NATURAL GAS IN TRANSPORT: TOMORROW’S FUEL TODAY

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ABSTRACT

Over the last decade, the price of diesel in the US has increased on average 12 percent per year\(^1\). Meanwhile, North America has an abundance of natural gas – enough to supply the next 100 years at current demand levels. With technologies that have helped to unlock these natural gas reserves and enabled efficient and economical development, this abundant supply is the basis of the affordability of natural gas in North America today. Natural gas is the cleanest-burning fossil fuel and LNG is the most energy-dense form of natural gas. LNG is a fuel of the future—available now.

Shell has a worldwide reputation for leadership in fuel and LNG technologies and is a leader in global LNG supply. As global demand for transportation fuels increases, including LNG, Shell is well positioned to meet this demand through decades of experience in LNG production, transport and distribution as well as in fuels distribution and development.

INTRODUCTION

The emerging world continues to grow fast, despite continued economic turbulence in Europe and other places. Along with this growth comes demand for energy – which is expected to double by 2050\(^2\). Natural gas will play a major role in the future energy mix due to its abundance, affordability and versatility.

Growing demand for energy is also driving huge changes in mobility. With five more people added to the population every second, our planet will to be home to more than 9 billion by 2050, many of them living in urban centers.

On land, these changes mean the number of cars and trucks is set to double to 2 billion by 2050\(^3\). At sea, the international shipping industry, already responsible for the carriage of around 90% of world trade\(^4\), will continue to grow\(^5\). At the same time, concerns about the environment are increasing.

Shell is constantly finding innovative ways to address these challenges and help move more people and goods cost-effectively and with reduced impact on the environment.

To meet growing global demand for transportation, we believe a range of different vehicle and fuel options will be required. While markets will vary in terms of their choices, LNG – natural gas in its liquid state - is now one of those transport fuel options.

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\(^1\) U.S. Energy Information Administration, U.S. No 2 Diesel Retail Prices from 2002 - 2012
\(^2\) U.S. Energy Information Administration, Short-Term Energy Outlook, January 2010
\(^3\) International Energy Agency, Transport, Energy and CO2: Moving toward Sustainability, 2009
\(^4\) International Chamber of Shipping, World Trade and the Reduction of CO2 Emissions, 2009
WHY NATURAL GAS IN TRANSPORT?

For around 50 years, liquefied natural gas or LNG has been used as a source of energy in the power sector. Now that natural gas is abundant, is sourced from a diverse range of countries and can be produced at a smaller-scale, LNG can also be used as a fuel for transport.

LNG as a transportation fuel has the potential to provide real economic and environmental benefits for operators in large, heavy duty applications such as ships, mining, trucks and trains. Since there is an abundant supply of natural gas, it is affordable - making LNG a cost-competitive alternative fuel.

When compared to conventional diesel, LNG used in transport has the potential to reduce emissions. Due to its product benefits and particularly its ability to help reduce local emissions without adding complexity to businesses, LNG fuel is expected to take off rapidly in the marine sector as the strict regulatory emission guidelines (ECA or emission control areas) continue to be implemented in North America and Western Europe.

LNG as a marine fuel has gained momentum within the last couple of years with several ports in Europe (including Norway, the Netherlands and those in the Baltic Sea) supplying LNG for maritime use. In the United States, several ferry systems are exploring options to invest in modifications to move to LNG and commercial carriers are also considering the shift.

BENEFITS OF LNG AS A FUEL

LNG as a transportation fuel has the potential to provide economic and some environmental benefits for operators of fleets of heavy-duty trucks, ships and trains as well as other industrial vehicles such as those in the mining sector.

For heavy duty truck operators facing a challenging economic climate, using LNG rather than diesel can reduce fuel costs by almost a third. Due to this, LNG is a highly competitive fuel option, particularly for those operators looking to invest in a new fleet. LNG also has the potential to deliver greenhouse gas savings. For those operators with spark ignition engines, LNG could deliver noise reduction.

For marine customers, LNG could also be a cost competitive fuel option and one that could help them comply with environmental legislation due to the potential to reduce local emissions namely sulphur oxide, nitrogen oxide and particulate matter.

SHELL AND LNG

Shell is a pioneer and a leader in the LNG industry. Shell helped to design and build the first commercial onshore LNG plant in 1964 – and has been designing and building such plants ever since. Shell is involved in every stage of the LNG value chain: from production, to liquefaction, to the shipping and distribution of natural gas to customers.

The LNG commercial fuel market is a natural extension of Shell technical and commercial expertise. Shell is able to take a leading role in developing the LNG for transport fuel industry because of its integrated business model and decades of LNG experience.

SHELL AND LNG IN TRANSPORT

Given Shell’s expertise across the LNG value chain, the extension into this market is a good fit for Shell.

As a fuel for trucks, LNG is relatively new but Shell is at the forefront of its deployment. In 2011, Shell made an investment decision to develop the production and refueling infrastructure, to supply LNG along a truck
route in Alberta, Canada (see Canadian Green Corridor). Shell also has plans to work with TravelCenters of America to provide LNG for heavy duty truck operators across the USA.

As a fuel for ships, LNG also has real potential. It has been used as a fuel by large ocean going LNG carriers for decades. However, it is still a new fuel option for other vessels such as cruisers, ferries, barges, tugs and offshore support vessels. Shell plans to create a viable LNG sales business in Europe with a focus on this more diverse marine sector. In fact, last year Shell acquired a Norwegian company called Gasnor to supply LNG to marine users in the Baltic region.

Shell also recognizes the potential of LNG and is looking into ways to use LNG as a fuel to support its own operations. For example, Shell signed a charter agreement for two 100% LNG-powered barges that will provide petroleum transportation along the Rhine in Europe. These barges will be taking advantage of LNG that will be available in the Rotterdam area.

CANADIAN GREEN CORRIDOR

Building on its expertise and the growing opportunity for LNG as a fuel, Shell has begun to develop an LNG fuel infrastructure and delivery system, focused in the Americas.

In 2011, Shell announced it would create a corridor of LNG fuelling stations in Alberta, Canada. These stations are now under construction to provide LNG to heavy-duty truck fleet customers at select Shell Flying J truck stops along the Canadian Green Corridor this year.

In order to produce LNG to meet customer demand, Shell developed the Moveable Modular Liquefaction System (MMLS) technology to deliver LNG on a smaller scale that would be economic and convenient for use in the transport sector. While some LNG for transport demand can be met by existing infrastructure, the MMLS enables Shell to capitalize on smaller scale opportunities where greater infrastructure investment would not be viable.

Construction has begun on one of these facilities, the Shell Jumping Pound gas processing facility in Alberta, Canada which is expected to begin producing LNG within the next year.

COLLABORATIVE PARTNERSHIPS

Shell is also actively developing new business opportunities with Original Equipment Manufacturers (OEMs) to substitute LNG for diesel and propane in a number of industrial sectors such as marine, on-road trucking, rail, mining and oil and gas drilling applications. Some of these include:

- An agreement with Wärtsilä North America to accelerate the deployment of marine engines which use LNG as a fuel.
• An agreement with **Westport Innovations Inc.** (Westport) to establish a co-marketing program in North America. This program provides customers a comprehensive and value-added package that includes fuel supply, customer support and comprehensive maintenance.

• An agreement with **GE’s transportation division** to jointly develop a solution for use of LNG for rail including the infrastructure required and a locomotive capable of running on both diesel and LNG.

• Additionally, Shell is currently collaborating with other technical companies to develop LNG infrastructure solutions for the North American mining industry. These solutions are intended to bring fuel cost reductions and emissions improvements to the sector through focused applications in the form of mobile mine haul fleets and other stationary applications.

**ROLE OF GOVERNMENTS**

Across all markets, comprehensive and enabling policies and regulatory environments will key to facilitate the increase in LNG deployment in transport. Policy will be needed to address market barriers and to ensure that the industries providing the fuels and technologies become competitive over the long term. Shell believes the following government actions would reduce market barriers and support faster deployment of LNG as a transport fuel:

• Provide short-term fiscal measures to LNG customers to reduce their investment risk and support early adoption.

• Develop or update design and safety codes, permitting and operating standards for the supply, distribution, storage and dispensing of LNG.

• Over the longer term, it will be important for LNG fuel to be able to compete on a level playing field with other fuels based on its own merits. This principle should be considered in terms of the design and duration of any policies moving forward.

**CONCLUSION**

It is generally thought that the LNG in transport sector will develop into a sizeable market in North America and Europe. In certain emerging markets such as China and India, LNG could be adopted on an even wider scale.

LNG is a credible alternative to diversify the Shell fuels portfolio with a cost-competitive, cleaner burning fuel for heavy-duty applications. While this LNG market will be small in the bigger scheme of global natural gas volumes, Shell hopes to develop a market material and profitable niche opportunity with a lot more potential for the future.