

GLOBAL LPG MARKETS, SUPPLY & DEMAND – 1 Tonnes=522 Gallons

Global events in 2011 have threatened the stability of the global LPG market. Ongoing public protests in the Middle East and North Africa have resulted in a civil war in Libya, government changes in Egypt and Tunisia, and scores of deaths in other countries, especially Syria and Libya. Japan's earthquake and resulting tsunami have created demand uncertainty in the world's largest LPG importing country.

Global LPG supply decreased by 1.1 million tonnes in 2009 relative to 2008. This was the first drop in production in more than 25 years. In 2010 production rebounded by nearly 6.2 million tonnes to about 241 million tonnes worldwide.

LPG supply should increase to 275 million tonnes by 2014 from about 241 million tonnes in 2010. Although LPG supplies from refineries should increase during the period, nearly 75% of the LPG increase is likely to come from the processing of natural gas.

Because LPG is a by-product of other processes, there is little ability to adjust LPG production to changes in demand. LPG storage is limited in most regions of the world. Consequently, prices can change rapidly in response to supply and demand. Arbitrage helps to make regional supply adjustments, but when global LPG supply length occurs (either seasonally or structurally), a demand response is needed to consume surplus LPG supplies.

This demand response comes from the petrochemical industry, which can quickly substitute relatively large amounts of LPG for other chemical feed stocks and is therefore highly sensitive to LPG pricing. This price-sensitive LPG demand accounts for about 3-7% of global LPG demand in a typical year.

Slightly more than half of global LPG demand comes from residential and commercial markets for heating and cooking in homes and businesses. Nearly 20% is chemical feedstock in applications that are not price-sensitive. The industrial market consumes about 9% of total LPG demand.

Another 9% of LPG becomes engine fuel (autogas), which excludes butanes used by the refining industry for gasoline blend stock and alkylation (5%). The remaining uses for LPG include agricultural applications and the manufacture of synthetic natural gas.

In 2010, base **LPG world demand** increased by about 3.1% to 231 million tonnes vs. 2009, but total supply only increased by 2.6%. Price-sensitive demand decreased in 2010, since more LPG was required to satisfy base demand. Total demand was about 240 million tonnes in 2010.

For 2010-14, it is expected that additions to LPG supply will outpace the growth in base demand, thus requiring more surplus LPG to be absorbed by the petrochemical industry. Total LPG supply will likely grow by nearly 3.4%/year through 2014, but LPG base demand is likely to grow at only a 3.0%/year in the same period. Total demand should reach about 260 million tonnes by 2014.

The Middle East is the world's largest LPG exporting region and the second largest LPG producer after the US-Canada. The Middle East produced about 51.9 million tonnes of LPG in 2010, which was nearly 22% of global production. Net exports were about 28.7 million tonnes. In the Middle East, about 75% of LPG production comes from associated gas and refineries.

LPG production in the Middle East increased by about 12.6% in 2010, following a 3.5% drop in 2009 related to OPEC reductions in crude oil production. Saudi Arabia is by far the largest producer in the region, with about 21.0 million tonnes of LPG production in 2010. Saudi Arabia is also the largest exporter with around 8.8 million tonnes shipped in 2010, but Qatar is now a close second at about 8.2 million tonnes.

Future LPG production and exports depend on the progress of projects that produce LPG as a by-product. Many projects have fallen behind announced schedules. Nevertheless, LPG production has been surging in Qatar due to several natural gas projects, and projects in the UAE should continue to increase LPG production there. Production has also been increasing in Iran, but Iranian LPG production fell behind both Qatar and the UAE in 2010.

LPG production in the Middle East should reach about 67.7 million tonnes by 2014, making the Middle East the largest production region in the world. This forecast assumes that civil unrest in the Middle East does not significantly disrupt LPG production. Thus far, the impact of the protests and government changes in the Middle East on LPG production has been small.

It is expected LPG demand in the Middle East to grow to about 30.4 million tonnes by 2014.

LPG production in **Latin America** (including Mexico and the Caribbean) was about 25.0 million tonnes in 2010, up about 1.7% compared with 2009. Gas processing accounted for about 63% of LPG production. Brazil and Mexico produced about 6.6 and 6.4 million tonnes of LPG in 2010, respectively, or a total of 52% of Latin American LPG production.

LPG production in Mexico has generally been declining since 2004, while a steady increase in Brazil has nearly offset Mexico's decline. Venezuela, Argentina, Peru, and Trinidad are also major LPG producers in the region, comprising another 38% of indigenous LPG supply.

It is expected LPG production in Latin America to climb to about 27.3 million tonnes by 2014, with the largest production gains in Colombia, Brazil, and Peru. Colombia plans expansions in both gas processing and refinery capacity that could significantly add to LPG production by 2014. Colombia is currently a slight net exporter of LPG.

In 2010, demand in Latin America was about 29.1 million tonnes, up from 28.6 million tonnes in 2009. Within the region, about 76% of the LPG is used in the residential-commercial sector. At 62 kg/person of residential-commercial LPG consumption, Mexico remains among the top per-capita LPG consumers in the world.

Ecuador's reported per-capita consumption is also high (65 kg/person). Highly subsidized, LPG in Ecuador sells for 11¢/kg for the residential market, which is among the cheapest LPG in the world. Reported residential-commercial demand is slightly less than 1 million tanks per year (toy) but growing quickly, and it is likely that a large portion of this residential LPG is finding its way to other markets and countries.

LPG demand will grow to about 30.9 million tonnes in Latin America by 2014. Brazil will likely have the highest volume of LPG demand growth in the region, increasing to 8.3 million tonnes from 7.9 million tonnes 2010-14.

Major LPG exporters within Latin America include Argentina, Venezuela, Trinidad, and Peru. Trinidad and Peru have recently completed expansion projects that have increased LPG supply.

By 2014, the largest LPG exporters in Latin America to be Argentina, Trinidad, Venezuela and Colombia. Mexico and Brazil are likely to remain the largest net importers.

Composite LPG Cylinders, World development

The evolutionary spectrum of composite materials runs from aerospace to propane cylinders.

Today's advanced composite materials, which are composed of a wide range of substances, have been in development for decades. For pressure vessels, composite materials consist of a variety of materials, such as resins, glass fibers, and plastic materials, in different combinations.

Composite LPG cylinders have many advantages over steel cylinders and consumers have a growing appreciation of their unique qualities. The usage of composite LPG cylinders is growing every day and, as a result, more and more LPG users are getting an even more positive experience from using this great energy. Often composite LPG cylinders are used to show innovation in a sector that is viewed as old fashioned and outdated.

In a time when a lot of time and money is spent trying on reducing CO₂ emissions and pollution in general, LPG is becoming more and more attractive as a motor fuel. The World LP Gas Association, through its Exceptional Energy initiative, is doing a tremendous job encouraging the use of LPG. This effort is being made on many different political and business levels in all parts of the world.

Composite LPG cylinders are the safest LPG cylinders ever brought to market, it is obviously very comforting to have them where families typically live, cook, eat and sleep in a confined space and fatalities would be high in the case of an explosion.

The lighter weight of the composite cylinder comes in very handy in areas with poor infrastructure and no public transport, for instance. Often users have to travel considerable distances to get a refill, and the more than 50 % reduction in tare weight either allows the user to collect more LPG for the same effort, or use less effort for the same amount of LPG.

The Western Hemisphere, and the U.S. in particular, are the largest untapped markets for these technologically advanced cylinders. At least two companies-Lite Cylinder Co. (Franklin, Tenn.) and its manufacturing partner **Composite Scandinavia** (Pitea, Sweden), and JNS Enterprises (Hilton Head, S.C.) and his rival **Ragasco** (Raufoss, Norway) are racing to introduce composite cylinders into the region once they receive final approval from the Department of Transportation (DOT). The agency oversees the construction and use of cylinders through the Title 49 Code of Federal Regulations.

A number of propane cylinder manufacturers began exploring the possibility of using the material in the 1980s. The initial reaction by some industry members was positive, said one long-time cylinder manufacturer, but the high cost of producing the containers ultimately reduced the number of companies exploring their development. Despite the possible economic hurdles, a small group of European manufacturers doggedly pursued the development of a working composite cylinder.

The cost wasn't the only stumbling block to introducing these cylinders. Codes and regulations would have to be changed. That process has been completed in Europe, Australia, and in parts of Asia. By the late 1990s, members of the U.S. industry were lobbying to change DOT rules

governing the storage and transportation of propane. Working with the National Propane Gas Association (NPGA) and the Propane Education & Research Council (PERC), industry members have been pushing DOT to amend the rules to allow composite cylinders for propane storage and transportation has been approved. Proposals to change NFPA's code governing the use of propane and cabinet heaters is also approved.

One of the first companies to commercially produce cylinders specifically for liquefied petroleum gases was **Composite Scandinavia** in 1989, a revolutionary non-liner method for producing glass fiber composite vessels. Composite Scandinavia joined forces with Sweden's plastics industry, including the R&D departments of the firms that supplied resin and glass fiber, to further improve the technology.

European standards for composite cylinders require a 10-year retest period. The DOT exemption currently issued to the Lite Cylinder Co. requires a five-year retest period. The cylinders are expected to have an extended service life, and many composite proponents believe the exemption will be extended to a 10-year retest period consistent with the European standard.

The Scandinavian manufacturer has been making composite cylinders since 1995. They sold more than 500,000 LPG cylinders, primarily to propane marketer customers in Europe, South Korea, and Australia with an investment of \$25 US millions Dollar and a turnover on 2008 of \$9 US millions dollar.

In the **U.S.**, **Lite Cylinder Co.** was founded in 2002. It will partner with Composite Scandinavia in introducing the cylinders, initially to the U.S., and later to Canada and the Caribbean. It began by importing a few thousand cylinders from Sweden in 2004 and 2005 to test the market for composite cylinders, a new 15,000 sq. ft. facility manufacturing since early 2006.

On the other hand, in summer 1999, Flakk Group became the principal owner of the publicly listed Norwegian Applied Technology ASA – the company in which Comrod was a central member.

Flakk Group, previously the principal owner of Devold AMT AS, (a premier supplier of multiaxial fibreglass and carbon fibre reinforcements), saw opportunities for growth in the composites industry. In summer 2000, a merger between Norwegian Applied Technology ASA and Devold AMT AS was finalised. This resulted in a total restructuring of the group. Unprofitable activities were phased out and new management was appointed to implement the company's new vision. The new Group was named Hexagon Composites ASA, and its head office was moved from Stavanger to Ålesund.

The aim was to achieve a listed group which had the strength to make further acquisitions of companies with composites expertise and the potential to expand its global market share.

Ragasco AS (formerly Raufoss Composites) became part of Hexagon Composites in October 2001 having been purchased from Statoil ASA and Raufoss ASA. The company is a leading developer and producer of composite pressure containers for LPG (Liquefied Propane Gas) and now also produces CNG (Compressed Natural Gas) high-pressure containers for the automobile industry.

Ragasco AS is a world leader in the manufacture of composite LPG cylinders and has been marketing them since 2000. In that time, more than six million of the company's LPG cylinders have found their way into the LPG industry. Most of its cylinders are used in European markets, but significant quantities are in use in the Americas and Middle East and, to a smaller degree, in Africa and Asia.

In 2003 reached 500,000 Composite cylinders produced.

In 2005 they started making a separate type of tanks for the North American market.

In 2006 an investment of over 30 million euros more than doubled previous capacity. The result is the most modern, efficient and automated production line of its kind worldwide.

Throughout 2008 Ragasco AS has developed two very important LPG markets; France one of the most heavily LPG consuming countries in Europe, and Venezuela where they became the supplier of the first full-scale composite project in South America with PDVSA (Venezuelan's Oil & Energy Company).

With more 1 million annual LPG composite cylinder capacity and an investment close to \$70 US millions dollar, today Ragasco AS is the most advanced production line for composite pressure cylinders world-wide, combines the latest blow molding and injection molding machinery with state-of-the-art filament winding technology in use with intelligent conveyor solutions and industrial robots.

In March 2010, **Ragasco AS**, (Hexagons fully own sister company), acquired Composite Scandinavia. Production at **Composite Scandinavia** in Sweden was discontinued at the end of the third quarter of 2012. The production equipment from Composite Scandinavia will be moved to the company's joint venture company in Russia for production of LPG containers for the Russian market. Production is expected to start in the first half of 2013, with an investment over \$40 US millions dollar.

Other Players in the world.

Kompozit-Praha was founded in the year 2000 by aerospace scientists with an objective of providing superior alternate to traditional steel LPG cylinders for the Russian market. The cylinders fulfil all current and announced European Norms and the company was looking for additional customers in the European Union, which the Czech Republic is expected to join in 2004. One of the companies actively talking to was BP. In 2009 Kompozit-Praha was acquired by Time Technoplast Ltd, a leading polymer product multinational company. Company has inducted high level of competent and professional managers for running the operations. Company has also added new components to production line, setup fresh facility for in-house component manufacturing and renovated the setup completely. Kompozit-Praha boasts of a high quality process & standards. The composite gas cylinder production is based in Dysina (Czech Republic) and another plant is being set up in Talasari, India with an initial investment of \$35 million US dollar. This facility expected to be operational and the end 2011. TTL is convinced about huge business potential for composite LPG cylinders on India, Malaysia, Thailand and Middle East. They expected to produce close to 750.000 cylinder with both facilities.

New Players.

Latin America. As a part of government's policies in Venezuela, PDVSA has been evaluating to develop composite cylinder technology in house after the purchase in 2007, 2008 and 2009 with a total of 900.000 composite cylinders from Ragasco AS.

In 2009, a joint venture between Gavenplast de Venezuela S.A. (local company specialized on plastic products) and Coninteco LTD (UK), consolidated a project for a new facility to manufacture 500.000 composite cylinders a year.

At the end 2011 started operation with an estimated investment of \$60 million US dollar and plan to export with the government support to mainly The Venezuelan market, and the Caribbean Islands, Argentina, Chile and Colombia.

Asia. With encouragement and full support from Malaysian Government to local entrepreneurs to introduce, utilize and produce innovative technologies and products, Faidhi Holdings Sdn. Bhd. (FHSB) has an objective accompanied the Government vision in Technology and Innovation sections as main highlight with aim to produce new concepts and innovative products by using advanced material (composite) towards gearing Malaysia into becoming the High Income First World Country in line with Vision 2020. The composite cylinder was developed with US\$ 2.0 million in funding aid from the Malaysian Domestic Trade, Cooperatives and Consumerism Ministry and the Science, Technology and Innovation Ministry. FHSB pioneer project, Composite Liquefied Petroleum Gas (LPG) Cylinder Project was envisioned back in the Year 2005, with the idea as an ideal replacement for the current steel LPG cylinders which can cause hazardous incidents that involved loss of human lives and damage to properties.

Since then, FHSB initiated a feasibility study on this project. Initial research and study had been carried out and until the Year 2010, the results and findings of the research and study were completed. In Year 2011, FHSB managed to produce 5 designs of composite LPG cylinder's working prototypes as proof that FHSB has sufficient capability, capacity and technology to manufacture the product locally without direct assistance from foreign parties. This product also has gone through standard testing's and certification. FHSB also has been awarded with the Project Completion Approval Letter that can be seen as a milestone to proceed into the commercialisation stage.

Faidhi Holdings plans to fire up a state-of-the-art manufacturing plant by next year which will be able to produce three million composite cylinders every year. The product was planned to be introduced for the mass market by the end of Year 2012, (investment is unknown).

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