


Potential Growth Markets for LNG – LNG for Transportation

John Hatley PE
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

WÄRTSILÄ

Agenda

What ?

The Opportunities

Target Markets

Why ?

Compelling Economic Savings

5 Drivers set Investment Clock

How ?

History Adoption

Integrated Gas Solutions

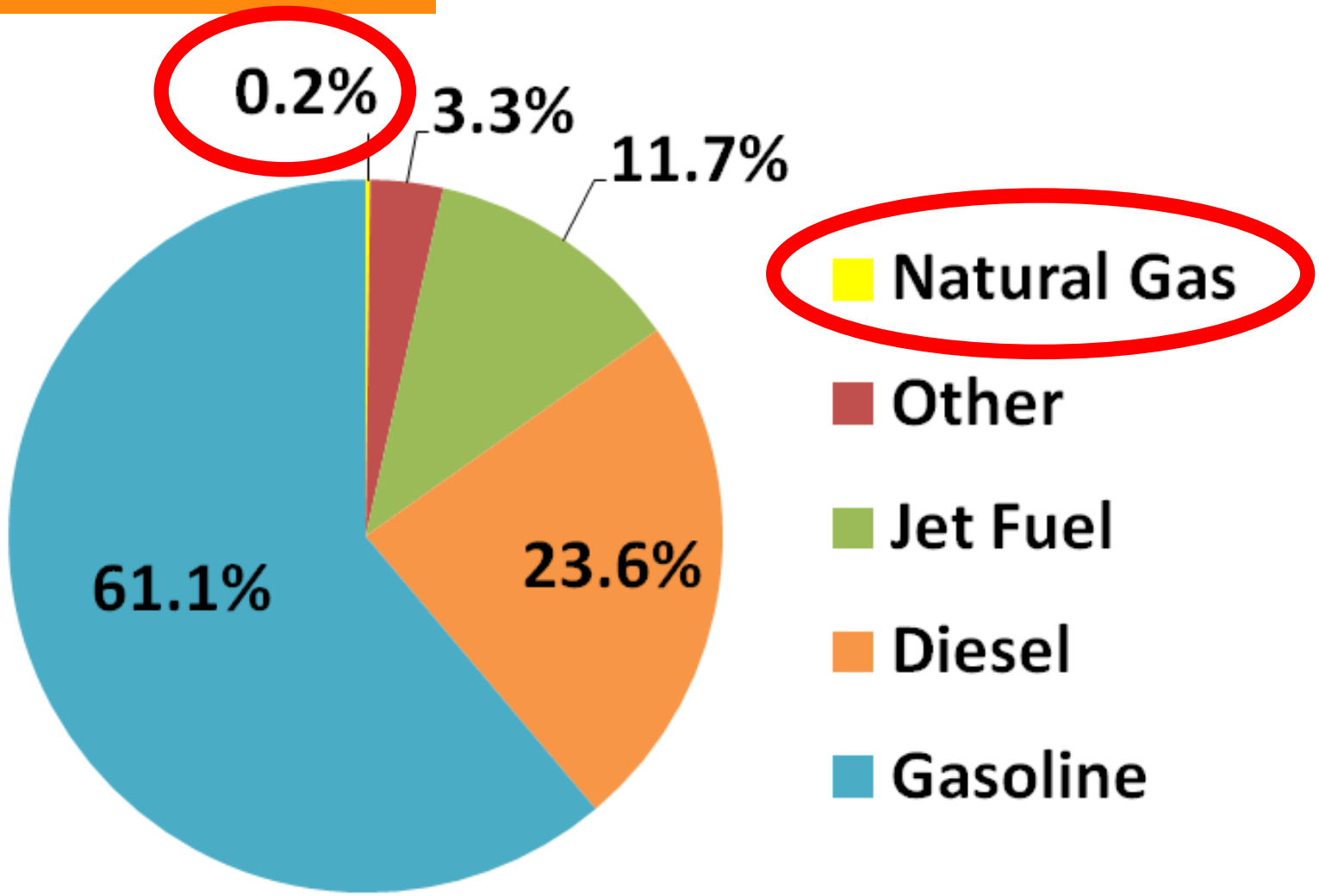
Conclusions

Recent Market Signals

The Future Decade for Gas

WÄRTSILÄ

Transportation Fuels

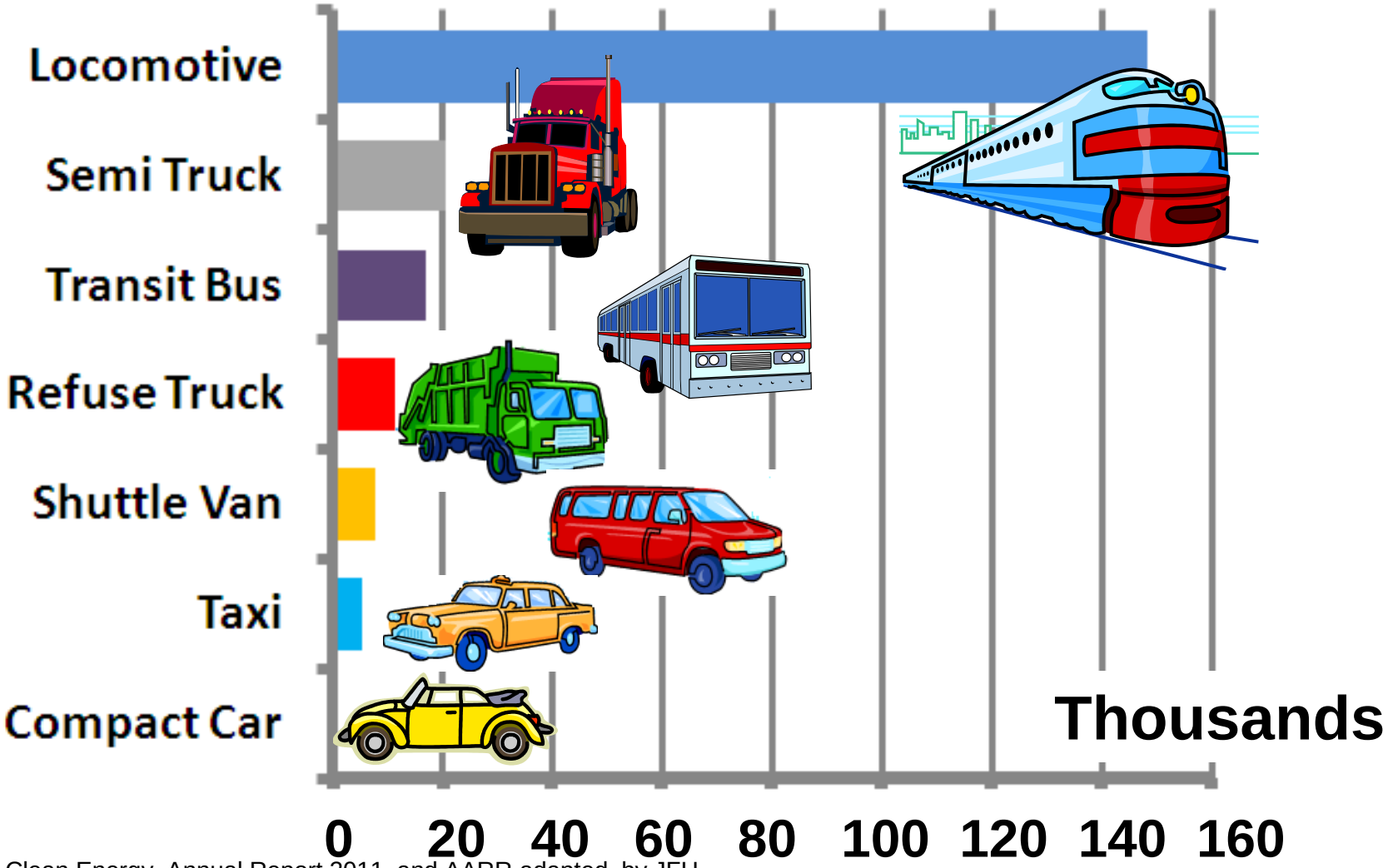


Source: Wall Street Journal, Wednesday March 6, 2013 page B1

@ 0.2% …Natural gas has most growth potential

WÄRTSILÄ

Annual Fuel Use : Gasoline Gallon Equivalents



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

Scale thousands gallons… where's marine?

New Market Development Target

Scalability

a large number of small lot consumers ...

Prefer a small number of large lot consumers

WÄRTSILÄ

Harbor Tug

Annual 268,600
Gasoline Gallon Equivalent GGE

WÄRTSILÄ

Ferryboat

Annual 664,000
Gasoline Gallon Equivalent GGE

Offshore Supply

Annual 1,072,000
Gasoline Gallon Equivalent GGE

WÄRTSILÄ

Mississippi Towboat

Annual 2,058,000
Gasoline Gallon Equivalent GGE

WÄRTSILÄ

Great Lakes Bulker

Annual 2,866,000
Gasoline Gallon Equivalent GGE

WÄRTSILÄ

Coastal Cruise

Annual 6,801,000
Gasoline Gallon Equivalent GGE

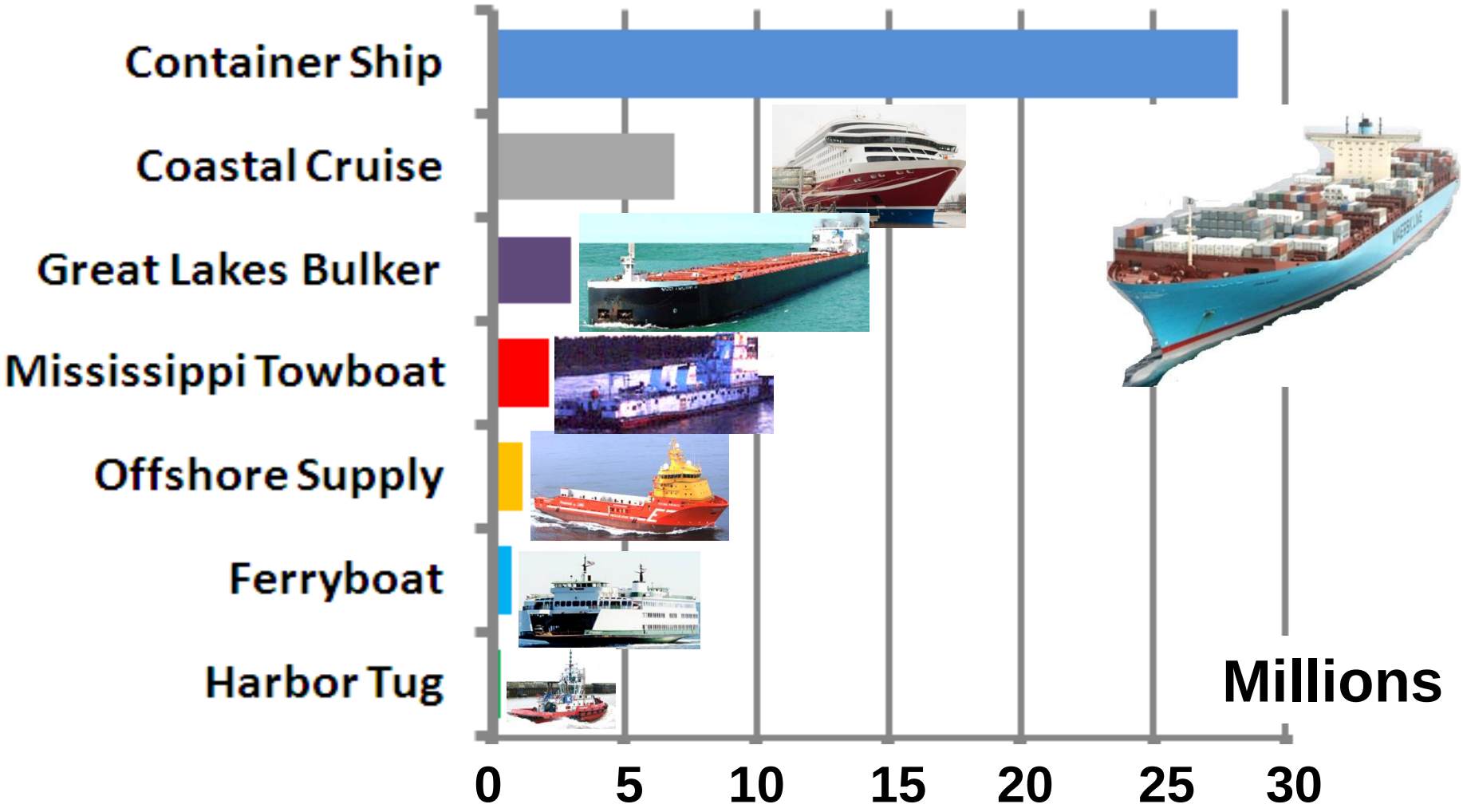
WÄRTSILÄ

Container Ship

Annual 28,090,000
Gasoline Gallon Equivalent GGE

WÄRTSILÄ

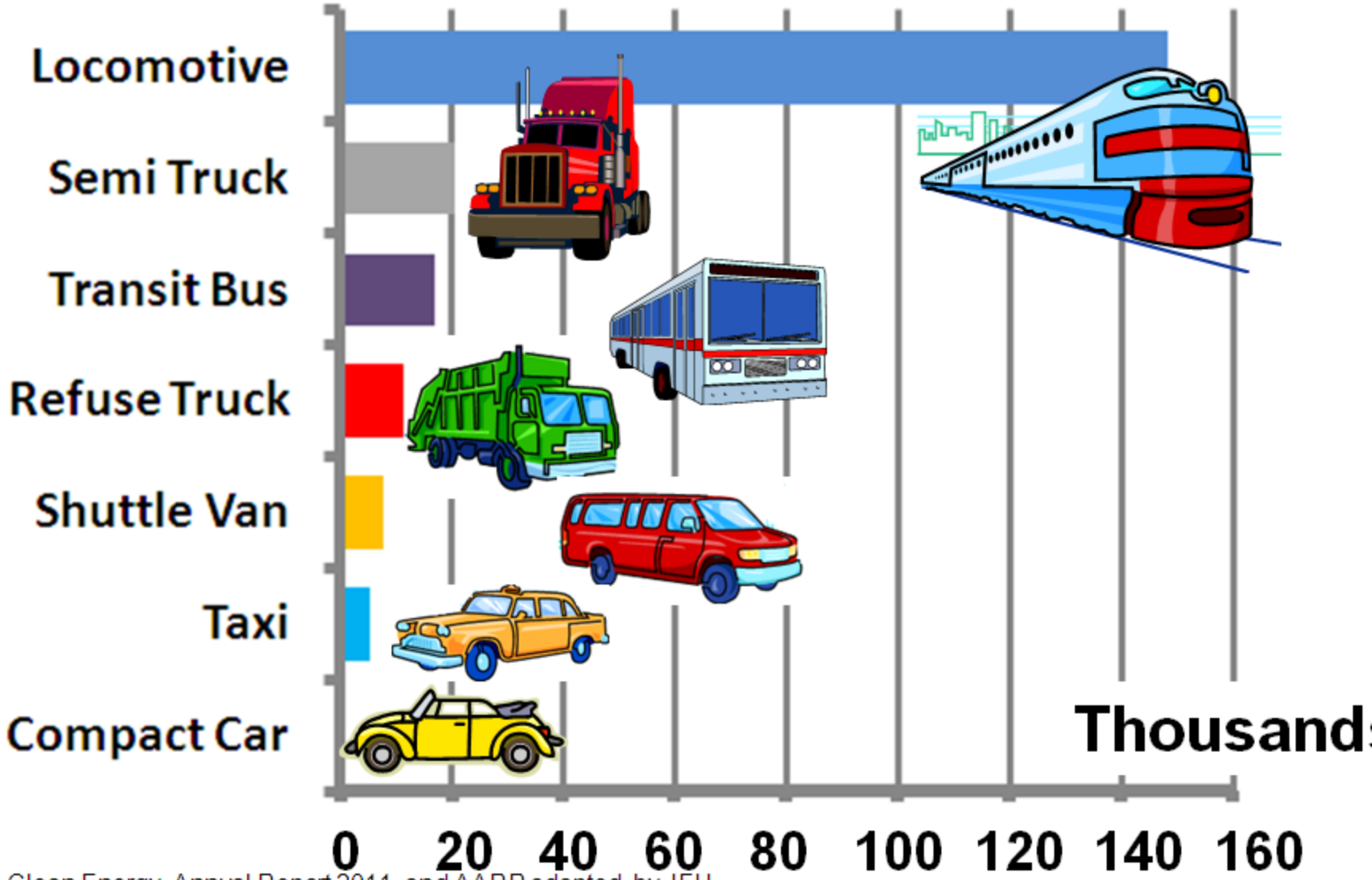
Annual Fuel Use : Gasoline Gallon Equivalents



Sources: Industry sources, adapted by JFH

Marine… scale millions… not thousands !

Annual Fuel Use : Gasoline Gallon Equivalents



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

Scale thousands gallons… where's marine?

Agenda

What ?

The Opportunities

Target Markets

Why ?

Compelling Economic Savings

5 Drivers set Investment Clock

How ?

History Adoption

Integrated Gas Solutions

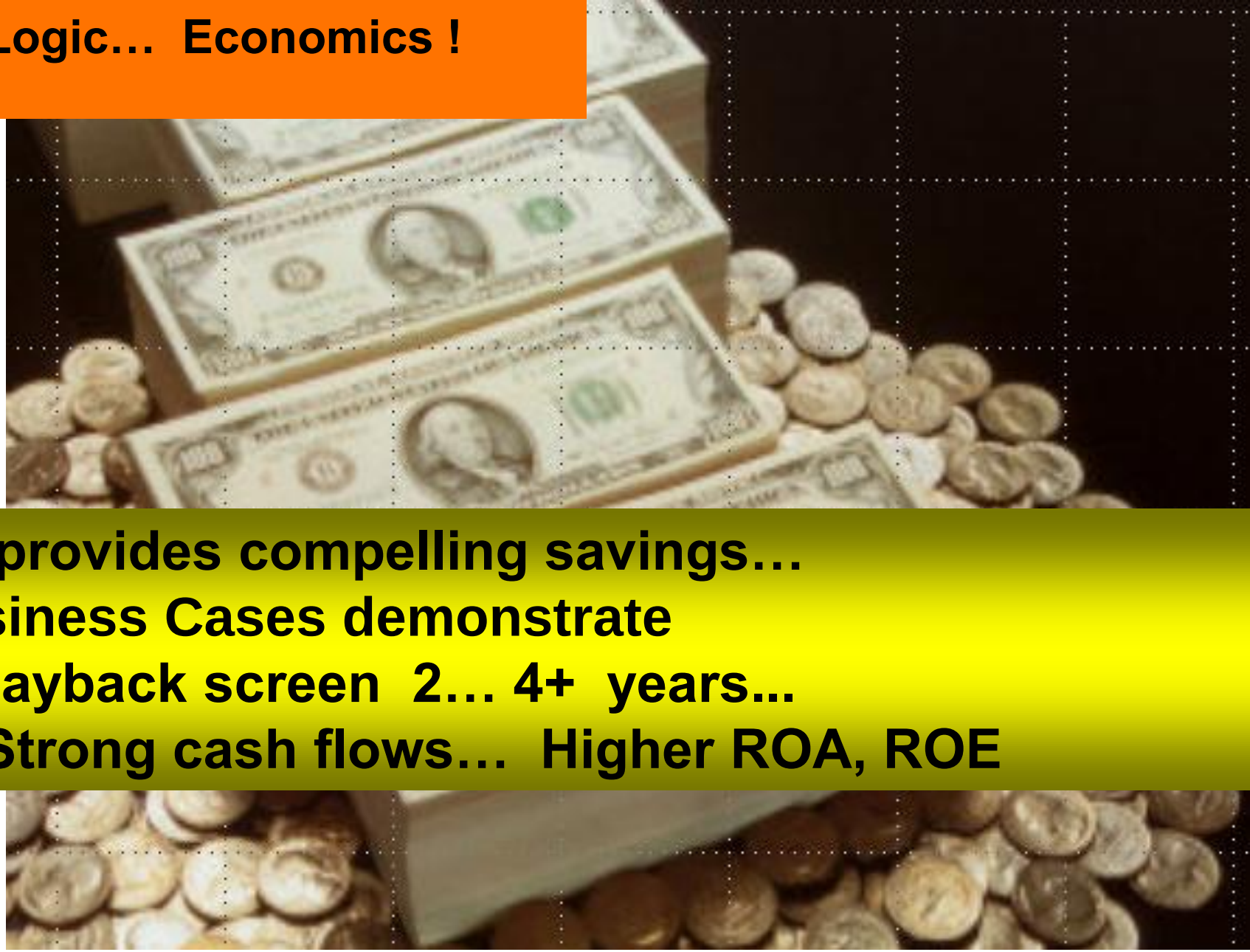
Conclusions

Recent Market Signals

The Future Decade for Gas

WÄRTSILÄ

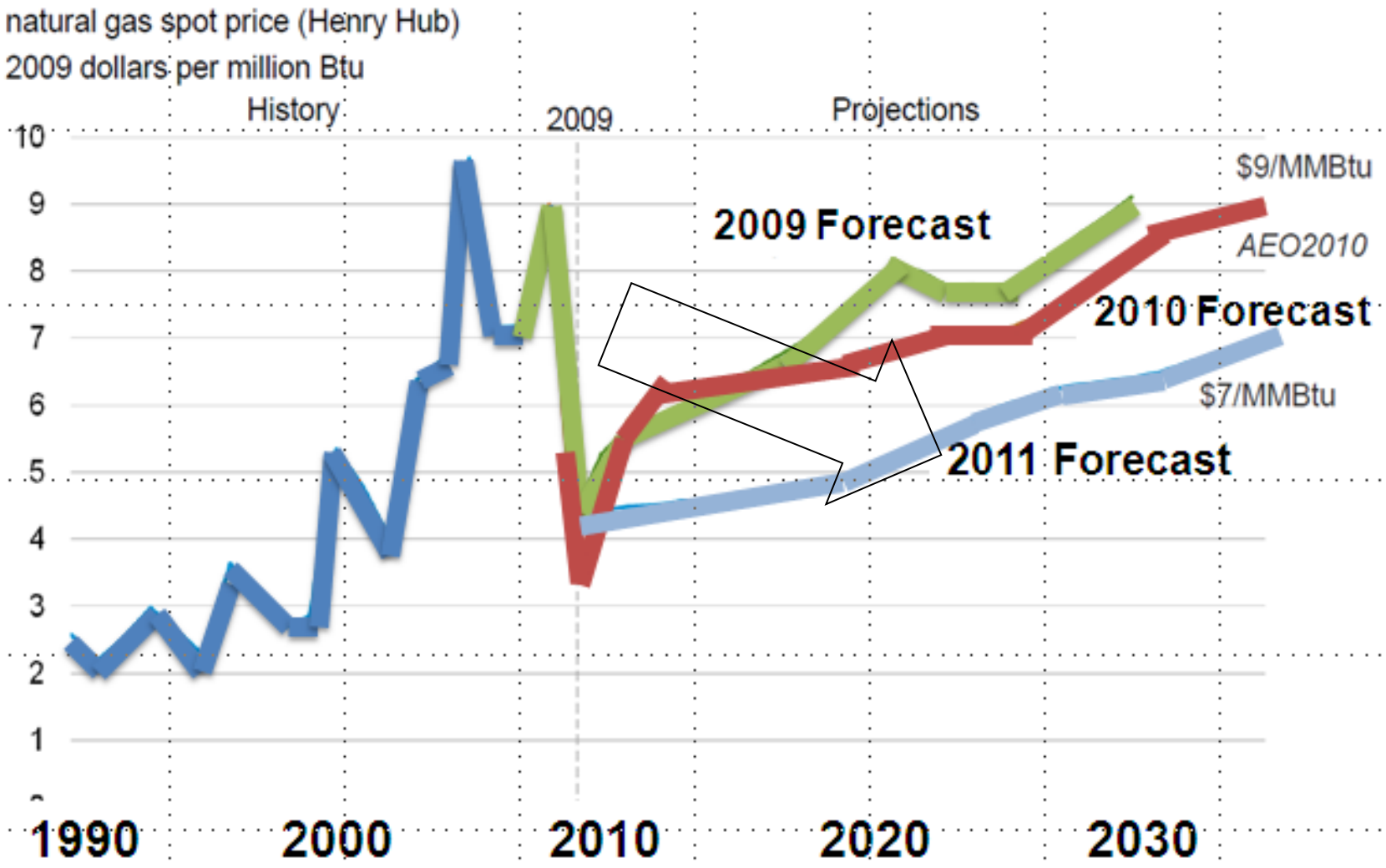
LNG Logic… Economics !



LNG provides compelling savings…
Business Cases demonstrate
Payback screen 2… 4+ years...
Strong cash flows… Higher ROA, ROE

WÄRTSILÄ

Natural Gas Henry Price Forecasts

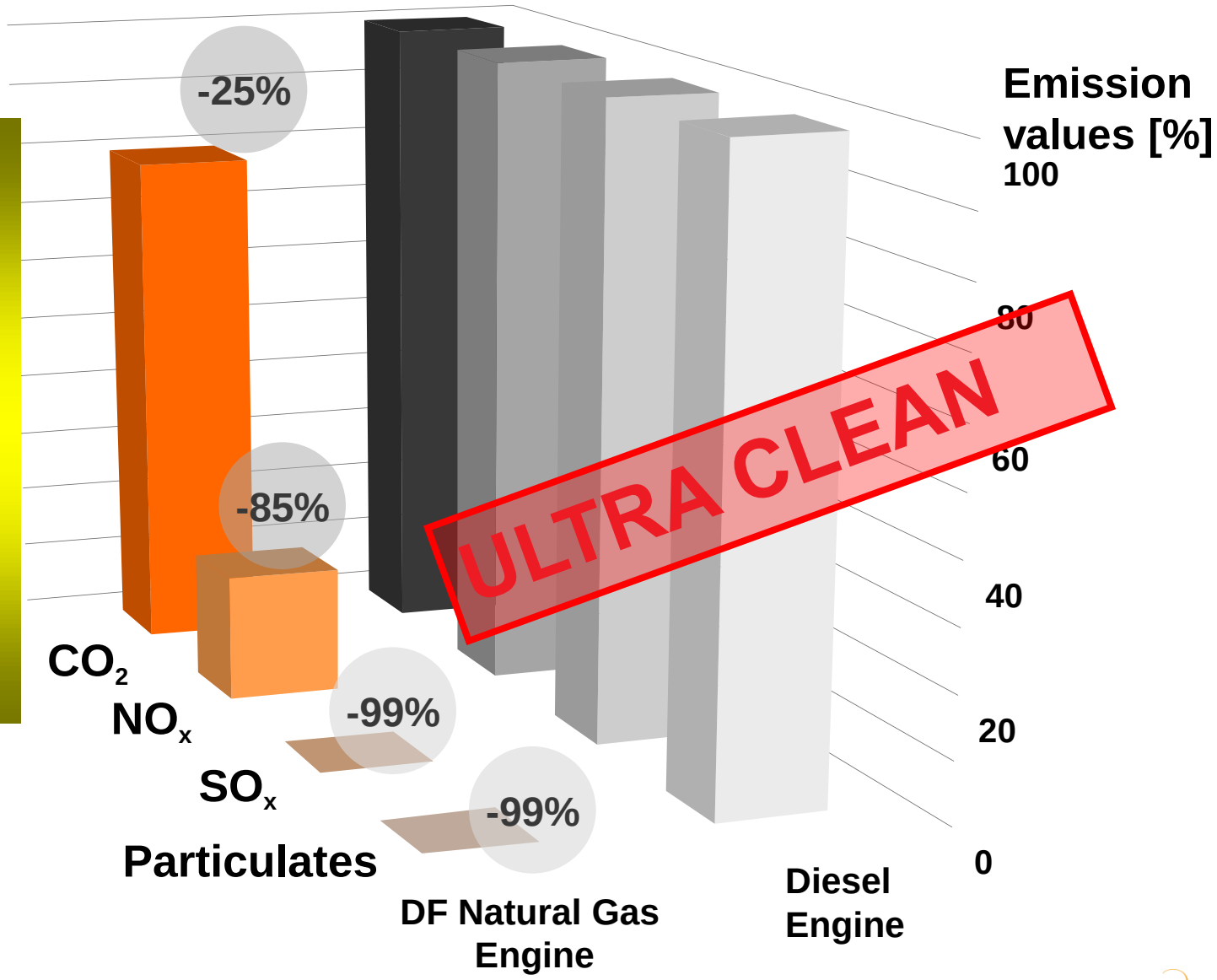


EIA forecasts … prices recede… = gas bargain …

WÄRTSILÄ

How clean ?

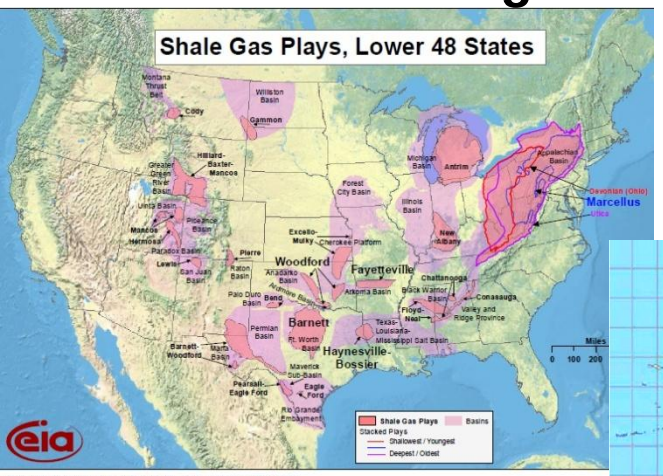
LNG provides significant emission reductions versus traditional diesel engines



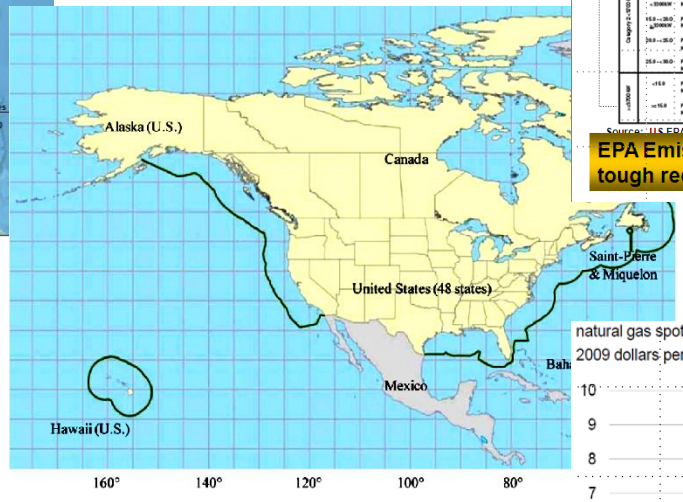
WÄRTSILÄ

5 US Game Changers

US centuries shale gas supply

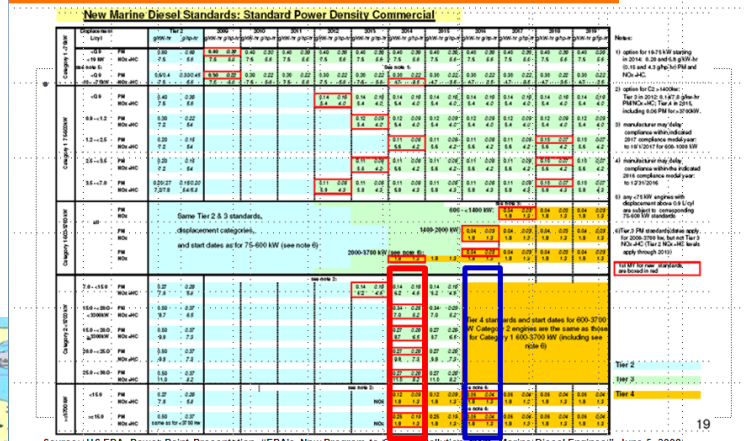


Emissions Control Area 2012



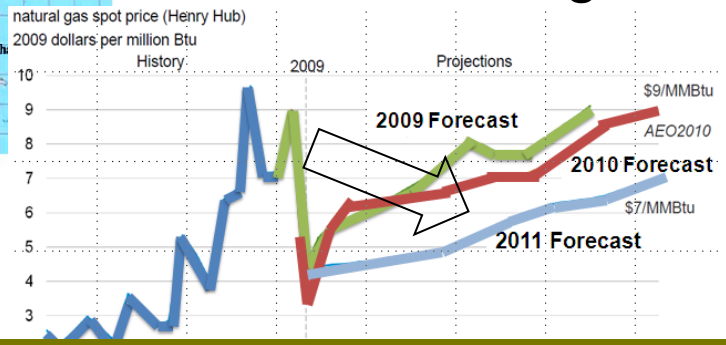
EPA Engine Emissions

EPA Category 1,2 Engine Emission Standards



EPA Emissions Progressively Tighten 2009 – 2018
tough reductions 2014 as Tier 3… further tightening 2016 Tier 4

Natural Gas bargain



EPA Fuel Standards

TABLE I–1—ANNEX VI NO_X EMISSION STANDARDS AND FUEL SULFUR LIMITS

			Less than 130 RPM	130–2,000 RPM [a]	Over 2,000 RPM
NO_X g/kW-hr	Tier I ..	[b] 2004	17.0	$45.0 \cdot n^{(-0.20)}$	9.8

5 gas drivers …shale supply + bargain prices + 3 EPA mandates = set Investment Clock

www.lngoneworld.com, www.bunkerworld.com, LR Fairplay

WÄRTSILÄ

Agenda

What ?

The Opportunities

Target Markets

Why ?

Compelling Economic Savings

5 Drivers set Investment Clock

How ?

History Adoption

Integrated Gas Solutions

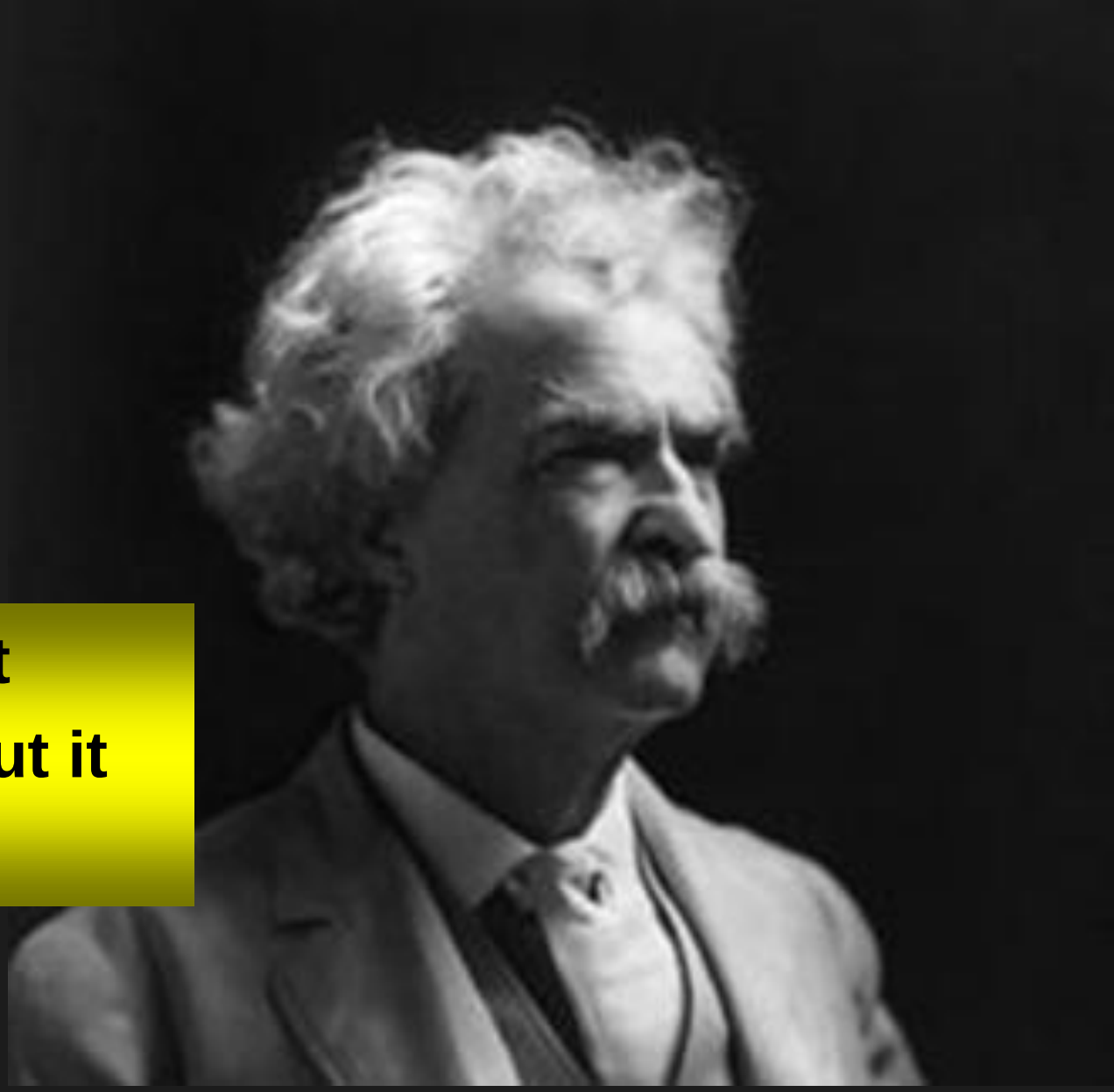
Conclusions

Recent Market Signals

The Future Decade for Gas

WÄRTSILÄ

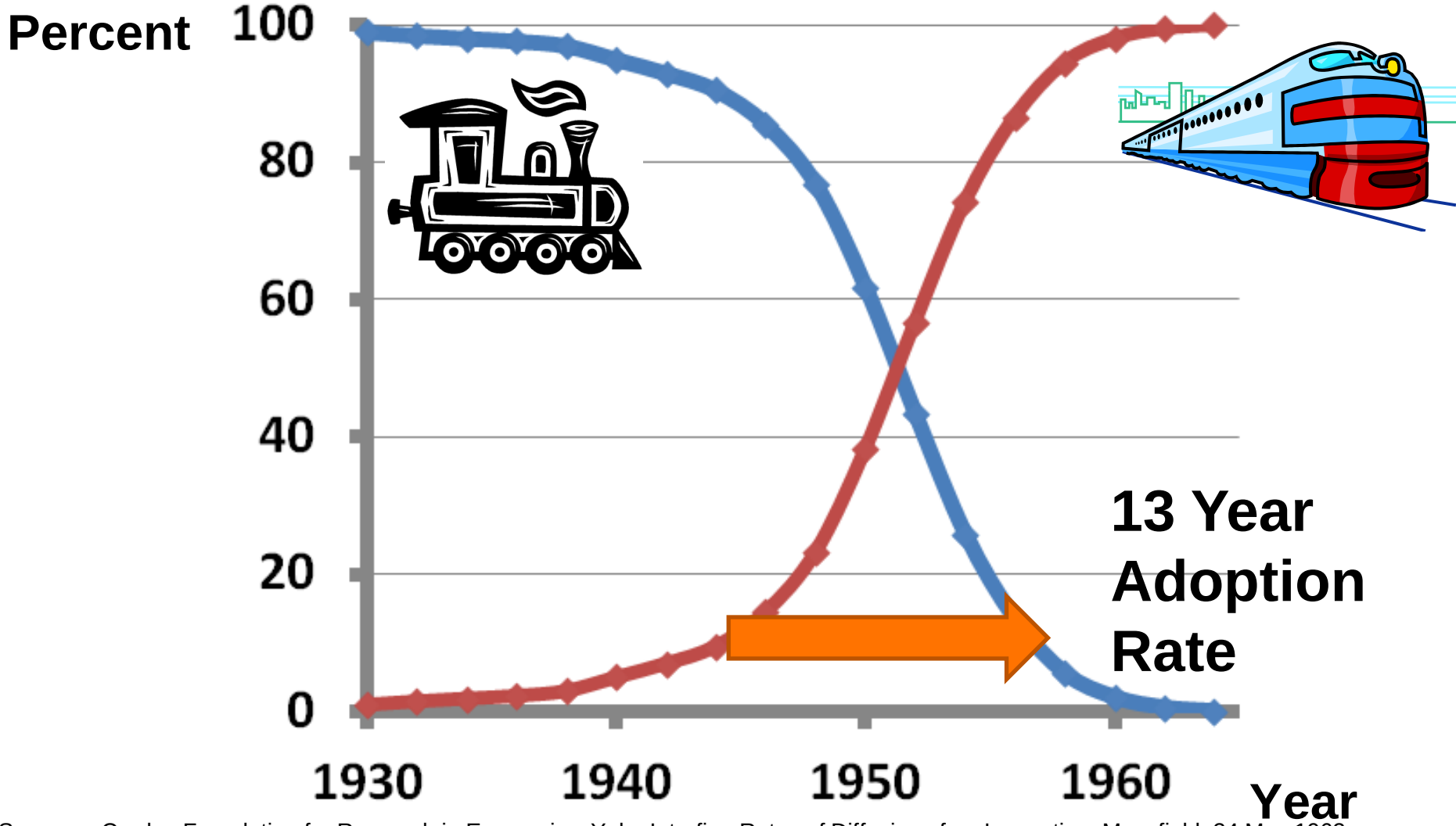
Mark Twain



History does not repeat itself, but it does rhyme

WÄRTSILÄ

US Railroad Substitution Steam to Diesel

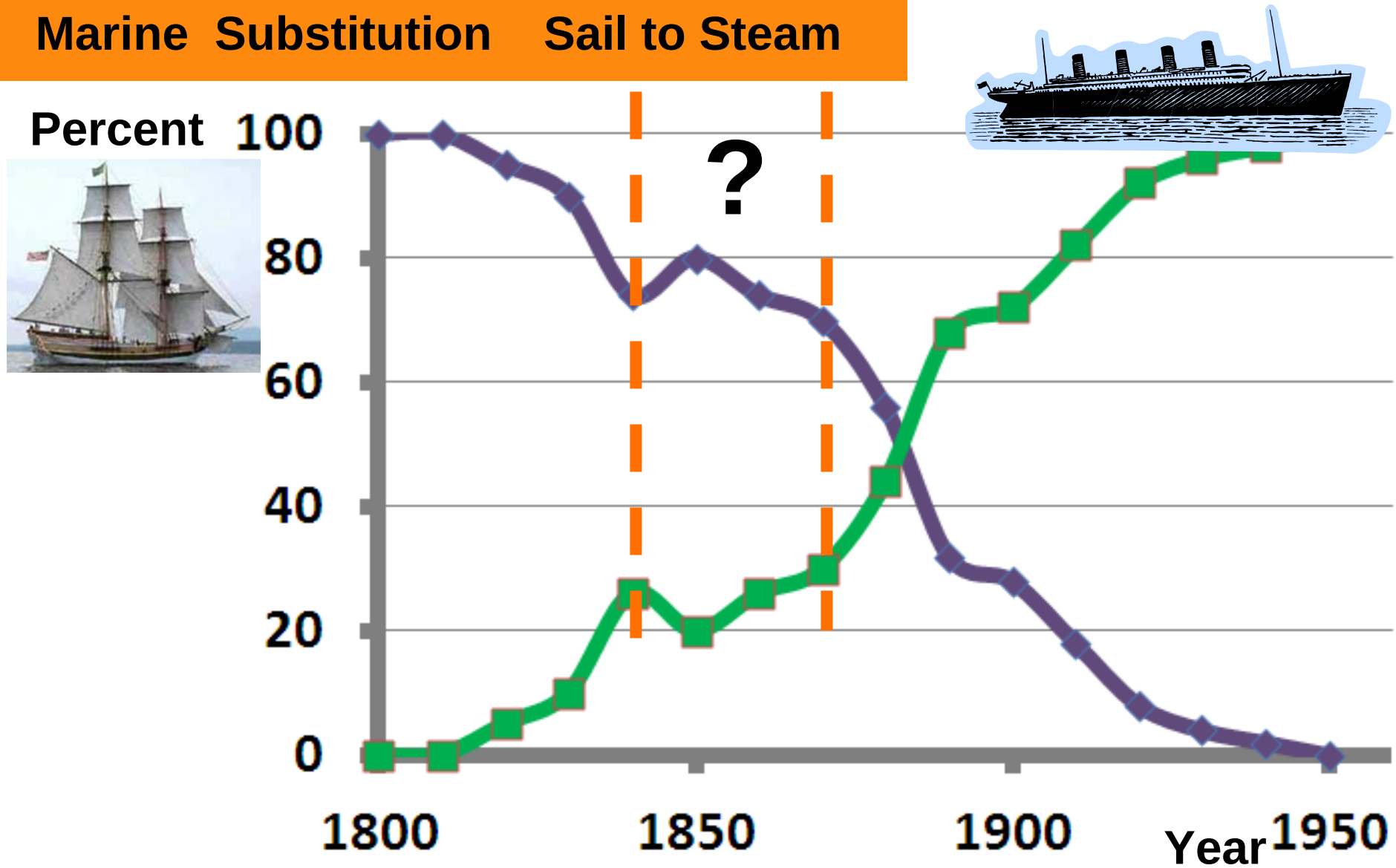


Sources: Cowles Foundation for Research in Economics, Yale, Intrafirm Rates of Diffusion of an Innovation, Mansfield, 24 May 1962:

Diesel 1944 @ 10%.... 1957 @ 90% dominant

WÄRTSILÄ

Marine Substitution Sail to Steam



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

Steam 1830 @ 10%... Why delay ?

WÄRTSILÄ

Clipper Ship Era 1840's

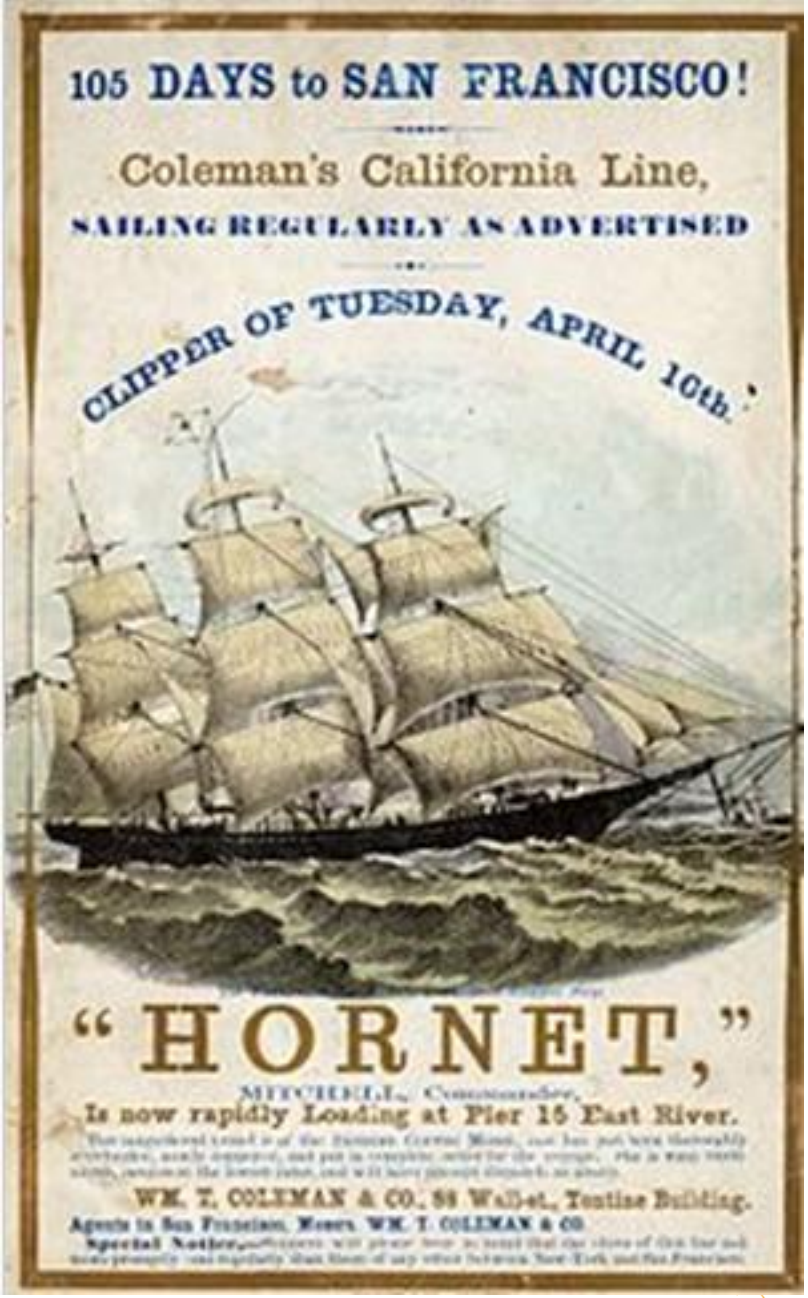
Large Sails

Remarkable Speed
(18 mph)

Good Cargo Capacity

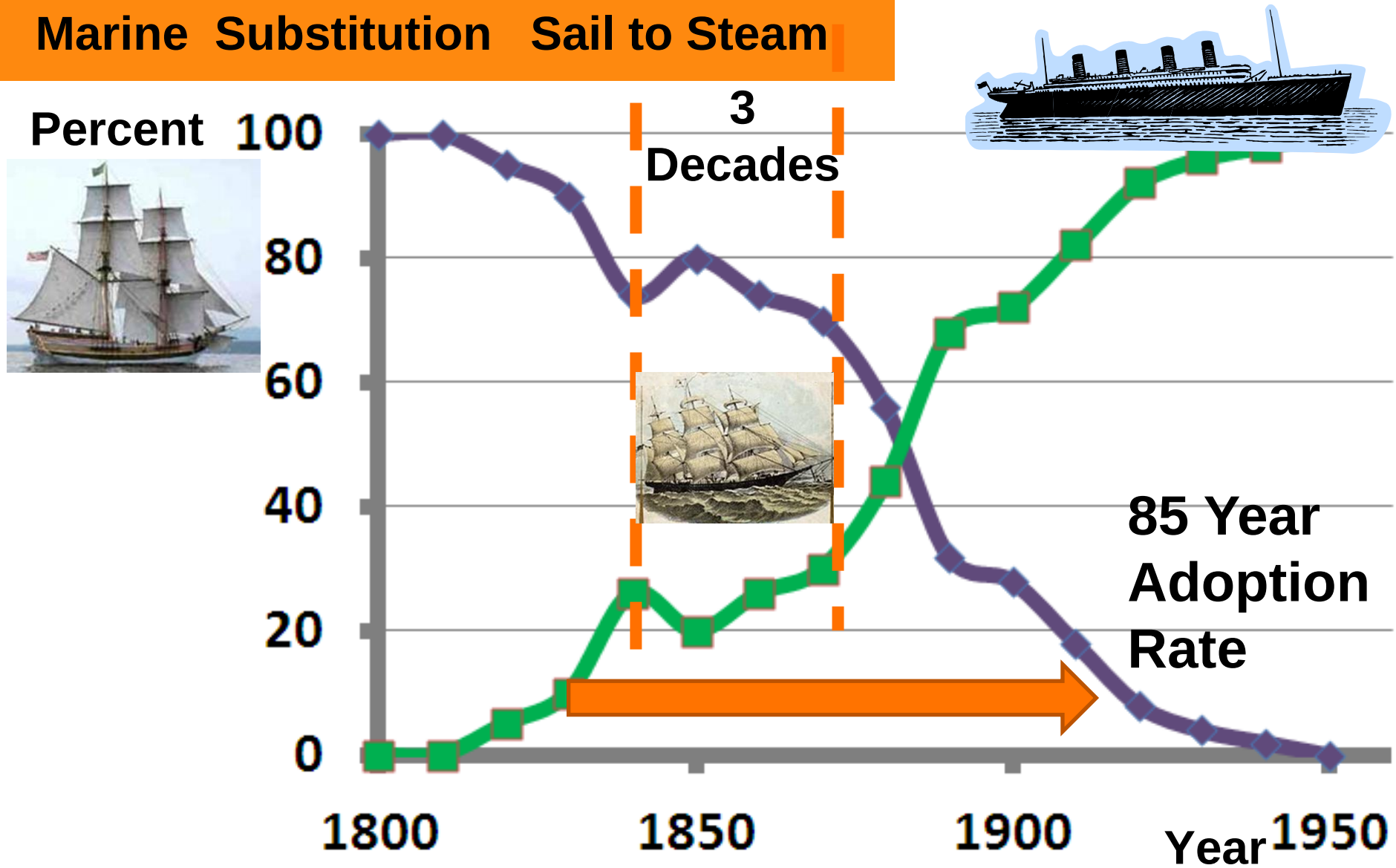
Smaller Crew
(reduced cost)

Sail defensive performance
… brief 3 decade surge



WÄRTSILÄ

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

WÄRTSILÄ

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

WARTSILA

12 November 2012

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

25 Year Milestone with 2,000 gas Engines…

Millions Operating Hours…Tens Millions Horsepower

= proven gas technology & LNG system

3 December 2012

Société des traversiers Québec

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

gas (LNG). The ship 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

4 December 2012

MarineLink.com

Maritime Reporter and *MarineNews* magazines online

Home | Magazines | Events | Advertising | Contact us | Sear

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.

WÄRTSILÄ

6 December 2012

4 + 1

Harvey Gulf were 4 LNG fueled supply boats … now 5…

CAPEX $290 Million + options

WÄRTSILÄ

Keeping Count ?

THE NUMBERS

Over $ 1 Billion CAPEX
more than 50 Million GGE

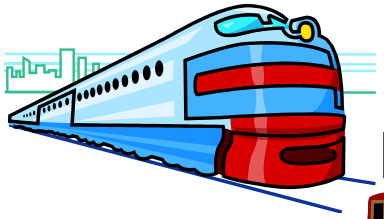
1st Week December + prior during 2012…

Americas marine segment committed to LNG fuel …

the early adopters iniated a new gas ERA

WÄRTSILÄ

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

15 January 2013 Viking Grace …

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

WÄRTSILÄ

5 March 2013

HOUSTON BUSINESS JOURNAL

Mar 5, 2013, 12:08pm CST

Shell planning LNG units in U.S., Canada

Royal Dutch Shell Plc (NYSE: RDS-A) said Tuesday it would build upon its liquefied natural gas plans with the development of two liquefaction units in the U.S. and Canada.

Both small-scale liquefaction units will produce 250,000 tons of LNG per year. Despite their relatively small size, the units will double the liquefied gas manufacturing

3 LNG plants each at 250K tons/yr

Geismar, Jumping Pond, & Sarnia…Online 2015

One unit will be installed at the Shell Geismar Chemicals facility in Geismar, La.

Supply security and price stability = certainty

…certainty breeds investment

WÄRTSILÄ

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

WÄRTSILÄ

Drivers = Decade Shift to Gas

Mandated Emissions & Fuel Restrictions

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Global Fuel % Sulfur	4.50%		3.5%								0.50%
ECA Bubble			Geographic emissions bubble encapsulates US/Canada								
ECA Fuel % Sulfur	1.00%					0.10%	Tight sulfur limits stress supply				
Category 1,2 Engines	Tier 2				Tier 3		After treatment burdens diesels				
Category 3 Engines	Tier 1	Tier 2					Tier 3				

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

WÄRTSILÄ

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

WÄRTSILÄ