



# 'LNG Vessels – First Hand Experience'

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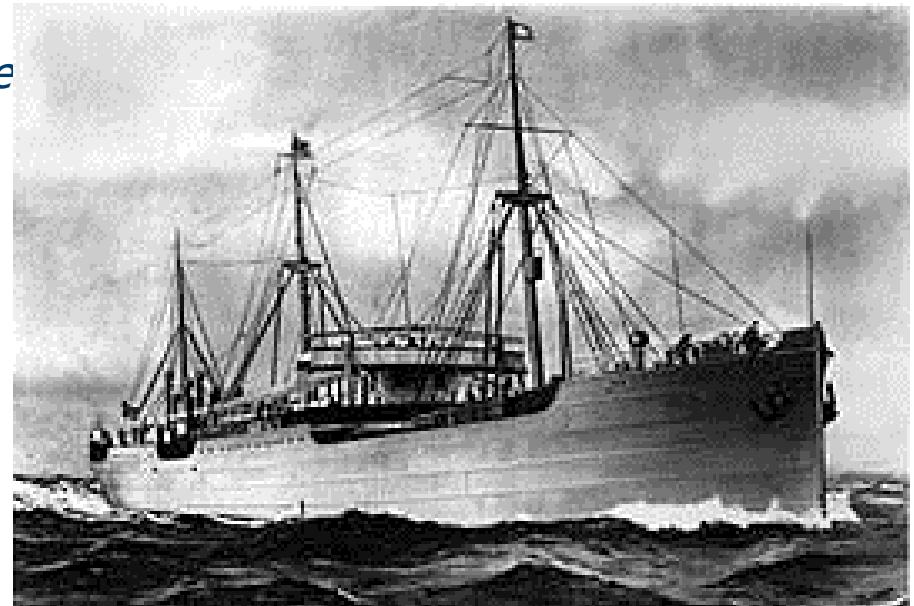
**LNG in Northern Adriatic Ports**  
**9 December 2015, Koper**

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# A bit of history...

*"The success of the sea trials was very marked, and there is every reason to expect that the engines will give equal satisfaction in regular running, and if this anticipation is realised there is no doubt that many oil engined vessels will be built for trading in parts where fuel oil can be regularly obtained."*

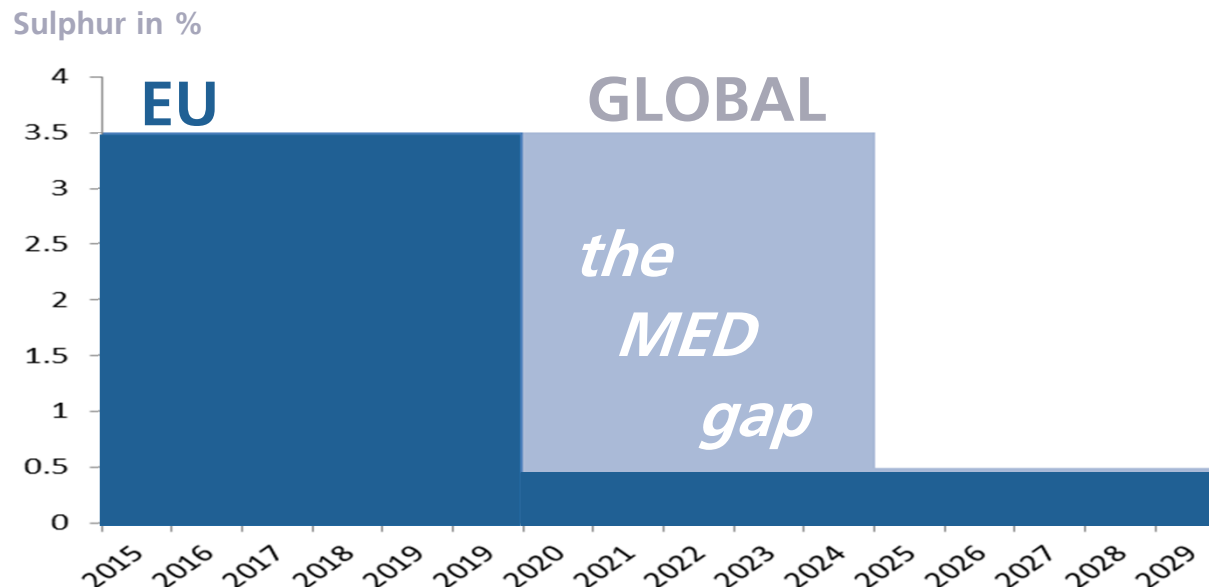
February 1912, extract from the survey report of Lloyd's Register's Chief Engineer Surveyor J T Milton onboard the Selandia, the first merchant ship to be fitted with diesel engines.



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# Marine bunker fuels and regulation of sulphur content

- (HFO) with high-sulphur content accounted for 76% of marine bunker fuel demand in 2010
- Regulators imposing emissions of the harmful pollutant sulphur dioxide (SOx) from ships, strict limits on sulphur content in marine bunker fuel oils implemented in coastal areas known as **ECAs**.
- A strict **global sulphur content** limit of 0.5% will be implemented in 2025.
- As the schedule for the sulphur limits approaches, **LNG as bunker fuel** is being considered as one alternative to conventional marine bunker fuel oils because it produces emissions with a SOx content of virtually 0%.



# Marine bunker fuels and regulation of sulphur content

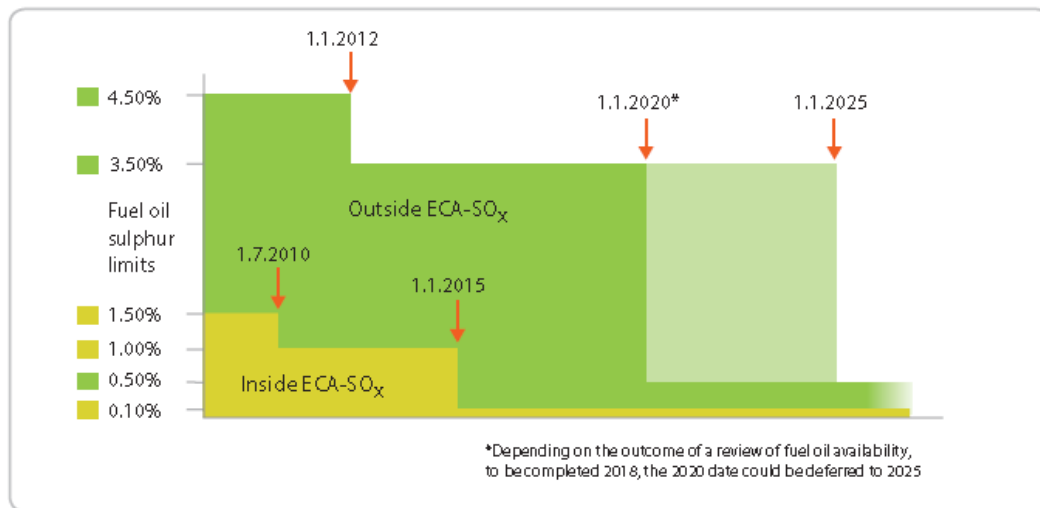
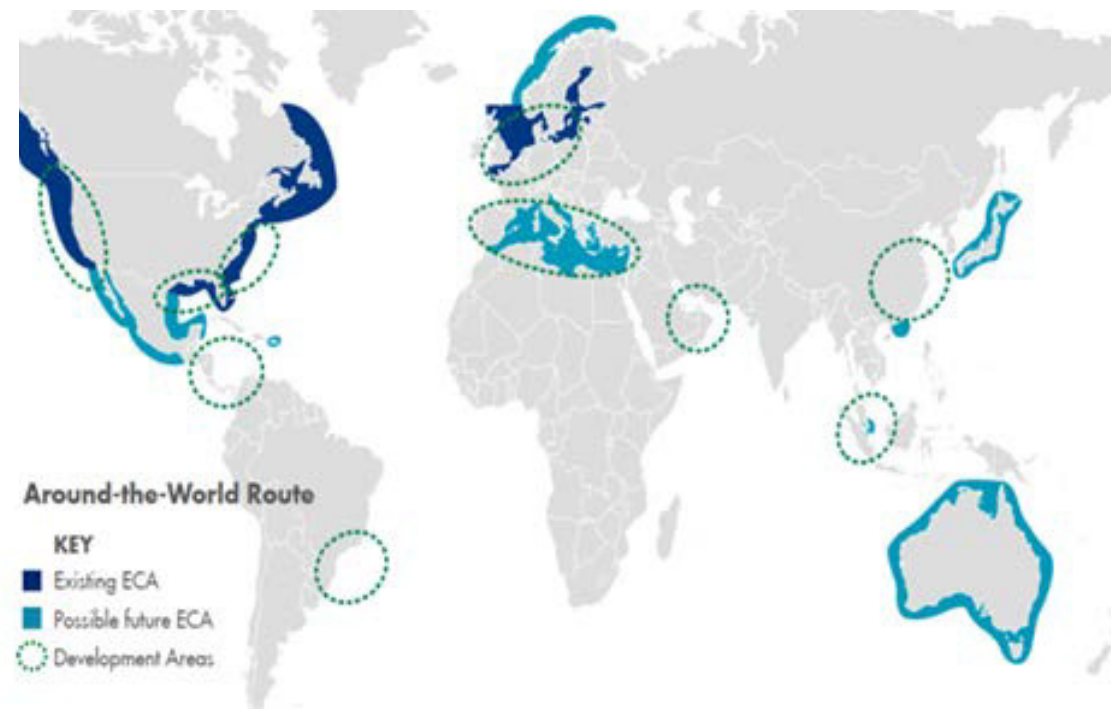


Figure 2: MARPOL Annex VI regulations and enforcement of sulphur limits with respective timelines



# HOW SHIPS CAN COMPLY WITH STRICTER LIMITS

- Operating on low-sulphur fuel oil (LSFO), which, depending on sulphur content limitation, could be marine diesel oil (MDO) or MGO (i.e., distillates)
- Operating on HFO with an exhaust gas treatment system (e.g. SCRUBBERS)
- Operating on liquefied natural gas (LNG)

| Compliance option                   | LNG   | HFO   | MDO/MGO                      |
|-------------------------------------|---|---|------------------------------|
| CO <sub>2</sub> removal             | 10-20%  | Abatement technologies                                      | No                           |
| SO <sub>x</sub> removal             | 100%  |   | MDO: <2 %;<br>MGO: 0.01 -1 % |
| NO <sub>x</sub> removal             | Up to 80-90%  |   | Abatement technologies       |
| Particulate matter                  | 98 -100%  |   |                              |
| Regulation in place                 | Developing  | Yes   | Yes                          |
| Infrastructure                      | Early stages  | Yes   | Yes                          |
| Cultural factors                    | Higher  | Established   | Established                  |
| Cost of use                         | LNG storage tank size; LNG fuel price uncertain; possible loss of cargo space | Abatement technologies required                             |                              |
| Potential to stretch the technology | Further CO <sub>2</sub> reduction   | End of cycle  |                              |
| Challenges /differences             | Bunker space/cryogenics /possible methane slip                                | Abatement technologies<br>Varied blends of distillates 2020 |                              |

Table 2: The three main options for compliance and corresponding emission reductions

# Bunkering infrastructure: a barrier to LNG adoption

- A critical aspect of the development of LNG as a fuel is the lack of an established bunkering infrastructure and supply chain network for delivering LNG as a marine fuel.
- This is considered a significant barrier to the widespread adoption of LNG as a fuel, with gas providers and bunker suppliers unwilling to invest in the necessary infrastructure until there is sufficient demand to supply commercial shipping with LNG fuel
- On the other hand, shipowners are unwilling to invest in LNG-fuelled ships if supplies of LNG bunker are difficult to obtain.



# EU Ports LNG as Fuel



## LNG Bunkering

Under  
Study/Development

Operational

## Alternative Fuels Directive 2014/94/EU

LNG available in EU Core ports by 2025

**LNG currently available as a bunker fuel**

- Antwerp
- Amsterdam
- Rotterdam
- Zeebrugge
- Stockholm
- Several Norwegian Ports

## Under Development:

- Several North Europe Ports

## Under Study

Several West and Med Europe Ports



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# LNG bunker supply assessment – port survey



## Lloyd's Register LNG Bunkering Infrastructure Survey 2014

The outlook of Ports on provision of LNG bunkering facilities



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