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Assessing the Impact of Natural Gas on Natural Gas Liquids: Policy challenges and imperatives

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About KAPSARC

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Key Points

Natural gas is facing an uncertain future because of competition from renewables, coal and policy drives to restrict carbon emissions. There is a strong case to increase the use of natural gas liquids (NGLs) as a petrochemical feedstock and to displace the use of biomass for clean cooking in developing economies. As NGLs are essentially methane co-products, a lack of demand for natural gas could disrupt NGL supplies. Understanding the implications of gas policies in end-user markets requires an overview of the natural gas value chain as a whole.

The surge in NGL production in recent years and its growing end-use necessitates more accurate data for NGLs to enable a more reliable analysis of the knock-on effects of natural gas-related policies.

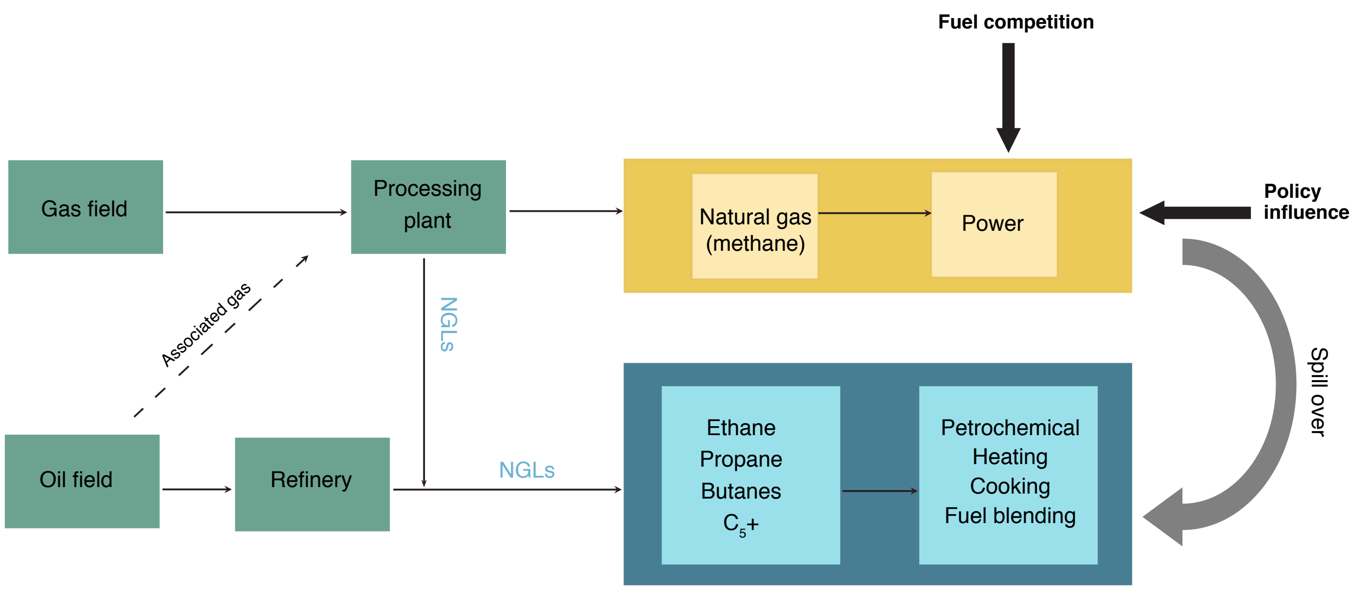
While natural gas faces uncertainties in the power sector, liquefied petroleum gas (LPG) – a type of NGL – for residential use is displacing traditional biomass in developing economies and improving human welfare. A mismatch in policy may disrupt the LPG supply chain and lead to security of supply issues and price shocks.

NGLs remain essential for the production of petrochemicals. Technology that converts non-food feedstock to chemicals still has some way to run before it is cost competitive. In addition, the environmental benefits are not assured.

The Middle East region and the Kingdom of Saudi Arabia, in particular, will remain key LPG providers to global markets, especially to India where more than 60 percent of the population lacks access to clean cooking.

The Kingdom's commitments to developing new gas fields are likely to result in higher NGL production and an increase in exports, subject to domestic supply and demand growth.

Simplified schematic of the oil and gas value chain reflecting impact on NGLs.



Source: KAPSARC.

Summary for Policymakers

The supply growth of natural gas liquids (NGLs) globally within the last decade is unprecedented. The future global demand growth for NGLs is expected to be strong in areas where relevant industries are garnering robust investment and policymakers support the use of NGLs. However, NGLs are hostage to the fate of natural gas markets, as their production is largely tied to the future production of natural gas. Competition from cheaper coal, calls to rein in carbon emissions from fossil energy, and the rapidly declining costs of renewable technologies imply that natural gas has to fight for its place in the future fuel mix.

NGLs may present a silver lining to the future of natural gas, given their close links. The power sector is usually considered the principal driver of future demand growth. However, natural gas is likely to have a bigger role to play in future, given the essential role of NGLs in displacing polluting fuels for cooking and heating, as a feedstock for petrochemical plants that produce thousands of consumer goods.

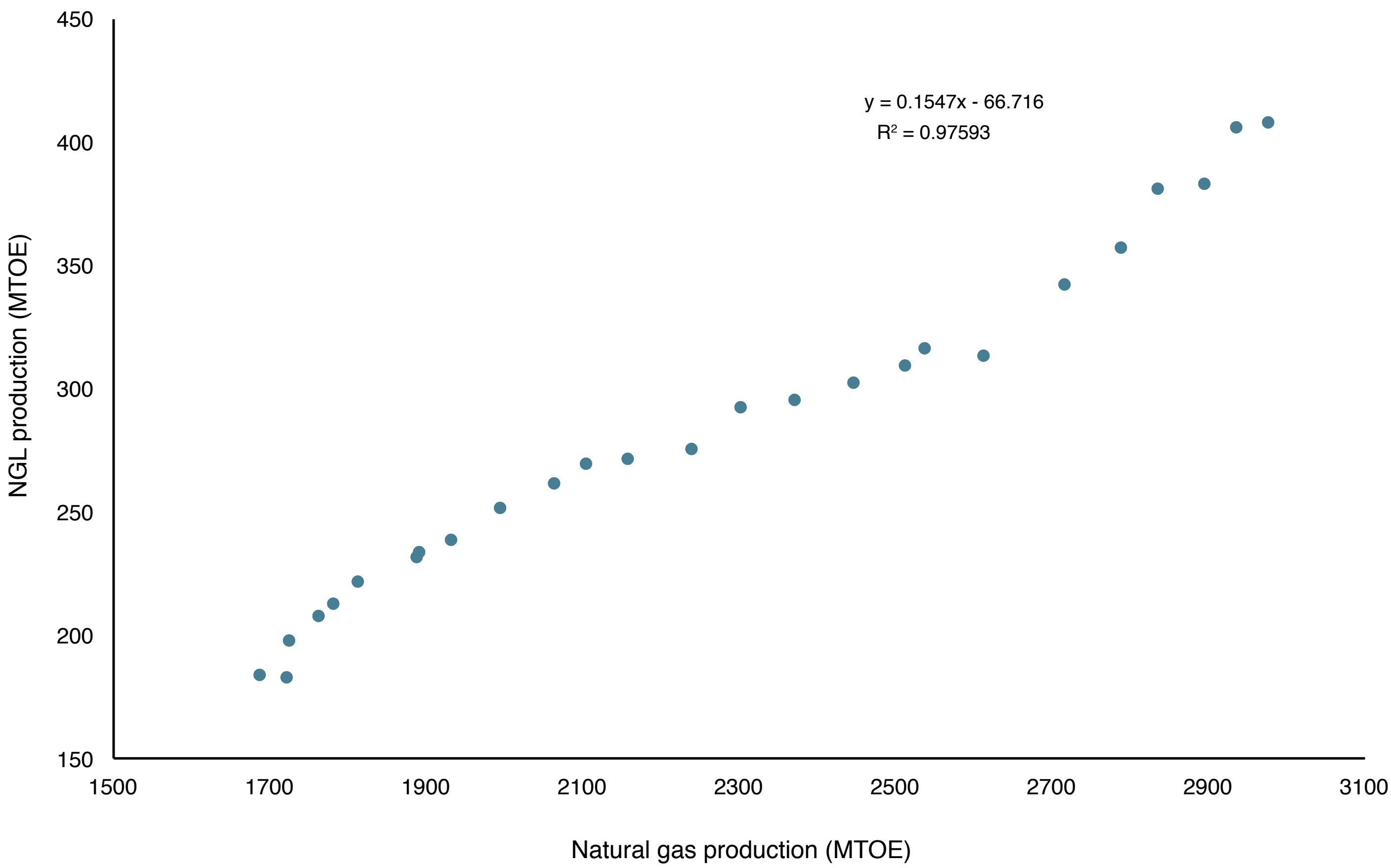
Policymakers who wish to limit the use of natural gas could produce knock-on effects on non-related industries – LPG as a clean fuel and petrochemical feedstock – that contribute to the goal of achieving overall energy sustainability. By recognizing the link between natural gas and NGLs outlined above, policymakers can reexamine policies that would otherwise focus solely on reducing the combustion of natural gas to achieve climate change goals, to maximize the societal welfare benefits throughout the whole natural gas value chain.

The Dependence of Natural Gas Liquids on Natural Gas Production

Natural gas liquids (NGLs) are rarely produced alone. NGLs are typically co-produced in natural gas streams: around three-quarters of global NGLs originate from gas processing plants while the rest, particularly liquefied petroleum gas (LPG), comes from oil refineries (IEA 2017). Consequently, any factor impacting gas production can also impact NGLs markets and trade flows. Hence, the future growth of NGL production is largely tied to the future supply of natural gas. Figure 1 shows a direct correlation between natural gas and NGLs production.

As co-products of gas production – associated and non-associated – NGLs are integral to the economics of natural gas drilling. This paper defines NGLs (unless stated otherwise) as hydrocarbon liquids associated with natural gas production, which are inclusive of ethane, various types of LPG (propane and butanes), pentanes and lease condensates. Due to their chemical composition, each NGL component, once separated, is stored and transported independently and has different end-uses. These include space heating, cooking, power generation, fuel blending and as a petrochemical feedstock.

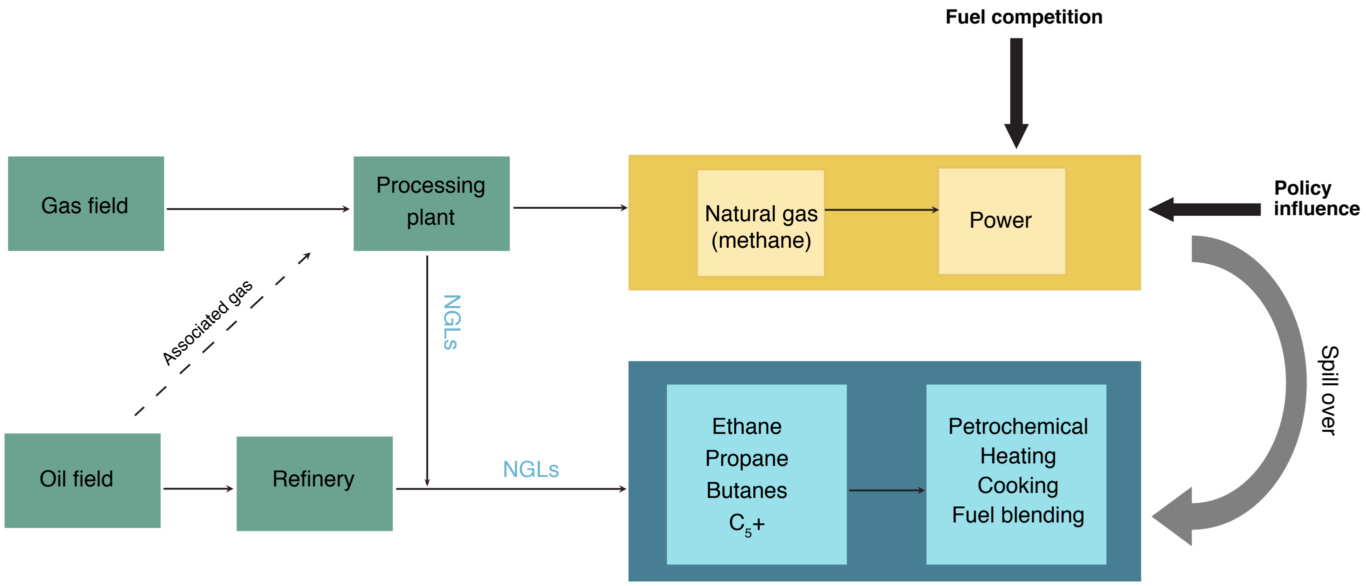
Figure 1. Correlation between natural gas and NGL production, 1990-2015.



Source: KAPSARC, using IEA data.

Past studies have argued that the challenging environment the gas industry is facing results from two underlying factors: the lack of support from policymakers and competition from coal and renewables (KAPSARC 2015, 2016). The latter makes finding the right fit in the future energy mix challenging for gas. The conventional narrative has been that the ramp-up of conventional and unconventional gas production worldwide and the efforts to improve air quality have supported the role of natural gas as an intermediary in the transition to a low carbon future. However, heightened global climate change awareness and the fact that LNG is relatively expensive means that natural gas faces an uncertain future in many regions. During the buildup to the 21st yearly session of the Conference of the Parties (COP21), countries outlined their plans to tackle climate change by submitting intended nationally determined contributions (INDCs). Out of the 158 INDCs analyzed by the World Future Council, only 22 countries mention using gas as a means to mitigate climate change (World Future Council 2016). Many of these countries have gas reserves or are within a pipeline distance away from a country with gas. In BP's latest edition of its Energy Outlook, it highlighted that its base case gas demand forecast, projected to have an annual growth rate of 1.6 percent to 2040, could be a third slower if regulatory policy to move away from coal weakens (BP 2018). LNG is likely to support an increasing share of global gas trade going forward but faces additional challenges. The delivered cost of LNG with the current price schemes has made it difficult to compete with coal and renewable energy technologies in some regions (with the exception of China's coal-to-gas switching policy which supported LNG imports). The combination of policy implications and fuel competition may have spill-over effects on NGLs supply and its markets (see Figure 2).

Figure 2. Simplified schematic of the oil and gas value chain reflecting impact on NGLs.



Source: KAPSARC.

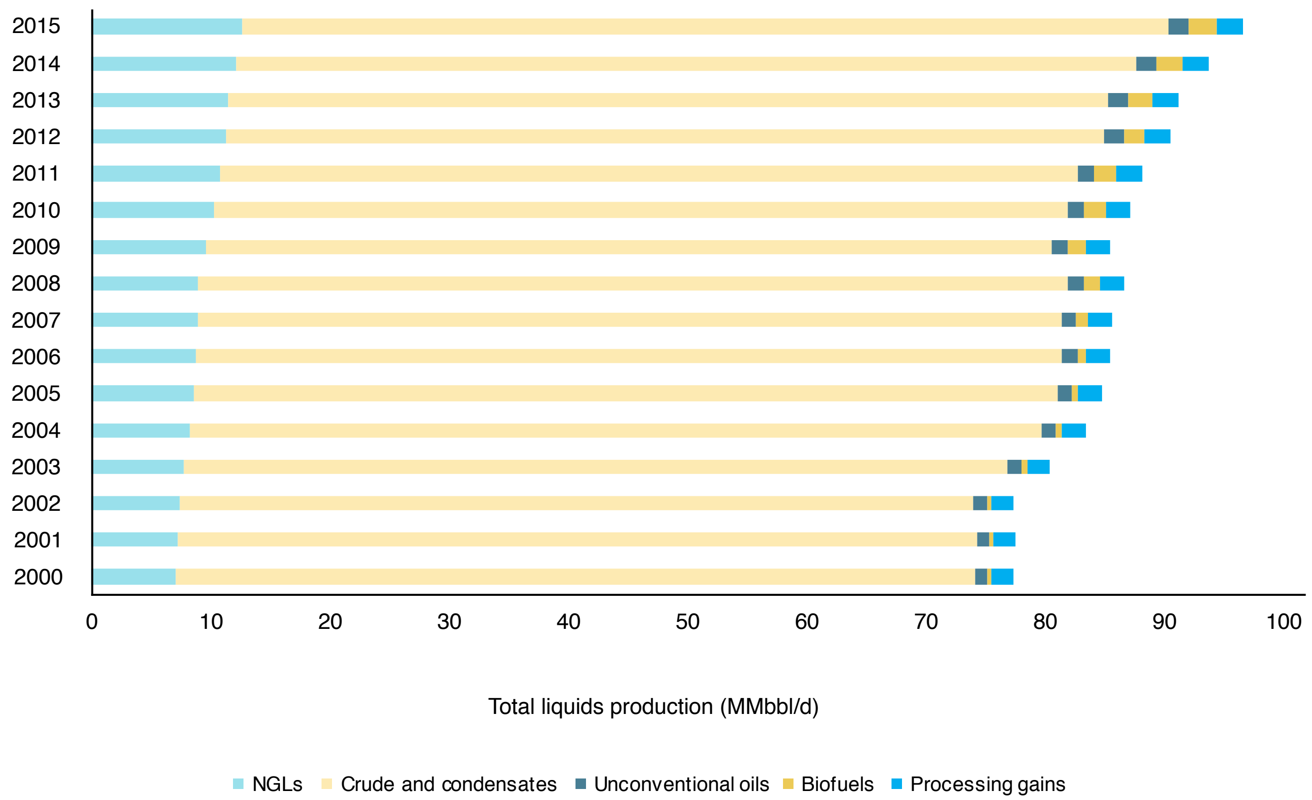
While natural gas lacks policy support and competition in many regions, particularly for power generation, NGLs are gaining momentum policy-wise, such as for use in clean cooking and heating in rural areas of developing economies. Meanwhile, there are still economic and social challenges to substituting NGLs and naphtha or other oil products for non-fossil-based feedstock in the petrochemical sector. While this paper does not quantify the impact of the pressures of gas demand on NGL supply, it addresses the mismatch in policy throughout the hydrocarbon value chain and draws attention to a growing NGL market that is hostage to the dynamics of natural gas fundamentals and regulations. While much policy has been focused on restricting the use of fossil fuels in power generation and transportation, policymakers need to understand the complexities of the links between the hydrocarbon value chains to avoid unintentional consequences for investors and end-users that rely on co-products of oil and gas production.

The Challenge of Accounting for NGLs in the Total Oil Supply

Though NGLs are mainly produced with natural gas, official statistical agencies classify them as 'oil.' This classification can be problematic for two reasons: first, the majority of NGL components (namely ethane, propane and butanes) are gaseous at atmospheric pressure and temperature; second, crude oils are almost always destined for refineries where most products are used for combustion. The use of NGLs in refineries is limited. The growth in the NGL supply since the start of the century has contributed significantly to the growth of total liquids production globally, as Figure 3 shows. This was particularly true during the era of high oil prices from 2008 to 2014 when NGLs, fetched higher revenues for producers, especially during the shale gas boom in the United States (U.S.). Between 2008 and 2015, global liquids production grew by almost 10 million barrels per day (MMbbl/d). NGLs comprised 36 percent of that growth, with oil (conventional crude, condensate and unconventional oil) contributing 53 percent of growth. This is a considerable difference compared to the period between 2000 and 2007 when NGLs accounted for a 22 percent share of growth while crude oil accounted for 67 percent.

Current data coverage of NGLs is patchy, and definitions and terminology on what constitutes an

Figure 3. Total world oil supply.



Source: KAPSARC, IEA mods.

NGL vary within countries (IEA 2010). For example, ethane is not considered an NGL in the Asia Pacific due to the characteristics it shares with methane (Troner 2013). There is no universal definition of condensate, nor an official specific gravity cut-off point to differentiate it from crude oil. The IEA includes field condensates as NGLs for OPEC-member countries because OPEC's data accounting practice calls for this segregation for quota purposes. Meanwhile, for non-OPEC countries, the IEA is "not certain whether the reported condensate is only gas plant condensate, or if it includes some field condensate as well" (IEA 2010). Consequently, it is difficult to make a fair comparison of current global NGL data. More accurate and consistent statistics would allow NGLs to be reliably analyzed and would help to avoid any unintended consequences of methane policy.

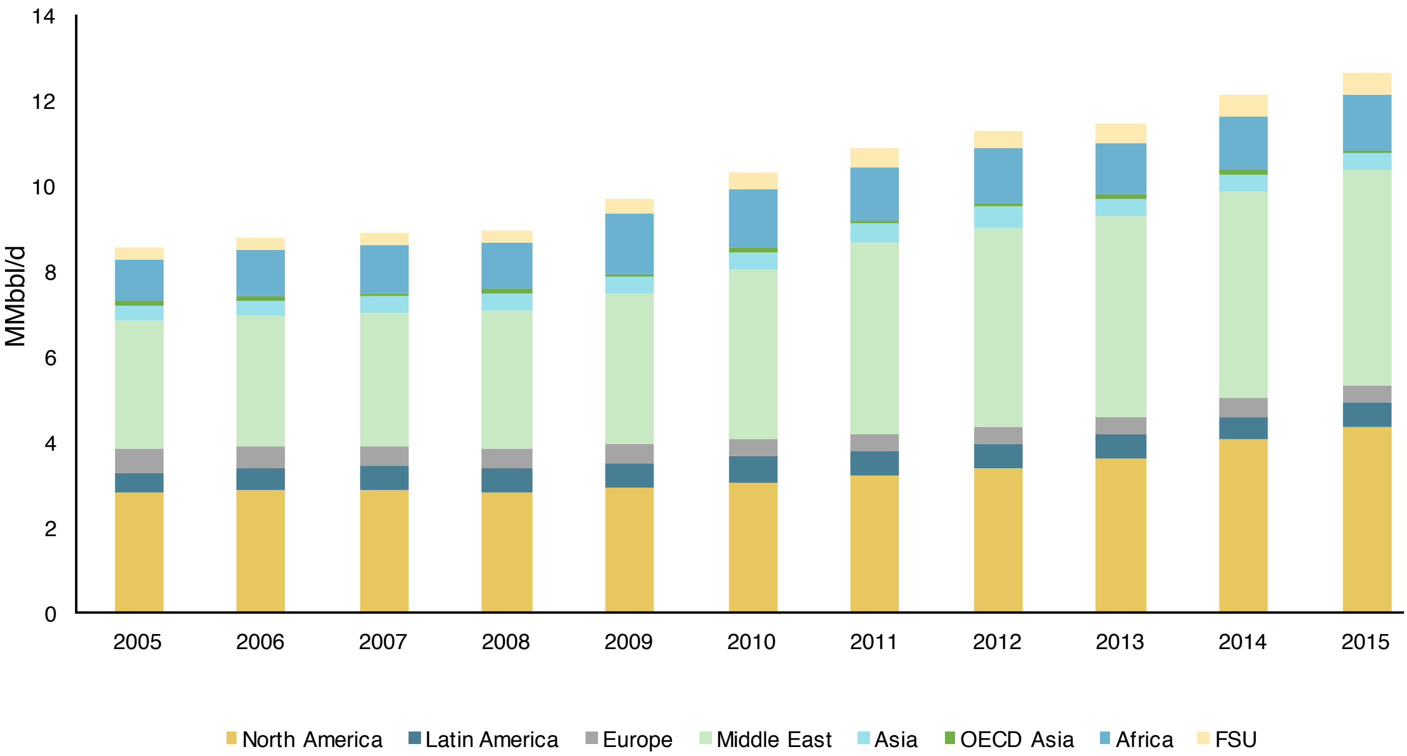
The Growth and Evolution of NGL Markets

NGL production took center stage with the rise of shale gas production in North America. However, the surge in NGL production has not been solely a western phenomenon (Troner 2016). Production growth rates of NGLs from parts of the Middle East and former Soviet Union (FSU) have also risen during the last decade. Figure 4 shows that between 2005 and 2015 NGL production from gas processing plants grew from 8.9 to 12.6 MMbbl/d, but the rate of growth was largely skewed toward the second half of this decade, averaging 4.5 percent annually between 2009 and 2015.

The main drivers behind this growth are the ramp-up of natural gas development, the rise in associated gas production, and the exploitation of wetter non-associated gas. It is important to note that the top natural gas producing countries are not necessarily the top NGL producers. This is because the liquids content in gas reservoirs vary from field to field, even within the same basin. NGL production is also a function of gas gathering and midstream infrastructure (rather than flaring), and is dependent on the efficiency and complexity of the processing plant used and its ability to extract as much of the NGLs away from the gas stream.

About half of NGL production from processing plants comes from OPEC-member countries, led by the Kingdom of Saudi Arabia, followed by Qatar,

Figure 4. Global NGL production from gas processing plants.



Note: The IEA includes field condensates in NGLs statistics for OPEC-member countries.

Source: KAPSARC, IEA MODS.

the United Arab Emirates (UAE), Iran, Nigeria and Algeria. The Middle East and North Africa (MENA) block has traditionally been the main exporter of LPG and condensates. The MENA region was responsible for over two-thirds of global NGL exports in 2008. However, with the advent of shale gas in North America and the surge in U.S. LPG exports, by 2014 the share of MENA exports had dropped to about 55 percent. In addition, MENA's main gas supply has come largely from associated gas production and has been struggling to keep its supply growth in line with historical growth rates (Darbouche 2012). However, the region, especially Saudi Arabia, is currently on an ambitious drive to target untapped non-associated gas fields as well as to increase the capacity of gas processing plants and refineries. This should generate an increase in NGL production volumes in the medium term. Meanwhile, Qatar and Iran have both announced expansion plans for the liquids-rich North Field/South Pars field which will likely increase flows of NGL into the market. In the long term, investing in downstream projects, such as petrochemicals, in the Middle East as a way to diversify the economy will increase the demand for more NGL to be available domestically.

The U.S. has always been the world's largest NGL producer, but its importance redoubled when supply of LPG outstripped demand and it became a net exporter of LPG in 2011. By 2016, the U.S. reached another milestone by exporting ethane for the first time on deep sea routes. Investments in new vessels and petrochemical upgrades in Latin America, Europe and Asia have taken advantage of the cheap feedstock. The rapid increase of end-user investment has shifted this market from what was traditionally a supply-push market to a demand-pull market.

The surge in NGL production has reduced prices significantly, providing a cheap source of low-carbon fuel for cooking and heating. It has also increased competition in the petrochemical sector against oil-based feedstock, which could in turn lower prices of manufactured products for emerging economies. The following two sections will look at the role of NGLs in energy policy and address the status of alternative feedstock for chemical production.

The Role of LPG in Improving Quality of Life in Developing Economies

Contrary to Organisation for Economic Cooperation and Development (OECD) countries' reluctance to support natural gas (except U.S. and Canada), LPG has received strong international support from developing economies. The United Nation's (U.N.) Sustainable Energy for All (SE4ALL) initiative launched in 2011, and one of the U.N.'s Sustainable Development Goals set in 2015, made clear that ensuring universal access to modern energy services is essential for improving household's quality of life and standards of living. About 2.8 billion people, or close to 40 percent of the world's population, mostly concentrated in Asia and sub-Saharan Africa, currently do not have access to clean cooking, and still rely on traditional biomass, coal and kerosene (IEA 2017). The World Health Organization has expressed grave concerns over the environmental pollution created by such fuels, which it says causes close to 4 million premature deaths a year (WHO 2016). The unsustainable harvesting of biomass also raises concerns of deforestation in some regions.

LPG has been identified as one of the solutions in tackling this issue. In 2013, SE4ALL and the World LP Gas Association announced a commitment to transition one billion people to using LPG by 2030 (WLPGA 2013). Although education and raising awareness do play a part in some household's decisions to switch to LPG, affordability remains the key determinant impacting this decision (Kojima 2011). Increased net exports from North America and the drop in oil prices have lowered regional prices of LPG, making it more attractive than wood and kerosene. Nevertheless, a strong political will is needed to sustain the financial and regulatory transition to LPG, including establishing the regulatory framework and infrastructure needed to make sure people, particularly in rural areas, can access the fuel without disruption.

The progress in making clean cooking technologies available to rural and low-income households has been slow. This is in part because policy on clean cooking is lagging relative to electrification policy (IEA 2016). The IEA's World Energy Outlook (WEO) 2016 noted that progress in clean cooking accessibility is not keeping pace with population growth. While electrification levels have improved compared to estimates in WEO 2015, the number of people still reliant on traditional biomass has increased by 20 million over the same period. Despite the world achieving close to 100 percent electrification by 2030, the latest WEO 2017 forecasts that the number of people with access to clean cooking will only increase by 500 million by 2030, which still leaves 2.3 billion people with no access (IEA 2017).

India's increase in LPG consumption is a prime example of how energy policy pushed the country to be one of the largest consumers of LPG. In India, around 63 percent of the population lacks access to clean cooking (IEA 2017). The Indian government has committed to various policy tools to help households access LPG. It currently provides $8 billion worth of LPG subsidies at the current level of domestic consumption (CEEW 2014). But consumption of LPG in India is highly skewed among various income groups. The richest 30 percent of the population receive more than 50 percent of the LPG subsidy, while the poorest 30 percent only receive 15 percent. In an effort to redirect subsidies to the poor and to soften the impact on the government's fiscal budget, it offered direct cash transfer and started a campaign to encourage high-income households to forego their LPG subsidy. Analysts also observed that even though there was an increase in LPG consumption in rural areas, biomass use also increased (Kumar, Rao and Reddy 2016). LPG adoption was not, therefore, driven by affordability only, but accessibility and awareness also played a part. To ensure the security of supply, the government of India has committed to supplying free LPG connections to 50 million poor and rural households by 2019 (IEA 2017). Data for the latest fiscal year ending March 2017 shows that domestic consumption of LPG reached 21.5 million tonnes – almost a 10 percent increase year-on-year. For the same period, imports made up just over 50 percent of LPG demand. This makes India currently the second largest importer of LPG in the world, surpassing Japan (Bloomberg 2017).

It is evident that LPG as a special component of NGLs has a role to play in a low carbon future as access to clean cooking technologies increases. This is where countries such as India need assurance that opposing policies will not disrupt the supply chain for LPG.

NGLs as Feedstock for the Production of Petrochemicals

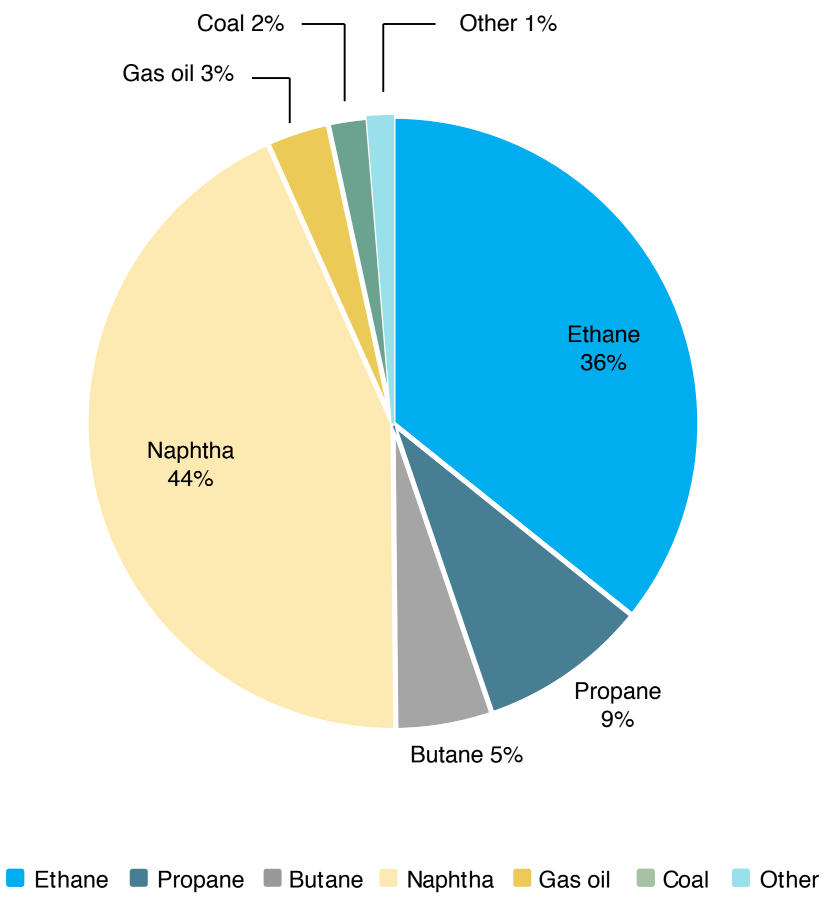
NGLs, among other hydrocarbons, are also proving to be indispensable feedstock for petrochemicals. The abundance of NGLs seen in the last several years, particularly from North America, are providing competitive sources of feedstock. Yet current renewable alternatives such as biomass are uneconomical, and their environmental benefits are not assured.

Investments in NGLs for petrochemicals have also spread globally to take advantage of abundant and cheap feedstock. But the uncertainty of the future role of natural gas may weaken gas production growth going forward which could subsequently cause volatility in NGL prices. This mismatch in policy may lead to a bumpy transition to a lower carbon future and diminish the welfare of the poorest in society.

Fossil fuels are mainly consumed as energy carriers, used in transportation or for the provision of heat and power. However, in 2015 about 14 percent of petroleum products, mainly components of NGLs and refinery naphtha, were consumed as feedstock for the production of chemicals and petrochemicals (IEA 2017). Almost all the manufactured products used today are touched in some way by chemical processes, making chemically produced materials and products practically unavoidable. Ethylene and propylene are one of the most important chemicals and key building blocks for derivatives that end up making a variety of plastics and fibers. Ethylene is among the most produced chemicals in the world and, combined with its derivatives, accounts for about 40 percent of global chemical sales (Bloomberg 2017). While two-thirds of global ethylene capacity is based on naphtha feedstock, in 2016 around 50 percent of total ethylene production came from NGL feedstock (mostly ethane, but also propane and butane), as Figure 5 shows. This is because ethane yields more ethylene than naphtha, but also the availability of low-cost ethane (and NGLs as a whole) – helped by North American shale gas production – has increased its utilization as a feedstock.

The push to reduce dependency on petroleum products and mitigate greenhouse gas (GHG) emissions has driven the search for alternative feedstock. The organic carbon inherent in biomass has made it a suitable equivalent to fossil fuels and has opened up a market for bio-based materials. From a technical standpoint, all manufactured materials can be produced from their bio-based counterparts, but it is a question of cost, scalability and technology. However, compared to fossil fuel feedstock, biomass has a more complex chemical structure, and thus adds considerable complexity to the economical and efficient conversion of biomass feedstock into useful chemical building blocks (ACS 2009). For the chemical industry, it is not only a question of keeping up with current demand, but also keeping up with new innovative products entering the market. Many of the products sold today were not available on the market several years ago, and the life-cycle of products is diminishing as new products enter the market. Consequently, chemical companies are continuously optimizing their innovation processes to enable a shorter time-to-market while safeguarding sustainability (IDC 2016). The commercial development of converting biomass (especially lignocellulosic biomass) feedstock to chemicals has been slower than expected (Valdivia et al. 2016). The potential for biochemical production is large, but its implementation will depend on the future availability and price of biomass feedstock, both linked to developments in food demand and

Figure 5. World ethylene production by feedstock in 2016.

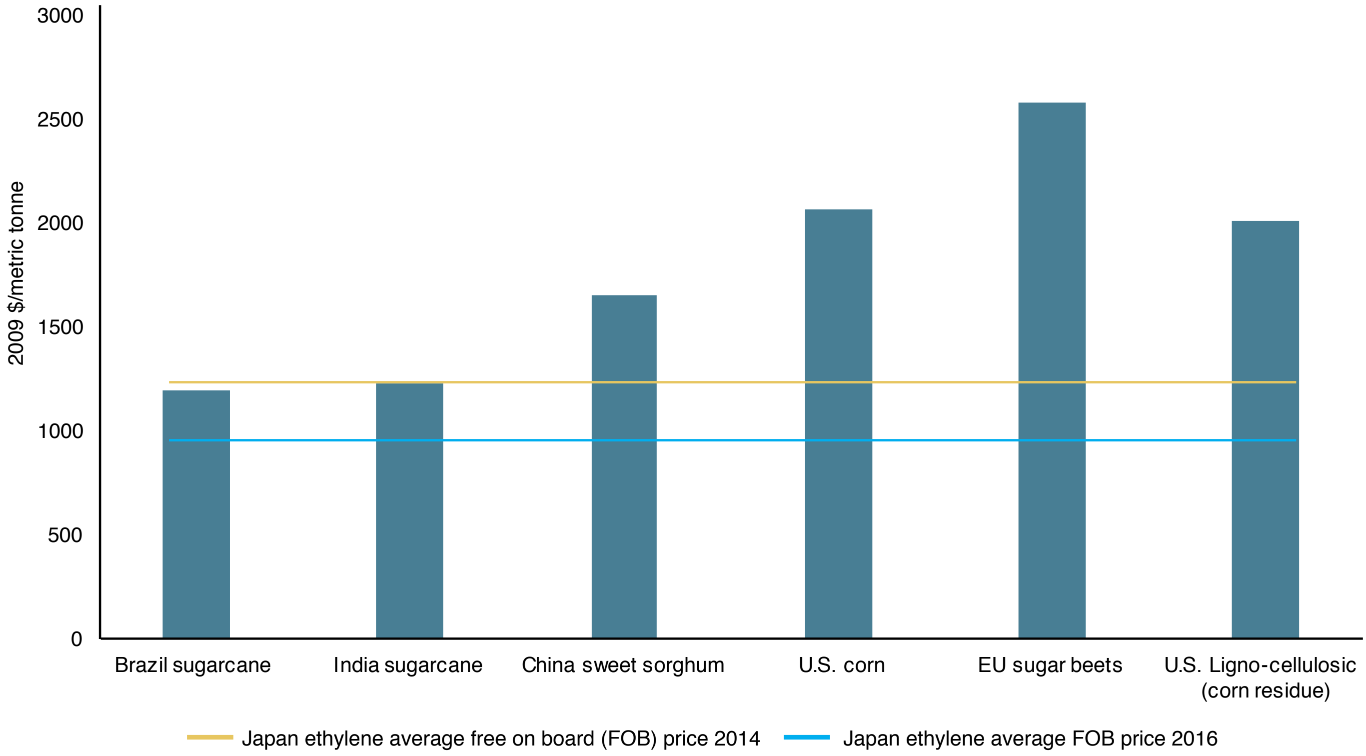


Source: http://www.lpgc.or.jp/corporate/information/program5_Japan2.pdf

the use of biomass in biofuels, heat and electricity production. The raw materials used in first generation biomass technology, such as corn and sugarcane, can compete with food and feed industries, which have led to political and social concerns. Policymakers favor second generation biomass conversion technologies that utilize lignocellulosic feedstock. It is abundant and can grow on marginal land, and most importantly comprises crops that do not compete with food. But the cost of processing lignocellulosic biomass is still high, and the commercial application of chemical production has been limited thus far. As Figure 6 shows, not many countries can produce bio-based chemicals economically (Brazil and India). And even after the drop in oil prices (the period after 2015), the economics have been less favorable.

From an environmental perspective, the low carbon efficiency of fermentation technologies, and high carbon dioxide (CO_2) stack emissions from gasification and gas conversion methods have raised questions about the environmental

Figure 6. Bioethylene production cost.



Source: KAPSARC, IRENA https://www.irena.org/DocumentDownloads/Publications/IRENA-ETSAP%20Tech%20 Brief%20I13%20Production_of_Bio-ethylene.pdf, Tecnon OrbiChem, Bloomberg.

sustainability of biomass-to-chemicals routes (Kajaste 2014). The energy consumption of converting biomass to chemicals, discussed in the existing literature on the subject, can be 3.5 to 5 times more than those from fossil routes (IEA 2013). Thus, life-cycle assessment (LCA) studies have shown that plastics derived from biomass emits more CO_2 than the traditional fossil-routes as Mayumi, Kikuchi and Hirao (2010) show. However, because CO_2 is sequestered in biomass during photosynthesis, the biomass conversion process starts from a 'negative' emission, significantly reducing the total CO_2 emitted from the end product. This leads to the potential for CO_2-neutral emissions in some cases (IEA 2013). It is also important to note that most LCA studies do not include land-use change and energy used for agriculture and harvesting, which can make biomass more GHG-intensive.

Currently, the biomass conversion process is produced in a single production chain, but integrating fuels and chemicals production through a bio-refinery is a promising approach to reducing costs and increasing efficiency. Analogous to an oil refinery, a bio-refinery would produce transportation fuels primarily with a spectrum of marketable co-products, including value-added chemicals, to maximize economic returns. There are also opportunities for heat integration within the bio-refinery complex that can improve environmental efficiency overall (Roddy 2013). Bio-refineries using lignocellulosic feedstock (or feedstock that do not compete for food and land) can offer the optimal pathway. However, implementation of large-scale bio-refineries for non-food applications is still lacking (IEA Bioenergy 2014).

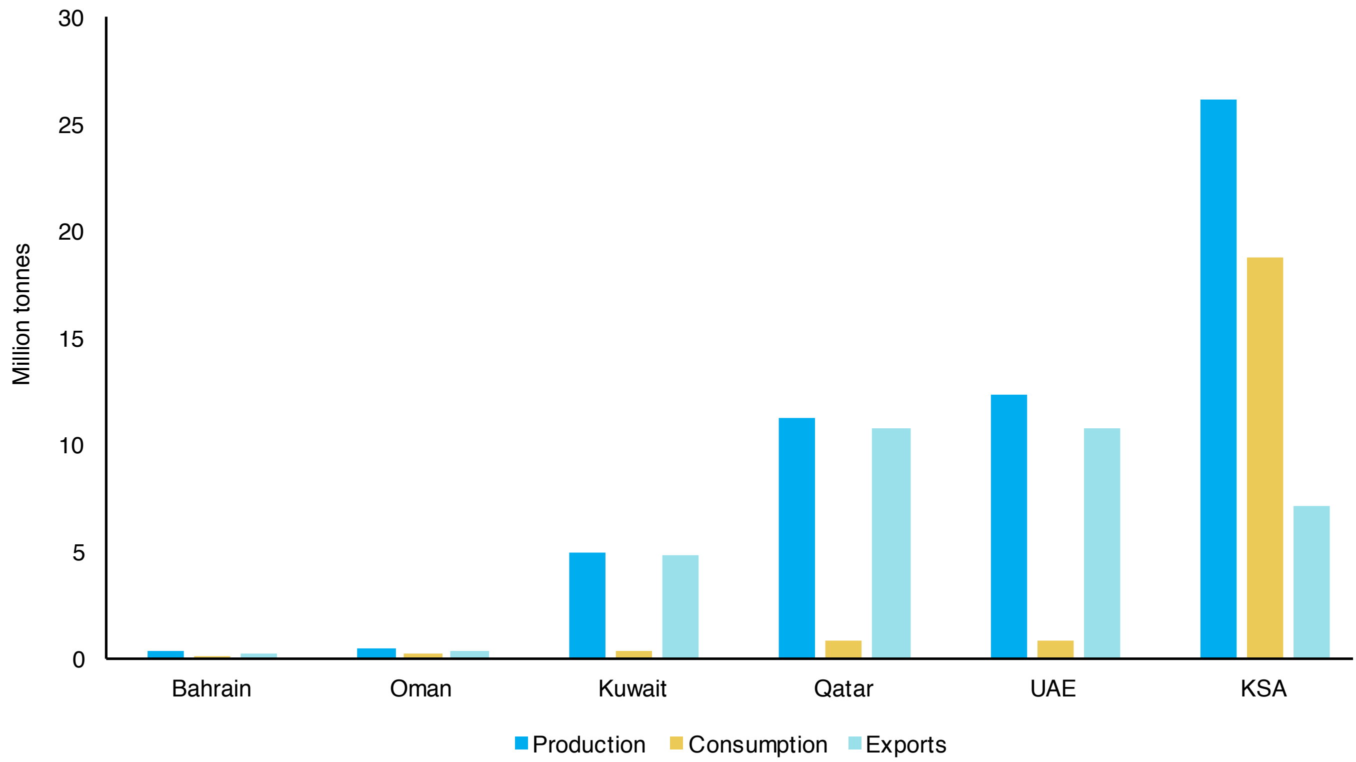
Saudi Arabia's Footprint in the LPG Market

As is evident from the discussion above, LPG is important both as a clean fuel in developing economies and as a growing feedstock for the production of petrochemicals, particularly propylene through propane dehydrogenation (PDH) plants. This has put the Kingdom in a unique position since it has traditionally been a major LPG supplier.

The Middle East is regularly presented as a growing producer and consumer of natural gas (IEA 2017). Natural gas already represents over 30 percent of the primary energy mix, and the development of renewables is not expected to lessen this number as demand continues to grow in the power and industrial sectors. Saudi Arabia stated in its INDC that it wants to "encourage investments on exploring and producing natural gas to significantly increase its contribution to the national energy mix" (UNFCCC 2015). Its power sector currently uses oil, oil products and natural gas, but the Kingdom plans to use 70 percent natural gas in this sector (Petroleum Economist 2017).

As natural gas production continues to grow, the Gulf Cooperation Council (GCC) bloc will continue to play a major role as a global LPG provider. In 2014, the GCC alone contributed to 35 percent of global LPG exports, led by the UAE, Saudi Arabia, and Qatar, and is expected to maintain its key role as the supplier to Asia, especially India (WLPGA; Argus 2016). Saudi Arabia was by far the largest LPG producer in the GCC in 2014 and second only to the U.S. globally. But it is also the largest consumer of LPG in the GCC region (Figure 7) and one of

Figure 7. GCC production, consumption and exports of LPG, 2014.



Source: Argus Statistical Review of Global LPG 2015.

the top five in the world. In 2014, it consumed over 18.5 million tonnes of LPG. This is comparable to the demand in India and Japan. The petrochemical sector consumes about 93 percent of that demand, mainly for the production of olefins, while the residential and commercial sectors consume the remainder.

The majority of Saudi Arabia’s LPG production comes from gas processing plants, with the country’s large refining sector supplying minor volumes. As such, the Kingdom’s future role as an LPG exporter will depend on its future gas development plans, the NGL content in newly developed gas fields, and local consumption. At the beginning of 2017, its proven gas reserves were estimated at just over 300 trillion cubic feet, making it the fourth largest gas reserve in the world (EIA 2017). However, the Kingdom’s production of dry gas (or sales gas) is only just keeping up with its rising demand. The government has reiterated the importance of natural gas development in the Kingdom, and the Ministry of Energy made reference to boosting raw gas production from the current 12 billion cubic feet per day (Bcf/d) to 17.8 Bcf/d by 2020, as part of the National Transformation Program.

Saudi Aramco has ramped up its gas processing plant capacity with the commissioning of the 2.5 Bcf/d Wasit gas plant, which reached its operational capacity in 2016. The plant is designed to process 250 thousand barrels per day (Kbbl/d) of NGLs, much needed after total NGL production declined in 2012, and has seen minimal growth thereafter. The petrochemical sector will welcome the boost in NGL production because of its heavy reliance on ethane and LPG as feedstock for the production of ethylene.

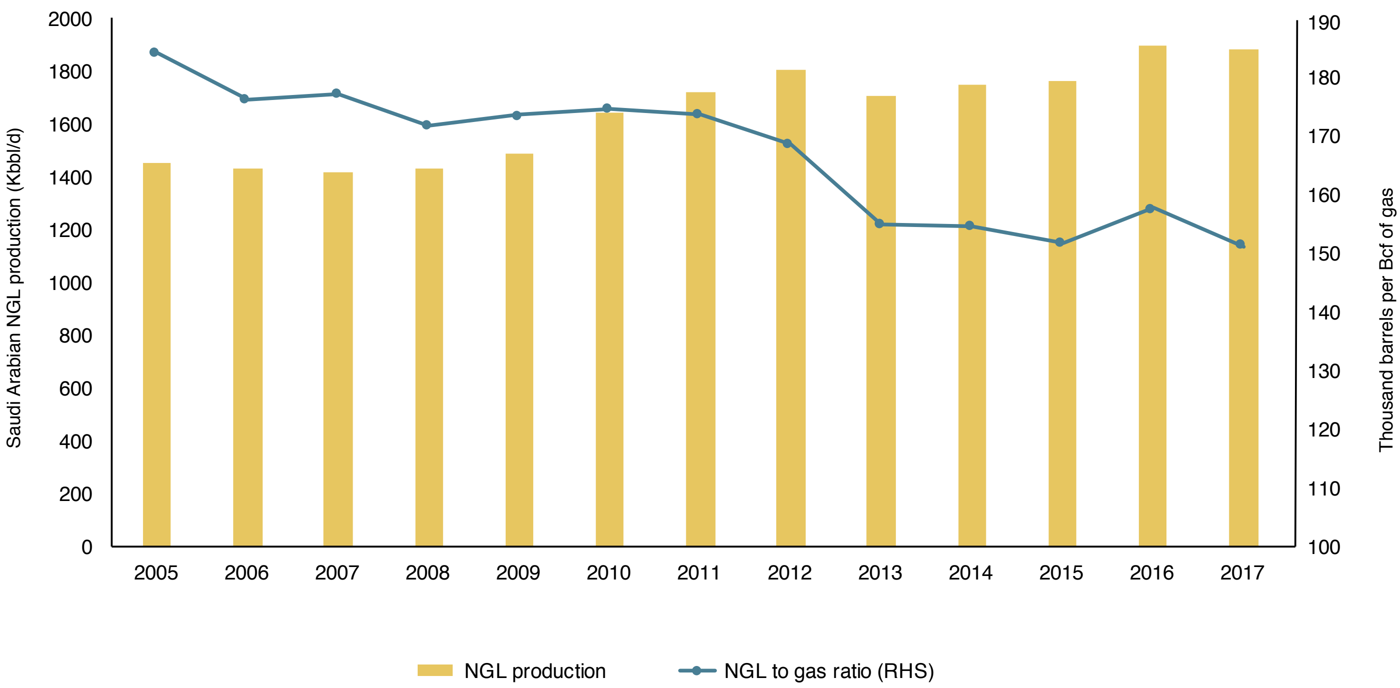
But natural gas typically becomes leaner as activity shifts to non-associated gas fields. With lower liquids content (especially heavier liquids such as LPG and condensates), more units of gas must be produced to sustain the total NGL growth. Processing and pipeline takeaway capacities also need to be expanded to alleviate any constraints that would limit the extraction of NGLs. Figure 8 shows that, since 2005, the NGL to gas production ratio has been gradually declining, only showing signs of recovery in 2016 with the addition of Wasit.

At least two more processing plants (Midyan and Fadhili) are scheduled to come online by the end of the decade. These plants will process an additional 2.5 Bcf/d of raw gas. But what the new geology holds in terms of liquids content is unknown. The Kingdom also got an additional boost of LPG production from new refining capacity with the commencement of the 400 Kbbl/d Yasref refinery in 2015. In addition, the 400 Kbbl/d Jazan refinery, scheduled to come online in 2019, would contribute some LPG. In total, this study estimates that LPG production from both refineries could add at least half a million tonnes a year to the 1.2 million tonnes of domestic refinery production seen in 2014.

As far as domestic LPG consumption in the petrochemical sector is concerned, there has been a trend toward flexible or mixed feed crackers across the GCC, including projects in Saudi Arabia, the UAE, Kuwait and Oman. This provides plant owners with the option to seek out the optimal feedstock choice depending on margins and availability. The Kingdom has been leaning toward greater usage of naphtha as a feedstock option in ethylene plants to compliment ethane, such as in the new Sadara complex. Despite the shift to liquid-based feedstock, and to create value-added industries downstream, it is possible that the Kingdom could add LPG cracking flexibility in future to diversify its options further, which may limit LPG exports.

At the same time, global trade for LPG has also changed with the U.S. becoming a net exporter in

Figure 8. Saudi Arabian NGLs to natural gas production ratio vs. NGLs production.



Note: NGLs component includes ethane, LPG, natural gasoline, and condensates.

Source: KAPSARC, Saudi Aramco.

2011. LPG exports from the U.S. grew by almost nine times between 2010 and 2016, reaching over 900 Kbbl/d on average (approximately 28.5 million tonnes per year) of exports according to Energy Information Administration (EIA) statistics. If expansions of export terminals keep up with the dramatic increase in U.S. exports, it is likely that the U.S. may overtake the Middle East (GCC and Iran) as the primary exporter to Northeast Asia by the end of the decade (IHS Markit 2017). LPG volumes into Northeast Asia will still be significantly driven by residential and commercial demand, but the chemical demand for the production of propylene via PDH plants, mainly from China, will account for the majority of the region's LPG imports.

However, the escalation of the U.S.-China trade dispute in August 2018 saw the implementation of a 25 percent tariff by China on U.S. LPG. This has already impacted trade flows of U.S. imports into China and re-opened a window of opportunity for Middle East exporters to gain market share in China (Reuters 2018). But Southeast Asia – mainly India – is expected to be the dominant market for the Middle East, given its proximity. Traditionally, exports to India were mainly sourced from the GCC, namely Saudi Arabia, Qatar, the UAE and Kuwait. However, rising demand has necessitated supply from other countries in the region such as Iran. As mentioned previously in this paper, around 63 percent of India's population lacks access to clean cooking and its new policy to give free LPG connection to poor households will increase exports of LPG to the country. It is estimated that India will import around 16 to 17 million tonnes of LPG by 2020, an increase of almost 55 percent from 2016 levels (The Times of India 2017).

Increased demand for LPG in cooking and as a petrochemical feedstock in Asia certainly benefits Saudi Arabia – one of the largest producers and exporters of LPG in the world. However, LPG consumption also delivers a social benefit to consumers when compared with the alternatives. The Kingdom intends natural gas to play a significant role in its economy, with as much as 70 percent of its energy mix coming from gas by 2030, up from the current level of 50 percent. Further development of gas fields to meet domestic methane demand will boost NGL overall production and may raise the supply of LPG for export.

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About the Project

The study is part of the Future of Natural Gas Markets initiative which focuses on a key element of the natural gas value chain. It aims to understand the impact of natural gas policy on natural gas liquids as the latter becomes a major component in the hydrocarbon equation.

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