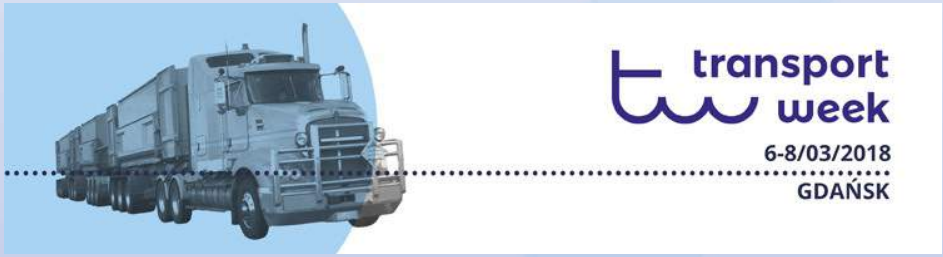
Opportunities & Synergies for LNG in the port and cargo handling industry

LNG Workshp and LNG Value Chain



Prof. Lawrence Henesey
Blekinge Institute of Technology,
Karlshamn, Sweden

Who is this guy?…

- ✓ Scientist on the application of Distributed Artificial Intelligence in Container Ports and Terminals.
- ✓ Develop solutions for energy and data transmission by employing automation and electrification technologies such as AGVs, ASCs, Automated cranes, RTGs and RMGs.
- ✓ Posseses 27 years of industrial work experience such as: Evergreen, Sea Land, Bank of America, Deutsche Post GmbH, Sea Trade Reefer,TTS Port Equipment, Conductix-Wampfler AG and SIMPORT AB.
- ✓ Member of the following organisations: Port Equipment Manufacturers Association (PEMA), Swedish Artificial Intelligence Society (SAIS), and Association of Computer Machinery (ACM).
- ✓ PhD in Computer Science from Blekinge Institute of Technology at Karlshamn, Sweden. MSc (Cum-Laude) in Transport and Maritime Management from the University of Antwerp, Belgium and degrees from Old Dominion University, Virginia, USA.

Learning Objectives for today:

- Brief History Lesson
- Opportunities for using LNG for other equipment and vehicles in a port
- Case for Terminal Tractors
- Case for yard cranes (Rubber Tired Gantry Cranes. RTGs)
- Case for other equipment, such as Automated Guided Vehicles and Straddle carriers
- Questions and Answers – don’t be shy – ASK!!

Developing LNG as a business opportunity using the "Value Chain" as a platform

Cargo Handling : Container Terminal case

A Very Brief History Lesson

Early days – For centuries, freight was handled manually

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Malcolm P. McLean

A truck driver who eventually built one of the largest trucking companies in America

He realized that there had to be a better way

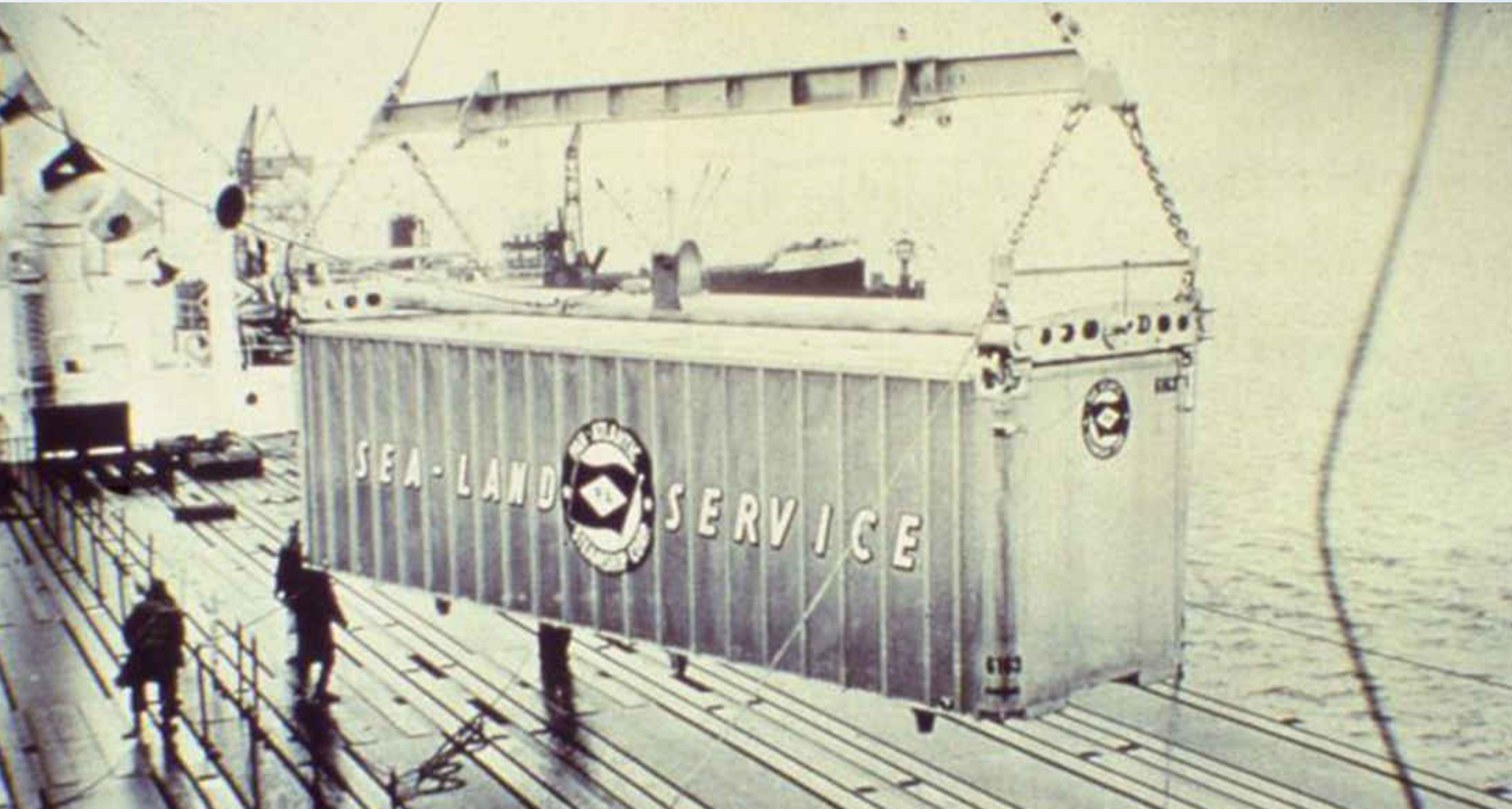
Thankfully he knew better…

In 1956 Malcom changed the shipping world forever!

The ship carried 58 35-feet containers, along with a regular load of 15,000 tons of bulk petroleum from Newark to Houston in April 26, 1956.

Port Newark, 1959

Just 5 Years later, a Global Standard was set that improved production, safety and cut costs while improving the way that we move goods around the world



As a result of Standardization…

Production went from a rate of
1.3 Tons/Hour to > 30 Tons/Hour

Cost to manufacture went from
$5.86/Ton to $0.16/Ton

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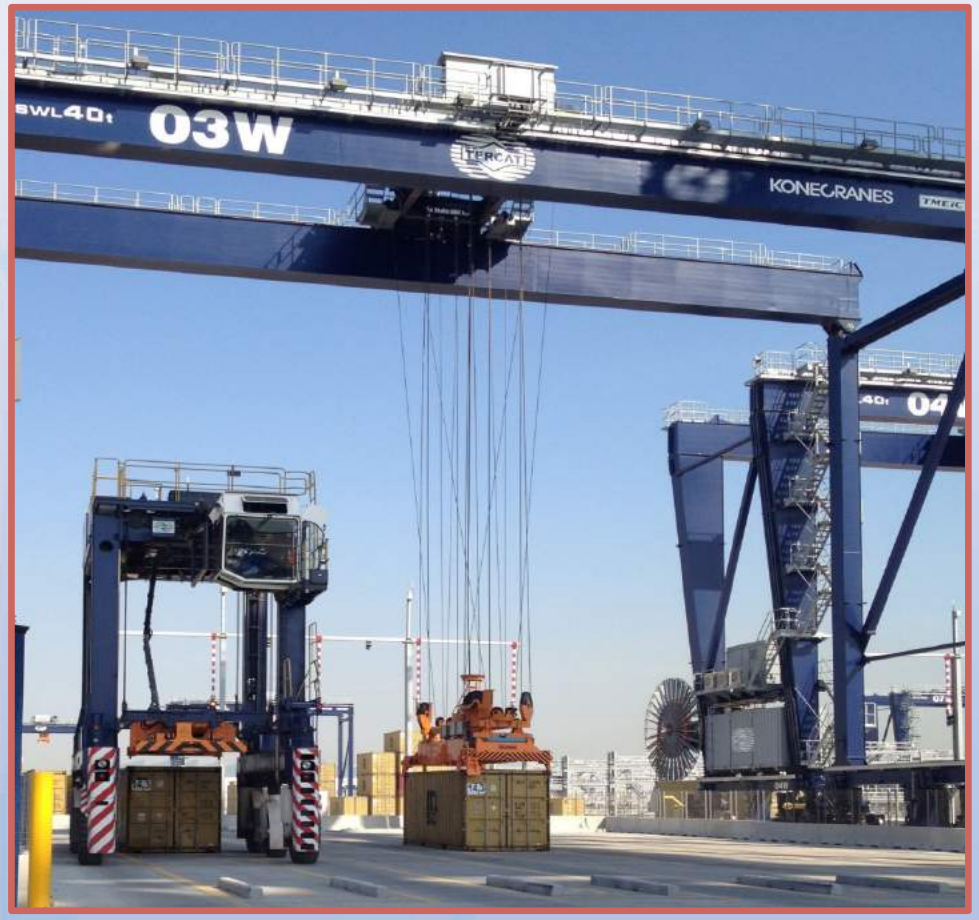
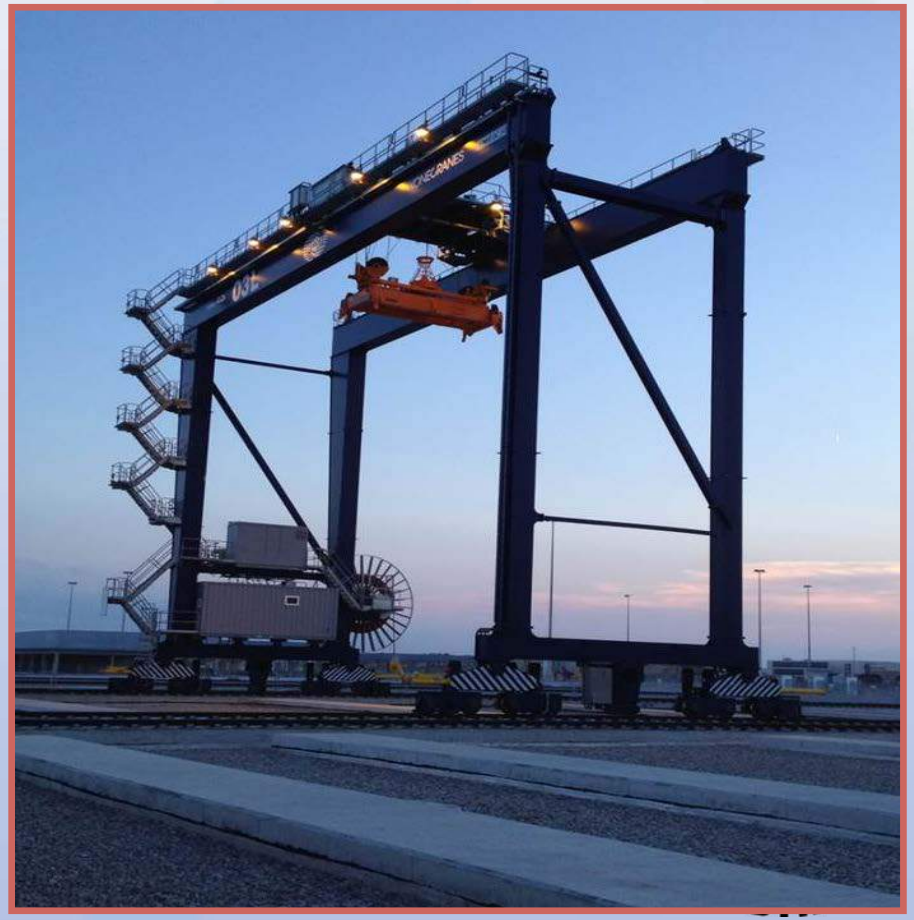
We find ourselves, once again, at the threshold of a new vision in terminal production, safety and cost savings





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Pick up any Trade/Industry magazine and we see that Automation and Energy is here to stay

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CAVOTEC
PINTSCH BUBENZER
PEPPERL+FUCHS
RAM SPREADERS
SICK Sensor Intelligence.
TMEIC We drive industry
KONECRANES
APS Technology
SANY
ELME Swedish Spreader Systems
navis
LIEBHERR
Franz Wölfer Elektromaschinenfabrik Osnabrück GmbH
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master terminal
Portunus PORT SPARES & SERVICES
KALMAR
Spahn+Burkhardt
APM TERMINALS Crane & Engineering Services
cascade
MICHELIN
ifm electronic
ARISTONCAVI
Nexans
RFT
MAFI TRANSPORT SYSTEMS
KABELSCHLEPP TSUBAKI KABELSCHLEPP
SIBRE sure to be safe
Schneider Electric
smart-Tecs
IDENTEC SOLUTIONS
TVH
LASE Industrielle Laortechnik GmbH
INTERCON
ISL APPLICATIONS
HPC
Liftech LIFTECH CONSULTANTS INC.
CERTUS PORT AUTOMATION
igus
BALTKRAN
BROSA
CRANEPORTS LIFTING · HANDLING & PORT EQUIPMENT
TERBERG BENSCHOP
VDL
SEOHO ELECTRIC CO., LTD.
LEHNERT crane intelligence
SYMEO ABSOLUTE POSITIONING
MGM OMG
stinis
JOHANNES HÜBNER GIESSEN ideas and solutions
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DUTCH LANKA TRAILERS
BANNER more sensors, more solutions
briedacabins
TEREX Port Solutions
MALMEDIE
TIMARS
TBA SIMULATION EMULATION SOFTWARE
PORTEK Knowledge & Solutions in Port Business
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Since the earliest days of containerization…

There have been a lot of major changes in the way we do business. Standardization will allow us to work effectively and utilize the best that technology has to offer.

Standardize Port / Terminal LNG Bunkering and Distribution Services. . .?

Market and Customer Trends

Market size for Port Equipment & Container Handling

7 Billion €

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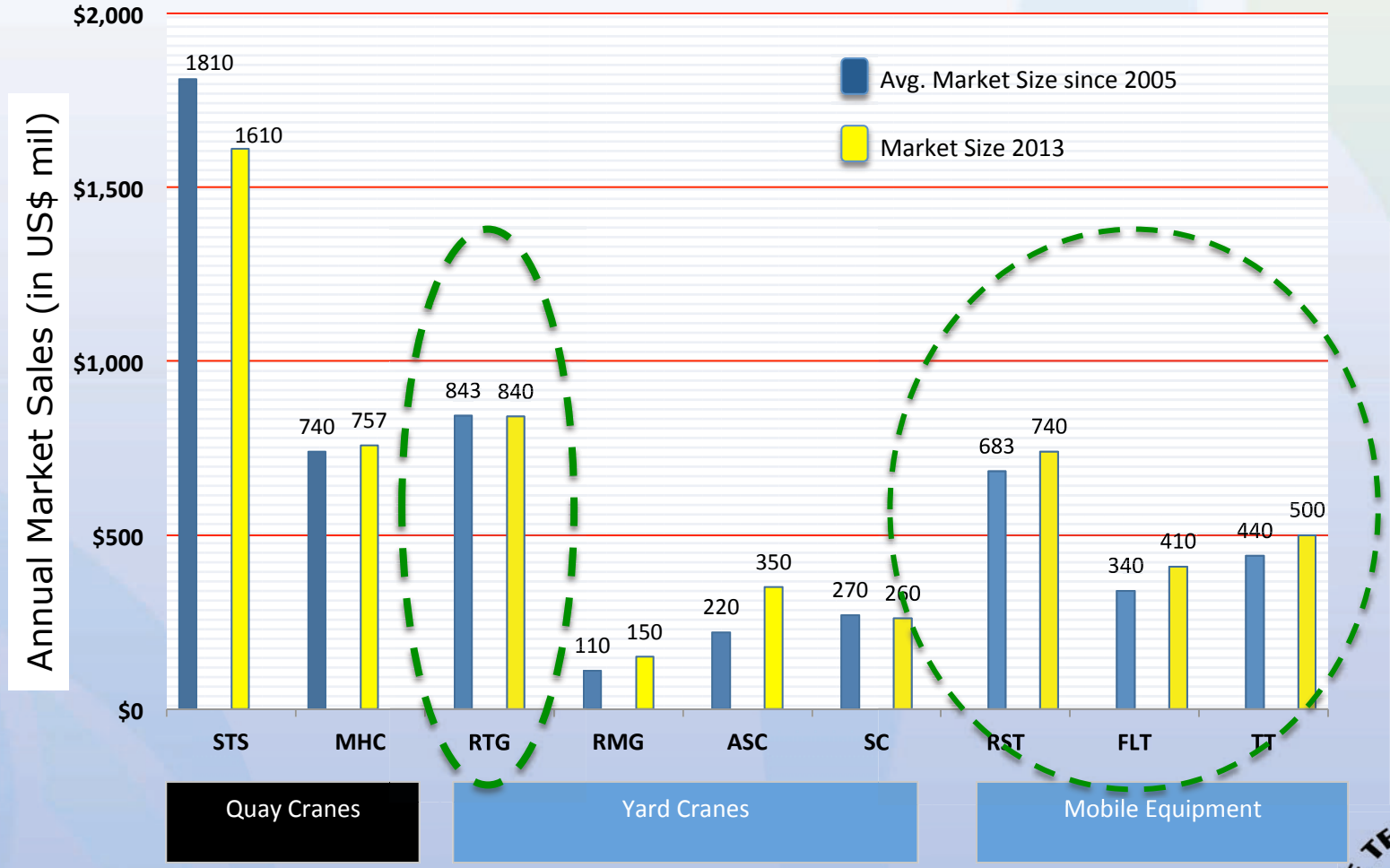
Port Equipment in Container Terminals

1. *STS* | Ship to Shore Cranes
2. *RTG* | Rubber Tyred Gantry Crane
3. *RMG* | Rail Mounted Gantry Crane
4. Intermodal Cranes
5. Horizontal Transport | AGVs, Trucks, Straddle Carriers
6. Shore Power Supply (LNG Bunkering..)

Market for Port Equipment - 2018



Part-financed by the European Union
(European Regional Development Fund)

Description and Segmentation

- ✓ Ports and terminals industry projected growth rate of 6% - till 2017
- ✓ Total global container throughput will be 830 million TEU (Twenty-foot Equivalent Units) by 2017. Growth rate of 40% between 2011-2017.
- ✓ Conservative growth rate of 5% will double current global container volumes by 2025
- ✓ Containerisation with strong port development in various regions.
- ✓ More Large ships ordered, 445 new ships with capactiy of 3,27million TEU
- ✓ Larger ships means more time at port - leading to more costs.

Main drivers of the Market

Trends	Container Ports	Consequence
Increasing competition of terminals	GTOs 	More efficient systems
Globalization	Carriers/Liners 	New investments in modern port facilities
Bigger Vessels		Bigger Cranes and faster logistics
Increase in energy costs	Port Authorities 	Energy Savings
Increasing environmental demands		Automation of Container Yards

Factors for developing Ecological Equipment

Environmental	Economical	Technological
reducing pollution (air and noise)	*reducing operating costs (oil prices) and maintenance costs*	*optimizing productivity & performances*

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*If necessity is the **mother of invention***

then

*vision is the **father of innovation!***

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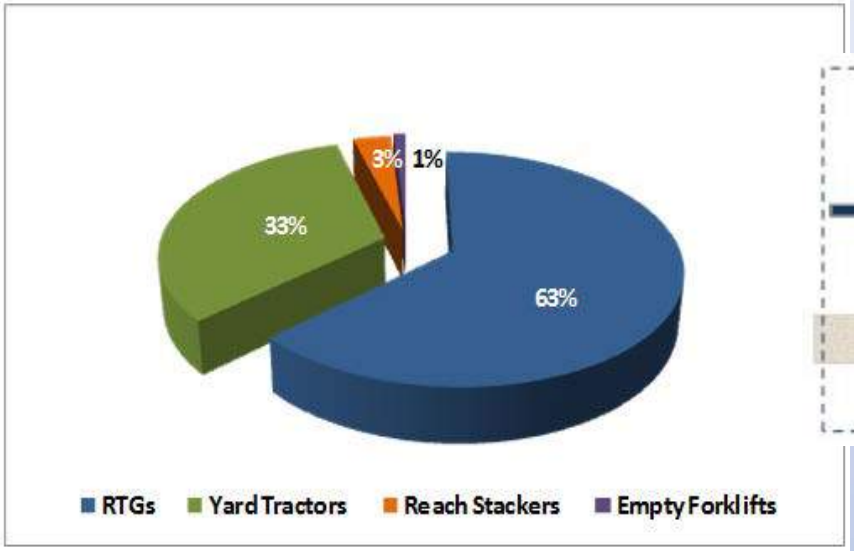
Lets Go GREEN!

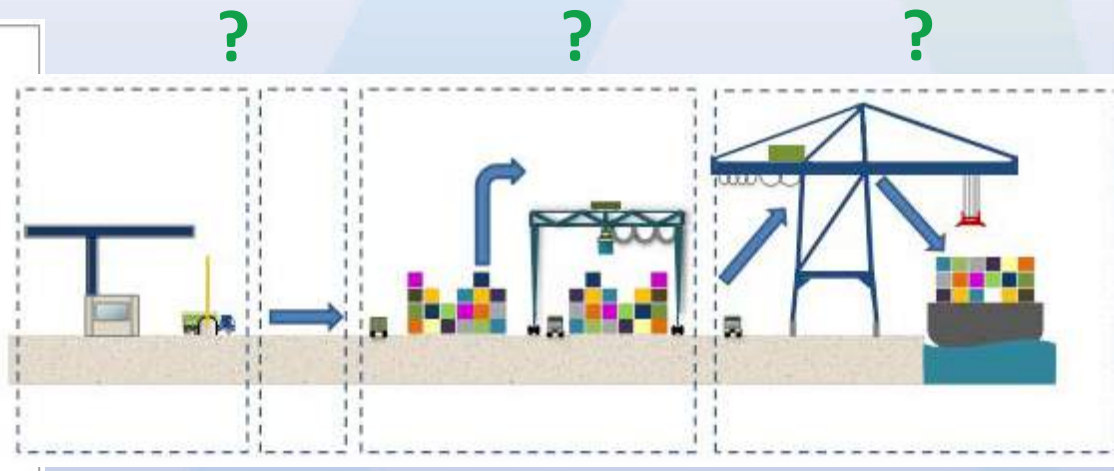
= *Ecological Equipment*

Where can we apply Ecological Equipment?

How much energy is consumed?



Where is the energy consumed?



Reference: GreenCranes Project

Which Machinery or Equipment to Consider?

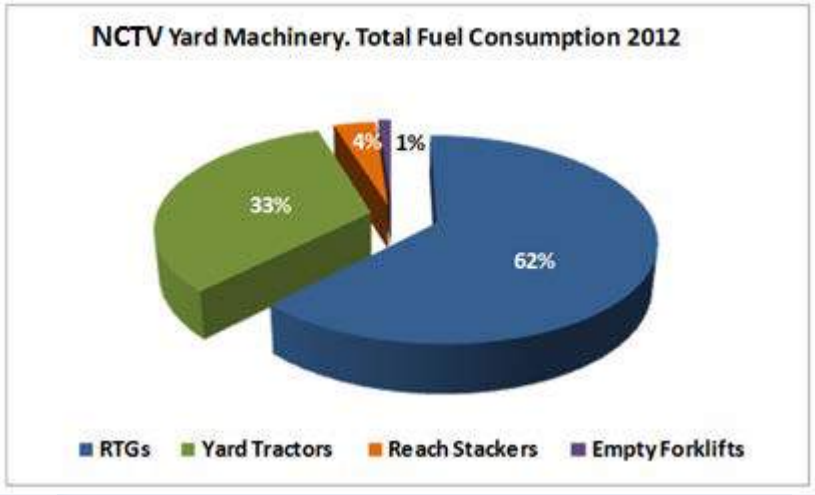
Rubber Tyred Gantry Crane (RTG)

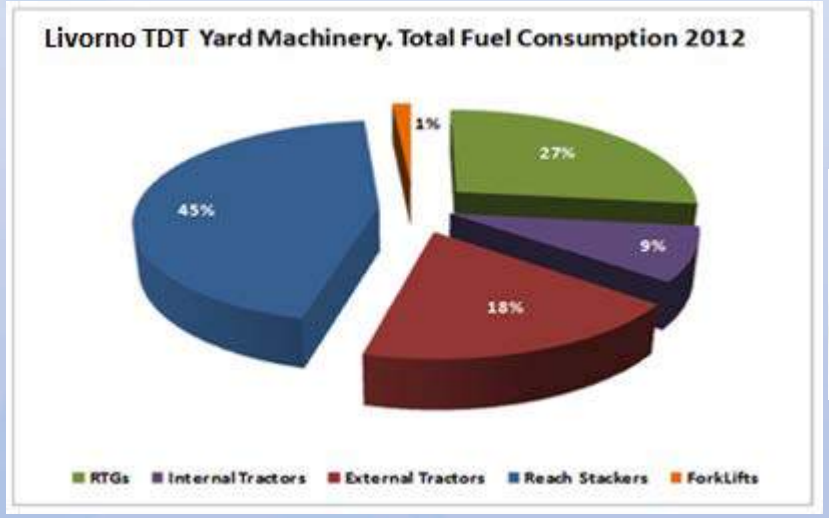
Terminal Tractor

Reach Stacker

Empty Forklift

How much DIESEL (FUEL) consumption?





4,049,138 L (58%)

2,245,147 L (32%)

611,460 L (9%)

80,819 L (1%)

90%

6,986,564 L

X 4,000 (1,300 L / year)

- Terminal Tractors are the most used type of horizontal equipment found in Container Terminals worldwide
- Terminal Tractors represent significant part of the total fuel consumption in a port – often the 2nd most consuming of fuel after yard cranes.

Feasibility Evaluation: Terminal Tractors

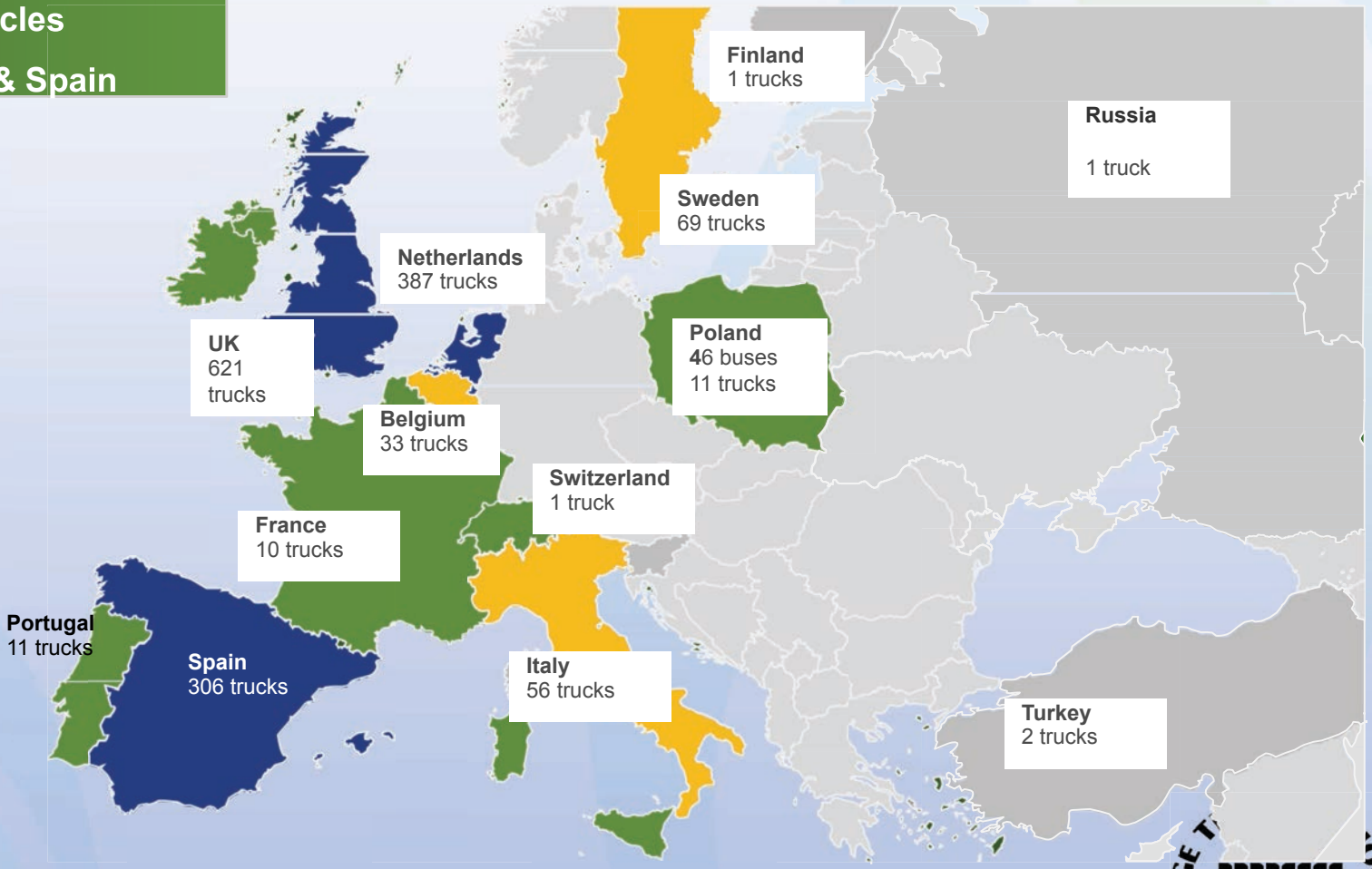
Terminal Tractors	RTGs	STS + Other
2,4 Million L 1,8 Million € GoB	4,6 Million L 3,4 Million € GoB	17,8 GWh 2,2 Million € kWh
Alternatives TT	**Alternatives RTG**	**Supply Alternatives**

• Gasoil TIER 4 / Stage IV (2014)
• LNG
• Dual Fuel
	• RTG Engine Replacement TIER 4 (2014)
	• LNG / Dual Fuel
	• Electrification
	  • Conductor Bar
	  • Cable Reel
		• Current Electrical Tariff
		• Tariff 6.1 (Electrical Supplier)
		• Tariff 6.3 (Electrical Supplier)

Current European LNG market

1.500 LNG Vehicles

Mainly UK, NL & Spain

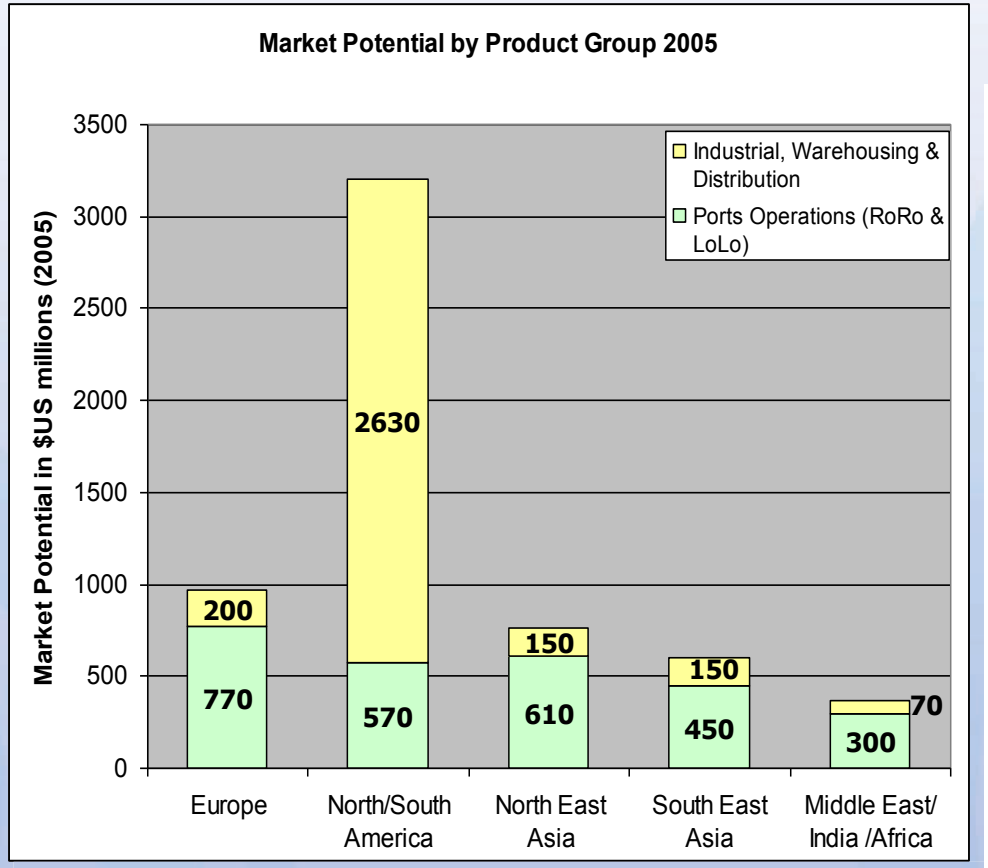


- > 200
- > 25
- < 10
- None

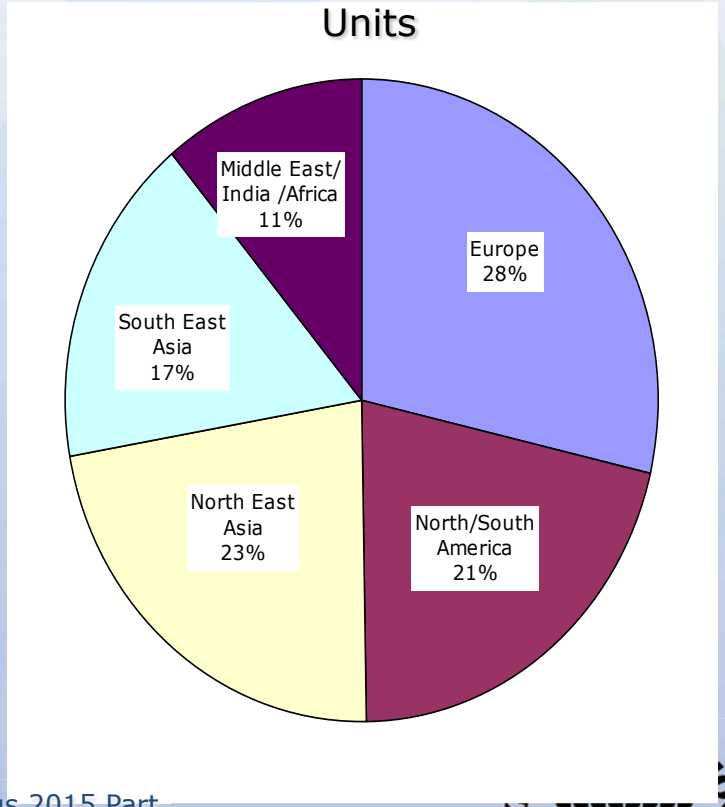
Source: NGVA Europe, 01.12.2014

Terminal Tractor Market?

- Terminal Tractor market accounted for 5900 units (2700 delivered to ports and 3200 to other facilites for warehousing and distribution

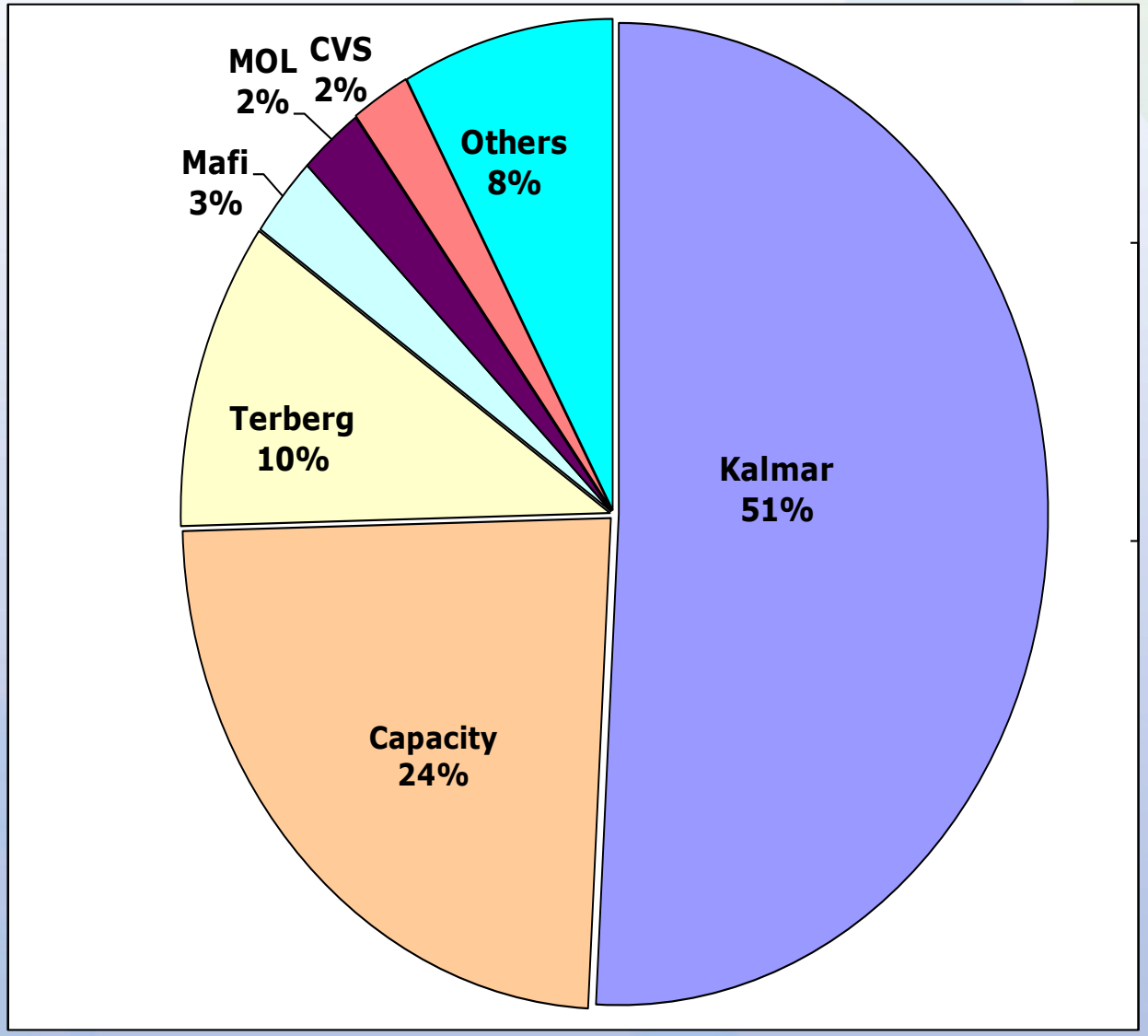


Terminal Tractors: 5900 Units



Source: OneStone Intelligence GmbH (2006) "Container Terminal Focus 2015 Part 4A:Container Terminal Equipment – Current Equipment Market".

Terminal Tractor Market by supplier



LNG Facts for Terminal Tractors

- LNG in fuel tank is stored at less than 100 PSI but at temperatures of –259 F and lower. It has the ability to **contain more fuel in slightly less space** and much lower pressure than CNG.

- Fuel consumption in liters per hour is about **13.2 – 17 Liters per hour**.(Cummins C Gas + 250 HP/750lb/ft T).

- Based upon a 216 liter usable tank size this would **limit to about 12 –16 Hours** on LNG vs. **about 24 – 30 hours on a standard 190 liter** tank of diesel.

- Clear, odorless, and non-corrosive.

Reference : Kalmar Industries

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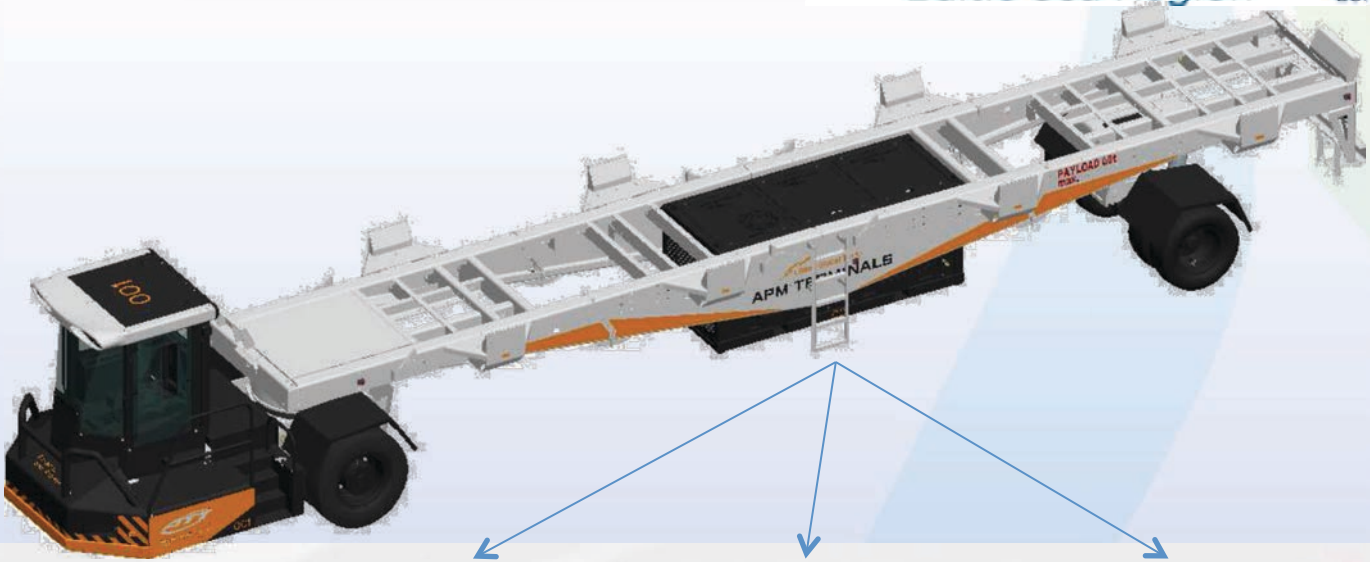

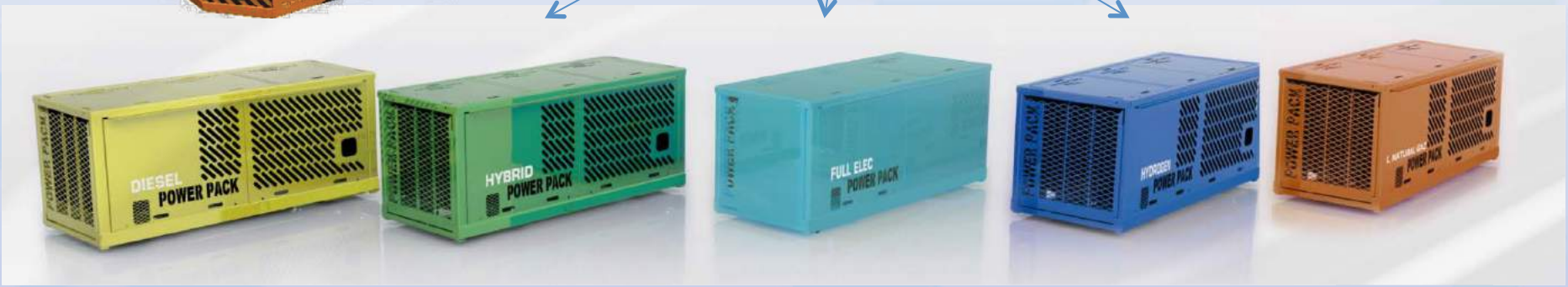

Diesel

Hybrid Diesel/ Electric

Full electric Battery

Future energy Full cell-hydrogen
Under development

LNG
Under development

GAUSSIN MANUGISTIQUE

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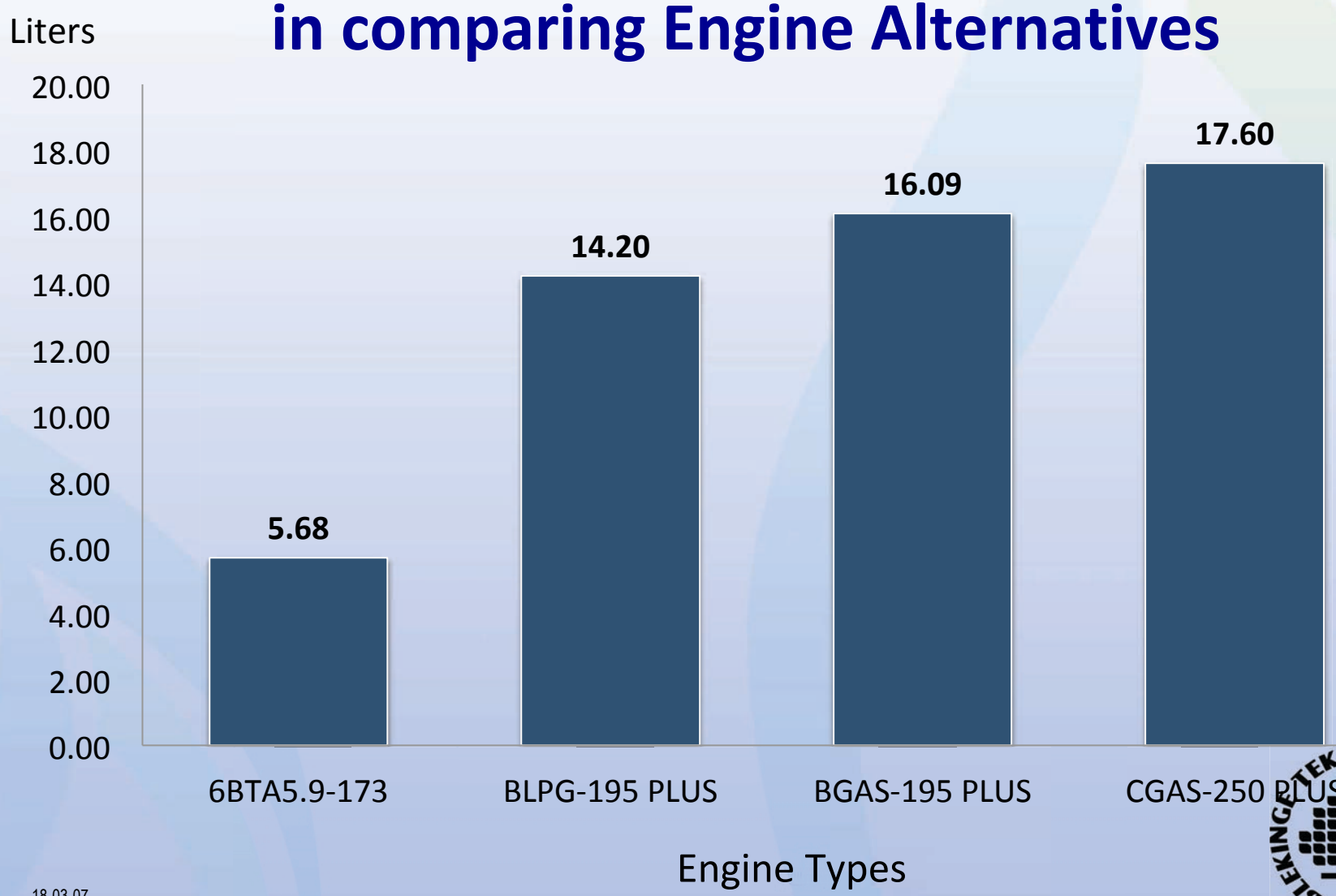
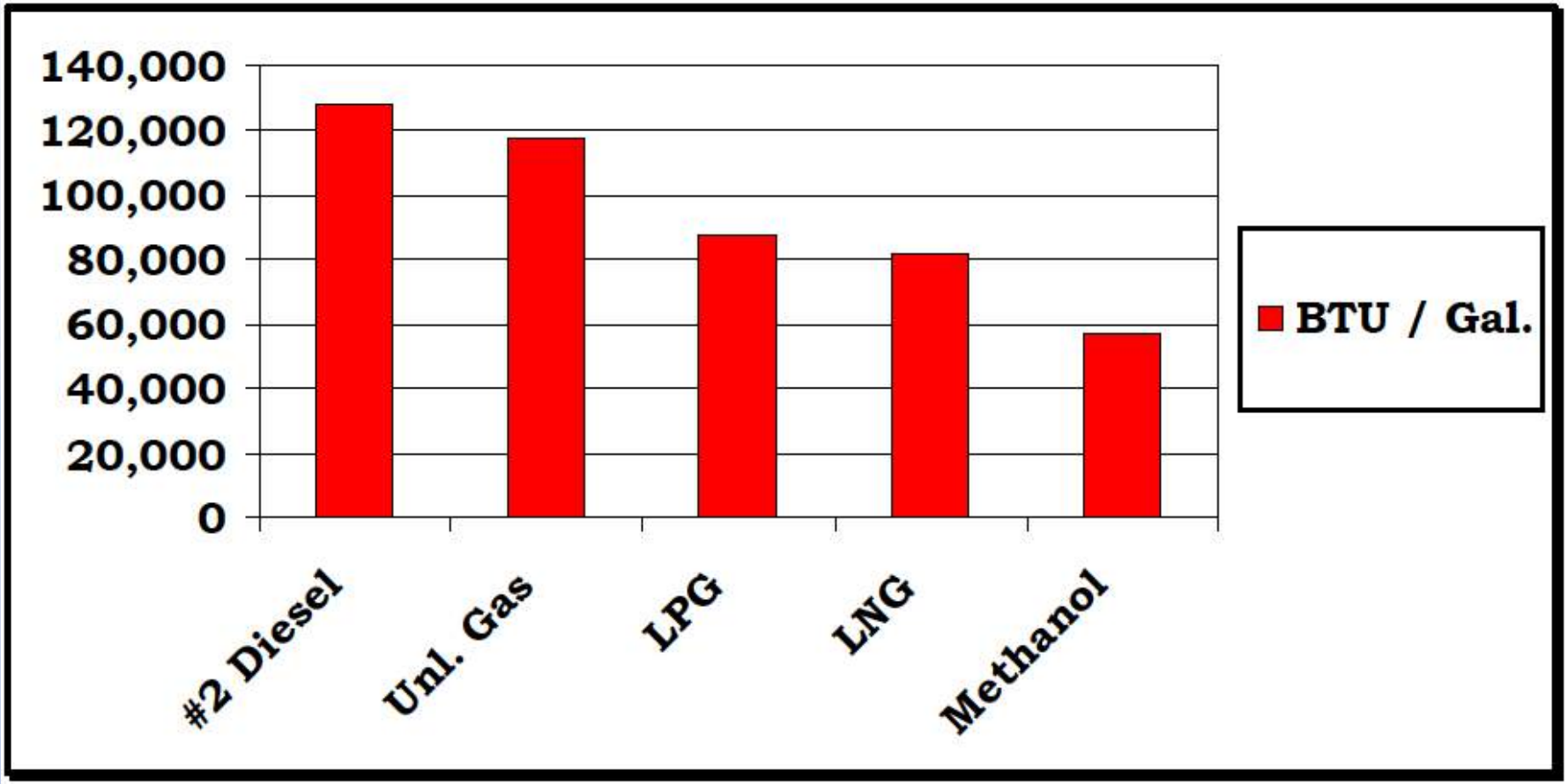
Fuel Consumption per Liter in comparing Engine Alternatives



Energy Comparison



Machinery or Equipment Deliveries 2008-2013

Equipment type	2008	2009	2010	2011	2012	2013
Reach Stackers	1408	796	1227	1452	1504	1324
FLTs Laden	198	110	113	146	178	146
FLTs empty	613	318	467	549	709	671
Terminal Tractors 4x2	2843	1778	1343	1727	1625	1596
Terminal Tractors 4x4	692	404	320	375	414	404

Terminal Tractor 4x2

Terminal Tractor 4x4

Reach Stacker

What is the Pay Back?

ICC = (Initial Cost of Vehicle) – Purchase Incentives + PVFuel – PVResale

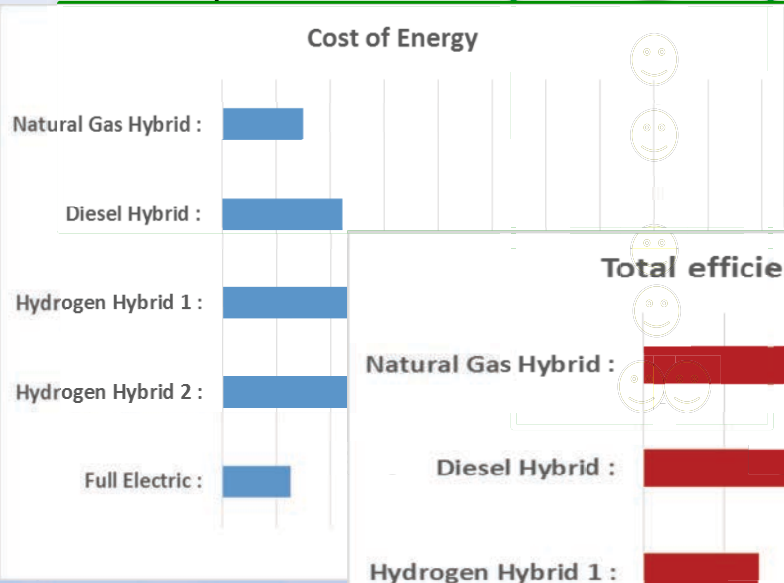
Where:

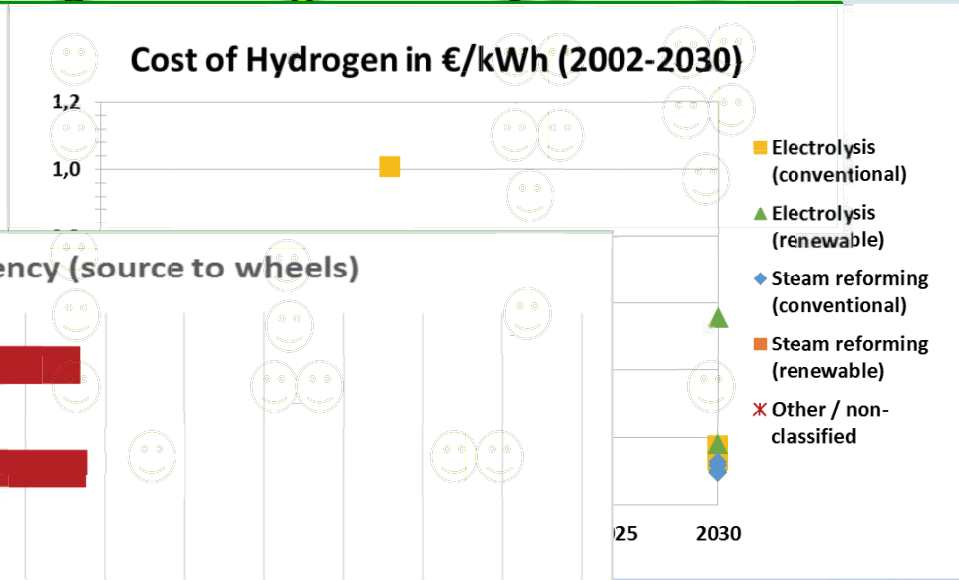
- **Purchase Incentives** = Value of Grants, Tax Credits, etc. Applied to Vehicle Purchase
- **PVFuel** = Present Value of Fuel Expenses During Vehicle Service Life
- **PVResale** = Present Value of Resale Value of Vehicle at End of Service Life
- **PV** = Ft /(1 + d)t
- **Ft** = Future Cash Flow in Year t
- **d** = Discount Rate

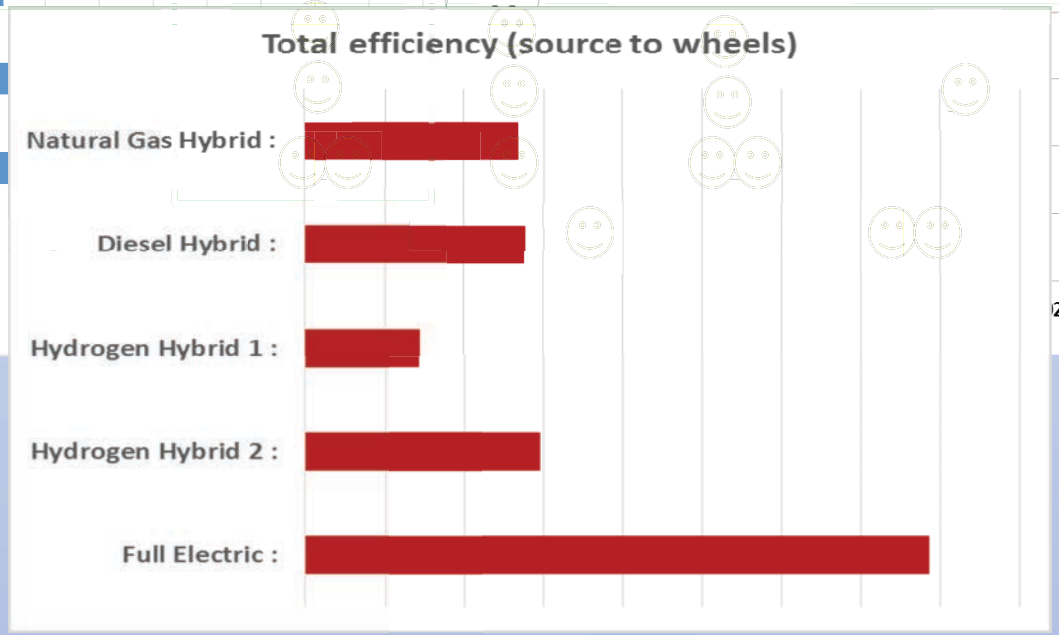
Factor	Diesel	LNG – No Incentives	LNG – LNG Incentives	LNG – SCAQMD (Max. 25 Vehicles)
Initial Cost of Vehicle	$80,000	$120,000	$120,000	$120,000
Purchase Incentives	$0	$0	$32,000	$40,000
Fuel Cost/Gallon After Tax Credits	$2.60	$0.50	$0.50	$0.50
Gallons/Operating Hour	1.7	3.8	3.8	3.8
Annual Operating Hours	2	2	2	2
Annual Fuel Costs	$8,840	$3,800	$3,800	$3,800
Service Life	10 Years	10 Years	10 Years	10 Years
Discount Rate	3%	3%	3%	3%
Present Value Fuel	$77,669	$33,387	$33,387	$33,387
Resale Value	$5,000	$0	$0	$0
Present Value Resale	$3,832	$0	$0	$0
ICC	$153,837	$153,387	$121,387	$113,387

Comparison Hybrid, Electric, LNG

	LNG-Elec	CNG-Elec	Diesel-Elec	Full-Elec	H2
Power Pack™ Cost(Capex)	☺	☺	☺☺	☺	-
Cost of Energy	☺	☺	-	☺	-
Efficiency	☺	☺	☺	☺☺	☺







- RTG are the main solution for moving containers in terminal yards worldwide
- RTG represent significant part of the total fuel consumption in a port (more than 50%)

Feasibility Evaluation: RTG

Green Cranes

Terminal Tractors	RTGs	STS + Other
2,4 Million L 1,8 Million € GoB	4,6 Million L 3,4 Million € GoB	17,8 GWh 2,2 Million € kWh
Alternatives TT	**Alternatives RTG**	**Supply Alternatives**

• Gasoil TIER 4 / Stage IV (2014)
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	• LNG / Dual Fuel
	• Electrification
	  • Conductor Bar
	  • Cable Reel
		• Current Electrical Tariff
		• Tariff 6.1 (Electrical Supplier)
		• Tariff 6.3 (Electrical Supplier)

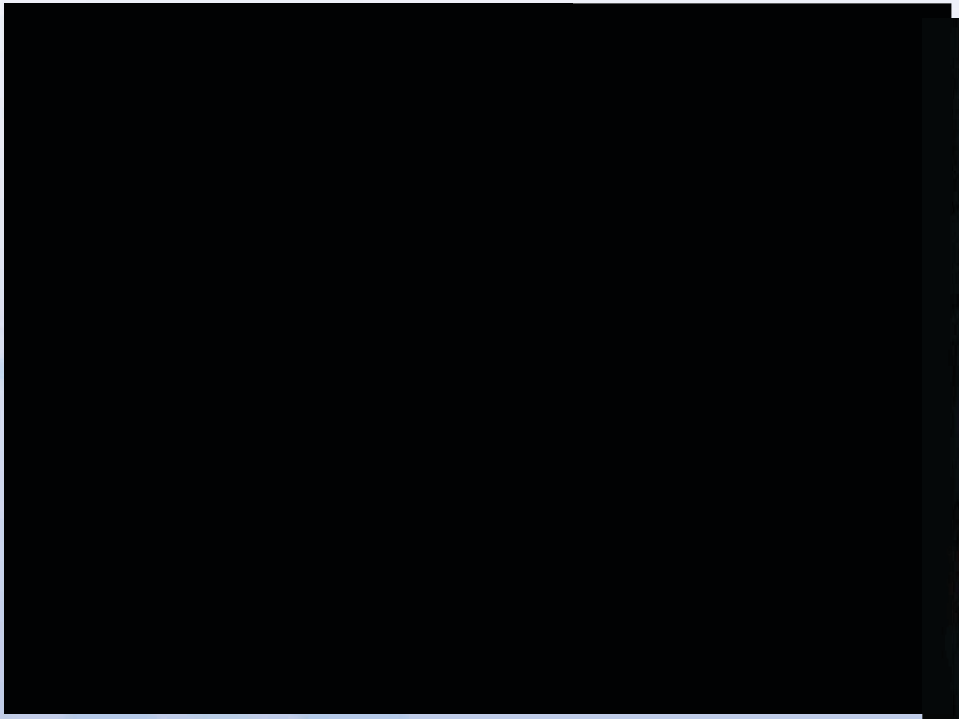
Facts + Figures

- Diesel engines are the main source of RTGs
- Container handling increases
- At the same time diesel prices increased rapidly
- In some cases RTGs account for 50 % of a container terminals‘ diesel consumption

Effects

- High fuel consumption & costs
- High dependecy on fossil fuels that have unpredictable prices
- High cost in larger size Genset service (- USD 20k / year)
- Environmental; carbon emissions, air and noise pollution

Other equipment to be « LNG-nized »



AGV –Automated Guided Vehicles

Straddle Carriers

Full LNG powered Reach Stackers

Kalmar is engineering a diesel-LNG powered reachstacker prototype as part of the GREENCRANES project.

"The LNG power is a very interesting future fuel alternative both for port equipment business as well as for the whole shipping industry. Natural gas extractions are increasing and this can clearly be seen as one of the future trends."

What have we learned in 20+ minutes. ?...

- Port **Container Terminals are huge energy consumers,** especially on those energy sources based on fossil fuels.

- From the **economic point of view**, increase of **energy prices** means more cost which **reduces Port competitiveness.**

- In terms of **environmental impact**, with the current motivation in having LNG bunkering and ships being built with LNG engines, the additional effort to **"bunker port equipment is a low barrier to entry (Cherry Picking).**

- Concerning **social impact**, ports are usually located near populated cities **affect nearby population as direct GHG emissions (derived from diesel oil) are locally deployed, not only CO_2, but also other pollutant and toxic gases like N_2O, Sulphur compounds and suspension particles.**

- Efforts to reduce fuel consumption and GHG emissions produced **by RTGs, yard tractors and reach stackers are <u>strongly recommended</u>.**

Total to Supply LNG for CMA CGM's New 22,000 TEU Ships

News:
05 Dec 2017
09.32am

Questions …

Is your Port Ready?

Will you be able to Compete or risk be left behind….?

Total and CMA CGM have signed an agreement covering the supply of around 300,000 tons of liquefied natural gas (LNG) a year for 10 years starting in 2020.

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More information found at:

www.GoLNG.eu

April 10-12, Bergen Norway

LNG STAKEHOLDERS WILL MEET ONBOARD FJORD LINE'S LNG POWERED FERRY

The upcoming international conference "LNG – best fuel of the future!" will take place onboard Fjord Line's LNG powered ferry M/S Stavangerfjord. Bringing together buyers and sellers from all Baltic Sea Region, the event will give an ideal platform to get the latest news on LNG technologies, legislation and funding possibilities, explore new markets and become a part of the current and future LNG supply chain.

On 10-12 April 2018, the ferry will host participants, representing business organisations from Denmark, Lithuania, Sweden, Norway, Germany and Poland. Professionals will meet to exchange ideas and opinions about LNG development, to review LNG regulatory landscape, deepen technical and scientific knowledge.

International conference is to be held within the framework of the Go LNG project that has brought together 18 partners from 7 countries.

The speakers list includes the delegates of the international companies *Bureau Veritas Marine & Offshore, Kosan Crisplant, Nauticor GmbH&Co KG, DNV GL, Fjord Line A/S, SkanGas* etc. Academic institutions, such as World Maritime University, established by the International Maritime Organisation (IMO), and Maritime University of Szczecin will also send their delegates to share their presentations.

Formal sessions and discussions will be coupled with matchmaking meetings, possibility to experience the bunkering of M/S Stavangerfjord and guided tour "LNG from the Engine room to the Bridge" – the programme will ensure that attendees were given meaningful time and outstanding networking opportunities.

Organisers of the upcoming conference highlight that new investments are required worldwide to meet the growing LNG demand: "It is time for the Baltic Sea Region LNG Cluster companies and businesses to demonstrate their vast knowledge, cutting edge technologies and newest innovations to the world".

The global demand for LNG is expected to increase 4-5% pr. year between 2015 and 2030. Most of the future LNG growth is anticipated to be created by further floating storage regasification units (FSRUs), the declining domestic gas production, small scale LNG and the transport sector.

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Thank You for your attention!

Asst. Prof. Dr. Lawrence Henesey

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QUESTIONS?....

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