APERC Coal Report 2017

February 2018

APERC
Asia Pacific Energy Research Centre

PUBLISHED BY:
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Foreword

Demand for coal has been soaring in many developing economies. Despite its high carbon emissions, coal is affordable and plentiful, particularly in the Asia-Pacific region, where it remains the backbone of numerous economies' power systems.

The release of this first edition of the APERC Coal Report reflects both the ongoing importance of coal to the APEC region and the state of flux the sector currently finds itself in. Coal is an important pillar of the power and industry sectors and will remain a sizable component of the energy mix in most APEC economies for many years to come. Despite this, de-carbonisation, smog and environmental concerns, market oversupply, and competition from cheapening renewables all pose challenges, in both developed and developing economies, to coal's reign atop the energy pile.

I would like to express my sincere gratitude to the authors and contributors for their time and effort in writing and publishing this report. However, I would also like to note that the views expressed in this paper are those of the authors and not necessarily of APERC.

Takato OJIMI
President
Asia Pacific Energy Research Centre
February 2018

Acknowledgements

We are grateful for the full support and insightful advice from Expert Group on Clean Fossil Energy members. 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 production
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

- Nearly 75% of global coal consumption occurred in APEC member economies in 2016. The region is home to five of the world's 10 largest net coal exporters and six of the world's top 10 net coal importers.
- Strong economic growth over the period 2005-2015 (averaging 3.1% a year) increased coal demand by more than 30%, from 2 274 Mtoe (in 2005) to 2 897 (in 2015), an annual rate of 2.5% (equivalent to 62 Mtoe per year or Canada's and Australia total coal demand in 2015 combined).
- By 2015, coal continues to dominate the power mix in the APEC region, accounting for more than half of electricity generation.
- Booming Asian economies have created a huge middle class population in the APEC region and subsequently increased iron and steel demand, which reached 1.2 billion tons in 2015 from around 750 Mt in 2005, and cement demand, which has more than doubled since 2005 to reach 3 billion tons in 2015.
- APEC as a region produces enough coal to meet its demand. In 2015, five economies met 98% of APEC's coal demand: China (59%), USA (14%), Australia (10%), Indonesia (8.7%) and Russia (6.4%)
- For the period 2005 to 2011, China's coal production increased at a rate of 8% annually but has flattened since because of a significant slowdown in domestic demand. US coal production has slowed significantly in recent years, from 536 Mtoe in 2011 to 431 Mtoe in 2015, because low gas prices are driving coal out of the power sector.
- In 2015, APEC members imported 415 Mtoe of coal, 48% more than in 2005. Over 80% of total APEC imports went to four economies: Japan (116 Mtoe), China (100 Mtoe), Korea (81 Mtoe) and Chinese Taipei (36 Mtoe).
- Demand for thermal coal continued to rise in emerging regions such as South and Southeast Asia on the back of growing power demand. Global thermal coal demand is expected to edge upwards to 2020, in tandem with economic growth, but decline in Europe and the United States.
- Demand for metallurgical coal is expected to increase steadily in India, while demand is expected to fall in China as the production volume for pig iron reaches its peak. Australia is expected to continue strong export growth to meet global demand.
- China's coal demand and production are expected to fall moving towards 2020 as government policies to adjust energy structure are implemented. However, coal imports are expected to remain mostly at the current level, depending on adjustments to demand and supply.
- Indonesia's exports, currently the largest in the world, are expected to decline as the government adopts measures to suppress production (to 400 million tonnes in 2019) aimed at the protection and effective use of resources.
- The seaborne thermal coal price, which has risen to the current level of US$90/tonne, is expected to drop to about US$70/tonne in the medium term before increasing again after 2018.

Table 1.1: Summary of recent coal developments in APEC (as of December 2017)

Economy	Latest developments	Impact to coal supply, demand and trade
Australia	• Uncertainty continues regarding the Carmichael mine in Queensland, which would be one of the largest in the world were it to go ahead, but faces enormous social and environmental opposition.	The economy will continue to export coal.
Brunei Darussalam	• The economy does not consume coal.	The economy does not use or produce coal.
Canada	• In November 2016, Canada announced plans to shut down coal plants and aims to make Canada's electricity 90 percent non-emitting by 2030.	Coal demand will continue falling as natural gas supplants it in the power generation sector. Metallurgical coal production expected to stabilise in near future.
Chile	• Chile launched the *Energy 2050* plan in 2015 with targets of having at least 60% of electricity generation from renewable energy by 2035 and 70% by 2050. The plan also targets GHG emissions reduction by at least 30% between 2007 and 2030.	Chile will remain a net importer of coal despite continued exports to India.
China	• China's 13th Five-year plan (2016-2020) and other plans laid specific targets on coal: o Restrict coal resource development in the east of the country. o Reduce coal consumption and replace it with alternative energy sources. o Promote the use of natural gas in place of coal in major cities. o Accelerate R&D of 700℃ ultra-supercritical coal-fired power generation. o Reduce coal consumption to less than 58% of energy consumption in 2020 compared to 64% in 2015. o Eliminate about 500 million tonnes of coal mining capacity and recombine about 500 million tonnes of capacity in 3 to 5 years from 2016.	Coal production will decrease while imports will depend on the effectiveness of plans to curb domestic coal demand.
Hong Kong, China	• The economy does not produce coal and only consumes a small amount.	Continue to import coal mainly from China.
Indonesia	• Government policy prioritising the domestic market will result in coal exports falling. The government also plans to cap production at 400 Mtpa gradually. • In 2014, the government launched a plan to build a mix of coal, gas, oil and renewable power capacity totalling 35 gigawatts (GW) by 2019. • However, the Energy and Mineral Resources Minister has also claimed that the country would only need an additional 15 GW in electricity generation by 2019.	Indonesia has enough coal for domestic consumption. However, export curbs may necessitate importers looking for alternative suppliers.
Japan	• The Ministry of Economy, Trade and Industry's *Long-Term Energy Supply and Demand Outlook* targets a reduction in coal demand as nuclear and renewables take a larger share of the fuel mix by 2030. • The fourth of Japan's 42 operable nuclear reactors restarted in June 2017.	Nuclear power restarts will displace baseload coal leading to lower future thermal coal demand. However, metallurgical coal demand remains strong in Japan.
Korea	• Korea's President recently announced the temporary shutdown of 10 coal-fired power plants that are more than 30 years old in June to mitigate air pollution.	There are considerable uncertainties in the economy as nuclear will be phased out at the same time as a number of coal power plants will be shut down. Korea will continue to import both thermal and metallurgical coal.

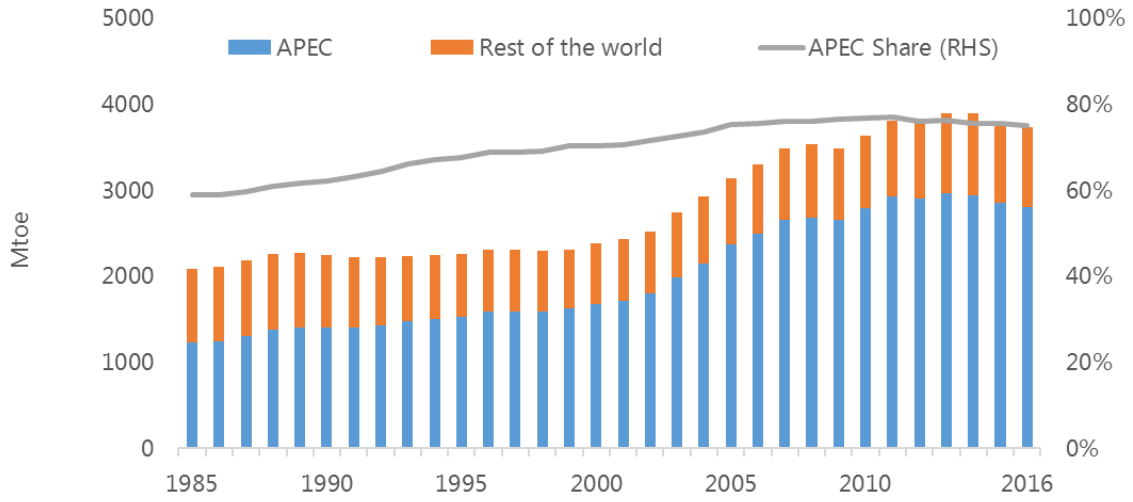
Economy	Latest developments	Impact to coal supply, demand and trade
	• The President also announced in June 2017 plans to stop building new nuclear power plants or extend the lifespan of existing plants.	
Malaysia	• Malaysia commissioned the first ultra-supercritical coal plant in Southeast Asia in 2017. Based on future power capacity planning issued by the Energy Commission, coal demand in the power sector will continue growing to meet new electricity demand.	The economy will continue to be one of the largest coal importers in the world.
Mexico	• No active plans to increase coal-fired power generation capacity as cheap gas will prove more than competitive.	Market forces will reduce the capacity of coal power plants from 5.6 GW to 4 GW by 2029 according to government projections.
New Zealand	• The economy does not have any specific policy or target on coal.	New Zealand's coal demand is smaller than its production, which makes the economy a net exporter of coal, albeit at a small scale.
Philippines	• The economy does not have any specific policy or target on coal.	Although the Philippines has some coal production, it is mainly for export due to different quality requirements in local coal power plants.
Papua New Guinea	• The economy does not consume coal. • Actively investigating coal resources in the Sepik Basin since 2015. There is a proposal to build a coal power plant in the economy. However, the project is on hold and there is no on-going or completed activities for this proposal.	The economy does not use or produce coal.
Peru	• The economy does not have any specific policy or target on coal.	As an emerging LNG exporter, the global shift towards cleaner energy provides opportunities for the economy.
Russia	• The draft of *Russia's Energy Strategy 2035* plans to encourage local companies to make full use of available energy domestically as well as to expand energy exports, including coal, to the Pacific region.	Export infrastructure expansion in the Far East region will continue giving coal importers more import source options.
Singapore	• The economy does not produce coal and only consumes a small amount.	Little impact on coal demand
Chinese Taipei	• The economy aims to phase out nuclear energy by 2025 and increase the share of renewables in electricity generation to 20%.	Thermal coal demand is expected to stabilise in the near term. The economy will continue to import all of its coal.
Thailand	• The largest coal mine in Thailand (Mae Moh) will continue to produce lignite as the associated power plant undergoes an upgrade program comprising of replacement of generators 4 to 7 next year with capacity of 656 MW and generator 8 and 9 in 2023 (from 1800 MW to 450 MW).	Coal imports will likely grow with increasing domestic demand.
USA	• In October 2015, the EPA issued rules to reduce GHG emissions from existing fossil fuel-fired electric generating units – the Clean Power Plan (CPP). In April 2017, the EPA announced that it is reviewing the CPP and will consider proceedings to suspend, revise or rescind the plan. • On 1st June 2017, President Trump announced the U.S. withdrawal from the Paris Climate Accord. • Environmental Protection Agency (EPA) formally submitted a proposal to scrap Clean Power Plan in October 2017 • The current administration has announced ambitions to improve (or revive) the coal industry.	The US Energy Information Administration (EIA) reports that coal production and demand in the US is expected to increase in near term as natural gas prices rise in 2017-18.
Viet Nam	• Viet Nam announced the Coal Master Plan in 2015 with orientation to 2025-30. Among targets in this plan are an increase in coal production from 41-44 Mt in 2016 to 47-50 Mt in 2020, 51-54 Mt in 2025 and 55-57 Mt in 2030; and a gradual reduction in coal exports.	Coal production is expected to increase in the near future but higher demand will result in Viet Nam becoming a net import of coal.

Section 1: Historic trends in the APEC coal market

Global context

The APEC region is a major coal consumer in the global coal industry. According to the *BP Statistical Review of World Energy 2017*, nearly 75% of global coal consumption occurred in APEC member economies, a huge jump from 59% in 1985[1] (BP, 2017) (Figure 1.1). Economic growth, urbanisation, market development and technology breakthroughs underpin the steady increase in coal demand. As it is relatively abundant and low-cost, coal is the fuel of choice for meeting energy demand in many APEC economies.

Figure 1.1: APEC and global coal consumption, 1985-2016



Source: BP (2017).

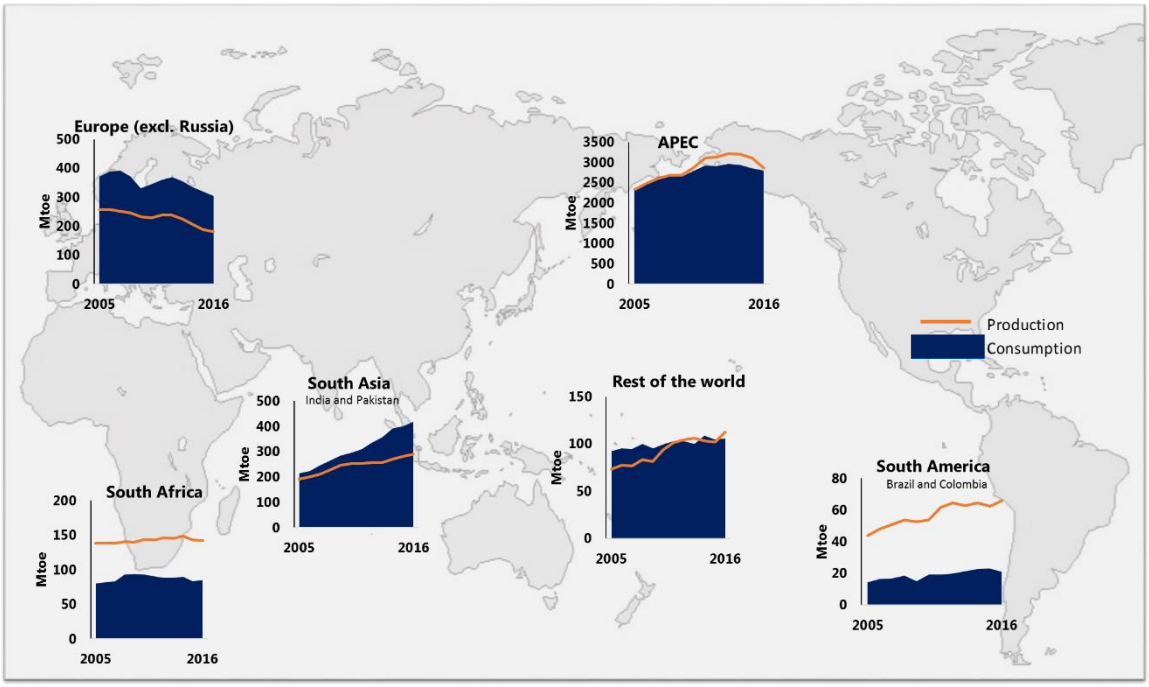
Increasing APEC regional demand is not a result of consistent growth across the region. Developing economies, such as China and those in Southeast Asia, were overwhelmingly responsible for the largest increases, particularly compared with developed APEC members. Besides developing APEC economies, India, another fast growing Asian economy, has recorded rapid increases in coal demand over the past decade. The economy doubled its coal consumption from 211 Mtoe in 2005 to 412 Mtoe in 2016 (Figure 1.2). Despite huge coal resources, India has become a significant importer, mainly from Australia and Indonesia, as domestic coal production struggles to keep up with soaring demand.

On the other hand, European economies, which used to be major coal producers and consumers, have declined in recent years. Coal consumption across the Eurozone peaked in 2007 at 393 Mtoe

[1] The BP Statistical Review of World Energy 2017 lists 19 out of 21 APEC members. The other two APEC members that are not listed are Brunei Darussalam and Papua New Guinea which, based on ESTO data, do not consume any coal.

before decreasing to 305 Mtoe in 2016 (despite a slight uptick between 2010 and 2012). Other major coal consumers, such as South Africa and Brazil, recorded almost flat demand over the past decade. Despite that, coal production in South Africa and Colombia, another major coal producer, increased because of export growth.

Figure 1.2: Global coal consumption and production by region, 2005-2016



Source: BP (2017).

A number of APEC members continue to be major coal importers and exporters. According to the International Energy Agency's (IEA) *Key World Energy Statistics 2016*, the APEC region is home to five of the world's 10 biggest net coal exporters: Indonesia; Australia; Russia; the United States and Canada. Similarly, six o

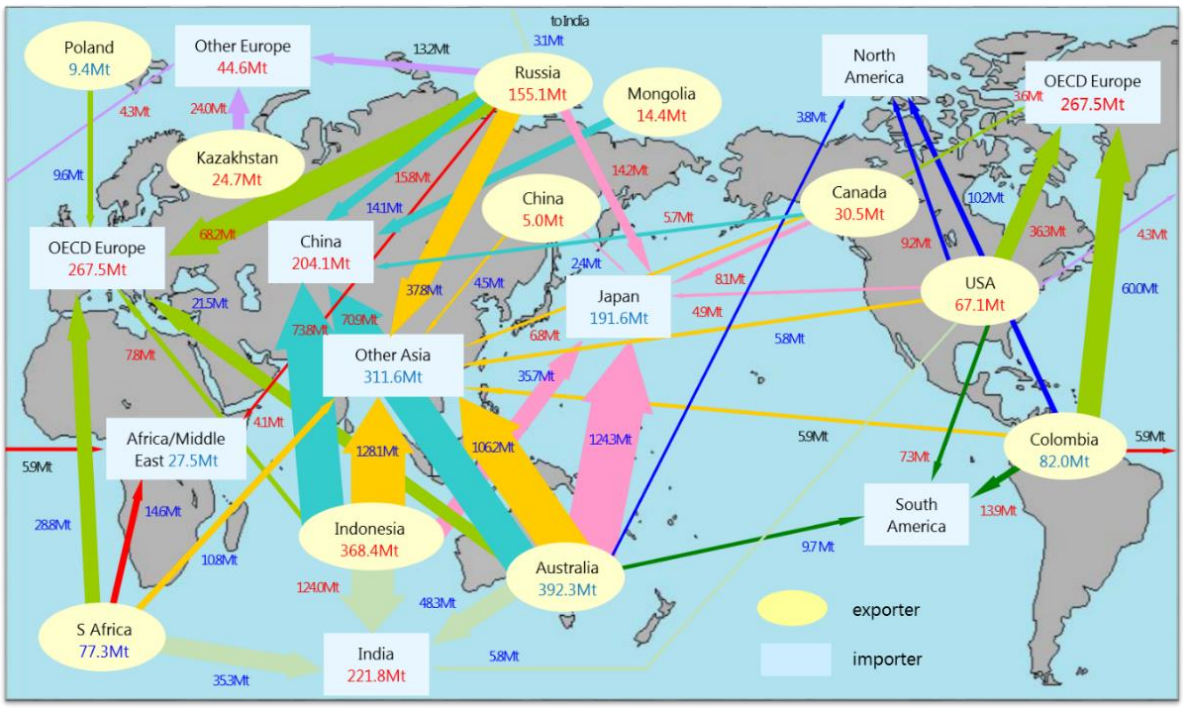
f the top 10 net coal importers are APEC members: China; Japan; Korea; Chinese Taipei; Malaysia and Thailand (IEA, 2016a).

Despite falling coal consumption, the Eurozone remains a major import destination. In 2015, the European members of the Organisation for Economic Co-operation and Development (Europe-OECD) cumulatively imported 268 Mt of coal, mainly from Russia (68 Mt), Colombia (60 Mt), the US (36 Mt) and South Africa (29 Mt) (Figure 1.3).

In 2015, India imported more coal than China, at 222 Mt and 204 Mt respectively, because of lower production and high domestic demand. Indonesia has been the main source of coal for India, supplying nearly 60% of total India's imports, followed by Australia with 48 Mt and South Africa with 35 Mt.

Nearly 70% of global proved coal reserves are located in APEC economies: Australia; the United States; Russia and China having the largest reserves (BP, 2017). The United States and Russia are expected to have a positive reserves-to-production ratio for more than 200 years. In China, coal reserves are expected to last around 70 years (BP, 2017).

Figure 1.3: Global coal trade, 2015



Source: IEA (2016b) and IEEJ analysis.

Economic growth in APEC

Economic growth in the APEC region was a robust 3.1% a year over the period 2005-2015, higher than the global average of 2.8% over the same period. China recorded the highest economic growth, reaching 14.2% in 2007 before sliding down to 6.9% in 2015, followed by the APEC-South East Asia region with average annual growth of 5.1% from 2005-2015 (Figure 1.4). All APEC-South East Asia economies recorded an average growth rate above 5.0% yearly except Brunei Darussalam and Thailand during that time.

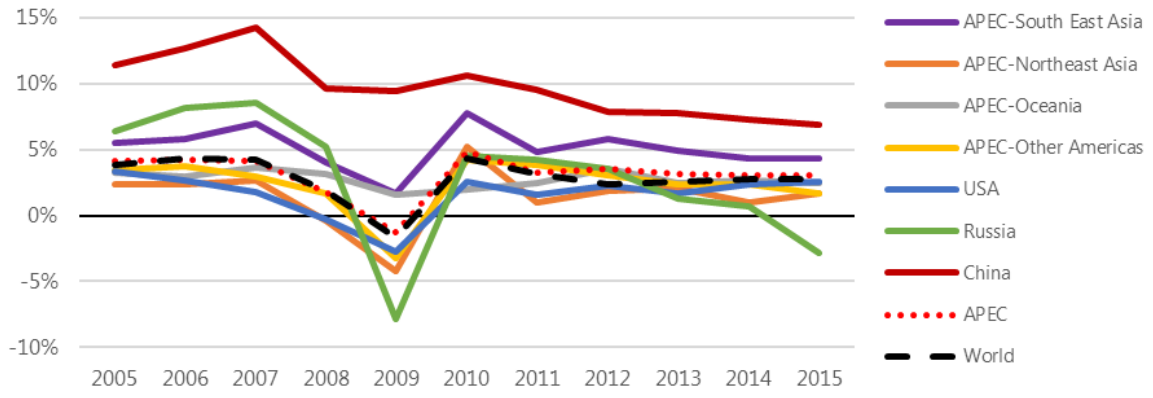
APEC-Northeast Asia recorded an average growth of 1.4% yearly for 2005-2015 period. However, during the 2007-08 global financial crisis all APEC-Northeast Asia [2] economies, except China,

[2] APEC-Northeast Asia: China; Hong Kong, China; Japan; Korea and Chinese Taipei

experienced recession. The USA and APEC-Other Americas members also showed similar growth trends to APEC-Northeast Asia economies.

Russia, a large energy exporter, was the hardest hit during the global financial crisis of 2007-08 as lower oil and gas export demand and much lower oil prices impinged GDP. Prior to 2008, Russia recorded an average economic growth of 7.1% per year (2005-2007). However, post-2008, Russia's economy only grew at average of 0.5% annually (2008-2015).

Figure 1.4: GDP growth in APEC sub-regions and world, 2005-15



Source: World Bank (2017).

Demand and supply trends in APEC

Demand continues to increase in APEC

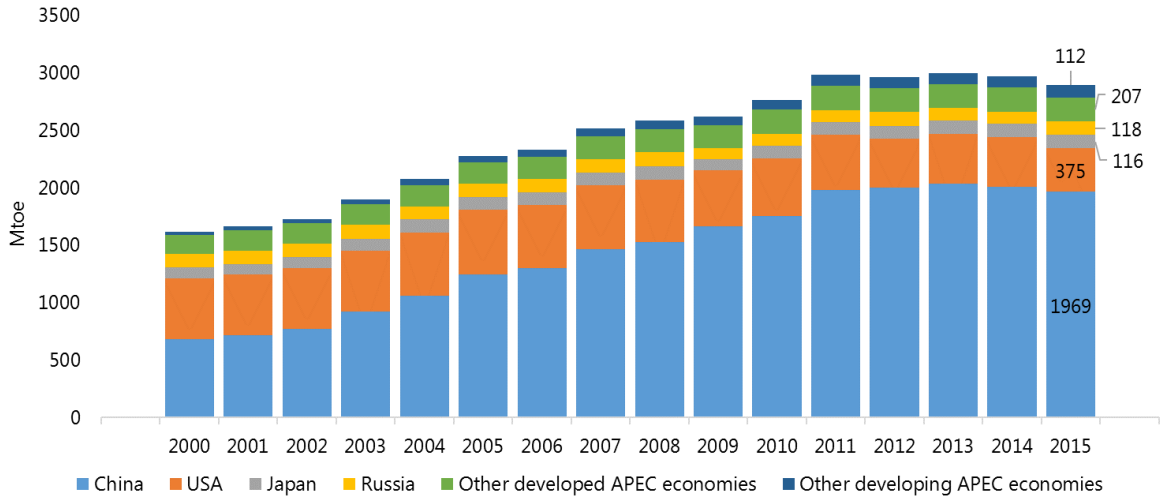
From 2005 to 2015, coal demand in APEC economies increased by 27%, from 2 274 Mtoe to 2 897 Mtoe, an annual rate of 2.5% (equivalent to 62 Mtoe per year or Canada's and Australia total coal demand in 2015 combined). In 2015, China accounted for two-thirds of total APEC coal demand, almost double the 2005 level (ESTO, 2017). South East Asia, another region undergoing rapid economic growth, has been the other major contributor to increased coal demand in APEC (Figure 1.5).

Two of the 21 APEC economies – Brunei Darussalam and Papua New Guinea – do not consume any coal, while 8 economies – China; the US; Japan; Russia; Australia; Korea; Chinese Taipei and Indonesia – accounted for 96% of coal demand over the period 2005-2015. Unsurprisingly, these eight economies also represented 89% of total APEC Gross Domestic Product (GDP) (ESTO, 2017 and WB, 2017).

Despite the global economic downturn in 2008-09, coal demand in more than half of APEC economies continued to increase over this period, led by Malaysia with 11% year-on-year growth followed by China with 9%, Viet Nam with 5%, Korea and Hong Kong, China, both at 4%. This trend certainly does

not indicate that coal demand is independent of broader economic conditions but it does reflect the resiliency, especially in Asia, of cheap fuel resources.

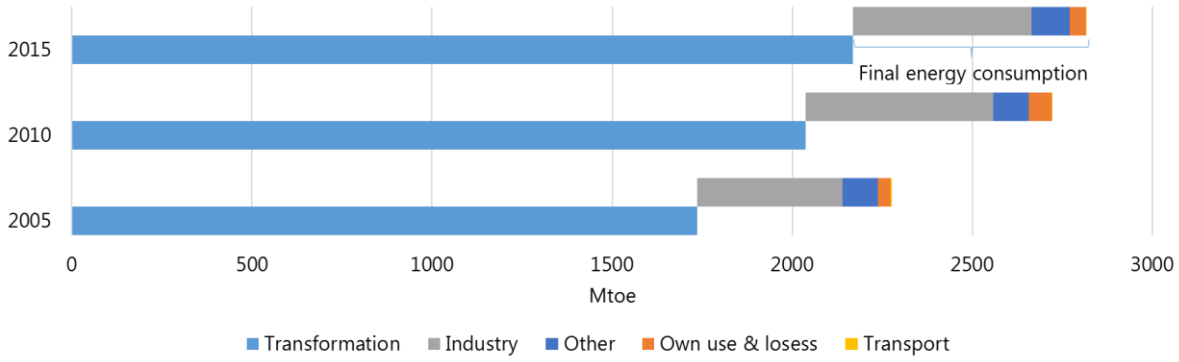
Figure 1.5: Coal demand in APEC, 2000-15



Source: ESTO (2017).
Note: Other developed APEC – Australia; Canada; Chile; Korea; Mexico; New Zealand; Hong Kong, China; Singapore and Chinese Taipei. Other developing APEC – Brunei Darussalam; Indonesia; Malaysia; Papua New Guinea; Peru; the Philippines; Thailand and Viet Nam.

In 1975, developed APEC economies accounted for around 60% of total APEC coal demand. By 2004, China had eroded this share to roughly 50%. Since then, annual economic growth of around 10% has seen a further increase in China's share of total APEC coal consumption to 67% of the APEC total in 2016 (BP, 2017). Demand in the power sector has consistently accounted for around three-quarters of total coal consumption in APEC, with industry (around 18%-19%) and other sector accounting for the rest (Figure 1.6) (ESTO, 2017).

Figure 1.6: Coal demand in APEC by sector, 2005-2015



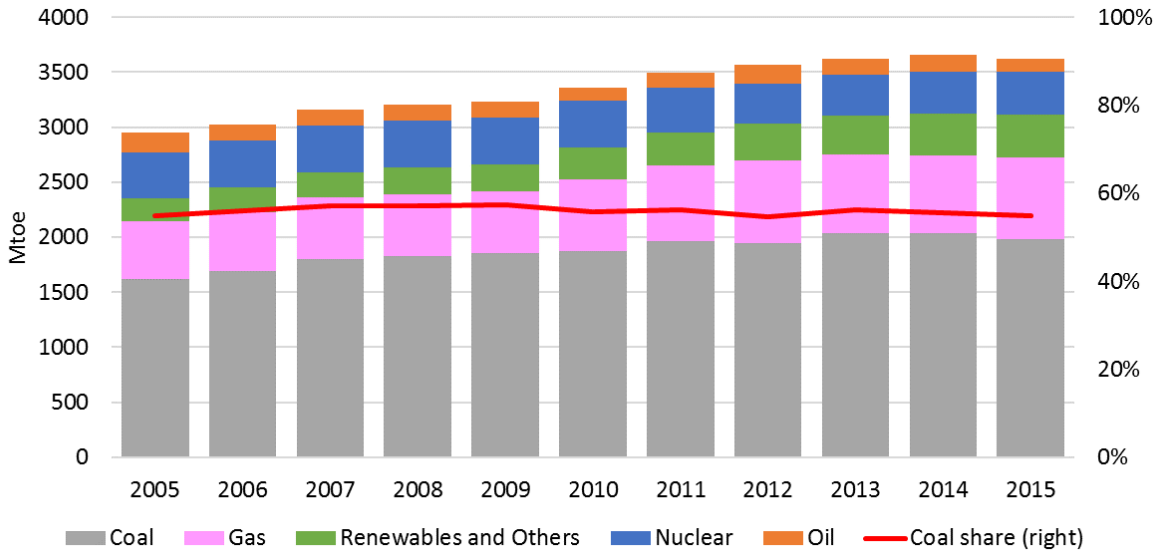
Source: ESTO (2017).

Transformation sector

In 2015, coal continues to dominate the power mix in the APEC region, accounting for more than half of electricity generation and is followed by gas (20%) and nuclear as well as renewables at 11% each. Between 2005 and 2015, total energy demand in the power sector increased at an annual rate of 2.1%, equivalent to the coal growth rate. Renewables recorded the highest growth rate of 6.0% per year followed by gas at 3.6% per year (Figure 1.7).

Developing economies such as China, Viet Nam, Indonesia and Malaysia recorded high annual growth rates of coal in the transformation sector (mainly electricity) with 5.2%, 20%, 12% and 11%, respectively over the period 2005 to 2015. On the other hand, some developed economies experienced declining coal consumption in the transformation sector, led by New Zealand with negative annual growth of 7.8% followed by Canada (-4.1%), the USA (-3.7%) and Australia (-1.6%).

Figure 1.7: Power mix in APEC and coal share, 2005-15



Source: ESTO (2017).

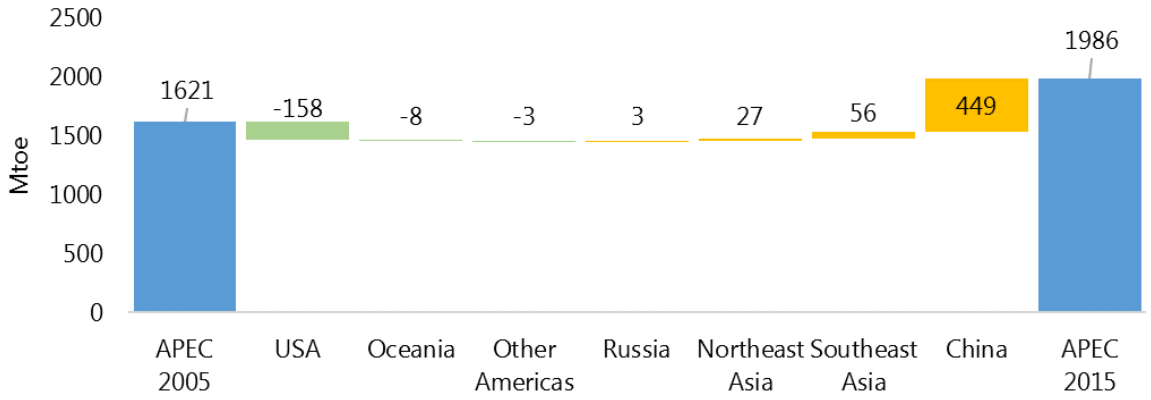
APEC's coal usage in the transformation sector[3] increased from 2 949 Mtoe in 2005 to 3 620 Mtoe in 2015. However, not all APEC economies recorded growth in this sector (Figure 1.8). In the US, for example, coal usage in transformation sector fell by more than 20%, from 509 Mtoe in 2005 to 351 Mtoe in 2015. The decrease occurred as the shale revolution increased the supply and reduced the prices of natural gas significantly enough to displace large quantities of coal-fired generation in the power mix, particularly in states with or adjacent to abundant unconventional gas resources (EIA, 2016). Only two states, Nebraska and Alaska, recorded growth in coal consumption for power while

[3] As some economies report usage not specifically for electricity generation but for combined heat and power (CHP), APERC uses coal use in the transformation sector as a proxy for coal usage in power.

use fell in the rest of the economy, led by Ohio, Pennsylvania, and Indiana with falls of 49%, 44%, and 37%, respectively, between 2007 and 2015.

Oceania and Other Americas recorded negative growth in coal consumption, albeit at a smaller scale than the US, with falls of 5 to 10 Mtoe between 2005 and 2015. Australia's coal consumption in the power sector fell by 7 Mtoe while New Zealand's was 1 Mtoe lower over the same period. In the Other Americas region, Canada's coal consumption in the power sector was 8 Mtoe lower, offsetting an increase of 5 Mtoe in Chile.

Figure 1.8: Coal demand in the power sector by region and economies, 2005 and 2015



Source: ESTO (2017).

On the other hand, almost all APEC-Asia economies registered growth in coal consumption in the transformation sector. Southeast Asia recorded a combined increase of 56 Mtoe in the transformation sector between 2005 and 2015. This was a result of the strong economic growth in the region (Figure 1.4), as well as expansion programs to improve electrification rates (Table 1.2). Since coal is one of the cheapest mass-produced forms of reliable energy, particularly in a region with abundant resources, most governments opt to optimise coal to provide electricity.

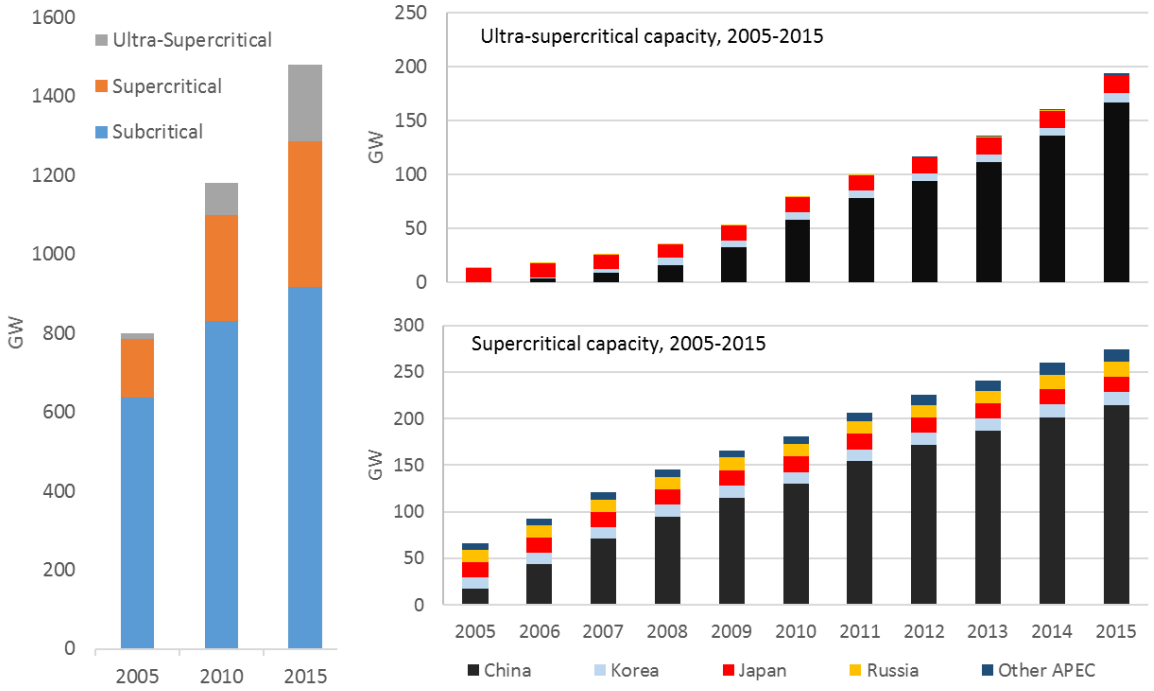
Table 1.2: Access to electricity for selected APEC members (% of population), 2005 and 2015

Economy	2005	2015
Chile	98	100
China	97	100
Indonesia	87	97
Malaysia	98	100
Mexico	99	99
Papua New Guinea	15	20
Peru	77	93
Philippines	79	89
Thailand	91	100
Vietnam	96	99

Source: WB (2017).

Ultra-supercritical (USC), an even more advanced coal technology, has also undergone extremely rapid growth. In China, capacity has doubled every year to increase from 4 GW in 2006 to 160 GW in 2015. Prior to 2005, Japan and Russia were the only economies with operating USC plants in APEC region, but by 2015, were joined by China; the US; Korea and Malaysia (Figure 1.9).

Figure 1.9: Coal power plant by technology type, 2005 to 2015



Note: Only capacity that is in commercial operation, mothballed or on standby considered in the analysis.
Source: Platts (2016) and APERC analysis.

China's power consumption has jumped by more than 6% since the beginning of the year 2017, partly because of torrential rains that forced China to cut capacity by as much as two-thirds at its Three Gorges and Gezhouba hydropower plants in an effort to ease pressure on the Yangtze river, forcing utilities to switch to coal. On top of that, heatwaves in the north also boosted air-conditioning demand, while coal mining and shipping were hampered by adverse weather in Indonesia and South Africa and strike action in Australia (Reuters, 2017).

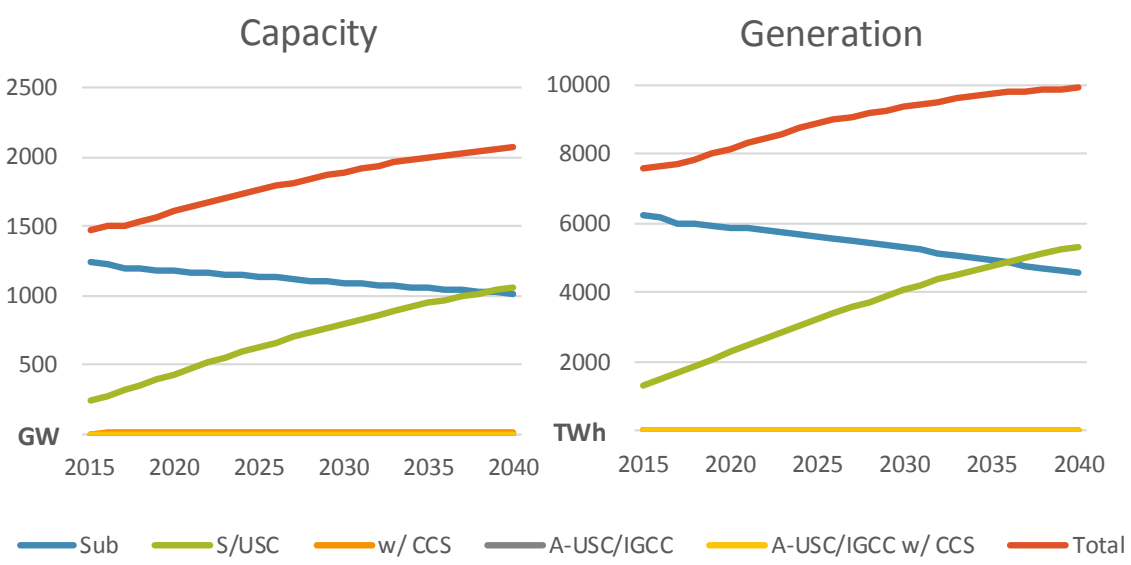
Box 1: Power sector coal use in the APERC Energy Demand and Supply Outlook 6th Edition

The 6th Edition of the Asia Pacific Energy Resource Centre (APERC) Energy Demand and Supply Outlook was released in May 2016. It comprised four different scenarios: business as usual (BAU), improved energy efficiency (EE), higher renewables and alternative power (itself consisting of four different power mix projections – coal will be the only one covered here) (APERC, 2016).

The Outlook highlights the significant role coal will continue to have in the power generation mix across the APEC region as it continues to grow under all four scenarios out to 2040 (though less than other fuel types).

Under the BAU scenario, coal will grow strongly to 2040 as new super- and ultra-critical (S/USC) plants are built, mainly in developing Asian economies. This will result in S/USC plant output and capacity overtaking subcritical in the mid and late 2030s, respectively (Figure 1.10). The higher efficiency of these new plants will slightly reduce the demand for coal as a fuel input.

Figure 1.10: BAU coal capacity and generation by technology type, APEC



Source: APERC (2016).

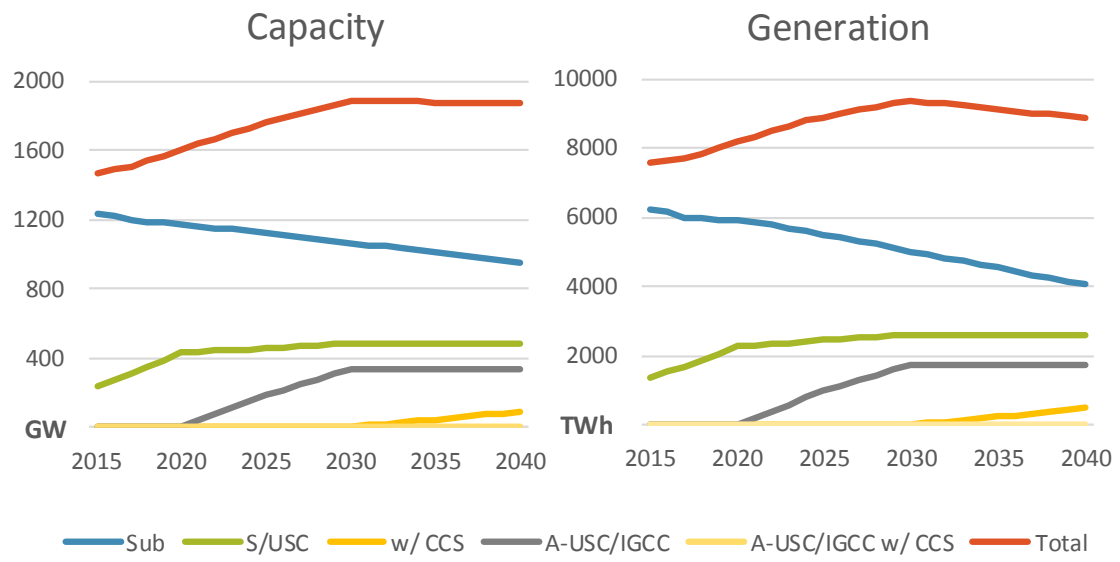
The EE scenario follows a similar trajectory to BAU but due to the impact of energy efficiency measures on demand growth there is much less need for more advanced new-build coal plants. Assuming proactive enactment of minimum standards and the adoption of 'best available technologies', particularly in developing countries, is integral to achieving this outcome. Lower demand results in output and capacity from existing subcritical plants remaining above S/USC for the length of the outlook period.

The high renewables scenario follows a very similar pattern to the BAU scenario, but with less new capacity and dispatched power from coal. This is because the preference for renewables in new

investment in grid capacity, itself a result of more favourable assumptions regarding those technologies, displaces new-build S/USC plants.

Finally, the high coal scenario in the alternative power mix results, unsurprisingly, in the greatest growth in coal-fired capacity and generation. This is the only scenario in which there are significant quantities of new coal technologies, advanced S/USC, integrated gasification combined cycle (IGCC) and carbon capture and storage, entering the generation mix. This in turn results in a significant reduction in carbon emissions compared with the BAU scenario, mostly through improved plant efficiency rather than CCS (which is small in comparison). More optimistic assumptions regarding technology development costs and efforts to mitigate carbon emissions drive the high coal scenario and result in S/USC and CCS growth from 2020 and 2030, respectively (Figure 1.11).

Figure 1.11: High coal scenario capacity and generation by technology type, APEC



Source: APERC (2016).

The enormous amount of existing generation capacity all but guarantees that coal will remain a large and important part of the fuel mix across the APEC region in coming decades. The degree to which varies, with the BAU and alternate power scenarios resulting in the highest volumes. For further information on the coal outlook contained in the 6th Edition of the APERC Energy Demand and Supply Outlook, please see:

http://aperc.ieej.or.jp/publications/reports/outlook.php

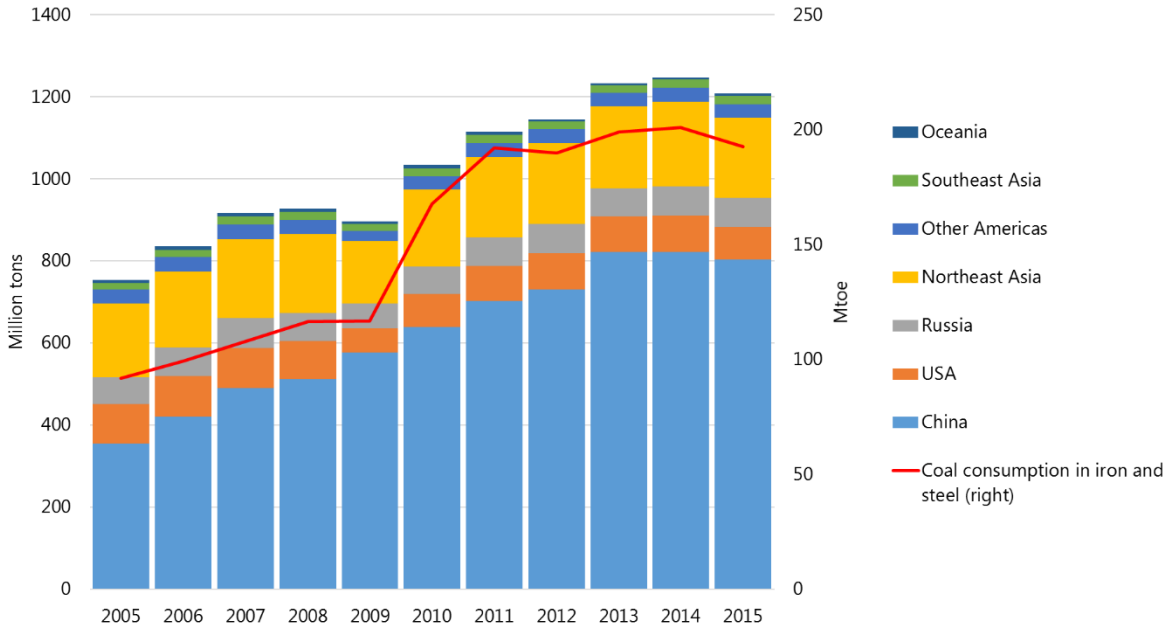
Industry sector

Booming Asian economies have created a huge middle class population with improved living standards and a strong desire for new buildings and possessions. Personal vehicle demand has exploded as people have started to travel further with their own car because of a lack of reliable public transportation in some emerging economies. With increasing demand for new houses and buildings as well as higher vehicle sales, iron and steel and cement demand have grown rapidly.

Iron and steel

Figure 1.12 shows the amount of iron and steel produced by APEC members, which reached 1.2 billion tons in 2013, up from around 750 Mt in 2005. China's steel production more than doubled while US steel production shrank by 17% from 95 Mt in 2005 to 79 Mt in 2015 (WSA, 2016). Australia, Japan and Malaysia also recorded slight decreases in iron and steel production.

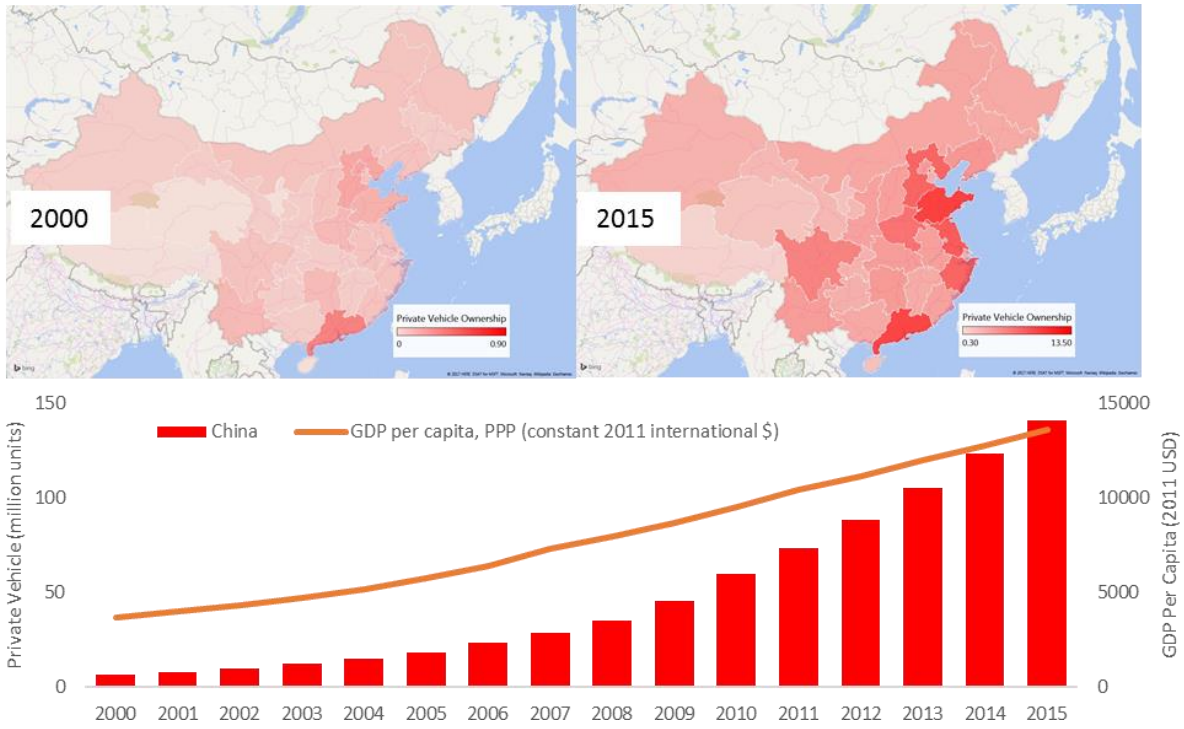
Figure 1.12: Iron and steel production and coal use, 2005-15



Sources: WSA (2016) and ESTO (2017).

China's rapid economic growth has lifted millions of people out of poverty and subsequently created a huge middle-income population within just two decades or so. According to the National Bureau of Statistics of China, in 2000, there are 6.3 million private vehicles in China. By 2015, total vehicles had reached more than 140 million. However, with improvements in public transportation in China, particularly in urban areas with newly built inter-city trains, private vehicles may not see the same high growth as in the past decade. Most of the increase in private vehicle possession occurred in coastal areas, as most economic growth is concentrated in those provinces (Figure 1.13).

Figure 1.13: Private vehicle ownership in China and breakdown by province, 2000-15



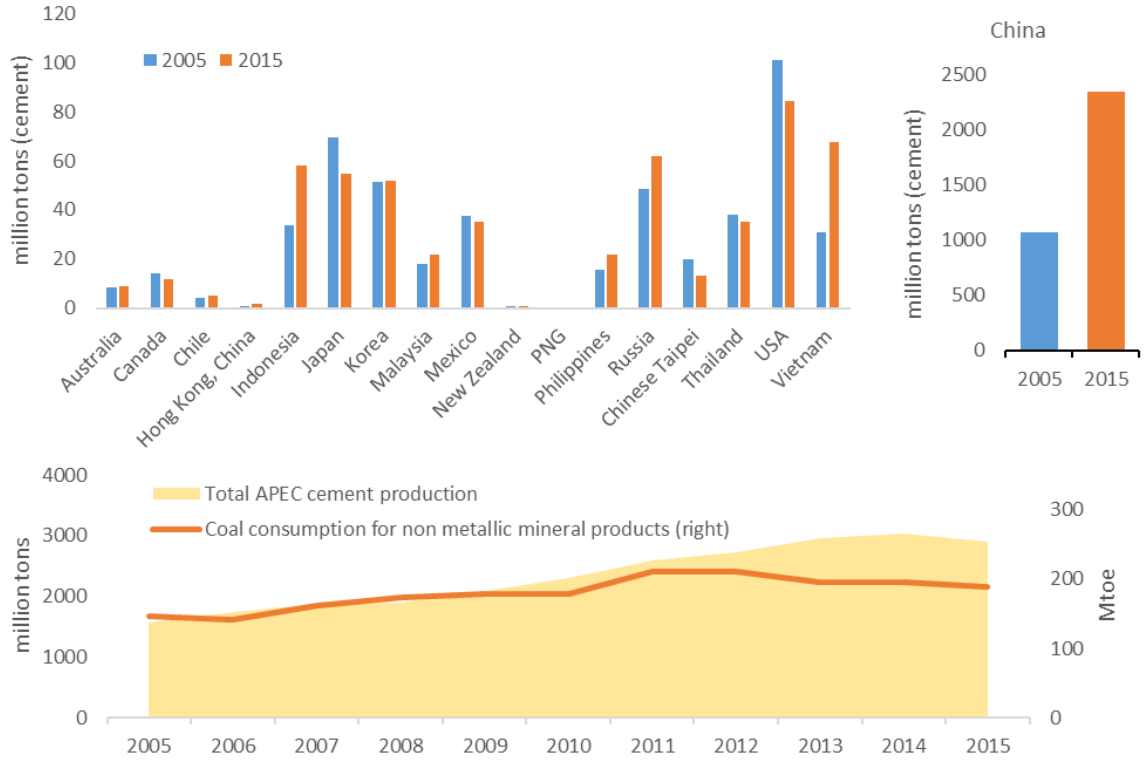
Sources: NBS (2017), WB (2017) and APERC analysis.

Cement production

In 2005, APEC members produced around 1.5 billion tons of cement, two-thirds of which came from China. By 2015, production had more than doubled to 3 billion tons, with China's share growing rising past 80%. Despite the rapid increase in output, decreasing coal intensiveness resulted in consumption growing modestly, from 145 Mtoe in 2005 to 178 Mtoe in 2014 (Figure 1.14).

Most developing APEC economies followed a similar trend, as Malaysia, the Philippines, Indonesia and Viet Nam experienced rapid cement production growth, the latter two doubling production within a decade. Chile, Korea and Mexico were the only OECD economies to experience cement production growth over that period.

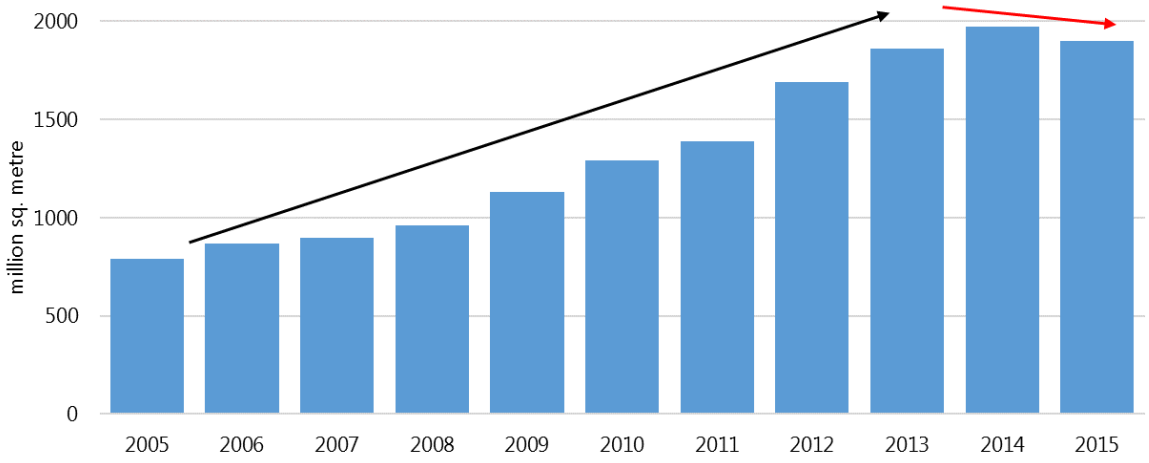
Figure 1.14: Cement production and coal consumption in APEC, 2005-15



Sources: USGS (2017), ESTO (2017) and APERC analysis.

While China is by far APEC's largest coal consumer for cement production, there are signs that consumption growth is moderating as new floor space completions have decreased over the past years according to data from the National Bureau of Statistics of China (Figure 1.15).

Figure 1.15: New floor space completed in China, 2005-15

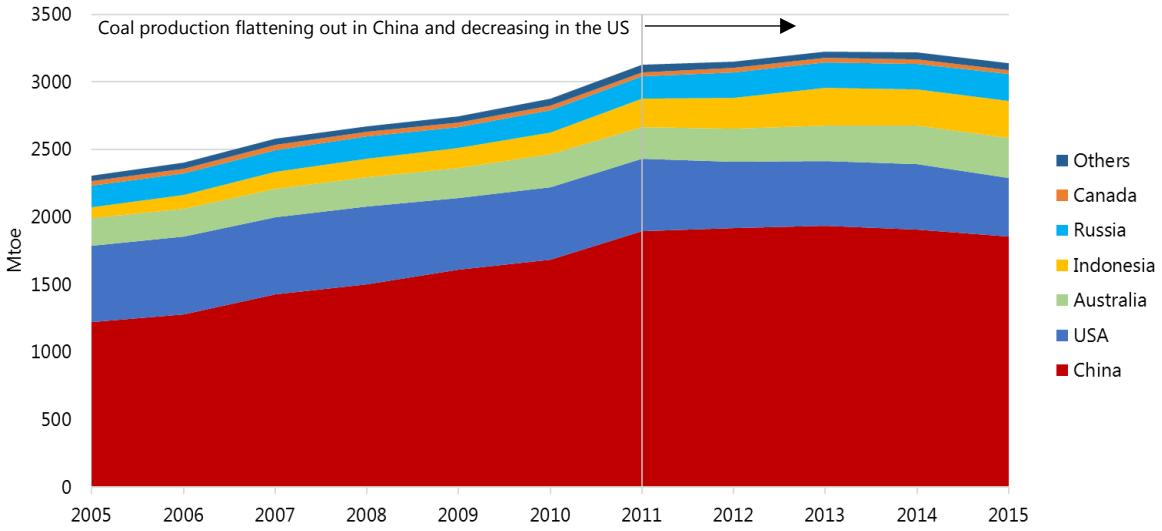


Sources: NBS (2017) and APERC analysis.

Coal production enough to meet APEC demand

APEC as a region produces enough coal to meet its demand. In 2015, five economies met 98% of APEC's coal demand: China (59%), USA (14%), Australia (10%), Indonesia (8.7%) and Russia (6.4%) (Figure 1.16).

Figure 1.16: Coal production by economy, 2005-15



Source: ESTO (2017)

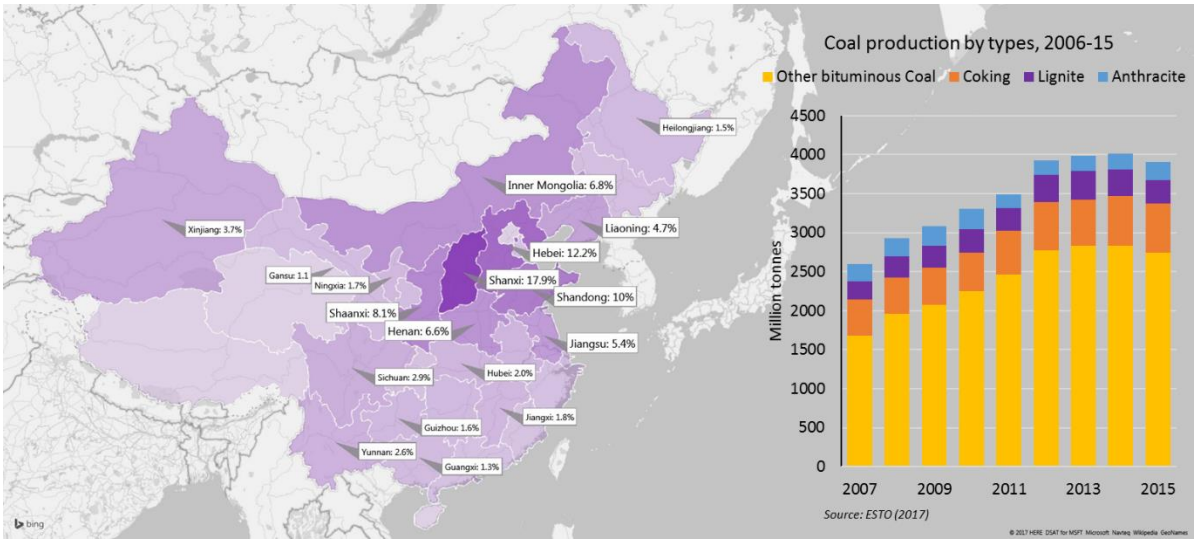
China

As the biggest coal producer and user in the world, China's coal production is wholly driven by local demand. For the period 2005 to 2011, coal production increased at a rate of 8% annually, from 1 100 Mtoe to 1 900 Mtoe, but has flattened since because of a significant slowdown in domestic demand.

While almost all of China's 31 provinces produce coal (in 2005 only Tibet and Hainan did not) the majority of coal mines are located in the north. In 2015, about 40% of coal production was in three Northern provinces: Shanxi (18%), Hebei (12%) and Shandong (10%) (Figure 1.17). It is interesting to note that by 2011, Beijing Province stopped reporting coal production statistics, although there are still a few coal mines there which are planned to be closed by 2020 (Beijing Government, 2016).

Thermal coal continues to dominate production in China. Coking coal and anthracite constitute 22% of coal production, a decrease from 24% in 2005, while the share of other sub-bituminous coal increased from 67% in 2005 to 70% in 2015 (ESTO, 2017).

Figure 1.17: Share of China's 2015 coal production by province and type of production, 2006-15



Sources: ESTO (2017), NBS (2017) and APERC analysis.
Note: ESTO reports the data in tonnes of oil equivalent unit. The conversion from toe to tons is based on the calorific value provided by ESTO in its publication.

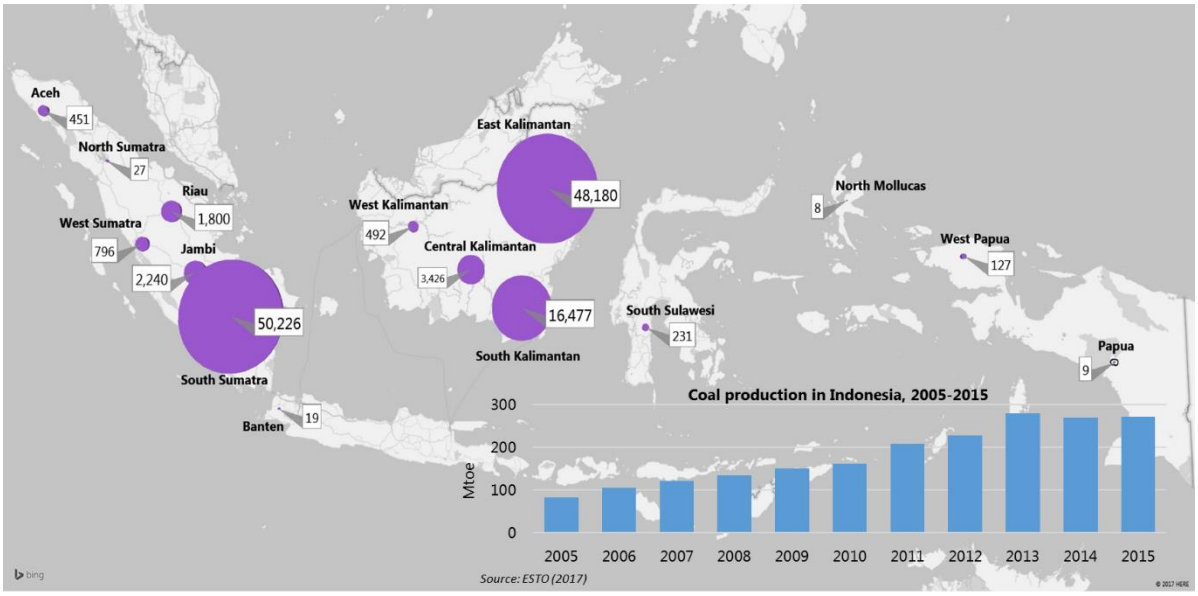
Indonesia

Surging coal demand in the mid-2000s, especially in emerging economies in Asia, prompted global coal production to increase rapidly. Indonesia, as one of the largest thermal coal exporters in the world, recorded production growth of 13% a year for the 2005-2015 period. Despite coal production in Indonesia tripling in a decade, domestic demand only doubled from 24 Mtoe in 2005 to 51 Mtoe in 2015, accounting for around 20% of total production.

As part of a government initiative to promote domestic coal consumption, Indonesia introduced a series of targets and policies that will slow coal exports and redirect production to local users. In 2009, the Indonesian government introduced the Domestic Market Obligation (DMO) regulation that covers all types of minerals and coal. Under this regulation, domestic coal users will declare their expected coal consumption for a year and all producers need to sell to these domestic users first. The coal user must get government permission in order to buy less than planned.

Based on the National Plan for Energy 2017 (known as Rencana Umum Energi Nasional or RUEN 2017), Indonesia plans to reduce coal production and cap it at 400 Mt by 2019 onwards. Most coal resources and production in Indonesia are located at Kalimantan and Sumatra Island (Figure 1.18).

Figure 1.18: Indonesian coal resources in 2015 and coal production, in million tons, 2005-15

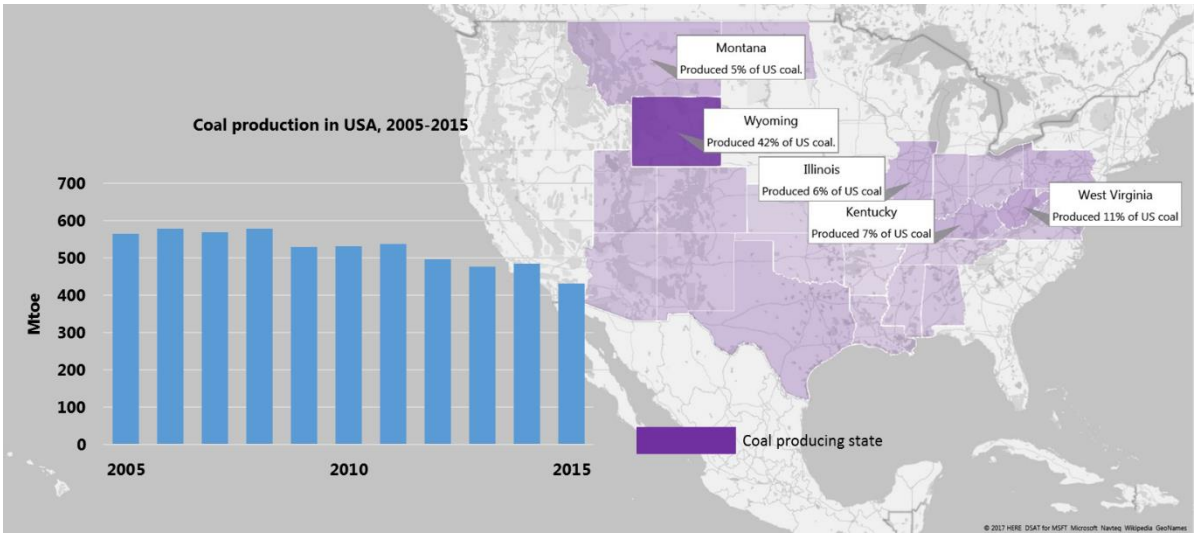


Source: DEN (2017).

United States of America

US coal production has slowed significantly in recent years, from 537 Mtoe in 2011 to 431 Mtoe in 2015 (ESTO, 2017) (Figure 1.19). Since reaching a high point in 2008, coal production in the US has been in systemic decline. Low natural gas prices, warmer-than-normal temperatures during the 2015-16 winter that reduced electricity demand, the retirements of some coal-fired generators, and lower international coal demand have all contributed to declining U.S. coal production (EIA, 2017a).

Figure 1.19: US coal production by type for 2005-2015 and shares by states in 2015



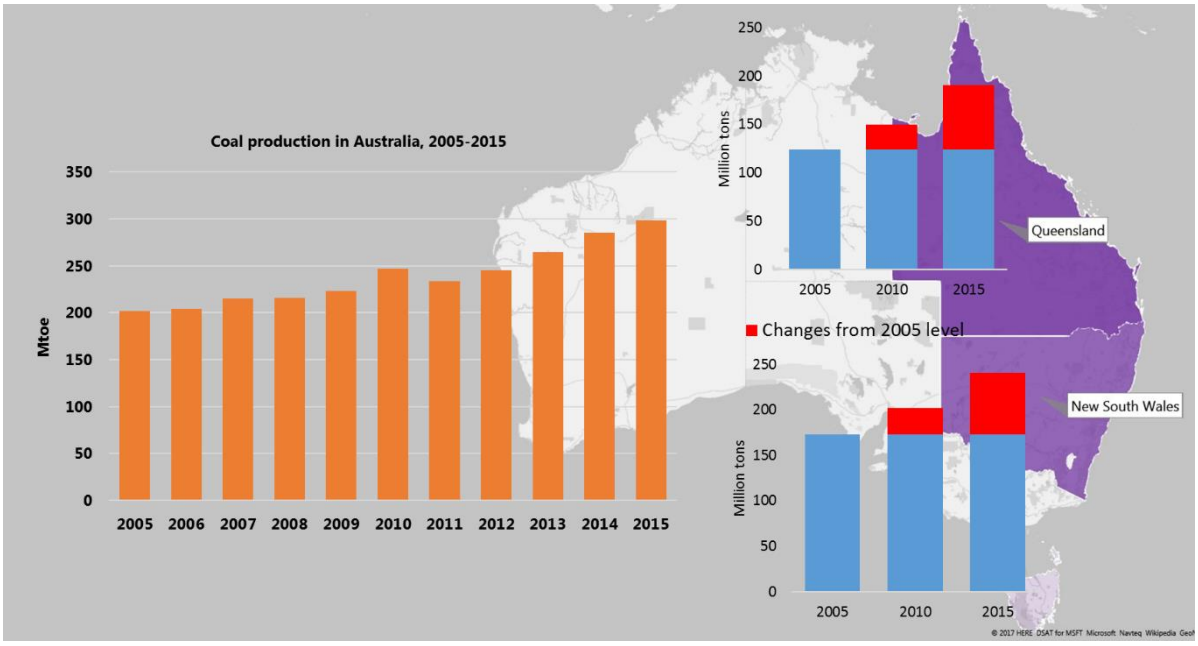
Sources: EIA (2017b), ESTO (2017) and APERC analysis

Half of the states in the US produced coal in 2015. Wyoming is by far the largest coal producer, with a share of 42%, followed by West Virginia (11%) and Kentucky (7%) (EIA, 2017b). Since peaking in 2008, almost all coal-producing states have had declining output.

Australia

Australia is a significant producer of both thermal coal (57% of total in 2014) and coking coal (43%) and was the world's largest coal exporter by volume in 2015. Increasing export demand has led to consistent growth in coal output, from 202 Mtoe in 2005 to 299 Mtoe in 2015, despite domestic consumption falling to 43 Mtoe in 2015, 17% lower than 2005 (Figure 1.20).

Figure 1.20: Coal production by type and major coal producing states in Australia, 2005-15



Sources: ESTO (2017), Department of Industry, Innovation and Science of Australia (2017) and APERC analysis.

Russia

Russia produced 200 Mtoe of coal in 2015, a 27% increase on 2005 levels. Coal demand in the economy increased marginally from 114 Mtoe in 2005 to 117 Mtoe in 2015. Most of Russia's coal mines are located in Siberia, which produced more than 80% of total production. This, along with Russia's huge land area, of which production location located far from the ports, presents challenges for Russian companies in bringing coal to demand centres.

Other notable developments

Besides the major coal producers above, a few other economies have experienced major developments in coal supply and production recently.

Chile

Despite being a coal importer, Chile's biggest coal mine in the southern region produces and exports coal to India. In 2016, Mina Inviernom, the coal mining company that developed the mine, produced 2.3 Mt, down from 4 Mt in 2014 due to low coal prices (Platts, 2017). Most of the coal produced from this mine was exported to India.

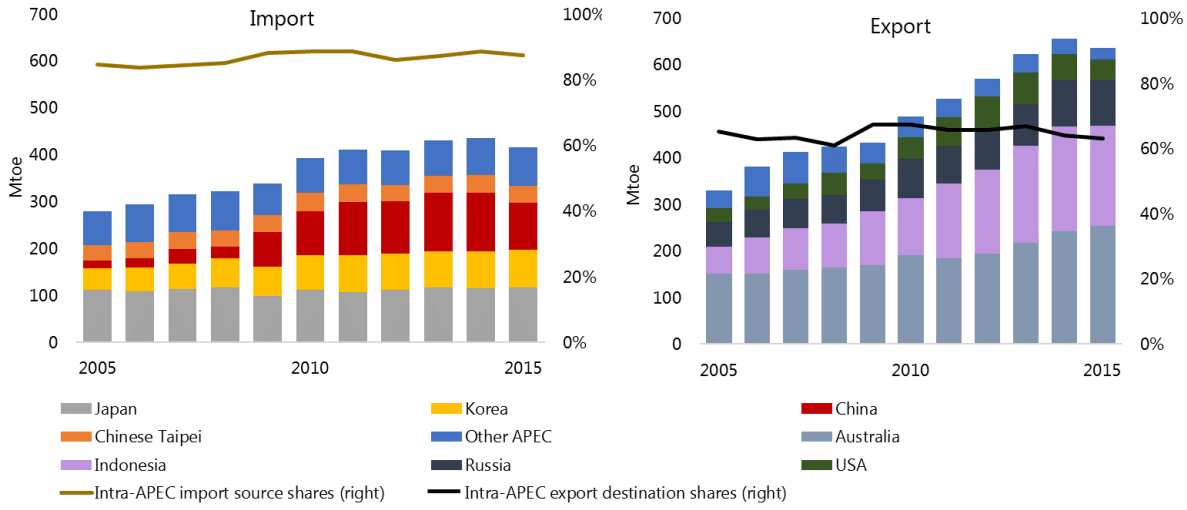
Papua New Guinea

The Papua New Guinea Mineral Resources Authority (MRA) has been active in resource development and in 2015 allocated $3 million for research into the viability of coal exploration and extraction. Among areas that have been actively explored is the Sepik Coal Basin, located in northern PNG (MRA, 2015). An Australian company has proposed building three mixed coal power generation plants in the economy to run on coal extracted from these fields (Mongabay, 2017) but the project is currently on hold.

Coal trade in APEC

In 2015, APEC members imported 415 Mtoe of coal, 48% more than in 2005. Over 80% of total APEC imports went to four economies: Japan (116 Mtoe), China (100 Mtoe), Korea (81 Mtoe) and Chinese Taipei (36 Mtoe) (Figure 1.21). Along similar lines, four economies constitute 96% of total APEC coal exports: Australia with 253 Mtoe, Indonesia (215 Mtoe), Russia (98 Mtoe) and the US (43 Mtoe).

Figure 1.21: APEC coal import/export by economy and intra-APEC trade shares, 2000-15



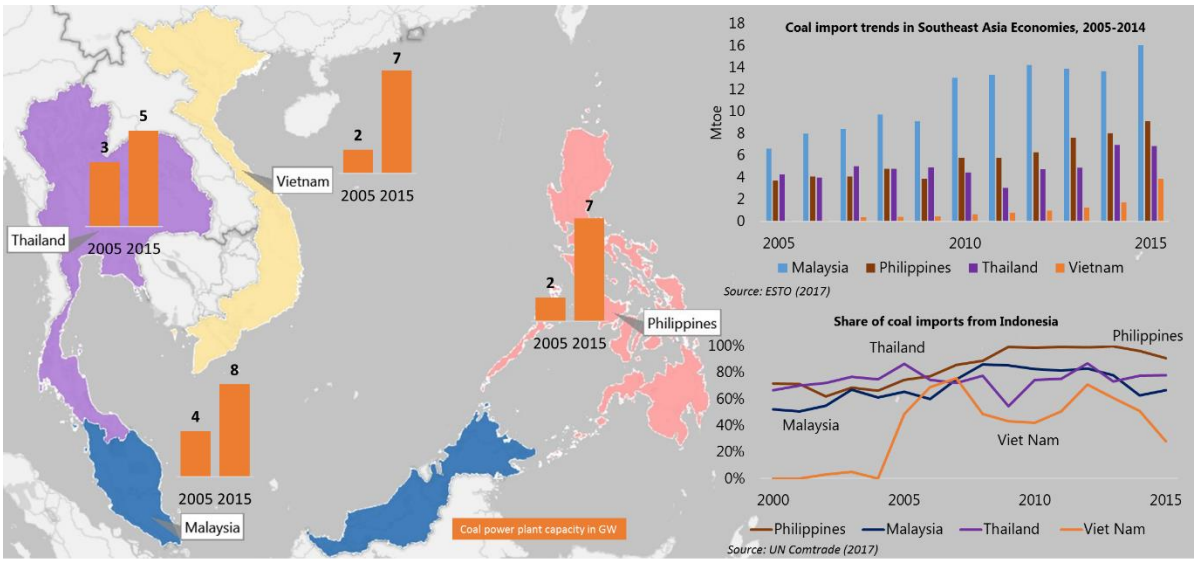
Sources: ESTO (2017) and UN Comtrade (2017).

Since a number of major coal importers and exporters are located in the region, intra-APEC coal trade has long been a significant component of the international coal market. Over the past decade, the

share of total imports from APEC members has been consistently above 80% while exports to APEC members has been consistently above 60% (UN Comtrade, 2017).

More recently, Southeast Asian economies such as Malaysia, the Philippines, Thailand and Viet Nam have experienced strong growth in coal imports to meet expanding coal power capacity (Figure 1.22). Viet Nam, traditionally a coal exporter, flipped to becoming a net importer in 2015 because of rapid growth in domestic demand. Proximity has resulted in Indonesia becoming the dominant exporter to the region.

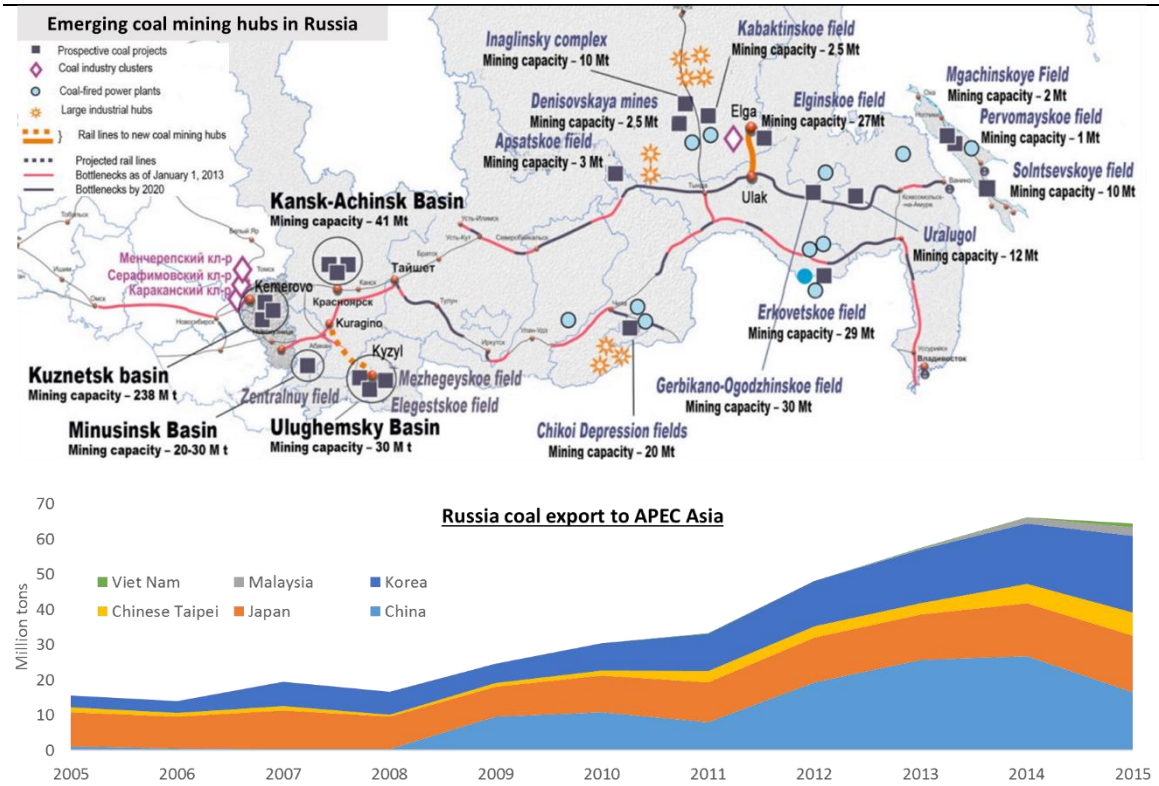
Figure 1.22: Southeast Asia-APEC coal import and coal power plant capacity, 2005-2015



Sources: ESTO (2017), UN Comtrade (2017), Platts (2016) and APERC analysis.

Russia, similarly, has started to expand their coal export infrastructure in the east to meet soaring demand in the Pacific region. Russian coal exports to Asian economies increased from 16 Mt in 2005 to 66 Mt in 2015 (UN Comtrade, 2017) (Figure 1.23).

Figure 1.23: Russia's emerging coal hubs and coal exports to Asia-APEC economies, 2005-15



Sources: UN Comtrade (2017) and Ministry of Energy of the Russian Federation (2015).

Some non-APEC economies, such as Colombia, South Africa, Kazakhstan, North Korea and Mongolia have also become major suppliers to the region. While Colombia exports its coal mainly to APEC-Americas economies, Kazakhstan, North Korea and Mongolia exported their coal mainly to China (UN Comtrade, 2017).

Section 2: Coal Demand and Supply Outlook

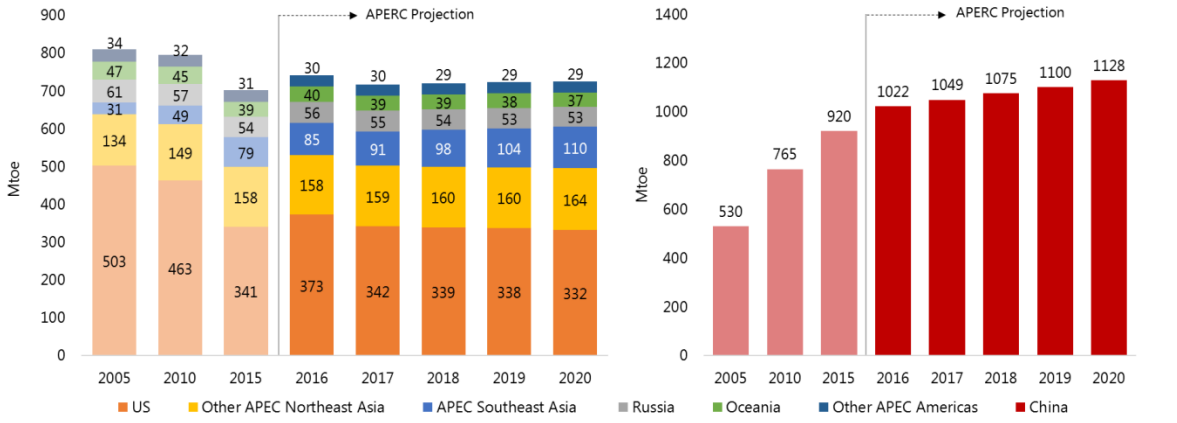
Demand Outlook

Thermal coal

The growth rate of world thermal coal consumption fell in 2015 and 2016 due to a decline in consumption in China, the United States, and Europe. However, the rate of decline in these regions slowed in 2017, while demand for thermal coal continued to rise in emerging countries and regions such as India and Southeast Asia on the back of an expansion in power demand.

China's power-sector coal consumption is projected to increase slowly through 2020, compared to the previous decade, as the government introduces regulations aimed at curbing use. US coal consumption will continue to fall, despite the efforts of the current government, because of the competition posed by cheap and abundant natural gas (Figure 2.1).

Figure 2.1: Historic coal consumption and projections in power sector, 2005-20



Sources: IEA (2017) and APERC (2016)
Notes: APERC projection was made in 2016 by using IEA 2014 historical data.
Other APEC Northeast Asia – Hong Kong, China; Japan; Korea and Chinese Taipei. APEC Southeast Asia – Brunei Darussalam; Indonesia; Malaysia; Philippines; Singapore; Thailand and Viet Nam. Oceania – Australia; New Zealand and Papua New Guinea. Other APEC Americas – Canada; Chile; Mexico and Peru.

Global thermal coal demand is expected to continue edging upwards to 2020. The trends for major coal consuming countries and regions are summarised below.

China

The Chinese central government has put in place policies to control coal consumption and production that has led to continuous declines since 2013, the peak year. However, in the first half of 2017, thermal power generation increased by 7.1% year-on-year as a result of growth in power demand amidst a slump in hydropower generation (itself a result of severe flooding) and warm weather. This is despite efforts to reduce coal consumption through the deployment of high-efficiency thermal

power generation, the closure of small- and medium-sized and aging power plants that do not meet environmental standards, and improvement of power generation efficiency by using of high-grade coal. Thermal coal consumption may therefore temporarily increase in 2017 but the growth of coal consumption will be controlled after 2018 as these structural changes take hold.

Southeast Asia

A number of coal-fired power plants have commenced commercial operation in Southeast Asia recently as a result of growth in power demand, and demand for thermal coal is rising steadily. Moving toward 2020, new coal-fired power plants will start commercial operation in countries such as Indonesia, Viet Nam, Malaysia, and the Philippines, and demand for thermal coal is set to grow.

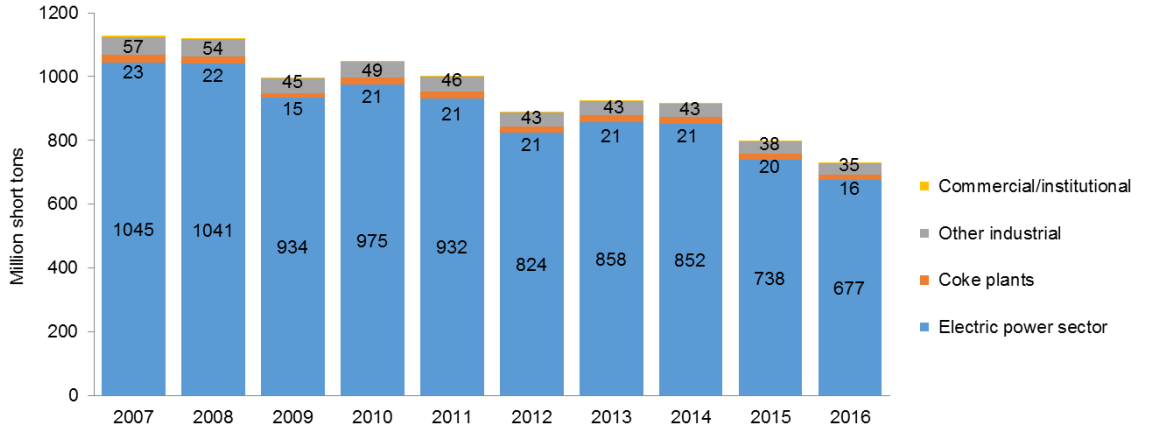
East Asia

In Korea, the start of new coal-fired power generation operations has led to rising import volume in 2017, which will continue to grow marginally after that. Likewise, the start of new coal-fired power generation facilities in Chinese Taipei is expected to bring about an increase in demand for thermal coal. On the other hand, the resumption of nuclear power plants generation in Japan is anticipated to cause a slight drop in demand for thermal coal.

United States

Competition with cheap gas has led to a drop in thermal coal consumption since 2014 (Figure 2.2). On top of that, new regulations on hazardous emissions substances lead to shut down of ageing coal-fired power generation facilities in the past five years. Thermal coal consumption will continue falling to 2020, but the rate of decline is expected to decrease as the closure of coal-fired power generation facilities slows.

Figure 2.2: Coal consumption in the United States categorised by usage, 2007-16



Source: EIA (2017c)

European Union (EU)

In the EU, the enforcement of air pollution standards and measures to reduce CO_2 emissions have contributed to progress in the reduction of coal consumption at coal-fired power plants as well as in the industrial sector. There are widespread trends within the EU to move away from coal, such as the goal to shut down all coal-fired power plants in the United Kingdom by 2025. According to the 'Energy, Transport and GHG Emissions Trend to 2050, EU Reference Scenario' published by the European Commission in July 2016, the EU plans to reduce the capacity of coal-fired power generation facilities in the EU from 177 GW in 2015 to 146 GW in 2020, and reduce coal consumption from 278 Mtoe to 251 Mtoe. More information is available in Box 2: Strengthening of Regulations on Coal-fired Power Generation in the EU, found below.

Other emerging regions

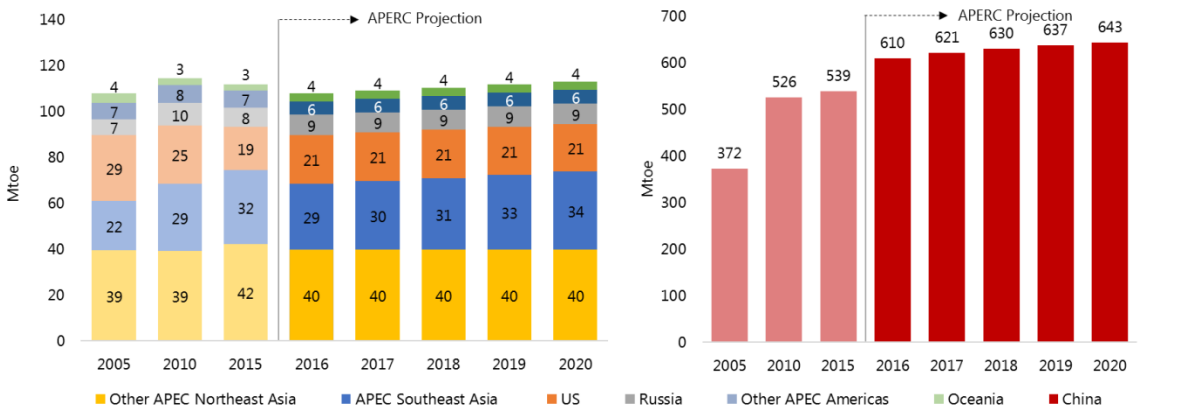
While there are several plans for coal-fired power plants in other emerging regions such as Latin America and Africa, it will be difficult to commence commercial operation by 2020 because of planning delays.

Metallurgical coal

Global consumption of metallurgical coal has fallen marginally in 2015 and 2016 because of a decline in consumption in China, resulting from a fall in pig iron production volume and improvements in efficiency (coal consumption per tonne of pig iron)

China and Southeast Asia economies are projected to record growth in industrial sector coal consumption while other APEC members are flat. (Figure 2.3).

Figure 2.3: Coal consumption in the industrial sector, 2005-20



Sources: IEA (2017) and APERC (2016).
Note: APERC's projection was made in 2016 using IEA 2014 historical data.

Moving toward 2020, demand for metallurgical coal in India is expected to increase steadily, while demand is expected to fall in China as the production volume for pig iron reaches its peak. In Japan, Korea, the United States, and Europe, despite fluctuations depending on economic trends, demand

for metallurgical coal is expected to move in a similar trend to pig iron production—remaining at largely the same level in Japan and Korea, and remaining at the same level or falling slightly in the United States and Europe. Apart from these countries, demand for metallurgical coal will increase in Brazil, and at steel mills in Viet Nam where production is starting, albeit on a small scale. The increase in demand in India and other developing countries will offset the fall in China, so total demand for metallurgical coal is expected to stay at the same level or increase slightly heading into 2020.

Lignite

Lignite consumption has remained at a level around 200 Mtoe, but showed a declining trend in recent years. Approaching 2020, consumption in India will increase because of growth in power demand. On the other hand, consumption is expected to fall in OECD member states which consume lignite for power generation, because of factors such as the Cabinet decision made by the largest consumer country, Germany, in October 2015 to stop the operation of some lignite power plants. Overall, global lignite consumption is expected to remain at the same level or decrease slightly over the next three years.

Production Outlook

Thermal and metallurgical coal

Global thermal coal production had been growing marginally since 2010, but declined in 2015. This was the result of declines in production in China, the United States and Indonesia, due to a fall in domestic consumption in China, decline in domestic consumption and exports in the United States and fall in exports for Indonesia.

On the other hand, metallurgical coal production increased until 2014, but fell in 2015 because of the impact of a fall in production mainly in China, the United States and Canada. The causes of the fall in production in the respective countries were a decline in domestic consumption in China and a fall in exports in the United States and Canada. The notable trends for primary coal producing countries to 2020 are summarised below.

China

As mentioned above, the government is driving efforts to control coal consumption and production. Production capacity far exceeds demand in China, and the central government is promoting the reduction of production capacity. Starting in April 2016, a measure to reduce the number of days of coal mine operation from 330 to 278 days a year was implemented in an effort to control production, but tightness on domestic demand and supply led to a hike in domestic coal prices. As a result, the government restored the number of days of coal mine operation to 330 days in November. China also exports a small amount of coal, which is not expected to increase, as domestic prices are comparatively higher than export prices. Therefore coal production will be controlled to meet domestic consumption.

United States

Coal production has been falling in the past few years because of falling domestic demand and exports. This trend is expected to continue to 2020 as gas retains its competitive advantage in the power sector and export demand growth remains sluggish.

Australia

Export and production volumes for both thermal and metallurgical coal have remained largely unchanged over the past few years. However, as Indonesia's export volumes fall, Australia's thermal coal production will likely rise to fill the growing Asian market. For metallurgical coal, production volume will also increase because of the anticipated gradual expansion of the seaborne metallurgical coal market. However, expansion of production in Mozambique, amongst other countries, will provide competition in meeting new demand.

Indonesia

Production has been declining in the past few years because of falling exports and deteriorating management at coal companies, brought about by sluggish prices in the four years to early 2016. Moving toward 2020, production is expected to shift downwards and stabilise around 400 million tonnes in response to government policies to reduce production gradually in order to efficiently utilise domestic coal resources.

India

Coal production is rising in tandem with the growth in consumption. However, domestic production is insufficient to meet demand, so import volumes are also on the rise. Under these circumstances, the Modi administration has formulated policies to increase domestic production, aimed at the effective utilisation of the wealth of coal resources in the country. To that end, it has established the ambitious goal of achieving 1.5 billion tonnes of production output in 2020.

Despite strong coal growth in India, cheap and expanding renewable capacity as well as coal supply shortages has resulted in the cancellation of multiple coal power plant projects – including a total of 13.7 GW in May 2017 (IEEFA, 2017).

Lignite

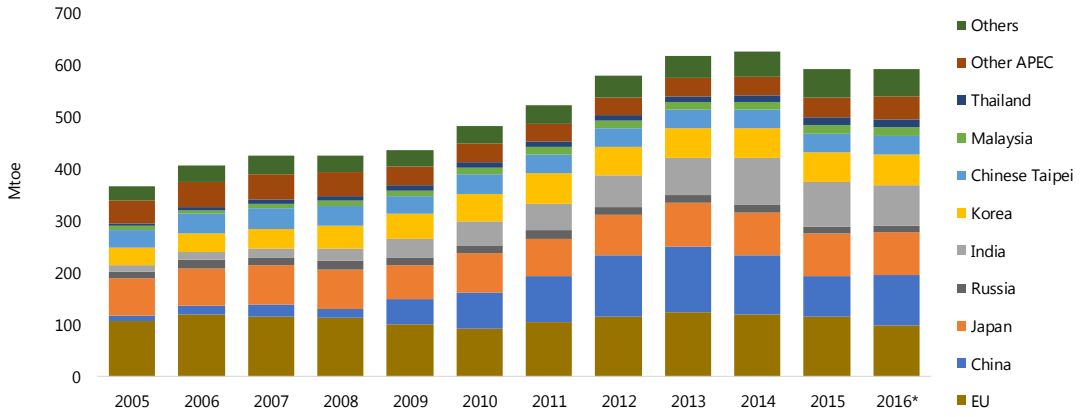
As lignite has high moisture and low energy content, power plants are typically built next to the mine so the coal is consumed directly onsite. Therefore, countries generally produce about the same quantity of lignite as they consume and international trade is negligible. Global lignite production will follow demand in gently decreasing towards 2020.

Trade Outlook

Thermal coal imports

Imports to China and the EU fell in both 2014 and 2015 in contrast to Southeast Asia, which grew in both of those years, as new coal-fired power generation facilities came online. Import volumes for India were mixed, growing steadily until 2014, but falling in 2015 (Figure 2.4).

Figure 2.4: Global thermal coal imports, 2005-16



*Note: *Estimated data.*
Source: IEA (2017)

China

China's coal imports increased significantly in 2016, and this trend looks set to continue in 2017. However, with the announcement that coal imports will be regulated at second-tier ports on 1 July 2017, it is likely that import volume will fall in the second half of 2017. Moving toward 2020, import volumes will likely to remain at the same level or decrease slightly if domestic demand and supply adjustments are successful.

India

Imports has fallen marginally since 2015 but are expected to continue growing again to 2020. While the Indian government is committed to increasing domestic production, it is unlikely that demand growth will be entirely satisfied by domestically produced high-ash coal.

European Union

Imports are in structural decline as the EU decarbonises. Coal-fired power generation plants will continue to close and be replaced by renewable – mainly wind and solar – generation.

Southeast Asia

Imports increased significantly in Viet Nam, the Philippines and Malaysia in 2016. The start of commercial operation of new coal-fired power generation facilities in the near future will continue to support import volume growth in Viet Nam, the Philippines, Malaysia and other parts of the region.

Korea, Chinese Taipei, Japan

Imports to Korea have been on the rise in 2017 as new coal-fired power generation facilities commence operations, and will continue to increase slightly to 2020. In Chinese Taipei, coal imports will likewise grow with the start of new coal-fired power generation facilities. On the other hand, the resumption of nuclear power generation facilities in Japan will result in decreasing thermal coal imports in coming years.

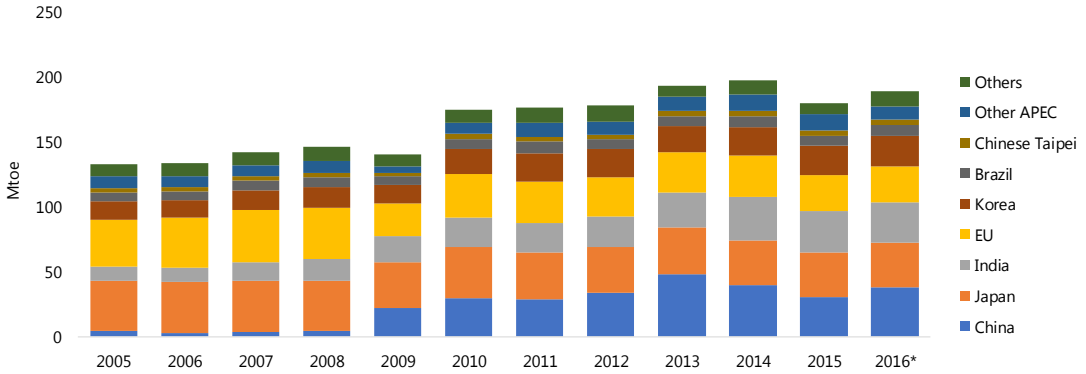
Other regions

There are plans to construct coal-fired power generation facilities in Africa, South America, and the Middle East. Import volumes will likely increase in the long-term, but are expected to grow only marginally heading into 2020.

Metallurgical coal imports

China's imports have fallen significantly for two consecutive years in 2014 and 2015, after peaking in 2013. Similarly, imports to the EU also fell in those years, extending a long-term decline. India's import volumes have been growing steadily over the past decade, despite a small fall in 2015, while Japan and Korea have remained largely unchanged (Figure 2.5).

Figure 2.5: Global metallurgical coal imports, 2005-16



*Note: *Estimated data.*
Source: IEA (2017).

China

Metallurgical coal imports grew in 2016 and early 2017. However, pig iron production has already reached its peak, so demand is expected to tail off through the remainder of the year. Like thermal

coal, import volumes over the next three years will remain unchanged or drop slightly based on the assumption that domestic demand and supply adjustments are successful.

India

According to customs clearance data, metallurgical coal imports in 2016 fell but are expected to increase again as growing demand, driven by the iron and steel sector, continues to 2020. Although India possesses vast quantities of coal resources, it has little metallurgical coal reserves and therefore needs to rely on imports.

Japan and Korea

Metallurgical coal demand, almost entirely supplied by imports, will remain largely unchanged through 2020.

European Union

Demand for metallurgical coal will likely remain unchanged or fall slightly, but import volume is expected to increase slightly because of a decline in production in the EU region.

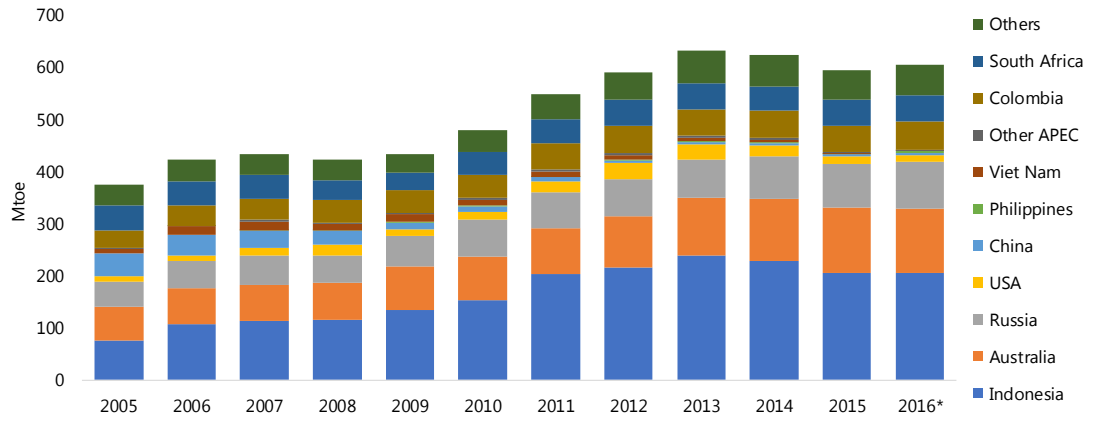
Others

Imports to developing economies such as Brazil, Indonesia, where small-scale iron mills are already in operation, and Viet Nam, where steel mill operations are starting up, will continue increasing, albeit slightly,

Thermal coal exports

Export volumes from Indonesia, the United States, and Viet Nam fell for two consecutive years in 2014 and 2015 but were somewhat offset by increased exports from Australia and Russia. In 2016, exports continued to decline for the United States, but increased for Russia and Colombia (Figure 2.6).

Figure 2.6: Global thermal coal exports, 2005-16



*Note: *Estimated data.*
Source: IEA (2017).

Australia

Export volumes will increase in response to the expansion of the Asian market and the fall in exports from Indonesia. The sanctioning of the Carmichael mine in the Bowen Basin, capable of producing 60 million tonnes of thermal coal a year if approved, would greatly increase Australian thermal coal exports but faces considerable hurdles.

South Africa

Exports have been shifting from Europe to Asia over the past decade and in 2016, half of the total were bound for India. This trend will continue as the European market shrinks and despite total export volumes decreasing slightly in recent years. Reserves in leading production regions are depleting, and the quality of the coal is deteriorating. While the development of coalfields in the north is underway, domestic demand will likely offset any new capacity, leaving exports, at best, unchanged.

Indonesia

The government is targeting 400 million tonnes for production volume in 2019, which given a growing domestic market, would necessitate a decline in exports to 2020. While there is a need to examine in detail the degree of growth in domestic demand, at the very least several tens of millions of tonnes of thermal coal are likely to disappear from the seaborne coal market.

Russia

Approximately 90% of Russia's coal exports are thermal coal. The volume of exports bound for Asia is on the rise (in 2016, approximately 50% of the exports were bound for Asia, of which 60% were exported to Japan, Korea, and Chinese Taipei), and will continue to increase in the future. Efforts are underway to develop ports with the aim of expanding exports to Asia, but bottlenecked rail transport capabilities are stymying significant increase in export volume.

Colombia

Currently a major exporter to the European market, which makes up 60% of all exports, Colombia will look to expand exports with a focus on both small nearby markets in South America and large, distant markets in Asia. With low free on board (FOB) costs, Columbian coal is very competitive, but the long transportation distance to Asia, usually via the Panama Canal, poses an expensive problem. Despite this, Colombian exports are likely to find their way to Asia as part of efforts by buyers to diversify their import sources.

United States

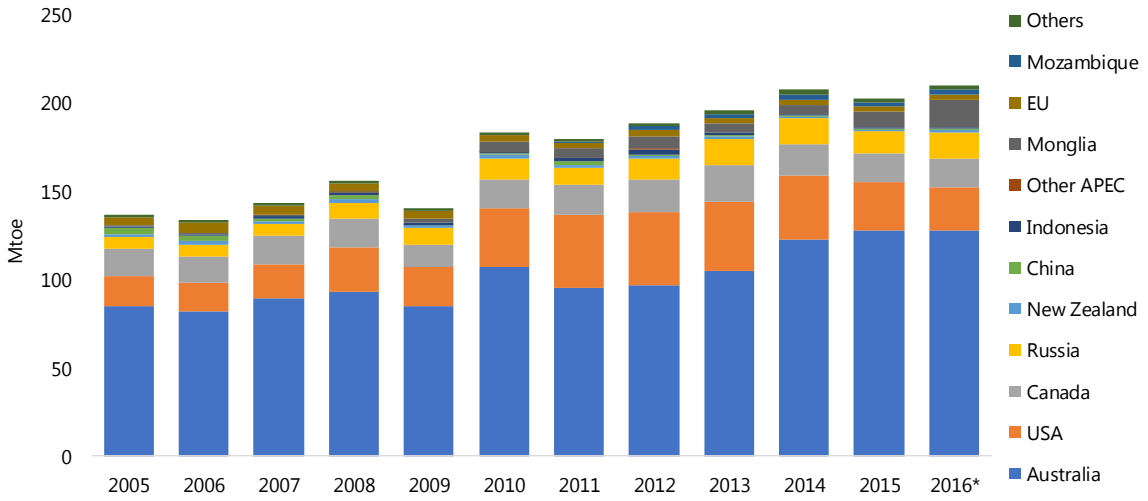
Exports will decline as the European market, which is its main export destination, shrinks in scale. Sluggish international coal prices and the decline in domestic consumption have caused cash flow problems for many coal companies, leading some to file for bankruptcy. Poor competitiveness due to high FOB costs is a major problem, as well as the long distance for marine transportation from shipping ports along the Atlantic Ocean when exporting to Asia. Unless expensive West Coast rail and

shipping infrastructure are developed to bring Wyoming coal to market, it is unlikely that exports will grow in the medium term.

Metallurgical coal exports

Global export volumes increased in 2016 after a slight fall in 2015. Australia's exports increased in 2014 and 2015, while export volume from the United States fell significantly over the same period. Exports from Russia and Canada also declined. In 2016, export volumes increased slightly for Australia, continued to fall for the United States, and increased for Mongolia (Figure 2.7).

Figure 2.7: Global metallurgical coal exports, 2005-16



*Note: *Estimated data.*
Source: IEA (2017).

Australia

Supply capability will increase with the increase in production at existing coal mines, as well as the resumption of suspended coal mines. Export volume will increase to meet the growth in demand.

Canada

Export volume had declined in the past few years, but is expected to recover with the increase in production by Teck Resources and the resumption of suspended coal mines.

Mozambique

Coal mining and infrastructural development are underway, contributing to improvements in supply capability. Export volumes are therefore expected to increase significantly from current volumes, centred on exports bound for Europe and India. Investments by companies such as Mitsui & Co., Ltd. and Nippon Steel & Sumitomo Metal Corporation will also boost exports to Japan.

Russia

Export volume to Europe will remain at the same level, but advancements in the development of coal mines and transportation infrastructure in the Far East signal that an increase in export volume to Asia are imminent.

United States

Current demand from export destinations has levelled off, but high FOB costs and growing supply capability in Mozambique will bring about a decline in the volume of exports bound for Europe. This will be offset by exports to India and South America, where import volumes are on the rise, as well as Japan and Korea, which are expected to be maintained due to the high quality of US metallurgical coal.

Mongolia

Most coal production is exported to China, which will continue to drive growth as Mongolian coal is cost competitive.

Box 2: Strengthening of Regulations on Coal-fired Power Generation in the EU

There has been growing criticism of coal in recent years due to the need to strengthen climate change measures. The EU enforces energy and environment policies that focus on de-carbonisation such as the EU Emissions Trading System (EU-ETS) – launched in earnest in 2008. However, while coal-fired power generation in the region declined from 2008 to 2010 against the background of economic downturn and a fall in power demand, it rose from 2010 to 2012, bringing about an expansion in the market share for coal-fired power and a reduction in the market share of gas-fired power.

While the reasons behind this are complex, the following factors have contributed to the resilience of coal-fired power generation in the fuel, carbon, and power markets.

- In the fuel market, coal prices fell on the back of global economic recession and oversupply, while natural gas prices rose.[4]
- In the power market, many countries have introduced feed-in tariff (FIT) schemes, bringing about a surge in renewable energy generation. This has displaced natural gas-fired power generation, which faces higher fuel prices than coal.
- In the EU Allowance (EUA) market under the EU-ETS, the price rose to almost 30 Euros/tCO2 in 2008, but nose-dived to 7.5 Euros/tCO2 in 2012 against a background of economic downturn, oversupply of EUAs, and an increase in FIT power, and has remained sluggish thereafter.

In the face of this situation, the EU introduced, or is considering the introduction of, the following measures to promote the scaling down or abolition of coal-fired power generation.

- With respect to coal production, in addition to rapidly reducing the amount of state subsidies, it became mandatory to submit to the European Commission plans for the closing of mines by the end of 2018. If mines do not meet the prescribed deadline, any subsidies must be fully refunded to the state.
- Under the EU-ETS, policy intervention to support renewable energy generation and improve market competition is aimed at tightening the carbon market and thereby increasing the cost of coal-fired power generation. At the same time, the EU is embarking on a more direct method of suppressing coal investment through the introduction of the Industrial Emissions Directive (IED), which is a form of command-and-control style environmental regulation.

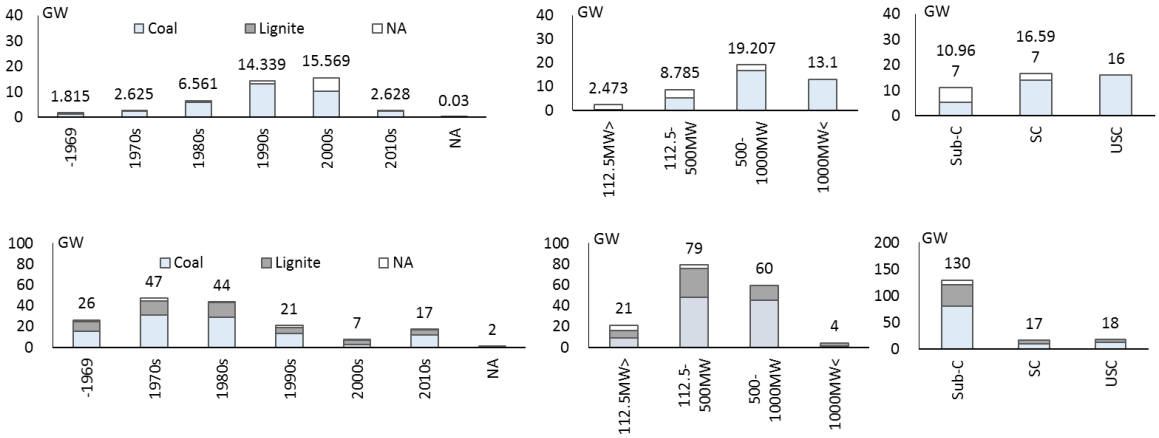
[4] The thermal coal spot price in Europe increased rapidly in 2008 and fell significantly in 2009. Thereafter, it rose throughout 2011, but did not return to its level prior to the Lehman shock. It then declined continuously until 2016. On the other hand, the wholesale price of natural gas in the EU fell significantly in 2009 and rose after that. Depending on the country, prices returned to pre-Lehman shock levels by 2012 or 2014, and did not suffer any major decline from 2012 to 2013.

- Under the capacity mechanism aimed at securing supply capability, the European Commission has proposed (in November 2016) rules that incorporate a CO_2 emission standard (550g/kWh) that is unattainable by coal-fired power generation unless it is accompanied by CCS, creating the possibility that coal-fired power generation could be excluded from the scope of the capacity mechanism.

According to the long-term energy outlook announced by the European Commission in July 2016, plant capacity for thermal power plants with CCS will be only 833 MW in 2020, and not exceed 1083 MW by 2030. There are no prospects for the expansion of coal-fired power generation without CCS. The percentage of coal-fired power generation in the region is expected to fall to 15% by 2030 and 5% by 2050.[5]

In the EU, the deterioration of aging coal-fired power generation facilities is a conspicuous problem, and there is an overwhelming number of facilities with low-power generation efficiency (Figure 2.8). This will assist in efforts to abolish or scale down coal-fired power generation.

Figure 2.8: Coal-fired power generation in EU and Japan



Sources: Platts (2016) and IEEJ Analysis.

[5] EU Reference Scenario 2016: Energy, transport and GHG emissions Trends to 2050, European Commission. Note that coal-fired power generation is classified as "solid fuel (solids)," and includes various types of coal, coking coal, as well as BKB (brown coal (lignite) briquettes), peat, oil shale, and oil sand (Eurostat).

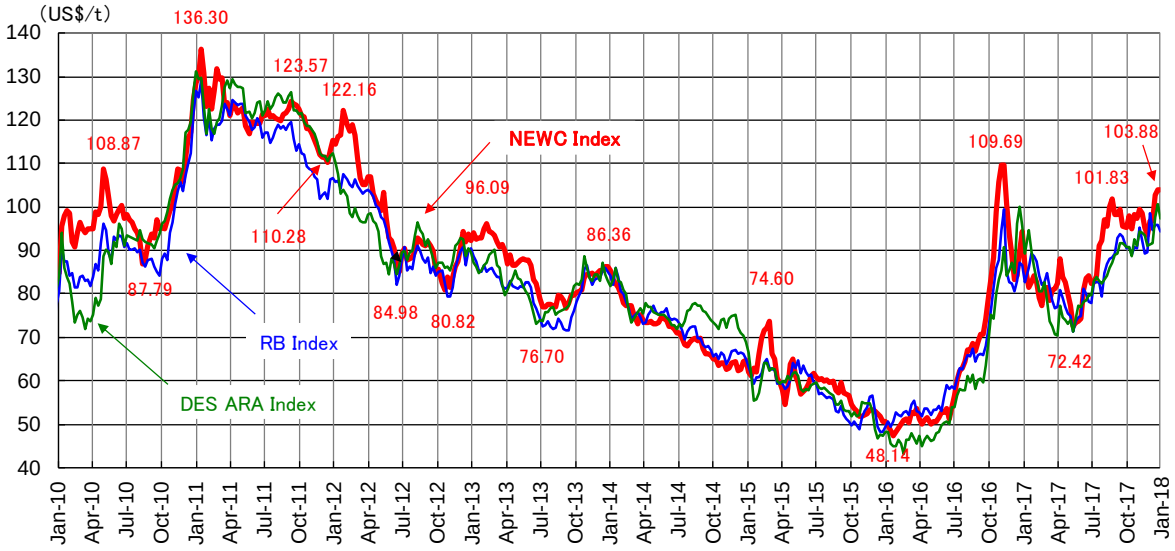
Section 3: Coal Prices

Coal prices, for both thermal and metallurgical coal, peaked at the beginning of 2011 before sliding into a period of sustained deflation that lasted until early 2016. The key contributing factors behind this trend were the high volume of investments in coal during the coal boom in the late 2000s when prices were high and the subsequent oversupply that emerged when demand failed to grow as expected after 2011. However, efforts were made to cut costs and reduce excess supply capability during this period, such as by closing or temporarily suspending inefficient mines. Along with the fall in imports to China, which took steps to significantly reduce imports for two consecutive years in 2014 and 2015, these efforts finally led to coal prices bottoming out in early 2016. Prices of both thermal coal and metallurgical coal rose slightly in the first half of 2016, before fluctuating violently in the second half of 2016 and 2017 mainly due to increased demand from China and some troubles in supply side such as natural disasters, accidents etc.

Thermal coal

The seaborne thermal coal spot price (Newcastle FOB price, NEWC Index shown in the figure below) peaked at US$136/tonne in January 2011, before entering a half decade long period of decline, reaching US$48/tonne in January 2016. Prices remained in the lower US$50/tonne range in the first half of 2016 then rose sharply from July to hit US$110/tonne by November (Figure 3.1).

Figure 3.1: Trend of thermal coal spot price, 2010-17



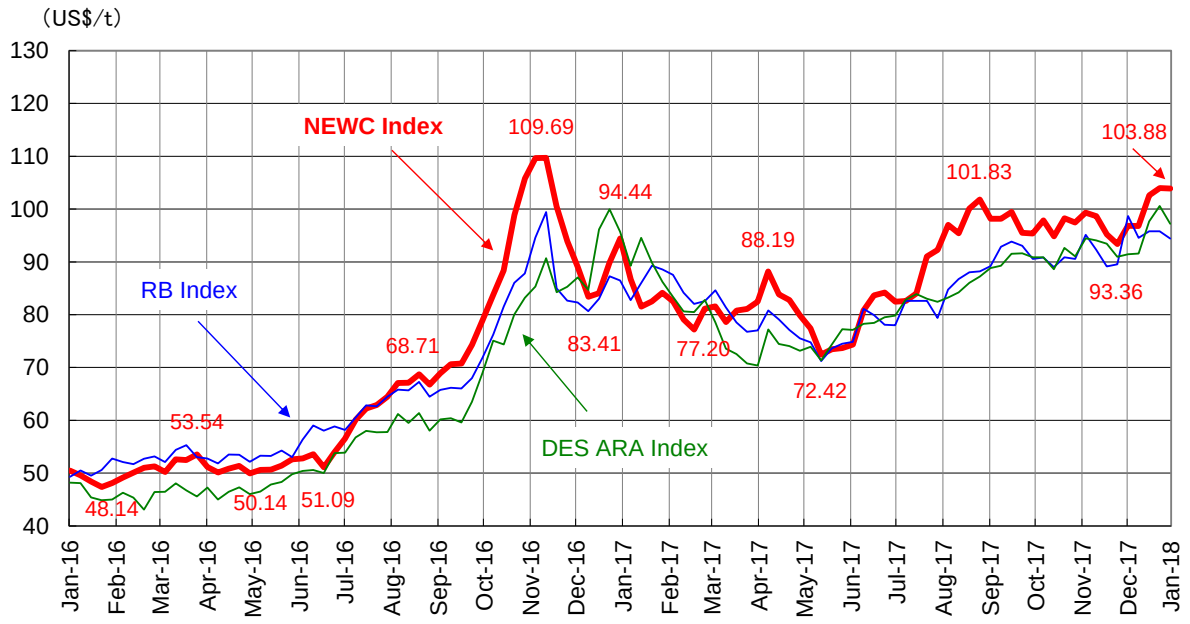
Source: globalCOAL (2017)

Prices began easing in early 2017 until Cyclone Debbie caused significant disruptions at Australian coal mines in the end of March, sending prices spiking briefly again. At the beginning of June,

countries such as China and Korea increased procurement in anticipation of the summer demand period, causing thermal coal prices to move upward, reaching US$100/tonne by late August. Prices remained in the upper US$90 range as strikes at Glencore continued, and exceeded $100 at the end of December as the winter demand season began.

The main reason behind the spike in prices in late 2016 is increased demand from China. Power demand increased at the start of 2016, and thermal power generation increased accordingly. Concurrently, as a result of policies to reduce production volume (reduction in number of days of mining operation per year from 330 days to 278 days), a slight oversupply of coal quickly became a shortage in supply. As such, the import volume for thermal coal increased year-on-year in anticipation of summer, which is a period of strong demand for coal, and coal prices rose to US$70/tonne by August. After that, predictions of a continued shortfall in domestic coal supply led Chinese buyers and traders to excessive procurement of imported coal in preparation for the winter demand season, driving coal prices to US$110/tonne in mid-November. As domestic coal prices in China had also soared, the Chinese government restored the number of days of mining operation back to 330 days in late 2016 and consequently, thermal coal spot prices fell to US$83/tonne (Figure 3.2).

Figure 3.2: Trend of thermal coal spot price, 2016-17



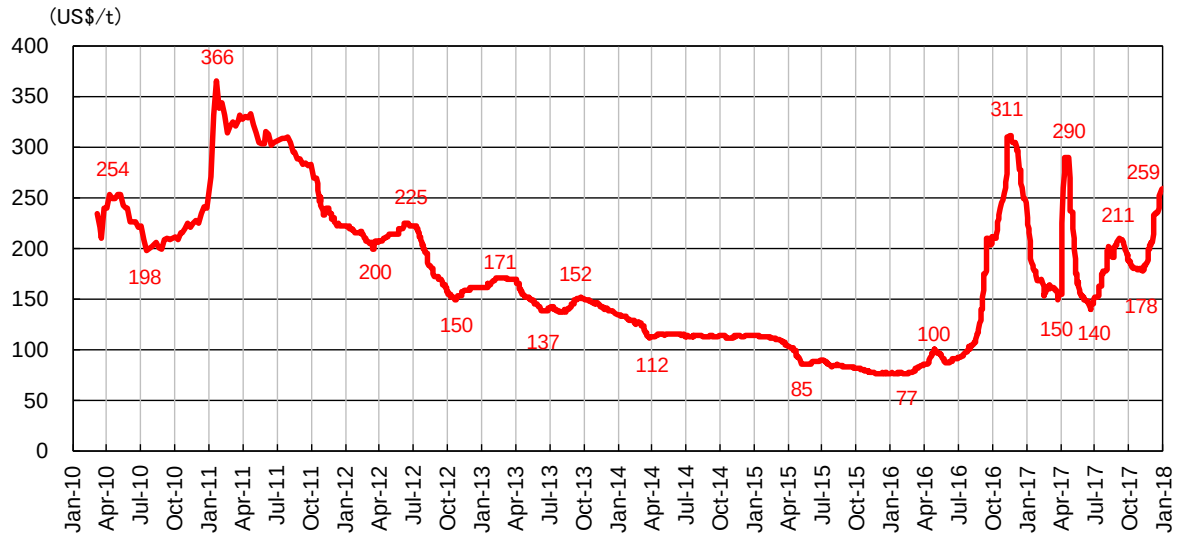
Source: globalCOAL (2017)

Metallurgical coal

Similarly to thermal coal, metallurgical coal spot prices (such as Australian Premium hard coking coal FOB) began to decline after peaking at US$366/tonne in January 2011, reaching US$80/tonne by

December 2015 (Figure 3.3). Prices remained stable – between US$80/tonne and US$100/tonne – until August 2016 when they started increasing rapidly and peaked at US$311/tonne in November. Prices were easing again before Cyclone Debbie struck Queensland, Australia, at the end of March, causing numerous mines to temporarily shut down and leaving damaged port and rail infrastructure. As a result, metallurgical coal prices shot up US$290/tonne before easing again as mines reopened and infrastructure damage was revealed not to be too extensive. Prices returned to $150 in June, but then jumped to $210 in September when Australia's Appin coal mine suspended operations due to methane gas issue. It fell temporarily to $180 in October, but began to rise again in late November due to poor production in Australia, reaching near $260 at the end of December.

Figure 3.3: Australian Premium hard coking spot price, 2010-17

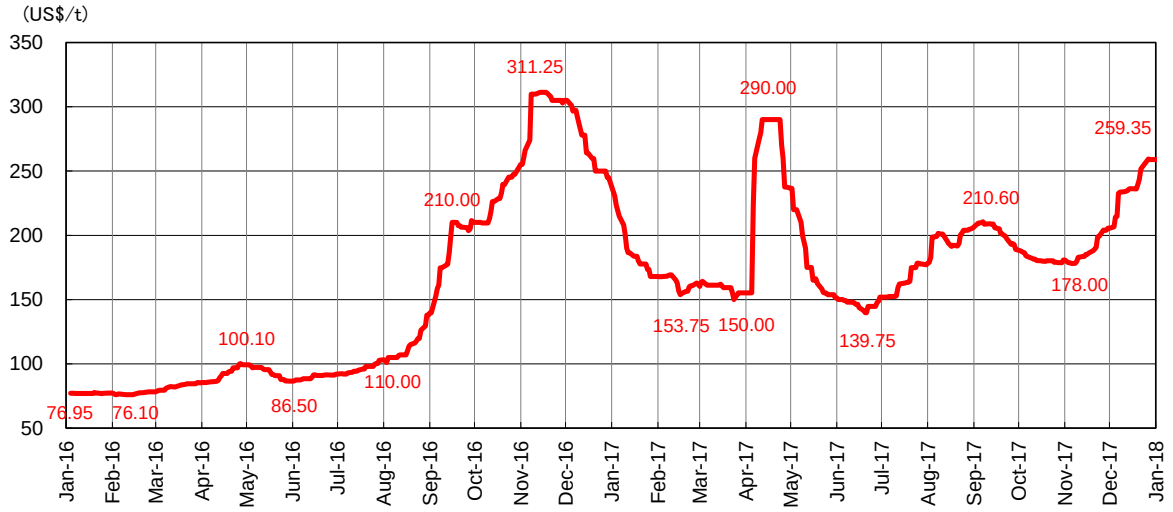


Source: IHS (2017)

The rapid spike in metallurgical coal prices in 2016 was also primarily caused by demand and supply trends in China. Iron and steel demand increased at the start of 2016, triggering a year-on-year increase in iron and steel production. Consequently, metallurgical coal prices, which had been in the higher US$70/tonne range at the beginning of 2016, increased to US$100/tonne at the end of April. After that, prices dropped to the middle range of US$80/tonne in June. However, several factors put pressure on China's metallurgical coal supply, including policies to suppress production volume, as well as damage to coal transportation systems caused by heavy rains that had begun at the end of July in Shanxi Province, which is a major production region for metallurgical coal. Furthermore, two metallurgical coal mines in Australia were forced to suspend production because of accidents. The combination of these factors led to metallurgical coal prices rising rapidly to US$311/tonne in November. Thereafter, measures to reduce production in China were halted, the metallurgical mines in Australia that had suspended production reopened, and plans were made to resume operation at

temporarily suspended coal mines and increase production at existing coal mines. As a result, the metallurgical coal price plummeted in early 2017.

Figure 3.4: Australian Premium hard coking spot price, 2016-17



Source: IHS (2017)

Forecast

The spike in coal prices in late 2016 pushed forward plans to reopen shuttered mines, and incentivised some existing mines to increase production. In addition, some new projects, which had been shelved with prices in decline, are beginning to move ahead again. Coal export capacity is therefore expected to increase in the medium term.

Thermal coal imports are expected to increase in Asia and non-OECD countries, particularly in Southeast Asia and India where power demand will increase in tandem with economic growth, and decline in Europe and the United States. Overall, global thermal coal imports are expected to grow. Import volumes for metallurgical coal will increase in countries such as India, and perhaps marginally in the EU, because of falling production, but remain flat in other developed economies. In China, which has a significant influence on the coal market, the central government's policy is to adjust energy structure consumption and production of coal, which will influence global markets through 2020. However, coal imports are expected to remain mostly at the current level, although this is also dependent on domestic adjustments to demand and supply.

Under such circumstances, export volumes from Indonesia, which is the world's largest exporter of thermal coal, are expected to decline as the Indonesian government has adopted measures to suppress production (reducing production volume to 400 million tonnes in 2019) aimed at the protection and effective use of resources. Consequently, Thermal coal price, which now exceeds $100 due to winter demand and temporary supply issues, is likely to fall toward early spring in 2018 and

thereafter remain at around $70-90 with seasonal fluctuations, and it is expected to increase again after 2019.

Metallurgical coal supply capability in exporting countries is anticipated to increase at the same time as new capability from Mozambique starts to come online. However, since import demand is unlikely to increase in tandem with the level of supply growth, there is a possibility of oversupply in the short term. Metallurgical coal prices, which have been growing recently, will enter a downward trend in the immediate future, but stop falling when supply and demand reach a balanced level. After that, it is expected to level off or increase gradually.

Coal prices from 2016 fluctuated violently as a result of factors related to China, natural disasters, and accidents. Going forward, events such as these will continue to have a significant impact on coal prices.

References

APERC (Asia Pacific Energy Research Centre) (2016). *APEC Energy Demand and Supply Outlook 6th Edition,* http://aperc.ieej.or.jp/publications/reports/outlook.php

Beijing Government (2017). *Beijing says: Goodbye mining, hello tourists*, http://www.ebeijing.gov.cn/BeijingInformation/BeijingNewsUpdate/t1460630.htm

BP (2017). *BP Statistical Review of World Energy June 2017*, https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review-2017/bp-statistical-review-of-world-energy-2017-full-report.pdf

DEN (Dewan Energi Nasional) (2017), *National Plan for Energy 2017,* http://jdih.den.go.id/download/1220/perpres-nomor-22-tahun-2017-tentang-rencana-umum-energi-nasional

Department of Industry, Innovation and Science of Australia (2017). *Resources and Energy Quarterly June 2017*, https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/ResourcesandEnergyQuarterlyJune2017/index.html

EIA (Energy Information Administration) (2016). Coal production and prices decline in 2015, https://www.eia.gov/todayinenergy/detail.php?id=24472

---- (2017a). *U.S. coal production and coal-fired electricity generation expected to rise in near term,* https://www.eia.gov/todayinenergy/detail.php?id=29872

---- (2017b). *Archive weekly and monthly coal production,* https://www.eia.gov/coal/production/weekly/

---- (2017c). *U.S. Coal Consumption by End-Use Sector, 2011 – 2017,* https://www.eia.gov/coal/production/quarterly/pdf/t32p01p1.pdf

EPA (Environmental Protection Agency) *Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units* https://www.epa.gov/sites/production/files/2017-10/documents/frn_cpp_repeal_2060-at55_proposal_20171010disclaimer.pdf

ESTO (Energy Statistics & Training Office, APERC) (2017). http://www.egeda.ewg.apec.org/egeda/index.html

globalCOAL (2017). *Coal Prices,* https://www.globalcoal.com/coalprices/

IEA (International Energy Agency) (2016a). *Key World Energy Statistics 2016*, https://www.iea.org/publications/freepublications/publication/KeyWorld2016.pdf

---- (2016b), *Energy Balances of World 2016 edition*

---- (2017), *Energy Balances of World 2017 edition*

http://ieefa.org/ieefa-asia-indias-electricity-sector-transformation-happening-now/

IHS (2017). https://www.ihs.com/products/steam-coal-markets.html

ITA (International Trade Administration) (2017). *Steel Exports Report: United States,* http://trade.gov/steel/countries/pdfs/exports-us.pdf

Ministry of Energy of the Russian Federation (2015). *Current Status And Development Prospects Of Coal Industry In Russia*, http://www.jcoal.or.jp/coaldb/shiryo/material/upload/1-12speech%203%20Russia%20Mr.%20Mochalnikov.pdf

Mongabay (2017). *Papua New Guinea Moves To Launch New Coal Mining Industry*, https://news.mongabay.com/2017/05/papua-new-guinea-moves-to-launch-new-coal-mining-industry/

MRA (Mineral Resources Authority of Papua New Guinea) (2015). *Mining & Exploration Bulletin2016*, http://www.mra.gov.pg/Portals/2/Publications/Mining%20&%20Exploration%20Bulletin%202016.pdf

NBS (National Bureau of Statistics of China) (2017). *National Data*, http://data.stats.gov.cn/english/easyquery.htm?cn=C01

WB (World Bank) (2017). http://databank.worldbank.org/data/home.aspx

Platts (S&P Global Platts) (2016). *World Electric Power Plants Database*, https://www.platts.com/products/world-electric-power-plants-database

---- (2017). *Chile resumes coal exports to India, imports rise 47% in October: Ministry*, https://www.platts.com/latest-news/coal/santiago/chile-resumes-coal-exports-to-india-imports-rise-21425790

Reuters (2017). *After China-induced price spike, coal set to resume long-term decline*, https://www.reuters.com/article/us-coal-prices-analysis-idUSKBN1A91IJ

USGS (U.S Geological Survey) (2017). *Cement Statistics and Information*, https://minerals.usgs.gov/minerals/pubs/commodity/cement/

UN Comtrade (2017). *UN Comtrade Database*, https://comtrade.un.org/data/

WSA (World Steel Association) (2016). *Statistics*, https://www.worldsteel.org/steel-by-topic/statistics.html