling Economic Savings
- 5 Drivers set Investment Clock

How ?
- History Adoption
- Integrated Gas Solutions

Conclusions
- Recent Market Signals
- The Future Decade for Gas
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Transportation Fuels

- Natural Gas: 0.2%
- Jet Fuel: 3.3%
- Diesel: 11.7%
- Gasoline: 23.6%
- Other: 61.1%

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

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

Sources: Clean Energy, Annual Report 2011, and AARR adapted by JFH

Scale thousands gallons... where's marine?
a large number of small lot consumers ...

Prefer a small number of large lot consumers
Harbor Tug

Annual 268,600 Gasoline Gallon Equivalent GGE
Ferryboat

Annual 664,000 Gasoline Gallon Equivalent GGE
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
Annual 28,090,000 Gasoline Gallon Equivalent GGE
Annual Fuel Use: Gasoline Gallon Equivalents

- Container Ship
- Coastal Cruise
- Great Lakes Bulker
- Mississippi Towboat
- Offshore Supply
- Ferryboat
- Harbor Tug

Sources: Industry sources, adapted by JFH

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

Scale thousands gallons... where’s marine?
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LNG provides compelling savings...
Business Cases demonstrate
Payback screen 2... 4+ years...
Strong cash flows... Higher ROA, ROE
EIA forecasts ... prices recede... = gas bargain ...
LNG provides significant emission reductions versus traditional diesel engines.
5 US Game Changers

US centuries shale gas supply

Emissions Control Area 2012

EPA Engine Emissions

EPA Category 1,2 Engine Emission Standards

Natural Gas bargain

5 gas drivers ... shale supply + bargain prices + 3

EPA mandates = set Investment Clock

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History does not repeat itself, but it does rhyme.
US Railroad Substitution Steam to Diesel

Percent

100

80

60

40

20

0

1930 1940 1950 1960

Year

13 Year Adoption Rate

Sources: Cowles Foundation for Research in Economics, Yale, Intrafirm Rates of Diffusion of an Innovation, Mansfield, 24 May 1962:

Diesel 1944 @ 10%.... 1957 @ 90% dominant
Marine Substitution  Sail to Steam

Steam 1830 @ 10%... Why delay?

Sources: Challenging the S Curve: Patterns of Technological Substitution, Brice Dattee, Copenhagen, Denmark 18 June 2007
Clipper Ship Era  1840’s

Large Sails

Remarkable Speed  
( 18 mph )

Good Cargo Capacity

Smaller Crew  
( reduced cost )

Sail defensive performance  
... brief 3 decade surge
Marine Substitution: Sail to Steam

Sources: Challenging the S Curve: Patterns of Technological Substitution, Brice Dattee, Copenhagen, Denmark 18 June 2007

Steam 1830 @ 10% ... 1915 @ 90% dominant
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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 enjoys in dual-fuel (DF) engine technology.

DF technology can be used in all vessel types, and offers attractive benefits that help shipping companies in their cost-control efforts and efforts to reduce their carbon footprint. In addition, the technology can be used in existing ships. With fuel prices constantly on the rise, shipping companies are now looking at ways to reduce costs and operators think that gas is the way forward in this sense. Wärtsilä has been involved in the development of DF technology and continues to be a viable and attractive alternative to existing engine technology. These new achievements provide even more evidence of this.

More recently, Wärtsilä Ship Power's new gas engine for large container ships was launched in 2011. This engine is currently being prepared for first installation in an order at a prominent shipbuilder. Upon completion, the new engines will provide a total of 70,000 kW. This is expected to be the largest containership of its type to be powered with dual-fuel technology.

The high demand for DF engines is evident in the large number of orders received by Wärtsilä at the end of 2011. For example, Wärtsilä has received an order from five separate shipyards for engines for large container ships. The total power capacity of these orders is 150,000 kW. In addition, five large orders have been received for DF engines for landside applications.

Wärtsilä Oyj is a global technology company and the world’s leading solutions and services provider for the marine and land-based energy sectors. A pioneer in world-marine engine technology, Wärtsilä has developed a comprehensive line of marine engines and systems for ships of all types and sizes. Wärtsilä has also built a global network of expert service centres to ensure the most reliable operation of its products, and to offer a complete, value-added service to its customers.

The Baltic News Network

12 November 2012

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 ferry, gas (LNG), is being built by Fincantieri Cantieri Navali Italiani in Italy and will 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.

Americas early adapter… CAPEX $180 Million + 2 options
NASSCO, TOTE: Historic Deal to Build World's First LNG Powered Containership

(MarineLink.com) Tuesday, December 04, 2012

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

delivery to occur by the fourth quarter of 2015, the second ship will be delivered in the first quarter of 2016. The contract between NASSCO and TOTE Shipholdings, Inc., a subsidiary of TOTE, Inc., includes options for three additional ships.
Harvey Gulf were 4 LNG fueled supply boats ... now 5...

CAPEX $290 Million + options
Keeping Count?

THE NUMBERS

Over $1 Billion CAPEX
more than 50 Million GGE

1st Week December + prior during 2012…

Americas marine segment committed to LNG fuel …
the early adopters initiated a new gas ERA
THE UNIT EQUIVALENTS

Locomotive          313  
Semi Truck          2,315  
Transit Bus         2,772  
Refuse Truck        4,171  
Shuttle Van         6,173  
Taxi                9,260  
Compact Car         77,167
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
3 LNG plants each at 250K tons/yr
Geismar, Jumping Pond, & Sarnia...Online 2015

Supply security and price stability = certainty
...certainty breeds investment
Gas Engine References

**Power Plants**
- 52 sites
- 155+ engines
- Began 1997

**Merchant**
- LNGC
  - 92 Vessels
  - 370+ engines
  - Conversions

**Offshore**
- PSVs/FPSOs
  - 19 vessels
  - 93+ engines
  - Began 1994

**Cruise and Ferry**
- LNG ferries
  - 1+1 vessels
  - 8 engines
  - Began 2013

**Navy**
- Coastal Patrol
  - Coming...

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>
<td>4.50%</td>
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Geographic emissions bubble encapsulates US/Canada

Tight sulfur limits stress supply

After treatment burdens diesels

Source: US EPA web sites, Hatley capture various sources

Paradigm shift to gas 1st on economics 2nd on emissions

Early adopters moving ahead… soon early followers!

Mid decade market tipping point

03 May 2013
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