APERC Oil Report 2018

March 2018

APERC

Asia Pacific Energy Research Centre

PUBLISHED BY:
Asia Pacific Energy Research Centre (APERC)
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ISBN xxxxxxxxxxxxxx
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Foreword

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XXXX 2018

Acknowledgements

We are grateful for the full support and insightful advice of Mr. James M. Kendell, Vice President of APERC, and Dr. Kazutomo Irie, General Manager of APERC. We also wish to thank the administrative staff of APERC and IEEJ as this study could not have been completed without their assistance.

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Abbreviation and Acronyms

Abbreviation

GW	gigawatts
kWh	kilo-Watt hour
Mtoe	million tonnes of oil equivalent
Mt	million tonnes
USD	US Dollar

Acronyms

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
CCS	carbon capture and storage
EIA	Energy Information Administration, USA
ESTO	Energy Statistic and Training Office, APERC
EU	European Union
GDP	gross domestic product
IEA	International Energy Agency
IEEJ	Institute of Energy Economics Japan
NBS	National Bureau of Statistics, China
UN Comtrade	United Nations Commodity Trade Statistics Database
USA	United States of America
USC	ultra-super critical
USGS	United States Geological Survey
WSA	World Steel Association

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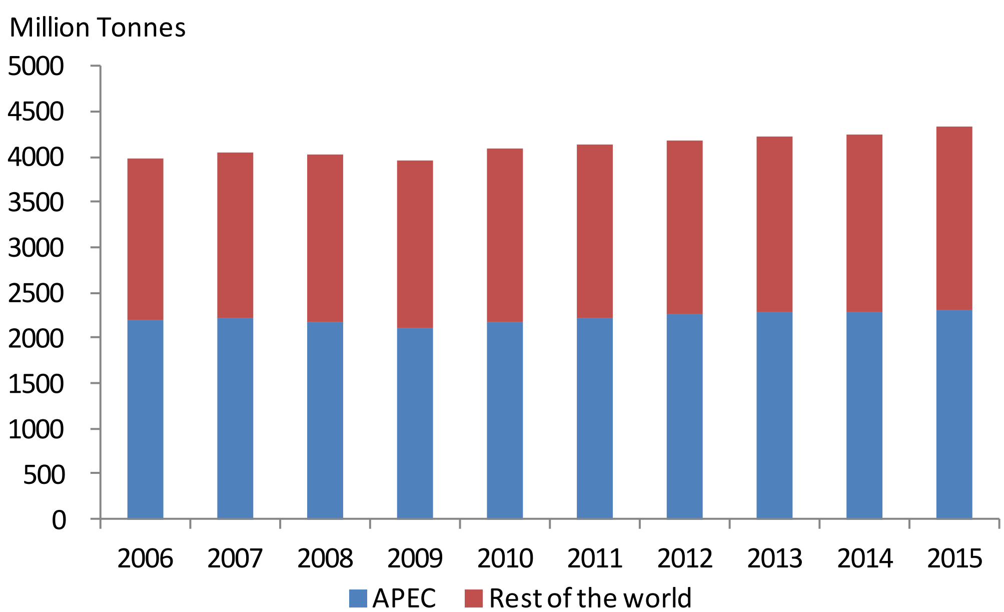
Summary and key trends

Section 1: Demand

Global context

Global oil consumption has been growing 0.9% per annum since 2006, and reached 4,341 million tonnes in 2015 (Figure 1.1). The APEC region accounted for 53% of the world total in 2015. The growth in the region for the past 10 years was 0.5%, which was lower than the rest of the world at 1.3%. This was mainly due to the demand decrease in the US and Japan.

Figure 1.1: APEC and global oil demand, 2006-2015



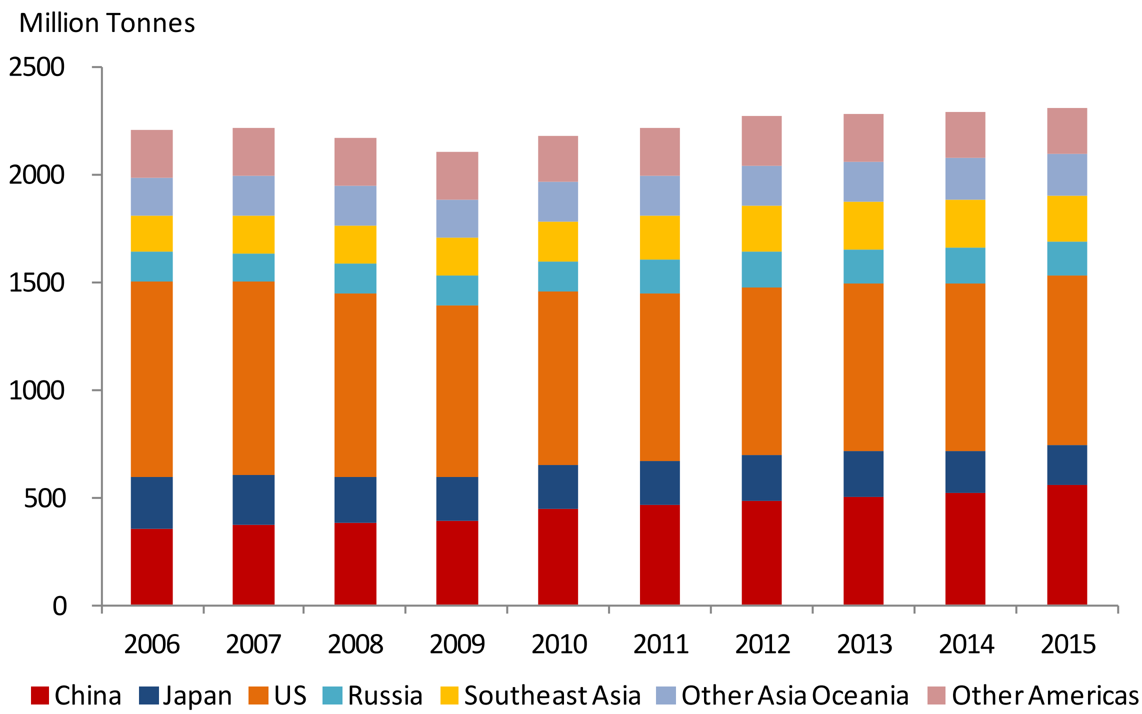
Source: APEC (2017), BP (2017)

Demand trend in APEC

Within the APEC region, the US was by far the largest oil consuming economy with 794 million tonnes in 2015 or 34% of the APEC total (Figure 1.2). The US was followed by China with 535 million tonnes in 2015. These two economies accounted for as much as 58% of the APEC total. With a growth rate of 4.5% per annum from 2006 through 2015, China was the fastest growing oil consumer in the region, too. Southeast Asia was another region with solid growth as demand increased by 2.4% per annum since 2006 to reach 215 million tonnes in 2015. On the other hand, Japan, the third largest consuming economy, was consuming less and less over the past 10 years. Its demand in 2015 was 187 million tonnes after a decrease of 2.4% per annum for the same period. Similarly, the US demand decreased by 1.4% per annum from 914 million tonnes in 2006 to 794 million tonnes in 2015. Russia and other Asia Oceania (Republic of Korea, Chinese Taipei, Papua

New Guinea, Australia, and New Zealand) show relatively solid demand growth, 1.6% and 1.1% since 2006 per annum, respectively. Demand in Other Americas, namely Canada, Mexico, Chile, and Peru, has been stable with around 220 million tonnes.

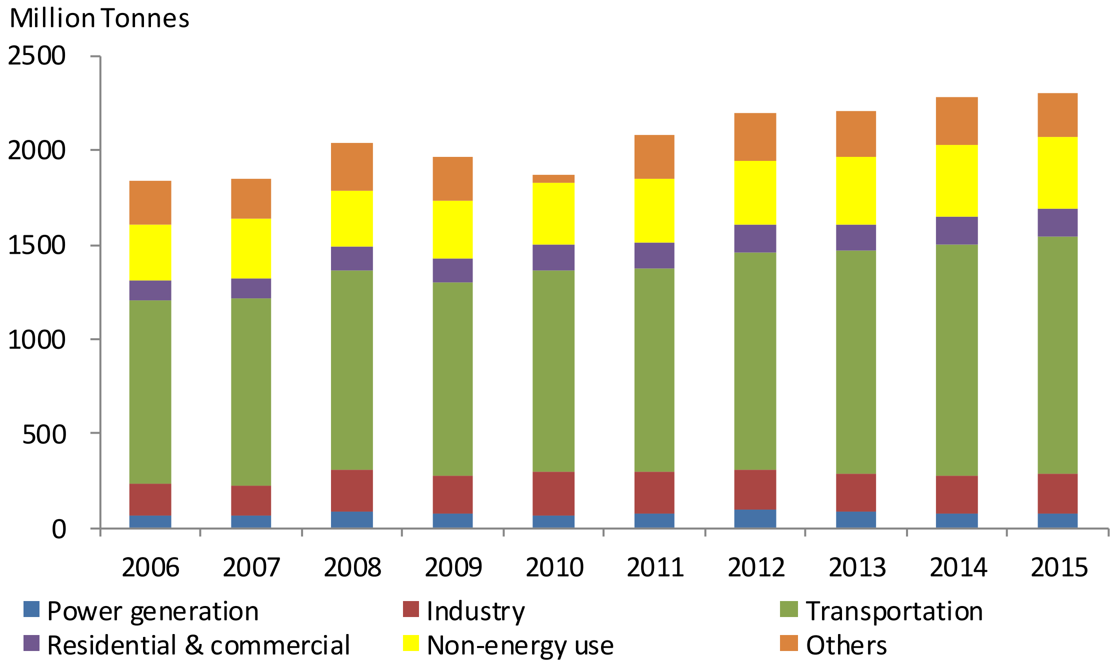
Figure 1.2: Oil demand in APEC, 2006-2015



Note: Other Asia Oceania = Republic of Korea, Taiwan, Papua New Guinea, Australia, and New Zealand
Source: APEC (2017), BP (2017).

Figure 1.3 represents APEC' oil demand by sector since 2006. It is clear that transportation is both the dominant and growing sector. The demand in transportation has increased 2.6% per annum and reached 1251 million tonnes in 2015, 54% of the total oil demand in the APEC region. Non-energy use, mainly feedstock for petrochemicals, is the second largest demand sector with 385 million tonnes. Backed by strong demand of petrochemical products, oil use for non-energy has increased by 2.5% per annum. The industry and residential sectors also show solid demand growth of 2.8% and 3.7% per annum, respectively, mainly because of healthy GDP growth as well as diffusion of modern energy in the residential sector such as LPG for cooking fuel.

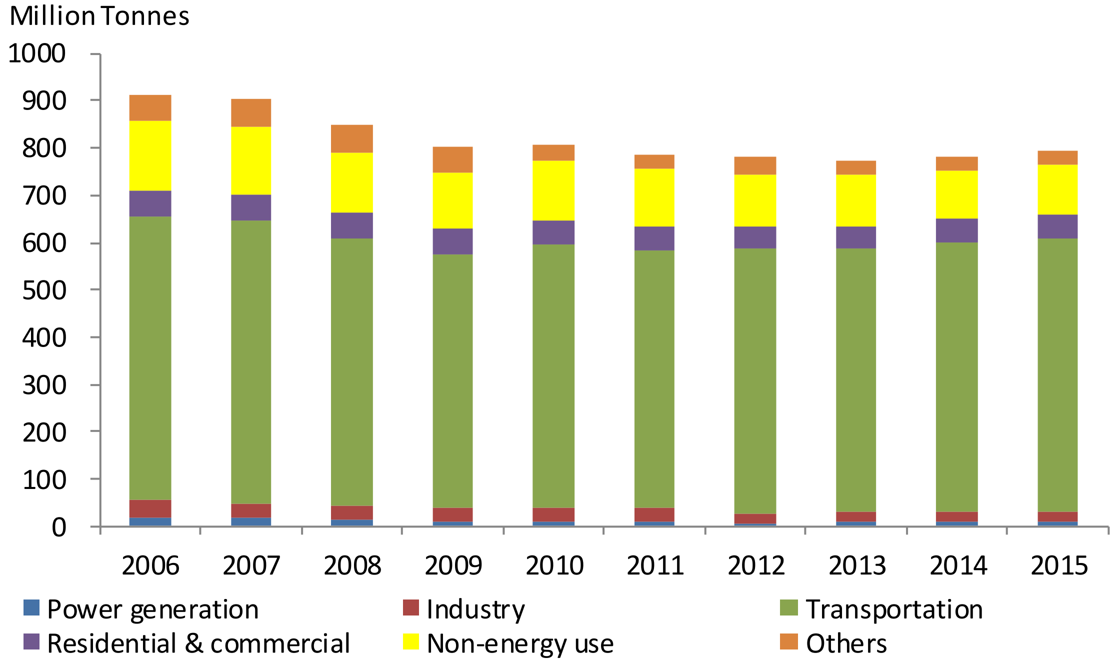
Figure 1.3: Oil demand in APEC by sector, 2006-2015



Source: APEC (2017).

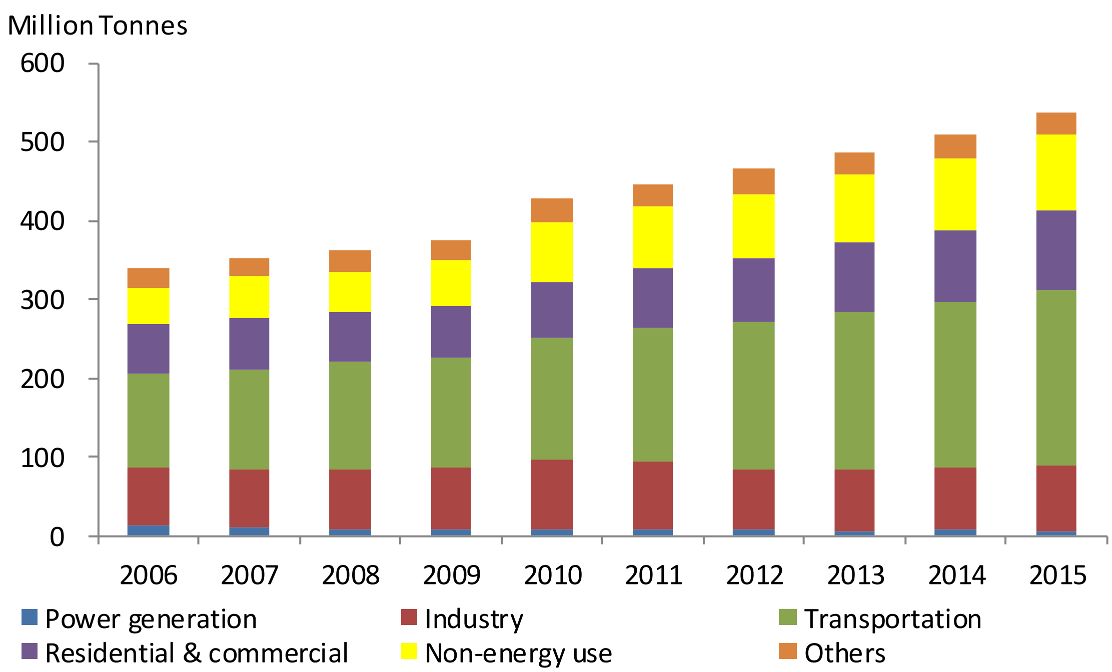
The largest two consuming economies, the US and China, warrant further analysis. US demand is not growing while China is the growth engine not only in the APEC region but at the global level. The US is very much a transportation-, or gasoline-, oriented market (Figure 1.4). China is more diversified in terms of demand sectors (Figure 1.5). Infrastructure development, diffusion of oil products in the residential sector, and rapid expansion of petrochemical plants explain the relatively strong growth in other sectors in China. Additionally, that building-up strategic reserved could have resulted in demand growth, although it is not clear to what extent due to data unavailability.

Figure 1.4: Oil demand in the US by sector, 2006-2015



Source: APEC (2017).

Figure 1.5: Oil demand in China by sector, 2006-2015

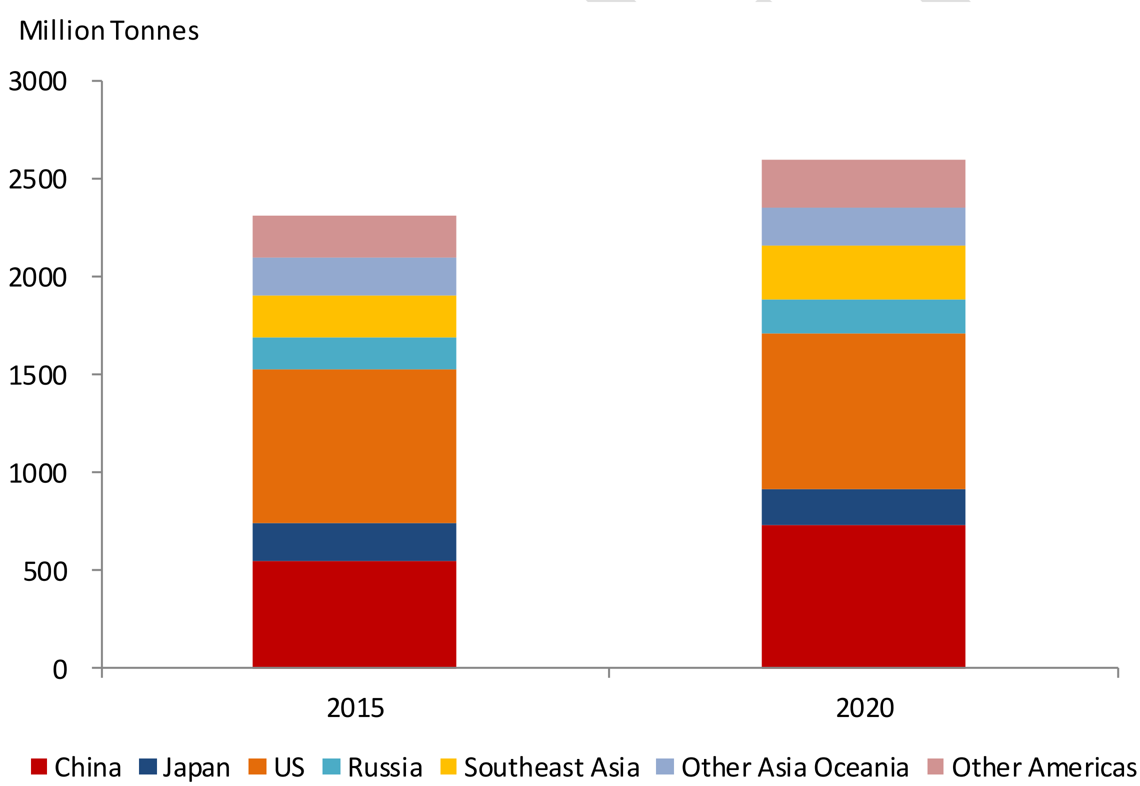


Source: APEC (2017).

Demand outlook

Oil demand in the APEC region is forecasted to increase by 2.4% per annum to reach 2,605 million tonnes in 2020. The largest growth will happen in China, where the demand will increase by as much as 5.7% per annum from 2015 to 2020. South East Asia is another growth engine in oil demand in APEC region, where the growth rate will be 5.2% for the same period. On the other hand, the demand in Japan is likely to decline by 0.7% per annum for the same period. Demand in other regions will increase, albeit relatively modestly. As a result, the share of China and Southeast Asia demand in the APEC region will expand from 25% and 10% in 2015 to 32% and 12% in 2020, respectively. It is clear therefore that the share of APEC oil demand will shift more to Asia in the coming years.

Figure 1.6: Oil Demand Outlook in APEC



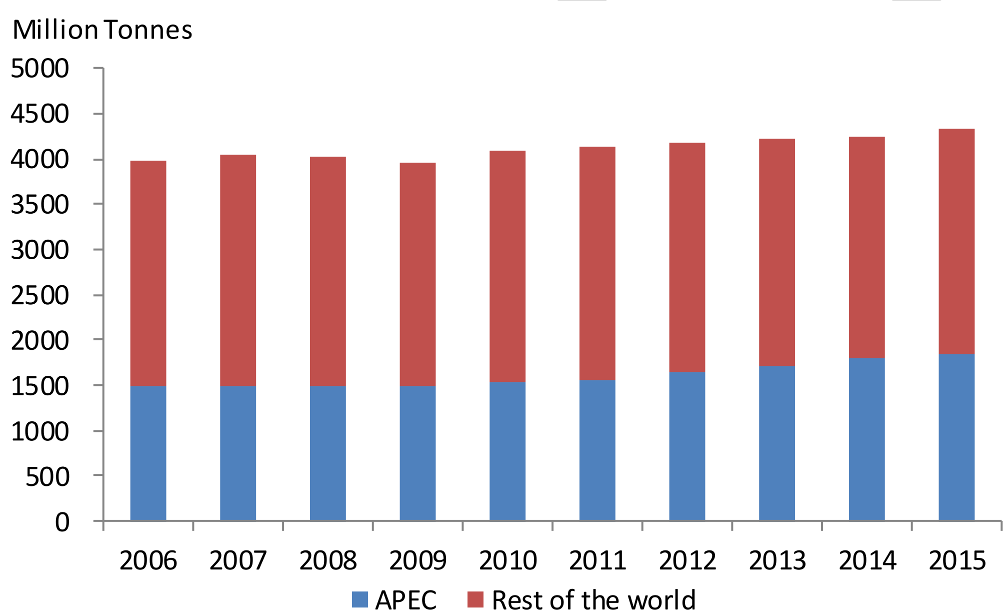
Source: APEC (2016).

Section 2: Supply

Global context

With an annual growth rate of 1.0%, global oil supply has been growing faster than demand since 2006. The total supply in 2015 was 4,359 million tonnes, of which the APEC region including the largest producing economies like the US and Russia, accounts for 53%. Within the APEC region, Indonesia was once an OPEC member economy, but it suspended its membership in 2016. 74% of the APEC growth between 2006 and 2015 is achieved by the US, particularly through shale oil expansion which will be discussed further in section 5.

Figure 2.1: APEC and global oil production, 2006-2015

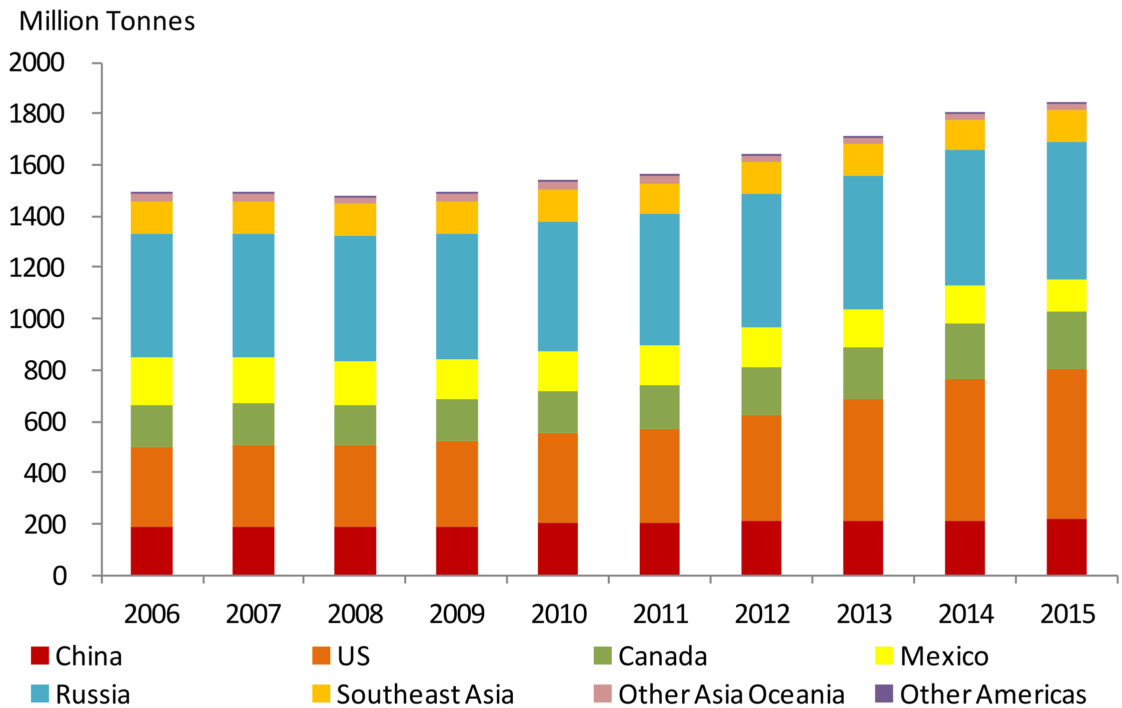


Source: APEC (2017).

Supply trend in APEC

Within the APEC region, the US and Russia are the largest producing economies with 582 and 536 million tonnes in 2015, respectively. These two economies share as much as 61% of the APEC region annual total. This is followed by Canada and China with 226 and 217 million tonnes in 2015. In terms of supply growth, the US is by far the largest with an annual rate of 6.2% from 2006 to 2015. The incremental production increase in the US since 2006 was 264 million tonnes, which is greater than the total production of Canada or China. Other regions and economies generally show declining trends. In 2015 Mexico, another major producing economy, produced 60 million tonnes less than it did in 2006. Southeast Asia and Other Asia Oceania have also declined slightly.

Figure 2.2: Oil production in APEC region, 2006-2015

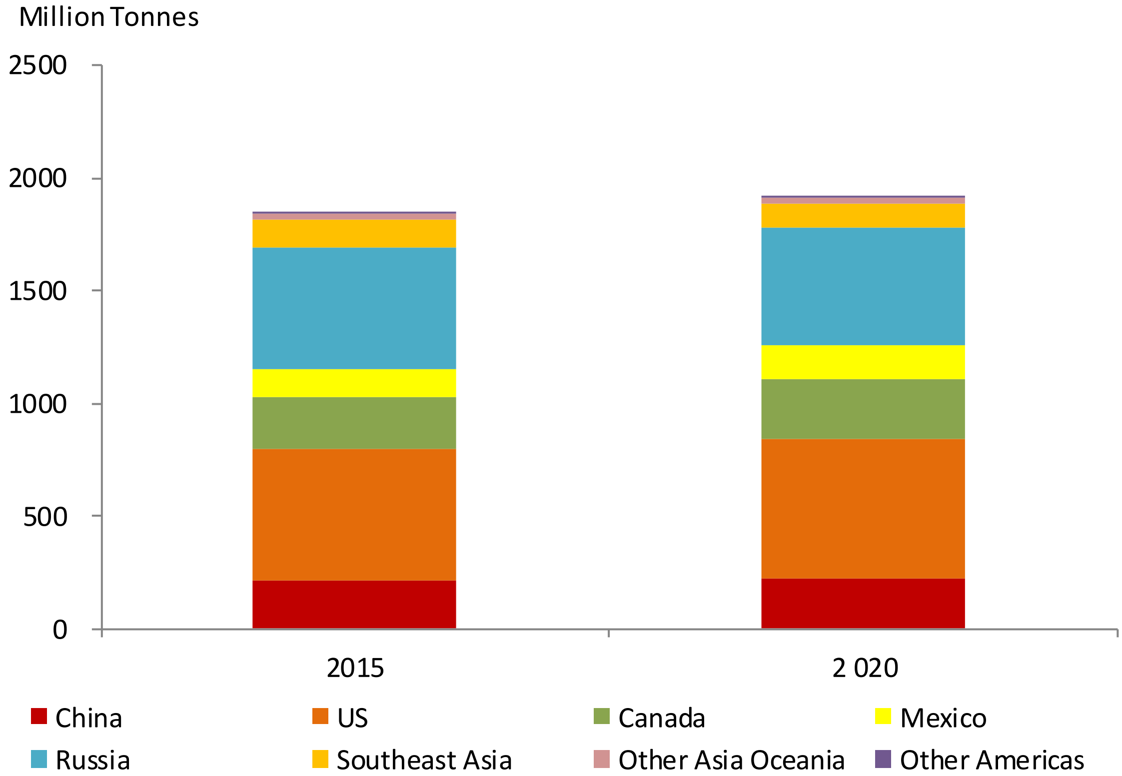


Source: APEC (2017).

Supply Outlook

Oil supply growth in the APEC region is likely to struggle to keep up with demand growth. Supply is forecasted to increase by 0.4% per annum to reach 1,926 million tonnes in 2020, while the growth rate of demand is 1.7% for the same period. Most of the supply growth will come from North America where the development of unconventional oil in the region will push up production by 97 million tonnes from 2015 to 2020. However, in 2017, companies like Statoil, Shell, and ConocoPhilips divested their oil sand assets in Canada. To what extent these divestments affect future oil sand production in the country will remain to be seen. Meanwhile, Russia, Southeast Asia, and Other Asia will show a decline of 34 million tonnes altogether for the same period. Therefore, unlike demand, the supply center in APEC region will shift to North America in the future.

Figure 2.3: Oil production in APEC region



Source: APEC (2016)

Section 3: International Trade

Selected factors that influence international oil trade are discussed in this chapter. The discussion is separated into supply, demand, supply and distribution infrastructure, market movement and environmental issues.

The key factor in supply is the impact of US tight oil development on trade while on the demand side, this chapter will discuss the impact of refining capacity in Asia and the Middle East. The impact on trade from the construction of US-Canada and China-Central Asia oil pipelines is discussed in the Supply and Distribution Infrastructure section. In market movement, this chapter will discuss the future oil price and in environmental issues, the difference among motor gasoline specifications that restrict oil trade and International Maritime Organization's 2020 sulfur quality standards are discussed.

Other indirectly influencing factors are not included for discussion in this chapter, e.g., oil inventory, upstream spare capacity, the weakening dollar, investment trends in the oil business, risks in the oil trade, etc.

Supply

Impact of Tight Oil on Future Trade

As US tight oil production increases, trade will react to the fact that the US is becoming less crude oil import dependent. The breakeven production cost of tight oil has dropped significantly over the years (by 30-40% vs 10-12% for other oil projects) to the range of US$ 39-48/barrel (July 13, 2016),[1] which increases its potential to be more competitive with conventional crude oil. Tight oil production has already reached 4.3 million barrels per day (MBD) in 2016, an equivalent of 48% of the total US production.[2] It is forecasted that the US will boost its tight oil production further to the level of 4.6 MBD in 2020.

As a result, the US is getting closer to become a net crude oil exporter instead of a net crude oil importer, most likely within a decade. A subsection at the end of this chapter will specifically discuss how APEC import dependence on crude oil and oil products changes.

Demand

Refining Capacity Addition in SEA and ME

Significant growth in new refining capacity has been observed in South East Asia (SEA) and Middle East (ME) to catch up with surging demand. With SEA striving to be energy self-sufficient using its own production capabilities instead of depending on imports, the total SEA economies plan to add a combined 1,400 thousand barrels per day (KBD) between now and 2022. The Middle East is moving to replace its crude oil exports with higher-value finished-product exports to be produced from existing and additional 2,600 KBD refining capacity installed between now and 2022.[7] Key players like China and India also plans to install another 400 KBD by 2019 and 800 KBD in 2021, respectively, which will result in Asia having spare capacity of up to 5,300 KBD. It is expected that trade will significantly increase along with these new capacities.

Supply and Distribution Infrastructure

Keystone XL and Other US-Canada Pipelines

With the possible installation of US-Canada pipelines (Keystone XL from Alberta to Nebraska[3] and other pipelines such as Dakota Access from North Dakota to the Patoka, Illinois, storage hub,[4] Trans-mountain pipeline from Alberta to British Columbia[5] and Enbridge Line 3 connecting Alberta and Manitoba to North Dakota and Wisconsin in the US),[6] a surge in oil trade is expected to take place along the US-Canada border. More frequent oil movements imply that supply within North America is becoming more self-sufficient instead of relying on supply from the Middle East and others. The US-Canada pipelines are expected to create jobs and benefits for both economies but the project justifications are based on environmental, national security and foreign policy implications. The used-to-be-traded quantities to the US will need to find a new home when these pipeline installation projects are completed.

China-Central Asia Oil Pipeline Installation

Another oil supply development can be seen from China's strategy to install the China-Central Asia oil pipeline in order to strengthen its energy security through the diversification of itsoil import routes. The advantage of this very long and expensive pipeline is in the connectivity of Central Asia to the rest of APEC. Geopolitically, Central Asia is very important due to its strategic location. Central Asia with its potentially abundant resources of both oil and gas can conveniently connect with many economies in the region including Russia, Iran, Turkey, and Afghanistan.

Market Movement

Impact of Oil Price on Trade

The oil price has fallen for the past three years driven mainly by the increased supply of unconventional oil in addition to surplus conventional oil and diminishing oil demand from the slowdown of economic growth especially in China and Europe. Moreover, instead of trying to intervene in the oil price drop, OPEC abandoned its policy of not cutting production (Nov 2016).

The drop in oil prices (from $90-100/barrel in 2014 to $50-55/barrel in 2017) has caused oil demand to rise in many economies but hasn't boosted economic activity as much as expected. It is noticeable that the re-balancing of oil supply-demand has shifted the focus of the international oil market from oil exporting economies (OPEC, Russia, etc.) to oil importing economies (China, India, Japan, EU, etc.).

Environmental Issues

Gasoline and Gas Oil Trade Restriction

Gasoline and gas oil trade may be hampered by the differences in their quality specifications. It is unavoidable that many different quality standards especially in gasoline and gas oil have been adopted, utilized and traded in APEC economies, e.g., EURO III, EURO IV, EURO V and etc. The vast differences of qualities among these grades have considerably limited trade among APEC economies. The challenge ahead is whether APEC should harmonize its oil specifications to optimize APEC oil trade, alleviate environmental emissions and reduce oil movement and its logistics costs or whether APEC should replace these gasoline- and diesel-powered cars with the electric vehicles.[8,9]

Impact of IMO's 2020 Global Sulfur Cap on Trade

New tanker regulations to limit sulphur content (from 3.5% to 0.5%) on marine fuels to be enforced in 2020 present a new factor in fuel oil prices. Although low sulphur fuel oil (LSFO) can be produced several ways(e.g., cracking fuel oil (FO) to gasoil (GO), changing to run sweeter crude and deep desulfurization of FO), all of these choices lead to higher costs of production. It is estimated that there will be a $30/mt premium for a 0.5% blend over the standard 3.5% FO.[10] These impacts are expected to be borne by refiners, crude producers, shipowners and bunker suppliers. There will be a change in trade flows as regional disparities in compliant bunker fuel output are expected. It is also expected that the new and planned refinery upgrades in the Middle East are expected to lead to a surplus of compliant fuel oil, while North America, Africa and Asia-Pacific are expected to be in deficit.

APEC Import Dependency[1]

Crude and Product Import Dependency

APEC's total crude and products import dependence showed a declining trend over the years, from 34% (2005) to 23% (2015) (Figure 4). Dependence fell slowly during the early years (between 2005 and 2010) as APEC relied on crude imports and has declined much faster during 2010 and 2015. The total import dependency in this period dropped significantly at about 2.2% per year from 32% (2010) to 23% (2015). Both crude oil and product import dependencies fell by 6% (from 37% to 31%) (Figure 5) and by 3% (from -6% to -9%) (Figure 6), respectively.

APEC's move to lower import dependency mainly reflects the US move to crude self-sufficiency through shale oil development and production over recent years. The US, as a major crude oil consumer in APEC, imports crude and products at an equivalent of 30% and 14% of total APEC, respectively. Its total import dependency has come down by 21% in five years (from 61% (2010) to 40% (2015)). Crude oil import dependency is down from 64% to 42% and the product import dependency is down from -6% to -16%.

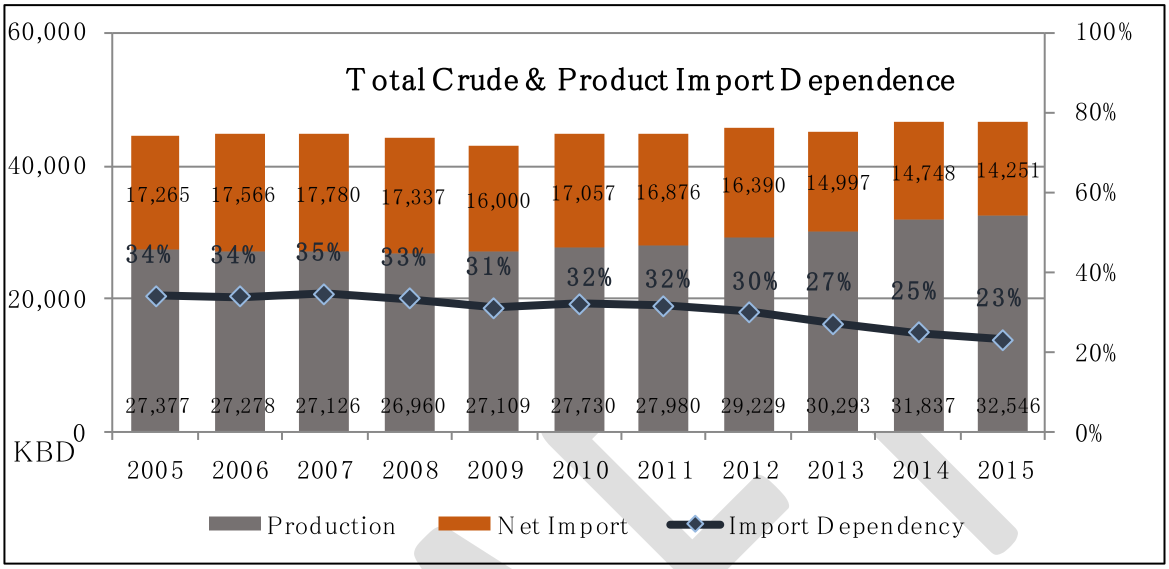
China, on the other hand, has become more crude import dependent over the years. For the past five years, crude oil import dependency had increased from 54% (2010) to 60% (2015) and so had the total (crude+product) import dependency. China's product dependency had not changed much and contributed very little to its total import dependency. While the US is bringing the total APEC import dependency down, China, which represented 26% of APEC crude consumption, is counteracting this to take the total APEC dependency up.

APEC, as a whole, is nevertheless getting closer to oil independence especially in the last few years during which the import dependency is declining at a very fast pace. This implies that reliance on raw material acquisition has been limited to a few economies.

It is expected that the APEC import dependency downtrend will continue in the next few years (Figures 7 and 8). It is very likely that the total APEC will be at either a low or medium import dependence level[11] and will eventually switch to be an export economy in the long run.

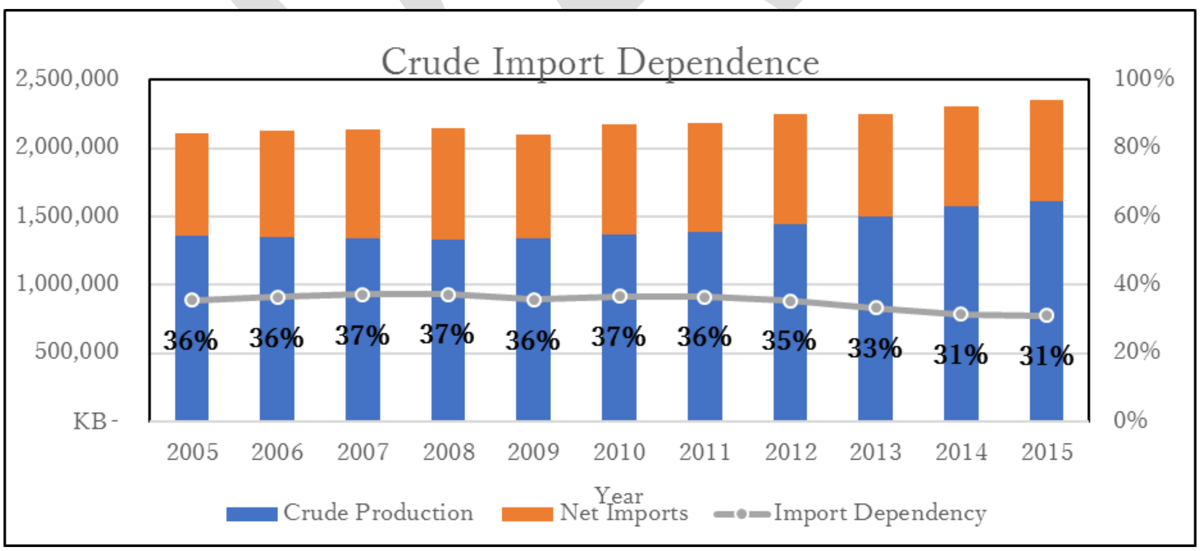
Footnote 1 import dependence = (net import + stock changes) / total supply

Figure 4. Total APEC Crude & Product Import Dependence



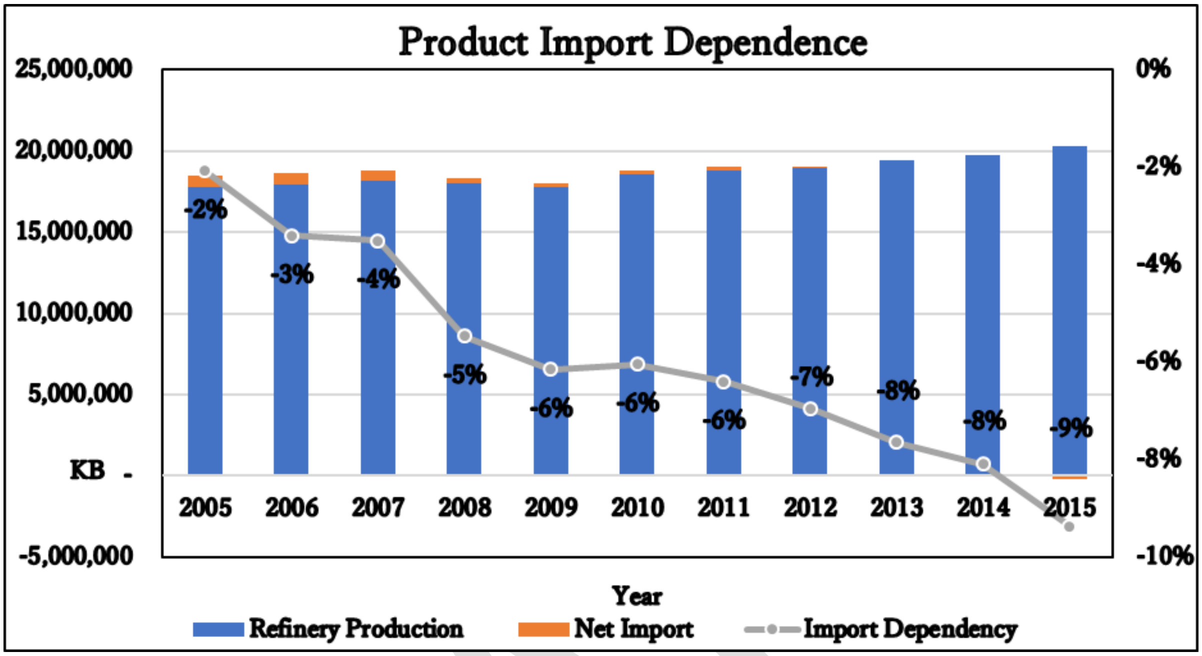
Source: APERC Analysis

Figure 5. APEC Crude Import Dependence



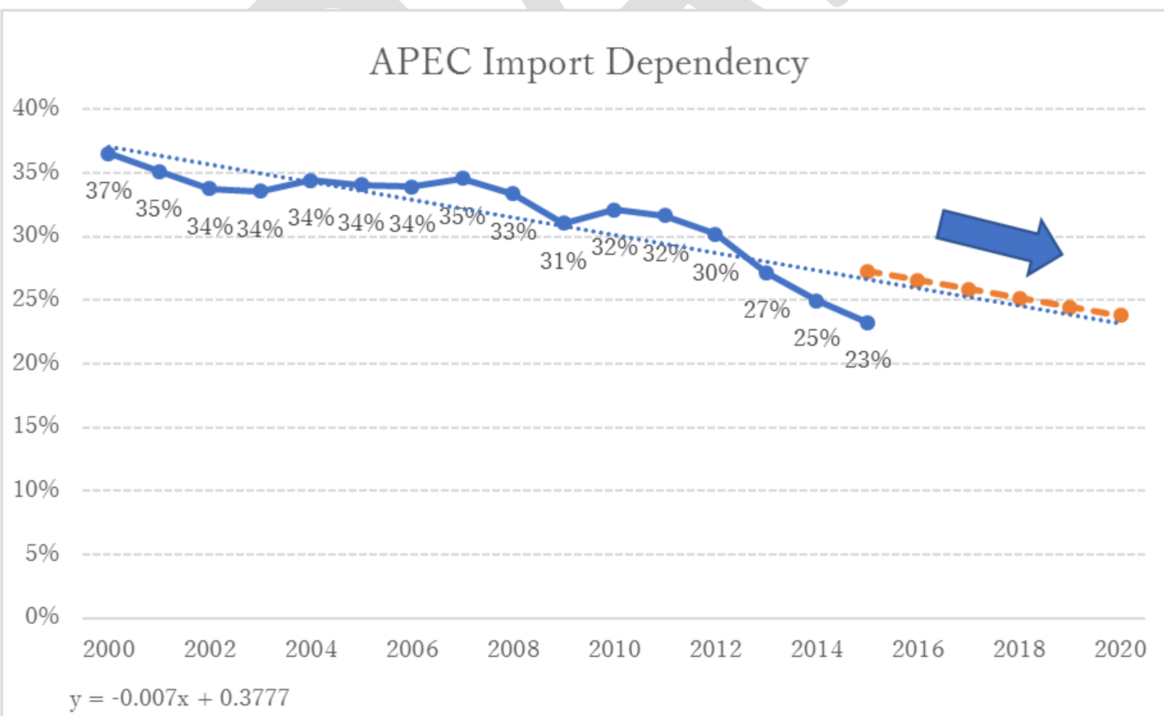
Source: APERC Analysis

Figure 6. APEC Product Import Dependence



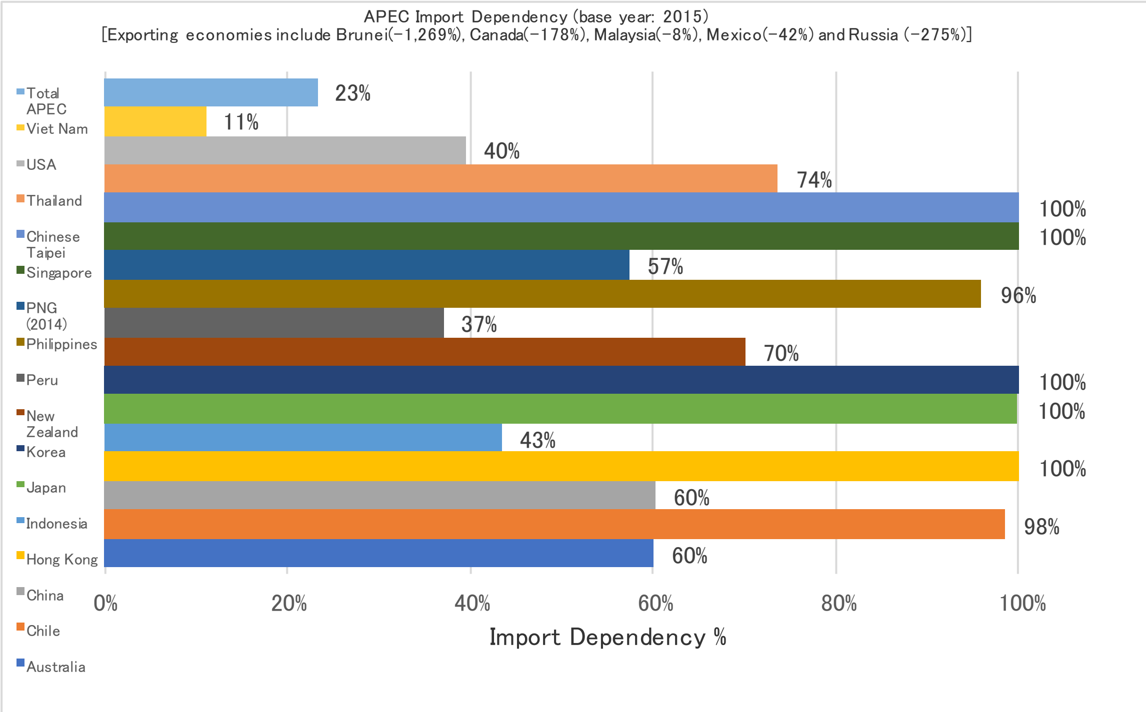
Source: APERC Analysis

Figure 7. Trend of APEC Import Dependency



Source: APERC Analysis

Figure 8. Total APEC Import Dependency



Source: APERC Analysis

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11. The IEA Model of Short-term Energy Security (MOSES), IEA, 2011, Page 16.

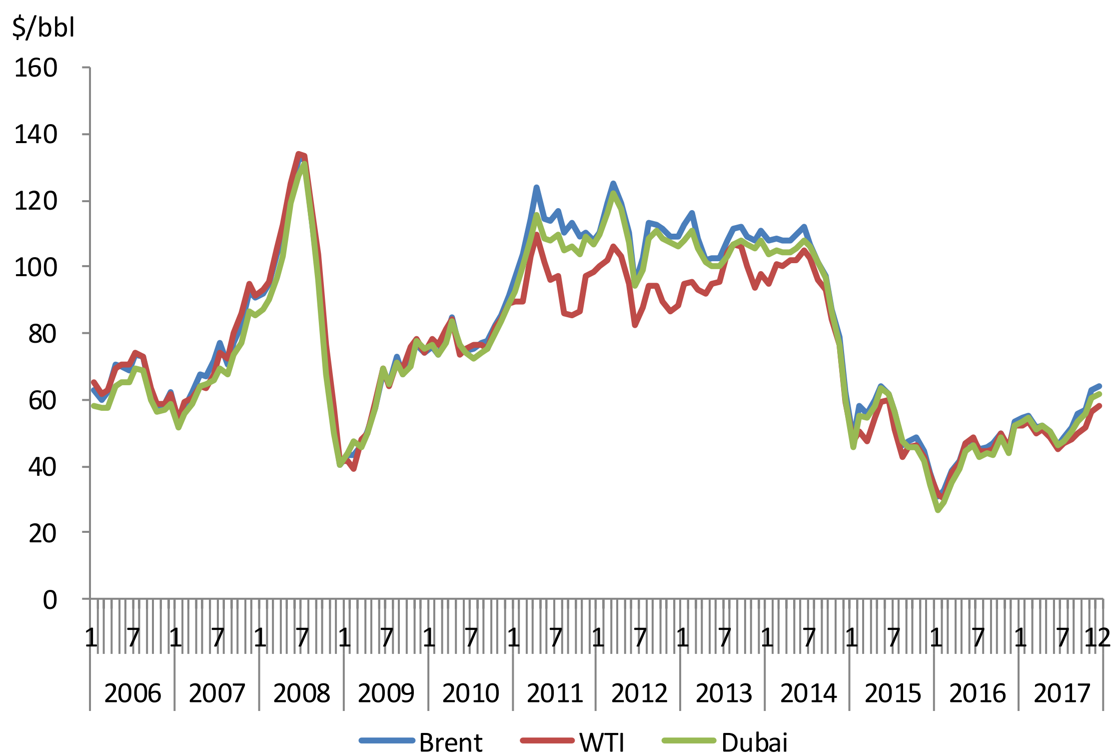
Section 4: Price

Crude oil prices have fluctuated widely since 2006 as shown in Figure 4.1. The Asian demand surge together with geopolitical tension pushed the WTI price to an all time high of $145/bbl in July 2008. The global economic downturn, triggered by the bankruptcy of Lehman Brothers, led to the nosedive of crude prices in the latter half of 2008, bottoming out at $33/bbl in February 2009.

Economic recovery supported prices in the subsequent five years. Prices were relatively stable in the range of $80-120 between 2011 and the first half of 2014. The period of $80-120/bbl oil coincided with the rise of shale oil, which became very competitive thanks to significant efficiency improvement. This period also witnessed the so-called Arab Spring that eventually resulted in the regime changes in Tunisia, Egypt, Libya, and a power vacuum in Syria that was partly filled by the Islamic State. The unprecedented spread between Brent and WTI in 2011-2013 is largely explained by the shale revolution and Arab Spring-the former suppressed WTI and the latter inflated Brent.

Struggling with the shale expansion, OPEC decided to end its production adjustment in November 2014 to regain the market share. The result was another nosedive of crude prices, which eventually fell below $30 in February 2016. OPEC once again returned to production cuts in November 2016, and prices have been recovering since then.

Figure 4.1: Crude oil prices, 2006-2017



Source: IEA (2017a)., IEA (2018)

Table 4.1 represents oil price forecast assumptions by APERC, IEA, and EIA. Although there is a discrepancy in terms of the referred price between IEA (average import price) and APERC/EIA (both Brent), prices are in a similar range towards 2030. These three organizations forecast price increases towards 2030, although the extent is slightly different. No detailed explanation is offered behind these assumptions. However, price increases are expected to stem from the fact that a tightening market balance (i.e. robust demand and slower supply growth) will require high-cost supply sources.

Table 4.1: Oil price assumptions by APERC, IEA, and EIA

$/bbl（2016 price）

	2015	2020	2025	2030
APERC（Brent）	53	75		100
IEA（Average import price of IEA member countries）	51		83	94
EIA（Brent）	53	75	86	95

Note: APERC does not assume a 2025 price. Nor IEA does assume a 2020 price.
Source: APERC (2016), IEA (2017b), EIA (2017).

Section 5: Highlights

US shale oil

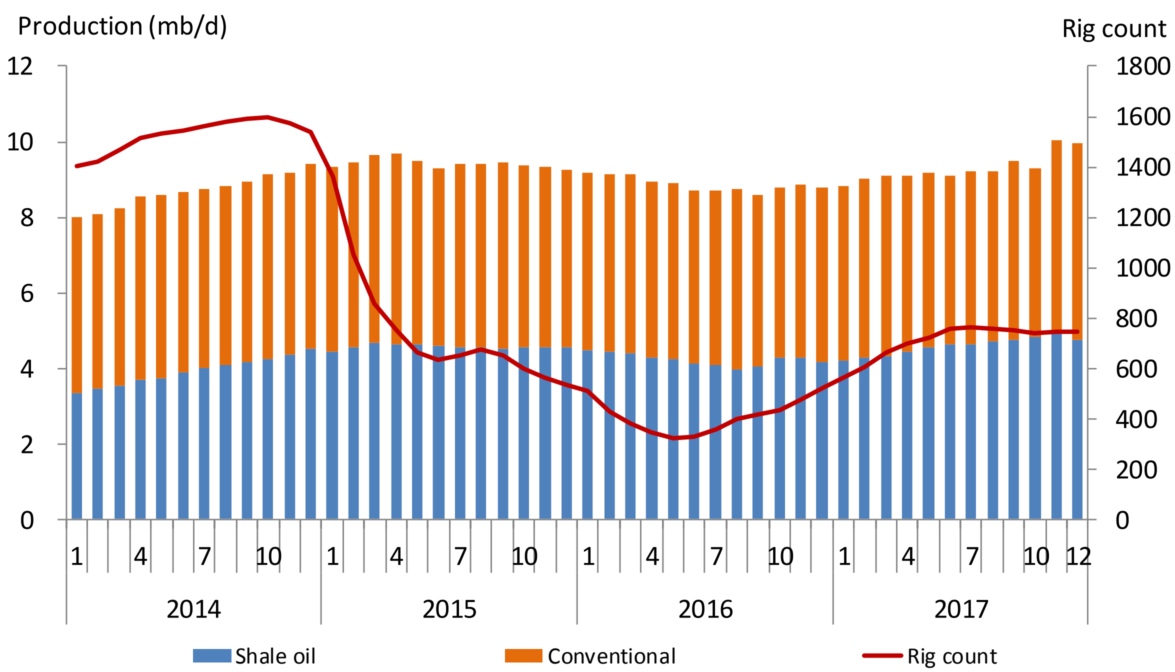
Shale oil developments have been driving the oil market in recent years. Shale oil production was 0.4 MBD in 2000, just 7% of total production in the US. Production started to grow strongly around 2010, and reached 4.6 MBD in 2017, about 50% of the total.

Much has already been said as to how the "shale revolution" transformed the global energy market. Yet the sheer impact of this revolution cannot be emphasized enough. US crude production has increased by 80% since 2008, and the economy became the largest crude producing economy in 2014. As a result, crude imports decreased by 22% from then peak in 2004. The sustained oversupply situation drove the Obama administration to lift a 40-year-old ban on crude oil exports in 2015. OPEC, which had aimed at maximizing market share since 2014, was forced back to its old strategy of production cuts in November 2016. All these developments were almost single-handedly driven by shale expansion in the US. The side effects are even greater. For instance, the cheap energy and feedstock cost revived manufacturing and petrochemical production in the US. A shift in the global power balance is even possible with the US cutting back its military presence in the Middle East.

The extraordinary expansion of shale oil stemmed mainly from the fact that production costs became cheap enough to attract investments. Horizontal-drilling and hydro fracturing have been around for decades, but this successful application to shale development pushed down production costs dramatically enough to compete with conventional oil. The rest is already history – commercial feasibility attracted investment and production surged.

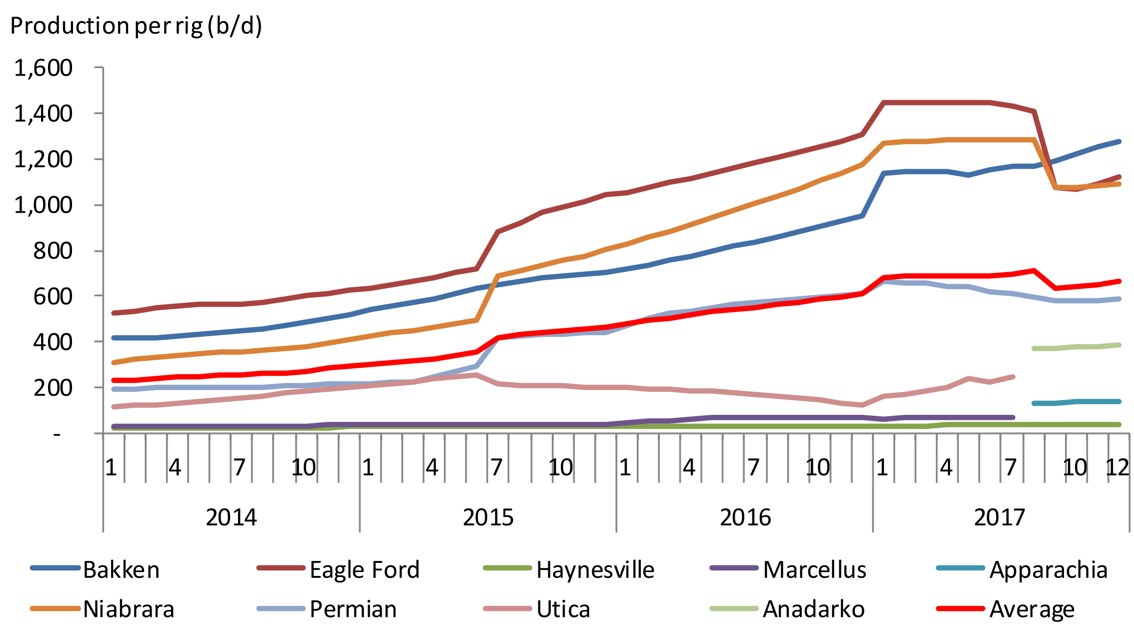
Lower oil prices since the late 2014 slowed down the shale expansion. Shale production peaked at 5.1 MBD in April 2015, bottomed out at 4.1 MBD in August 2016, and recovered to 4.74.5 MBD in December 2017. Rig count, an indicator of future production, hovered around 750 in the 4th quarter of 2017. Efficiency gain (expressed in production per rig in the figure below) has been the core of the revolution because it drove down production cost. But that seemed to stall in some shale plays.

Figure 5.1: Crude production and rig count in the United States, 2014-2017



Sources: EIA (2018a) and Baker Hughs (2018).

Figure 5.2: Production efficiency by shale play in the United States, 2014-2017



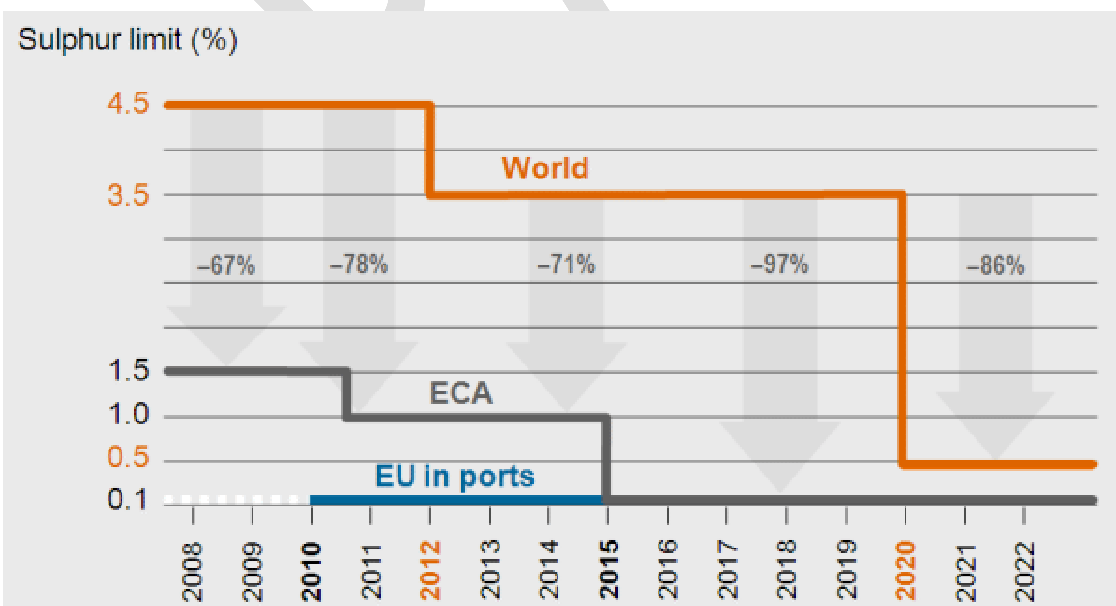
Sources: EIA (2018b).

Whether this trend will continue is one of the biggest questions in oil market today. While either scenario can be argued with certain rationality, it is notable that technological development for higher production efficiency is still taking place. Some argue that techniques like longer horizontal drilling, higher proppant loadings, and improved reservoir modelling with big data could add another 1 mb/d. In this sense, the revolution is still underway. The Energy Information Administration (EIA) maintains that shale will reach 6 mb/d in 2030s in its Annual Energy Outlook. The International Energy Agency (IEA) is even more optimistic, projecting the production of 8.1 mb/d in 2030 in its World Energy Outlook. Higher than expected oil prices and efficiency gains will obviously incentivize producers to invest more in shale plays. Thus, it is highly likely that shale production growth will get back on track and continue to suppress the oil price in the years to come.

IMO bunker regulation

The majority of the bunker fuel has been high sulphur fuel oil (HSFO) for many decades. However, this is expected to change radically in the near future. In October 2016, the International Maritime Organization (IMO), which is responsible for international shipping, decided to tighten the sulphur content regulation from 3.5% to 0.5% starting January 1, 2020. The IMO decision is based on the fact that bunker fuel accounts for 40% of the global sulphur emission from oil, and the recognition that tightening the emission standard is necessary to mitigate the environmental impact stemming from bunker fuel. Some regions and economies already set stricter regulations by setting emission control areas (ECA)— the EU and North America set 0.1% sulphur content since January 2015.

Figure 5.3: Tightening sulphur regulation on bunker fuel



Sources: Wartsila (2010)……..Is the ECA only North America? Please add a note.

Should the shipping industry address regulation, there are three options - switching to low sulphur (less than 0.5%) oil, installing sulphur scrubbers onboard, or switching to alternative fuel like LNG. Each option has pros and cons, and different applicability and impact on refineries, as illustrated in the table below.

Switching to 0.5% bunker oil does not require huge capital costs for scrubbers but most likely leads to higher fuel cost. Although few troubles have been reported in relation to fuel switching, some shipping companies are concerned about imperfect combustion in engines that were originally designed for HSFO with higher viscosity. Installing a scrubber enables continued use of low cost HSFO, but requires CAPEX for the scrubber itself. There is also an issue of supply availability of HSFO if most ports switch to 0.5% bunker oil in 2020 onwards. LNG fuelled ships undoubtedly appeal to environmentally-sensitive ship operators because they do not emit sulphur at all, but shipbuilding costs are very expensive.

Most shipping companies seem to be taking a wait-and-see attitude, which means they will not invest in scrubbers or LNG fuelled ships. Therefore, by method of elimination, low sulphur fuel is likely to be the major option. Actually switching to low sulphur oil, more specifically marine gas oil (MGO) is the major option chosen in European and North American ECAs. There is also a concern about regulation compliance. IMO is working on hammering out the details of implementation of the regulation, including the inspection and penalty, but many analysts point out the difficulty in enforcement especially in the open sea. It is uncertain whether there will be non compliance, or “cheating" and some operators will continue to burn HSFO in order to enjoy lower fuel cost. It is thus important for APEC member economies to create a viable monitoring system so that the regulation can be dully enforced.

Table 5.1: Options for global sulphur regulation by International Maritime Organization

	0.5% bunker oil	Scrubber	LNG
Pros	• Wide availability	• Lower fuel cost	• No sulfur emission
Cons	• • Higher fuel costUncertain combustibility	• Capex Expense • Fuel availability	• Capex Expense • Fuel availability
Suitable for	• Most shippers	• Bulkers, tankers	• Environmentally sensitive shippers
Impact on refineries	• Alternative outlet for HSFO needed • Opportunity for low-cost blending	• Lower impact	• Alternative outlet for bunker oil in general needed
Prospect	• Main stream	• Better chance in 2020s?	• Popular in 2030s?

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