

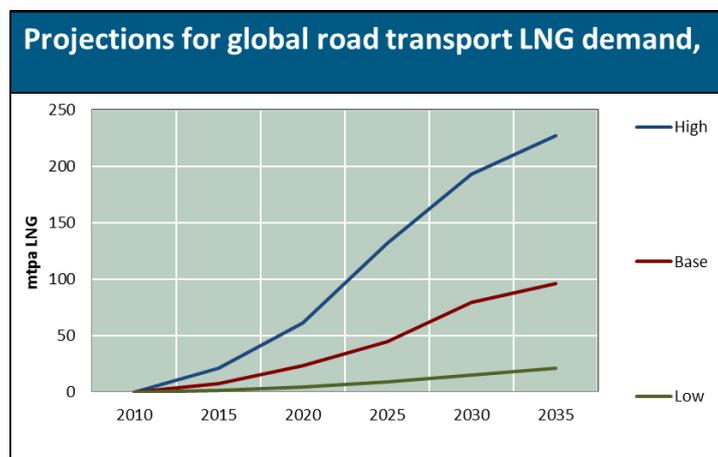


Rueil-Malmaison, September 29, 2014

According to a new report by CEDIGAZ, the International Center for Natural Gas Information, LNG as a fuel will capture a significant market share in the transport sector by 2035. The greatest potential is seen in road transport, where annual demand is projected to reach 96 million tons per year (mtpa) in CEDIGAZ' base scenario while demand in the marine sector could grow to an estimated 77 mtpa. The rail sector could add another 6 mtpa to global demand. However, the development of LNG as a transport fuel faces a number of challenges, and will have to go hand in hand with the development of fuelling infrastructure.

■ Fuel cost differentials will drive the growth in trucking sector

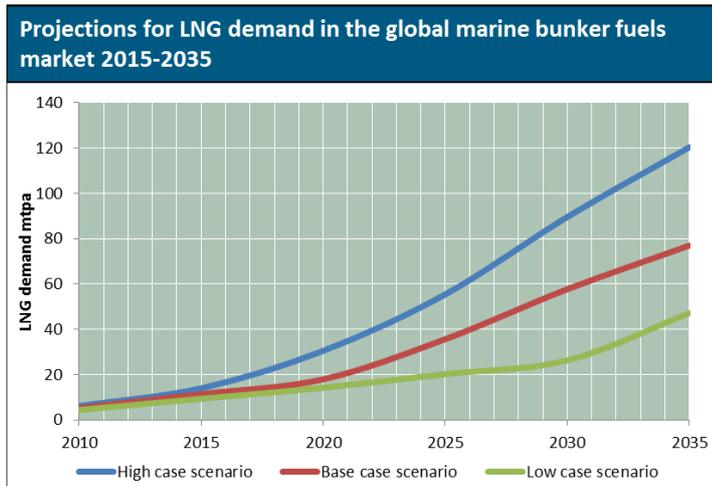
Use of LNG in land transport will be largely limited to heavy duty vehicles (HDV) and will essentially be driven by the difference between the price of diesel and that of LNG. In contrast with the marine sector, environmental legislation is unlikely to play a major role in triggering the adoption of LNG as a fuel for land transportation, as traditional fuels and technologies will be able to comply with the gradual tightening of emissions standards.



However, the cost advantage of LNG relative to diesel currently provides a strong economic incentive in the trucking industry. In its base scenario, CEDIGAZ projects a worldwide demand of 45 mtpa in 2025 growing to 96 mtpa in 2035, with China representing almost half the global market. China has several features that combine to make it a prime candidate for the development of LNG in the road sector. The country has the world's largest inland goods transport market and has already developed an extensive LNG supply infrastructure, initially as a means of transporting gas from remote fields or to consumers who were not connected to the pipeline supply network. With at least 100,000 LNG vehicles and 1,100 refuelling stations at the end of 2013, China already has a head start over the rest of the world in this nascent market. However, gas price reform in China may slow LNG growth there. LNG should also carve out a significant market share in the US, Europe and the rest of Asia.



■ Environmental legislation will be key in the marine sector



There is little doubt that the use of LNG as a fuel will grow in the marine sector, though the rate and pace of growth will be highly dependent on the timing and geographical scope of emissions restrictions set out in the MARPOL treaty. Compliance with the new emissions limits will require either: to switch to cleaner but more expensive oil-based fuels, to implement costly flue gas treatment technologies, or to switch to LNG. Economic analysis taking

into account all relevant factors (capex, opex, operational constraints, loss of cargo space etc.) show LNG to be a very attractive solution when compared to other compliance solutions, although the breakeven time will depend on several parameters such as the age of the vessel, the cost differential between LNG and traditional fuels, and the time spent in Emissions Control Areas (geographic areas with stricter emission standards under the MARPOL treaty). CEDIGAZ' base scenario projects the demand for LNG as a marine bunker fuel to reach 35.7 mtpa in 2025 and 77 mtpa in 2035.

■ LNG in rail could play a role in a small number of countries

Rail has a relatively low share of energy consumption in the transport sector. In addition, the potential for LNG in the rail sector is likely to be most evident in countries with high levels of long haul freight and low level of penetration of electric powered traction in the freight sector, conditions found in relatively few countries. In CEDIGAZ' base case, LNG demand in rail is projected at 0.9 in 2025, 3 mtpa in 2030 and 6.2 mtpa in 2035. The countries with the highest potential are the United States, China and India.

For more information: info@cedigaz.org

Cedigaz (International Center for Natural Gas Information) is an international association with around 90 members worldwide, created in 1961 by a group of international gas companies and the Institut Français du Pétrole Energies nouvelles (IFPEN). Dedicated to natural gas information, CEDIGAZ collects and analyses worldwide economic information on natural gas, LNG and unconventional gas in an exhaustive and critical way.

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LNG IN TRANSPORTATION

CEDIGAZ September 2014 – 402 p. – PDF format – public price €2,400 (VAT excluded) for a one user license

STRUCTURE OF THE REPORT

The report is divided into three parts. **Part One** provides a detailed overview of the technology for utilising LNG as a transport fuel in each sector, and considers the key economic and environmental drivers for the adoption of LNG as a transport fuel. **Part Two** builds on this foundation to analyse the potential growth of LNG in transportation over the period 2014 to 2035, and **Part Three** provides detailed data and analysis on key markets for LNG in transportation.

Part One is sub-divided in four chapters. **Chapter One** describes the Global LNG supply chain, reviewing the interaction between the existing LNG industry and infrastructure, and the potential utilisation of LNG in transportation. **Chapter Two** reviews the utilisation of LNG in the shipping sector, including the different storage and refuelling technologies, and impact of MARPOL and the establishment of Emissions Control Areas (ECAs), and the economic drivers for LNG. **Chapter Three** reviews the utilisation of LNG in the road transport sector, including analysis of the engine types, the choice between CNG and LNG (as well as diesel) for HGVs and other vehicles, and the key economic and environmental drivers. **Chapter Four** considers the potential use of LNG in the rail sector, including engine and refuelling technologies, competition with diesel and electric power and key drivers.

Part Two addresses the question of the size of the potential market for LNG as a transport fuel in two ways. **Firstly**, it provides the CEDIGAZ view of LNG usage in each of the marine, road and rail sectors by modelling future LNG usage based on an analysis of the data available. **Secondly**, it undertakes a review of various public domain projections made by stakeholders for each these sectors. As a result of this dual analysis it is possible to produce a range of projections for future LNG usage in the marine, road and rail transport sectors over the period 2015-2035. **Finally**, Part Two of this report concludes by combining the CEDIGAZ analysis of LNG usage in the different sub-sectors in order to produce an aggregated range of LNG usage projections for the transport sector as a whole for the period 2015 to 2035.

Part Three provides detailed data (at the extent that is available) on use and infrastructure for LNG in transportation for 46 countries around the world. Part Three is sub-divided into chapters covering each region. Within the chapters there is a regional summary of facilities and prospects for LNG in transport, and then country by country analysis of the potential LNG market, bulk LNG supplies (including a list of LNG terminal facilities), and LNG filling stations, operational and proposed.

THE AUTHORS

Chris Le Fevre has worked in the energy sector for over 30 years including a variety of positions to executive director level in Transco and British Gas. Before that he worked for Shell International in the Netherlands and Malaysia. Since 2002 Chris has run a successful independent energy consulting business serving a range of clients throughout Europe. Recent projects include LNG terminal and gas storage studies, UK and continental gas market studies for project principals and lenders, advice to European gas companies on liberalisation, gas sourcing and business development, assistance on energy sector due diligence for buyers, executive training and analysis of energy retail issues.

Mike Madden is the Managing Director of MJMEnergy, an international expert in gas, LNG infrastructure and energy markets. As a chartered engineer with over thirty-three years' operational and commercial experience, bringing a unique blend of technical and commercial experience to clients and this report in particular. He started his career at British Gas (BG) in gas transmission operations before moving to BG's Gas Transportation Services. Where he led team of negotiators, negotiating gas transportation and storage contracts. Mike founded MJMEnergy in 1995, which has been involved in providing consultancy and training services to the world's energy markets in over 40 countries. In particular Mike has provided consultancy on gas market liberalization and restructuring, gas storage, transmission, network codes, LNG imports and TUAs. *Mike has also written a number of energy related is currently working on the forthcoming MJMEnergy LNG Supply Handbook, 2015-2035*

Nick White is Principal Consultant at MJMEnergy, where he has been working since 1997, covering a wide range of

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research, consultancy and training. Key areas of expertise include energy market liberalisation, energy trading, LNG, gas storage, regulation, and third party access to infrastructure. Nick currently heads up MJMEnergy's training business, where he is Course Director on the LNG Economics and Markets course, as well as working on a range of consultancy projects. Nick is the editor of MJMEnergy's *LNG Today* report, and is co-author of a number of other energy market reports, including *Liberalising Gas Markets in Europe*, *Convergence in the Global Gas and Power Industry*, and *the Long-term Capacity Auctions*. He is currently working on the forthcoming *MJMEnergy LNG Supply Handbook, 2015-2035*.