



## Meeting report

# Transport

Chair: Farid Benyahia

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### PRESENTATION

#### Shipping and CCS: A systems perspective

N. Mac Dowell and N. Shah

*Centre for Process Systems Engineering, Dept. of Chemical Engineering, Imperial College London, UK*

In this contribution, we present an overview of the contribution made by the shipping sector to global CO<sub>2</sub> emissions. We review the currently proposed technology options for mitigating these emissions, and propose a new option for the control of greenhouse gas emissions from shipping.

### PRESENTATION

#### Green shipping

Talal Al-Tamimi

*RasGas Company Limited, Doha, Qatar*

The state-of-the-art facilities of RasGas and QatarGas process natural gas from Qatar's North Field, the World's largest non-associated gas field. At the Ras Laffan site, gas is liquefied to LNG and then loaded to tankers for transportation. But along with the objective of supplying LNG to customers as efficiently as possible comes the responsibility to be environmentally aware and, in particular, to ensure that any carbon emissions during the loading and transportation are minimised. The presentation outlines RasGas's approach.

The transportation of LNG by the giant tankers designated Q-Flex and Q-Max—vessels with cargo capacities of the order of 215,000 m<sup>3</sup> and 266,000 m<sup>3</sup>, respectively—is discussed. A key point is that, although these vessels are much larger than the conventional carriers, the fuel consumption is almost the same, with obvious economic and environmental advantages. It is emphasised that carbon dioxide emissions to the atmosphere from the LNG cargo itself are minimal since the carriers are fitted with on-board facilities to liquefy the boil-off gas and return the LNG to the cargo tanks.

Mentioned is a proposal to retro-fit systems so that natural gas can be delivered to the existing diesel main engines: LNG from the vessel's cargo tanks will be vaporized and the gas used as the fuel. The benefits of replacing marine diesel fuel with gas are delineated, not only with respect to carbon emission reduction, but also to ensure that the legal restrictions on the sulphur content of a marine fuel are satisfied.

Finally, the Jetty Boil-off Gas Recovery Project (JBOG) is discussed. The project is a major attempt to reduce the BOG generated and flared at the Ras Laffan LNG terminal. It is remarked that GHG emissions can be substantially reduced and the recovered gas can be used to generate a significant percentage of the power required by the State of Qatar.

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## DISCUSSION

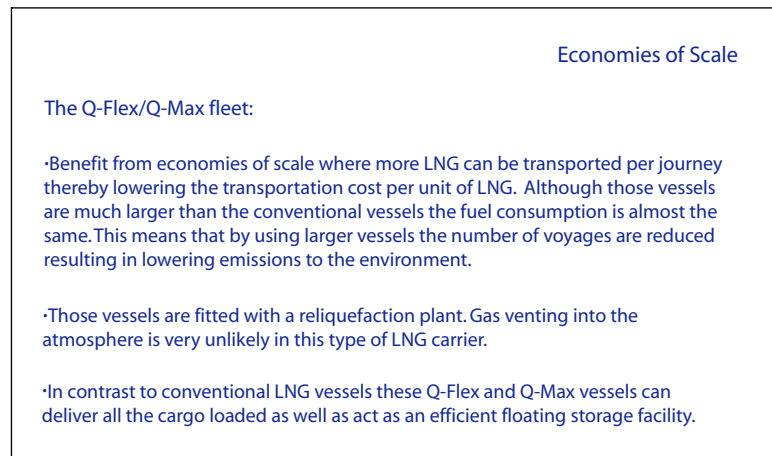
Several in the audience remarked that it was interesting to learn from **Mac Dowell's** talk that the CO<sub>2</sub> emissions from shipping are approximately equivalent to that from road transport and aircraft.

**Apas Bandyopadhyay** (*Qatar Ministry of Environment*) followed up **Mac Dowell's** outline of the special requirements for ship-board capture facilities; two points, for example were mentioned in the paper: that the size of the equipment has to be minimal and, if the equipment was solvent based, the solvent had to have low volatility—to avoid, in particular, a potential fire hazard.

**Mac Dowell** recommended ammonia as a possible candidate. **Bandyopadhyay** then asked if ammonia had been used in shipping. **Mac Dowell** said:

*“To my knowledge ammonia hasn't been used as a sorbent for CO<sub>2</sub> capture from shipping. I think that it is a possible solution though as it is cheap and produces useful byproducts during the capturing process. Other amines, for example MEA, have in fact been onboard submarines for years. So solvents are a feasible solution—though making them operate on the small scale with low energy requirement would be the challenge.”*

The audience, especially those visitors to Qatar, appreciated **Al-Tamimi's** description of the huge tankers, designated Q-Flex and Q-Max, in Qatar's LNG fleet. Discussion was stimulated by the contents of his slide reproduced in Fig. 1. Many in the audience, for example, learnt that the LNG cargo itself does not contribute directly to CO<sub>2</sub> emissions. **Mac Dowell** and others remarked that improvements in fuels, and in ship construction and operation in general, would give significant reductions in GHG pollutants. **Lindstedt**, for instance, remarked that more efficient propeller systems would obviously reduce emissions.



**Figure 1.** Description of economies of scale of the Q-Flex/Q-Max fleet, from Al-Tamimi's slides.

**Robert Steele** (*QatarGas*) stated that the Qatar fleet used a 5% pilot fuel largely in order to satisfy the mandated maximum sulphur content, but he also added that converting the engines to burn natural gas is an obvious solution to reducing sulphur and other pollutant emissions. **Al-Tamimi** reinforced this statement:

*“Using LNG as energy source onboard the LNG carriers will reduce the amount of sulphur produced from the vessels and will allow the vessel operators and the charteres to comply with the mandated rules inside the emission controls area in Europe and other parts of the world.”*

Attendees took up **Al-Tamimi's** brief overview of the Ras Laffan Jetty Boil-off Gas Recovery Project; to quote from the website (April 4th, 2012)<sup>1</sup>:

*“The ‘Jetty Boil-off Gas (JBOG) Recovery Project’ aims to recover gas currently being flared during Liquefied Natural Gas (LNG) ship loading at the Port of Ras Laffan. The*

<sup>1</sup>[http://www.zawya.com/story/Qatargas\\_Jetty\\_Boiloff\\_Gas\\_Project](http://www.zawya.com/story/Qatargas_Jetty_Boiloff_Gas_Project).

*project is part of the Common Facilities Projects at Ras Laffan Industrial City in the north of Qatar. The project will enable boiled-off gas to be collected from LNG ships and compressed at a central facility. The compressed gas will then be sent to the LNG producers to be consumed as fuel or converted back into LNG. This project, when fully operational, will recover the equivalent of some 0.6 million tonnes per year of LNG.”*

Thus, not only would a reduction in flaring reduce GHG emissions directly, the recovered gas could be used to generate power for domestic consumption.

**NOTES**

All presentations and related materials referred to in this article are available as ‘Supplementary Material’ online at <http://www.qscience.com/toc/stsp//CCS+Workshop>.