Working Paper

Childhood’s End: Developing Asian Giants & the Future of Global Oil Demand

Al Troner
Nonresident Scholar, Center for Energy Studies, Rice University’s Baker Institute for Public Policy; President, Asia Pacific Energy Consulting

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**Personal Note**

I first went to Singapore in 1984. As an energy journalist, I was fortunate enough to work with a *tabula rasa*, an empty slate of energy publishing, and I established the first regional oil and gas news and pricing services for Dow Jones and Telerate. Singapore, and indeed all of Asia Pacific, was a very different place from what the region is today.

Politically, hot guerilla wars and smoldering insurgencies ranged from Kampuchea to Kashmir. Authoritarian governments dominated the panorama, while old conflicts, such as India and Pakistan, had yet to add a dangerous nuclear dimension. Colonies and protectorates were still in place, notably Hong Kong and Brunei.

Economically, Japan was riding high on the crest of the *Bubble Economy* and the phrases Newly Industrialized Countries (NICs) or Newly Industrialized Economies (NIEs) just were becoming known. State-directed economies dominated many markets, including China or India. Asia’s two giants turned to market economics, with the former abandoning Marxist economic ideology while the latter remained mired in Neruvian socialism. Only Japan was truly an export giant; South Korea, Singapore, Hong Kong, and China were only just emerging as sustained and large-scale exporters.

I returned to Singapore in 1989 to establish a regional office for Petroleum Intelligence Weekly (PIW), a long-established and well-respected newsletter. In that short period of less than five years much had changed: NICs were firmly established, China started to grow at a fantastic rate of expansion undeterred by Tiananmen Square, and the *Bubble Economy* showed the shakiness of Japan’s export machine. An emerging middle class became apparent not only in NIC markets like South Korea, Taiwan, Hong Kong and Singapore, but also in China, India, and Indonesia—the Developing Asian giants.

I banged the drum regularly to alert the energy world of the accelerating growth rate, the speed at which Asian economies were expanding, and the broad extent of that expansion. Asia Pacific entered the world stage and energy planners and analysts began to include that region in their future supply/demand forecasts, even if at times producing a distorted image. This study reflects more than 30 years of personal experience working and living in Asia Pacific, which provided the *raison d’être* for our company, Asia Pacific Energy Consulting.
Chapter 1. Introduction

A generation ago, most Westerners would associate Asia Pacific with poverty, overpopulation, war, endless political squabbles, and poor sanitary conditions. The region was considered exotic; it was seen as the odd other, a contrary and backwards world. This stood in sharp contrast to the developed economies of the Organisation for Economic Cooperation and Development (OECD), which in 1990 included only Asia Pacific exception markets: Japan, Australia, and New Zealand. Yet oddly enough, Western economists broadly assumed that Asia Pacific would follow, step by step, the path of economic development taken by North America and Western Europe.

Also for energy, many analysts assumed that Asia Pacific energy demand would mirror the earlier experience of Western markets. And some of the old truths of energy analysis—that economies move to oil and gas consumption as they mature; that petroleum demand gradually moves to the transportation sector from stationary use; and that light products eventually dominate oil demand—were proven true, but others were not. Asia Pacific’s fantastic oil demand growth rates, 1990 to 2000, meant that the region’s development has differed from the West. For example, fuel oil (a.k.a. residual fuel) saw its share of regional demand fall to 19.3% in 2000, compared to 32.5% in 1990. This was consistent with the earlier experience of Western markets. Yet in absolute volume terms, the region used more of this heavy product at the turn of the century than it did in 1990, with consumption rising from 730 thousand barrels daily (MBD) to 838 MBD over the decade. Regional oil demand followed a similar course, but never exactly the same road, as the West.

Two trends have driven change, first in NICs in the 1990s and now currently in Developing Asia. First is the desire of the emerging middle class to own private transportation—which included the fast-track transition from bicycles to motor scooters, then to motorcycles and ultimately upgrading to automobiles. Second, Asia’s growing middle class demands that government clean up the environmental degradation caused by policies focused solely on maximizing economic growth. Asia’s middle class forced governments to begin to clean up their act. What had occurred in the 1990s for NICs has become the current policy goal for much of Developing Asia.

As the demand grew and Asian markets began to open up to foreign energy investment, Western oil/gas companies began to drool in anticipation and a gold rush mentality began to dominate investment thinking. This is true particularly for China in the mid-1990s. Not even the Asia Contagion crash of 1997–98, or the Great Recession of 2008–09 stopped continued demand growth. For almost every year from 1994 to 2014, Asian oil demand led regional oil markets in annual percentage gains. From 1990 to 2000, overall Asia Pacific growth added roughly 10 million barrels a day (MMB/D) and at end-decade was nearly 24 MMB/D. The region had to be counted in world energy balances.

Naturally, Western attitudes also changed. Asia went from being ignored to become the centerpoint of future growth, with majors and mini-majors, such as ExxonMobil, Chevron, BP, Shell, and Total, becoming partners in refineries, petrochemical plants, liquefied petroleum gas (LPG) receiving terminals, and gasoline distribution networks. Caltex, which originally was a joint venture (JV) of Chevron and Texaco but now, like Texaco, has become a part of Chevron, began to encounter real competition from other western companies, as did Shell, its major retailing
rival. For all of the 1990s and well into the beginning of this century, these two companies were first and second (changing the lead post at times) in total Asia Pacific product sales.

The Middle East Gulf also took note. Exports of refined products began to move in ever greater volume to the East rather than the West; even more so, crude export volumes ballooned for Asia Pacific buyers, and Qatar, the emerging liquefied natural gas (LNG) superpower of the past 20 years, focused on sales to Asia after quickly satiating Western appetite for gas imports. Gulf exporters began to consider Asia Pacific their own demand backyard and were confident that any future expansion in sales would be easily absorbed by the region.

More importantly, many energy analysts became used to Asia Pacific as the leader in world oil/gas demand growth and came to depend on the region’s continuing consumption growth to keep global markets in balance. Analysts would often pencil in the assumption of 600 MBD to 800 MBD, at times as much as 1 MMB/D, concluding that Asian demand growth would right the world balance by sopping up excess supply.

Asia was now the top investment region, likely to be the epicenter of future oil growth for the foreseeable future, with China definitely taking the lead. In fact, China came to epitomize all of Asia altogether. This strange assessment came to dominate thinking in the United States, in particular among financial institutions, banks, and investment funds that were substantial oil players in the past decade up to the Great Recession. A distorted view of the energy sector emerged—that companies who wanted future growth had to focus on China, and that China somehow was equivalent to Asia. After ignoring China for energy investment into the late 1980s, companies became obsessed with Beijing—while often ignoring India, another Developing Asia giant.

The fault was not solely that of potential investors. A slow pace of liberalization in India, only a partial energy sector liberation, and generations of massive and still growing bureaucracy dampened foreign investors’ enthusiasm. There was even less interest in smaller Developing Asia markets (e.g., Indonesia), near-NIC markets (e.g., Thailand and Malaysia), as well as NICs, compared to the enthusiasm for China.

These investment hindrances slowly faded over the years. We believe that 2014 marked a watershed year for Developing Asia. It was the first year that the region showed definite signs of shifting from a high-growth, excessive oil consumption region into a more mature and steady consumer of oil and gas. Asia Pacific demand growth will continue as the global pace-setter for petroleum product consumption, but annual percentage gains of 6+, or up to 1 MMB/D on any consistent basis, have become a thing of the past.

A. Thesis

A fundamental shift in Asian energy use, most notably in China, is increasingly evident. We believe this is a structural and not cyclic phenomenon; it not only shapes the rate of demand growth, but also the nature of oil consumption. This will force markets to recognize that, while Asia Pacific will remain the engine of world oil demand growth, future growth will be at a lower rate of expansion. Further, future demand will shift away from mid-barrel to light-ends products, such as LPG, gasoline, and naphtha. This means changing prospects for US product and natural
gas liquids (NGL) exports and, in particular, diverging prospects for light-end exports and middle distillate barrels sold abroad.

US oil exporters will be presented with a bad news/good news situation through the end of the decade. The bad news is that we do not expect Asia to record the levels of demand growth during 2000–10, let alone the boom-boom decade of 1990–2000. Developing Asia has begun to exhibit characteristics of more mature economies, as they have expanded and grown more sophisticated over the past 30 years. Analysts should lower their high growth expectations. The good news is that Asia Pacific likely will continue to lead world oil demand growth for the remainder of this decade and the next. This growth will be greatest in the light end of the barrel, including NGLs, as well as refined products. American exporters sell what Asia increasingly needs. Most of all, Asia is ready to play poker—and US exporters now have to learn how to deal the cards.

This study uses both country/market surveys and thematic analysis. To this end, we will focus on Asia’s developing giants—China, India, and Indonesia—while surveying, in lesser detail, representative markets for Organisation for Economic Development (OECD), near-NIC, and NIC groupings.

B. Asia Pacific—Center of Global Demand Growth (1990–2015)

Ignored Until That Point: Until the 1990s, Western analysts usually ignored Asia Pacific as unimportant. Little differentiation was made between Asian economies. Except for the NICs—South Korea, Taiwan, Singapore, and Hong Kong—this enormous region, from giant China to tiny Cambodia, was lumped together as Third World Asia.

Bubble Bursts: As the 1990s opened, Japan was firmly at the top of the Asian pecking order: Japan’s oil demand of 5.1 MMB/D was larger than the combined demand of China (2.2 MMB/D), India (1.2 MMB/D), South Korea (1.0 MMB/D), and Australia (0.66 MBD). It was the height of the Bubble Economy, and Japanese companies were buying assets across the world. Tokyo commanded a seemingly unstoppable export machine. Yet warning signs of trouble ahead were apparent even in 1990. The collapse of the Japanese real estate market by the end of 1991 led to a rapid decline in asset values. The miracle economy finally had gone bust.

Asia Shrugged: In 1991, Asia as a whole gained 748 MBD in demand, which increased by 897 MBD in 1992 and a further 739 MBD in 1993, with respective growth rates of 5.6%, 5.3%, and 4.9%. Growth rates at this level or higher were the norm well into the first decade of the current century, with the exception of the 1997–98 recession, which saw demand drop by about 200 MBD. Demand growth in this region was relentless between 1990 and 2015, with two pauses in the expansion: the 1997–98 regional Asian Contagion and the global 2008–09 Great Recession, which each reduced growth rates but only briefly pushed demand marginally below the previous year’s level.

Singapore Emerges: While far smaller, Singapore emerged as an alternative trading and refining center to Japan, and the products trade migrated south from Tokyo by the 1990s, with crude trade following by the turn of the century. Japan became a second-run theater in the oil
trade. Singapore was blessed with a magnificent natural harbor, which was located at a strategic point in the Middle East to Northeast Asia trade arena and operated under a generally hands-off regulatory policy with little government intervention as well as a highly educated and hard-working labor force. Product price assessments in Singapore soon complemented Tokyo numbers in regional trade.

**Main Supply Flow Middle East Gulf/Northeast Asia:** In 1990, Japan, China, and South Korea accounted for 62.5% of the region’s oil consumption. Both Tokyo and Seoul were totally import dependent, while China still supplied its own oil needs. Crude and product trade was dominated by the west-east movement from the Middle East Gulf to Northeast Asia, while many other tankers, particularly products shipments, stopped in Singapore. Southeast Asia was often supplied by Singapore; other than for crude, Australasia was self-sufficient, and South Asia took moderate volumes of oil and product directly from the Middle East Gulf.

**Middle East Supply Dependence:** Asia Pacific was heavily dependent on Middle East imports, and the Gulf was particularly vital for crude supply. In addition, Saudi Arabia, Kuwait, the United Arab Emirates, and Iran were major suppliers of refined products, from LPG to fuel oil. Imports of crude or refined products from other regions that are currently important, such as West Africa, the Mediterranean, Canada, South America and Russia/CIS, were inconsequential in the 1990s.

**Rising Import Dependency:** Since Asia Pacific crude and condensate production was stagnant, ranging between 7 MMB/D and 8 MMB/D, any additional oil supply had to be imported as crude, or, less often, as product.

**Figure 1. Asia Pacific Crude Dependence (in MMB/D)**

![Graph showing Asia Pacific Crude Dependence](image)

Source: Asia Pacific Energy Consulting (APEC).
C. China—Leader of Asia Pacific Demand Growth Since the Late 1990s

Chinese Demand Revealed: Before discussing in detail the growth in Chinese energy demand, a dirty little secret needs to be revealed: Consultants, including APEC, must estimate demand data and then correct it later for errors. It should be emphasized that no official, timely supply/demand balance exists for China, because official consumption data, offered exclusively in the national statistical yearbook, only appears some two years or more after events occurred. Many price assessment agencies offer monthly demand numbers based on apparent demand, but this can be extremely misleading without complete, comprehensive, timely, and accurate stocks data—which simply does not exist. All analysts correct their data with official numbers well after the event—not withstanding their lack of methodology disclosure and heavy dependence on their sometimes inaccurate models.

Another issue must too be addressed: As is the case in the comparatives tall and short, demand has to be measured in both relative and absolute terms. Chinese product demand in 2014 was big in absolute terms—approaching 10 MMB/D. Yet Chinese consumption is still only slightly more than half of US demand. In addition, this nearly 2:1 ratio comparison comes after years of minimal US gasoline demand growth.

Eyes Wide Shut: The West, particularly the United States, had initially ignored the impact of China. While oil companies noted the demand growth of the early 1990s—which was often well over 7% between 1991 and 93—it took a second demand surge in 1995–97, to grab their commercial attention. The change in attitude was remarkable. After totally ignoring Asia, many analysts began an obsession with China that has continued to the present day. For many, China became Asia. When China failed to produce gains of 500 MBD or more between 2000 and 2010, Western observers took out their worry beads.

A Generation Ago: Already 25 years ago, China was beginning to have an impact on world oil and petrochemical balances. Chinese companies began trading on international markets; China was a major regional crude exporter on par with Malaysia or Indonesia. At that time, China still refined a portion of its oil output in foreign refineries, notably in Singapore. China Petroleum & Chemical Corporation, known more commonly as Sinopec, started a base petrochemical and refinery building drive. This was paralleled by another national oil company, China National Petroleum Corporation (CNPC), also known as PetroChina, which expanded rapidly into the downstream sector. China was a comer, as everyone in Asia realized. Speculation grew as to when China might replace Japan as Asia’s economic locomotive as Tokyo remained mired in its post-bubble slump.

To a Free Market: China was just moving out of a period of Maoist economic autarky. Despite “paramount leader” Deng Xiaoping’s exhortation that it was “glorious” to become rich, China didn’t exactly know what a free market economy was. In this transitional phase, while companies ventured abroad, their chief concerns remained at home. For refiners, product output for the home market was top priority, with profits being strictly a secondary concern. Large investments were made to meet the twin goals of downstream modernization and expansion. The move to a market economy was slowed by the persistence of centralized planner thinking.
Imports Begin: From 1990 to 2000, Chinese oil use nearly doubled. The breakneck growth of the 1990s meant that by the end of the decade, total oil demand outpaced domestic production and for the first time ever, China had to import crude oil. These crude imports had to be low in sulfur, as most refineries had their distillation towers built of untempered steel and higher sulfur crude would corrode refinery metal in units and pipes. For this reason, Chinese buyers preferred regional waxy, sweet imports, similar to major domestic grades Daqing and Shengli, which then made up more than 75% of Chinese oil output.

Figure 2. Chinese Oil Demand Takes Off (in MMB/D)

Source: APEC.

Outpacing; Misled: As detailed above, Chinese demand had consistently outpaced Western expectations. Western forecasting of demand by sector was even less accurate. Many Western analysts had (and some still do) assumed that China would follow Atlantic Basin demand patterns, seen decades earlier. To some extent, this mindset hampered analysis of all Asia oil balances, but this has been most noticeable with respect to China. Asia Pacific has taken a different development route and energy analysts must be careful not to make false assumptions.

Continental Market: The sustained, high-level demand growth in China was underpinned by five interrelated factors: 1) a low initial benchmark, i.e., the country’s relative poverty at the beginning of Deng’s campaign to building a market economy, 2) the size of the population, 3) Chinese willingness to work hard for success, (4) the country’s vast territory (similar to that of Russia, India, Australia, Canada, and the United States), and finally 5) massive foreign investment. Nevertheless, despite more than 25 years of sustained expansion and China becoming the world’s second largest oil consumer, the country is still seeking the path toward a fully market-driven energy sector.

At Home, Abroad: By 2000, it was evident that demand growth could only be met by importing energy from abroad, first oil, then gas and coal. Chinese companies scoured the globe since the
turn of the century, buying upstream assets to feed the hungry dragon. Gas followed oil, with a massive trunkline bringing supply from Kazakhstan and cargoes of LNG from Asia Pacific and the Mideast Gulf by 2010. It should be underlined that China’s import hunger was matched by concerns over supply security. As a precaution for the possibility that a conflict would restrict waterborne oil and gas supply, pipelines from Central Asia, Russia, and Myanmar were constructed for continued oil and gas to flow to China.

**King Coal?:** Coal has remained the dominant fuel for base energy and was growing as a share of total energy use until fairly recently. Despite all of the growth in oil and gas demand, it was King Coal that dominated energy demand. Yet environmental concerns have begun to play a part in central planning. While coal remained the biggest single source of base energy, even in 2014, oil had grown to a sizable proportion of total energy use, and gas use began to make an impact. Coal made up nearly two-thirds of Chinese demand, but gas, and to a lesser extent renewables, had captured much of coal’s demand growth.

**Figure 3. China: Coal’s Share of Base Energy Demand**

![Graph showing coal's share of base energy demand from 2007 to 2014.](source:APEC; BP Statistical Review of Energy.)

**D. Asia Pacific: Many Markets, Wide Range of Economies**

If we define Asia Pacific as including all countries within the great, irregular triangle of Pakistan eastward to Japan and then south to New Zealand, it consists of more than two dozen country/markets, though some of these (Nepal, Papua/New Guinea, Myanmar, and Timor Leste, et al.) are far too small to detail in this study. We have also excluded the small Pacific island nations as well as the recently independent Central Asian republics and the Russian Far East, from this analysis, as they do not constitute core Asia Pacific markets.

Further, Asia Pacific markets range in population from the giants of China and India, which each has well over a billion people, to Indonesia, which now has about 300 million citizens, to tiny entities such as Brunei, which has less than 450,000 inhabitants.
Asia Pacific ranges from a few advanced economies, such as Japan, Australia, and New Zealand to what is known as Developing Asia, which constitutes the great majority of Asian markets. This study will focus on the two oil demand giants of China and India, and to a lesser extent Indonesia, and how each appears to have made considerable progress in moving from Developing Asia energy market characteristics to near-NIC status.

We will explore three basic issues: 1) what demand growth will be like through 2018 and beyond, 2) how that impacts world energy balances, and 3) the nature of this shift in terms of the type of oil products used and how that will impact individual demand sectors. Parallel to this, we suggest how US exporters can understand and then benefit from learning the basic mechanics behind this great shift in Asian oil consumption.

It should be noted that almost all of Asia Pacific is import dependent for crude oil or oil products. This applies to all four economic groups this study uses to categorize Asian Pacific countries—Developing Asia, OECD, NIC, and near-NIC status.

Lastly, it is important to point out that while the Middle East Gulf has been purposefully excluded from direct analysis, this subregion is often considered in tandem with Asia Pacific, as it traditionally produced the export volumes of crude, products, NGLs, and gas that helped Asia Pacific meet its demand needs. It too varies enormously in market size and export volumes, as well as in their importance as suppliers of crude, products, NGLs, and gas. The Mideast Gulf is an integral part of Asia Pacific supply.

E. The Great Recession Accelerated Demand Tilt

It has been evident for more than a decade that trade and demand have been moving toward the East of Suez markets. While the Mideast Gulf has also been a part of the trend, it has been Asia Pacific that has been the main driver. In 2014, Asia Pacific buyers accounted for 85% of Mideast Gulf crude exports; on average, almost 93% of export products moved east, with jet/kerosene the only regular product export to Europe, though naphtha, some gas oil, and fuel oil made scattered and irregular appearances in trade.

The accelerated shift has impacted demand, trade, and markets both in absolute and relative terms. In absolute terms, while the West saw declines in demand through 2014, Asia Pacific saw growth, though minimal, between 2008 and 2010. This was followed by accelerated demand growth in 2011–13, then a sudden slowing of demand growth in 2014. In relative terms, while Asia Pacific’s 2008–10 growth rate was minimal, consumption did not decline, as was the case in Western markets. By 2014, the East of Suez region made up almost a third of global oil consumption; China made up more than a third of Asia Pacific’s petroleum use.
Of all world regions, Asia Pacific has the widest range of economies (Developing, NIC/Newly Industrialized Country, near-NIC, and OECD) and types of oil markets (from self-sufficient to near total import dependence). In terms of consumption size, the region ranges from Developing Asia giants, such as China and India (3 MM B/ or larger) to mid-sized demand countries such as Thailand and Singapore (more than 1 MM B/D) to tiny country markets, such as Papua New Guinea, Myanmar, and Timor Leste. In our analysis, we have divided markets by their level of sophistication, ranging from Developing Asia to OECD economies (China/India versus Japan/Australia). We also will detail NIC (Singapore and Taiwan) to Near-NIC economies (Thailand and Malaysia).

What Western analysts often do not fully appreciate is how these categories shift. In the early 1980s, South Korea, Taiwan, Singapore, and Hong Kong were just gaining recognition as NICs. Since then, South Korea has graduated to OECD status, and Singapore should follow after 2020. Taiwan’s oil demand has shifted fully to transport and petrochemical demand, and Hong Kong, re-incorporated into China, consumes mainly transport fuels. Other countries have moved up the ladder as well, notably Malaysia and Thailand. These markets rarely have been recognized as near-NICs. (Note: While South Korea joined OECD nearly a generation ago, we are treating this country solely as a NIC market throughout this study for purposes of historical analysis.)

Also, there is the disappearing divide between those who produce crude and gas and are net exporters and those who must import almost all their oil. As consumption grew since 1990, even major oil producers, such as China, have become major crude importers. China, Indonesia, Malaysia, and Vietnam, which were major oil exporters in 1990, imported some crude by 2014.
Years of outpacing Western demand growth already had shifted trade and marketing to East of Suez. When the Great Recession made Western demand decline, it simply slowed demand growth in Asia. The gap—two different regions going in opposite directions—made the growing significance of Asia Pacific to the world oil market more apparent.

The shale revolution has pushed light barrels from the Atlantic Basin east, while forcing Mideast crude exports also eastward to Asia. In the past three years, the United States became the world’s largest products exporter and will soon become the largest NGL exporter as well. For Asia, this offers the welcome prospect of a large-scale alternative oil, gas, and NGL supplier.

F. China Slowdown 2013–15: Cyclic or Structural

Asia Pacific demand growth has been relentless, and in the Great Recession, it helped accelerate the growth of Asia Pacific’s emergence as the world’s premier center of oil consumption. In 2009, while demand dropped by 3.7% in the United States and by 4.7% in OECD Europe—and the total OECD consumption decreased by 4.2%—Chinese demand rose by 3.9% and Asia Pacific’s demand increased by 0.3%. Even though these growth rates for East of Suez could be considered anemic compared to demand growth of 2000–07, the fact remains that Asia Pacific oil use increased when the recession gripped all world economies.

China’s oil demand weight has increased within Asia Pacific as well. In 1990, China accounted for roughly 16.4% of regional demand; by 2000, that rose to 21.2%. By 2014, China accounted for more than a third of all Asia Pacific oil consumption, just as the region made up close to 38% of world oil demand.

But this had to end one day, as the economy matured, as the government encouraged energy efficiency as a primary sector policy, and as the substitution of other fuels like natural gas began to cut the usage of heavy products as well as stationary consumption, such as power generation.

In 2014, growth in China and the rest of Asia was lower than anticipated by the West, and many Western analysts assumed this was a temporary aberration and that Chinese demand—and by implication all Asian demand—would quickly bounce back to high growth rates. But was this slower 2014–15 demand growth rate temporary or permanent, cyclic or structural? This report suggests that 2014 was the beginning of a shift to lower, though steady demand growth—first in China and then across Developing Asia—as retail subsidies for product sales were curbed or abolished in some markets. More mature economies, energy conservation, and the spreading use of natural gas mean that Developing Asia is settling into a lower but steady rate of expansion, perhaps in the range of 3% p.a. This shift will be gradual and may not be fully achieved by the
end of the decade, but it looks fairly certain that a great structural change is well underway. In summary, we should expect lower growth rates on a much larger demand base.

G. Asia Pacific—Can It Absorb Any Oil Surplus?

Many Western energy analysts expected that high demand growth rates will persist for years to come. Yet, as outlined above, there is a structural shift underway in Asian demand. We emphasize that there is no possible challenger to Asia Pacific as the global leader of energy growth, and based on per capita GNP, Asia still has considerable room for further growth. Yet a number of factors will slow demand growth to more manageable levels. The impact of this structural change will be global, as doubts rise with respect to the region’s ability to absorb oil surplus in all circumstances. Western growth expectations began to diverge from Asian reality.

Having been converted to rising expectations, many analysts continue to assume that Asia will be able to rescue the world economy when a global slowdown is threatened. Yet expectations often lag reality, particularly when a shift in fundamentals is underway. As Asian economies mature, attitudes and mindsets change, which became most evident as Chinese economy slowed down last year. The traditional Chinese response to slowing growth was to fund a wide range of high cost infrastructure projects, such as a near-immediate approval of refinery and petrochemical grassroots projects and an expansion of existing plants. Such initiatives stimulated both the overall economy as well as energy demand growth.

But unlike during earlier economic slowdowns, the central government did not respond with large-scale capital investments. Why? Because earlier stimulus programs spent vast sums of money to build facilities to turn out products that no one particularly wanted, often making only minimal profit, if not taking outright losses. There still is growth in Chinese oil products consumption, but building new plants in the home market is no longer seen as the best way to meet that demand. Spending on high-cost infrastructure is also no longer believed to be the best way to stimulate overall economic growth.

Despite its modest oil demand growth, using installed refinery capacity has converted China into a regular oil products exporter. China has become an accidental oil exporter, but an exporter capable of selling large volumes of moderate- to top-quality product. Unlike India, which was quickly accepted as an exporter of top-quality product once the first Reliance refinery was completed, China’s gradual turn from importer to exporter had surprised many in Asian trade. Indeed, the region is still adjusting, even as refinery startups in the Mideast increase the eastward flow of high-quality product exports.

The long-term implications of Asia Pacific as the world’s demand growth leader was reflected in its share of global demand, as illustrated in the following figure. No sustained global recovery in oil demand can emerge without Asia Pacific participation. Yet it is wrong to believe that Asian oil demand growth can always be counted on to absorb supply surplus.
H. Changing Asia Pacific Demand

1. SHIFTING DEMAND FOCUS

The changing nature of Asian oil products demand often has been underappreciated. But only in recent years has Asian demand finally moved toward Western assumptions of how oil consumption changes as economies mature—something that was not true in the past. This incomprehension is ironic, considering the long-held belief that Asia would follow closely Western development. Now that Asian oil demand has begun to follow Western development norms, many analysts have underappreciated the shift.

For example, Western energy economists, noting the strong economic growth in Asia in the 1990s, predicted a sharp drop in fuel oil use as the NICs roared ahead and Developing Asia’s economic expansion began with a bang. Yet the region’s demand growth was so high that by 2000, even heavy products such as residual fuel saw not a fall but a rise in volume. And all this occurred despite the fact that fuel oil’s share of the consumption barrel fell.

The trend continues now. Despite Singapore emerging as the world’s biggest bunker port by 2000, fuel oil as a proportion of the regional demand barrel declined but only to less than 7% in 2014. In absolute volume terms, residual consumption remained large despite massive regional natural gas substitution. Regional oil demand followed a similar course, but never exactly the same road, as the West.

Another common misperception among Westerners is that transport fuel use in a product group accounts for all demand in that group. This sort of twisted logic assumes that all gas oil demand...
is road diesel and all kerosene use is for aviation transport. Yet Asia is different, and a substantial proportion of mid-barrel demand has remained in non-transport consumption sectors. Nearly a third of China’s massive gasoil consumption in 2014 was for non-transport sectors, primarily for industry but also for power generation. India remained the largest consumer of non-transport kerosene grades, i.e., Illuminating Kerosene (IK) or as labeled in this market, Standard Kerosene Oil (SKO). Even so, transport demand in multipurpose products such as gas oil and kerosene has been gaining traction, as has bunker consumption as a proportion of overall fuel oil (or residual) demand. We expect this trend to deepen and widen as the decade progresses.

2. LIGHT ENDS OUTPACE MIDDLE DISTILLATES

In recent years, Asia Pacific light-end products, supplemented by NGLs, have outpaced middle distillates in demand growth. The annual BP Statistical Review of World Energy provides a basic affirmation of APEC’s contention—that light products will outpace heavy. BP muddied the waters somewhat by including refinery LPG not as a “Light Distillate,” but as a part of “Others,” but we were able to correct this with APEC LPG demand numbers. A quick look at the past 15 years shows how quickly this trend is reshaping Asia Pacific oil use.\(^1\)

Table 2. Changing Times—Asia Pacific Products Demand

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<th>Year</th>
<th>Light Products</th>
<th>Medium Products</th>
<th>Heavy Products (Fuel Oil)</th>
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I. US Exports; Natural Fit

The growing Asian demand for light ends has coincided with the shale revolution in the United States and a massive influx of sweet, light crude and NGLs onto the US market. With a crude export ban in place, the United States had to focus on exporting light refined products and NGLs. But, since late December 2015, the paradigm has shifted.

Sales Drive: Light products have made up a growing percentage of expanding US product exports. Excluding NGLs ethane and slightly refined condensate, LPG, gasoline, and naphtha made up nearly 38% of American sales abroad in 2014. Previously, with US crude exports restricted, sales abroad have consisted of refined products and NGLs. While slightly refined condensate exports, which began in mid-2014, were minimal, we expect that ethane and condensate will add a further 200 MBD to US sales abroad by 2018. We expect that light ends, including NGLs, will make up nearly half of all US product exports by 2020. Of course, with

\(^1\) LPG is an NGL derived from gas field production and from refining, though it is also considered a light product. It is always very light and needs specialized containment to remain a liquid. Most “Others” products consist of very specialized, small volume, and heavy oil production such as petroleum coke or bitumen.
crude oil exports now in play, lighter grades of crude are likely to be exported directly rather than lightly processed.

**US Exports Fit Asian Needs:** A structural Yin/Yang of opposite but complimentary forces has been emerging in recent years and will shape world oil and gas markets for decades. North America, if considered as a whole, will be structurally long in oil, NGLs, and gas. We expect Canada to follow the US shale revolution’s trajectory by 2020, with Mexico joining sometime in the coming decade. The removal of the 40-year-old crude export ban coupled with other supply-side developments will result in the United States pushing crude oil, refined products, NGLs, and LNG into international markets. In contrast, Asia Pacific will remain an importer of crude, refined products, NGLs, and gas.

**Reducing Dependence:** At the same time, Asia Pacific countries/markets want to reduce their structural dependence on Mideast Gulf suppliers. They want to incorporate other pricing elements in their purchase contracts so as to no longer be at the mercy of Mideast sellers’ whim. To this end, they want to develop another long-term, large volume supply point that can serve as a counterweight to the Mideast Gulf’s current export dominance. The long-term trend will be that North America will compete with the Mideast to see who wins the future demand growth of Asia Pacific.

**Panama Canal Cuts Transport Costs:** The Panama Canal is a vital link in that US export chain. While the US West Coast (USWC) has the advantage of geographic proximity to Asian markets, the US Gulf Coast (USGC) has a substantial edge in almost every other export factor. The USGC has a relatively easy permitting process for building infrastructure, a greater number of sophisticated refineries with more capacity, and most of all, proximity to two of the three largest tight oil basins: Eagle Ford and the Permian. The Panama Canal serves as an enabler, rather than a magic wand—it puts the USGC close enough to compete with Mideast sales on the basis of different price formulae.

The revamped canal will allow transit of all LNG tankers other than the two largest, the Q-Max and Q-Flex classes, or roughly 90% of the world’s LNG fleet. It will accommodate all currently operating or planned LNG tankers. It will allow for the shipment of liquids tankers of 160,000 deadweight (DWT), or roughly 1.2 million barrels (MMbbls) of crude, and products tankers will be easily accommodated. And while the canal’s expansion is scheduled to be finished in 2017, the Canal Authority already has been considering a further expansion of its carrying capacity.

**J. Export Opportunities**

**Lower Growth, Light-Ends Focus:** US oil exporters will be presented with a bad news/good news situation through end of the decade. The bad news is that we do not expect Asia to record the levels of demand growth experienced in 2000–2010, let alone the boom-boom decade of 1990–2000. Developing Asia has begun to exhibit characteristics of more mature economies, as they have expanded and grown more sophisticated over the past 30 years. Analysts should lower their high growth expectations. The good news is that Asia Pacific likely will continue to lead world oil demand growth for the remainder of this decade and next decade. This growth will be greatest in the light end of the barrel, including NGLs, as well as refined products.
US Export Interests: US product exporters have sold into Atlantic Basin markets for decades, but the Panama Canal revamp has opened a range of Pacific possibilities. Powered by the shale revolution—and an easing of export regulations—NGL producers responded quickly to marketing in Asia. We hope to be able to highlight other ongoing trends that will provide new sales outlets.

K. Linked Lines of Query

1. Overall Demand Growth; Changes in Sectoral Use

This part of our study will provide country surveys detailing overall changes in demand growth and analyze shifts in product consumption by sector. The most important demand changes include shifting consumption patterns within each product group, including LPG, gasoline, naphtha, kerosene/jet, gas oil/diesel, and residual fuel. Product utilization in Asia in recent years has changed rapidly and this, at least in part, has shifted the focus of demand growth from the traditional emphasis on consuming middle distillates to the increased use of light products.

We will survey the impact of retail subsidies, an important area since as of 2015, only Japan, Singapore, Australia, and New Zealand were indisputably free energy markets (though Thailand may join them soon). We will also attempt to identify specific product areas through which US exporters can quickly gain market entry.

Our focus will be on demand growth in Developing Asia, looking first at China, then the other demand giant, India, and finally Indonesia, a smaller but significant demand market. Further, we will survey changes in sectoral use—in particular, the shift to increased gasoline use in traditional diesel markets—in Developing Asia as well as in near-NICs, such as Malaysia and Thailand. We further will detail the shift in petrochemical feedstocks to a broad range of non-naphtha alternatives. We forecast still regular growth in all these markets, albeit at a lower rate than has been the norm in the past decade.

Many of the traditional fundamentals of Asia Pacific oil no longer apply or, if they do, have far less importance than they did in 1990, 2000, or 2010. Gas oil is finally dominated by road diesel demand, even in China, long the biggest non-transport consumer of this product group. Indonesia largely has backed out home kerosene use. While India has lagged in this regard, decontrol of gas oil/diesel under the Modi government will shift general gas oil use to transport diesel, while further reforms are expected in LPG and kerosene subsidies.

2. Deregulation and Retail subsidies; Impact on mid-distillate Demand growth

Since 2010, Asia Pacific light-ends demand growth has consistently outpaced middle barrel products, often at rates nearly double that of middle distillates. And much of that has been seen in LPG, which is versatile and clean-burning, though costly and difficult to transport and store as it needs specialized containment. Removal of subsidies impacted the shift to lighter products, too. Near-NICs Thailand and Malaysia reduced diesel demand moderately by simply reducing its comparatively heavy subsidy compared to gasoline, a lesson also used by Vietnam. For India, the
final removal of gas oil subsidies and a reduction for general kerosene grade subsidies will likely cut mid-barrel consumption considerably by the end of the decade.

It should be noted that while Asian base petrochemical companies have been shifting to LPG, condensate, and ethane use, naphtha still made up slightly more than 80% of regional feedstock demand in 2014. Asia is structurally dependent on naphtha imports. Even though decreasing in importance, naphtha still will dominate petrochemical feedstock supply through the coming decade. Naphtha also will be needed as the basestock for gasoline manufacturing.

To highlight the shifts in demand growth, the study will detail the pace of deregulation and the competitiveness of various products—most importantly, the competition between gasoline and diesel, the major land transport fuels. Overall, we will detail the shifting patterns of consumption between light ends, middle distillates, and heavy products (residual) to show how they impact current trends in oil consumption. The direct burning of crude, as boiler feed, is a practice that has virtually ceased across Asia Pacific other than in Japan, though as late as 2000, more than 350 MBD of crude oil was burned as a fuel oil substitute in the region.

The impact of price deregulation has accelerated the use of light product over middle distillates. This has been achieved most fully in Indonesia and to a lesser extent in Thailand, Malaysia, and Vietnam. We will see how far general gas oil demand drops in India, a first rank gas oil/diesel market, by year end. The focus of this study will be retail subsidies for middle distillate (kerosene and gas oil/diesel) consumption, concentrated in non-transport use. We believe these measures will increase gasoline and LPG demand, while decreasing general-quality kerosene grades and gas oil, and to a lesser extent diesel. Please note that the transport sector is divided between light products (gasoline/LPG) and middle distillates (diesel/aviation fuel), leaving aside residual bunker, which is also a transport fuel.

3. Future Comparative Growth Rates

The move of oil demand out of static, stationary consumption and toward lighter products, particularly in the transportation sector, has begun. In our base case demand forecast, we will examine how the progressive removal of retail subsidies will impact future demand growth. Further, we will weigh the relative demand growth rates of light-end products versus the rest of the oil barrel.

Overall, we will review and analyze light products consumption growth in comparison to middle distillate demand growth in recent years, by product. Our scope of analysis will concentrate on Developing Asia versus OECD markets.

4. The Impact of Product Quality in Maturing Asian Economies

Finally, we will examine the issue of product quality and how product specification improvements, known as “spec tightening,” are impacting demand and demand patterns. We will forecast a base case, what future spec tightening is anticipated in Developing Asia, and how this will shape future light and middle distillate demand patterns. The drive to better quality products
Childhood's End: Developing Asian Giants

is progressive, cumulative, and irreversible—and, in one particular area, where Asia is moving forward, closely follows a Western market pattern.

We will examine quality premiums in product prices. Why have high-conversion refiners (e.g., Reliance and more recently, Jubail and Yanbu JVs) and GTL plants (e.g., Shell and ORYX GTL) been unable to gain expected premiums in product sales over recent years? Will the move to a mature economy demand pattern for Developing Asia increase product premiums? What lessons does this hold for American product exports?

The move toward lighter products, and better quality products often used in transport, has been underappreciated. A good example is Thailand, a near-NIC market. Despite nearly 147 MBD of gasoline use, Thailand remains solidly a diesel market, with this transport fuel alone accounting for a third of national oil use. Jet/kerosene, for aviation, accounts for all demand in that products group, while automotive LPG and to a far lesser extent fuel oil for bunker remain other areas of transport fuel use. Together in aggregate, they made up 58.4% of oil consumption—despite a major use of naphtha and LPG as petrochemical feedstocks. Compare this to a classic Developing Asia market, such as Bangladesh. Dacca has general quality gas oil, mainly for power generation, which makes up 41.7% of all oil use. Despite having no petrochemical capacity and using massive amounts of gas, transport fuels still made up only 27.2% of demand. Transport fuels usually have far more stringent quality requirements than average oil product.
Chapter 2. Asia Pacific Demand Growth: Demand Growth by Sector

A. Asia Pacific

1. Basic Parameters of Demand

Total crude and product consumption in Asia Pacific more than doubled between 1990 and 2015 (from 12.9 MMB/D to almost 28 MMB/D). We will utilize 2004–14 as our base 10-year statistical period for examining product trends. For this analysis, as well as the more detailed country profiles, we will rely heavily on APEC data, which has been gathered from government statistics, specialized energy media, and the industry itself for the past 21 years.

From 1990 to 2000, demand for major oil products rose from 12.9 MMB/D to 18.8 MMB/D, a 46% increase. From 2000 to 2014, products demand rose from 18.8 MMB/D to nearly 28 MMB/D, a gain of more than 48%. In the past 30 years, no other region has added oil demand at such a rate. And while Latin America and sub-Saharan Africa have had high growth rates in recent years, the scale of consumption is vastly different. Excluding Mexico, India alone consumes more oil than these two regions combined.

In general terms, all of Asia Pacific demand was expanding at a tremendous clip in 1990. Even Japan, which was still under the influence of the Bubble Economy expansion, saw demand increase by 3.5%, while South Korea’s consumption rose by a sizzling 21.5%, typical of the NICs. On a five-year basis (1990–95), the two groupings were not far behind the Developing Asian giants, China (8.2%) and India (5.1%). Representing Developing Asia, Vietnam, which finally emerged from decades of a command economy, registered demand growth in 1990 of 24.8%, albeit from a base of less than 70 MBD that year.

This pace has slowed down substantially within the last several years. China’s new norm for 2013–14 was 4.4%, and India’s demand grew by 0.8%. Japan saw demand fall 4.7%, while South Korea, long in a demand slump, saw consumption shrink by 0.1%.

The substantial difference is that growth rates for each of these snapshot years (1990 and 2014) are based on vastly different scales of base consumption. Chinese demand in 2014 was in the range of 10 MMB/D, so a 3% demand growth rate in 2015 would still mean a 300 MBD gain in consumption. In 1990, it would have been 66 MBD. Similarly, India’s 3% growth in 2014 would have meant 95 MBD in demand gains; in 1990, it would have been only 35 MBD. The total volume of demand in all of Asia has grown enormously, but the growth has been particularly impressive in Developing Asia.

The nature of that change was not only in size, but also by fuel group. In 1990, gas oil/diesel made up 28.4% of all oil products consumption. Taking into consideration kerosene consumption, which totaled 11.2%, the mid-barrel accounted for nearly 40% of all products demand. By 2014, that had declined slightly to 38.5%. But the most dramatic change was in the bottom barrel. In 1990, fuel oil made up 25.9% of the demand barrel; by 2014, this had fallen to only 6.9%. Who was the greatest winner in this generational change? It was light-end products, with gasoline, naphtha, or LPG leading at various times in consumption growth over the past 25 years.
Sectoral use also shifted dramatically, though this trend is more difficult to notice as it is hidden in demand statistics by product group. We will detail this in the next section.

2. DEMAND TRENDS BY PRODUCT & SECTOR

Looking Back

In 1990, LPG was used overwhelmingly in the residential/commercial sector, with only scattered demand in transport and petrochemicals. Diesel dominated Asian transport needs and was the top road fuel in China, South Korea, Thailand, Malaysia, Singapore, Indonesia, Malaysia, the Philippines, and India, as well as the smaller markets across South and Southeast Asia. Gasoline’s major markets were Japan, Taiwan, Australia, and New Zealand.

Most non-transport demand in kerosene came from residential/commercial sectors, whether for cooking/lighting (Developing Asia) or heating (mainly Japan). While diesel was the dominant road fuel, non-transport, stationary use of gas oil made up the majority of regional consumption, notably in China, the biggest gas oil consumer. Industry and power generation were the two sectors primarily using large volumes of both general gas oil and residual. Fuel oil use, industry, power, and ships’ bunker were the major demand sectors. In 1990, China consumed more than 650 MBD of residual, while India used nearly 550 MBD. Even OECD Japan was consuming enormous volumes of this product—more than 1.7 MMB/D, including direct burn crude. This was a very different demand pattern from what we have seen already in 2010, let alone 2014.

Subsidies

As noted earlier, historically few Asian markets were completely free in oil pricing and sales. Progress has been slow in most Asian markets, but it appeared in late 2014 and early 2015 that deregulation had been on the move again. It must be realized that retail subsidies have long been a matter of it being cruel to be kind. Governments justify the use of retail subsidies as a way of helping the poor by sheltering the less well-off from the full cost of an oil product. Yet in many such markets, a good deal of subsidized product goes to the middle class, not the poor. Further, keeping prices artificially low tends to encourage wasteful consumption of oil products. As in the example with India and LPG, or until recently with kerosene in Indonesia, the rationale is to aid the poorer citizens by supplying a basic good at a reduced price. But it rarely worked out that way in practice: In India, the middle class long has benefited from cheap LPG, while the poor still burnt dried cow dung.

Government planners in many Asian markets have begun to realize that they are subsidizing unnaturally high, almost cancerous, rates of demand growth. As a result, the countries face a dilemma of whether to produce more oil and refine it, meaning refineries would have to be built, or to import more product. In the 1990s, Indonesia was a net oil products exporter. By the turn of the century, the balance had reversed sharply. From 2012 to 2013, Indonesia imported more than 600 MBD of product while producing only around 900 MBD of crude. A series of measures to reduce imports were implemented, including product substitution, price increases, and finally the near-abolition of retail subsidies. In 2015, imports were expected to fall at least by a third. Yet it is India, not Indonesia, which will be the crucial market to watch over the next one to two years, as the Modi government is expected to roll back subsidies for LPG and kerosene grades.
**Transport Fuels; Breakout Point**

As noted, light-end products have outpaced middle distillates in the demand growth race in recent years. This has been a push/pull phenomenon, as both product groups’ demand behavior has changed. There has been a slowing demand growth for middle distillates, which are no longer supported by retail subsidies, complemented by increased light-ends use in petrochemicals and the shift from diesel to gasoline and, to a far lesser extent, LPG. In fact, of the entire mid-barrel nexus, the only product that still has rapidly rising demand has been jet/kerosene for aviation.

In recent years, the rate of demand growth for light-end products often has been up to double that of middle distillates. We do not expect this to change significantly through the end of the decade. In fact, if India shifts from its current heavy dependence on diesel to increased gasoline use, the light-ends demand growth rate may further outpace middle distillates.

The gasoline/diesel competition is particularly significant. In the past, gasoline was seen as *rich man’s fuel* and was heavily taxed in most markets in the name of social equality. Diesel on the other hand was viewed as a *social good*, where consumption should be encouraged. In many markets, there was no differentiation between transport diesel and non-transport gas oil use, unlike in Germany where the famous *red dye* has been long used to distinguish home heating gas oil from higher quality—and more heavily taxed—diesel. The net result: gasoline growth was registered as Asia’s middle class grew over the past 25 years, but diesel demand grew far faster. It was cheaper in terms of tax/tariff burden, and supported by retail subsidies in many markets.

Transport fuel demand has a definite connection to rising Asian incomes. Economists have long speculated about a *breakout point*, when expanding middle class incomes allow for the possibility of acquiring private transport. In OECD, NIC, and near-NIC Asia Pacific, the progression has been clear. People moved from bicycles to motor scooters and motorcycles first, then to small, less expensive, and often locally manufactured automobiles, and finally to high-end cars, which in the past decade has often meant sport utility vehicles (SUVs) rather than the traditional sedan. Parallel to this has been the slow shifting of many regional economies to increased gasoline use for land transport, favoring it over diesel. In Developing Asia, this has already occurred in China and Indonesia, though India has remained a strongly diesel-oriented market. Yet the cut-away of gas oil/diesel subsidies may shift Indian fuel use as well, as it had done earlier in near-NICs like Malaysia.

We expect both trends will become the norm as per capita income grows and the private transportation sector takes off, along with greater fractions of the populations in each country moving into the middle class. This is a structural boost to light products consumption that will occur even if overall demand growth rates slowed.

Other factors also contribute. For LPG, there has been considerable demand growth outside of the traditional residential/commercial sector, which is dominated by cooking and space heating. A growing proportion of LPG in 2014 was used in petrochemicals. Further, concerns about air pollution, particularly in densely populated urban areas, created significant LPG demand for transport in a number of regional markets, with public transport a prime target, in particular taxis.
Thus, it is no accident that Asia Pacific has two of the largest volume transport LPG markets, South Korea and Australia, though the fuel is also used in a range of other markets, including Thailand, Singapore, Malaysia, Japan, and more recently China.

Naphtha has remained king of Asia’s petrochemical feedstock sector, despite considerable inroads made by LPG and condensate in recent years. Yet to understand the product naphtha fully, some simple definitions are in order.

First, while we have treated naphtha as a finished product, many consider it a semi-finished material, as it is always a precursor to some other product. Naphtha has two primary areas of consumption: in reforming to create reformate or as the basestock for creating gasoline, or as petrochemical feedstock to create petrochemical intermediates ethylene, propylene, or Benzene, Toluene, Xylene (BTX). In Asia, it also remains in limited use as boiler feed for power generation. The important thing though is not what naphtha is, but what it has the potential to become.

Naphtha as a product group is divided into paraffinic and naphthenic (N+A) grades. The first is used mainly in ethylene cracking, which yields the petrochemical intermediate ethylene, utilized to manufacture plastics. Paraffinic naphtha also serves as the basestock for the blending of gasoline, though this represents a much lower value than its use as olefin feedstock.

In contrast, N+A naphtha is dual-purpose. For gasoline, it provides reformate, the essential component needed to blend a simple naphtha basestock into gasoline. Yet reforming, at a higher severity, also produces higher octane reformate, used in aromatic petrochemicals, when it is converted into intermediates BTX. The dual focus of reformate is reflected in BTX units, operating in refineries and aromatic petrochemical complexes. Aromatic petrochemical plants can be used to produce lower-quality gasoline, as was the case in Iran from 2009 to 2012, when gasoline demand outstripped the National Iranian Oil Company’s production capacity.

Naphtha grades are classified according to the composition of its content of paraffins, olefins, naphthenes, and aromatics (PONA). This PONA analysis is simply a shorthand accounting of these elements contained within this product. Paraffinic naphtha contains well over 50% of paraffins, while the inverse applies for N+A naphtha; when the two equally divide, the naphtha is called a borderline grade.

The two grades differ significantly in their demand pattern. Paraffinic naphtha is like a slide in a children’s playground. One starts from the top of the slide and there is no stopping until exit at the bottom. In terms of demand direction, paraffinic naphtha is best solely in petrochemicals as there is only one primary commercial use for paraffinic naphtha—to make ethylene. N+A naphtha is more like a modern spy novel, with multiple cut-outs, leading to multiple demand choices very early in a processor’s decision-making process. Should N+A naphtha be used to make gasoline, gasoline reformate, or petrochemical reformate? If making gasoline, does the operator aim for top-quality material, or lesser-quality outturn? Should finished gasoline be sold, or semi-finished product, or solely reformate as a gasoline component? Multiple choices with varying commercial challenges are the essential driver in N+A naphtha use. Paraffinic naphtha is more of a one-trick pony that can do only one thing, but does it quite well.
Paraffinic naphtha traditionally dominated Asian markets in the past, yet the growing importance of aromatic petrochemicals, paralleled by Asia’s shift from diesel to gasoline, appears to have strengthened N+A material’s premium over paraffinic naphtha. This can be seen in condensate prices as well as in the prices of naphtha.

The demand for kerosenes as a product group in Asia Pacific presents an interesting contrast when compared to West of Suez markets. Analysts in OECD markets tend to assume that kerosene and jet-grade kerosene are the same, and thus the overall kerosene demand would approximate the volume of aviation fuel consumption. However, in Asia, sizable volumes of kerosene consumption were in non-transport sectors. Not even all jet kerosene in this market was used for transport, as Japan used far more jet-grade kerosene for home heating than it did for aviation.

Further, Asia contains many markets where residential and commercial consumption for lower quality grades like IK and SKO dominated demand. India has long been a prime example of this. In 2014, non-transport use of kerosene, supported by high retail subsidies, accounted for 68% of the country’s overall kerosene consumption, which totaled 290 MBD. Similarly, high proportions of non-transport kerosene consumption also were seen in neighboring Pakistan, Bangladesh, and Sri Lanka. It is very clear that non-transport consumption of kerosene, mainly IK and SKO grades, still made up more than a third of South Asian kerosene demand in 2014.

A similar story can be told for gas oil/diesel, with most Western analysts assuming that gas oil is simply a synonym for diesel. This is clearly not the case in China where non-transport, lower quality general gas oil consumption still made up nearly a third of national demand. In Indonesia, non-diesel consumption is similar, constituting 31% of all gas oil demand. Only when countries reach near-NIC or NIC status, such as in Thailand (2%) and South Korea (3%), does diesel demand completely dominate gas oil consumption. APEC estimated that in 2014, just under 30% of Asia Pacific gas oil consumption consisted of general gas oil grades, not diesel—a rather sizable volume of more than 2.5 MMB/D.

Fuel oil, also known as residual or residue, has undergone dramatic demand changes over the past decade, mainly due to the growing use of natural gas in the region, whether piped or in the form of LNG. As late as 2000, fuel oil played a major role in power generation, industry, and other minor stationary uses. By 2010, residual remained prominent only in ship’s fuel, or bunker. Singapore has emerged as the world’s largest single bunker port over the past two decades, and more than 95% of that bunker was derived from various grades of fuel oil.

In 1990, Japan dominated regional LNG use and indeed was (and remains) the world’s largest volume LNG importer. At that time, South Korea and Taiwan had just begun purchasing LNG, and their LNG sectors remain nascent. By 2014, China, India, Thailand, Singapore, Indonesia, and Malaysia joined the LNG importer club; by 2017, they will be followed by Pakistan, Bangladesh, Vietnam, and possibly the Philippines. China imported its first LNG only in 2006, yet by 2014 it was the world’s third largest volume importer.
Pipelines have also played a role in backing out residual use. Regional gas pipeline networks remain extremely limited. Despite decades of planning, a proposed gas pipeline to link the Association of Southeast Asian Nations (ASEAN) markets remains on the drawing board. China, South Korea, Thailand, Pakistan, and Malaysia have been the only countries operating national gas distribution systems, even if they are limited. China, which completed three West-East trunklines by 2014, was the only country to import large volumes of piped gas, currently from Central Asia and Myanmar. By 2020, Russian supply will be added as well. We expect increasing gas availability will back out residual demand, just as expanded rural power grids had rolled back kerosene consumption in residential/commercial sectors.

As noted earlier, India will be the next testing ground for the premise that retail subsidies have boosted mid-barrel demand growth. Indonesia, however, illustrated what happens when product substitution coupled with curbing kerosene subsidies are imposed. In 2008, the Indonesian government had become gravely concerned about highly subsidized kerosene demand, which made up 15% (some 181 MBD) of total Indonesian consumption. The oil ministry removed subsidies for home kerosene use (mainly cooking) and offered fiscal incentives to switch to LPG consumption. By 2014, kerosene demand plunged to 88.8 MBD, or 6.8% of total Indonesian demand. If aviation fuel use wasn’t included, kerosene only accounted for 1.2% of national demand.

A similar story is unfolding for gas oil/diesel. In 2014, this product group accounted for almost a third of all Indonesian oil use, totaling 434 MBD. True diesel, however, made up roughly 66.4% of gas oil demand. With the January 2015 subsidy reforms, we expect demand for this mid-barrel product group to decline by 70 MBD to 80 MBD in 2015. Many non-transport uses for gas oil, such as power generation, will find the fuel too expensive to use without subsidies. Some Indonesian analysts believe it also may shift transport fuel growth from diesel to gasoline, as the latter was weighed down by high taxes in the past, compared to diesel sales. Eliminating retail subsidies certainly will have a huge impact on mid-barrel demand growth through the end of the decade.

In both of these Indonesian examples, a lighter product has made inroads into demand of a heavier middle distillate. The stripping of retail subsidies will impact light products too, but we believe overall middle distillates will be affected far more deeply, and we expect this trend to spread across Asia Pacific markets by 2020. In 2008, jet/kerosene and gas oil/diesel combined totaled 648 MBD Indonesian consumption, or 53.6%. By 2014, these two product groups totaled 522.8 MBD, but only 38% of total oil use. Light ends gained what middle distillates lost.

Quality also has begun to have some impact on all categories of Asia Pacific economies. For years, many Developing Asia markets used to pretend they were implementing product quality standards equal to those already imposed in the European Union (EU), calling their specifications Euro 5 or the latest EU quality standard, Euro 6. This was always a charade—often, a Developing Asia market would regulate a single key quality point, normally sulfur, and then simply ignore other EU quality requirements. Chinese authorities have finally admitted that their standards were markedly different from that of the EU, and Chinese product specifications now are labeled National Standard rather than Eurosce
This can have important ramifications. For example, China in 2014, in moving toward its supposed equivalent to Euro 6, required that diesel had a minimum octane number of 51 (in urban areas). Yet the allowable sulfur level of 350 PPM (0.035S%) for diesel and general gas oil sales was higher than the European standard. Other secondary specifications, such as density, T95, and polyaromatics content, also were notably looser than Europsocs.

Yet directionally, China—and the rest of Developing Asia—has been following the European quality drive. And this is making the manufacture of better-quality diesel more expensive than a decade ago, when Developing Asia markets permitted the sale of far lower quality product. Diesel has remained a manufactured product; gasoline increasingly in modern times is an assembled product. The cost of making high-quality diesel has increased relative to gasoline. Notably, this too will slow demand growth, as higher costs are passed onward to consumers.

B. Developing Asia

1. China

Overview

The widespread belief that China can stand in as a proxy for Asia is a dangerous assumption, because in many aspects, China has atypical characteristics for the region—and by applying Chinese market characteristics to an entire region, one risks outright distortion of fundamentals.

China still is not a fully free market, but an economy in transition from the Command Model. While the central government has relinquished many micromanagement tools, it has not given up all direction of state company management. Conversely, Beijing has yet to learn how to effectively wield the tools of macroeconomic management, primarily through monetary policy. Instead we witness a work in progress, and this is particularly noticeable in the energy sector.

China cannot be ignored, by virtue of its sheer size and growing economic clout. Yet for accurate appraisal, it must be examined within the context of the region. As a continental country, it spans arid, mountainous, temperate, and subtropical climate zones. Slightly bigger than the United States, the vast majority of China’s population is concentrated in the eastern provinces, particularly along the coast and through the two great valleys of the Huang He (Yellow) and Yangtze rivers. The dichotomy between the populations on the coast and the interior land extends to economic development and wealth. The provinces at the mouth of these two rivers, together with that of the Pearl River (Guangdong), share large concentrations of population and wealth.

Across this vast continental country, Beijing has been trying to shift economic activity from a command economy to a market economy. The transition has been slow, and the state often intervenes in the domestic market when events move contrary to government policy, such as when the central government moved to support Chinese stock market shares. Yet most of all, this has been a slow process of shifting mentality, as Chinese business executives learn that the market can have as much influence as the state in shaping the national economy.
Profit is not paramount for state companies, and their still ill-defined “social obligations” have some most uncommercial consequences. While retirement and staff trimming undoubtedly reduced payroll costs at national oil companies CNPC/PetroChina and Sinopec, a decade ago the former employed over a million workers; the latter some 600,000. This was at a time when the largest super-majors, ExxonMobil and Shell, each employed fewer than 100,000 staff members, including all their affiliates. Other obligations pop up regularly in commercial dealings. After China signed a government-to-government accord with Kazakhstan, CNPC/PetroChina was compelled to implement the gas sales contract, which was priced far above LNG market levels of that time.

No matter—CNPC had to accept the supply and then sell it at state-set market prices, which in essence forced the company to provide a subsidy for accepting and distributing government-contracted gas imports. The bureaucrats’ response was that the company was given exclusive rights to the (soon to be four) West-East trunklines. This was the government’s compensation quid pro quo.

In general, China remains a top down system, though popular discontent can shift government policy. From 2012 to 2014, a number of aromatic petrochemical plants were proposed for urban sites in densely populated areas. Protests forced the cancellation of some proposals, while other projects, notably in the Sichuan and Fujian provinces, were shifted to new locations. Public sentiment influences government policy in other ways. While Beijing was cleaned up for the 2008 Olympics, significant pollution problems remained. The winter smog of 2012–13 was so bad that popular sentiment forced the government to ban almost all coal use in the city and municipalities surrounding Beijing, as well as implement significantly tighter specs for oil use in the capital, requiring higher quality fuel than elsewhere in China.

In a longer term, the government has implicitly accepted that the primacy of economic growth alone without any concern for air and water pollution is unsustainable. Following the footsteps of the OECD markets, the NICs, and then near-NICs, China has begun to clean up. And the rest of Developing Asia is not far behind.
Figure 6. Expansion of Chinese Base Refining Capacity

![Graph showing the expansion of Chinese base refining capacity from 1990 to 2014.](image)

Source: APEC; Industry.

**Demand Trends by Product**

**LPG**

China’s LPG supply comes mainly from refining; a small volume of LPG will always be produced from distillation and shows up in refinery outturn, unless burned as process fuel. Yet with the massive expansion of China’s refinery capacity, the country has emerged as a major LPG producer, second only to Saudi Arabia in the East of Suez region. Unlike the Kingdom, Chinese refiners never invested in LPG storage and transport infrastructure, let alone export logistics. The product’s price controls only were lifted in 2009 as the state abandoned setting a central price. Yet refiners, who are the source of most Chinese LPG supply, were conditioned by long years of a price-controlled market to avoid investment in LPG storage and transport infrastructure. Therefore, LPG produced by refineries in the interior never makes its way to the populated and highly industrialized coastal areas. In fact, most Chinese LPG is consumed within 30 kilometers (km) from its supply point, and this has not changed.

Further, Chinese LPG differs from international quality standards. For the reasons explained below, it has long been formulated differently than standards abroad. Typically, Chinese LPG is 60% butane and 40% propane, which is the inverse of world average, where propane dominates. The lower quality standards for China’s refinery-derived LPG forced petrochemical users to import large volumes of propane as feedstock. With incomplete government statistics, it has been difficult to get an exact accounting of China’s LPG balance. Even a respected authority such as
the World LP Gas statistical yearbook appears to have completely ignored field production of LPG, which was about 32 MBD in 2014.²

Why such odd market conditions? They all originated as a result of product price controls. Strict price controls existed for the LPG sales originating from refineries and onshore field LPG, but free market pricing was permitted for offshore LPG production and imports. There was little incentive for refiners to upgrade the quality of their refinery LPG output, so this odd half price-controlled/half free market system resulted in Chinese petrochemical companies willing to import higher-quality LPG, when China as a market was a net long LPG producer.

LPG demand in China was also divided, with refining output in the interior consumed locally and refiners having little interest in promoting LPG use. On the coast, where consumers pay more for supply, particularly for LPG imports, growth has been the strongest, and here the diversification of LPG demand has made its greatest strides.

Today, electric and piped gas have begun to reduce LPG use in households, though the parallel back-out of coal keeps LPG use fairly high. Yet it must be underlined that residential demand in 2012 still made up 70% of all LPG demand. Industry made up 20% of consumption, while petrochemicals made up only about 3% of total LPG consumption. Even more important has been the rural versus urban divide—rural residential use of LPG for heating, cooking, and water heating was far greater than industrial consumption and will remain so in the absence of piped gas supply.

What has been changing though has been the move of Sinopec—followed, albeit slowly, by CNPC/PetroChina—to broaden their range of petrochemical feedstocks, supplementing naphtha with LPG and processed condensate to broaden choice. Sinopec made the first moves by modifying ethylene cracking furnaces in its coastal olefin plants to run propane and, in some cases, butane. These plants will operate for the most part on imported material, though the quality of domestic LPG supply did not appear to be an issue.

This increase in LPG use in petrochemicals has been supported by another shift. In recent years, Chinese plants often have been able to make more than enough of the intermediate ethylene, but have fallen short in supplying propylene, the other basic building block of plastics manufacture. As Chinese refineries supply ever less propylene, petrochemical companies moved to meet the shortage by building propane dehydrogenation (PDH) plants. Since domestic propane output was of substandard quality for this process, PDH plants needed to import foreign supply.

ConocoPhillips was alert enough to spot this export opportunity and sealed a sales contract with Sinopec for about 33 MBD. Based on shale gas production, we believe this sale is the harbinger of a growing wave of US light product exports, challenging traditional Mideast suppliers.

Imports of propane have been growing rapidly, due to PDH needs. China had 15 PDH projects planned and was scheduled to have six plants operating by the end of 2015. Coastal ethylene crackers will have access to both domestic and foreign supply. Petrochemical feedstock needs will increase imports, and a good proportion of that will likely be from US supply by 2017.

² Information gathered from Chinese industry sources.
As seen in the previous section, LPG competes against naphtha in olefin manufacture, directly and indirectly. A less obvious interfuel competition takes place between LPG and natural gas. In 2014, LPG made up 7.6% of national demand, but that consumption tended to be in interior regions that had no access to piped gas and were distant from coastal LNG receiving terminals. The entry of gas supply can have drastic impact on LPG use, as was the case in Guangdong.

At the turn of the century, this southern province was the poster child for China’s economic miracle, bustling with new light industry. The arrival of LNG in 2006 in Guangdong rapidly changed the local LPG picture. Most imports were backed out within three years, while overall LPG demand was capped and then began to drop. This back-out of LPG imports by gas has not been unique to China. It likely will occur in any market where the two fuels compete head-to-head, unless retail subsidies favor one over another.

The transition away from LPG has been gaining momentum over the past 10 years. Gas, even when based on imported LNG, was often less expensive than LPG, as well as more convenient. In 2004, 65% of urban households with access to gas were using LPG; in 2014, it was less than 50% and continuing to fall. However, natural gas has barely penetrated the rural market, where LPG remains the primary household fuel, and this likely will continue for some time.

**Gasoline**

Despite efforts to suppress or at least slow down expanding car use, China’s gasoline demand has grown steadily, often exceeding overall national oil demand growth. While 2014 consumption growth was minimal, total gasoline consumption remained strong. From 2003 to 2013, Chinese gasoline demand more than doubled. While gasoline use was first estimated to have exceeded diesel demand as far back as 2007, the lead has moved back and forth between the two fuels a number of times. We estimated that gasoline use was still about 200 MBD less than diesel in 2014. But rapidly slowing diesel demand growth and the expanding fleet of larger automobiles make it likely that gasoline will take the lead by 2020 and remain the top road fuel.

Just how different China’s transport fuels demand pattern is from an OECD economy is evident when comparing it to the United States. Chinese gasoline demand in 2013–14 was about 2.1 MMB/D, or less than a quarter of US consumption, which totaled 8.9 MMB/D. Yet China’s overall oil demand was just below 10 MMB/D in 2014, or slightly more than half of US oil use. Though the level of US gasoline demand is exceptional, there is a tremendous way to go before Chinese supply/demand will reflect a mature economy, let alone evolve into an American-style consumption model.

Yet there has been a subtle shift to gasoline use running ahead of diesel, and this has caused significant structural problems. Gasoline demand growth, combined with a tremendous expansion in petrochemical naphtha consumption, has forced refiners to run at fairly high utilization rates to meet both competing light ends demand points. But Chinese refineries are geared to producing middle distillate, particularly gas oil, and not light ends. Higher operating rates to meet gasoline needs also produce a large and often growing overhang of middle distillates, which must be exported. It is no accident that the central government in 2013 began
granting product export quotas, focusing on the mid-barrel, to rid refiners of rising product stocks. The government is under growing pressure to increase these quotas and make them permanent, rather than subject to approval on a yearly basis.

Unlike other product groups, gasoline, no matter what the grade, is used solely in transportation, and the overwhelming majority of gasoline is used as a road transport fuel. Because of this, there is no sectoral competition between varied grades of gasoline and different modes of use. However, there is the traditional interfuel competition with diesel, and the struggle to dominate land transport is the story of China’s long march to a market economy. Gasoline may have topped diesel as early as in 2003, but 2007 appears to have been a decisive year in establishing transport fuels as the drivers of Chinese demand. In that year, gasoline consumption topped diesel again, but more importantly, road diesel finally made up a majority of overall gas oil use.

We use conditionals such as “appears” because our assessment of diesel use has been based on informed estimates. There still are no official supply figures on diesel versus general gas oil use. The underlying reason for gasoline’s success has been the rise of private vehicle ownership. This desire for car ownership in turn was a consequence of China’s economic success.

Until the 1990s, private vehicle ownership was minimal—total Chinese gasoline demand was less than 450 MBD and for the most part, gasoline was used by government ministries and state enterprise cars. The general public was just making the transition from motor scooters, just as they had made the transition from bicycles in the previous decade. By the late 1990s, gasoline demand began to accelerate, and by the turn of the century, the surge of gasoline demand became a wave of increasing consumption. Despite numerous measures meant to curb demand growth, China’s love affair with the automobile has not faltered since.

It is important to outline what automobile ownership means in modern China. In essence it is a sign—to family, neighbors, and, in a broader sense, the world—that a family has “arrived” and should be considered a solid member of the middle class. This has been the widespread and popular sentiment that has propelled China into overtaking the United States as the world’s largest single car market. A car is a sign of achievement, and a foreign model car or a special type such as an SUV especially advertises status much more effectively than most symbols of the middle class.

The phenomenon helps to explain why most forecasts of Chinese gasoline demand growth often fall far from the mark. Many analysts assume that Chinese car owners will use their vehicle, if not like an American, then similar to how an average Western European would drive. They use the probabilistic calculation of ‘X’ number of cars, driven ‘Y’ number of miles/kilometers (km), at ‘Z’ miles/km per gallon/liter (ltr) as the basis of their calculation and link this to overall GNP growth. Further, they assume that cars often will be used as daily transport to work.

Yet because it is a status symbol first and foremost, China’s use of automobiles differs from the West. Cars are only used by a small minority of Chinese for transport to work; urban public transport remains the norm. Cars generally are not the mode of travel for an annual vacation, nor are they used to visit family, particularly if they reside in another city. A substantial minority of cities with well over 1 million inhabitants have not yet been linked to the national road network.
And when the Lunar New Year holidays approach, it is the rail stations and airports that provide the chief means for most long-distance travel.

Still, gasoline accounted for nearly half of all land transport use in 2014 and was a major contributor to urban air pollution, despite the continued upgrading of gasoline quality specifications. China’s massive refinery construction program—by 2014, more than 16 MMB/D of base refining was operating in this market—has assured sufficient domestic supply to meet home market demand. There have been signs in recent years that refining has overbuilt, and one of the indications has been the import/export balance. Imports have been virtually nil since 2010, with few years recording no gasoline imports at all. Even so, exports have begun to grow, with sales abroad of 112 MBD in 2013 and 119 MBD in 2014, despite lackluster Asian gasoline markets those years.

Gasoline quality also has steadily improved. Leaded gasoline was finally banned in 2003. Octane, the primary measure of gasoline quality, has steadily risen with three grades (90/93/97 Research Octane Number/RON) offered nationwide. Sulfur has been reduced to 0.01%S (100 Parts per Million/PPM) in Beijing and 0.005%S (50 PPM) under national standards. Other measures to curb air pollution include progressive lowering of aromatics and olefins ceilings. Chinese National Standard is certainly not Eurospec 5 quality, but it is recognizably in the same league.

**Naphtha**

In 2013, China overtook South Korea and became the largest consumer of naphtha in Asia Pacific, and with demand topping 1.3 MMB/D in 2014, it appears to have increased its lead. This is a far cry from 1990, when total Chinese naphtha demand was less than 100 MBD.

This fantastic rate of demand growth was generated by two factors: the conversion of most Chinese olefin plant to using naphtha exclusively, or as the majority feedstock, and the overall expansion of Chinese base petrochemical capacity. Current efforts to diversify feedstocks used in both olefins and aromatic petrochemicals have, in a sense, come full circle to the conversion program of the last century.

This tremendous rise in consumption, coupled with the parallel rise of gasoline use, has created a supply squeeze in the light ends of the demand barrel, as the two products accounted for more than a third (34.8%) of total consumption in 2014. Sinopec, as the largest national petrochemical producer, has moved to using condensate, and more recently LPG, in ethylene cracking, with particular focus on plants in Shanghai, Tianjin, and Maoming.

Traditionally, NGLs have been underappreciated by Chinese petrochemical operators, and this has been the third reason why naphtha use grew to a huge proportion of China’s oil consumption. Under the price-controlled system that dominates this market, condensate is treated as crude, LPG has seen prices freed, and there has never been a pricing system established for ethane—it is simply burnt as natural gas. It is only in recent years that Chinese planners have begun to appreciate the utility of NGLs, particularly in petrochemicals.
Figure 7. Expansion of Chinese Ethylene Cracking Capacity, 2005–2015

Source: APEC; Industry.

Competing NGL feedstocks each have premium and discount characteristics. Unlike other NGLs, condensate does not need specialized containment or dedicated infrastructure. It is the only NGL that produces the full range of products. However, it has a particularly big naphtha impact, as whole condensate almost always produces more than 50% naphtha. Until recently, domestic production in China was treated as crude and simply spiked into the black oil pool. Condensate imports paid the same tax/tariff rates as crude oil. Yet over the past decade an appreciation of condensate’s potential light ends impact has emerged. All three major oil companies, i.e., Sinopec, CNPC/PetroChina, and China National Offshore Oil Corporation (CNOOC) now operate condensate splitters.

As noted earlier, LPG was long ignored as a potential supplementary feedstock to naphtha in ethylene cracking. We believe olefin plants will use ever greater volumes of LPG feedstock, in part because of the emergence of the United States as a major new supplier. Butane can, like condensate, be used for both olefins and aromatic petrochemicals, while propane can solely be utilized for ethylene cracking.

Ethane remains the odd man out, and no plans have been made public on converting ethylene cracking to ethane-only use. Ethane, like LPG, must have specialized containment, which adds substantially to capital and operating costs. Unlike LPG, it is best used only in ethylene cracking. It suffers another major handicap: In Asia Pacific, gas production rarely contains ethane at a more than 4% to 5% proportion of total gas (C1/C2). To gather sufficient supply for an ethane-only 1 MM MTA ethylene cracker, wellhead gas production of about 1.6 BN CFD would be needed to supply the 80 MM CFD of ethane. Beyond having considerable gas reserves, ethane use implies the existence of a large-scale gas gathering, processing, and stripping system. China
is moving toward that stage of gas development, but planners have yet to seriously consider ethane as a primary ethylene cracking feedstock.

Unlike other major base petrochemical producers in Asia, China supplied most of its own feedstock needs, despite a generation of sustained petrochemical capacity expansion. While naphtha demand growth has slowed to levels of 3% to 4% p.a., compared to annual gains of 8% to 12% a decade ago, meeting this demand has become ever more difficult for Chinese refiners—hence the move to diversify feedstock choices.

Naphtha imports have increased in recent years, approaching 90 MBD in 2014, because China tends to be short of the N+A naphtha needed to either to make gasoline or use in the rapidly growing aromatic petrochemical sector. Almost all paraffinic naphtha needs for ethylene cracking have been supplied by domestic Chinese processing, through refining or splitting. N+A material remains short, a tightness exacerbated by gasoline manufacturers’ occasional need for the same material. Quality has not been an issue per se, yet whether a naphtha is paraffinic- or N+A-oriented has become an issue, as China increasingly seeks condensate and naphtha with high N+A content.

**Jet/Kerosene**

Unlike in many Asia Pacific markets, general-grade kerosene (IK & SKO) has never been one of the major demand products in China. Instead, LPG and coal dominated residential sector demand. Yet jet/kerosene, used for aviation fuel, has blossomed as a major demand product. Just like the Japanese tourists who dominated the 1980s, followed by the Koreans, Taiwanese, and Singaporeans in the 1990s, the Chinese have dominated package tourism since the turn of the century, first in Asia and now increasingly in Western destinations. Chinese leisure travelers topped 100 million for the first time in 2014, and this number is forecast to increase by 10% this year.

While general-grade kerosene demand has been stagnant or shrinking, jet/kerosene consumption has expanded steadily, offsetting the decline for lesser-quality grades. In 2004, jet demand totaled 153 MBD of the total 253 MBD kerosene use in China, or 61.9%. By 2014, aviation fuel demand approached 390 MBD and made up nearly 81% of all kerosene use. Unlike Japan, China rarely had used jet/kerosene as a heating fuel; almost all jet consumption was for aviation fuel.

It is particularly impressive that this rising aviation fuel demand was accomplished from scratch—in 1990, China had virtually no domestic air sector and only limited international air service. An entire network of airports and civil aviation support has been created in little more than a generation. And the Chinese public has taken to the air, and not only for foreign guided tours. For the Lunar New Year holidays, air travel has supplemented the overcrowded rail network in moving massive numbers of travelers across China. The Chinese Lunar New Year has grown to increasingly resemble the annual *Great Thanksgiving Airport Scramble* in the United States.

But there is a flipside to this massive building of airports and aviation infrastructure. In 2008, with great fanfare, the Chinese government announced the construction of 97 airports across the
country, in an effort to make sure no inhabitant was further than 100 km away from air transport. Many were built and remain virtually unused till this day. Thus, the government has become more cautious about these capital programs, often launched as a means of jumpstarting growth when the Chinese economy would slow down. Too many factories have been registering losses for turning out goods that no one wants; this continued pattern would be unhealthy for China’s future.

Currently, more than 60 inland airports are under expansion, with another 30 new regional airports being built. Government planners estimate China’s airports will increase to 240 by 2020, from around 200 today. The question remains how frequently will they be used. While the government was busy building airports, it was also busy building a high-speed rail (HSR) network, which is now the largest in the world and getting bigger. This already has led to a drop in the number of some short- and medium-haul domestic flights, and will likely keep per capita air travel demand much lower than it would have been without the HSR system.

Similar questions now are being asked about refinery expansions, new refineries, and base petrochemical complexes that are being constructed. Government approval will become harder to obtain for big-cost, large, and high prestige projects in the energy sector, and financing for such proposals will become more difficult. Growth simply through capital spending will not be the way of the future.

China’s kerosene balance is an example of having to both import and export in the same product group. China has been exporting at least 100 MBD of IK/SKO grades since 2008, and also exported more than 200 MBD of these lower-quality grades from 2013 to 2014. Yet until recently, Beijing was a regular jet/kerosene importer. While China still imports jet, including about 90 MBD in 2014, this has been due more to logistics than an overall shortage. For buyers in southern China, it is cheaper to buy kerosene from Singapore than from within China. In early 2015, China exported its first jet cargo to Europe—quite a turnaround from a country that used to buy aviation fuel from every major supplier East of Suez.

The quality issue is clear in Chinese kerosene. Jet will continue to be prized and grow with the further expansion of the Chinese aviation sector; lower-quality grades will see demand continue to decline, though certain specialized uses, such as petrochemical solvents, will remain. Yet since jet is a heart swath in refining, producing more jet will inevitably result in further outturn of lower-quality kerosene that will have to be exported.

**Gasoil/Diesel**

Gasoil/diesel has long been the cornerstone of Chinese oil demand. In 1990, it made up 30% of total Chinese demand, 34% in 2000, 38% in 2010, and 40% in 2014. However, change is in the air and it may well be that 2014, or perhaps 2015, will represent the high tide mark for middle distillate demand in Asia Pacific’s number one market. With gas oil/diesel demand of about 3.5 MMB/D in 2014, the volume of this product group’s demand is larger than all petroleum use by all countries in Asia Pacific other than Japan, India, and South Korea. It is a larger volume than most OECD countries’ total oil use.
The growth in gas oil/diesel often obscures a fundamental of demand mechanics. While overall demand in this gas oil/diesel product group is expanding, all the growth has been on the transport side, i.e., diesel. Generally, this growth has been large enough to more than compensate for the declining use of general gas oil. While gasoline demand growth has outstripped diesel, diesel consumption too has increased by a large volume, and often compensated for falling general gas oil demand.

This biggest product demand group has also been among the most misunderstood. Many Western analysts have been consistent in ignoring or underplaying the role of lesser-quality, non-transport gas oil in Chinese demand. Nor have they fully explored the implications of the diesel/gasoline struggle regarding which transport fuel will represent the majority of future national demand.

To begin, overall gas oil/diesel demand growth settled at 1% in 2014. But this statistic is misleading. For the past decade or so, the use of higher sulfur, lower cetane value general gas oil grades has been steadily decreasing. Yet overall, the gas oil/diesel product group continued to expand due to the steady growth of diesel.

This leads to the question of how fuel use is divided in the Chinese vehicle pool. With the retirement of old Russian gasoline-fueled trucks more than a generation ago, all commercial vehicles have run on diesel, from the largest earth movers down to delivery vans. This was paralleled by a general prohibition on manufacturing diesel engine automobiles. Volkswagen was one of the few foreign joint venture manufacturers granted a diesel license for cars; between domestic production and imported models, diesel use by automobiles remained minimal.

A large portion of diesel demand comes from heavy trucks used in the coal industry. Limited Chinese waterborne transport must be supplemented by rail shipments to bring the coal of North-Central China to the main consumers in Eastern China. Trucks have a major role in moving coal at the mine site as well as loading coal and moving fuel to railheads. A recent estimate was that coal mining and transport accounted for up to 33% of all diesel consumption in China.

Gasoline use in 2014 was slightly less than diesel. And while we will deal with the interfuel consumer issue further below, it is important to consider the continuously underappreciated topic of how gas oil was consumed in the past. Non-transport demand for gas oil traditionally was from industry and power, but also from other smaller-volume demand areas such as marine bunkers. In 2007, this non-transport demand totaled 1.18 MMB/D, or 47% of gas oil use. In that year, it was clear that transport finally made up a majority of gas oil use. Yet if one scrolls forward to 2014, when diesel use was a solid 68% of all gas oil consumption, non-transport gas oil use was still a hefty 1.15 MMB/D. These numbers show that modernization has reshaped the gas oil/diesel product group, as road transport use makes ever greater gains. Still even now, China’s non-transport gas oil use has remained huge. This 1.15 MMB/D is nearly half that of Germany’s total oil demand, the biggest European market.

Interfuel competition also has moved to the fore. The lead has passed back and forth between the two fuels a number of times, but we expect in the medium term (about three years), the slowdown in the coal industry will cut into diesel growth as trucks haul less coal, while the shift
of Chinese consumers to larger vehicles, often SUVs, will underpin a higher gasoline demand growth.

**Figure 8. Truck Sales in China**

![Truck sales in China](image)


In this face-off, it is not only a matter of each fuel’s demand strength, but also each fuel’s weakness. Gasoline’s demand growth has been relentless in that consumption has expanded year on year, regardless of measures taken to curb vehicle ownership and car use or raised gasoline prices at the pump. Since 2000, demand growth in time of economic prosperity has ranged between 7% and 10%. In years of downturn, such as the 2008–10 crash, demand growth slowed, showing a minimal gain of less than 1% in 2009 that was followed by strong growth the following year.

In contrast, diesel has shown signs of a continuing slowdown since the Great Recession began. While diesel continued to displace general gas oil, and its demand growth rate was high enough to outweigh general gas oil losses, gas oil/diesel demand growth has flagged. We believe this is at least in part due to the continuing structural changes in the Chinese economy.

Renewed efforts to cap and eventually reduce coal’s role in base energy use have been serious and have begun to show signs of impact. The slowing coal production impacted diesel, as it is the primary fuel used in coal transport. We believe increased efforts to cap China’s considerable
carbon emissions—for whatever its true merits—will continue to push general gas oil use out of industry and power. The simple availability of gas, two dozen LNG import terminals, piped imports from Central Asia and Myanmar, as well as growing domestic production makes gas oil substitution a reality in much of China. Continued expansion of the overall national gas pipeline network will continue to back out general-quality gas oil. It is not improbable that the 2014–15 timeframe may represent the high point of diesel/gas oil demand as a share of overall Chinese oil consumption.

Diesel/gas oil supply has grown steadily with the overall expansion of Chinese refining capacity, and this product group always accounted for the largest share of refinery outturn. Supply has grown as rapidly as additional distillation capacity was commissioned. In 2007, gas oil/diesel outturn was less than 2.5 MMB/D, but that volume reached close to 3.7 MMB/D by 2014. This has led to yet another situation highlighting China’s shift away from a traditional Developing Asia products balance. Export and imports of this product have always been small volume, generally far less than 50 MBD, with imports mainly of high-quality diesel used to blend gas oil output, and exports mainly of severely cracked gas oil sold for blending or direct consumption. The primary purpose of Chinese refining—unlike India—has always been to satisfy the domestic market, with product exports only as an afterthought.

**Figure 9. Expansion of Chinese Refining Capacity**

![Graph showing expansion of Chinese refining capacity from 2004 to 2015, with data points indicating percentage increases.](image)

Source: APEC; Industry.

The buildup of Chinese refining capacity from 2004 to 2014, mainly intended to meet pressures on the light-end of the demand barrel, has resulted in an overhang of gas oil. In the past, Chinese refiners had to seek permission on a cargo-by-cargo basis for sales abroad. In 2013, however, the government recognized the size of the product overhang problem and began issuing sales quotas, allowing export of unneeded products. Middle distillates were the primary target for quota sales. That year, mid-barrel exports totaled 272 MBD and last year rose to 311 MBD. For the August
to December 2015 period, China saw planned exports rise to 869 MBD, far above the original set volumes.\(^3\)

China’s emergence as Asia’s accidental exporter of crude products has made central planners rethink their assumptions for the sector. Since mid-2014, all refinery proposals, whether expansion or greenfield, have come under more rigorous government review, and a similar process is underway for petrochemical projects. Planners suspect, and APEC would concur, that the refining sector has been built out to an extent that exports will have to grow as a result of past capital investment policies. How China will solve this overcapacity problem longer term—as demand growth rates settle to more moderate levels—remains uncertain.

Product quality concerns have been a top priority for regulators, as traffic has been a major contributor to urban air pollution. Measures have been taken to restrict the use of general gas oil in city power generation, and some light industry has been moved away from urban areas. Yet the base problem always comes back to product quality, and China, which began tightening gas oil/diesel specs for the 2008 Olympic Games, has since continued to mandate higher quality products.

For diesel, sulfur has been reduced to 0.005%S (50 PPM) in cities and to 0.035%S (350 PPM) in rural areas; cetane number has been increased to 51 in urban areas and 49 in the countryside, while a moderate cap of 11 was imposed for polyaromatics (PAH) for both rural and urban product. Beijing has had a stricter set of product specs imposed, requiring only 0.001%S (10 PPM), but multiple grades of cetane value. Beijing quality standards have begun to be imposed on other cities, first in Shanghai and later Guangzhou (Canton).

General gas oil quality points remained looser, but still marked a considerable increase in quality over 2008 standards. A minimum cetane number of 48 was required for urban use and 46 for rural areas; sulfur was limited to 0.035%S (350 PPM) in both urban and rural demand, and a PAH cap was finally implemented for general gas oil as in diesel specs. Exports of lower-quality general gas oil are likely to increase considerably by the end of the decade.

Finally, it should be noted that China has been experimenting with a wide range of alternative transport fuels beyond LPG. They included compressed natural gas (CNG), LNG, electric (both cars and railroads), methanol, biodiesel, and bio-gasoline. None of these constitute a major supply source on a national scale, and while some will find a specialized niche in transport fuels, we do not expect that the group would total much more than 1% of China’s transport balance.

**Fuel Oil**

Even more than LPG, fuel oil demand has been impacted by Chinese gas use. In the 1980s and 1990s, fuel oil use was seen as a positive step to reduce the burning of dirtier coal. In recent anti-pollution measures, coal substitution, particularly in power generation, has shifted to increased gas use. Gas substitution for residual in industry has proceeded more slowly and has had some limited impact. China has eliminated direct burning of crude, a practice that persisted in small

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\(^3\) Platts Oilgram, “Sinochem eyes oil; product exports”, 9/7/2015, p. 2
volumes as late as 2000. The only true growth area in 2015 has been in fuel oil used as marine bunker, though imports of fuel oil as cracker feedstock also have remained substantial. The ships fuel also will come under pressure as international standards move to a lower sulfur ceiling by 2020.

In the 2009–14 period, fuel oil demand had fallen by almost a third; since 2000, fuel oil consumption nearly halved. The most obvious explanation has been the increasing penetration of gas into the Chinese market, which to the greatest extent impacts residual use. China has long depended on imports of residual, both for general consumption and for refinery cracker feedstock, but this appears to have declined somewhat, totaling 313 MBD in 2014.

Natural gas can perform seamlessly in fuel oil substitution in industry and power generation. It has greater difficulty in backing out residual in the shipping sector. From 2004 through 2012, the last year for which we have the official bunker demand statistics, consumption increased by nearly 50% to reach 330 MBD. We estimate that fuel oil demand in this sector was about 340 MBD in 2014, a slow year for Chinese international trade. Similarly, gas has capped the use of residual for district heating and will continue to back fuel oil out of this sector demand.

Some basics on bunker fuels are in order here. While the use of LNG as ship’s fuel has begun in Western markets, only limited efforts have been made to use gas as bunker fuel in Asia. LNG as bunker fuel works best when a ship takes a regular route back and forth, such as in a ferry route, which allows the fueling of LNG at only two supply points. China’s bunker needs are for shipping routes worldwide and its ability to use LNG as ship’s fuel will be limited by LNG supply ports. Rather than convert from fuel oil to LNG, it is far more likely that Chinese shippers would retrofit vessels to diesel use and refiners would upgrade gas oil to provide further bunker fuel.

That said, China’s residual bunker use in 2014 was considerable, somewhere in the range of 340 MBD. China does not use international methodology for bunker numbers, and we believe fuel oil demand is in addition to cited domestic consumption for residual. Bunker is considered an export rather than a sector demand.

There remains one residual sector, however, where fuel oil absolutely cannot be substituted, namely as cracker feedstock. Chinese refiners possess a formidable array of severe secondary units, many of them built in the past 10 years. Chinese processing does not produce enough residual to supply these refineries with sufficient volumes to fully load their residual catalytic crackers (RCCs) and hydrocrackers (HDCs). (Please note that some HDCs utilize fuel oil, not gas oil, as their cracker feedstock.) This will provide a safe fuel oil demand sector far into the future.

Export of residual, usually severely cracked fuel oil, has averaged roughly 150 MBD to 200 MBD in recent years. Imports, mainly of straight-run fuel oil (which has not been processed through a secondary unit) used as cracker feedstock ranged from 300 MBD to 500 MBD over the past few years.
Beyond the differentiation between straight-run and cracked fuel oil, most quality concerns for residual quality focus on sulfur percentage. There are three levels of sulfur allowable in residual, according to sector use. General gas oil, used in industry, has a sulfur cap of 2.5% (25,000 PPM); while the ceiling for power generation is 3%S (30,000 PPM), and the international standard cap for bunker was recently lowered to 3.5%S (35,000 PPM). Other specs of lesser importance require limits on metals content and a minimum ability to flow, i.e., viscosity.

As in gas oil, considerable low-quality fuel oil is produced by secondary processing and this lower quality residual is often sold abroad. Poor-quality higher-sulfur fuel oil produced in China, when not used for bunker, is often exported to Singapore, where refiners and independent traders blend enormous volumes of this product for various sector uses. Imports, from the Mideast and Asian sellers, bring in volumes of straight-run fuel oil and a particular type of fuel oil known as low sulfur waxy residual (LSWR). To obtain a medium- or low-sulfur fuel oil blend, such as for power generation, LSWR is often blended with higher sulfur material, with the former lowering overall sulfur content and the latter improving viscosity. Inversely, when fuel oil meant for bunker consumption contains too much sulfur, a low-sulfur residual is added to bring the blend within sulfur limits. Blending, as much as further processing, are key functions of a refinery to increase quality in products to marketable levels.

Note: Many analysts have a catchall category called Others, which combines a wide range of minor petroleum products, including petroleum coke, unfinished products, petroleum wax, bitumen, and lubes. There often exists considerable variation in these numbers according to the reporting agency or consultant creating the balance. We have opted not to detail this category in all the country markets covered. China, for example, has an estimated production of Others of as little as 350 MBD to as much as 1,491 MBD in 2010, and while China’s volumes in this category have been the largest, Others can be significant elsewhere in Developing Asia. The category is problematic for two main reasons: first, there is no standard methodology for accounting the products that make up Others; second, governments have limited interest in recording all the products making up that category.

**Demand Trends by Sector**

**Petrochemicals**

There is a common misconception among energy analysts that all petrochemical feedstocks are more or less equivalent, i.e., plentiful supply of ethane would be enough alone to support a big expansion of US base petrochemicals. But reality suggests the opposite: each feedstock has a strength or weakness, and it is necessary for a manufacturer to have a wide range of feedstock choices.

Naphtha will remain the vast majority of Chinese petrochemical feedstock well into the next decade, even if a concerted campaign is undertaken to convert Chinese ethylene crackers to multi-feedstock use. Naphtha accounted for about 89% of petrochemical feedstock in 2014, with condensate and LPG making up most of the rest, though the oldest plants still use gas oil.
Condensate, used directly in ethylene furnaces and indirectly when processed for naphtha, will remain a major source of alternative petrochemical feedstock. We expect LPG demand to expand rapidly, both on ethylene cracking and on the use of propane for PDH plants.

It is likely that demand for N+A-oriented condensate and naphtha will outstrip that of paraffinic material. Pressure will remain on N+A grades of naphtha to maximize gasoline output. N+A naphtha is used for reformate, the intermediate for gasoline and aromatic petrochemicals.

**Transport**

We expect gasoline to gain and then expand its lead over diesel, as coal mining and coal use are capped. While it is difficult to predict what concerted measures the central and regional governments will take to slow vehicle ownership and use, we would expect that gasoline demand growth will remain considerably higher than that of diesel, with a demand growth rate of about 4% to 5+% entirely possible, even if overall Chinese products growth averages only 2% to 3%. If the government attempts to ease the light-ends pressure on refiners, it may allow the manufacture of diesel engine cars, though we believe this reversal of long-standing policy to be unlikely. Also, cars are subject to increasingly stringent fuel economy standards, so future vehicle fleet growth won’t translate into the same rate of fuel growth as in the past.

Alternative fuels for land transport will account for only a small percentage of demand by 2020, perhaps up to 2%, and will be unlikely to penetrate transport markets in any meaningful way, unless the government subsidizes alternative fuels while simultaneously raising taxes on conventional fuels.

Poor air quality in China’s major cities will exert continuing pressure to improve Chinese gasoline quality. We expect that sulfur ceilings will be lowered and the allowable levels of olefin (a major contributor to smog) will be reduced. For diesel, the sulfur ceiling will also be lowered, the minimum cetane value increased, and the PAH ceiling reduced—all important measures for cleaner fuel combustion and producing less particulates.

By 2014, China had become a significant exporter of gasoline and diesel. If refiners will be compelled to keep utilization rates high to meet the gasoline/naphtha demand short, while growth rates for these two transport fuels slow down, we may see exports grow substantially by 2020, even if no new refining capacity is added in the second half of the decade.

It should be noted that for the first time, Chinese refiners have been exporting aviation fuel regularly, though in modest volumes. For most of the 1990–2010 period, China was the major target market for export refiners, such as Singapore and South Korea. Bunker demand, both fuel oil and gas oil, will also continue its steady expansion through 2020.

**Industrial**

This sector is likely to be most threatened by gas use, particularly when an oil product is used solely as a source of boiler feedstock. Petroleum coke in space heating has been more or less
eliminated by now, but it remains important in making synthetic rubber and in certain areas of metallurgy.

Similarly, general grade gas oil and residual face back-out in areas where piped gas or LNG have become accessible. Gas oil use in industry has been shrinking for the past decade or so, while the near halving of fuel oil consumption between 2004 and 2014 was mainly due to the substitution of gas, either from the West-East trunkline or from LNG imports in coastal areas.

No changes in fuel oil specs have been planned through the end of the decade. General gas oil will see a progressive curbing of allowable sulfur.

**Residential/Commercial**

Residential/commercial demand has long been dominated by domestic LPG, and it is preferred as a cooking fuel in most of China, though gas has begun to make some demand inroads in urban areas. Kerosene demand in this sector traditionally has been in rural areas, but consumption has been slowly falling. Similarly, gas oil, which had been used in small volumes as heating fuel, has been capped and now backed out of sector use.

Overall, natural gas and electric power have been slowly forcing oil use out of the residential sector and small businesses. Both have gained considerable market share from oil use in this sector and can be expected to continue to expand through the end of the decade. We expect little change in product quality for LPG or kerosene, though general gas oil specs will tighten through 2020.

**Power**

Traditionally, two separate and distinct power markets in China using oil products existed. First, the use of oil was burning fuel oil in steam plant power generation, which would provide baseload power. Second, gas was used for turbine generation, single or combined cycle. When gas was unavailable, turbines could run on products lighter than fuel oil, usually general grade gas oil.

The first area of utilization has been for the most part eliminated by the arrival of gas supply. Gas turbine use of gas oil has resisted change better, as many large commercial buildings have gas oil-powered backup generators. Gas oil use in power also remains in scattered remote pockets where gas distribution has not reached so far. Gas has been the great driver of change in this sector, and it has been apparent that oil use will remain minimal wherever gas is available in sufficient volume.

There has been a progressive tightening of specifications for fuel oil used in power generation, and the sector can no longer be used (with bunker) as a sulfur sump to get rid of higher sulfur residual. A 3%S (3,000 PPM) ceiling for power use of fuel oil means that there is often careful blending of LSWR with higher sulfur residuals as well as limited desulfurization of fuel oil.
2. India

While distinctive in many ways, India’s market shares many characteristics typical for all of Developing Asia, including China and Indonesia.

**Demand Trends by Product**

**LPG**

LPG in India has been an example of how retail subsidies can boost demand for a light-ends product as much as middle distillates. For decades, Indian government has heavily subsidized retail LPG sales to the residential/commercial sector, while partially discounting sales to industry. The former accounted for about 86% of demand, while industry accounted for 11%. Transport, agriculture, and petrochemicals used either no LPG or only minimal volumes of less than 1%.

The reasoning for this long-running policy was that subsidizing LPG would make this fuel affordable for the poor. Yet for the truly poor, even the subsidized commercial fuel, LPG or not, was unaffordable. Thus, in reality, cheap LPG has been a gift to India’s urban middle class.

Partial reform of gas oil, kerosene subsidies, and pricing mechanisms for other products was undertaken some 25 years ago under then-Finance Minister Manmohan Singh. But the reforms left the entire system of LPG pricing and distribution unchanged. Currently, Gas Authority of India Ltd. (GAIL) actively seeks to discourage new customers, as it can neither negotiate the...
price of LPG it buys from upstream company Oil and Natural Gas Corporation Ltd. (ONGC) or downstream Indian Oil Corporation Ltd. (IOC), nor can it set its own retail prices. The gap between market and government-set prices is made up by state funding. But that compensation is often late and, at times, does not fully cover fiscal losses.

Refiners and gas producers attempt to limit their LPG production, which is unprofitable under the current price-controlled system. At the same time, LPG demand has nearly doubled, from 312 MBD in 2004 to 563 MBD in 2014. Thus, LPG imports have been rising. By 2014, imports gained more than 300% from 2004 levels to reach 254 MBD. India had emerged as one of Qatar’s top LPG customers, as well as a priority market for Saudi Arabia. LPG, like crude oil, now makes up a large share of India’s import bill, but unlike crude, it is imported so it can be sold at a loss. By 2015, it has become obvious to all but the most obtuse bureaucrat that something had to be done.

But subsidies are easier to create than to abolish. Thus, while the government under Prime Minister Narendra Modi is likely to move on gas oil/diesel and kerosene sales, LPG’s future remains uncertain. Reform is controversial, even though most analysts see the need as pressing. But all politicians fear to attempt to make major changes and upset the voters who elected them.

We have assumed that there will be at least minor reform in subsidies for LPG sales by 2018, but we cannot give a more exact timing of when that will occur. Until then, demand growth will be dictated by the Indian government’s willingness to provide the supply to satisfy that. To supply that LPG, imports will have to increase, as India’s LPG output will rise only marginally by 2020.

This will be perhaps the pressure point that will force the government’s hand to implement reform. India is a net exporter for every product but LPG. However, it only supplies about 15% of its own crude needs and must constantly watch its balance of payments in regard to the oil trade. If imports increase much further, the government may act—if only to stem a cash outflow.

LPG demand growth in recent years has been 9.3% in 2011, 4.1% in both 2012 and 2013, and 13.8% in 2014. Generally, when the country’s overall economy is booming, demand growth is near or above 10%; when the economy slows and the government begins to restrict LPG imports, demand grows at a more reasonable pace of 4% to 5%. We expect that with minimal subsidies reform, demand growth will average a 4% to 5% p.a. gain, easing the pressure to import ever more LPG.

Indian LPG specs follow Saudi standards, which differ only slightly from US quality standards on some secondary specifications. US exporters will find no bar in quality standards for Indian sales, but of course the Mideast Gulf is much closer to the Indian market.

**Gasoline**

India opted for diesel over gasoline decades ago and is one of the most strongly dieselized markets in Asia Pacific, as diesel accounts for 74% of road transport fuel use. Limited reforms in 1990 and 1991 and early in the last decade had some positive impact on knocking out uneconomical use of general gas oil. Yet the decade-long rule of Prime Minister Singh, despite praise of his earlier work as finance minister, showed little appetite for further reform.
The issue of pricing structure is of great importance to all of Developing Asia, where gasoline was traditionally priced far higher than diesel, its only large-scale competitor in road transport. This was in part because of the perception that gasoline was a rich man’s fuel, while cheap diesel was a gift to the working and agricultural classes, including the rural poor. The definition of diesel was fairly broad, as we have already noted. Other quality grades of gas oil were sold under diesel subsidies, and this supposed road diesel was used in sectors such as industry and agriculture.

Long-running retail subsidies and overall price structure kept gasoline prices high to discourage its use, while diesel was kept relatively inexpensive.

However, the opening up of India to the outside world has seen some dramatic changes in gasoline use. Many modern imported automobiles run on gasoline, not diesel. Those imports caused gasoline demand to increase by 14.6% in 2012 and by 6.4% in 2013 until falling 2.6% in the downturn of 2014. The question emerges as to whether diesel can maintain its fully dominant share of road fuel use when the removal of retail subsidies allows diesel prices to rise, making it relatively more costly compared to gasoline.

India’s massive refining expansion since the beginning of the century has converted the country into a substantial export refiner. Led by Reliance, which operated the two largest and most sophisticated plants in this market, India exported 200 MBD or more through 2011 and 2012, and more than 300 MBD from 2013 to 14. Reliance has dominated sales of better-quality gasoline grades and exports cargos to most long-haul markets, including the Atlantic Basin. Competitors, notably Bharat, Hindustan, Mangalore, and IOC, have focused on medium- and low-quality grades, with sales into the Mideast Gulf, Southeast Asia and East Africa.

There has been no change in gasoline specifications since 2004. India continued with only moderate-quality gasoline, 91/95 RON grades with fairly high aromatic and olefin ceilings, though with moderately low sulfur content, continuing an urban (0.005%S) and rural (0.015%S) divide. Indian refiners can manufacture most gasoline grades, with Reliance able to meet specifications for any market globally, but there is little incentive to do so in their home market.

Though both China and India have long been dependent on imported crude, India has always been trade-oriented, whether dependent on product imports before 2000 or as a growing products exporter for the past 15 years. This remarkably different market viewpoint is especially stark if one considers that India has been dependent on imported crude far more and for far longer than China. While China’s interest remains chiefly in the home market, Indian interests look abroad.

Naphtha

Unlike China, Indian petrochemical companies have been satisfied to remain overwhelmingly dependent on naphtha, at least for now. The Indian market has no pressure to meet competing light-ends needs, and petrochemical feedstock needs can easily be met by domestic refineries. Instead, India has become a major naphtha seller, with export volumes in 2014 exceeding those of many Mideast Gulf exporters. Imports continued at small volume (less than 35 MBD) in recent years, but only for specialized grades, usually highly paraffinic or N+A naphtha.
Reliance has dominated base petrochemicals as much as refining in the past 15 years and accounted for three-quarters or more of petrochemical output in some years. Its two giant refineries (which possess working capacity of 654 MBd and 568 MBd, respectively) made up more than a quarter of India’s base refining, while the depth and range of its severe secondary and intermediate quality units remain unsurpassed in this market. Reliance also operated nearly a third of Indian olefin capacity and much of its aromatic petrochemicals plant. Its modern and sophisticated management has often been able to outpace domestic competition by almost any measure of profitability.

Naphtha has three sectors of demand: 1) as basic petrochemical feedstock for ethylene cracking, 2) as the base feedstock for reformate, to create a gasoline component, or as a feedstock for BTX, 3) and as basestock in creating gasoline through blending. Major products naphtha and gasoline together made up for large-volume sales abroad. In 2013, combined naphtha and gasoline exports totaled 529 MBd, with Reliance frequently selling to distant markets. In 2014, this total rose marginally to 547 MBd even as refiners trimmed utilization.

Two factors will impact future naphtha demand. First, there is the question whether Reliance (and to a far lesser extent IOC) will proceed with plans to add a further 3 MM MTA plus of ethylene cracking to the national olefin sector. Second, it remains to be seen if new refining capacity from Saudi Arabia (Jubail and Yanbu) as well as Abu Dhabi (Al Ruwais) softens naphtha prices for East Asia naphtha sales. We expect that all three ethylene crackers will go ahead, sopping up 75 MBd to 80 MBd of naphtha supply, but the impact of new Mideast refining is far harder to pin down. Reliance and other Indian refiners have been under growing pressure from Mideast competition. This pressure has been as much on gasoline as on naphtha, and there are no easy solutions for Indian exporters for these two products.

We expect N+A naphtha demand to outpace paraffinic grades, particularly as Reliance expands its aromatic petrochemical capacity as much as its ethylene cracking.

**Kerosene/Jet**

If high-quality material dominates a products group, as can be seen in gas oil/diesel, jet/kerosene in India offers an inverse example of lower quality dominance. In the Indian market, jet/kerosene as aviation fuel accounted only for 42.5% of all kerosene use, one of the lowest proportions of jet used compared to overall kerosene in the region. It was minimal compared to high-volume aviation fuel users such as Singapore (98% jet) and Australia (99.9% jet). Even medium-volume consumers, such as Indonesia (83.1% jet), had much higher aviation fuel use than India.

Probably the most obvious reason behind these puzzling numbers lies in the retail subsidies for kerosene. Kerosene, sold as the grade SKO, has remained the mainstay of urban lighting and cooking and an important supplement to non-commercial fuels used in rural India. Another reason has been India lagging behind in rural electrification. While progress has been made in laying power distribution lines, electricity theft has left most of the state power distribution statutory boards bankrupt. Thus, electricity was unable to back out kerosene use, as distribution of the former has been uneven and delivery inadequate.
Kerosene has been the Third Rail of Indian politics, similar to social security in the United States. And while all bureaucrats—and most politicians—realize that reform is inevitable in the longer term, they do everything they can to postpone that day. Pilot programs have begun authorizing direct payment to the poor to allow kerosene sales without retail subsidies, but no large-scale program has been tested. (For further details, please see Chapter 3-B on Indian subsidies.) A large share of subsidized kerosene, perhaps as much as 40%, is stolen, ending up on the black market.

Since kerosene has no special containment needs, making it far less expensive to move and store than LPG, and because Indian refineries can meet all kerosene needs, including jet, we expect that kerosene retail subsidy reform will come later than LPG reform. There is no growing fiscal pressure stemming from rising imports of kerosene, making reform delay probable.

There has been no change in SKO product specifications for generations. Demand has been dominated by residential/commercial use, followed by aviation fuel consumption. Small volumes have been used in the rail sector and in solvents manufacture.

Depending on the thoroughness of reform, we will see a capping or reduction of kerosene use, as subsidies for SKO are rolled back. We do not expect this to occur before the end of the decade.

**Gasoil/Diesel**

Gasoil and diesel remain at the heart of the Indian demand barrel. Despite the steady demand growth of other products, this product group still made up 44% of Indian consumption in 2014, a higher proportion of the demand barrel than in China. Add in the considerable demand for kerosene and middle distillates made up 53% of total products demand in this market.

It should be noted that some uneconomical general gas oil use was already pushed out of the economy by earlier partial reform of retail subsidies for this product. Under Singh’s term as finance minister in the early 1990s, a partial cutback in subsidies for non-transport use of gas oil resulted in this product group’s demand falling for well over a year, recovering with some regularity only by the mid-1990s. In 2014, diesel made up 80% of gas oil use and 74% of road fuel consumption, leaving gasoline with slightly over a quarter of sector share.

Two already mentioned factors have accounted for diesel’s dominance in land transport. Gasoline prices were kept artificially high, favoring diesel use, and the Indian domestic automobile industry favors diesel engines. Both advantages are likely to diminish if not entirely disappear. The Modi administration in September 2014 abolished diesel subsidies, moving the price of diesel and gasoline to more comparable, if not at exactly equal, levels. Second, Indian drivers have been shifting rapidly to foreign model autos in recent years, either those built in India in joint venture projects or imported directly from abroad. These cars tend to be gasoline, not diesel-fueled. Further, Indian manufacturers, such as Maruti, Mahindra, and Tata have begun to offer gasoline-powered cars, particularly in their up-market sedans and SUVs. A combination of equalized pricing at the pump and the Indian market’s desire for gasoline-powered vehicles will likely cut diesel’s current dominance.
Nearly three times more diesel was consumed in India in 2014 than gasoline; in 2004, the ratio was nearly 5:1. Diesel demand has grown both in absolute volume as well as a percentage of overall gas oil consumption, but gasoline has begun to catch up ever so slowly. We expect that reform of retail subsidies will become the catalyst for much faster change, perhaps following China’s shift.

India in 2000 had relatively high gas oil and diesel product quality standards, but it has done little to improve them in recent years. At the turn of the century, Indian product specs were tougher for both groups than China’s and comparable to near-NIC specifications of that time. By 2014, Indian gas oil quality was marginally higher, while diesel quality points were roughly equal, with China holding the advantage in better-quality rural fuel use. Yet Indian specs have not changed since 2012 and then only minimally, while Chinese efforts to improve quality have continued. By 2015, China’s overall product quality for both gas oil and diesel was superior to that of India.

**Fuel Oil**

Over the past decade, fuel oil demand has slowly deflated in India as gas has become substituted for much of power generation and at least some industrial fuel oil use has moved to lower-quality gas oil. From 2007 to 2011, demand remained remarkably stable, ranging from 210 MBD to 230 MBD, as anticipated gas supply from offshore development had yet to materialize. In 2012, fuel oil consumption for the first time dropped below 200 MBD, and in 2014 fell nearly 23% to average of only 149 MBD, in part due to rising LNG imports.

In mobile power generation, gas oil has tended to remain the dominant fuel, though it competes with naphtha and condensate. We expect to see more domestic gas output firmly capped and then roll back fuel oil use once the Reliance dispute with the Indian government is settled. In the interim, and particularly when LNG prices are low, imported gas has been playing the same role of suppressing fuel oil use.

Fuel oil quality has remained unchanged for some years. General fuel oil use allows a sulfur ceiling of 3.8%, a level now higher than international bunker. Power use has the same limit of sulfur as in China, which is 3%. An important difference, though, is that bunker sales remain tiny and many ships fuel abroad in the United Arab Emirates (UAE)/Fujairah, or in Singapore.

**Demand Trends by Sector**

**Petrochemicals**

Naphtha appears likely to remain the overwhelming top choice of base petrochemical plants, though Reliance has made some moves to broaden its feedstock range. The company often ran condensate in its large-scale refineries for specific naphtha characteristics, as well as utilizing direct-feed condensate when prices were reasonable. Yet only one condensate splitter operated in India. This ONGC plant had no petrochemical feedstock role, and expansion is unlikely.
Ethane, however, is another matter. Reliance has ordered six large-scale cryogenic tankers to move this NGL from the US shale gas developments, including its own equity output, to use in company ethylene crackers in Gujarat. In an odd sense, this is both a step back and into the future. Most of IOC’s plants originally ran solely on ethane, and Reliance caused an enormous stir in commissioning its first ethylene crackers based on naphtha in the early 1990s.

LPG remains a question market in this sector, due to the negative influence exercised by heavily subsidized sales for residential users. As in Thailand, subsidies distorted the entire range of LPG uses, and Indian petrochemical producers have shied away from converting cracking capacity to handle this NGL. Yet if ethane can be imported from North America at a profit, there is little reason why LPG, which also needs containment, should not as well.

**Transport**

It would appear that diesel will remain the top land transport fuel for some time, but it is also likely that gasoline will considerably erode this middle distillate’s lead by the coming decade. How quickly that will occur is a function of the extent to which retail prices are equalized at the pump, i.e., how retail subsides will be curbed. LPG and CNG will play minor roles in meeting Indian road full needs, but in reality it is diesel pitted against gasoline—with the Indian government’s future reform as the deciding factor.

**Industrial**

While general gas oil and fuel oil both play major roles in Indian industry, it is coal that makes all the difference. India is the second largest coal consumer in Asia Pacific and the third largest worldwide. Indian coal consumption in 2014 was only a sixth of China’s, but it still accounted for 54.5% of this market’s base energy use. And while China has pledged to roll coal use back, India will be investing billions of dollars in developing domestic coal reserves in its eastern states. Coal will play an important role in industrial energy use for a long time. We expect the backout of both oil products and coal to occur only once pipeline gas from domestic reserves becomes easily available and is sold at market prices. And this too goes back to much delayed reform, in this case on the price of domestic natural gas.

**Residential/Commercial**

Kerosene remains the chief cooking and, in rural India, lighting fuel, followed by LPG in urban areas. Non-commercial fuels continue to play a major part in rural household energy supply. Natural gas has made only limited inroads into urban India, despite reticulation programs that began a generation ago. Electric power distribution has been a major sore point for both the central government, which shares authority with each state in this sector, and private consumers, who have been frustrated by limited power distribution and its general unreliability of supply.
Power

Indian power generation relies little on oil—only 1% of capacity in 2013 was oil-based installed capacity. Gas fared slightly better at 9%, but overall, coal dominated power generation, taking a 59% share of all installed capacity. As in China, India is heavily dependent on coal for baseload power generation.

An interesting difference is that renewables and alternatives, including solar power, biomass, etc., accounted for 12% of the energy mix. How commercial this output is remains to be seen, but if India is to cap coal use, it is rather likely that gas and nuclear power will play major roles.

3. INDONESIA

Overview

Quietly and with little fanfare, another Developing Asia demand giant has emerged. Indonesia has long been little appreciated by many analysts. For decades, Indonesia was Asia’s sole member of the Organization of Petroleum Exporting Countries (OPEC) and led regional oil exports. Yet years of upstream neglect led to an oil output decline, while a long-running system of generous retail sales subsidies created unnaturally high demand growth rates. By early this century, Indonesia was a net oil importer.

The traditional problems in Indonesian energy have been transparency and corruption. The overthrow of President Suharto in 1998 led to hopes of change and sector reform. Instead, 15 years were lost in legislative and administrative muddle, while oil and gas production rates continued to sink.

Beginning in late 2014, the newly inaugurated administration of President Joko Widodo moved dramatically to cut back the retail subsidies. The regulatory reform led to the outright abolition of many subsidies and the trimming of a number of other price supports. By one oil industry executive estimate, some 95% of Indonesian subsidies were eliminated in a series of measures issued through January 2014. While some of the reforms were partially reversed—or implemented differently than originally planned—this was unprecedented for Indonesian government action in terms of thoroughness and speed.

In part, this speed was dictated by an unsustainable situation. As of early 2014, retail subsidies were costing the Indonesian government approximately $30 billion/year, or roughly the cost of building three world-class refineries. Meanwhile, Jakarta has not completed a new refinery since 1992. Beyond this direct cost, there is an indirect cost for subsidies in that they do not allow efficient development of the energy sector. This is possibly most obvious in the area of new energy development. Geothermal power, if based on real world market prices, would certainly have made up a far greater share of Indonesian base energy use by 2015 and could have easily have supplemented other fuels in power generation.

In brief, the January program abolished subsidies for premium gasoline, capped diesel subsidies at Indonesian Rupiah ( IDR) 1,000/ltr (or about US$0.073) for diesel, and maintained substantial subsidies for LPG and IK sales, though reducing the volume of subsidized product. Under the
new system, the prices of Premium Gasoline and Solar Grade Diesel were no longer capped and assigned direct retail subsidies; instead, they were evaluated and adjusted every month in accordance with fluctuations in the exchange rate and global oil prices. State-owned oil and gas company Pertamina—not the government directly—would temporarily finance any subsidy shortfall.

It should be underlined that gasoline on average accounted for 62% of total fuel subsidies, and gas oil/diesel made up 35%. The government estimated a 90% savings in subsidies in CY 2015. The Indonesian government’s course of action has been restricted by court rulings that prevent pricing from fully following market conditions. For the immediate future, the government aims to have fuel prices increase gradually in line with fluctuations in the Indonesian Rupiah/USD exchange rate and global oil prices. Even though the reforms were not as sweeping as first thought—originally only public transport and fishing fleet diesel use were to be subsidized—they were still a bold initiative.

**Demand Trends by Product**

**LPG**

LPG is one of the few recent examples of continued retail subsidies favoring light products demand over middle distillates. In a few years, this transformed Indonesia from a moderate-volume though regular LPG exporter to a consistent large-scale importer.

It should be noted that Indonesia’s price control and subsidies system was never all encompassing, i.e., not all products were under direct price control. Major products, considered *fuels*—i.e., gas oil, diesel, gasoline, jet/kerosene, and aviation gasoline/turbine fuel—were within price-controlled and subsidized grouping, which made up more than half of refinery outturn and the vast majority of product imports. Non-fuel petroleum products labeled *BBM products*, consisted of naphtha, Low Sulfur Waxy Residual (LSWR), gasoline components, bitumen, coke, and lubricants, and were not subsidized. LPG has been sold both on subsidized as well as free market pricing, depending on quantity.

At the turn of the century, Indonesia exported 30 MBD to 40 MBD of LPG, for the most part derived from two major LNG projects, the Arun and Bontang liquefaction complexes. This field LPG, plus product striped from piped gas production, made up the bulk of output, with the remainder supplied by refining.

In 2008, the government took a major step to reshape domestic demand by maintaining retail subsidies for LPG sales to residential sector buyers, while abolishing these for this sector in purchasing IK. The impact was immediate and substantial. LPG demand rose 60% from 2008 to 2009, averaging 93 MBD, and it nearly doubled to 170 MBD by 2014. Demand for IK grade fell dramatically, while total kerosene demand declined to less than 100 MBD for 2011–14, with much of that jet grade used for aviation fuel.

It may seem counterintuitive to substitute a relatively expensive product with substantial infrastructure needs, such as LPG, for a relatively inexpensive portion of the outturn barrel. Yet Indonesia, like India, had to function under the big handicap of large-volume gas oil/diesel
needs. In 2014, this one product group alone accounted for 33% of all Indonesian oil demand; in 2008, it made up 38.6% of the demand barrel and with kerosene added, 53.6% of total demand. Mid-barrel demand had to be curbed, and LPG was the most freely available substitute product.

Indonesia is coming to a tipping point too for LPG now. In the current state budget, the government funded up to 181.8 MBD of subsidized LPG, at a cost of $2.11 billion. This was an increase of 15.6% over 2014 demand—or another 24.6 MBD of LPG that will have to be imported.

In 2014, Indonesia imported close to 111 MBD of LPG, or almost four times the level of 2009 imports. As in India, Indonesia had become a favored Mideast Gulf export market.

It appears that substitution replaced a kerosene import problem with an LPG import problem. How this will be overcome remains unclear. As in all Developing Asia markets, electricity has been growing rapidly as a primary energy supply for residential/commercial use and in 2013 made up 42% of this sector’s energy use. Still, the growing LPG burden must be addressed soon.

**Gasoline**

When subsidies were slashed in January 2015, it was calculated that the fuel-subsidy burden would drastically fall to IDR 25 trillion (US$1.990 billion) from its initial target of IDR 276 trillion (US$20.19 billion), saving around IDR 251 trillion (US$18.36 billion). Previously, gasoline subsidies have accounted for nearly two-thirds of oil product subsidies on average, roughly double the subsidies paid for diesel. The government’s actions simply knocked out almost two-thirds of retail subsidies completely and capped costs on another third.

Some of the most dramatic changes in Indonesia’s demand since the turn of the century have taken place in road fuel use. Traditionally, Indonesia, like Malaysia, was considered a moderately gasoline oriented economy—gasoline made up a majority of land transport fuel, but not an extraordinarily high percentage of demand, and high-volume diesel use was also the norm. In 2003, gasoline made up 56% of land transport fuel demand. Nearly a decade ago, in an effort to ease demand pressure on diesel, Pertamina began offering a lower-quality gasoline blend. Its public acceptance was immediate and successful—by 2008, gasoline demand rose to 311 MBD, or 65% of land transport use. By offering subsidies on premium grade gasoline as well regular grade gasoline, demand accelerated as consumption broadened.

By 2013–14, the problem of runaway gasoline demand became apparent, with consumption reaching 517 MBD in 2013. This remained a serious import problem, despite a sharp demand drop, after gasoline prices were raised in late 2014. From 2004 through 2014, gasoline consumption almost doubled. It was obvious that retail subsidies had to be reformed and quickly.

Complicating the situation, programs to upgrade existing refineries were long delayed. Pertamina’s nine refineries, with a design capacity of 1.36 MMB/D, needed to be renovated and expanded, particularly to add modern severe cracking units (cokers, R/FCC, and HDC) to extract greater volumes of lighter product from fuel oil and gas oil. It was estimated that if the current upgrading program was completed by 2016, lighter product output would rise by 50%.
By 2014, gasoline’s share of transport fuel demand had fallen to 61%, and both gasoline and diesel demand fell rapidly in the first half of 2015. Which of the fuels will be impacted to a greater extent is unknown, but preliminary statistics suggest that gasoline will retain its majority in transport fuel demand. Under the subsidy system, the government predicted gasoline demand would rise by 52% during the 2013–18 period, but the latest forecasts show a lower rate of gain.

Pertamina has been strongly marketing its new 90 RON grade known as Peralite, hoping to replace the lower-quality 88 RON gasoline grade that now dominates consumption. Indonesia still regulates the price of 88 RON, while 90 RON and 92 RON pricing is completely free market. In mid-2015, Indonesia used roughly 417 MBD of this lower quality 88 RON grade.

**Naphtha**

Indonesian methodology on naphtha demand has long been somewhat suspect. We believe that at least part of the considerable volumes of naphtha used as basestock in making gasoline has not been fully recorded. But it is clear that with only one operating ethylene cracker and limited aromatic petrochemical capacity, gasoline blendstock remained the top naphtha utilization in 2014 and will likely remain so until new base petrochemical capacity is commissioned by the end of the decade. While Indonesia could have easily utilized a range of NGLs to use as petrochemical feedstock, naphtha has remained the top feedstock used in ethylene cracking.

**Jet/Kerosene**

For decades, Indonesia was similar to India in having a substantial demand for lower-quality IK that only could be met by increasing imports of this product, running in parallel with continued steady and moderately strong expansion of gas oil/diesel use. In 2007–08, the government finally acted by taking the step of substituting LPG for kerosene, aiming for zero residential/commercial use by 2012. LPG was chosen as it was produced in moderately large quantity in Indonesia, and overall demand was relatively minimal in 2007. Like India, a large share of household energy, perhaps up to two-thirds, came from non-commercial fuels in this market, mainly wood and other biomass.

Indonesia never reached its stated 2012 kerosene reduction goal, but still IK demand, which peaked at 214 MBD in 2007, was more than halved by 2010 and even in 2014 remained under 90 MBD. As IK demand was backed out by LPG substitution, aviation fuel needs have continued to grow steadily. In the years 2004–14, jet consumption almost doubled to reach 72 MBD. In 2014, aviation fuel made up 84% of all kerosene use, compared to 17% in 2004.

**Gas Oil/Diesel**

Gas oil/diesel remains a big gun in Indonesia oil consumption, though it is no longer the largest volume product. In 2004, gas oil/diesel made up 40% of the Indonesian demand barrel, while diesel constituted more than 17%. By 2012, gasoline demand had overtaken general gas oil/diesel combined.
While diesel made up nearly 66% of overall gas oil use last year, nearly 160 MBD of lower quality gas oil grades still were consumed by industry and, most of all, power generation. There is considerable room to knock out uneconomical use of general gas oil grades, and while the data so far is only preliminary, demand numbers for 2015 suggest a decline of 10% to 12% in gas oil use. While the January reforms were originally expected to completely abolish gas oil/diesel subsidies, except for public transport and fishing fleet fuel use, the adopted fixed and capped diesel subsidy of IDR1,000/ltr instead will slow demand growth in these sectors.

It is interesting to see how quickly inexpensive (relative to diesel) gasoline shifted this market away from the mid-barrel. In 2004, diesel had a 42.6% share of land transport fuel use. By 2014, that share had fallen to 39.1%, and we expect that the latest subsidy reform will cut this further.

The inability of state utility Perusahaan Listrik Negara (PLN) to meet growing electric needs and the unreliability of their service has led to a proliferation of private power generation, often using small gas oil-powered mobile generators. For certain export industries, such as air-flown fresh fish and cut flowers, this was not a luxury but a necessity. It is unclear how much higher prices will cut into this growing demand center for gas oil.

Current plans are to increase power generation from 42 gigawatt (GW) to about 90 GW by 2022 and completely back out gas oil and fuel oil from the power sector. Diesel use, under a nonsubsidized market, is expected to, at worst, remain static in the 2015 government projections. Overall general gas oil consumption will decline, most likely quite sharply.

Fuel Oil

Fuel oil demand has also been kept moderately strong by PLN’s inability to build new gas-powered generation and a lack of domestic piped gas output to supply such generation. Indonesia had been a major exporter of LSWR for decades, while importing small volumes of non-waxy fuel oil for specialized demand, such as for lubricants and bitumen. Exports continue, but domestic needs have been diverting residual volumes ever further into the home market.

As LNG use increases, slow down in the rise in fuel oil demand should occur. Oddly enough, the rising demand for residual in the domestic market has remained despite much more favorable power generation economics for coal plants. In 2014, roughly 13% of power generated came from fuel oil and general gas oil—and this comes out to a large volume of oil product when one considers that Indonesian power use in 2013 topped 190 terawatt hours (TWh), more than double the power use of only 90 TWh in 2003. Yet in recent years, coal dominated the power sector and made up 52% of power generated. Despite Indonesia’s long history as a producer and exporter, gas accounted for only 24% of power generation.
**Demand Trends by Sector**

**Petrochemicals**

Base petrochemical use of oil has been relatively limited, with the Chandra Asri ethylene cracker using mainly naphtha and limited volumes of condensate. The Trans Pacific Petrochemical Indotama (TPPI) complex split condensate for naphtha to feed a large-scale aromatics complex.

**Transport**

At present, gasoline is competing solely against diesel for road transport fuel use in this market. Gasoline has increasingly dominated the transport sector, but a single factor would reshape this sector—an increased use of natural gas and NGLs in urban transport. The Jakarta metro area had an estimated 30 million inhabitants in 2014, or roughly 10% of the country’s 300 million citizens. Indonesia has a half-dozen urban areas with more than 5 million people, spread out along an island archipelago wider than the continental United States. A drift in government policy over the past two decades left gas use at 20.5% of total Indonesian energy consumption in 2013, lower than it was 10 years earlier (29.9%). If competitively priced, the use of CNG, LNG, and LPG certainly could cut sharply into both gasoline and diesel use. Setting a policy that allows gas and NGLs to compete with conventional road fuels would diversify fuel use and slow overall oil demand growth.

It should be noted that with three large-scale liquefaction complexes and a long experience in LNG trade, substitution of gas for fuel oil and gas oil bunkers makes good economic sense, particular since much of the marine traffic consists of regular freight routes and ferries connecting the country’s major islands of Java, Sumatra, Kalimantan, and Sulawesi. The domestic fleet consists of roughly 2,000 small ships, but a nation made up of islands cannot afford to ignore the implicit savings in LNG bunker. Instead, it’s Singapore that is pioneering this fuel use in Southeast Asia.

All in all, Indonesian transport fuel demand has come a long way. In 2014, it made up 56% of all oil use; 20 years earlier, it barely topped 38% of total oil demand.

**Industrial**

This has been the sector, together with power, where coal has begun to make a difference. While considerable use of low-quality gas oil remains, coal has slowed its demand growth significantly. It is known as Industrial Diesel Oil (IDO) and consumed solely in stationary sector demand, such as industry. Rather confusingly, a portion of what is designated as Automotive Diesel Oil (ADO) is not used in transport, but labeled this way so it could theoretically run diesel vehicle engines. One should not mistake Indonesian statistics for ADO as the same as for true road diesel.

The rapid emergence of an Indonesian coal industry has been a factor little appreciated outside of Asia itself. Indonesia has become a major competitor to Australia for sales to China and increasingly expanded Indian coal imports. This has made coal available, modestly priced, and ideally suited to filling the gap in stationary energy use, where one would expect a historically important producer such as Indonesia to turn to gas.
In 2003, oil accounted for 50.4% of base energy use, gas represented 29.9%, and coal only 17.7%. By 2013, oil’s share fell to 43.7% of the barrel, but the share of gas in the national energy mix dropped by almost a third to register 20.5% of base energy use. Of all fuels, it was coal that was the biggest gainer, with almost all supply produced in Indonesia and much of it coming from Kalimantan, a short distance from Java and Bali. Kalimantan, also known as the Indonesian portion of Borneo, accounted for more than three-quarters of power demand in recent years.

Residential/Commercial

LPG has taken the place of kerosene in all but the most remote locations far from LPG bottling and distribution points. Electric use in the household has just begun to appear as a major sector supply source, but tends to be focused in Jakarta and other large urban areas, such as Surabaya. Non-commercial energy use in this sector has remained significant, though it has fallen from making up nearly half of all energy consumption in the 1990s to between 25% and 33% of total energy use at present.

Power

The Indonesian government has ambitious plans to completely back out oil use in this sector, but it is relying upon coal, not gas, to become the baseload fuel for power generation. Current plans are to construct an additional 42 GW of installed capacity—up from the current total of 53.5 GW—by 2024 to keep up with projected power demand growth rates averaging 6% p.a. The program called for $90 billion in investment, and coal will make up nearly half—20 GW—of generation capacity. Oil-field power generation will be converted to coal or gas use in future operations.

C. NIC/Near-NIC Asia

1. TAIWAN

Taiwan has long been considered a stable pillar of the NIC group countries that have not yet achieved fully industrialized status but boast income and living standards comparable to OECD economies—in fact, better than some OECD members.

A remarkable feature of Taiwan’s economy has been the nearly stagnant demand since oil consumption stopped expanding in 2006. Since then, oil use has been steady, between 900 MBD and 976 MBD. Major variations usually come from changes in naphtha consumption, depending on international petrochemical markets. But even naphtha, which showed the greatest changes, never varied by more than 16%, with its largest volume under 400 MBD. Small percentage gains in LPG, gasoline, and jet/kerosene were offset by declines in gas oil/diesel and fuel oil.

In part, this has reflected stagnation in Taiwan’s economic growth, but we suspect that it is solid, though indirect, proof that Taiwanese factories have moved into joint development projects in southern China at a rate far higher than estimated.
Demand Trends by Product

LPG

All domestic LPG supply comes from Taiwan’s two refiners. Industry, rather than residential/commercial, was the chief demand sector. Consumption was fairly steady through 2011 but has shown a significant uptick since 2012 in the increased use of LPG as a petrochemical feedstock, with Formosa Plastics Corp. (FPC) importing material for feedstock use when international prices allowed. The company has modified ethylene furnaces for its olefin plant to use LPG and has been a regular buyer of LPG, usually propane.

Gasoline

Unlike most Southeast Asian neighbors, Taiwan has always favored gasoline over diesel use. Other than in 2011, when gasoline demand rose 13%, consumption for this product has barely moved and has been range-bound between 168 MBD and 171 MBD. Taiwan used three grades of gasoline, 92, 95, and 98 RON, and other than reducing sulfur allowable to 0.001%S (10 PPM) in 2012, it has not changed product quality in years.

Taiwan traditionally imported regular volumes of poor-quality gasoline, upgraded the material, then re-exported it, with China, Vietnam, and the Philippines as the major markets. These sales were often greater than 50% of gasoline demand and were a reliable refinery moneymaker.

Naphtha

Similarly to South Korea, refiners in Taiwan have sought to maximize gasoline outturn and import naphtha as petrochemical feedstock for petrochemical buyers. In recent years, these naphtha exports have grown to considerable volumes, often topping 250 MBD, though part of that was N+A-oriented grade, which is best suited for gasoline or aromatic petrochemical use.

While Taiwan’s petrochemical producers have added LPG to their feedstocks pool, condensate demand has remained minimal and there appears to be little interest in utilizing ethane imports.

Kerosene/Jet

Taiwan is a respectable smaller kerosene market, but almost all demand is for aviation fuel. General kerosene grades have been consumed exclusively in residential/commercial demand, generally in remote sections of the island. Both refiners utilize a wide range of severe secondary capacity, and Taiwan has long been a steady exporter of kerosene, most recently in the 25 MBD to 30 MBD range. Since refiners tend to use a heavy and sour slate, and their outturn of middle distillate has traditionally been considerable.
Gasoil/Diesel

Road diesel dominated this products sector use, though overall gasoline far outweighed diesel as the primary land transport fuel. Small volumes of lower-grade gas oil were used in agriculture (6.6%) and in the commercial sector. Gasoil/diesel is one of the key products in Taiwan refiners’ export strategy. Traditionally, refiners imported steady volumes of lower-grade gas oil, upgraded it to road diesel quality, and exported the bulk of it, mainly to China, but also to Vietnam and the Philippines. Yet in recent years—2013 to 2014—imports dropped to virtually nil, and domestic refining provided a big boost to export volumes, which totaled more than 200 MBD both years. It appeared that refiners shifted to a middle distillate export mode, with essentially a stagnant domestic market. There have been no quality standard changes for gas oil/diesel recently.

Fuel Oil

While long recognized as a NIC, Taiwan has remained a notable consumer of fuel oil in power generation, accounting for 8% of total generation in 2014, with coal (49%) and gas (27%) making up most other generation supply. It is remarkable that this NIC has a similar pattern of fuel use for the power sector as a classic Developing Asia market, such as Indonesia. Most fuel supply in all cases is imported, and LNG, even with new and efficient combined turbine plants, finds it difficult to compete against coal.

Taiwan’s electricity generation, mostly fueled by fossil energy, has grown by 26% in the past decade, from 199 TWh in 2000 to more than 250 TWh in 2012. Taiwan's electricity policy is focusing on replacing older fossil fuel units with more efficient power plants and increasing its installed capacity from renewable sources to diversified fuel sources. The retirement of nuclear plants, which accounted for 16% of power generation, will be replaced by coal and gas-fired capacity.

The policy of replacing fuel oil-powered plants has reduced the power sector’s share of overall residual demand to 35%, now exceeded by industrial fuel oil use, which comprises 42%. There have been no changes in Taiwan’s 0.5% sulfur ceiling for power generation use of fuel oil, and quality overall has remained unchanged in recent years.

Demand Trends by Sector

Petrochemicals

Naphtha has and will continue to dominate, although LPG has become an important swing feedstock. A portion of Taiwan’s considerable naphtha imports has been of N+A material, both for aromatic petrochemicals as well as gasoline manufacture.

Transport

Gasoline continued to dominate, although diesel has been the dominant fuel for light trucks and military consumption. Taiwan has a small but growing fleet of LPG-powered vehicles.
Industrial
Gas oil and fuel oil have retained small though significant shares of industrial fuel use, particularly in steel and metallurgy. Coal, however, has remained the main sector energy source.

Residential/Commercial
Electric has been the chief energy source in the residential/commercial sector, although small volumes of LPG, kerosene, and gas oil were also consumed.

Power
Fuel oil has remained one of the four legs of fuel supply for power generation, but it is being gradually backed out by coal and gas. These energy sources are expected to gain further share of power generation capacity with the retirement of four nuclear plants over the next five years.

2. Singapore
While Singapore remains defined as a NIC by most economists, in terms of oil use, the island Republic already had graduated to OECD status by 2014, with a demand pattern much more typical of the OECD norm than even some OECD members. Despite a sophisticated economy, Singapore’s energy statistics remain fragmented and incomplete—the government still has yet to release national oil demand figures that include any meaningful detail.

Demand Trends by Product
LPG
Blanketing electric and gas distribution have nearly eliminated home LPG use in Singapore over the past decade. There has been a growing use of LPG in public transport, but in terms of actual volume, demand has remained relatively small. Oddly enough, considering Singapore’s traditional role in LPG trade, neither propane nor butane had a major role as petrochemical feedstocks. Shell’s ethylene cracker has relied mainly on condensate processed through a large-scale splitter; ExxonMobil has been moving toward a gas oil-based feedstock use for its olefin production.

Gasoline
Gasoline use is minimal, considering the wealth and population of this country, due to long-running measures to restrain private vehicle ownership and use. Still, the total demand of more 20 MBD in 2014 was fairly high, considering the small size of this island nation and the high taxes on both vehicle ownership and transport fuels. Gasoline blending, though, has become a major commercial activity over the past decade. Activity increased considerably between 2004 and 2014, as exports rose from slightly more than 300 MBD to more than 550 MBD. Domestic
gasoline quality was moderately high for RON 92, 95, and 98 grades, with sulfur capped at 0.005% (50 PPM), though aromatics and olefins caps were fairly high at 50% and 18%, respectively.

**Naphtha**
Demand has remained fairly steady in the 140 MBD to 160 MBD range, with the bulk of consumption in petrochemical feedstocks. Singapore operates multiple ethylene crackers as well as aromatic petrochemicals, and naphtha demand for this sector has long been important. As gasoline blending has grown as a commercial activity, we expect naphtha imports to rise in parallel. Singapore had two condensate splitters operating in 2014, with one, Jurong Aromatics, focusing on gasoline and aromatic petrochemicals manufacture and the other, Petrochemical Corporation of Singapore (PCS), producing mainly petrochemical feedstock.

**Jet/Kerosene**
Jet fuel for aviation made up almost all kerosene use and has grown as a function of the Changi Airport’s continuing expansion. City-state Singapore used almost as much aviation fuel in 2014 as the Australian continent, a reflection of Singapore’s ambitions to become the aviation hub for long-haul air travel for the region.

Aviation fuel is the first of what we call outward bound transport fuel use. Singapore in reality has no hinterland—the country is smaller than New York City. Yet tiny Singapore is a demand giant when it comes to fuels that transport people and goods to and from the country. Aviation fuel, together with diesel for transshipment to Malaysia and ships bunker, made up a large share of Singapore’s total oil use. This is why this small national market still has had an aggregate oil products consumption of more than 1 MMB/D since at least 2008. A similar OECD country-market is the Netherlands, which in 2014 used 980 MBD in oil products, a majority of which were consumed in transport—shipping, aviation, and the merchandise carrying trade, both truck and rail, for neighboring markets in Northwest Europe.

**Gas Oil/Diesel**
General gas oil demand has been minimal in recent years, with almost all consumption in road diesel. Unlike gasoline, a large proportion of diesel use is for the carrying trade to Malaysia. We estimated in 2014 that this demand sector made up more than 90% of the 91 MBD of diesel use.

Another major area of gas oil/diesel demand has been in bunker fuels. Marine gas oil and marine diesel have been small in volume compared to fuel oil use in this sector, but it is likely to grow as many European ships convert to lower sulfur diesel grades from high-sulfur fuel oil.

While total diesel demand was a considerable 88 MBD—or more than four times more than gasoline—most of this consumption came from the Malaysian transshipment, with trucks moving freight to the neighboring market. As was the case with gasoline, diesel product specs were moderately severe—sulfur allowed was capped at 0.001%S (10 PPM) and the minimum cetane number of 51 was relatively high, but PAH restrictions were fairly loose.
Fuel Oil

By far, marine bunker has the major role in Singapore’s residual demand. Over the past decade, it averaged 95% of the island Republic’s overall residual consumption. Singapore at the turn of the century grabbed the first spot as the world largest bunkering port and since then has steadily increased its lead over Western contenders, such as the Amsterdam-Rotterdam-Antwerp (ARA) region. Still, expectations of an automatic increase in bunker demand were dented by 2013, when bunker consumption actually fell. Longer term, Singapore hopes to maintain its leading role in supplying ships fuel by building an LNG-based bunkering role. We believe it will take some time before a significant portion of shipping converts to using LNG, but ultimately this will cap then draw down fuel oil sales in Singapore.

Disruption to piped gas supply from Malaysia and Indonesia underlined the Republic’s supply vulnerability. Supply security was the initial driver for LNG imports. Once that decision was made, authorities promoted the port as an LNG trade hub. Further, for supply security, fuel oil-based power generation was retained. We expect, though, that residual eventually will be backed out by gas, though gas supplied as LNG.

When totaling gasoline, jet aviation fuel, road diesel, gas oil and bunkers, and fuel oil bunker, the Singapore transport fuels account for roughly 81% of the country’s total oil use. This is a proportion even higher than OECD markets such as Japan.

Demand Trends by Sector

Petrochemicals

Overall petrochemicals have still depended on naphtha as their baseload feedstock, though condensate and, more recently, LPG have been trimmed to feedstock slates. ExxonMobil’s startup of an ethylene cracker using gas oil will change feedstock use when it finally reaches full working capacity, though competitor Shell is expected to remain with its current feedstock mix.

Transport

Total inland transport fuel use was modest—some 35 MBD to 40 MBD in recent years, combining LPG, gasoline, and domestic diesel use. Export-oriented transport fuel use has been considerable and led by fuel oil bunker, aviation, and the diesel-based re-export trade to Malaysia.

Industrial

Oil use in industry has been minimal and made up mainly of LPG and gas oil, though kerosene (solvents) and fuel oil also have been used in small quantities.
Residential/Commercial
Oil product use in this sector has been negligible since 2014.

Power
Most power output has been based on gas, though some generation came from fuel oil-based units.

3. Hong Kong—China, Special Administrative Region (SAR)

Demand Trends by Product
Hong Kong is similar in some ways to Singapore as a small island-focused market, but differs in three important points. First, it has only part of Singapore’s role as an outward bound transport fuel provider, and its fuel demand totals less than a third that of Singapore. Second, much of its trade is for re-export, though that volume has diminished considerably as Shanghai has reasserted its role as China’s top port. Finally, Hong Kong operates no refineries or base petrochemical plants—it produces no oil product or petrochemicals. Of course, Hong Kong is politically a part of China, though a Special Administrative Region (SAR), while Singapore has been independent for 50 years.

LPG
LPG, used as a vehicle fuel, made up 80% of 2014’s 12.5 MBD demand, with the remaining small volume divided roughly in half between city gas production and residential/commercial use. We expect transport use of LPG to grow under government incentive programs, while residential/commercial and city gas demand will vanish by sometime in the coming decade.

Gasoline
Like Singapore, SAR authorities have tried to limit automobile use, particularly on the Hong Kong Island. Total gasoline demand in 2014 was well under 10 MBD. Singapore, Japan, and South Korea were the main suppliers for this product. Mainland China dominated all other products, both for import and export.

Naphtha
Hong Kong figures do not break out naphtha use, but we believe it is minimal, since Hong Kong has no refining or petrochemical activity.

Jet/Kerosene
As in Singapore, almost all kerosene use is as aviation fuel, and at 119.9 MBD in 2014 consumption was equal to that of Singapore. Yet as more international air traffic to China has
been flying directly to Beijing and Shanghai, there is considerable doubt as to how much further Hong Kong can maintain its role as an international aviation hub.

**Gas Oil/Diesel**

The sectoral breakdown of gas oil/diesel is the same as in Singapore, but breaks out differently in market shares. As in Singapore, general gas oil use is minimal, though a bit higher than in the island Republic, due to agricultural needs in the new territories. The Chinese carrying trade made up 40% to 45% of the total 2015 demand of 70.5 MBD, much lower than in Singapore, while marine bunkers were slightly higher than in Singapore, as Hong Kong supplies the China coastal trade.

**Fuel Oil**

Until relatively recent, Hong Kong power depended on fuel oil for a substantial portion of its generation needs. The substitution of regassified LNG for power plant use from 2010 to 2013 eliminated this sector’s residual consumption. All fuel oil demand is in the bunker sector, and Hong Kong’s 108 MBD in residual bunker sales in 2014 was roughly 15% of that of Singapore. Non-bunker sales were less than 2 MBD in 2014.

**Demand Trends by Sector**

**Petrochemicals**

None.

**Transport**

Only a small volume of gasoline is used, with LPG a major urban transport fuel. Diesel was dominated by the transport of goods to and from China proper.

**Industrial**

None.

**Residential/Commercial**

Small volumes of kerosene, LPG, and gas oil still are used in this market.

**Power**

Fuel oil was essentially backed out of the system by 2014. Gas and coal-fired power generation have become the norm.
D. OECD Asia Pacific

1. JAPAN

Though no longer Asia’s demand leader, Japan remains a major oil market. It is the third largest petroleum consumer worldwide, with demand of 4.03 MMB/D in 2014. Yet it is also an aging market and an economy mired in the post-Bubble malaise for a generation. Japan’s demand fell nearly 20% from 5.01 MMB/D consumption in 2004. Respected groups such as the Institute of Energy Economics Japan (IEEJ) forecast a further decline by 2020, as Japanese industry moves abroad.

Japanese oil demand was actually given a boost by the Fukushima nuclear power plant accident, which forced the closure of most nuclear power generation for an extended period. The net result was a big boost to fuel oil demand, prompted by power boiler-feed needs. The Yen's depreciation and soaring natural gas and oil import costs through the first half of 2014 continued to deepen Japan's only recently emerging trade deficit. The balance reversed from a 30-year trade surplus, which was $65 billion in 2010, to a deficit that reached $112 billion in 2013. The drop in oil prices between 2014 and 2014 has eased this deficit and provided some relief to Japanese utilities.

Demand Trends by Product

LPG

Japan has long been a major LPG consumer and has supplied this need through substantial refinery output of 139 MBD in 2014, but it also has been heavily dependent on imports, some 370 MBD. Demand was dominated by residential use, mainly in cooking and water and space heating, particularly outside of major urban areas. Industry accounted for 17.1% of demand, petrochemicals for 12%, and transport for 6.1% in recent years.

A major move that will shape the future of Japanese LPG use and overall demand is the emergence of generally cheaper supply, originating from shale gas production in the United States. Currently, transport via the Panama Canal has been limited by the narrowness of locks—only a small group of special-design narrow-beam Japanese tankers can traverse the waterway. Yet the opening of the expanded canal by 2017 should see US sales zoom—the Japan LP Gas Association expects US purchases to reach nearly 95 MBD by 2018, about a quarter of all imports.

This may also prove a lifeline for Japan’s beleaguered petrochemical sector. Handicapped by older and generally smaller ethylene crackers, Japanese manufacturers have one great advantage over their Asian rivals—their plants possess more feedstock flexibility. In particular, Japanese petrochemical firms can take advantage of less costly LPG feedstock.
Gasoline

While only roughly half the size of the Chinese gasoline market, Japan’s motor fuel production and consumption remain a marvel. Tokyo dictated the highest quality standards for the region more than a decade ago, and its 89 RON and 96 RON, which contain 0.001% (10 PPM) sulfur and low aromatics and olefins product, is still the best quality in Asia Pacific.

Japanese refiners have met these needs for the most part from their outturn. Unlike Singapore, but similar to China, refiners have traditionally focused on meeting domestic market needs as their top priority. Gasoline imports and exports have remained more or less in the range of 25 MBD to 50 MBD since 2011 and at even lower volumes prior to the Fukushima disaster.

Japan has remained mainly a gasoline market, despite contributions from transport LPG (in 2014 about 36 MBD) and diesel, some 582 MBD. Similar to their US counterparts, Japanese refiners are geared toward producing top-quality gasoline. We see little reason this would change in the foreseeable future.

However, there have been signs of declining consumption. Demand had hovered around 1 MMB/D between 2004 and 2010, then began an uneven fall, totaling only 923 MBD in 2014. Diesel registered small gains but made up less than 40% of the land transport fuel market.

Naphtha

While Japanese petrochemical companies remained formidable competitors, the closure of some smaller plants and the shifting of some production offshore led to a slow decline in naphtha.
deman. This fall in naphtha use was exacerbated by the shift of Japanese companies to non-naphtha feedstock. Japanese olefin producers have the highest feedstock substitution flexibility in the region and use considerable volumes of LPG and condensate as well as naphtha. At nearly 800 MBD of feedstock demand, Japan remained a major base petrochemical consumer, but South Korea and China exceed Japan’s naphtha demand. Japan is no longer the top Asian market.

**Jet/Kerosene**

Japan is a unique kerosene market. While jet grade made up the greater part of kerosene use, the majority of that was for traditional residential/commercial heating, rather than aviation fuel. In 2014, jet as aviation fuel made up 41.6% (211 MBD) of kerosene demand, and 121 MBD of jet aviation demand, or 57.3%, was sold for US Air Force needs and as bonded sales to international aviation. This enormous market for non-transport jet consumption (also including grades such as Dual Purpose Kerosene/DPK) sets Japan apart.

Centralized heating has never been widespread, even in post-World War II Japan, while energy prices have always been high. The typically ingenious Japanese solution was to heat residences, room by room, using a kerosene heater only when a room is occupied.

Kerosene remains one of the few product groups where Japanese demand still exceeds that of China. Yet even with the high prices of 2012 through mid-2014, together with the devaluation of the Yen and the rise in gas and district heating, Japanese cities have reduced residential jet use.

**Gas Oil/Diesel**

While some kerosene was used in industry, it was gas oil that made up the bulk of oil demand in this sector. Industrial consumption (29%) was the second largest sector for oil consumption behind transportation. It should be noted that since the 2011 nuclear plant shut downs, gas oil was also used as a peak generation fuel in combination with cycle turbine power production.

Road diesel made up a majority of all gas oil consumption (72.3%), while Japanese vessels use a sizable volume of marine diesel and marine gas oil for coastal trade and fishing. Still, demand for this product group fell by 31% over the past decade from a high of 1.171 MMB/D in 2014, and further decline would appear likely.

All gas oil and diesel sold in Japan is 0.001% (10 PPM) sulfur and the cetane index varies from 45 to 50, depending on the season.

**Fuel Oil**

Despite being an advanced industrialized economy, at the bottom of the barrel Japan exhibits characteristics typical for a Developing Asia economy and its oil use. In 2010, Japanese fuel oil demand, dominated by power plant and bunker use, had fallen to 440 MBD. Then the Fukushima nuclear disaster of March 2011 occurred, which led to the eventual temporary closure of all
Japanese nuclear power plants. To fill the gap, power companies turned to LNG and fuel oil. Residual demand jumped to 575 MBD in 2011 and rose to 629 MBD by 2013 before falling to 525 MBD in 2014. A portion of fuel oil consumption actually came from the direct-burn use of mainly waxy, low-sulfur crudes as boiler feed. In 2012, that peaked at 256 MBD, but fell to 192 MBD in 2013. In 2014, Japan burned more crude oil than was refined in Sri Lanka, Bangladesh, the Philippines, Vietnam, Papua New Guinea, and New Zealand.

**Demand Trends by Sector**

**Petrochemicals**

Naphtha demand will remain the dominant feedstock, but will likely fall to the 70% range as a share of feedstocks used by the end of the decade. LPG, which for the most part is imported from the United States via an expanded Panama Canal, will become a regular feature of petrochemical feedstock choice, though condensate will also play an important role. So far, Japanese petrochemical companies have shown only limited interest in ethane imports.

**Transport**

Despite Japan’s substantial use of gasoline, diesel, and aviation fuel and despite the country being one of the largest volume users of bunker outside of Singapore, transport fuels only made up about 54% of Japan’s total oil use. The large-scale consumption of jet/kerosene in the residential/commercial sector and a high-volume use of fuel oil in power generation since 2011 are, of course, market characteristics unique to Japan. We would expect the phase-out of both types of oil consumption by 2020 to raise transportation’s share of total oil use to well over 60%.

**Industrial**

Fuel oil traditionally filled the role of coal in many industrial enterprises, but it has been gas oil that dominated in the past decade, particularly in metallurgy. Gas, in the form of LNG, was generally considered too expensive to use in most industry, though Nippon Steel & Sumitomo Meta Corp. was for many years a direct contract customer.

**Residential/Commercial**

While gas and district heating in Japan’s large cities continues to gain share, residential heating has remained dominated by jet/kerosene. Smaller volumes of LPG have been used for residential consumption in rural Japan and for cooking in urban Japan. Some 17% of Japan’s LPG use was in the residential/commercial sector.

**Power**

In 2014, power generated from nuclear plants was zero, but the first of newly inspected and certified power plants were scheduled to restart operations by the end of 2015. In 2013, oil products made up 14% of the generation needs of this market, which was double the demand of
2010, while gas use rose to 43% of total generation, up nearly 50% over 2010 levels. It will take at least until 2018 before all nuclear plants are inspected and recertified for operation, and this will keep fuel oil demand high.

2. SOUTH KOREA

After years of stagnation, Korean oil demand began to grow again in 2010, though exhibiting odd characteristics for an expansion. Most of the overall demand growth came from petrochemical use of naphtha, which rose from 39.3% to 45.3% of total oil use, or to 1,088 MBD in 2014. There was modest demand growth in both gasoline and diesel, but this was more than offset by the near collapse of fuel oil consumption, which declined by nearly 30% to 191 MBD in 2010–14. Refining remained export-oriented, and China continued to be the top customer for both refined products and base petrochemicals.

**Demand Trends by Product**

**LPG**

South Korea has been a major LPG market for years and, like in the case of Japan, its domestic supply comes only from refining. Imports still make up a majority of Korean supply. Unlike China and Japan, Korea has been a major market for LPG in transport. In 2014, nearly half of LPG demand was for vehicle fuel, an estimated 140 MBD. While residential/commercial demand has remained significant—about a quarter of all consumption—petrochemical feedstock use of LPG has been steadily growing and has approached 20% of all LPG use. Next to Japan, Korean petrochemical manufacturers have been most active in expanding their feedstock range to reduce an overdependence on naphtha imports. For this reason, LPG and condensate use have grown. In 2014, Korean feedstock flexibility was estimated at about 20% to 25% of total feedstock use.

It was interesting to note that while Korean refiners and condensate splitter operators have shown considerable interest in US condensate exports, their enthusiasm for LPG supply has been muted. This perhaps will change once the expanded Panama Canal reduces transport costs for USGC cargoes moving west across the Pacific.

**Gasoline**

Gasoline remains distinctly the weak sister to diesel in transport demand, accounting for 201 MBD to 397 MBD. Still, it has shown consistent demand growth since 2008, albeit at a low percentage. Traditionally, the Korean tax/tariff system penalized gasoline use in favor of diesel and, to a greater extent, LPG. We believe gasoline consumption will still rise slowly, though laboring against this tax/tariff handicap.

Gasoline quality has continued to improve in recent years and both 91 RON and 84 RON grades were low in sulfur at 0.001% (10 PPM,) had tough limits on aromatics, and moderately severe limits on olefins and oxygenates.
Naphtha
Despite considerable effort to expand petrochemical feedstock use, the overall continued expansion of Korean base petrochemicals increased naphtha demand by nearly 20% in the five-year period ending in 2014. The latest focus in this sector has been the expanded aromatic petrochemical production, with China being the chief export outlet. By 2014, South Korea was operating the largest volume of condensate splitter capacity in the region, and most petrochemical companies have already converted some of their ethylene cracking furnaces to handle LPG as well. In recent years, naphtha has grown to dominate both the demand barrel as well as imports. In 2014, naphtha made up 45.3% of Korean oil consumption and 63% of all product imports.

Jet/Kerosene
General kerosene consumption has been small in volume, primarily used in rural Korean households and as a solvent in petrochemical and refining operations. Jet grade for aviation fuel dominates this product group, accounting for 71.6% of 161 MBD of kerosene demand.

Gasoil/Diesel
Gasoil/diesel has remained the other main pillar of consumption in the Korean market and in 2014 made up 17% of the demand barrel. Together with naphtha it made up nearly two-thirds of national oil product use.

Gas oil use in industry was backed out by LNG-based gas supply. Unlike Japan, South Korea has a national gas transport network, and the trunkline has grown to serve nearly every region of the market since its inception in the late 1980s.

Diesel remained the main transport fuel of this market, and diesel demand in 2014 was more than twice that of gasoline. Korean diesel specifications have moved ahead of Japanese specs in the last decade, though general gas oil quality standards allowed 0.015%S (150 PPM) compared to Japan’s unitary 0.001%S (10 PPM) ceiling for both general gas oil and diesel. Still, as of 2014, Korean diesel had a higher cetane value and stricter secondary specs than Japan.

Fuel Oil
In the five years ending in 2014, fuel oil demand fell nearly 30% and averaged 191 MBD last year, with most of that consumption being for ships bunker. Natural gas use has backed out both fuel oil and general gas oil from industrial demand as well as use in space heating. We expect a further decline of fuel oil use through the end of the decade.
Demand Trends by Sector

Petrochemicals
We expect naphtha to make up the majority of feedstock supply for some time, but with increasing use of LPG and condensate. South Korean petrochemical buyers have shown little interest in potential US ethane supply.

Transport
Diesel will remain king of the road, with gasoline use slowly expanding, despite fiscal handicaps in retail sales. We expect LPG to remain a major transport fuel in the future.

Industrial
Stationary fuel use continues to be backed out by piped gas based on LNG imports. We expect general gas oil and residual demand to slowly decline as gas imports expand, in part because of lower LNG prices likely in the second half of this decade.

Residential/Commercial
LPG has dominated this sector in terms of continued use and was focused mainly on cooking and commercial applications, though gas and electric have been backing out oil use. Gas oil was the dominant heating fuel until the arrival of piped gas by the early 1990s, while kerosene was still used in rural Korea in small volumes for household consumption.

Power
Gas has had the same back-out impact on fuel oil use in power generation. Korea, like Japan, depended heavily on nuclear power. However, Japan’s nuclear accident has not changed Seoul’s policy.

3. Australia
Until 2014, Australia experienced modest though steady demand growth, mainly in the transport sector, focusing on diesel rather than the traditional fuels of gasoline and LPG. The big news has been the continuing closures of Australian refineries and the government’s willingness to depend on foreign refiners, mainly in Singapore, to meet domestic product needs. Only three refineries and a condensate splitter remain, as well as a handful of specialized lube and bitumen plants.

Demand Trends by Product

LPG
Since most of Australia’s LPG supply comes from field output, not refineries, LPG production was affected minimally by the spate of refinery closures since 2012. After hitting a 10-year high
of 71 MBD in 2007, demand has actually been off somewhat in recent years, due to the conversion of gasoline powered private vehicles to LPG use. The 60 MBD consumed in 2014 was the lowest in all years between 2004 and 2014. Transport made up more than 55% of LPG use and in 2014 averaged about 33 MBD. The halt in LPG demand growth has meant that Australia remains a regular exporter, chiefly to East Asia.

Gasoline
LPG substitution a decade ago followed by reduced tax/tariff for diesel on retail sales helped to reduce and then keep a cap on gasoline demand. From 2004 to 2010, gasoline use fell 6.9% but since has ranged between 315 MBD and 325 MBD. Australian gasoline specs have been high quality, though not as stringent as Japanese standards. Canberra allows a sulfur ceiling of up to 0.015% (150 PPM). This market unusually maintains four gasoline grades—81/85/91/95 RON.

Naphtha
Australia’s petrochemical sector is quite small and ran almost exclusively on ethane, supplemented by small volumes of LPG.

Kerosene/Jet
Almost all kerosene demand is for aviation fuel, and this market has remained a mainstay of jet demand growth for decades. In 2004, aviation fuel made up 9.5% of the demand barrel; by 2014, that had grown to 14.8% of all Australian oil use.

Gas Oil/Diesel
Quietly and with little fanfare, Australia has become a dieselized market, with gasoline relegated to second spot as early as 2010. Gasoline use remained considerable in 2014, some 315 MBD, but diesel demand was substantially greater at 403 MBD.

Fuel Oil
Overall fuel oil use was tiny at about 14 MBD, much of which was for ships’ bunker.

Demand Trends by Sector
Petrochemicals
Ethane will remain the chief feedstock, supplemented by small volumes of LPG.
**Transport**
Diesel will continue its dominance, unless the Australian government changes tax/tariff policies for road fuels. Gasoline also remains a major transport fuel, followed by LPG.

**Industrial**
It should be noted that, while we had defined diesel use as transport, a good deal of diesel and general gas oil was consumed by the mining sector, which if considered industrial, accounted for most of the industrial oil product demand.

**Residential/Commercial**
LPG was the only oil product commonly used in Australian homes, which depend on electricity and gas for the majority of their energy supply.

**Power**
Demand has retreated mainly to ships’ fuel use.
Chapter 3. Recent Developments in Middle-Distillate Retail Price Subsidies

A. China

1. EIA Viewpoint

The US Energy Information Administration (EIA) has taken the view that the high point of gas oil/diesel demand was in 2010, when consumption spiked. Like most analysts, the agency made no attempt to distinguish road diesel from general gas oil consumption and estimated the gas oil/diesel group to make up a third of the demand barrel. It compared 34% of national demand for gas oil/diesel to 23% of gasoline consumption. APEC calculations have drawn the same conclusion, but using solely road diesel to compare with gasoline, as both are true transport fuels. Even after non-transport use is deducted from middle distillate consumption, it is clear that diesel demand is higher in absolute volume than gasoline in 2014, though only marginally. It should be noted that the lead for top road fuel in China has changed hands a few times since 2007.

While we believe that the EIA analysis of transport fuels has been flawed, the agency is correct in identifying the reasons why road diesel growth has flagged. This is a result of several factors: slower economic growth, decreased production from the coal and mining sectors, using diesel transport, greater efficiency in heavy-duty vehicles, and increased use of natural gas-fired vehicles in recent years. The EIA contrasted this with strong gasoline demand growth as a result of strong car sales, due to the emergence of a strong Chinese middle class. Rising incomes eventually lead to rising transportation expectations.

While we agree with EIA’s assessment that many factors impact future demand growth—the pace of economic development and income growth, fuel efficiency rates, and government restrictions on car use—we also think deep-seated structural changes are underway.4

2. Managed Float; Indirect Subsidies?

The current pricing system is based on a managed float—Chinese retail prices follow international levels, but only after some time lag, and not automatically, despite official explanations of an agreed pricing mechanism. The basic principal behind this pricing system is to link prices to the international market but to retain management of prices to avoid market “chaos.”

The overall impact of this pricing system is that when world prices are low—as they have been overall since oil prices began to decline in June 2014—the Chinese public pays more for its transport fuels (gasoline and diesel, taxes included) than consumers in the United States and Canada, a remarkable feat considering Chinese per capita incomes remain lower than the average in North America and Western economies. Price controls are not designed to keep Chinese products cheaper than the world average.

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4 China International Data and Analysis, US Energy Information Administration, last updated May 14, 2015.
When prices rise into the $80 to $100/barrel (BBL) range, Chinese retail prices follow world price levels fairly well, though with some time lag. It is when prices move well over $100/BBL that the government intervenes to offer direct subsidies to keep the price of oil products down.

3. THE 2013 REFORMS

The central government launched a major revision of its base price mechanism, which uses a basket of world marker crudes to determine the underlying value of oil. China’s product pricing system is based on setting retail prices for major products in relationship to a rolling 10 working day average of a crude basket, including Brent, West Texas Intermediate (WTI), and Oman. When these benchmark crudes varied more than 4%, in theory, Chinese product prices would be adjusted.

In 2013, the adjustment period was reduced to 10 working days from 22, and a 4% price band was abolished as well, although the new regulations stipulated that price changes of less than 50 Yuan/MT would not change Chinese prices. This system was designed to move domestic product prices in line with international crude, as more than two-thirds of China’s crude runs now use imported oil. This was supposed to make the system more quickly market reactive.

The halfway measure was more notable for what it didn’t say rather than what it did. The Chinese government did not release any detailed explanation of pricing mechanisms, nor did it spell out what marker crude grades would be used as pricing reference. Instead, the National Development and Reform Commission (NDRC) would make “appropriate adjustments.” Some analysts said that the lower level of transparency in this reform round was meant to make speculation on oil product prices more difficult to execute.⁵

Despite failing to correct the pricing system’s main problem and Chinese prices tending to lag international price changes, the new system has worked sporadically in tracking price changes. The Chinese pricing system worked best when marker crude prices were just under $100/BBL and when inflation fears were low. If either condition was unfulfilled, Chinese prices moved out of sync with free market world prices.

In 2014, the Chinese government met its goal of no more than 3.5% inflation. But the price of oil, as indicated by international markers, dropped steadily through the second half of 2015, despite some gains earlier that year. Prices have averaged closer to $50/BBL than $100/BBL. Product prices have subsequently been adjusted downward.

In many ways, the stop-gate measures the central government has introduced over the past two decades reflect a deep ambivalence about fully embracing a free market in oil products, which is consistent with the government’s continued controls over other strategic commodities. The government’s claim that it was making energy pricing market-oriented was undercut by a lack of clarity in detailing the new regulations. This indicates that the Chinese bureaucracy still prefers piecemeal measures rather than bold steps to fully reform prices.⁶

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⁶ Ibid.
4. Free Market Fears

The China Daily, often seen as a government policy platform, announced: “Under the new system, the National Development and Reform Commission (NDRC) reserves the right to keep oil prices from being lowered.” The paper further reported that the NDRC said “price adjustments under the new system may be suspended, postponed or downsized in special cases, much as sharp rises in domestic inflation, emergencies or dramatic swings in global oil prices.”

While the government said it would be reviewing the system annually, no changes have been made since 2013. And while the NDRC was considering sector subsidies for public transport and agriculture, no subsidies have been approved. It appeared in this latest exercise that the NDRC remained most comfortable with a managed float system, despite its drawbacks, and that full transition to a free market in oil may take some time. As the government commission expressed its goal, the NDRC wants a “suitable” price to cover feedstock and fixed and operating costs. What makes up “suitable” is the catch. 8

5. Lagging Prices; Refinery Investment

The Chinese government wants to avoid a repeat of the 2008 oil price peak, which caused billions in losses to the country’s two main refiners, Sinopec and CNPC/PetroChina. This is a particularly sensitive issue, as refiners in 2015 are being asked to invest heavily so national product specifications can be improved in the new National-5 standards. A major policy aim in the NRDC’s search for a “suitable” price has been to ensure refinery profits to help repay the enormous investments being made in refinery upgrading.

6. Guaranteed Margins; Pass-On

Refining margins have been guaranteed. Below $80/BBL, refiners are guaranteed a 5% margin. This falls on a sliding scale to 0% as prices rise to $100/BBL. When prices move to $130/BBL, the government will subsidize product sales directly. NDRC can suspend or trim price changes. There is no automatic pass-on of savings to retail customers when prices fall.

7. Consumption Taxes/Value Added Tax (VAT)

A consumption tax was first introduced in the 1990s and increased in December 2014 and January 2015, with hikes ranging from 12% to 17%. Value Added Tax was introduced in 1979, but in recent years it has targeted blended gasoline producers. Consumption taxes treat diesel as a core economic good and give at least a marginal subsidy to its use.

Consumption taxes were meant to slow demand growth, as refiners pay the government upfront. Yet an era of much lower oil prices has allowed the large integrated companies like Sinopec and CNPC/PetroChina to pass on only a portion of the increase and expand their market share.

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8 Ibid.
It is interesting to note that the December 2014 increase was 12% or Yuan1.12/liter (US$0.18/ltr) for gasoline, while diesel rose 17.5% to Yuan 0.94/ltr (US$0.14/ltr). In January 2015, the consumption tax for gasoline rose from Yuan1.4/ltr to Yuan 1.53/ltr; diesel rose from Yuan 1.1/ltr to Yuan 1.2/ltr. Even though the rise in diesel tax was larger, total tax for gasoline remained considerably higher, with gasoline costing Yuan 162/MT versus diesel’s Yuan 119/MT. Taxes have risen rapidly over the past two years and gasoline tax increases have tended to outpace those for diesel.

8. LAST WORD

Reformers remind government planners that, unless the country moves to market-based pricing in the medium term, there will be a great and continued danger that the economic gains of the past two decades will be severely eroded, if not fully lost. Yet a counter-argument has been that the other preconditions to allow a free market to operate efficiently have yet to emerge. Among the more important: sufficient storage depots to deal with supply/demand imbalances; a commodities market where price discovery can be made; a transport network that can move product from surplus to shortage areas; and legal requirements against collusion. Government planners fear that freed pricing without full infrastructure support easily would lead to speculation and profiteering, and politically discredit the very concept of a market economy.

B. India

In October 2014, the Narendra Modi government completely eliminated retail subsidies for gas oil/diesel and allowed prices to move to market levels. While subsidies continued for IK and LPG sales, funds allocated for subsidies were slashed by 50% for FY 2015. In FY 2014, which ended March 31, 2015, some $41 billion was allocated for fuel, food, and fertilizer subsidies, and more than 25% was earmarked for oil products. The reform opened up considerable debate in India.

Table 4. Energy Subsidies in Some Non-OECD Countries (2007)*

<table>
<thead>
<tr>
<th>Country</th>
<th>Coal</th>
<th>Gas</th>
<th>Oil</th>
<th>Power</th>
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</thead>
<tbody>
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<td>-27.0%</td>
<td>-7.1%</td>
<td>-22.3%</td>
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<tr>
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<td>-18.9%</td>
<td>-29.2%</td>
<td>-21.9%</td>
</tr>
</tbody>
</table>

*Note: Figures represent percent deviation to reference price.


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9 The exchange rate at the time of writing was Yuan 6.67/US$1.00.
1. **Gas Oil/Diesel vs. Gasoline Subsidies**

Reformers saw abolishing gas oil/diesel subsidies as a major victory because:

- This product group is the largest part of the Indian demand barrel;
- Diesel accounted for a far greater share of road fuel use than gasoline; and
- Gasoline subsidies were removed by 2013 as the relatively lower cost of diesel
  underpinned demand growth for this product.

In a certain sense, the Modi move was the full completion of cautious efforts initiated by the previous Singh government, which in 2013 began to slowly raise the price of diesel by US$0.01/ltr (Indian Rupee/INR0.66/ltr) per month. The Singh administration’s goal was to reduce government subsidy losses to zero. In FY 2012, diesel “under-recoveries” totaled US$10 billion (INR66.36 billion). In contrast, gasoline subsidies peaked at US$1.1 billion in FY 2010.\(^\text{10}\) *Under-recovery* is India’s euphemism for losses, i.e., the difference between international and retail sales prices.

The Indian state compensates marketing companies for their losses through subsidized sales, though government payments often have been late and, at times, less than in full. Oil retailers are reimbursed for their losses erratically and with a lag, which means repayments can be delayed to make federal budgets look better. Indian Oil Company’s (IOC) subsidy-related losses in 2014 were about US$9.5 billion; for the entire industry about US$18.3 billion.\(^\text{11}\)

The Modi government continued gradual diesel decontrol and brought under-recoveries to zero by October 2014. The government did not have to pay cash subsidies for companies to sell diesel at below market cost. But because international oil prices were so low at that time, retail prices at the pump actually fell.

This removal of all diesel subsidies likely will have the biggest impact on transport fuels. Gasoline prices were about 45% higher than diesel; many analysts have been searching for signs of *de-dieselization*, i.e., a move away from diesel and toward gasoline. First post-reform data has not supported this theory—in February, gas oil/diesel demand growth was a healthy 7.4%, but this was believed to be more a reflection of the absolute diesel price level rather than the closing cost difference between diesel and gasoline prices.

An additional benefit of deregulation is that it allows private companies to compete against the three state marketing companies. At present, only Reliance sells through its own retail outlets on a limited scale.

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\(^{10}\) The exchange rate at the time of writing was INR66.36/US$1.00.

\(^{11}\) Wall Street Journal, 7/7/2014, “This is why India has to shrink the subsidy raj”
2. The Burden

In percentage terms, gas oil/diesel has not been the worst of the Indian government’s worries. It has been the sheer size of gas oil/diesel demand, coupled with the still hefty differential of nearly 21% between market and subsidized price that have made this product group such a burden.

As can be seen in the table below, gasoline was the least subsidized product and LPG the greatest recipient of subsidies. Both LPG and IK were subsidized by more than 100%.

Table 5. Underpricing of Fuel Products, 2011–12 (in INR/ltr)

<table>
<thead>
<tr>
<th>Product</th>
<th>Import Parity Price</th>
<th>Regulated Price</th>
<th>Difference</th>
<th>% of Regulated Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerosine</td>
<td>46.9</td>
<td>14.8</td>
<td>32.1</td>
<td>216.9%</td>
</tr>
<tr>
<td>LPG</td>
<td>911.5</td>
<td>410.5</td>
<td>501.0</td>
<td>122.0%</td>
</tr>
<tr>
<td>Diesel</td>
<td>57.0</td>
<td>47.2</td>
<td>9.8</td>
<td>20.8%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>72.7</td>
<td>68.1</td>
<td>4.6</td>
<td>6.8%</td>
</tr>
</tbody>
</table>


3. A Look at LPG

The considerable subsidies in LPG sales were supposedly to supply cooking fuel to the rural poor. Yet surveys over the past 10 years have shown that less than 10% of rural households used LPG; the vast majority of it was sold in urban areas.

As has been the case with all subsidized product sales in India, a considerable amount of subsidized LPG is pilfered, often stolen by organized rackets. As much as a third of all LPG sales go to the black market, a tribute to Indian organizational skills as stealing a product that needs special containment takes special skills. The Indian euphemism for illegal LPG sales is “leakage.”

In November 2014, a pilot program began for direct consumer compensation for LPG purchases. The scheme would make direct deposit in the banking accounts of qualifying recipients, which would then pay a market price for their LPG canisters. The temptation to steal highly discounted LPG canisters would be thus greatly reduced.

As has been the case in many Asian markets, LPG reform stumbled a number of times. The previous Singh government recognized it had to curtail middle class purchases of subsidized LPG. In September 2012, the number of canisters per household per year was limited to six (each canister weighed 14.2 kg). Soon the limit was expanded to nine canisters by early 2013 and then finally abandoned later that year.

A new element entered government thinking at that time. Since state upstream companies produce LPG, in addition to refiners, they too have to subsidize sales. ONGC, GAIL, and Oil India Ltd. (OIL) administer government subsidies and also make their own direct contribution by selling their field LPG at lower than international prices.
In an effort to get its privatization program moving, the Modi government will assume all LPG subsidies for the current FY 2015. New Delhi hopes to sell 5% of ONGC, but investors expressed grave concerns over the state company’s subsidy obligations. To meet subsidy costs last year, ONGC was forced to use money from its capital expenditure funds. Some idea of even a “small” subsidy burden can be gained from Table 6 below. A bad year for subsidies will cost the government and upstream firms a quarter of a billion dollars.

Table 6. LPG Who Pays Oil Subsidy? Govt. vs. State Companies*

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Govt. Contribution</th>
<th>Upstream Firms - Direct Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crore INR</td>
<td>Billion US$</td>
</tr>
<tr>
<td>FY 2013</td>
<td>100,000</td>
<td>16.53</td>
</tr>
<tr>
<td>FY 2014</td>
<td>70,722</td>
<td>11.69</td>
</tr>
</tbody>
</table>

*Note: 2014 Rate = 60.5/1; Crore = 10,000,000


4. KEROSENE CORUNDUM

The sad story of SKO subsidies is similar to that of LPG, with two important distinctions. First, since kerosene needs no special containment, the “leakage” problem is even greater than for LPG, with some regions losing more than 60% of their kerosene allotments to pilferage on a mass scale. Second, kerosene has been the subsidized product that has been least responsive to international pricing. From 2009 to 2013, the international price of kerosene rose by about 150%; Indian kerosene prices during that period hardly moved at all.

The Modi government wants to attempt a back door reform for kerosene. Subsidies will be given through a direct benefit transfer to bank accounts of qualifying families, with no direct subsidy given at sales point. Those who qualify for subsidized kerosene will receive reimbursement directly. The Modi government hopes this will drive down subsidized kerosene sales sharply from the estimated FY 2015 demand of 155 MBD. A pilot project in 2014 in Rajasthan saw demand curb by 67% using the direct transfer system.

5. TAXES

The final area of reform for Indian product sales would be in tax/tariffs charged. Oil products are not exempt from federal excise tax—when gas oil/diesel subsidies lapsed in October 2014, the low level of international prices was actually below the Indian government-set prices. The Modi government has considered increasing the federal excise tax to sop up the difference between subsidized price levels and current low international oil prices.

A second aspect of taxes that makes India very different from other markets is that India has a federal government. Consequently, Indian states can set their own taxes on oil product sales, as well as tariffs on oil product moving from other states. In some Indian states, more than half of the pump price is duties and taxes—despite subsidies being a federal responsibility and cost.
Measures to *equalize* the retail price of products have been mooted, but none has reached a proposal stage.

**C. Indonesia**

1. **Subsidy Reform**

The government under President Jokowi Widodo took as series of steps from November 2014 to January 2015 to completely overhaul the Indonesian oil products pricing system, abolishing subsidies for premium gasoline while capping subsidies for gas oil/diesel. The net result will be a sharp drop in the cost of subsidies, which tops 15% of the national budget. The government plans to raise infrastructure investment by 50% to build ports, airports, roads, and industrial parks, hoping to raise the 2015 growth rate to 7% from original projections of 5%.

In OECD’s 2013 estimate, Indonesia was a country where the sales price of energy was subsidized 20.5% to 50.1%; in contrast, India and China were subsidized at the 1% to 20% level. Subsidy payments, OECD calculated, took up about a fifth of the budget that year. Total removal of subsidies, which was not implemented in the 2014–15 reforms, would add up to 0.7% of GDP growth by 2020.

The government’s timing was good and its handling of a potential political fallout adroit. In November 2014, gasoline subsidies were reduced by 31%, while diesel subsidies were cut by 36%. Despite the drastic cuts, there was no public protest. This is in contrast to earlier similar attempts. In 1998, President Suharto’s IMF-induced subsidy cuts triggered riots that led to the regime’s collapse. In 2013, attempts to reduce subsidies for LPG sales were rescinded in the face of continuing public protest.

Timing was important. The Widodo government moved when the price of Indonesian subsidized gasoline was actually higher than international levels. The reforms reduced gasoline prices to Indonesian Rupiah/IDR7,600/ltr (US$0.53/ltr), when the price with subsidies in December was IDR8,500/ltr (US$0.59/ltr).12

Table 7 illustrates the extent of the government subsidies, showing 2013 pricing. Subsidies were the lowest on gasoline and the highest on IK, but the burden was heaviest on gasoline and diesel use since gasoline demand was growing rapidly while kerosene consumption was capped and then backed out by LPG substitution.

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12 The exchange rate at the time of writing was IDR14,414.73/US$1.00.
Table 7. Indonesian Retail Subsidies—2013*

<table>
<thead>
<tr>
<th>Product</th>
<th>Retail Price</th>
<th>Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IDR/ltr</td>
<td>US$/litr</td>
</tr>
<tr>
<td>Premium Gasoline</td>
<td>6,500</td>
<td>0.45</td>
</tr>
<tr>
<td>Road Diesel (Solar)</td>
<td>5,500</td>
<td>0.38</td>
</tr>
<tr>
<td>Illuminating Kerosine (IK)</td>
<td>2,500</td>
<td>0.17</td>
</tr>
<tr>
<td>LPG</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Note: The exchange rate in 2013 was IDR14,414.73/US$1.00.


One of the problems in calculating subsidies and their costs has been the constantly moving nature of products demand. The following table illustrates some of the difficulties. First, there is the problem of ever increasing cost. The time lag between the initial 2013 budget, its revised version, and the proposed 2014 budget was less than a year. In that time, the cost of subsidies rose 9.2% or IDR1.6 trillion.

Table 8. Indonesia Petroleum Subsidy Budgets, 2013–14*

<table>
<thead>
<tr>
<th>Subsidy</th>
<th>Initial 2013 Budget</th>
<th>Revised 2013 Budget</th>
<th>Proposed 2014 Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trillion IDR</td>
<td>Billion US$</td>
<td>Trillion IDR</td>
</tr>
<tr>
<td>Subsidy Cost</td>
<td>193.8</td>
<td>17.4</td>
<td>199.9</td>
</tr>
<tr>
<td>MBD of Subsidies</td>
<td>792.6</td>
<td>827.1</td>
<td>827.1</td>
</tr>
</tbody>
</table>

*Note: The exchange rate in 2013 was IDR14,414.73/US$1.00.

Source: Indonesia Energy Subsidy Review, Global Subsidies Initiative (GSI) and International Institute for Sustainable Development (IISD), March 2014.

Gasoline was clearly the main driver in ballooning costs. From the initial 2013 budget to the provisional 2014 estimate, demand rose 11.3%. In comparison, subsidies for gas oil/diesel fell by 3.2% and nearly halved for kerosene, but increased an impressive 23.8% for subsidized kerosene (see below). The final cost for CY 2014 was US$19.6 billion dollars, exceeding all estimates.

Table 9. Size of the Problem—Subsidized Fuel Consumption

<table>
<thead>
<tr>
<th>Product</th>
<th>Budget 2013</th>
<th>Revised 2013</th>
<th>Budget 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>503.1</td>
<td>530.7</td>
<td>560.0</td>
</tr>
<tr>
<td>Diesel</td>
<td>260.2</td>
<td>275.7</td>
<td>251.6</td>
</tr>
<tr>
<td>Kerosine</td>
<td>29.3</td>
<td>20.7</td>
<td>15.5</td>
</tr>
<tr>
<td>LPG</td>
<td>121.6</td>
<td>138.3</td>
<td>150.6</td>
</tr>
<tr>
<td>Total</td>
<td>914.2</td>
<td>965.4</td>
<td>977.7</td>
</tr>
</tbody>
</table>

Source: Indonesia Energy Subsidy Review, by Global Subsidies Initiative (GSI) and International Institute for Sustainable Development (IISD), March 2014.
2. The Reform Program

Indonesian gasoline grades can be confusing when tracking the subsidy changes to this product by grade. The high subsidies for lower-quality gasoline, 90 RON, were abolished. This 90 RON grade confusingly is named Premium, while better-quality 92 RON gasoline is named Pertamax. There were no subsidies for higher-quality gasoline grades 92 RON and 95 RON, but these two grades made up only a relatively small percentage of total gasoline use.

For gas oil/diesel, the situation was even more complicated. Initially, it was announced that all subsidies were abolished for diesel, primarily road diesel but also including marine bunker. Two exceptions were given: for public transportation vehicles and for the country’s extensive fishing fleet. This was later revised to a fixed cap subsidy on road diesel and marine diesel bunker of IDR1,000/ltr (about US$0.08/ltr), though overall prices will follow international levels.

It should be noted that a substantial percentage of gas oil labeled as Industrial Diesel Oil (IDO) sales are not covered by subsidies. Further, regarding Automotive Diesel Oil (ADO), the Indonesian designation of diesel does not guarantee that the fuel is earmarked for transport, only that it theoretically could be used as transport fuel. Much of the ADO was used outside of transport, because subsidies made it cheap.

The net results were that the central government’s subsidy costs would be reduced about 90 percent and this will release some $19.8 billion for infrastructure investment in the FY 2015 budget, which began in April 2015. Most important, it will curb Indonesia’s runaway demand growth.

3. Pending Reforms

Unfinished business remains on LPG and kerosene subsidies. The government must continue direct and indirect LPG subsidies to completely back out the domestic use of IK. But at the same time, all incremental LPG demand is now being met by imports, in essence substituting an LPG import problem for the original kerosene import problem.

It appears that kerosene use is naturally dissipating, due to increased use of electric, gas, and LPG. But LPG subsidies create a looming and persisting problem. In FY 2015, the government set aside IDR28.27 trillion (US$1.96 billion) for direct kerosene subsidies to cover 182 MBD, up from 157 MBD in 2014. Pertamina cannot produce any further LPG volumes. All incremental supply will have to be imported, and imports accounted for nearly two thirds of domestic supply to meet the 169.6 MBD of LPG demand in 2014.

It should be noted that subsidized and nonsubsidized are terms used in a particular fashion in this market. Subsidized means the LPG sale is directly subsidized by the government; nonsubsidized means that it is sold at a government-set cap, well below international prices, with Pertamina absorbing the difference between the two. From 2009 to 2014, Pertamina was not allowed to raise the price of its nonsubsidized LPG sales. It is planned that the state company will have a review of its nonsubsidized prices every six months, but current price reforms have left this proposal in limbo.
D. Survey of Other Major Gas Oil/Diesel Market Countries

1. Malaysia

*Demand Trends by Product*

**LPG**
While overall Malaysian oil demand grew by about a quarter between 2004 and 2014, LPG consumption rose by nearly 88%, supported by subsidized sales to the residential sector and a slow but steady expansion of LPG consumption as a petrochemical feedstock. Yet since most LPG came from still expanding gas output, Malaysia has remained a net LPG exporter.

**Gasoline**
Gasoline demand outstripped diesel use in 2004 and has steadily increased its lead. Malaysian demand growth has been considerably impacted by retail subsidies. Consumption topped 214 MBD in 2008, but a series of price changes cut into gasoline use—only in 2013 did demand finally exceed that volume level. Malaysian gasoline, 95 RON and 97 RON, is of moderate quality, with fairly high benzene and aromatics content. Gasoline sulfur ceilings are currently in the process of being lowered to 0.005% (50 PPM).

**Naphtha**
A limited volume of naphtha is used in petrochemicals, as well as in gasoline blending. Malaysian petrochemical firms use LPG, ethane, condensate, and naphtha as primary feedstock.

**Jet/Kerosene**
Almost all kerosene demand comes from aviation fuel consumption. The expansion of Kuala Lumpur’s main airport helped increase jet consumption by one-third between 2004 and 2014, but further gains likely will be smaller.

**Gas Oil/Diesel**
Gas oil and diesel demand has been almost static over the past 10 years, though diesel made up the overwhelming majority of gas oil use. In contrast, gasoline use rose almost 25% between 2004 and 2014.

**Fuel Oil**
Residual accounted for a considerable proportion of power generation capacity in the 1990s, but it was backed out by natural gas use for the most part. While gas peaked and was replaced in part by coal, fuel oil demand has rebounded somewhat in the power sector, though it never recovered market share in industry.
Reform Moves

Malaysia had used a managed float pricing system, called the “automatic pricing mechanism” since the early 1990s, with prices adjusting to international levels on a regular monthly basis. Most Malaysians were unaware of this system because the government absorbed the difference between actual cost and pump price through a system of subsidies. Standard 95 RON gasoline was subsidized by 23% of market price; diesel in contrast was subsidized at 28.6% of market value. Premium 97 RON gasoline received no subsidy.

To introduce “fiscal discipline,” Malaysia in December 2014 abolished all fuel subsidies, which chiefly focused on 95 RON gasoline and road diesel, leaving consumers to pay the full price of managed float price levels. It is estimated that this move will save at least $6 billion in subsidy costs for the current year. Gasoline and road diesel made up about 57% of the total Malaysian demand barrel in 2014.

The reform does not mean that the Malaysian government suddenly had become a free market advocate. The managed float system is expected to be used to determine the prices of 95 RON and diesel fuel on a monthly basis as long as global oil prices stay at or below US$80/BBL. At prices higher than US$80/BBL, “subsidy rationalization” would be implemented—though the type and extent of such subsidies has not been spelled out.

2. THAILAND

Demand Trends by Product

LPG

Thailand for many years was one of the few Asian markets generally free of price controls. The major exception, under the influence of politics, was LPG, which was heavily subsidized initially for transport use but eventually for a broad range of demand areas. From 2004 to 2014, demand nearly tripled, rising from 82 MBD to 211 MBD. However, in late 2014 the current military-led government began stripping away subsidies for LPG use. We expect that this will cut transport and residential demand and increase petrochemical consumption. We expect that LPG’s outsized influence in the demand barrel—nearly a quarter of all oil product consumption—will steadily shrink.

Gasoline

Gasoline demand has grown only marginally over the past decade, and unlike Malaysia, Thailand has remained an overwhelmingly diesel-oriented market. Gasoline quality for 91 RON and 95 RON grades was moderately high, as Thailand required 0.005% (50 PPM) sulfur limits before a similar requirement was introduced in Malaysia. The country also imposed tighter aromatics and olefin limits than its neighbor.
Naphtha

Thailand uses a full range of feedstocks in its petrochemical sector, including ethane, LPG, condensate, and, of course, naphtha. As was the case in Malaysia, naphtha comes from the country’s sizable refining sector, while NGLs are sourced from imports and domestic supply.

Kerosene/Jet

Thailand has used kerosene almost fully for aviation, as residential/commercial kerosene demand was never a major factor in this market.

Gas Oil/Diesel

Gas oil/diesel made up slightly less than a third of overall Thai oil use, compared to almost half of Indian oil demand. Yet Thai diesel use was even higher than Indian demand, far exceeding India’s 80% share of diesel use of gas oil. Most stationary gas oil use, mainly in industry, was backed out by piped natural gas, leaving demand to consist overwhelmingly of transport fuel.

This perhaps accounted for the relatively low-to-average quality allowed for general gas oil use, a surprisingly high 1.5% sulfur ceiling (15,000 PPM), and a 45 cetane number. In contrast, diesel specifications were top quality in 2014, with only a 0.005% (50PPM) cap allowed for sulfur and a minimum cetane number of 50 mandated.

Fuel Oil

Piped gas, now supplemented by LNG imports, had a significant impact over the past two decades on fuel oil consumption. First, residual use in industry was replaced, and state power generator Electricity Generating Authority of Thailand (EGAT) later substituted gas for residual use in all plants.

Oil Fund Reform

Diesel

In August 2014, Thailand’s military-led government began reforming the diesel subsidy system. Diesel prices were government controlled and did not change from 2011 to 2014 under the direction of the previous Yingluck Shinawatra-led government. While the Oil Fund was supposed to be revenue neutral, it had been used by the Shinawatra government for various populist measures, including extensive product subsidies, notably in road diesel and LPG. Subsidies in Thailand are based on contributions from oil retailers. In recent years, the price of gasoline was raised in order to provide a subsidy for less costly road diesel sales. But because the government has had to step in and recapitalize the Oil Fund a number of times, the subsidy has become a public expense. In 2014, the total subsidies cost was estimated at Baht 500 million (US$15.5 billion), with roughly 60% for diesel and 40% for LPG.
In one way, subsidies for gas oil/diesel were not as damaging as those for LPG, because Thai refineries were able to meet gas oil/diesel demand without any difficulties, even though demand for this product group rose some 14.1% during the 2009–14 period, reaching 363 MBD. No imports were needed. This was, however, not the case of LPG.

**LPG**

Reform began at the end of 2014, which ushered in the first price increases for LPG since 2007. Two different impacts were seen from the Shinawatra subsidy program. Overall, the price of LPG was constrained through direct Oil Fund subsidies, with the Oil Fund having to be replenished from the general budget. Further, LPG pricing varied according to sector/use, with transport paying the lowest price at Baht 21.4/kg (US$0.66/kg). The net result was that overall LPG demand surged, while LPG used in transport gained a large share (roughly 29%) of this product’s consumption.

Since demand swiftly outpaced domestic production, imports of LPG began to grow. In 2007, domestic production was 130 MBD, demand reached 117 MBD, and there were no LPG imports. By 2011, demand rose to 188 MBD and peaked at 213 MBD in 2013, with imports of 62 MBD. State oil/gas company Petroleum Authority of Thailand (PTT), which from 2008 to 2014 had to import LPG at world prices and sell it at a government-set price, estimated that subsidies costs from 2012 to 2014 amounted to some $15.6 billion—all of which was unrecovered.

The current government is gradually raising the wholesale price of LPG to world levels, while it has moved to force a convergence of sector prices to encourage the use of LPG in petrochemicals and as cooking fuel. Subsidy costs should drop considerably, and government planners were aiming to cap these at no more than $5 billion for 2015.

**Chapter 4. Asia Pacific: Comparing Light-Ends and Middle Distillate Growth**

**A. Analysis Drivers—Light-End Products**

**1. LPG**

Of the light-end portion of the barrel, LPG is the light product most commonly—and often heavily—subsidized. In Asia Pacific, as in other world regions, residential/commercial consumption dominated. In contrast, petrochemicals used only a small proportion of propane and butane.

What makes LPG different is its key physical characteristic of requiring special containment using refrigeration or pressure. This often makes LPG more expensive to use than other light products. It requires specialized transport, storage, and handling infrastructure, investments that cannot be used for any other oil product.

This costly and specialized infrastructure is an entry barrier for producers who want to export excess LPG supply. It costs money to make money in international LPG sales, and investments...
in the hundreds of millions of dollars to build an export chain have been the norm, as the USGC most recently witnessed.

This problem of infrastructure further impacts LPG supply/demand balances. When a large-scale producer does not pursue the export option because of costs, most output, whether from refinery or gas field, is dumped on the market as close to the supply point as possible. This introduces an element of price inelasticity into LPG balances, as there will be a certain market demand that will never fall, unless refiners consume all their LPG outturn as process fuel.

LPG is the only end product that is derived as much from upstream production as from downstream refining. In the United States and Mideast, large-scale LPG producers and exporters derive the majority of their LPG supply from stripping field gas, rather than from processing crude. The inverse is often the case in Asia, with refinery-derived LPG making up most supply for China, the region’s largest producer.

In Asia Pacific, refinery-derived LPG has made up most incremental output since the 1990s. Major refinery-based LPG producers include China, Japan, India, and South Korea. Roughly 90% of Chinese LPG production was derived from refining. Saudi Arabia’s LPG supply was, until recently, almost the same percentage originating from gas production. Through 2020, however, most incremental Asia Pacific LPG production will come from new gas developments.

**Figure 12. Divergent Sector Use of LPG—2014**

Some deep structural shifts are underway in Asian LPG use. LPG demand in Asia Pacific has been dominated by residential/commercial use. Western markets, both North American and European, see demand spread more broadly among chemical, industrial, and refinery LPG use. Even in residential demand there are significant differences, East and West of Suez. In Atlantic
Basin markets, space heating takes precedence in the residential sector. In Asia, cooking is the top source of residential LPG demand. All these markets, however, are united by one trend—when piped gas and electricity become easily available and dependable, LPG use normally is backed out.

We expect sustained growth in petrochemical use LPG in Asia Pacific, with propane used in ethylene cracking and PDH manufacture, while butane can be used both in olefinic and aromatic petrochemicals. Asian petrochemical firms have continued efforts to increase the range of petrochemical feedstocks they can use, while expanding the range of suppliers.

LPG illustrates the complimentary and competitive aspects of NGLs. It is complimentary to gasoline production, as isobutane produces alkylate, while butane produces isomerate, both important gasoline components. Yet when used directly in vehicles, LPG competes against gasoline as a transportation fuel. Similarly, LPG often is produced in the same manner as plant condensate, i.e., it is stripped from the gas stream in gas processing complexes. Yet LPG competes against this same condensate as a petrochemical feedstock.

If piped gas always backs out residential/commercial LPG use, its impact is far more devastating on industrial LPG consumption. Since natural gas in general is significantly less expensive than LPG, it quickly backs out this NGL when available to industrial users in large volume.

While our outlook predicts that the cutaway of retail subsidies will impact Asia Pacific middle distillates the most, there also will certainly be an impact on LPG use in two major Developing Asia markets, India and Indonesia. Subsidy reform is expected to move in gradual stages in both countries, but we expect India to take action on LPG before Indonesia. The shifting of more than 250 MBD of Mideast LPG sales will have a big impact on US LPG export efforts.

2. **Gasoline**

Unlike all other major products, gasoline has only one sector use: transport. We believe the challenge gasoline has mounted to diesel’s traditional dominance in land transport fuel use will grow stronger as mid-barrel subsidies are curtailed or abolished. Gasoline likely will overtake road diesel as the leading transport fuel in the region, perhaps by the coming decade.

Though difficult to quantify, it is apparent to anyone with long experience in Asia that popular attitudes have changed. Gasoline is no longer demonized as a *Rich Man’s* fuel, and diesel is no longer promoted as the great society leveler. Each fuel has been weighed in recent years on its own merits and there are certain attributes of gasoline that have made it superior to diesel use.

The extension of product quality specifications to focus on particulates is one area where diesel has steadily lost ground to gasoline among air pollution specialists. While it is true that you will always produce more diesel than gasoline from a barrel of oil and that modern road diesel standards are quite severe, the mid-barrel product still produces more particulates per volume unit than gasoline. In a region where giant cities are common—China has Beijing, Shanghai, Tianjin, and Guangzhou, which each have more than 12 million inhabitants—particulate levels count.
Asia’s emerging middle class finally has been reaching income levels where vehicle ownership becomes likely, not only plausible. We estimate the take-off income for private vehicle ownership in 2014 was roughly $10,000 in 2010 purchasing power parity (PPP) dollars. No longer is it just OECD, NIC, and near-NIC Asia that has been reaching this income level, but also parts of Developing Asia. In China and India, we see the start to the inevitable progression from bicycle to motor scooters and motorcycles to private automobiles, with this latest stage being equivalent to South Korea in the 1980s or Thailand in the 1990s. This implies that, despite restrictions on car ownership and use, the traffic jams of Beijing and Mumbai can only grow worse.

As mentioned earlier, Western forecasts of Chinese gasoline demand often have been wildly inaccurate in the past, as they assumed that Asian driving behavior would resemble, if not duplicate, the Western experience, in particular that of the United States. Yet in markets such as China, the automobile has been a status symbol of certifying economic success, of having “made it” into the ballooning middle class. Cars are not used for daily transport to work; they are used only on occasion for social travel. Trains and air flights still dominate holiday travel. But the automobiles are there and potentially could be used on a daily basis. They remain a massive potential source of new gasoline demand.

India’s slow shift from overwhelming diesel use to a more balanced transport fuel demand, at least in part, has been due to automobile imports. For decades, locally made diesel engine vehicles dominated Indian roads. The growth of joint auto manufacturing ventures with foreign partners encouraged the production of gasoline-powered engines, while auto imports have steadily risen over the past decade, and these too tend to be gasoline powered. Ford, GM, Nissan, Mitsubishi, Suzuki, Hyundai, Renault, BMW, Mercedes Benz, and Fiat are among the companies whose sales are changing Indian fuel use.

Product spec tightening is progressive and can only go in the direction of better quality, even if it can experience temporary, short-term setbacks. Gasoline is one of the most noticeable products when it comes to spec tightening, and while Developing Asia fuel standards are not quite at the EU levels of severity, they have improved—and will continue to improve—throughout the decade. Simple rising urbanization as well as the greater use of private transport makes it certain that gasoline will remain a focus for quality improvement.

3. NAPHTHA

While often considered only a semi-finished product in the Atlantic Basin, naphtha is usually accounted as a finished product in Asia Pacific. Naphtha has two chief consumption areas, as petrochemical feedstock and as the basis of gasoline manufacture. Until recently, petrochemicals overshadowed the use of naphtha for gasoline production in Asia Pacific.

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13 This number is derived from Medlock, Kenneth B. and Ron Soligo, “Automobile Ownership and Economic Development—Forecasting Motor Vehicle Stocks to 2015,” The Journal of Transport Economics and Policy, Spring 2002. Specifically, the results from that analysis were inflation adjusted to 2010 to estimate the value indicated.
All naphtha is light and clean, with few impurities. What is most relevant is a grade’s composition, whether it is paraffinic- or N+A-oriented. In Asia Pacific, paraffinic naphtha made up the baseload of ethylene cracker feedstock in 2014, and though olefin plants will widen their feedstock choices, it likely will make up a majority of feedstock used for the foreseeable future. Other than this, paraffinic naphtha serves as basestock for building gasoline blends.

N+A naphtha has been the more versatile grade. When processed, it produces reformate, both the building block for gasoline as well as the feedstock for aromatic petrochemicals. The multiple uses of naphtha give it many market drivers and make supply/demand balances complex.

Ethylene crackers across Asia have been diversifying petrochemical feedstocks by adding LPG, condensate, and ethane to their feedstock choices. This will mean the back-out of at least some petrochemical naphtha use, particularly for olefins, but naphtha will remain a key feedstock for the region long into the future.

The Mideast Gulf had been the traditional source of incremental naphtha supply, and we expect that this subregion will become less important as a supply source for Asian importers. This will be due in part to decreased naphtha availability, as Mideast producers focus on meeting domestic gasoline needs while exporting premium gasoline. But Mideast naphtha exports also will meet increased competition from US sales of LPG, condensate, and, soon, ethane.

Naphtha’s importance in Asia Pacific product balances has been less than fully appreciated among Western analysts. Even in the face of competition from other NGL feedstocks, naphtha will remain a major product in this region for many years.

B. Analysis Drivers—Mid-Barrel Products

1. KEROSENE

The chief fact dominating this product group is that a substantial percentage of kerosene is still being used in the stationary use sector, mainly in residential and commercial consumption for lighting, cooking, and heating. In this region, the assumption that all kerosene equals jet-grade material for aviation is in essence wrong—kerosene and jet are not synonymous terms. In fact, Asia is the home to an anomaly where its leading OECD market, Japan, uses a large volume of jet-grade kerosene for home heating rather than as a transport fuel. Lower-quality grades of kerosene, SKO and IK chiefly, have seen demand retreating across the region, while jet use has grown, but it will take some time before Asian demand becomes mainly jet grade and is used solely as aviation fuel.

Subsidies have been propping up kerosene demand in India, despite an overall retreat of general kerosene use across the region in the in-home/residential sector; as the experience of Indonesia had shown, substitution of one product for another (albeit also subsidized) can back out kerosene use quickly in residential consumption.

Yet the broader trend is the same across Asian markets—when gas and electricity distribution reaches cities and then rural areas, most consumers switch to cleaner energy. In this sense, the
use of IK/SKO is rather like LPG, steadily retreating in the face of wider electricity and gas distribution.

Jet/kerosene consumption, however, has continued to steadily grow and double-digit expansion has been the norm, rather than the exception, for many years since 2000. Jet demand growth East of Suez will continue to outpace that of regions West of Suez; the center of gravity for aviation fuel has been moving steadily eastward, even before the Great Recession.

Two drivers have underpinned aviation fuel consumption: the spread of mass tourism to Developing Asia, in particular China, and the expansion of air freight traffic for highly perishable goods, such as Singaporean orchids or Australian abalone. It is no accident that aviation fuel demand has grown steadily in all three of these markets.

Singapore also illustrates the emergence of another trend: the development of a regional air hub. The island Republic has pulled ahead of regional rivals Bangkok and Kuala Lumpur and is challenging Hong Kong as a major consumer of jet/kerosene. Tiny Singapore used a third more aviation fuel in 2014 than did the entire continent of Australia, and further expansion of the Changi Airport makes future growth inevitable in the medium term.

The kerosene products group illustrates a trend also apparent in the other middle distillate products group, gas oil/diesel. Analysts often pay too little attention to the parallel and opposite demand trends within a product group. In kerosene, general kerosene grades have been losing ground, seeing demand fall year by year rather than grow. Concurrently, jet/kerosene has been making rapid gains despite the fact that a significant market, Japan, uses large volumes of jet grade for residential heating. The alert analyst must weigh both the growth and the decline of demand within a product group, in order to come to verifiable conclusions.

2. GAS OIL/ADO

Gas oil/diesel suffered from a similar two-trend confusion. Gasoil is the name of the overall product group. Diesel—also known as road diesel, transport diesel, or ADO—is a specific higher-quality grade of gas oil used solely for land transport. Other grades of generally lower-quality gas oil have been consumed in industry for both power generation and as ship fuel.

The two words are not synonymous, though in the Atlantic Basin diesel is often used as a shorthand term for all grades of gas oil. General gas oil grade consumption in Western markets usually makes up a small proportion of total gas oil use, as demand consists overwhelmingly of true road diesel. Not so in Developing Asia. In China, which consumes the greatest volume of gas oil/diesel of any market worldwide, general gas oil grades still accounted for nearly a third of demand. Considering this totaled about 1.16 MMB/D, it is clear a large volume of gas oil demand in Asia has nothing to do with transport.

This two-part action for the gas oil/diesel group makes forecasting tricky for analysts. Many refuse to note that different grades of gas oil are moving in different directions concurrently. Noting this phenomenon is important in weighing demand growth. China in 2014 saw gas
oil/diesel growth slow to 1% growth—yet that number was reached by combining a road diesel demand growth rate of more than 3% with a general gas oil consumption decline.

The overall direction of general gas oil consumption will remain that of steady decline. For road diesel, the rate of demand growth will likely slow, as subsidies for diesel are stripped away and the price gap of diesel relative to gasoline gets smaller. The two trends together, shrinking general gas oil use and more slowly growing demand for diesel, should become noticeable by 2018. This, too, is part of the maturation of Developing Asia economies.

In both India and China, joint ventures between local and international car makers have generally yielded gasoline-powered cars. In India, it already has had a noticeable impact on diesel’s share of overall road fuel demand; in China, the government restricted the number of joint venture plants that would produce diesel-engine cars. It would appear, based solely on current trends, that diesel use in Asia Pacific is near its peak, if it hasn’t peaked already.

A further pressure on future diesel use has only just begun to emerge. Experts in air quality have been increasingly concerned about particulates, which diesel generally generates at far higher levels than gasoline. European product specifications (Euro 6) have begun to take particulates reduction into account for future diesel quality. While Asia Pacific will not follow suit immediately (i.e., by the next decade), we are sure to see further spec tightening and loss of future diesel demand growth due to higher quality standards. If governments move to restrict road diesel overall, it may lead to a sharp swing back to gasoline use in markets traditionally dominated by diesel.

Natural gas, both piped and derived from LNG shipments, is hitting general gas oil use hard in two traditional sectors, power generation and industrial consumption. One possible rescue trend for demand may emerge based on the tightening of international specs for ships bunker. The latest international regulation, reducing residual bunker to no more than 3.5% (35,000 PPM) sulfur, caused some hiccups but was implemented without too much trouble worldwide. The next step, a proposed reduction to no more than 0.5% (5,000 PPM) sulfur by 2020, has ship owners and bunker suppliers nervous, as sufficient residual desulfurization to supply world bunker needs will not emerge by the end of the decade. A possible interim step solution has been the conversion of ships to run on marine gas oil rather than residual. General gas oil grades may well prove to be the oil bridge until ships eventually convert to using LNG as their principle bunker fuel.

C. Forecast/Outlook—By Sector: Demand Giants vs. West

1. Sector Focus on Transport and Petrochemicals

Developing Asia

The three giant Developing Asia markets (China, India, and Indonesia) will have a considerable impact on the intermediate-term outlook for 2015–18. We expect the major transport fuels (gasoline, diesel, and jet) to accelerate demand growth by 2016 as recovery strengthens in the United States and broadens in Europe. In absolute-volume terms, solely from these three country/markets, this means 760 MBD in demand gains in this sector.
Though smaller in volume, we expect the petrochemical sector to make the greatest gains. We see an increase of 321 MBD, based on naphtha consumption and LPG demand gains of 3.3%, mainly in Chinese petrochemicals. Together with transport sector growth, this is a total gain of more than 1 MMB/D in the 2015–18 period, based solely on these three markets.

Table 10. Developing Asia Giants Products Demand Forecast (in MBD)*

<table>
<thead>
<tr>
<th>Product</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>1,429.4</td>
<td>1,493.4</td>
<td>1,542.7</td>
<td>1,592.1</td>
<td>1,643.2</td>
<td>1,700.7</td>
</tr>
<tr>
<td>Gasoline</td>
<td>2,972.1</td>
<td>2,975.8</td>
<td>3,033.1</td>
<td>3,138.3</td>
<td>3,269.9</td>
<td>3,427.7</td>
</tr>
<tr>
<td>Naphtha</td>
<td>1,594.6</td>
<td>1,653.2</td>
<td>1,704.6</td>
<td>1,773.7</td>
<td>1,866.8</td>
<td>1,966.3</td>
</tr>
<tr>
<td>Jet/Kero</td>
<td>829.8</td>
<td>857.4</td>
<td>874.8</td>
<td>889.7</td>
<td>903.6</td>
<td>920.6</td>
</tr>
<tr>
<td>Jet</td>
<td>546.3</td>
<td>582.9</td>
<td>620.0</td>
<td>662.3</td>
<td>710.8</td>
<td>759.7</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>5,366.5</td>
<td>5,343.8</td>
<td>5,320.7</td>
<td>5,406.3</td>
<td>5,539.6</td>
<td>5,676.5</td>
</tr>
<tr>
<td>ADO</td>
<td>3,729.2</td>
<td>3,792.8</td>
<td>3,812.4</td>
<td>3,924.2</td>
<td>4,036.5</td>
<td>4,161.6</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>589.6</td>
<td>527.1</td>
<td>518.4</td>
<td>510.6</td>
<td>504.8</td>
<td>501.5</td>
</tr>
<tr>
<td>Others</td>
<td>1,547.7</td>
<td>1,607.4</td>
<td>1,638.6</td>
<td>1,674.1</td>
<td>1,714.5</td>
<td>1,756.8</td>
</tr>
<tr>
<td>Total</td>
<td>14,329.7</td>
<td>14,458.1</td>
<td>14,632.9</td>
<td>14,984.8</td>
<td>15,442.4</td>
<td>15,950.1</td>
</tr>
</tbody>
</table>

*Note: Developing Asia giants include China, India, and Indonesia. Source: APEC.

We expect jet to lead products in demand growth over the 2015–18 period, with a 6.4% growth on average. LPG demand growth will slow as subsidy reform takes hold in India and possibly Indonesia. We expect gasoline demand growth to expand its lead over diesel, with an average annual growth of 4.2% through 2018. The continued decline in general kerosene and gas oil demand has been reflected in the overall growth of less than 2% for each total product group.

Table 11. Developing Asian Giants Products Demand Growth Rate Forecast (in MBD)*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>4.5%</td>
<td>3.3%</td>
<td>3.2%</td>
<td>3.2%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>0.1%</td>
<td>1.9%</td>
<td>3.5%</td>
<td>4.2%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Naphtha</td>
<td>3.7%</td>
<td>3.1%</td>
<td>4.1%</td>
<td>5.2%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Jet/Kero</td>
<td>3.3%</td>
<td>2.0%</td>
<td>1.7%</td>
<td>1.6%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Jet</td>
<td>6.7%</td>
<td>6.4%</td>
<td>6.8%</td>
<td>7.3%</td>
<td>6.9%</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>-0.4%</td>
<td>-0.4%</td>
<td>1.6%</td>
<td>2.5%</td>
<td>2.5%</td>
</tr>
<tr>
<td>ADO</td>
<td>1.7%</td>
<td>0.5%</td>
<td>2.9%</td>
<td>2.9%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>-10.6%</td>
<td>-1.7%</td>
<td>-1.5%</td>
<td>-1.1%</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Others</td>
<td>3.9%</td>
<td>1.9%</td>
<td>2.2%</td>
<td>2.4%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Total</td>
<td>0.9%</td>
<td>1.2%</td>
<td>2.4%</td>
<td>3.1%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

*Note: Developing Asia Giants include China, India, and Indonesia. Source: APEC.

In the broader competition of light-ends products (LPG, gasoline, and naphtha) versus middle distillates (kerosene and gas oil/diesel), we expect light products in these three markets combined to finally outweigh mid-barrel products as a proportion of the demand barrel by 2016. Subsidy reform particularly cuts into middle distillate demand growth in 2016.
While light products will overtake mid-weight as the largest share of the demand barrel, middle distillates will still account for a healthy 41.3% of consumption by 2018. How quickly light ends will grow as a share of overall demand will depend on the pace and toughness of subsidy reform.

**China**

Table 13. China Products Demand Forecast (in MBD)

<table>
<thead>
<tr>
<th>Product</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>758.3</td>
<td>761.3</td>
<td>777.2</td>
<td>799.0</td>
<td>829.4</td>
<td>867.6</td>
</tr>
<tr>
<td>Gasoline</td>
<td>2,060.8</td>
<td>2,143.2</td>
<td>2,220.4</td>
<td>2,306.9</td>
<td>2,406.1</td>
<td>2,521.6</td>
</tr>
<tr>
<td>Naphtha</td>
<td>1,272.4</td>
<td>1,325.8</td>
<td>1,374.9</td>
<td>1,440.9</td>
<td>1,511.5</td>
<td>1,588.6</td>
</tr>
<tr>
<td>Jet/Kero</td>
<td>455.5</td>
<td>478.3</td>
<td>501.3</td>
<td>523.9</td>
<td>548.5</td>
<td>576.5</td>
</tr>
<tr>
<td>Jet</td>
<td>355.3</td>
<td>385.7</td>
<td>416.6</td>
<td>452.1</td>
<td>493.1</td>
<td>533.8</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>3,478.3</td>
<td>3,515.0</td>
<td>3,624.0</td>
<td>3,729.1</td>
<td>3,829.7</td>
<td>3,925.4</td>
</tr>
<tr>
<td>ADO</td>
<td>2,278.3</td>
<td>2,388.8</td>
<td>2,471.6</td>
<td>2,543.2</td>
<td>2,611.9</td>
<td>2,677.2</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>336.0</td>
<td>318.5</td>
<td>311.5</td>
<td>305.6</td>
<td>301.3</td>
<td>299.2</td>
</tr>
<tr>
<td>Others</td>
<td>1,367.0</td>
<td>1,427.0</td>
<td>1,452.7</td>
<td>1,481.7</td>
<td>1,514.3</td>
<td>1,547.6</td>
</tr>
<tr>
<td>Total</td>
<td>9,728.3</td>
<td>9,969.1</td>
<td>10,262.0</td>
<td>10,587.1</td>
<td>10,940.8</td>
<td>11,326.5</td>
</tr>
</tbody>
</table>

Source: APEC.

Continued LPG growth will come from petrochemicals. Average gasoline demand growth will be far higher than that of diesel, but in absolute volume terms, diesel will remain the top road fuel. General-quality kerosene and gas oil demand will continue to slide, but this will be obscured by rising jet and diesel consumption.
Table 14. China Products Demand Growth Rate Forecast (in MBD)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>0.4%</td>
<td>2.1%</td>
<td>2.8%</td>
<td>3.8%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>4.0%</td>
<td>3.6%</td>
<td>3.9%</td>
<td>4.3%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Naphtha</td>
<td>4.2%</td>
<td>3.7%</td>
<td>4.8%</td>
<td>4.9%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Jet/Kero</td>
<td>5.0%</td>
<td>4.8%</td>
<td>4.5%</td>
<td>4.7%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Jet</td>
<td>8.6%</td>
<td>8.0%</td>
<td>8.5%</td>
<td>9.1%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>1.1%</td>
<td>3.1%</td>
<td>2.9%</td>
<td>2.7%</td>
<td>2.6%</td>
</tr>
<tr>
<td>ADO</td>
<td>4.9%</td>
<td>3.5%</td>
<td>2.9%</td>
<td>2.7%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>-5.2%</td>
<td>-2.2%</td>
<td>-1.9%</td>
<td>-1.4%</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Others</td>
<td>4.4%</td>
<td>1.8%</td>
<td>2.0%</td>
<td>2.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Total</td>
<td>2.5%</td>
<td>2.9%</td>
<td>3.2%</td>
<td>3.3%</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

Source: APEC.

Total demand growth will fall to levels of less than 3%, which will greatly impact regional growth rates. LPG’s growth will be met in great part by imported material. We expect gasoline demand growth to be more than twice that of diesel by 2018. Despite a slowing of the expansion of Chinese base petrochemical capacity, we expect naphtha use to continue to rise steadily.

Table 15. China Light-Ends Vs. Middle Distillate Products Demand Forecast (in MBD)

<table>
<thead>
<tr>
<th>Product</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>4,091.5</td>
<td>4,230.3</td>
<td>4,372.5</td>
<td>4,546.8</td>
<td>4,747.0</td>
<td>4,977.8</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>3,933.8</td>
<td>3,993.3</td>
<td>4,125.3</td>
<td>4,253.0</td>
<td>4,378.2</td>
<td>4,501.9</td>
</tr>
<tr>
<td>Subtotal</td>
<td>8,025.3</td>
<td>8,223.6</td>
<td>8,497.8</td>
<td>8,799.8</td>
<td>9,125.2</td>
<td>9,479.7</td>
</tr>
<tr>
<td>% Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>3.4%</td>
<td>3.4%</td>
<td>4.0%</td>
<td>4.4%</td>
<td>4.9%</td>
<td></td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>1.5%</td>
<td>3.3%</td>
<td>3.1%</td>
<td>2.9%</td>
<td>2.8%</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>2.5%</td>
<td>3.3%</td>
<td>3.6%</td>
<td>3.7%</td>
<td>3.9%</td>
<td></td>
</tr>
<tr>
<td>% Share Total Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>42.1%</td>
<td>42.4%</td>
<td>42.6%</td>
<td>42.9%</td>
<td>43.4%</td>
<td>43.9%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>40.4%</td>
<td>40.1%</td>
<td>40.2%</td>
<td>40.2%</td>
<td>40.0%</td>
<td>39.7%</td>
</tr>
</tbody>
</table>

Source: APEC.

Already by 2013, light products made up a larger share of Chinese demand than middle distillates. The difference between the two should more than double by 2018.
Much depends on the timing of subsidy reforms. We have assumed that kerosene reform will occur before LPG, as the Indian middle class will fight for its share of cheap household fuel. Overall, we expect demand to slow down and to ever so slowly see the dominance of gas oil/diesel in the Indian demand barrel shrink.

**Table 17. India Products Demand Growth Rate Forecast (in MBD)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>13.8%</td>
<td>5.5%</td>
<td>4.0%</td>
<td>2.7%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>-2.6%</td>
<td>2.9%</td>
<td>2.3%</td>
<td>3.8%</td>
<td>4.9%</td>
</tr>
<tr>
<td>Naphtha</td>
<td>0.0%</td>
<td>0.5%</td>
<td>0.8%</td>
<td>8.0%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Jet/Kero</td>
<td>2.1%</td>
<td>-1.5%</td>
<td>-2.8%</td>
<td>-4.0%</td>
<td>-4.5%</td>
</tr>
<tr>
<td>Jet</td>
<td>3.3%</td>
<td>3.1%</td>
<td>3.9%</td>
<td>4.2%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>0.3%</td>
<td>-4.8%</td>
<td>-1.8%</td>
<td>1.9%</td>
<td>2.3%</td>
</tr>
<tr>
<td>ADO</td>
<td>-0.5%</td>
<td>-2.4%</td>
<td>3.0%</td>
<td>3.1%</td>
<td>4.1%</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>-22.6%</td>
<td>-0.6%</td>
<td>-1.1%</td>
<td>-0.9%</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Others</td>
<td>0.1%</td>
<td>3.8%</td>
<td>4.3%</td>
<td>4.5%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Total</td>
<td>0.8%</td>
<td>-0.8%</td>
<td>0.2%</td>
<td>2.3%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Source: APEC.

We expect demand for both general kerosene and general gas oil grade to fall in the immediate future, though diesel is expected to make a comeback by 2016–17. Only fuel oil demand is expected to consistently drop, though LPG consumption may be capped if the government refuses to pay for imports to meet demand.
Unlike China and Indonesia, India will still see a majority of its demand coming from middle distillates, though mid-barrel consumption should fall below 50% by 2016. Unlike China, India’s light-ends gains will see a rise in gasoline and naphtha demand offset to some extent by slower LPG growth.

Light products demand growth should steadily outpace middle distillate from 2014 to 2018, despite continued expansion of diesel consumption.

**Indonesia**

**Table 19. Indonesia Products Demand Forecast (in MBD)**

<table>
<thead>
<tr>
<th>Product</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>176.7</td>
<td>169.6</td>
<td>172.1</td>
<td>175.9</td>
<td>179.9</td>
<td>185.3</td>
</tr>
<tr>
<td>Gasoline</td>
<td>517.2</td>
<td>448.9</td>
<td>417.9</td>
<td>427.5</td>
<td>444.6</td>
<td>466.4</td>
</tr>
<tr>
<td>Naphtha</td>
<td>61.4</td>
<td>66.5</td>
<td>67.5</td>
<td>68.5</td>
<td>69.9</td>
<td>71.8</td>
</tr>
<tr>
<td>Jet/Kero</td>
<td>90.1</td>
<td>88.8</td>
<td>87.6</td>
<td>87.9</td>
<td>88.3</td>
<td>89.3</td>
</tr>
<tr>
<td>Jet</td>
<td>71.5</td>
<td>73.9</td>
<td>76.2</td>
<td>76.7</td>
<td>80.1</td>
<td>82.2</td>
</tr>
<tr>
<td>Gas Oil</td>
<td>498.0</td>
<td>434.0</td>
<td>368.9</td>
<td>373.3</td>
<td>381.2</td>
<td>391.8</td>
</tr>
<tr>
<td>ADO</td>
<td>329.0</td>
<td>288.0</td>
<td>252.0</td>
<td>259.6</td>
<td>268.7</td>
<td>281.5</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>61.0</td>
<td>59.5</td>
<td>58.7</td>
<td>58.4</td>
<td>58.2</td>
<td>58.0</td>
</tr>
<tr>
<td>Others</td>
<td>52.0</td>
<td>51.6</td>
<td>52.2</td>
<td>53.0</td>
<td>54.5</td>
<td>56.2</td>
</tr>
<tr>
<td>Total</td>
<td>1,456.4</td>
<td>1,318.9</td>
<td>1,224.9</td>
<td>1,244.5</td>
<td>1,276.6</td>
<td>1,318.8</td>
</tr>
</tbody>
</table>

Source: APEC.

We forecast a noticeable slowing of demand growth in the immediate future, with the pace of expansion picking up once again by 2017–18. Gasoline will remain the top product consumed, though demand will only match 2014 levels by 2017–18.
If LPG subsidy reform moves more quickly than anticipated, this will cut into future demand growth. While we expect diesel demand to expand faster than gasoline, gasoline will remain the top road fuel. Only fuel oil use will consistently fall through 2018.

Table 21. Indonesia Light-Ends Vs. Middle Distillate Products Demand Forecast (in MBD)

<table>
<thead>
<tr>
<th>Product</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Ends</td>
<td>755.3</td>
<td>685.0</td>
<td>657.5</td>
<td>671.9</td>
<td>694.4</td>
<td>723.5</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>588.1</td>
<td>522.8</td>
<td>456.5</td>
<td>461.2</td>
<td>469.5</td>
<td>481.1</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1,343.4</td>
<td>1,207.8</td>
<td>1,114.0</td>
<td>1,133.1</td>
<td>1,163.9</td>
<td>1,204.6</td>
</tr>
<tr>
<td>% Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>-9.3%</td>
<td>-4.0%</td>
<td>2.2%</td>
<td>3.3%</td>
<td>4.2%</td>
<td></td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>-11.1%</td>
<td>-12.7%</td>
<td>1.0%</td>
<td>1.8%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>-10.1%</td>
<td>-7.8%</td>
<td>1.7%</td>
<td>2.7%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>% Share Total Products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>51.9%</td>
<td>51.9%</td>
<td>53.7%</td>
<td>54.0%</td>
<td>54.4%</td>
<td>54.9%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>40.4%</td>
<td>39.6%</td>
<td>37.3%</td>
<td>37.1%</td>
<td>36.8%</td>
<td>36.5%</td>
</tr>
</tbody>
</table>

Source: APEC.

While analysts tend to think of Indonesia as a middle distillate market, it has been dominated by light products for quite some time. We expect expanding demand for jet and diesel will stabilize the mid-barrel share at 36.5% to 37.0% through 2018.
**Developing Asia Vs. West of Suez Regions**

Table 22. Developing Asia Giants Vs. US/OECD/Europe Products Demand Forecast (in MBD) *

<table>
<thead>
<tr>
<th>Region</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Asia Giants</td>
<td>14,329.7</td>
<td>14,458.1</td>
<td>14,632.9</td>
<td>14,984.8</td>
<td>15,442.4</td>
<td>15,950.1</td>
</tr>
<tr>
<td>US</td>
<td>18,961.0</td>
<td>19,035.0</td>
<td>19,516.0</td>
<td>19,826.0</td>
<td>19,891.0</td>
<td>19,871.0</td>
</tr>
<tr>
<td>OECD Europe</td>
<td>13,585.0</td>
<td>13,377.0</td>
<td>13,535.0</td>
<td>13,514.0</td>
<td>13,449.0</td>
<td>13,329.0</td>
</tr>
<tr>
<td>Total OECD</td>
<td>46,023.0</td>
<td>45,606.0</td>
<td>46,142.0</td>
<td>46,327.0</td>
<td>46,319.0</td>
<td>46,189.0</td>
</tr>
</tbody>
</table>

% Growth Rates

<table>
<thead>
<tr>
<th>Region</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Asia Giants</td>
<td>0.9%</td>
<td>1.2%</td>
<td>2.4%</td>
<td>3.1%</td>
<td>3.3%</td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>0.4%</td>
<td>2.5%</td>
<td>1.6%</td>
<td>0.3%</td>
<td>-0.1%</td>
<td></td>
</tr>
<tr>
<td>OECD Europe</td>
<td>-1.5%</td>
<td>1.2%</td>
<td>-0.2%</td>
<td>-0.5%</td>
<td>-0.9%</td>
<td></td>
</tr>
<tr>
<td>Total OECD</td>
<td>-0.9%</td>
<td>1.2%</td>
<td>0.4%</td>
<td>0.0%</td>
<td>-0.3%</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Developing Asia giants include China, India, and Indonesia.

Source: APEC.

In the end, growth is a function of need and price, and many elements can impact this.
Table 23. Developing Asian Giants Vs. US/OECD/Europe Light Ends Vs. Middle Distillate Demand Forecast (in MBD)

<table>
<thead>
<tr>
<th>Region</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (in MBD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing Asia Giants Subtotal</td>
<td>12,192.4</td>
<td>12,323.6</td>
<td>12,475.9</td>
<td>12,800.1</td>
<td>13,223.1</td>
<td>13,691.8</td>
</tr>
<tr>
<td>Light Ends</td>
<td>5,996.1</td>
<td>6,122.4</td>
<td>6,280.4</td>
<td>6,504.1</td>
<td>6,779.9</td>
<td>7,094.7</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>6,196.3</td>
<td>6,201.2</td>
<td>6,195.5</td>
<td>6,296.0</td>
<td>6,443.2</td>
<td>6,597.1</td>
</tr>
<tr>
<td>US Subtotal</td>
<td>16,820.0</td>
<td>16,998.0</td>
<td>17,727.0</td>
<td>18,604.0</td>
<td>18,977.0</td>
<td>19,324.0</td>
</tr>
<tr>
<td>Light Ends</td>
<td>11,553.0</td>
<td>11,509.0</td>
<td>12,174.0</td>
<td>12,945.0</td>
<td>13,264.0</td>
<td>13,625.0</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>5,267.0</td>
<td>5,489.0</td>
<td>5,535.0</td>
<td>5,659.0</td>
<td>5,713.0</td>
<td>5,699.0</td>
</tr>
<tr>
<td>OECD Europe Subtotal</td>
<td>11,301.0</td>
<td>11,288.0</td>
<td>11,613.0</td>
<td>11,706.0</td>
<td>11,719.0</td>
<td>11,642.0</td>
</tr>
<tr>
<td>Light Ends</td>
<td>4,117.0</td>
<td>4,147.0</td>
<td>4,150.0</td>
<td>4,133.0</td>
<td>4,077.0</td>
<td>3,964.0</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>7,184.0</td>
<td>7,141.0</td>
<td>7,463.0</td>
<td>5,573.0</td>
<td>5,742.0</td>
<td>7,678.0</td>
</tr>
<tr>
<td>Total OECD Subtotal</td>
<td>39,238.0</td>
<td>39,383.0</td>
<td>40,507.0</td>
<td>41,481.0</td>
<td>41,976.0</td>
<td>42,385.0</td>
</tr>
<tr>
<td>Light Ends</td>
<td>22,640.0</td>
<td>22,612.0</td>
<td>23,301.0</td>
<td>24,074.0</td>
<td>24,457.0</td>
<td>24,808.0</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>16,598.0</td>
<td>16,771.0</td>
<td>17,206.0</td>
<td>17,407.0</td>
<td>17,519.0</td>
<td>17,577.0</td>
</tr>
</tbody>
</table>

% Growth Rates

<table>
<thead>
<tr>
<th>Region</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Asia Giants Subtotal</td>
<td>1.1%</td>
<td>1.2%</td>
<td>2.6%</td>
<td>3.3%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>2.1%</td>
<td>2.6%</td>
<td>3.6%</td>
<td>4.2%</td>
<td>4.6%</td>
<td></td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>0.1%</td>
<td>-0.1%</td>
<td>1.6%</td>
<td>2.3%</td>
<td>2.4%</td>
<td></td>
</tr>
<tr>
<td>US Subtotal</td>
<td>1.1%</td>
<td>4.3%</td>
<td>4.9%</td>
<td>2.0%</td>
<td>1.8%</td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>-0.4%</td>
<td>5.8%</td>
<td>6.3%</td>
<td>2.5%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>4.2%</td>
<td>1.2%</td>
<td>1.9%</td>
<td>1.0%</td>
<td>-0.2%</td>
<td></td>
</tr>
<tr>
<td>OECD Europe Subtotal</td>
<td>-0.1%</td>
<td>2.9%</td>
<td>0.8%</td>
<td>0.1%</td>
<td>-0.7%</td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>0.7%</td>
<td>0.1%</td>
<td>-0.4%</td>
<td>-1.4%</td>
<td>-2.8%</td>
<td></td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>-0.6%</td>
<td>4.5%</td>
<td>1.5%</td>
<td>0.9%</td>
<td>0.5%</td>
<td></td>
</tr>
<tr>
<td>Total OECD Subtotal</td>
<td>0.4%</td>
<td>2.9%</td>
<td>2.4%</td>
<td>1.2%</td>
<td>1.0%</td>
<td></td>
</tr>
<tr>
<td>Light Ends</td>
<td>-0.1%</td>
<td>3.0%</td>
<td>3.3%</td>
<td>1.6%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>1.0%</td>
<td>2.6%</td>
<td>1.2%</td>
<td>0.6%</td>
<td>0.3%</td>
<td></td>
</tr>
</tbody>
</table>

% Share Total Products

<table>
<thead>
<tr>
<th>Region</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Asia Total</td>
<td>14,329.7</td>
<td>14,458.1</td>
<td>14,632.9</td>
<td>14,984.8</td>
<td>15,442.4</td>
<td>15,950.1</td>
</tr>
<tr>
<td>Light Ends</td>
<td>41.8%</td>
<td>42.3%</td>
<td>42.9%</td>
<td>43.4%</td>
<td>43.9%</td>
<td>44.5%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>43.2%</td>
<td>42.9%</td>
<td>42.3%</td>
<td>42.0%</td>
<td>41.7%</td>
<td>41.4%</td>
</tr>
<tr>
<td>US Total</td>
<td>18,961.0</td>
<td>19,035.0</td>
<td>19,516.0</td>
<td>19,826.0</td>
<td>19,891.0</td>
<td>19,871.0</td>
</tr>
<tr>
<td>Light Ends</td>
<td>60.9%</td>
<td>60.5%</td>
<td>62.4%</td>
<td>65.3%</td>
<td>66.7%</td>
<td>68.6%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>27.8%</td>
<td>28.8%</td>
<td>28.5%</td>
<td>28.5%</td>
<td>28.7%</td>
<td>28.7%</td>
</tr>
<tr>
<td>OECD Europe Total</td>
<td>13,585.0</td>
<td>13,377.0</td>
<td>13,535.0</td>
<td>13,514.0</td>
<td>13,449.0</td>
<td>13,329.0</td>
</tr>
<tr>
<td>Light Ends</td>
<td>30.3%</td>
<td>31.0%</td>
<td>30.7%</td>
<td>30.6%</td>
<td>30.3%</td>
<td>29.7%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>52.9%</td>
<td>53.4%</td>
<td>55.1%</td>
<td>56.0%</td>
<td>56.8%</td>
<td>57.6%</td>
</tr>
<tr>
<td>Total OECD Total</td>
<td>46,023.0</td>
<td>45,606.0</td>
<td>46,142.0</td>
<td>46,327.0</td>
<td>46,319.0</td>
<td>46,189.0</td>
</tr>
<tr>
<td>Light Ends</td>
<td>49.2%</td>
<td>49.6%</td>
<td>50.5%</td>
<td>52.0%</td>
<td>52.8%</td>
<td>53.7%</td>
</tr>
<tr>
<td>Middle Distillates</td>
<td>36.1%</td>
<td>36.8%</td>
<td>37.3%</td>
<td>37.6%</td>
<td>37.8%</td>
<td>38.1%</td>
</tr>
</tbody>
</table>

*Note: Developing Asian giants include China, India, and Indonesia.

Source: APEC.
2. COMPARISON OF GROWTH RATES IN OECD VS. NIC/NEAR NIC VS. DEVELOPING ASIA GIANTS

Transport

Gasoline/United States

Remarkably, the revival of gasoline demand growth in the United States occurred despite the handicaps of higher mandated minimum mileage on new vehicles, a tepid economic recovery, and only limited outlets for gasoline exports. It appears that low prices have spurred a demand response. More Americans are driving and much further than before.

If, as our base case forecast assumes, the price of oil globally will only recover to $60/BBL to $70/BBL by mid- to late 2016, the return of gasoline demand growth should become a permanent feature of American product balances in the medium term.

Gasoline exports remain dominated by Mexico and, to a far lesser extent, Brazil. Mexico’s purchases in 2014 accounted for nearly half of US sales abroad, while Brazil has purchased large volumes of US product despite an increasingly uncertain economic outlook. Sales of gasoline and diesel have grown in West Africa and smaller Latin American markets.

Diesel/Europe

Europe has begun to have second thoughts about its shift to diesel over the past two decades. Traditionally, Mediterranean members of the EU, i.e., southern European markets, favored diesel, while northern markets emphasized gasoline. A number of markets where gasoline traditionally dominated, notably Germany and the Netherlands, were impacted by relatively high taxes on gasoline compared to diesel and shifted to the latter. Meanwhile, the expansion of the EU eastward since 2000 added a mixed bag of markets generally oriented toward diesel.

The imposition of Euro 6,\textsuperscript{14} with its emphasis on reducing particulates pollution, may result in a shift back to gasoline use, or a de-dieselization of Europe, with this shift accelerating under the impact of the Volkswagen diesel scandal. Yet it is difficult to predict this as likely in our outlook in light of the great uncertainties overshadowing EU quality standards.

The relationship between the United States and the EU for many years relied on the sale of European gasoline and components to the United States, which in turn sold high-quality diesel for EU transport. Conversely, the increased competitiveness of US refiners could result in increased gasoline sales to the EU market. This reciprocal balancing of markets may well change, if Europe shifts back to gasoline use over diesel.

\textsuperscript{14} Euro 6 is the latest diesel engine emission legislation for the European Union (EU), limiting tail-pipe nitrogen oxide (NOX) emissions as well as particulate matter. It was implemented by January 2014 for all new vehicles.
Alternative Fuels—LPG, CNG, LNG, Biofuels, and Alternatives

The Obama administration made much ado in its initial years about its flexibility in charting the future of US transport fuels, with the favored phrase “All of the above.”

However, little concrete has actually been done since 2008 to broaden American consumers’ choices for land transport fuels. Taxes remained unchanged, penalizing diesel to favor gasoline use, and proposals to build national networks of LNG or CNG distribution for road fuel vanished without a trace. To evaluate their possible role in US transport fuel use in the next five years, we consider each fuel in detail below.

LPG: While hardly mentioned at all by green fuels advocates, LPG, both propane and butane, plays a major part in road transport in some OECD countries (Australia and Italy) and Asia Pacific NICs (South Korea and Singapore). It has the advantages of higher calorific value per volume unit than CNG, can be distributed without LNG’s high infrastructure costs, and has the additional virtue of helping to soak up the long propane supply that has emerged in the US shale revolution. China, India, and Indonesia use small volumes of LPG in transport, but we do not expect to see any significant gain in this sector by 2020.

CNG: This fuel suffers the handicaps of relatively limited mileage before necessary refueling, as well as high infrastructure costs for transport and distribution. It would most likely work best on primary US interstate highway routes running east to west (i.e., I-10 or I-80) or busy north/south coastal roads (like I-5 or I-95). It has the advantage of burning quite cleanly, and natural gas will likely be in structural oversupply for many years. However, capital investment, even if only along on select highways, would run into the tens of billions of dollars annually for decades. India has experimented with limited CNG-fueled vehicles in its densely populated cities, using it for mass transit systems, notably in New Delhi.

LNG: An alternative within the transport fuel scheme would be to supply LNG as a primary fuel for interstate highway traffic, using the emerging example of LNG sales for bunker. LNG is simply super-cooled natural gas, which is transformed from a gaseous state to a liquid. LNG has the substantial advantage of offering much more bang for buck over CNG—an LNG-fueled vehicle can travel far greater distances without refueling. But this comes at a cost—CNG is constrained by pressure, while LNG is constrained by temperature. It takes energy to keep LNG in a liquid state, and this additional infrastructure makes capital as well as operating costs for LNG far greater than that for CNG.

Biofuel/Ethanol: The Environmental Protection Agency (EPA) in 2014 wisely decided to delay mandating higher proportions of ethanol in gasoline blends, due to the technical and economic problems that would be caused by breaching the 10% blend wall. We believe ethanol will remain a part of the US gasoline pool, but that there will be little effort to expand its use. Ethanol has not been used in any of our Developing Asia markets.

Biofuels/Biodiesel: Oddly enough, although attention has been focused on ethanol and its impact on foodstuffs, biodiesel, which can be produced from vegetable oils, has garnered little support. This is rather surprising when one considers that the United States is the largest producer of both corn and soybeans, major sources of vegetable oil. Without government incentives, which we do
not anticipate emerging, biodiesel is unlikely to make any impact in the United States. However, it has already had some impact on Indonesian gas oil/diesel supply and demand.

**Petrochemicals**

The other sector that will be a primary source of light-ends demand growth will be petrochemicals. As in the transport sector, consumers will be faced with new feedstock choices with shale gas-derived NGLs making a substantial supply impact. The United States and China will be the focal points of increased petrochemical capacity.

**US Petrochemicals—the Big Base Buildout:** A total of 10 new ethylene crackers, mostly on the USGC, have been announced and most are expected to start up by 2018. If all are completed, this would add 12.5 MM MTA of ethylene production to US capacity. In addition, some 1.5 MM MTA of further debottlenecking is planned for existing olefin complexes. We do not believe that all of these proposals will conclude as finished projects, but if all were completed, this would boost US ethylene cracking capacity by more than half. This will constitute a tremendous call on potential petrochemical feedstocks.

**The Chinese Phenomenon:** Just as the US sector is undergoing a major expansion, China, which over the past decade has added an enormous amount of ethylene cracking capacity, is expected to see expansion slow down. While the petrochemical sector will add some new plants, central government planners have had growing concerns about overbuilding capacity. All projects in this sector, as well as in refining, are under review as Beijing balances the need to stimulate economic activity against a looming capacity overhang. We expect that Chinese ethylene cracking capacity will remain at 50% to 66% that of American plants, depending on which US projects are completed.

**Ethane Not For All:** Analysts have focused on ethane as the primary feedstock in base petrochemicals because of how much of it produced as a byproduct of shale gas development. There is no other feedstock that converts to ethylene at a higher efficiency than ethane. Yet this NGL is not the perfect solution—it is not the preferred feedstock to create propylene and it is unsuitable as a feedstock for aromatic petrochemicals. In reality, US ethylene crackers will use ethane as a primary olefin feedstock, but there will be considerable need for other feedstocks in base petrochemicals.

**Europe Revives?:** While many European producers look at the emerging expansion of US petrochemicals with trepidation, the more astute ones have been attempting to line up feedstock supply from US exporters. Some calculate that even in the medium term, US feedstock will make their operations more competitive.

**Feedstock Supply Long:** It should become obvious to sector analysts that petrochemical feedstock avail will outpace the ability of the United States to absorb incremental supply, even if all announced expansions will be completed. This is particularly evident in ethane, but it also will be the case for LPG, condensate, and perhaps even refinery naphtha, should US gasoline exports significantly slow.
3. WHAT PROSPECTS SHOULD US EXPORTERS WATCH FOR?

**Light Products Will Be Needed More than the Rest of Barrel**

Though short-term fluctuations in relative price, supply/demand balances, and even shipping rates can shift buyer interest quickly to any part of the barrel, we expect that, on average, buying interest in Asia Pacific will continue its steady migration from middle distillates to light-end products and NGLs. In 2012–14, demand growth in LPG, gasoline, and naphtha outpaced kerosene and gas oil/diesel in this region by nearly 2:1. Interestingly enough, LPG was often the product to make the greatest gains, despite the high capital and running costs of product special containment. While markets such as India and Indonesia heavily subsidize LPG sales, we expect that the reduction of retail subsidies will hit mid-barrel products harder than light ends.

**Light Products Include NGLs, from Ethane to Condensate**

NGLs still suffer from the unwanted child syndrome, as neither the gas side nor the oil side wants to recognize that gas liquids impact product balances—often decisively. The impact of NGLs on petrochemicals is generally acknowledged, but few analysts think much about the ways that condensate can shape gasoline production, or how ethane competes with naphtha as ethylene cracking feedstock, or of the impact of isobutane on alkylate availability. NGLs, as much as light refined products, must be considered together as a whole, making up the Light-Ends Space.

**Top-Quality Product Is Not Always the Best Seller**

A lack of market experience leads some to assume that top-quality product always gains top dollar. This is not always the case, as premiums erode for high-quality product when too many sellers are all focusing on a relatively small market segment. A careful refiner will consider whether manufacturing lower-quality outturn, say 0.01% (100 PPM) sulfur gasoline, rather than 0.001% (10 PPM) sulfur will provide a better margin.

**Identify and Target Specific Quality Niches, Such as Gasoline Without Additives**

The clever marketer sees sales opportunities that their competitor does not, though they are plainly in sight. In particular, the exporter will focus on differences in quality between US and foreign buyers. In the United States, Methyl tert-butyl ether (MTBE) is banned; that is not the case, however, in Asia Pacific or the Mideast Gulf. MTBE manufacture and export is a natural output from the shale revolution, which provides plentiful supplies of methane and butane, the basic feedstocks for this product.

**Don’t Get Ahead of Prevailing Product Specifications Unless Targeting a Specific Market**

Planning product quality in some ways is like readying for a wing shot when hunting. The hunter does not aim at the bird, but where he expects the bird to be. So there is a large amount of anticipation in creating the highest quality product, but refiners also have to exercise caution—
they do not want to get too far ahead of high-quality product needs. Even in focusing on a specific high-quality market, they carefully appraise their prospects versus competition.

**Use a Different Pricing Basis as a Wedge to Break into Traditional Mideast Markets**

One major attraction that US product and NGL exporters will have for Asia Pacific buyer is that the base of their sales contract will be (at least in part) rooted in North American price markers. This has been the case in natural gas (Henry Hub), NGLs (Mont Belvieu), or products (USGC FOB product assessments). This pricing factor will often be considerably different—due to the structural supply overhang in the US domestic market—than the traditional pricing set in the Mideast Gulf, Singapore, and Tokyo. It has been noticeable how quickly Mont Belvieu LPG prices became a part of term LPG contracts and how US condensate sales were marked not only off of Brent, the most commonly used crude marker, but also off WTI.

**Panama Canal Expansion Offers Lower-Cost Alternative to Cape of Good Hope Route**

The transport costs for all US light-ends exports from the USGC will decrease with the opening of an expanded Panama Canal. This will allow exporters to move cargoes west across the Pacific, rather than east through the Atlantic and Indian Oceans. The distance of the USGC-Japan route is about 20% greater than Qatar-Yokohama, but it will help to even up shipping costs. US sellers will always weigh the gains in economies of scale in shipping versus the greater difficulty of selling a large cargo in a single port discharge.

**Despite Permitting Complications, Additional Export Facilities on USWC Will Emerge, Cutting Voyage Time**

While it is difficult to predict with any certainty the permitting process on the US West Coast, we believe export facilities for NGLs, possibly joined by refineries’ excess light product avails, will begin to flow to Asian buyers by the coming decade. This, of course, will have considerably lower shipping costs than exports from the USGC.
Chapter 5. Product Quality Premiums

A. The Nature of Tightening Product Specifications: One-Directional, Progressively Cumulative, and Irreversible

The nature of product quality improvement is universal, whether in the Atlantic Basin or Asia Pacific. Tighter product specifications were first demanded in Western markets, and in recent years the EU has pushed ahead of the United States in demanding more stringent quality.

Asia Pacific, however, is catching up with the West and using European product standards as a loose model for the quality points they desire in oil products. A refiner would also argue that changes are always costlier as specifications are tightened. They are cumulative in that the regulations become ever more difficult to meet with traditional refinery operating techniques and irreversible because no market moves permanently to lower-quality fuel standards.

Spec tightening generally moves at a stage-by-stage pace through levels of quality standards. Gas oil/diesel sulfur ceilings generally moved from 0.1% (1,000 PPM) through various sulfur ceilings of 0.05% (500 PPM) and 0.01% (100 PPM) before reaching the virtually sulfurless quality standard of 0.001% (10 PPM). Every tightening of quality standards builds on previous standards; it is rare for a change of product quality to leap many steps ahead, though this has occurred in some Asia Pacific markets over the past two decades.

Improved quality standards are virtually irreversible. Neither the Asian Contagion Crash of 1998 nor the Great Recession of 2008–09 saw any permanent reversal of quality standards already implemented. A handful of minor changes, mainly for residual sulfur, were implemented and soon rescinded in both economic slowdowns. Once an improved quality standard is mandated, it is not reversed.

Some further product quality observations:

Eurospec Quality Standards: Until recently, Asian governments characterized their product specifications as equivalent to the quality standards mandated within the EU. The quality standards set in 2009 constitute Euro 5 specs; special regulation of gas oil/diesel particulates made up the new rules for Euro 6 quality, which were implemented in 2013–14. China, India, and other Asian markets often would claim Euro 3 or Euro 4 quality standards, when in fact the product in question only met part of the major quality requirements and often few of the secondary requirements. For example, diesel specifications in China might have met European levels of sulfur and minimum cetane value, but still allowed a different and heavier density range and set no restriction limits at all on PAH or particulates. China finally abandoned the charade and called their product specifications “National Standard,” making no pretense of matching up with Europe. Other markets though, continue the same game. A casual market observer should be made aware that even if an Asian refiner claimed Euro 6 standards for gasoline or Euro 6 for road diesel, all quality points should be confirmed to see that they match up.

Differing Rates of Change: Normally, quality improvement proceeds in a step-by-step, staged manner—sulfur levels are not cut from 0.1% (1,000 PPM) to 0.001% (10 PPM) in one swoop. Yet there are some periods when the rate of product spec tightening accelerates and other times
when it slows down. Generally speaking, as quality standards become fairly high—such as 100/50/10 PPM sulfur levels in gasoline—regulators move carefully and more slowly, as each further step in quality improvement has high capital costs and limits refiners’ ability to supply the domestic market.

**The Summer Olympics Factor:** Oddly enough, there is one factor in Asia Pacific that always accelerates the implementation of tighter product specifications—the Summer Olympics. This was true for a developed country with fairly high standards (Australia/Sydney 2000), a NIC just beginning to improve product quality (South Korea/Seoul 1988), and a Developing Asia giant (China/Beijing 2008), where the combination of national pride and concern over air quality for outdoor athletics gave new traction to rapidly tighten product specs. China has continued to tighten its product quality, particularly after two consecutive years of Beijing winter smog that bordered on a public health emergency.

**No Sulfur Sump Left?:** If residual bunker adopts a far lower sulfur ceiling for fuel oil use than for ships’ fuel, this will close off one of the last parts of the demand barrel by which refiners traditionally could *back out* their excess sulfur. Fuel oil in general acted as a sulfur sump for all of the impurity that had to be removed from light- and mid-weight products. But, as the sulfur ceiling for residual use in power generation and industry were lowered, increasingly it was fuel oil bunker that acted as a product grade that could absorb excess sulfur.

**Cost of Remaining in Business:** Finally, there is a decision that all refiners must make when facing new and tougher product quality: whether to invest in expensive quality improvement units or simply abandon the commercial activity. Refiners often call this *the cost of remaining in business.* Tightening product quality and related capital costs are only one factor; refinery size and the age of the plant also play a part in the final decision, but tightening product specs at times can be the catalyst for refinery closures.

**B. Product Premiums Yet to Justify High-Cost, High-Quality Investment—Why?**

1. **QUALITY AND REFINING**

Refining capacity in recent years has been growing in the United States, the Mideast Gulf, and Asia Pacific. It has been shrinking mainly in Europe. We expect this trend to continue through 2020.

Different factors have prompted expansion in each region. In the United States, expansion was spurred by the need to process an ever greater volume of light feedstock; in the Mideast and Asia Pacific, the need was to create more sophisticated refining and refineries.

A specific sub-class of refinery has emerged in East of Suez markets: the export-focused, quality-driven refining plant. Examples of this new refinery class include Reliance’s two refineries in Jamnagar, India; Aramco’s JV refineries in Jubail and Yanbu; and the UAE’s big expansion of ADNOC’s Al Ruwais plant. While other Asia Pacific refineries are large—SK Energy’s Pusan refinery has more than 800 MBD in base capacity—or fairly sophisticated, such
as Sinopec’s Zhenhai refinery, which has nearly 500 MBD in base capacity, these plants export regularly in large volume but do not specialize in high-quality product sales.

In some ways these new quality export refineries have taken over part of the role of Singapore, which has acted as the regional product balancing point as a supplier of special quality products as well as a consistent large-scale products exporter. Singapore in 2014 still exported enormous volumes of product and remains the premier blending point for the region, but Singaporean refining capacity overall can only be accounted as moderately complex. Reliance’s second Jamnagar plant can produce any level of product quality for any market worldwide in large volume without distorting its refining outturn. The newly commissioned Jubail (partner Total) and Yanbu (partner Sinopec) refineries reportedly have this same level of flexibility in outturn.

Singapore regularly turned a profit through operational efficiency, filling niche markets, and blending product to specific market needs—there was no extra emphasis on quality, per se. Sales to Bangladesh, East Africa, or Timor Leste were on par with high-quality markets, such as Australia, Japan, and South Korea. Yet the quality export refineries that were designed to earn money on the superior quality, whether in India or the Mideast Gulf, have had trouble placing their barrels in high-quality markets. This is partly because of sophisticated markets like Japan and South Korea being able to meet any quality level needed for domestic products; in part, it has been the slow, uneven recovery of demand in Western markets. Exporters like Reliance for a number of years have looked at all global markets for quality product export sales, but increasingly found tough competition from the US refiners, particularly in Northwest Europe and Latin America.

Finally, there is the cost of staying in business argument: As governments mandate better quality product, refiners have no choice but to invest in the additional refinery units to produce tighter spec outturn or shut down. In the short term, refiners can import product and blend to spec to meet new quality standards, but ultimately they must be able to produce better-quality outturn themselves. This has been why so many European refineries have been shutting down—they were generally too old and small to make further capital investment worthwhile. Refiners such as Total and ENI have shut a number of plants, converting them to product tank farms or biodiesel plants, with investment in quality improvement units restricted to a handful of larger, newer refineries.

2. Quality and Gas-to-Liquids (GTL) Plants

East of Suez has been home to most of the world’s operating GTL plants; Qatar alone runs 174 MBD in capacity. The Pearl plant (140 MBD nameplate capacity) has been operated by Shell; the smaller Oryx project, run by Sasol (34 MBD nameplate) started operations first.

From the start, both projects had planned to use the premium on the extremely high quality of their synthetic product to compensate for exceptionally high capital costs. Shell reportedly spent $18 billion to $19 billion to complete its plant—creating 121,000/BBL to 129,000/BBL of installed capacity. While higher than anticipated NGL production from the upstream segment of the project in the North Field provided Shell enough revenue to cover the cost overrun, this was very expensive new capacity compared to a grassroots refinery. Company executives admitted in
This is particularly interesting because of the two very different design/operating approaches the projects took. Pearl was meant to be a large-scale project capable of producing ultra high-quality naphtha, kerosene, and diesel, as well as specialty products, such as base oil for lubricants. Sales could be made in finished product or in high-quality blendstock and could use either local refinery outturn or the relatively nearby Shell refinery at Jubail, Saudi Arabia for blending. Marketing was meant to be flexible and cover a wide range of product and volume. Pearl has sold outturn both west and east, though most sales have been to Asia Pacific. Shell developed its own North Field tract and benefitted from upstream NGL output, unlike Oryx, which purchased gas from Qatar.

In contrast, the much smaller Oryx project has taken a focused approach, emphasizing a single product—diesel—and mainly sales to Europe. While there is an element of technical limitations in the divergent marketing, most of the difference has been due to differing marketing strategies. The plain fact remains for both projects that premiums had so far not justified capital costs.

**Figure 13. Abu Dhabi Term Naphtha Prices (in US$/Ton)**

![Graph showing Abu Dhabi Term Naphtha Prices](image)

Source: APEC.

**Tracking Quality Marker:** We have used Abu Dhabi’s Pentane Plus grade, a very light, sweet, and paraffinic condensate stripped from gas output, as representative of high-quality paraffinic naphtha, because petrochemical companies buy this grade as a top-quality ethylene cracker feedstock. Though technically a condensate, this material is sold as paraffinic naphtha, like Saudi

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15 According to private discussions between industry executives and APEC, 2013–14.
A-180. It was contrasted with ADNOC’s Low-Sulfur Naphtha, which is a medium-quality paraffinic naphtha also used by olefin plants.


**Worth the Export Effort?** Saudi Arabia used to sell its A-180 grade on a term basis, initially from two ports. Since 2013, sales have been conducted solely on a spot basis, i.e., on occasion. While merely speculation, we do wonder if disappointing premiums for very high-quality ethylene cracking material was the reason Aramco dropped term exports.
C. How Long Will It Take for Maturing Developing Asia Quality Standards to Catch Up with OECD and NIC Levels?

Table 24. Gasoline—Regular Grade, Sulfur, Aromatics, and Benzene

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<td>India (urban/rural) - 91 RON</td>
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<td>Sulfur %Wt.</td>
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<td>Indonesia - 88 RON (1)</td>
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<td>Singapore - 92 RON</td>
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<td>S. Korea - 91 RON</td>
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<td>Taiwan - 92 RON</td>
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Notes: (1) 88 RON grade will be replaced by 990 RON grade by 2018.
(2) Aromatics 45/42% volume should read as 45% volume max, with a pool average of 42% volume over six months.

Source: APEC; Industry.
Table 25. Road Diesel—Sulfur, Cetane, and Polyaromatics

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Notes: (1) Indonesia runs a two-tier road diesel system, with its “ADO” grade often used as general grade gas oil. (2) A minimum cetane index of 45 is mandated for specialized uses.

Source: APEC; Industry.

We have used only three quality points to track each of the major transport fuels, gasoline and road diesel. For gasoline, we selected based on sulfur, aromatic content, and the specific aromatic benzene, as mandated in the market’s regular grade gasoline. Sulfur is a general quality point for fuel cleanliness; benzene is the most important pollutant for the total aromatics allowed in a gasoline blend and gives some idea of the fuel’s impact on air quality. For diesel, we detailed only true road diesel, excluding all general grades of gas oil and used sulfur content, cetane value, and PAH as quality points, all important indicators of potential pollutants.

Some trends become rather noticeable in the timing of specification changes. In the 2004–14 timeframe, most spec changes occurred around 2006 and 2010. The timing for first changes was not remarkable—many Developing Asia, Near-NIC, and NICs were completing quality improvement moves that were initiated in the 1990s but were interrupted by the Asian Contagion recession of 1998. The 2010 improvements came only after the onset of the 2008–09 Great
Recession. While Asia Pacific bounced back far faster than Western markets, this still is puzzling, as economic downturns tend to delay changes in product quality. The moves to improve product quality in China, however, had more to do with growing public concern over urban smog, first highlighted by the 2008 Olympic Games.

At the beginning of the century, Japan had by far the highest quality standards for its products in the region. By 2014, NICs, such as South Korea, had caught up with Japanese standards or exceeded them, at least in some aspects. As a general rule, the quality gap between the four major groups, namely OECD, NIC, Near-NIC, and Developing Asia, had become smaller. For much of the 2004–14 period, little changed in Japan and Australia, the most advanced economies, while the other market groupings continued to tighten product specifications. And when China and India improve product quality, particularly for diesel, it has considerable impact across the region.

Other conditions shape the pace of tightening product specs. If gasoline sulfur levels in 2015 were examined, the range of variation between OECD, NIC, and near-NIC markets had narrowed to a minimum, with Malaysia allowing the highest sulfur levels (0.015%S, or 150 PPM) and South Korea and Japan permitting the lowest levels at 0.001%S (10 PPM). Singapore and Taiwan (0.005%S, or 50PPM), Australia (0.015%, or 150 PPM), and Thailand (0.015%, or 150 PPM) fell in between these two extremes. Since 10 PPM is a gasoline grade virtually free of sulfur, there is not too much sulfur drawdown that can be further accomplished in any of these markets.

The range, of course, is much greater in Developing Asia, even in the three country/markets we have examined and putting aside minimal-quality smaller markets, such as Pakistan and Vietnam. China has begun to build a quality lead over India in the past two to three years, and it is far ahead of Indonesia. It was also the first of the trio to require a 0.005% (50 PPM) sulfur ceiling in gasoline.

Just as economic downturns generally delay big changes in product quality, moves by a major market to a new quality standard tend to promote further changes in other markets. The oil industry is notable for its herd behavior, and while that explains a part of this phenomenon, other factors are at work, too. The most important is that common product specs promote trade and regional products balancing—it is easier to deal in a commonly consumed good if all concerned parties use roughly the same quality material.

In weighing how long it will take Asia to catch up with Western product quality standards, particularly Europe’s, one factor is important but unquantifiable—the desire of Asia’s growing middle class to have clear air and water, and their willingness to pay for the higher quality oil products that promote this. This fundamental shift in attitudes may accelerate spec tightening.

Europe has remained the pace setter on product quality, but attention has shifted to particulates, rather than the conventional measures of oil product quality. Efforts to improve oil product quality may be further stalled by political and social problems, as well as mass migration. Also, in the longer term, the EU must consider whether it intends to support oil refining as a strategic industry. Still, we expect minimal changes in the short-term to intermediate outlook.
Other factors also are at work to make improvements in quality more likely. When demand growth rates slow down naturally, due to a maturing economy rather than an economic downturn, governments often are more willing to push through new quality mandates. As Developing Asia moves toward near-NIC status, we can expect further spec tightening.

Finally, there is the giant US market, the largest single country/market worldwide and the largest volume user of gasoline. The last substantive measures to tighten oil product specs were nearly a decade ago. Oddly enough, considering the importance the Obama administration has placed on “carbon pollution,” it has done nothing to improve general oil product quality since 2008. As a result, US quality levels have fallen even further behind European standards. We expect US quality standards to continue to lag Europe for some time.

The base case outlook for Asia Pacific includes the following assumptions:

Asia Pacific will continue to lead world regions in demand growth, certainly through 2020 and likely through 2030, both in absolute volume and in percentage growth. That level of growth will be roughly half of what the world has come to expect as the norm for this region, i.e., roughly 3%, +/- 0.5%.

Developing Asia markets will continue to reduce and eventually eliminate retail product subsidies as economically unsound. The rate of subsidy removal will be faster if oil prices remain low. For political, social, and economic reasons, it is always easier to eliminate product subsidies when oil prices are low. Most analysts expect soft oil prices for some time.

Asia’s growing middle class and its political clout will impact the rate of spec tightening. In some country democracies, such as India and Indonesia, this is obvious. In other markets, such as China, while all political power resides with the Communist party, the government has at least partially taken on middle class concerns. The August 2015 explosion and fire, which dispersed large volumes of toxic petrochemicals across the port of Tianjin, refocused attention on the nation’s spotty record of environmental protection. Current spec tightening is “top-down,” but it has been prompted by growing clamor to clean up China’s massive cities.

Reducing and eventually eliminating product subsidies is one thing, but moving to the next logical step of freeing prices and letting markets determine prices is another, and a far bigger challenge. In the three Developing Asia markets—China, India, and Indonesia—all three systems have considerable and deep-set resistance to allowing market-dictated oil product prices. In fact, under current legal interpretation of the 2001 Omnibus Energy Law in Indonesia, market-set product prices are believed by many to be prohibited. We see India as the country most likely to move to market-based oil pricing, China remains half-decided on the issue, and Indonesia is the most resistant to free market principles.
Table 26. Catching up With Europe (Euro V and Euro VI specs across Asia Pacific)

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<tr>
<td>Japan</td>
<td>2020</td>
<td>2022+</td>
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<td>Australia</td>
<td>2021</td>
<td>2024+</td>
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Source: APEC; Industry.

D. What Marketing Parameters Should US Exporters Follow in Selling Products Based on Quality?

**By Product Type:** US exporters should focus on the light products and NGLs, though there will be times that middle distillates, or even residual, may well be profitable to sell abroad. For Asia Pacific, the future will be skewed even further toward light ends.

**By Sector:** We expect oil use in Asia Pacific will continue its decline in power generation and industry, further shifting demand to transportation and petrochemicals. Demand growth in transport fuels will be greater in gasoline than road diesel, though LPG will retain a small but noticeable market share. Petrochemical feedstocks tend to consist of light-end products, whether ethane, LPG, condensate, or naphtha. While some petrochemical companies have been moving in the opposite direction—ExxonMobil recently started up an ethylene cracker based on gas oil—we expect light ends to continue to dominate feedstock choices. Future US supply naturally fits these sectoral uses.

**By Growth Rate:** While slower demand growth in Developing Asia can be expected, there still will be a need to import light-end products, particularly in China. And import needs will not only be seen in Developing Asia markets, but also in Asia Pacific OECD, NIC, and Near-NIC markets as well. OECD markets, such as Australia, will be avid product importers, even if demand growth remains modest. Import-dependent petrochemical producers, such as Japan, South Korea, Taiwan, and Singapore, will often see feedstock import volumes balloon in a very brief period, even if their overall demand growth remains minimal. Most regional buyers, regardless of demand growth, prefer to broaden their suppliers for all products and NGLs.

**By Cargo Size:** While the expanded Panama Canal will give US exporters a less expensive transport option, there remains the delicate balancing between gaining economy of scale in using larger cargo size and market lumpiness in absorbing a large product cargo. Even cargoes at the
size of the 160,000 DWT, the new Panama Canal transit limit, would have only a limited number of Asian buyer outlets, including Japan, South Korea, China, and Singapore. A number of other markets, such as India or Thailand, likely would be difficult to penetrate, at least in part, because very large NGL or refined product cargoes of 80,000 DWT to 160,000 DWT or greater would be difficult for any one customer to utilize quickly.

**As Finished or Semi-Finished Product or as Components:** Sellers can vary the type of product they sell, from finished product to semi-finished product and even to gasoline components. Exporters would switch sales focus, depending on buyers’ needs and sellers’ profits. US exports could easily shift between finished product (such as gasoline) to semi-finished products (such as naphtha basestock), to components (such as reformate, alkylate, and isomerate). Reforming naphtha provides reformate; alkylate comes from isobutane and isomerate originates in butane. Selling gasoline components could be as profitable—and far less complex—as trying to meet the many different gasoline specs across Asia Pacific.

**By Shaping Condensate Quality:** Upstream and midstream companies can shape the physical traits of export-bound, slightly refined condensate by careful selection of field output, by adjusting cut points in stabilization/distillation, and by blending. A condensate blend could be oriented to produce either maximum naphtha, N+A naphtha for gasoline, or middle distillates. The point is to provide a premium feedstock best suited to buyer needs.
Chapter 6. Conclusions

Unblinking Realism: This study has emphasized the considerable gap between Western perceptions of Asia Pacific grounded in the past and the current reality of the world’s biggest oil-consuming region. In energy, Asia Pacific has gone from being virtually ignored pre-1990 to becoming a point of nearly obsessive focus, as can be attested by stock market gyrations of August 2015, based in part on the perception of a lower rate of oil demand growth in China.

Facts of Life/Lower Demand Growth: Many Western analysts have assumed that Asia would add up to 1 MMB/D p.a. in new demand every year, with China accounting for at least half of that. Their assumption of growth rates of 5+% as the norm has dominated barrel counting for the past 20 years. Yet it is obvious that the 2013–15 slowdown has not been a temporary glitch in the Chinese economy, but is instead symptomatic of structural shifts that are reshaping Developing Asia. Demand growth rates, we believe, will drop by roughly half by 2020, from the assumed norm of 5+% p.a. to an average of around 3% for the region.

Asia Pacific Epicenter Demand Growth: Even so, at this time there is no other world region that can take over Asia Pacific’s role as a demand pacesetter. Latin America and sub-Saharan Africa are often named as emerging markets that will replace Asia as demand leader. We believe it is possible that demand growth in either region may exceed Asia Pacific’s rate of expansion through 2020, but this conclusion ignores a sense of scale. India in 2014 used more oil than all of sub-Saharan Africa and Latin America (excluding Mexico) combined.

Moving to Light Ends: Asia Pacific was traditionally geared to middle distillate consumption. The major road transport fuel was diesel, not gasoline. Significant volumes of gas oil and kerosene were used outside of the transport sector, and gas oil and kerosene sales were often supported by high retail subsidies, encouraging demand growth. In recent years, however, light-ends product demand growth has regularly outpaced the mid-barrel. From 2012 to 2014, demand growth for LPG, gasoline, and naphtha was near 3%, almost 25% higher than the middle distillate growth rate of 2.3% during the 2012–14 period.

Impact of Subsidy Cutaway: Asia has been moving to cut back, if not abolish, many of the retail subsidies that promoted unnaturally high demand growth for decades. While both light and mid-barrel products have been subsidized in the past, we see a far greater impact on demand growth for middle distillate rather than light products. Reforms in India and Indonesia have been rapidly reshaping gas oil/diesel demand in 2015—we await the other shoe to drop, when China moves ahead to cut subsidies within its price-controlled system.

Moving to a Free Market? Though Developing Asia still aims to move toward a free market in energy, the question remains as to how fast cutting away retail subsidies will lead to this free market. The outlook varies by country and political system. In China, party leadership would rather tinker with its current system than undertake broad reform. In India and Indonesia, two different approaches have been seen. India has dismantled its subsidies system piece by piece, but it will take some time before it is completely abolished. Indonesia, realizing it could no longer afford to subsidize unnaturally high demand growth, moved swiftly to curtail subsidies, though some interpret the law as protecting non-market pricing.
**Tremendous Change Since 1990:** Just the fact that these three major Developing Asia markets have been discussing a move to free market pricing shows how much the region has changed over the past 25 years. It must be emphasized, however, that the development of Asia Pacific markets had not, and will not, match Western development lockstep. Even so, it is clear that a number of Asian economies finally have become sophisticated enough to move, as an overall direction, toward more light-ends demand and to greater use of transport fuels.

**Relative Scale:** The emergence of Developing Asia over the past generation has changed the dynamics of world demand beyond recognition. As the world’s second largest oil consumer, China made up roughly a third of Asia Pacific’s 2014 demand, and the entire region made up approximately a third of global oil demand. What happens in Asia Pacific impacts all markets.

**China Overcompensation?** After ignoring China for decades, Western analysts and traders have become obsessively focused on this market. China has made up a large part of the regional market now for many years and it has been a magnet for a wide range of commodities for much of that time, not only petroleum. But China is not Asia and Asia is not solely China. As a market, China has some characteristics atypical for Asia Pacific.

**Command to Market Economy:** China is unique among our Developing Asia detailed markets in one major sense—it is the only country still in transition from a full command economy to an eventual full market economy. The transition has not been easy, and the central government’s tendency had been to tinker with a floating price system rather than abandon it. Yet some products, such as LPG, have been liberalized and sell at free market prices. Beijing, however, in riding the directed price tiger, fears to get off and does not yet fully trust the market to fairly price the value of a major commodity.

**A Different Kind of Growth:** The forced growth of the past 25 years, directed from above, has been shifting to market-directed growth, emanating from forces below in society itself. The most obvious example has been in transport fuels: the ambition remains for most Chinese residents to own their car, despite attempts to curb vehicle ownership and urban use, and we believe this trend will only grow stronger this decade. Car ownership will continue to grow and almost all of it will be fueled by gasoline, not diesel.

**Lower Growth, Far Bigger Base:** China also provides a concrete example of what lower growth rates, based on far higher total demand, mean in real numbers. In 2015, China’s demand growth will likely be 3% on nearly 10 MMB/D, which would be a gain of 300 MBD. In 1990, to equal that in absolute volume, demand would have had to grow by more than 13% on a base of 2.2 MMB/D. In absolute volume terms, China, India, Indonesia, and the smaller markets of Developing Asia will still add large volumes of annual demand gains by 2020.

**India—Unleashing the Bazaar:** While the Modi government’s partial cutback of retail subsidies disappointed some, it should be noted that few markets have as high of a gas oil/diesel demand as India, and few countries have diesel so totally dominate road transport. Unlike earlier Congress Party governments, the Modi administration believes in free markets, and we expect considerable further oil sector reform. For decades, economists have wondered what growth rates
would result if the government would harness the ingenuity, financial resources, and profit instincts of the bazaar. We may well soon see what will happen, if the bazaar is fully harnessed in a free market.

**Change from Below, Not Above?:** India, like Indonesia, had to deal directly with public opinion or face the results in its next election. Cutting away retail subsidies will occur mostly when oil prices are low, and in some cases, the new market price for a product actually has been lower than the government-set price, including a retail subsidy. By and large, there has been considerable support for reform in both democracies. It should be noted that raising fuel prices in 1998 was one of the factors in the collapse of the Suharto administration.

**Under-Rated India Gets Little Respect:** We believe India will finally earn some recognition from international oil analysts as a parallel and distinctive driver of Developing Asian demand, separate from and at times counter-cyclical to China. It was remarkable in mid-2015 that Indian demand appeared robust and solid, in contrast to the increasing uncertainty weighing down the Chinese economy. Both countries are keys to Asian markets and indeed the world oil market, but now India, too, has gained some acknowledgement.

**Indonesia—Decisive Action Possible:** Traditionally, Indonesia has had a well-deserved reputation for extended indecision in undertaking any reform. Yet Jakarta has taken some of the boldest moves so far on reforming product subsidies. Far more needs to be done—in particular in reference to LPG subsidies—but the central government has shown that even in a volatile Developing Asia market, reform can take place.

**Seeking Balance:** Indonesian government planners hope subsidy reform will slow demand growth, much of which is met from product imports. While Jakarta is unlikely to regain its role as a major oil exporter, a move toward world price levels will also encourage upstream companies in this market, as they must offer 25% of their total production as a Domestic Market Obligation (DMO) to Indonesian buyers.

**When Free Market?** Eliminating retail subsidies is not exactly the same as introducing a fully free market for oil products. We expect the shift to a free oil product market will occur post-2020, with the timing most uncertain in China. Of course, it is always easier to deregulate when oil prices worldwide are relatively low.

**Catching Up:** Most evident in China and least apparent in Indonesia, Developing Asia markets have begun to catch up with European quality standards, at least so far as the Euro 5 level of product specifications. The gap within the Asia Pacific region between Developing Asian and OECD markets also will erode. High-quality markets post-2020 may expand enough to consistently support solid quality premiums.

**A Trinity of Change:** Three drivers are forcing change in Asia Pacific: maturing economies in Developing Asia underpin a shift to lower regional demand growth; the emphasis in the demand barrel has shifted from middle distillates to light-ends product; and the move to reduce and then eliminate retail subsidies. This shift to light products will be accelerated by the stripping away of retail product subsidies, which have traditionally focused on the mid barrel. While we expect that
Asia Pacific will continue to lead global oil demand, these parallel trends will change the face of this regional market by 2020.

**Emerging Yin/Yang:** US exporters must take advantage of the opportunities these changes offer. The United States, as a result of the shale revolution, will remain in a supply overhang in the long term. Similarly, Asia will remain import-dependent for oil products, NGLs, gas, and crude—and has demonstrated interest in reducing its traditional dependence on Mideast supply. A natural relationship of opposing but complimentary forces is emerging, with the United States, at very minimum, serving as a supply counterweight to the Mideast. And since Asia Pacific’s needs are increasingly for light products and NGLs, US sellers are in a strong position as suppliers.

**The US Challenge:** For the foreseeable future, world demand growth will be focused on Asia. Barring a major change in policy, US exports will consist of refined products, NGLs, and gas. Mideast Gulf exporters are currently the predominant suppliers of all three items to Asia. We believe, however, in the second half of this decade, these sellers will have to face a US export challenge.