

17th INTERNATIONAL CONFERENCE & EXHIBITION ON LIQUEFIED NATURAL GAS (LNG 17)



LNG as bunker fuel: Challenges to be overcome

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International Organizers



Host Association



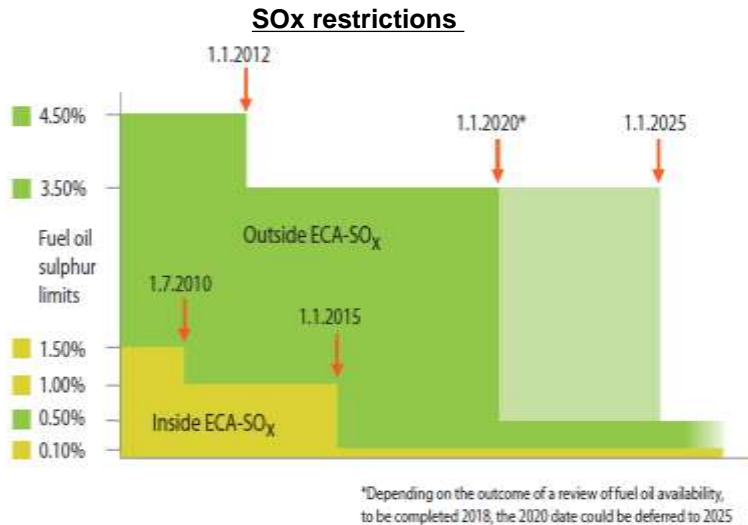
LNG AS BUNKER FUEL HAS A SIGNIFICANT POTENTIAL. HOWEVER, SOME CHALLENGES NEED TO BE ADDRESSED, BUT THERE IS NO SHOW-STOPPER

1. Drivers and regulations
2. Market potential, Economics and competitiveness
3. Challenges: Supply chain development, Safety, standards, codes, regulations...

DRIVERS AND REGULATIONS

Two main drivers for the use of LNG as bunker fuel

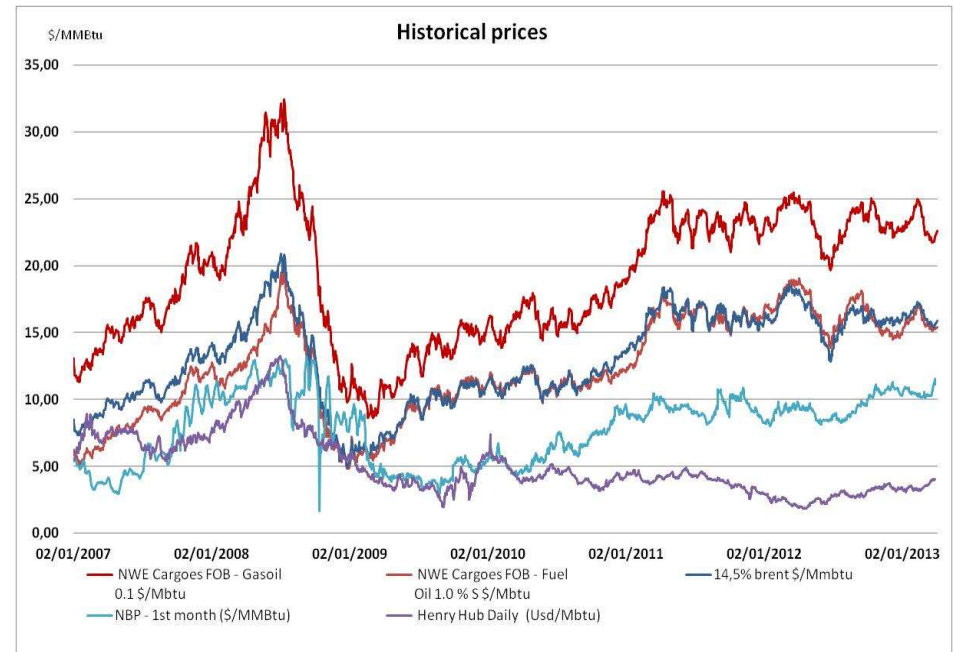
IMO Regulations regulation on SOx and NOx



Emission control Areas



Price differentials in some regions



Bunker volumes impacted by regulations

- 2015 : around **60 Mtpa** LNG equivalent (eq to 70 Mt/y or 1,45 Mbl/d HFO)
- 2025 : around **175 additional Mtpa** LNG equivalent (eq to +200 Mt/y ou +4,25 Mbl/d HFO)

MARKET POTENTIAL FOR LNG AND COMPARISON WITH OTHER ALTERNATIVES

	HFO Low Sulfur (0,5% S)	Gasoil	HFO + Scrubber	LNG
Product availability	1			
Infrastructure development				4
Environment: IMO regulations and beyond				
Technology availability and Impact in ship design			3	
Operations, Maintenance and OPEX			5	
Price		2		6

1. LSHFO: very unlikely: Price and product availability
2. GO: Expensive solution but simple to implement; therefore considered as short term fallback
3. Scrubber solution not always feasible because of ship design (stability). Technology has yet to be proven
4. LNG supply chain and bunkering procedures have to be developed
5. Complicated operations and maintenance (+ sludge management) for Scrubber
6. Scrubber and LNG will compete on price

TOTAL GAS & POWER FORECAST

- **11 Mtpa LNG in 2020** ~3% of LNG market ~5% of overall marine fuel market
- **33 Mtpa LNG in 2030** ~5% of LNG market ~10% of overall marine fuel market
- **Growth will be gradual:**
 - First « short sea » in SECA area, then « deep sea »
 - The « deep sea » market could develop faster than predicted, if economies of scale make the conversion cost effective

BUNKER PRICE COMPETITIVENESS: LNG VS. HFO+SCRUBBER

Considering:

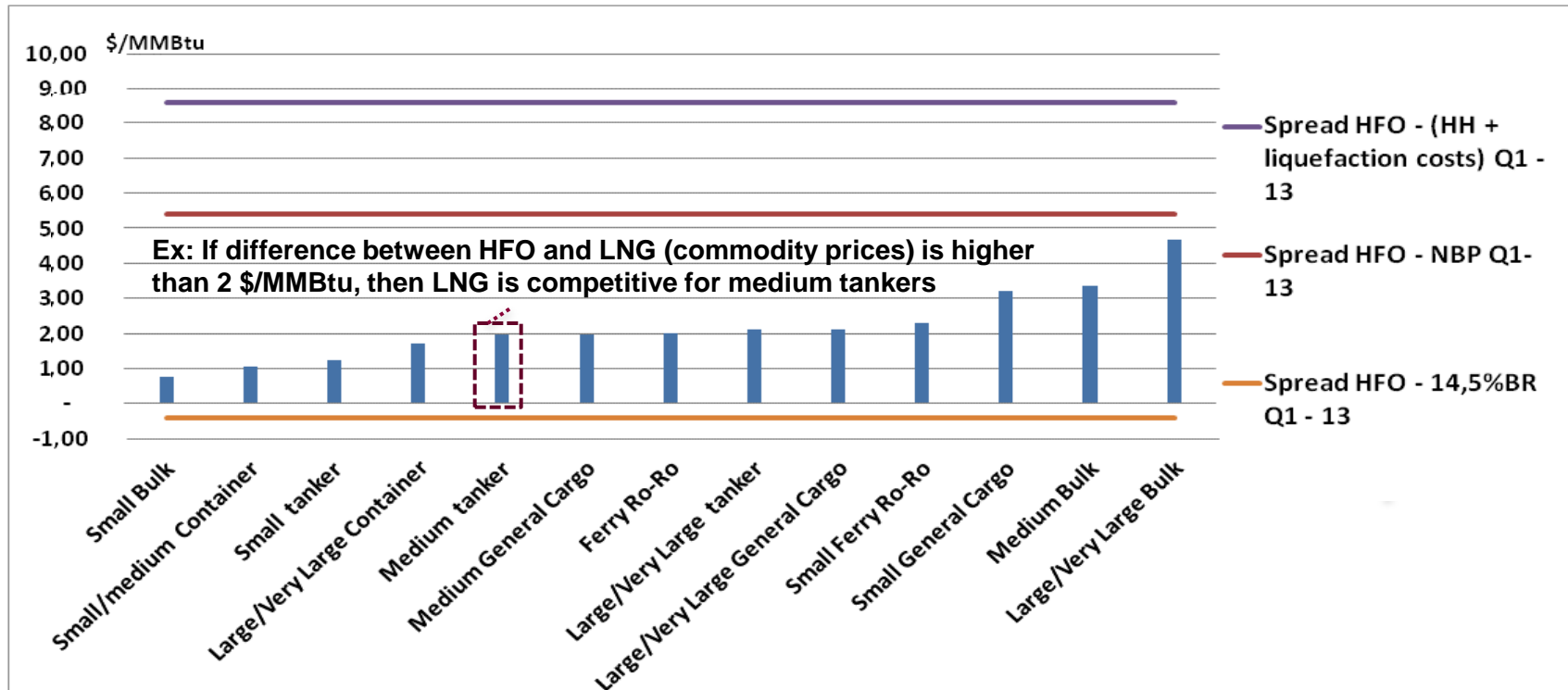
HFO 3.5% + scrubber

- Cost of scrubber
- Extra investment with an RoI of 15% over 15 years
- Additional OPEX: maintenance cost, extra consumption, logistics of products...
- Existing logistic costs

LNG

- Extra Capex on engines and tanks
- Extra investment with an RoI of 15% over 15 years
- Lower maintenance costs
- Loss of commercial space
- Logistic costs

What's the price differential between HFO and LNG in order to LNG being the most economic option?



- With current prices, LNG is only competitive in some regions compared to HFO+ Scrubber (qualitative considerations aside)
- Break-even price for LNG depends on the market (between NBP and Long Term Asian price)

BUNKERS' PRICE COMPETITIVENESS: LNG VS. MARINE GO

Considering:

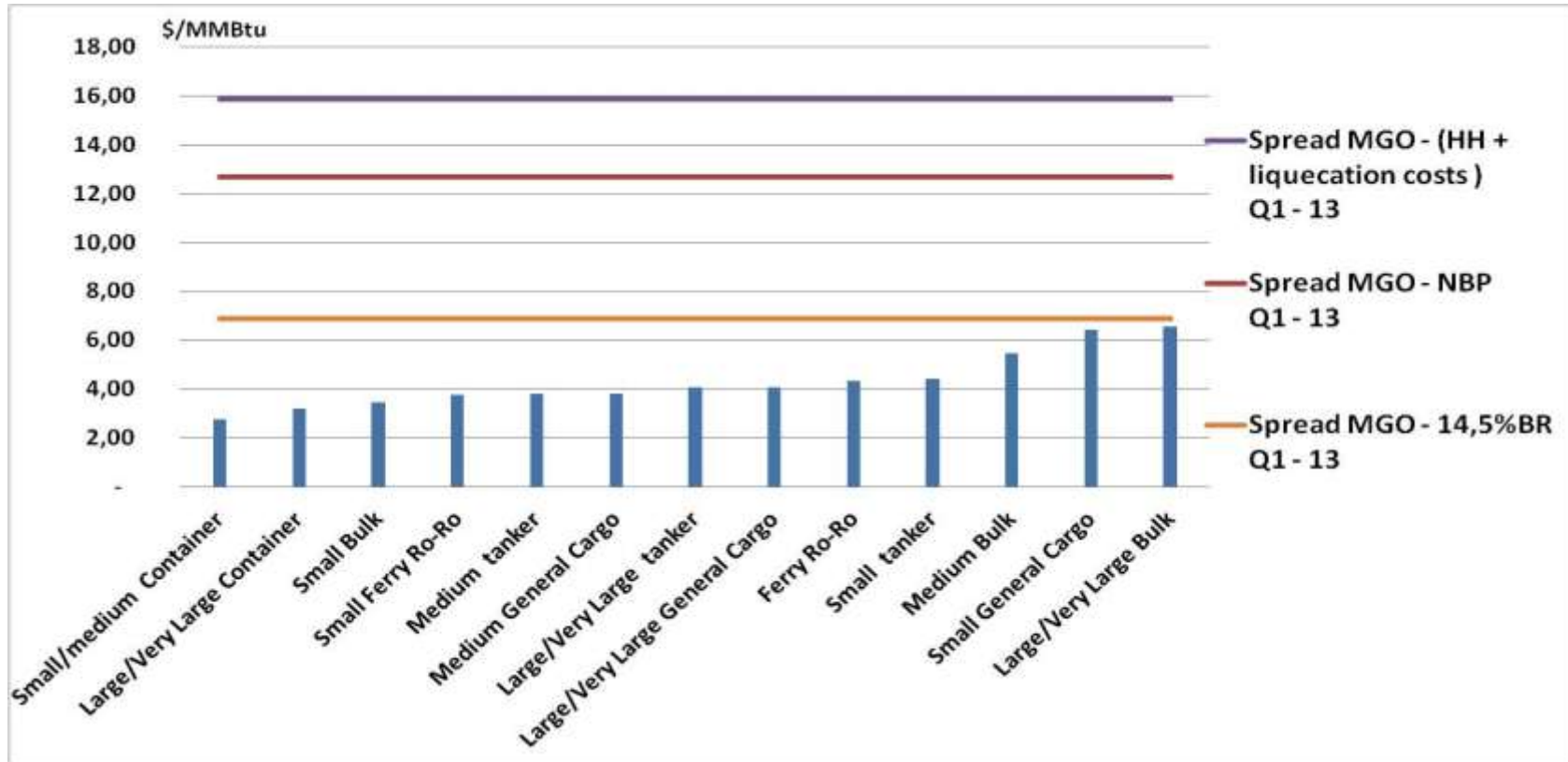
Marine Gasoil (MGO)

- No extra costs required
- Current logistic costs

LNG

- Extra Capex on engines and tanks
- Extra investment with an RoI of 15% over 15 years
- Lower maintenance costs
- Loss of commercial space
- Logistic costs

What's the price differential between Gasoil and LNG in order to LNG being the most economic option?



→ With current price spreads, LNG is competitive in all markets compared to Gasoil

BUILDING THE SUPPLY CHAIN: DESCRIPTION AND COSTS FOR SMALL PORTS

Loading from terminal in Europe



Transport

Phase 1: trucks



Port Logistics and Bunkering



Bunkering from a fixed location land based

Phase 2: feeder ~500 to 2000 m³ LNG

Customers

Short Sea Vessels (mainly ferries)

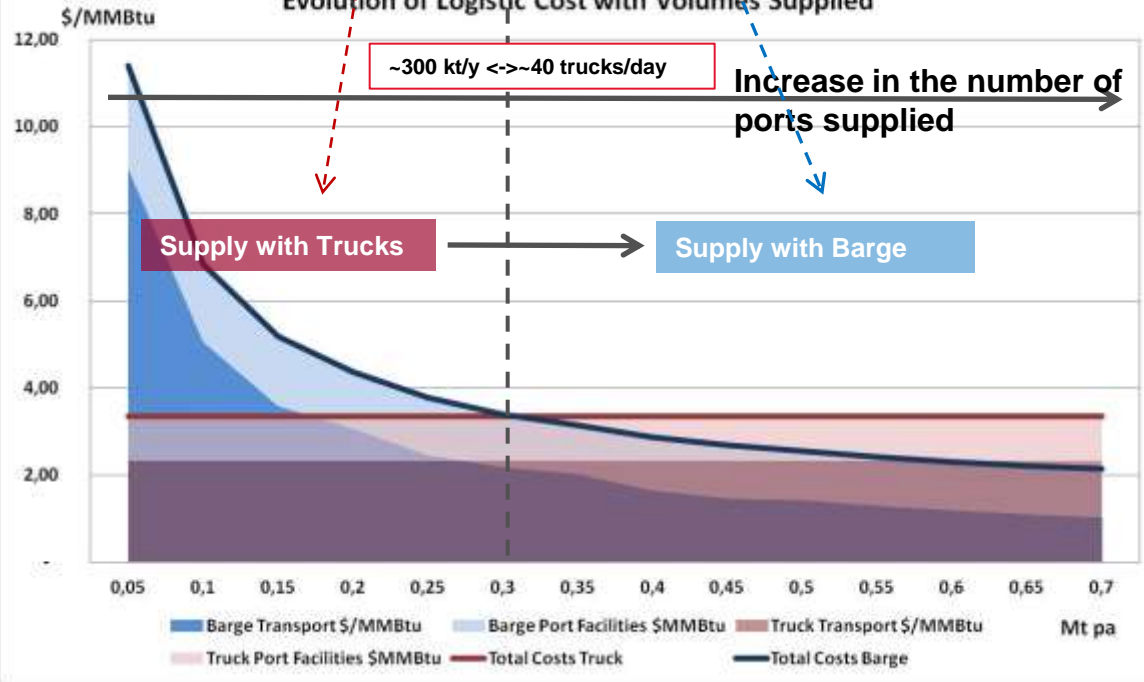
Consumption in one Port: 25 kt – 100 kt

Liquefaction facilities in producing regions (North America)

①

②

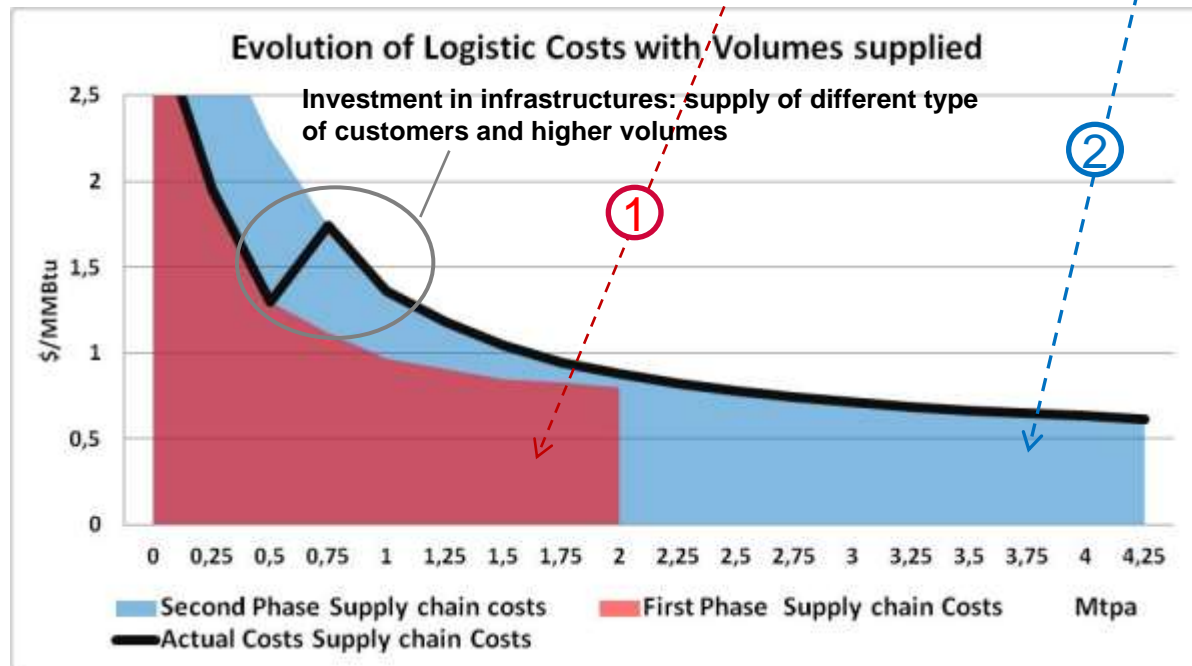
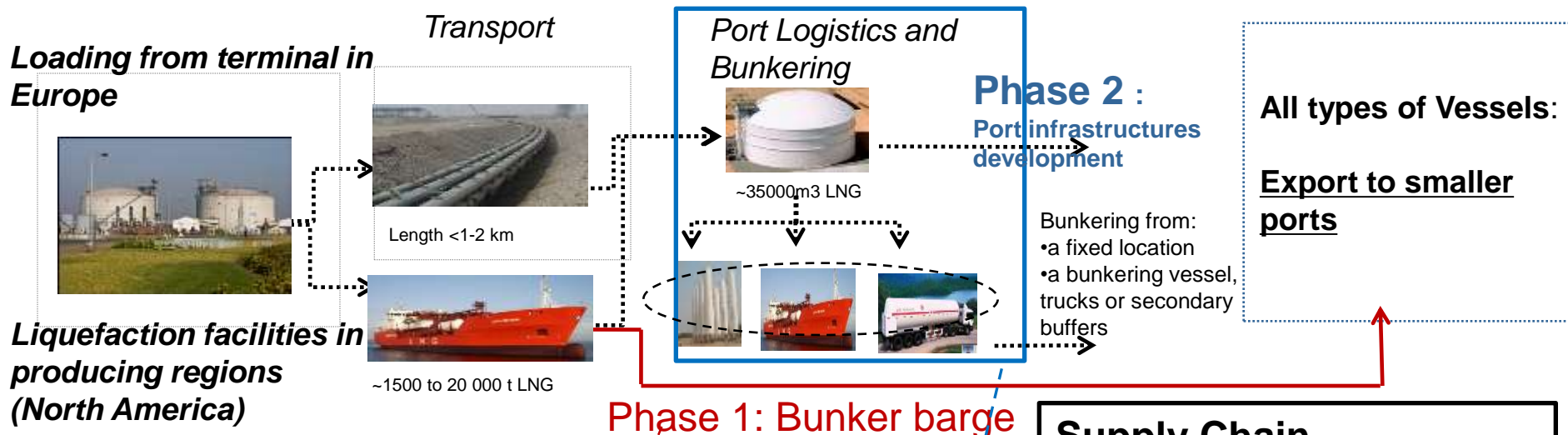
Evolution of Logistic Cost with Volumes Supplied



Supply Chain

- Flexible dimension in Port
→ **Possibility to scale infrastructures development; thus low risk of under/over investment**
- High cost per energy delivered (very low economy of scale):
 - Use of feeders: high volumes or ports supplied
 - Procurement Costs
- Framework to ease permitting procedures and safety standards of small projects is to be developed

BUILDING THE SUPPLY CHAIN: DESCRIPTION AND COSTS: LARGE PORTS



- Supply Chain**
- Dimension adjusted to the highest volume to supply: Risk of over/under investment
 - Economy of scale to be obtained
 - Minimum Volume secured to launch investments
 - Very high market potential with only one project
 - Framework for permitting and Safety procedures to be developed

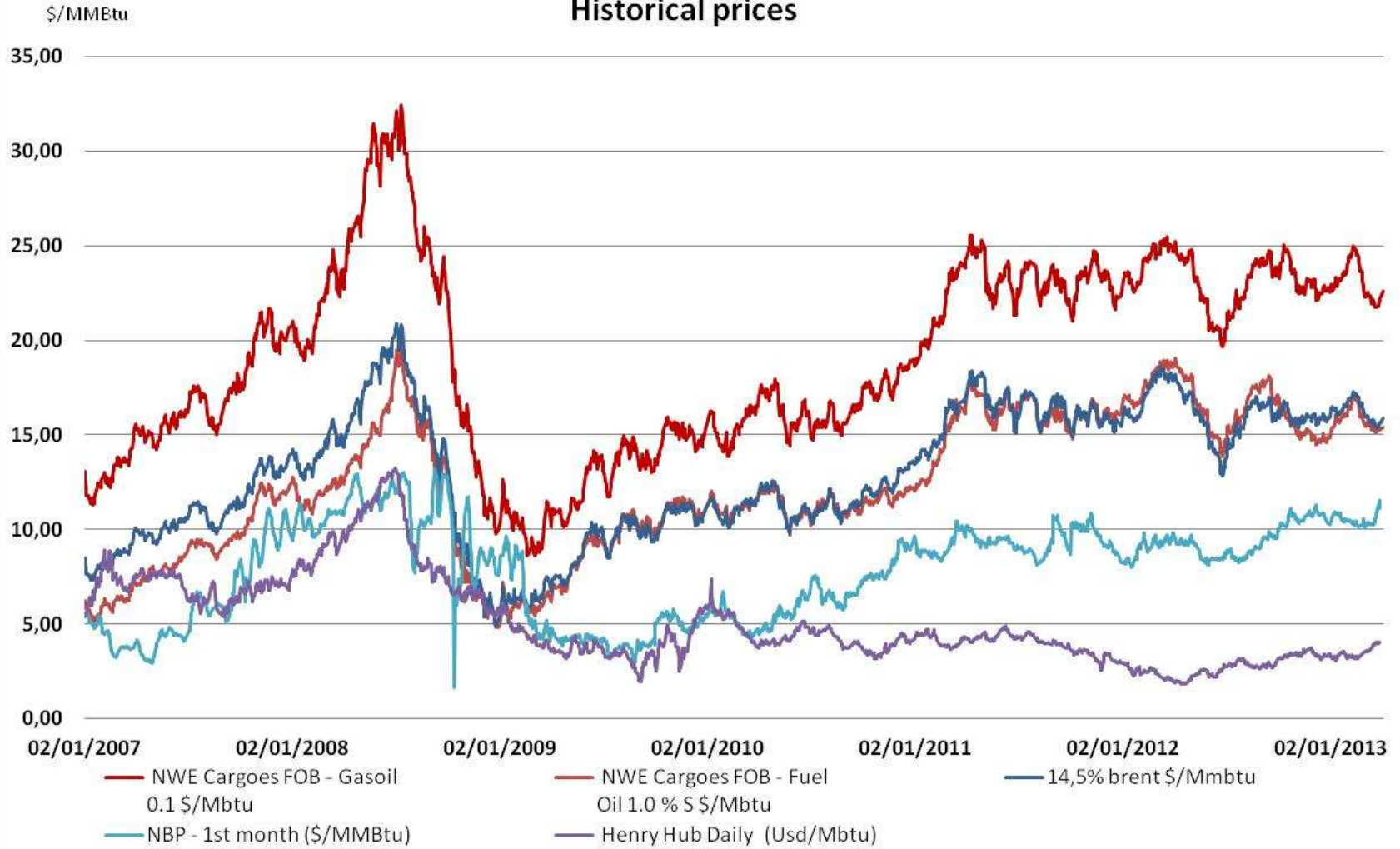
OTHER MAIN CHALLENGES

- Small Scale LNG poses a challenge: A prerequisite is **to maintain Safety track record**
 - LNG accessible to new players
 - Safety needed in Design and Operations
 - Gas stakeholders to share their know-how on LNG
 - It's in the interest of the entire industry!
- **Common Standards** needed in order to develop this market:
 - Useful for shipyards and industry manufacturers
 - Confidence to investors along the chain on technical feasibility and safety
 - Allow deep sea lines to operate
- A clear and stable **regulatory framework** is a must
 - All stakeholders are required to contribute
 - First pilots projects will be considered as reference and are therefore of high importance
 - Safety can't be compromised but requires to be economic
- **Contractual challenges:**
 - Gas Quality: Methane Number vs. HHV/Wobbe, quality adjustments ?
 - Gas contracts vs. Bunkers contracts: ToP, LT commitments, Pricing...
 - LNG terminal Business Model: new business to develop, terminal facilities sizing adapted ?
- LNG Availability in terminals vs. need for long term commitments in Europe

**LNG AS BUNKER FUEL HAS A SIGNIFICANT
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ADDRESSED, BUT THERE IS NO SHOW-STOPPER**

BACK-UP

Historical prices



MARKET POTENTIAL

	Pros	Cons
Gasoil	<ul style="list-style-type: none"> • ‘Business as usual’ for shipowners 	<ul style="list-style-type: none"> • Price. • Product availability.
HFO Low Sulfur (0,5% S)	<ul style="list-style-type: none"> • ‘Business as usual’ for shipowners 	<ul style="list-style-type: none"> • Solutions other than blended products (when feasible) are highly unlikely. Desulfurization units would entail an investment equivalent to that required for the deep conversion processes.
HFO + Scrubber	<ul style="list-style-type: none"> • Product Availability. • ‘Business as usual’ for refiners, bunker suppliers and ship-owners (concerning bunker supply) • In some cases, Price 	<ul style="list-style-type: none"> • Solution has still to be proven • Ship design and stability challenges • Sludge management: need to create a logistics chain and adapt port infrastructure • Higher OPEX, fuel consumption and maintenance costs
LNG	<ul style="list-style-type: none"> • No need to install further treatment for NOx • Potential CO2 reduction • In many cases, Price • Much lower maintenance. 	<ul style="list-style-type: none"> • More space needed for the gas system on board. • Bunkering points and associated logistics to be created. • Safety aspects increase complexity of the supply chain, ship design and operations • Skilled and trained crew

CONTRACTUAL ISSUES

•Gas Quality:

- Engine Manufacturer use Methane Number where gas Industry uses Wobb Index and HHV/LHV
- In Europe: Not compatible with LNG terminal specifications and not possible to physically adapt the quality
→ Contractual / Pricing arrangements
- In US: Liquefaction facilities dedicated to LNG Fuel

•Gas contracts vs. Bunker contracts

- Need for Long term commitments on both sides
- Minimum take-off
- Oil indexed Price formulas

•LNG terminal business model

- New operations and customers to handle
- Smaller ships interfering with current services
- Store of LNG needed: Not always possible in the terminal (because of Design and/or Throughput Agreements)
- Access to new customers: problems of scale. Only available for current shippers as an upside of the traditional business (from large to small?)

• Availability of LNG vs. need of commitments to supply:

- LNG terminals in Europe are receiving less and less LNG
- Current terminals throughput agreements and LNG business are not adapted to small scale
- Demand for bunker will remain low for some time
- LNG delivery commitments can be replaced by pipe gas but this swap is not possible if the LNG is needed in liquid form
→ **Pricing of LNG to attract LNG on a regular basis to Europe.**

SUPPLY ISSUES IN EUROPE: FROM LARGE TO SMALL SCALE?

Considering that:

- LNG terminals in Europe are receiving less and less LNG
- Current terminals throughput agreements and LNG business are not adapted to small scale
- Demand for bunker will remain low for some time
- LNG delivery commitments can be replaced by pipe gas but this swap is not possible if the LNG is needed in liquid form



Several issues to be solved:

- On a start-up phase: commitment for shippers to ensure LNG availability for small volumes vs. loss of opportunity to reroute
 - Need of risk sharing among shippers
 - LNG pricing will take into account this loss of flexibility for very small volumes
- If the business develops: **Pricing of LNG to attract LNG on a regular basis to Europe.**
- ~~If pricing in Europe sinks, consider LNG pricing vs. liquefaction...~~