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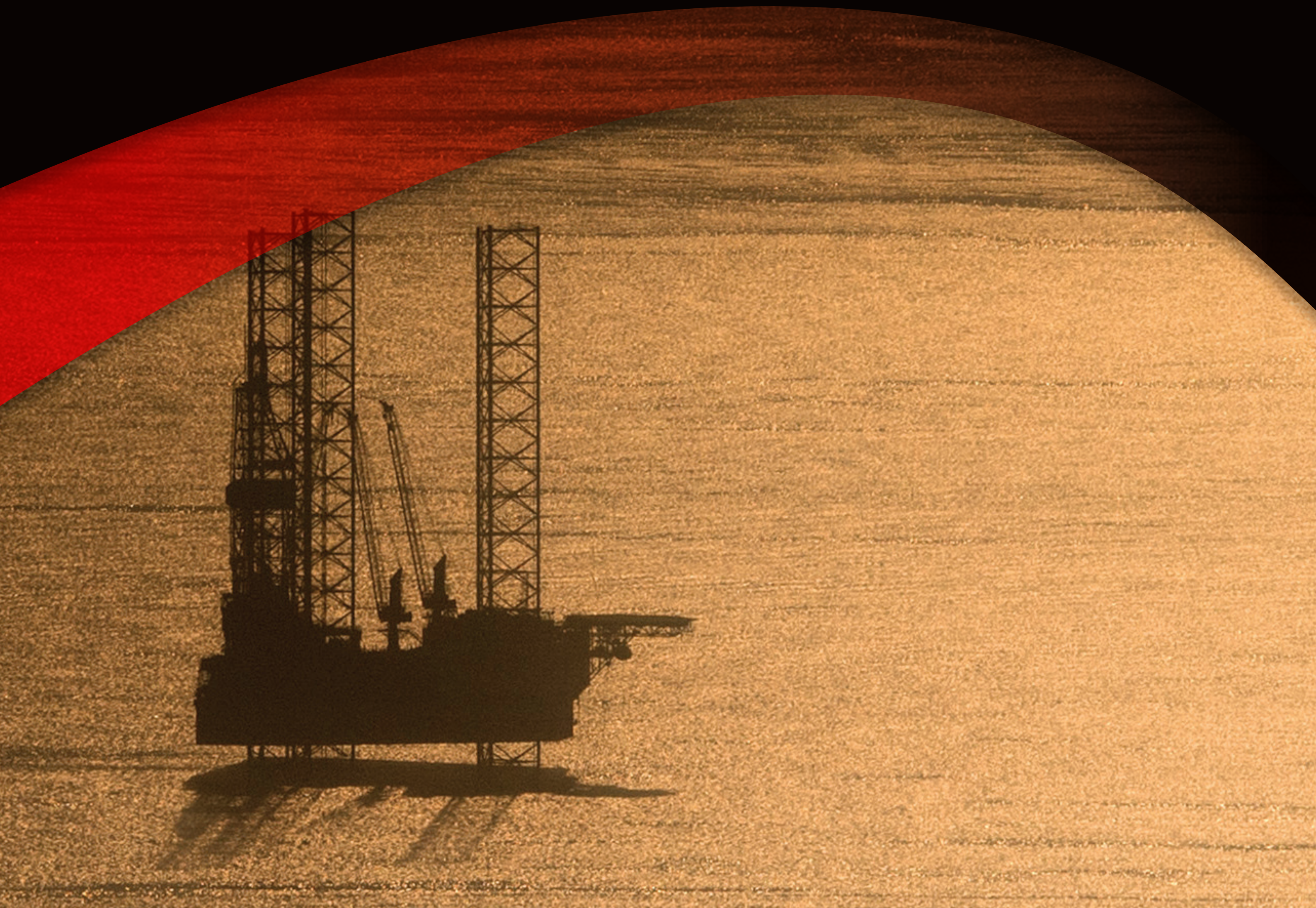
2030 Energy Mix – Key Regional Trends

Marching Towards A Cleaner Future



2030 Energy Mix – Key Regional Trends

Marching Towards A Cleaner Future

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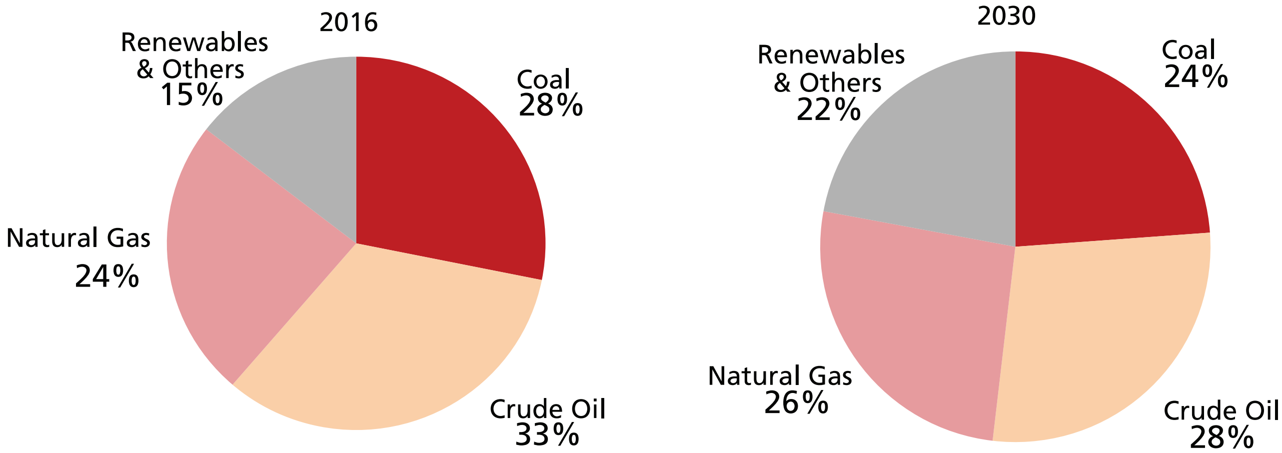
Executive Summary

Clear trend toward renewables, but fossil fuel demand to grow on an absolute basis nonetheless

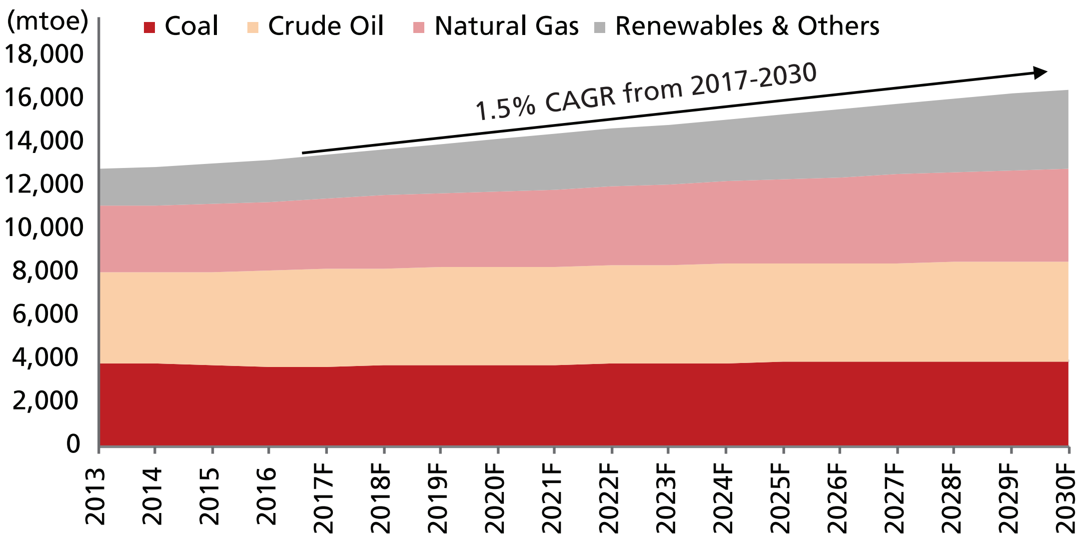
We expect global energy demand to increase at an average rate of about 1.5% per annum from 2017 to 2030, which is premised on the back of global GDP growth of around 3.25% p.a., offset by improvements in energy efficiency (i.e. declines in energy intensity). Despite a clear shift toward renewables in the energy mix, from 15% in 2016 to 22% in 2030, we believe demand for the three key fossil fuels – coal, oil, and natural gas – will not peak until 2030, albeit grow at differing rates. Natural gas demand will be strong and, in 2030, is expected to be around 33% higher than 2016 levels, while demand for coal and oil will grow much slower.

Change in energy mix – 2016 vs. 2030 (DBS expectations)



Source: DBS Bank forecasts

Growth in energy demand (in million tonnes of oil equivalent)



Source: DBS Bank forecasts

We identify and elaborate on six major regional and global energy trends

1. **Increasing importance of gas in China's energy mix.** Natural gas is greatly supported by the Chinese government as a type of fossil fuel that burns cleaner than oil or coal. China targets increasing the overall energy consumption proportion for natural gas from 5.9% in 2015 to 10% in 2020 and 15% in 2030. By the end of 2017, natural gas consumption had increased 15% y-o-y to 239.5b cubic metres (m3). In order to reach the government's target, we expect natural gas consumption to reach above 340b m3 by 2020, representing a compound annual growth rate (CAGR) of 13% from 2016 to 2020. The growth will be driven by industrial coal boiler conversions, rural household coal-to-gas conversion for heating, and lower domestic gas prices following pipeline reforms, which will stimulate demand.

2. **Increasing clean energy sources in China's electricity mix.** In China, power supply has been dominated by coal but the fuel mix is changing to include more wind and solar power. In 2017, coal power generation accounted for 73% of China's total power generation versus 80% in 2013. During the period, the proportion of renewable energy (RE) increased to 6.7% in 2017 versus 2.7% in 2013. We expect the ratio of RE in power to further increase to 9.3% in 2020 and 14.5% in 2030. From 2020 to 2030, we expect non-hydro renewable energy will account for around a 53% increase in China's power generation. Supportive government policies are still in place and, with advancements in technology driving down the construction and operating costs of wind and solar power farms, RE may reach tariff parity with coal earlier than expected.

3. **Rise of electric vehicles and impact on oil demand.** Passenger transport accounts for around 20% of global oil consumption. Our autos analyst expects global electric vehicle yearly unit sales to grow strongly from around 1.26m units in 2016 to over 26m units in 2030, representing an almost 15 times increase in yearly sales volumes. Much of the increase in sales will come from Asia, in particular China. We estimate this will affect about 6% of oil demand by 2030, but the more important component of the demand picture is increasing fuel efficiency. Thus, oil demand growth from other sectors and emerging economies will be offset by the above factors and we project global oil demand will grow quite slowly until 2030. Hence, supply will be the key determinant for oil prices in the medium- to long-term. We expect the 2018 Brent crude oil price to average between US$70 and US$75 per barrel (bbl) and our 2019 average forecast for Brent is slightly lower at around US$65-70/bbl.

4. **US as net energy exporter.** Strong domestic production, thanks to the technological breakthroughs that more than halved production costs of shale oil and gas, coupled with relatively flat energy demand paves way for the US to become a new energy exporter. Last year, the US became a net natural gas exporter, with exports quadrupled y-o-y to 1.94b cubic feet. US liquefied natural gas (LNG) exports are set to quintuple by 2019 from 2017 levels to 9.6b cubic feet per day. If this materialises, the US will become the world's third-largest natural gas exporter by 2020, following Australia and

Qatar. For oil, US producers now export around 1.5-2.0 million barrels per day (mmbpd), which could rise to 4.0mmbpd over the next five years, as most of the incremental shale production is likely to be exported, owing to the lack of domestic refineries able to handle the light sweet oil. This is likely to have a moderating effect on oil & gas prices, and help Asian countries lower their import costs and diversify their sources of energy.

5. **Coal usage yet to peak in Asia.** Coal accounts for around 50% of Asia's energy mix, and we believe that it will continue to be one of the most important energy components going forward, given its affordability and availability. There is a need to ensure the availability of stable electricity supply to power industrial activities. We estimate global coal demand will still exhibit slow growth overall over FY17-30, with declining demand from Europe and flattish demand from China offset by growing demand from India and ASEAN countries, mainly Thailand and Indonesia. We forecast a coal price benchmark of US$75 per tonne in FY18-20F, and US$70 per tonne in FY21F and beyond, on the back of tight supplies.

6. **India as a leading energy consumption and reform story.** India's energy consumption growth is healthy with around a 5% CAGR in oil consumption over the last 5-10 years, and a 4% CAGR expected up to 2040 based on International Energy Agency (IEA) forecasts. There is a strong reform push in India's power sector and a push by the government toward renewables in the power mix, which should result in a much higher proportion of renewables in the power sector, with a declining share of fossil fuels. Reforms in the oil & gas space – deregulation, pricing freedom, natural gas usage promotion – have improved prospects for gas distribution and downstream oil players, who will also benefit from attractive volume growth in the medium- to long-term.

Coal accounts for around 50% of Asia's energy mix, and we believe that it will continue to be one of the most important energy components going forward, given its affordability and availability

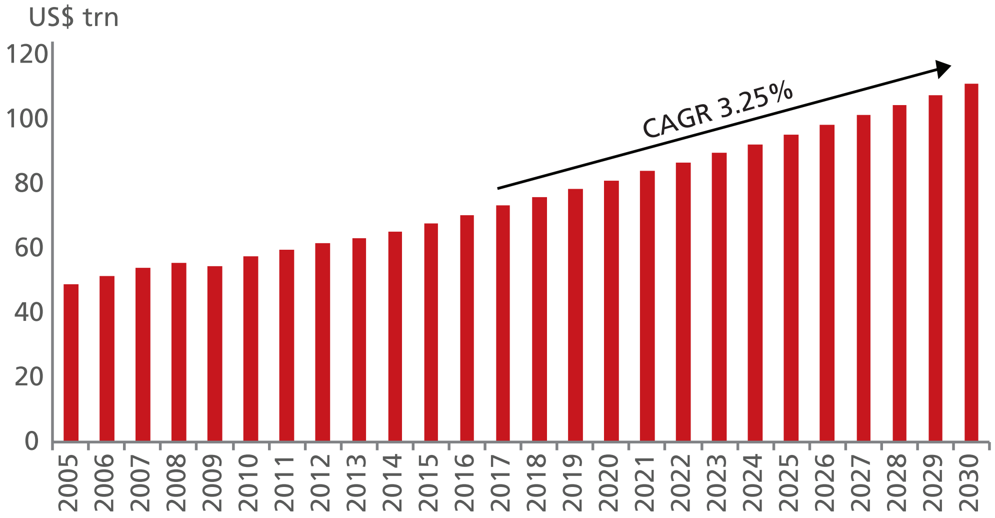
Energy Mix Transition Overview

Growth in global GDP will continue to boost demand for energy

Global Energy Demand and Energy Mix Transition Forecast

The world economy continues to grow, driven by increasing prosperity in the developing world. Global GDP growth is projected to average around 3.25% up to 2030, not too different from growth rates seen in the past two decades or so. Global output is partly supported by population growth, with the world population increasing by around 1.2 billion to reach nearly 8.5 billion people in 2030, a CAGR of just over 1%. But the main driver of economic growth is increasing productivity (i.e. GDP per person), which accounts for the majority of global expansion and is expected to lift more than 2.5 billion people from low incomes. The increasing prosperity of the developing world is a key force shaping economic and energy trends over the next 25 years. Over 80% of the expansion in world output is driven by emerging economies, with China and India accounting for over half of that expansion. While African countries will likely account for nearly half of the increase in global population, contribution to world GDP growth will be less than 10% as it continues to be weighed down by weak productivity.

Growth in world GDP (at 2010 purchasing power parity, US$, real GDP)



Source: OECD data

Growth rates will however, slow down, compared to previous decades

The expansion in global output and prosperity drives the growth in energy demand, with growth in energy consumption led by fast-growing developing economies. As highlighted earlier, global energy demand is forecast to grow at a CAGR of around 1.5% until 2030, but this is a slowdown from the over 2% CAGR of the previous 20 years. This slowing in demand growth is largely due to deceleration in population growth trends, and better energy efficiency – that is, energy intensity (energy used per unit of GDP) falling more quickly than in the past. So global GDP grows by 3.25% until 2030, but energy consumption increases by only 1.5%. The other key trend contributing to lower energy intensity is increasing electrification of final end-user demand, especially in transport and heating.

The world's energy system is highly sensitive to changes in energy efficiency

The world's energy intensity (units of energy per unit of GDP) has been declining on average by 1.4% per year for the last two decades. One of the main reasons for this is the accelerating electrification of the energy system, as electricity use is more efficient than burning fossil fuels directly, owing to less heat loss. This effect is accentuated by the move toward renewables – as solar and wind generation capacity have insignificant associated energy losses. The efficiency trend will be further boosted by the mainstreaming of electric vehicles, which typically consume less energy compared to liquid-fuel powered vehicles. There are lower efficiency improvements in the aviation, maritime and rail transport sectors as internal combustion engines are likely to be the mainstay in these sectors in the medium-to long-term.

Energy losses will decline with the rise of renewables

Fossil fuel power plants convert only a portion of their input energy to electricity, as much of the input energy is lost as heat. Though combined heat and power plants capture some of this heat for useful purposes, losses are still significant. In the case of renewable power generation, electricity is generated directly from wind, solar irradiance, and from running or elevated water. Although 100% of the input is not converted into electricity, the electricity generated is considered primary energy as the wind, sun or water not captured is never counted as part of the energy system. Hence, with a growing proportion of renewable power generation in the energy mix, losses to heat in the production of energy will decline.

The Overlooked Driver of Demand – Energy Intensity

Energy intensity plays a sizeable role in energy demand

Energy intensity is defined as the primary energy consumed per unit of GDP. A diverse number of factors can influence energy intensity, including a secular shift away from energy-intensive industries in certain countries, technology improvements and evolution (e.g. proliferation of smart metres, which enable more accurate control of consumption; or a shift to electric vehicles, which are more energy efficient), government policies, and so on. Energy intensity on a global basis declined at a CAGR of 1.34% from 1990 to 2010 (based on World Bank data), with that number accelerating to 2.40% from 2010 to 2015, led by the middle- and high-income countries; and notably China and Japan, which are two of the top ten consumers of energy, and saw their energy intensity decline by 23% and 21%, respectively, over that five-year period. IEA data indicates that 2016 saw a further 1.8% decline in energy intensity globally; that is US$2.2t when translated to dollar-savings – a sizeable figure.

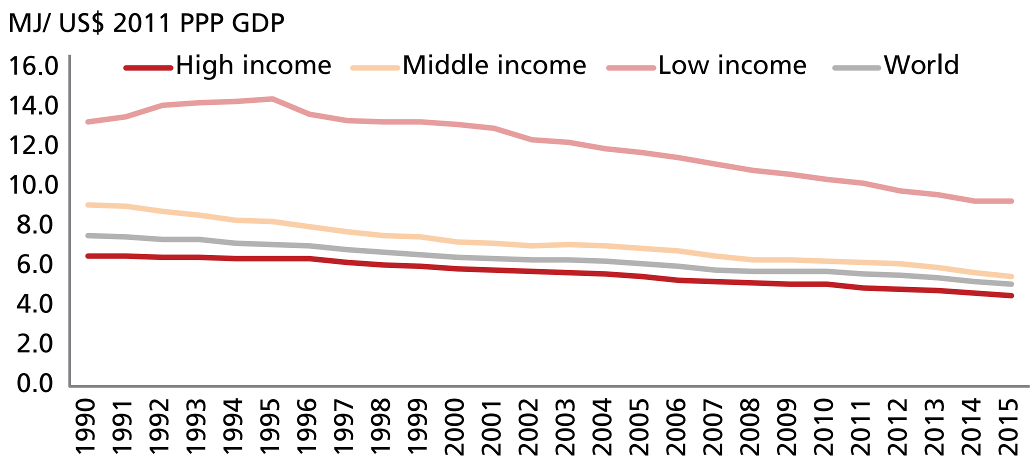
For some import-dependent countries, such as Japan and Germany, gains in energy efficiency (the inverse of energy intensity) have a strategic role vis-a-vis energy security; if not for these gains, energy imports would have been higher (e.g. Japan's 2016 oil and gas imports would have been 20% and 23% higher, respectively, if energy intensity had remained constant since 2000). Thus, energy security is another push factor for countries to adopt more aggressive energy efficiency targets.

From a demand standpoint, declining energy efficiency offsets growth in global GDP, and the net number drives energy demand, which has obvious implications for energy prices and energy companies.

We expect global energy intensity to continue declining at an average of around 1.5% per annum from 2017 to 2030

This will be largely driven by efficiency improvements and regulations aimed at reducing greenhouse gases to meet Paris Climate Agreement pledges. For example, progressively stricter regulations relating to the energy efficiency of trucks and air-conditioning – both of which are significant sources of energy demand. According to the IEA, as of 2017, over 68% of the world's energy use is not covered by efficiency codes or standards (that number would be larger if you exclude China), which means there is still much policy headroom when it comes to driving energy intensity lower.

Global energy intensity trends over a 25-year time period



Note: Energy intensity is measured in Mega Joule (MJ) of energy consumed per unit of GDP measured in 2011 constant currency US$ purchasing power parity terms

Source: World Bank

Energy intensity trends over different time periods

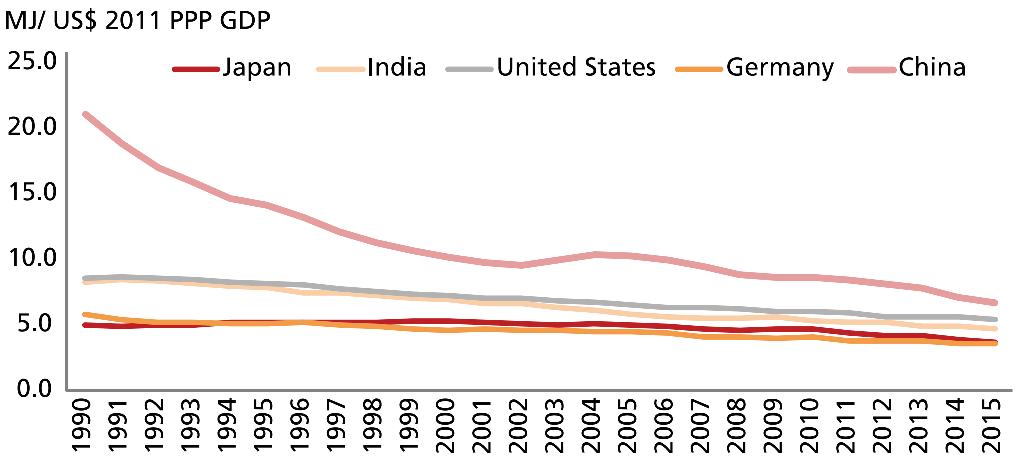
	CAGR 1990-2000	CAGR 2000-2010	CAGR 2010-2015
Country Groups			
High Income	-1.02%	-1.33%	-2.35%
Middle Income	-2.26%	-1.36%	-2.72%
Low Income	-0.12%	-2.33%	-2.15%
World	-1.54%	-1.13%	-2.40%
Key Countries			
Japan	0.54%	-1.14%	-4.60%
India	-1.75%	-2.58%	-2.44%
China	-7.02%	-1.63%	-5.07%
US	-1.65%	-1.87%	-2.29%
Germany	-2.35%	-1.18%	-2.62%

Source: World Bank data, DBS Bank calculations

Chinese energy efficiency declined during its high growth decade of 2000 to 2010

As can be seen from the table above, the trend of energy efficiency improvements or declines in energy intensity is not uniform across time periods for various country groups or for individual countries. For developed or high-income countries, the trend is most secular with improving efficiency in every time period as we move forward in time. However, for middle and low-income countries, periods of high growth may be associated with high energy intensity, which could slow down the overall improvement rate. This is most apparent for China in the 2000-2010 timeframe, where very high GDP growth rates coincided with lower focus on energy efficiency. Energy efficiency has now picked up again in the current decade, where Chinese GDP growth has moderated and a focus on environment friendly energy practices has evolved. Move over to low-income countries like India, and it seems that improvements in energy efficiency are lower in the current decade owing to higher economic growth. Thus, the Chinese pattern could repeat for emerging countries like India, which will likely moderate the pace of energy efficiency improvements to an extent as we move toward 2030.

Energy intensity trends for key high energy consuming countries



Source: World Bank

Energy Mix Will Change as Shift Toward Cleaner Energy Marches On

Our global forecast for the 2030 energy mix is based on bottom-up country-level forecasts, based on government targets

We note that many governments have now formally stated policies on reducing emissions levels (especially post-Paris Climate Agreement) and are targeting more renewables in the energy mix up to a 2030 horizon. Our forecasts are primarily based on these targets, working on a country-level basis and aggregating those numbers to reach our global forecast. While a country-by-country analysis of all 195 countries is beyond our scope, we note that the top 15 energy-consuming countries account for three-quarters of global energy demand (with China and the US as frontrunners, at 23% and 17% of global demand respectively, and India coming in a distant third at 5.5%), and therefore have focused on these countries as the cornerstone of our bottom-up methodology. While there might be concerns that targets may not be representative of the true trajectory; we believe that, in general, the targets set by the top 15 energy consuming governments are fairly achievable and, in fact, necessary to meet Paris Climate Agreement pledges.

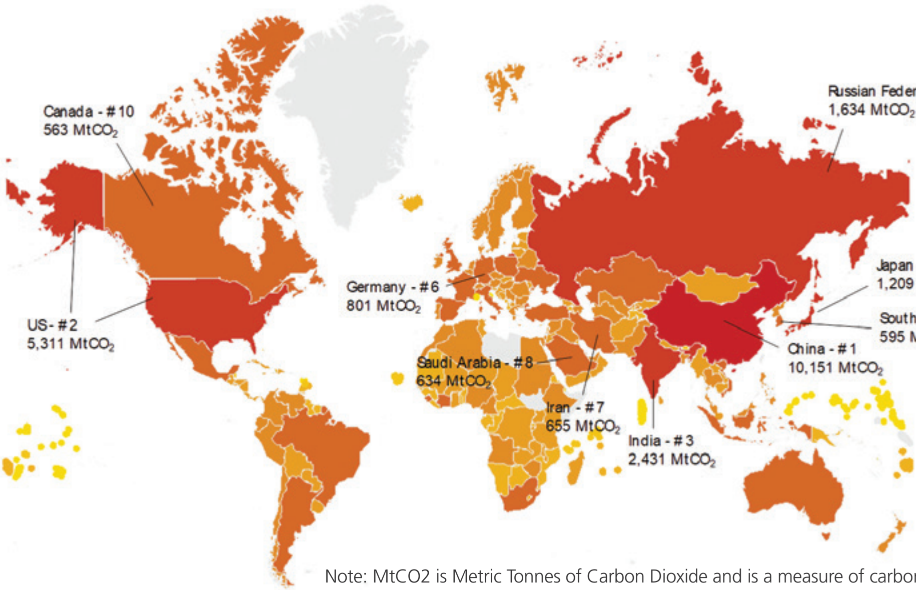
Paris Climate Agreement: A landmark deal to drive emissions down

While agreements and negotiations around emissions reductions have been taking place for the last three decades, the landmark Paris Climate Agreement, signed in 2015 and involving 197 nations representing more than 88% of global greenhouse gas (GHG) emissions, was a game-changer. Each nation ratifying the agreement has submitted "Nationally Determined Contributions" (NDCs) detailing its commitments, aligning the capabilities and circumstances of each individual country with the goals of the global Paris Climate Agreement framework.

Clean energy to take a larger role in global energy mix

The Paris Climate Agreement helps in formalising some of the policy directions of the top GHG emitters, which is not only important from an environmental perspective, but also from a global energy mix perspective, as the top emitters are invariably also the largest consumers of energy in the world (barring Brazil and Saudi Arabia, who are in one 'top ten' list but not the other). China (23%) and the US (17.1%) alone accounted for around 40% of the world's energy consumption in 2017. The next largest consumer – India – trails considerably behind at 5.5%. In general, there is a shift toward lower fossil fuel use, and a larger share of the mix going to renewables. Additionally, within the NDCs, we can see that some countries (e.g. China) have explicitly targeted reaching a percentage of non-fossil fuels in the energy mix by a certain time period.

Heat map of the largest carbon emitters globally (darker = higher)



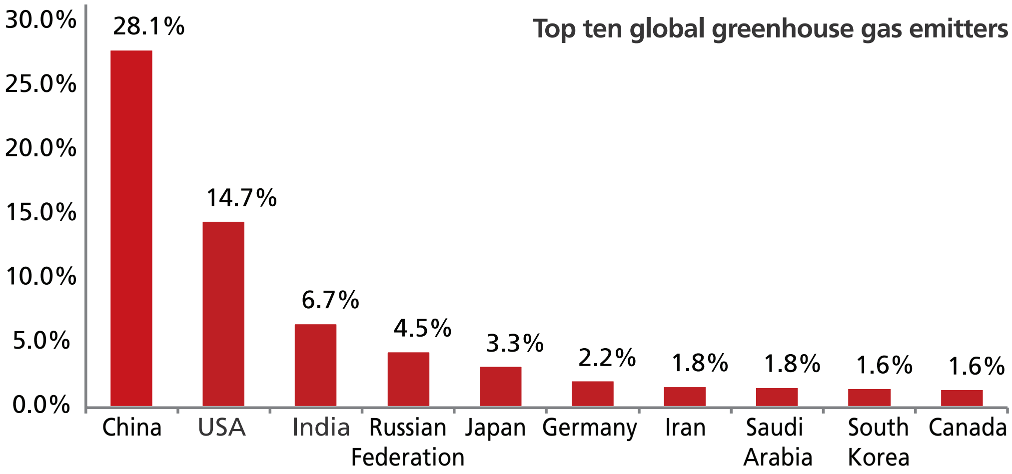
Note: MtCO2 is Metric Tonnes of Carbon Dioxide and is a measure of carbon emissions
Source: Global Carbon Atlas

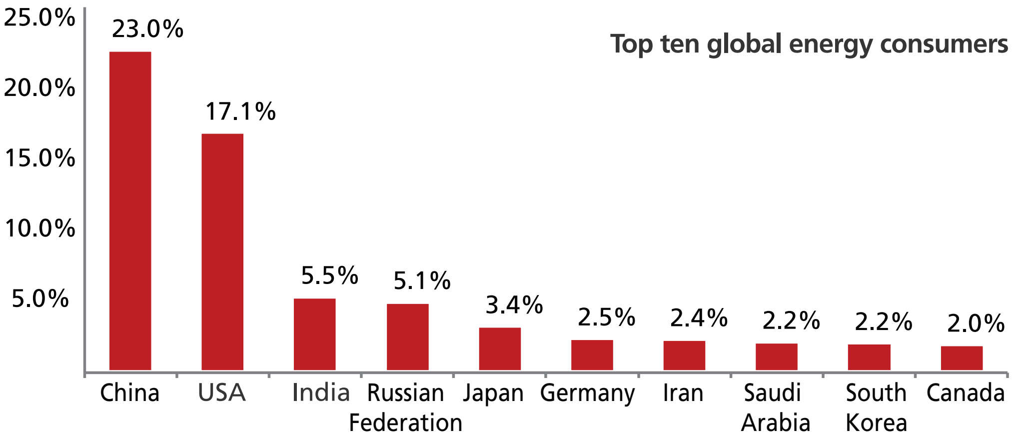
Summary of major global climate change agreements

Agreement	Year	Details
Kyoto Protocol	1997	• First signed in 1997, introducing legally binding emission reduction targets for developed countries • Second commitment period (Doha amendment) began on 1 Jan 2013 and ends in 2020. Participating countries to reduce emissions to 18% below 1990 levels • Weakness of Kyoto Protocol: only requires developed countries to take action. US never signed up; various others have pulled out. Thus, it now only applies to 14% of the world's emissions
Copenhagen and Cancun Agreements	2009/ 2010	• Copenhagen Accord in 2009 subsequently adopted by the Conference of the Parties (COP) (to the 1992 United Nations Framework Convention on Climate Change) in 2010 as the Cancun Agreement. Not legally binding • Regarded as an interim arrangement through 2020 until a legally binding successor to the Kyoto Protocol was put in place. • Set a goal of limiting global temperature increase to 2 degrees celcius • Called on all countries to put forward mitigation pledges • Established broad terms for reporting and verification of actions • Goal to mobilise US$100b/year in public and private finance for developing countries • Establishment of a new Green Climate Fund
Paris Agreement	2015	• Landmark agreement with 197 nations having signed the agreement, and 176 parties currently having ratified, representing more than 88% of global greenhouse gas emissions. • Aims to keep global temperature rise below 2 degrees Celcius above pre-industrial levels with an aspiration of 1.5 degrees Celcius. • Involves both developed and developing countries • Calls on signatories to submit their "Nationally Determined Contributions" (NDC), and make new pledges for deeper emissions cuts every five years • Developed countries to provide US$100b/year in funding to poorer countries to assist through 2025

Source: Climate Action Tracker, IEA, various government websites

Top ten global greenhouse gas emitters vs. top ten global energy consumers – mostly the same folk





Source: Global Carbon Atlas, BP Statistical Review

Climate change pledges – Top five emitter/consumer countries

China		
Paris Agreement	2030 unconditional target(s)	Peak CO2 emissions latest by 2030 Non-fossil fuels as share of energy supply by 20130: 20% Forest stock: up 4.5billion m3 by 2030 compared to 2005 Carbon intensity: 60-65% below 2005 by 2030
	Coverage	Economy-wide
	Land Use, Land-Use Change and Forestry (LULUCF)	
Copenhagen Accord	2020 target(s)	Carbon intensity: 40-45% below 2005 by 2020 Non-fossil share of energy supply: 15% in 2020 Forest cover: up 40million ha by 2020 compared to 2005 Forest stock: up 1.3billion m3 by 2020 compared to 2005
	Condition(s)	None

Climate change pledges – Top five emitter/consumer countries cont.

US		
Paris Agreement	Ratified?	Yes, but Trump has communicated intent to withdraw. Legally in place until Nov 2019
	2030 unconditional target(s)	Emissions levels 26-28% below 2005 by 2025 Emissions levels 9-17% below 1990 by 2025 excl. LULUCF
	Coverage	Economy-wide, incl. LULUCF
	LULUCF	Included
Copenhagen Accord	2020 target(s)	17% below 2005 by 2020 incl. LULUCF
	Condition(s)	None
Kyoto Protocol	Member of KP CP1 (2008-2012)	Not ratified
	Member of KP CP2 (2013-2020)	No
	KP CP1 target (below base year)	7% below 1990
	KP CP2 target (below base year)	N/A

India		
Paris Agreement	Ratified?	Yes
	2030 unconditional target(s)	33-35% below 2005 emissions intensity of GDP by 2030 Non-fossil fuels as share of cumulative power generation capacity by 2030: 40%
	Coverage	Not specified
	LULUCF	Additional (cumulative) carbon sink of 2.5-3.0 Gigaton Carbon Dioxide Equivalent (GtCO2e) by 2030
Copenhagen Accord	2020 target(s)	20-25% below 2005 emissions intensity of GDP by 2020
	Coverage	Excluding agriculture sector
	Condition(s)	None
Long-Term Goal(s)		Per-capita emissions never to exceed those of the developed world

Climate change pledges – Top five emitter/consumer countries cont.

Russia		
Paris Agreement	Ratified?	No; ratification now looks to be delayed until 2019
	2030 unconditional target(s)	Emissions 25-30% below 1990 levels by 2030
	Coverage	Economy-wide, incl. LULUCF
	LULUCF	Target is subject to “the maximum possible account of absorbing capacity of forests”
Copenhagen Accord	2020 target(s)	Emissions 15-25% below 1990 levels by 2020
	Condition(s)	a) Appropriate accounting of the potential of Russia’s forestry sector b) Undertaking by all major emitters of legally binding obligations to reduce emissions
Kyoto Protocol	Member of KP CP1 (2008-2012)	Yes
	Member of KP CP2 (2013-2020)	No
	KP CP1 target (below base year)	0% below 1990

Japan		
Paris Agreement	Ratified?	Yes
	2030 unconditional target(s)	Emissions 26% below 2013 levels by 2030
	Coverage	Economy-wide, incl. LULUCF and overseas credits for 2030
	LULUCF	LULUCF credits considered
Copenhagen Accord	2020 target(s)	3.8% below 2005 emissions levels by 2020
	Condition(s)	LULUCF credits considered
Long-Term Goal(s)		Reduce greenhouse gas emissions by 80% by 2050 (base year not specified)

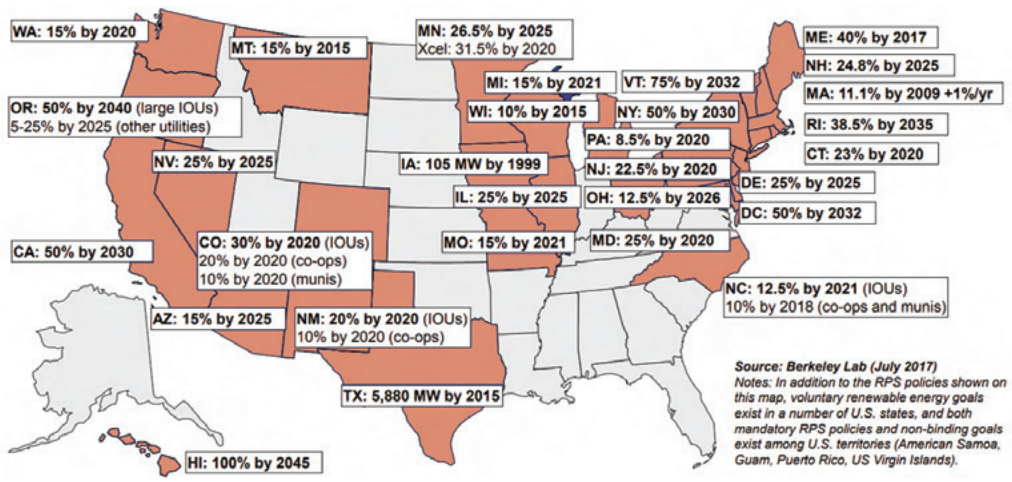
Source: Climate Action Tracker

Focus on the US – State-Level Targets Driving Emissions Reductions

Renewable Portfolio Standards a key regulation in the US

While the US has no national-level target for its energy mix, a major policy driver of the shift toward renewables in the energy mix is the Renewable Portfolio Standards – a state-level requirement on retail electric suppliers to source a minimum percentage of their retail load from renewable energy sources. Currently 29 out of 50 US states and DC have an RPS in place, though not in any standardised form – target proportions and timeframes vary considerably. Overall though, RPS policies have accounted for roughly half of all US renewable electricity generation since 2000, so they are a major driver of the adoption of renewables in the US.

US Renewable Portfolio Standards, by state

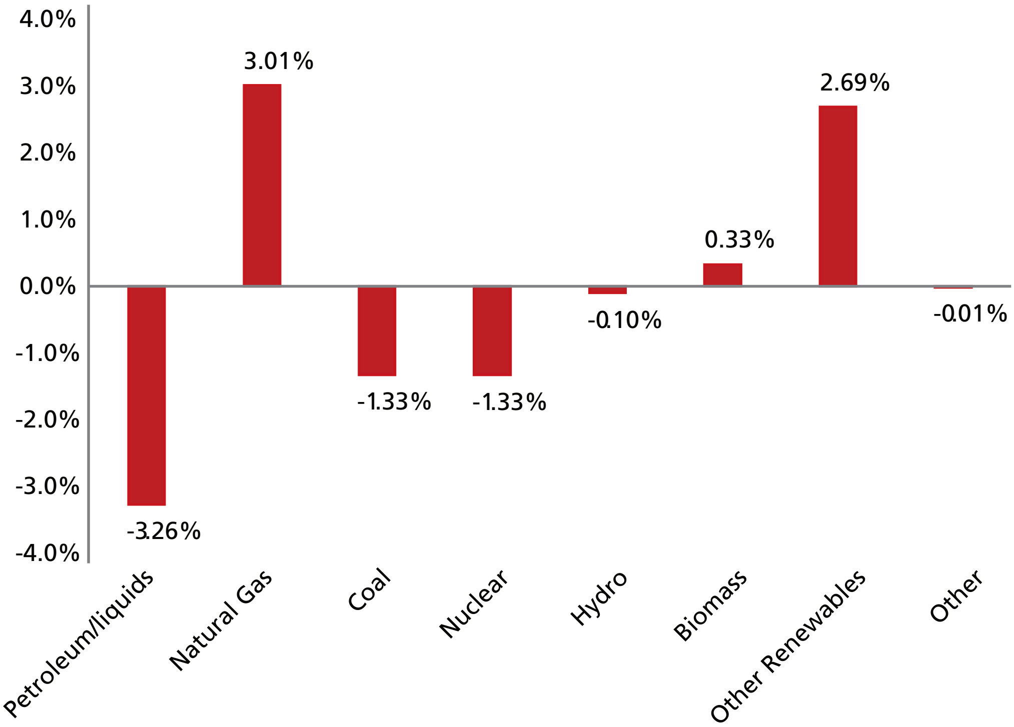


Source: Berkeley Lab 2017 Annual RPS Summary Report

Renewables requirements under RPS in 2030 will be 1.83 times that of 2017 levels

Based on forecasts by the Berkeley Lab (the research arm of the Department of Energy), total RPS requirements are set to grow at a CAGR of 4.8% from 2017 to 2030, with 2030 RPS requirements representing around 1.83x those in 2017. This matches the US Energy Information Agency's (EIA) prediction of non-hydro renewable energy to grow by around 83% over that same time frame, with its proportion in the US's total energy mix increasing from 3.5% in 2017 to 6.2% in 2030. Natural gas is the other beneficiary, with its proportion in the energy mix climbing by about 3%, owing to continued growth in shale gas volumes

Change in energy source's proportion as part of total US consumption – 2030 vs. 2017 (%)



Source: US EIA forecast

With its objective to "make the skies blue again", China has embarked on various policies to reduce the proportion of dirtier fuels in its energy mix, while boosting the usage of cleaner fuels. In particular, as part of the 13th Five-Year Energy Development Plan issued in January 2017 by the National Development and Reform Commission (NDRC) and the National Energy Administration (NEA), a mandatory target was introduced for the first time for coal, with the aim of reducing its proportion of the energy mix to below 58% in 2020 That number was about 62% in 2016 and 60% in 2017, so China may very well overshoot the target if this trajectory continues. Meanwhile, China plans on ramping up usage of natural gas to above 10% by 2020 and above 15% by 2030.

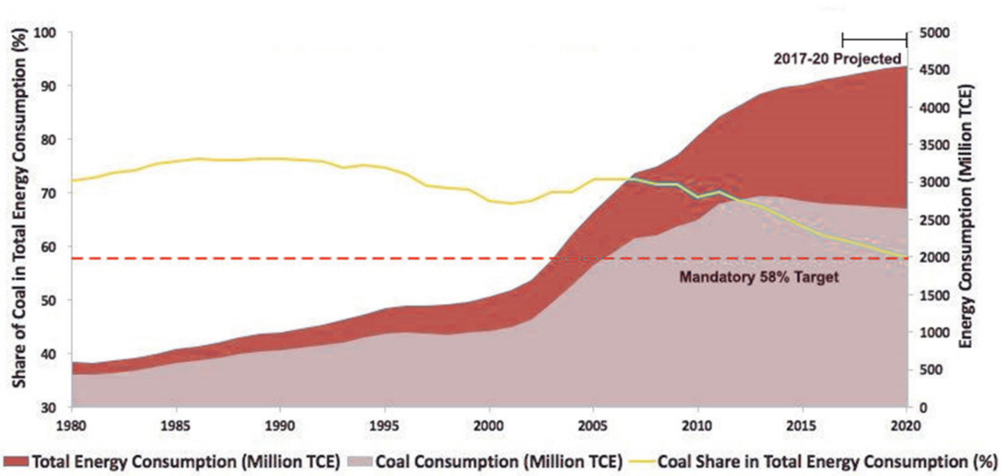
In terms of fossil fuel use, as state-owned enterprises dominate production of fuels in China, we can reasonably expect high-level policy objectives to trickle down to the company level, giving credence to the targets set.

Summary of China's key energy mix targets from the various papers released by the government

	2020	2030	2050
Primary energy consumption (tonnes of coal equivalent)	5bn	6bn	
Non-fossil fuel proportion in energy mix	>15%	>20%	>50%
Non-fossil fuel proportion in power generation activities		>50%	
New Energy Demand		Should mostly be met by clean energy	
Coal share of energy mix	<58%		
Natural gas share of energy mix	>10%	>15%	
Energy consumption per unit of GDP	Down 15% compared to 2015		
Carbon emission per unit of GDP	Down 18% compared to 2015		
Energy self-sufficiency rate	>80%		

Source: NDRC

Coal as a proportion of China's energy mix should continue declining in the near-term

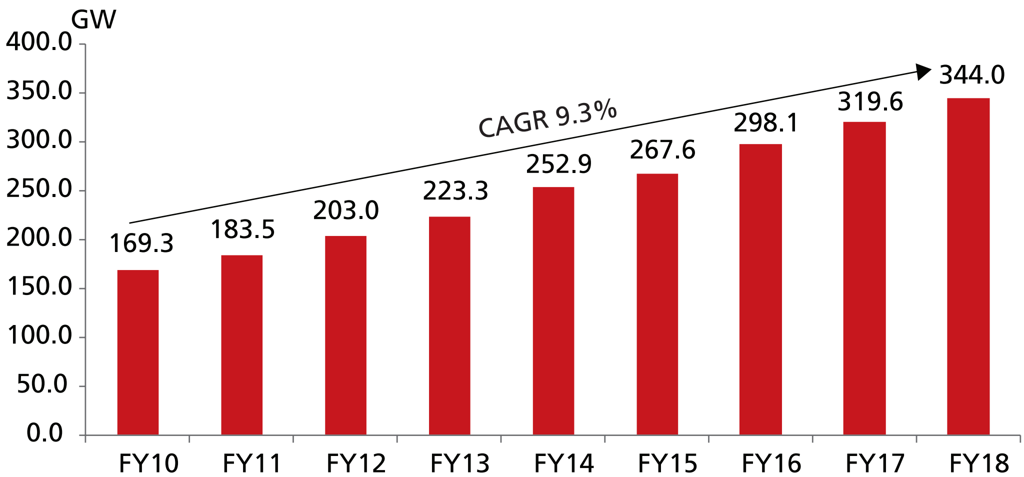


Focus on India – 175GW Renewable Energy Goal

Strong growth in power sector following reforms

India's power sector is mainly governed by the Ministry of Power. The enactment of the 2003 Electricity Act has brought about revolutionary changes in almost all the areas of the sector. This Act created a conducive environment to promote private sector participation and competition in the sector by providing a level playing field. This has led to significant investment in generation, transmission and distribution areas. Over the years, the installed capacity of power plants (utilities) has increased to about 3,44,002 megawatt (MW), as of March 2018, from a meagre 1,713 MW in 1950. The per capita consumption of electricity in the country has also increased from 15 kilowatt hours (KWh) in 1950 to about 1,075 kWh in 2015-16. The government has also achieved its target of 100% village electrification by electrifying all 5,97,464 census villages. Regional grids have been integrated into a single national grid, thereby providing free flow of power from one corner of the country to another through strong inter-regional alternating current and high-voltage direct current links. As a result, the all-India peak demand (MW) as well as energy (million units) shortage have registered steady declines. The peak demand shortage and energy shortage have declined to 0.8% and 0.9%, respectively, in 2017-18, compared to 11.9% base deficit and 12.7% peak deficit during 2009-10.

Total installed power generation capacity growth over FY10-18

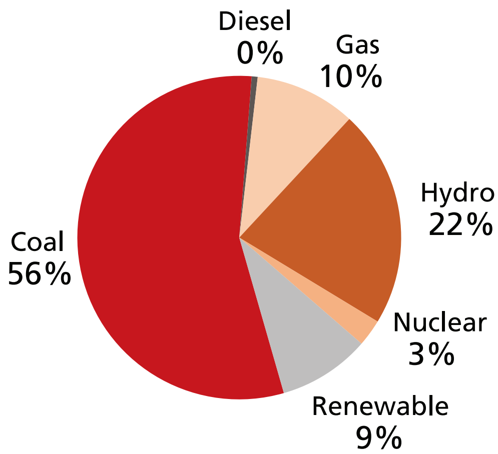


Source: CEA, Emkay Global Research

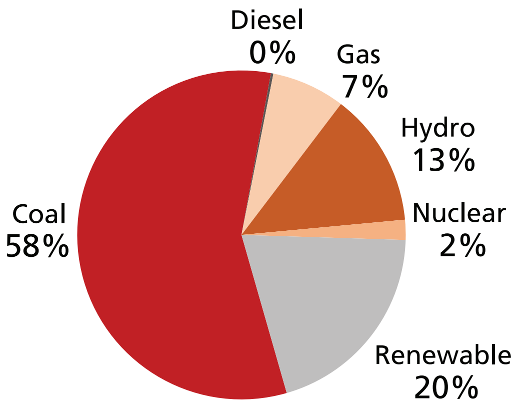
Capacity addition growth skewed toward renewables in recent past

There has been significant growth in capacity addition over the past eight years, largely dominated by coal capacity addition. However, with a commitment to address environmental issues, the government has, of late been, focusing more on adding renewable capacities. The government is targeting adding 175 gigawatt (GW) of renewable capacity by 2022, compared to only around 32GW of installed capacity as of FY15. Current installed renewable capacity – which has already more than doubled in the past three years – stands at 69GW as of March 2018.

Power sector fuel mix composition as of March 2010



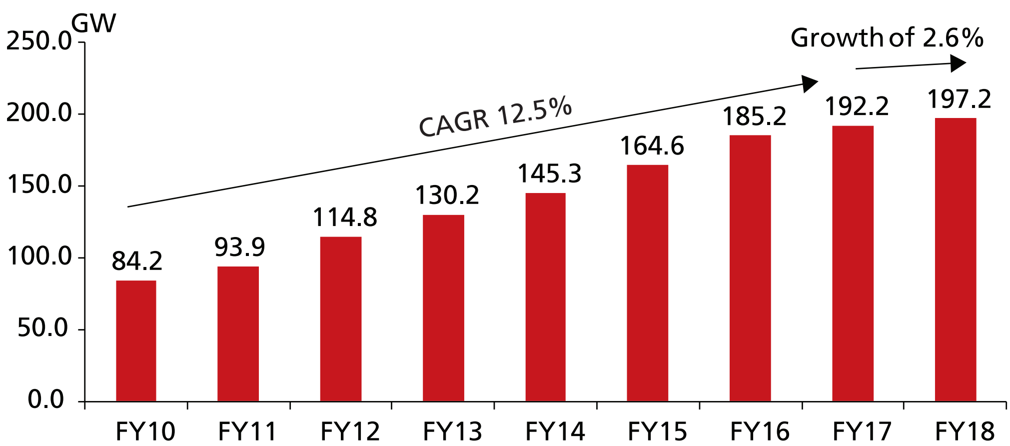
Power sector fuel mix composition as of March 2018



Source: CEA, Emkay Global Research

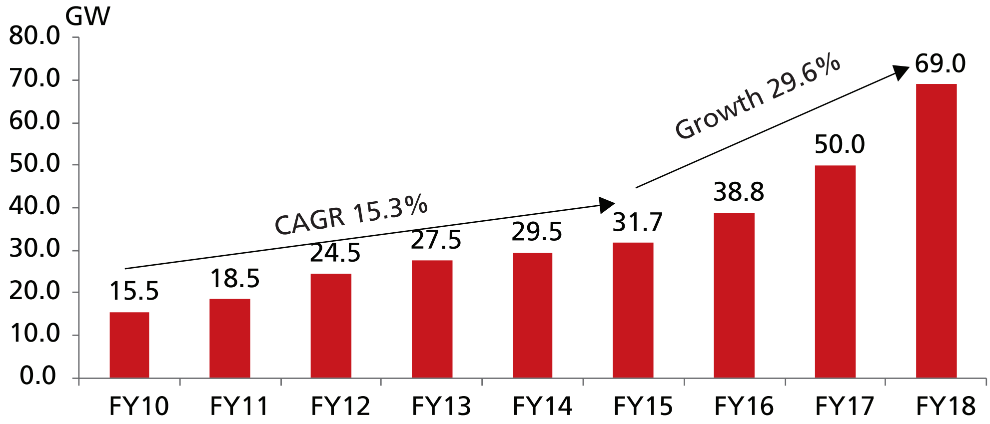
Capacity addition across the coal segment had witnessed a strong CAGR of 12.6% over FY10-17. However, growth was very subdued in FY18, at only 2.6% on the y-o-y basis, primarily due to the increased focus on renewable capacity. Conversely, renewable energy capacity grew at a CAGR of 15.3% over the FY10-15 period, but witnessed a very significant jump with a CAGR of over 29.6% during the FY15-FY18 period.

Capacity growth in total installed power generation for coal over FY10-18



Source: CEA, Emkay Global Research

Capacity growth in total installed power generation for renewables over FY10-18



Source: CEA, Emkay Global Research

Outlook for capacity addition – focus on renewables

While there are around 35-40 GW of thermal capacity under construction, India's government is now focused on setting up large scale renewable capacity as part of its commitment to the Paris climate talks.

India has set an ambitious target to install 175GW of renewable capacity by 2021-2022

This comprises 100 GW solar, 60 GW wind, and 15 GW of biomass, small hydro and waste to power projects. The current installed renewable capacity in India stands at 69GW as of March 2018. FY18 (fiscal year to March 2018) saw a 38% y-o-y rise in renewable capacity addition (the highest ever) dominated largely by solar capacity addition (140% rise y-o-y to 21.7GW in FY18 versus 9GW in FY17).

The ambitious target was set by the Indian government during the Paris climate change talks as part of India's commitment to a clean environment and ecology for future generations. India, along with France, has set up an International Solar Alliance (ISA) – a treaty-based coalition of 121 solar resource rich countries, which are located between the Tropic of Cancer and the Tropic of Capricorn – to address the special energy needs of member countries and provide a platform to collaborate on addressing the identified gaps through a common, agreed approach.

India will contribute US$27m to the ISA for creating the corpus, building infrastructure and recurring expenditure over a five-year duration from 2016-17 to 2020-21. In addition, public sector undertakings of the government – the Solar Energy Corporation of India and the Indian Renewable Energy Development Agency – have contributed US$1m each for creating the ISA corpus fund.

Renewable installed capacity in India (current vs target)

Type of project	FY18 (MW)	Target FY22E (MW)
Small Hydro	4,486	5,000
Wind	34,046	60,000
Bio Power	8,839	10,000
Solar	21,652	100,000

Source: CEA, Emkay Global Research

Government needs to focus on supportive infrastructure for renewables expansion

The setting up of renewable capacity will result in new challenges related to transmission of power as, unlike thermal base load capacities, power flow in solar and wind depends largely upon climatic conditions and is thus volatile in nature. This leads to a major challenge for grid operators in maintaining grid frequency, as high volatility can lead to collapsing of the grid. Thus, the Indian government is also simultaneously working toward procuring large amount of batteries and inventories at affordable rates and also on improving grid technology.

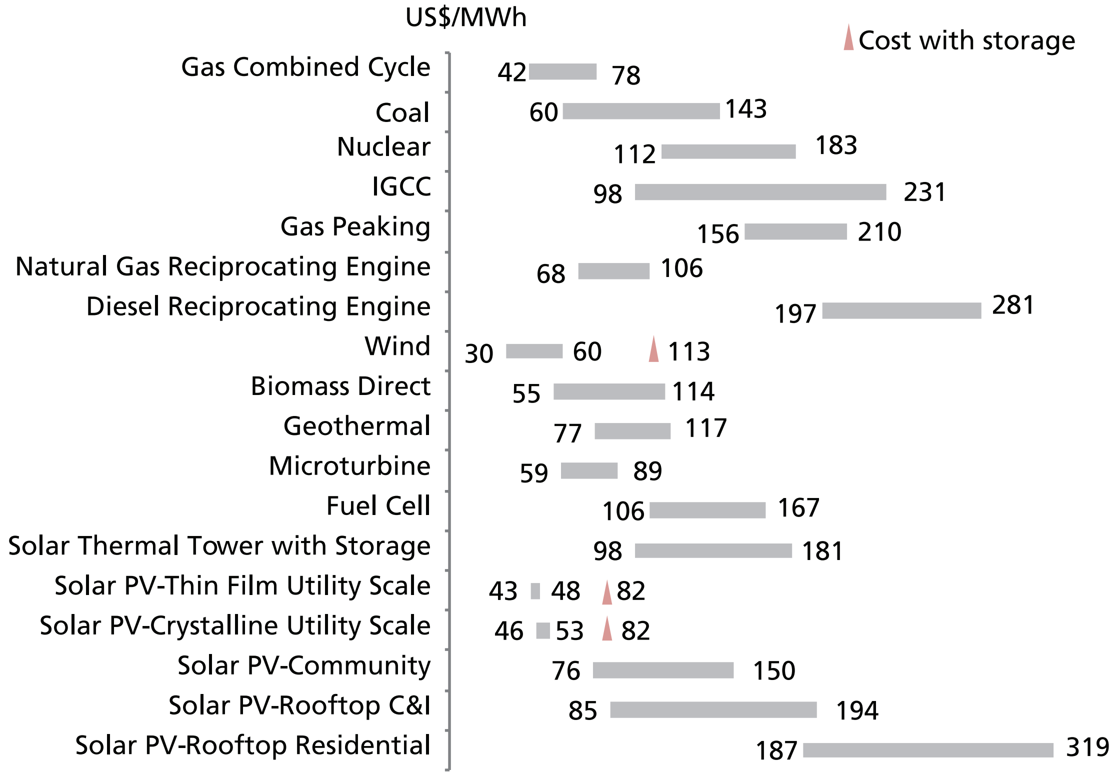
Cost of Alternative/Renewable Energy Sources Continues to Fall

Renewable power generation costs and capital costs continue to decline, fuelling greater adoption

According to estimates from a Lazard study, as shown below, the levelised cost of energy (LCOE) for wind and solar power have fallen by 67% and 86%, respectively, over the last eight years in the US market, and are quite competitive with fossil fuels like gas and coal, if we exclude storage requirements. Capital costs for a number of alternative energy generation technologies are currently in excess of some conventional technologies (e.g., gas), but costs are declining and, coupled with uncertain long-term costs of fossil fuel technologies, alternative/renewable energy generation technologies are quickly closing the hitherto wide gaps in electricity costs. Of course, dispatch characteristics and grid infrastructure issues will ensure a mix of renewable and fossil fuel (both base load and peaking) technologies will co-exist in future, albeit with a higher mix of renewable capacity in the system than at present.

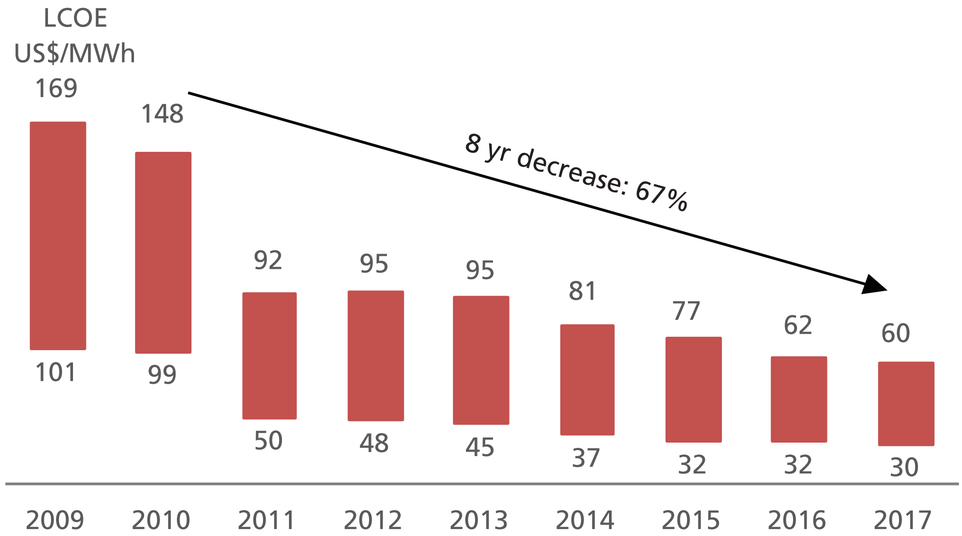
"Dispatch characteristics and grid infrastructure issues will ensure a mix of renewable and fossil fuel (both base load and peaking) technologies will co-exist in future, albeit with a higher mix of renewable capacity in the system than at present."

Unsubsidised levelised cost of energy (LCOE) comparison in the US market (US$/MWh basis)



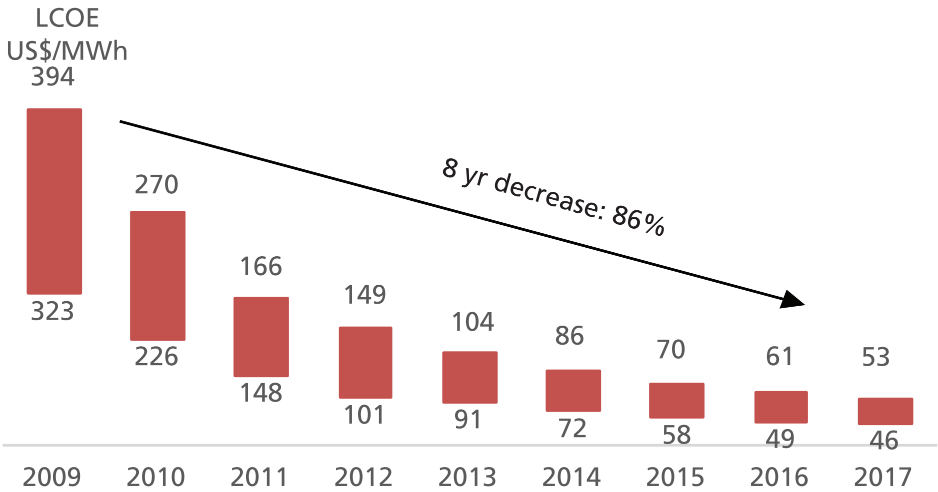
Source: Lazard's Levelised Cost of Energy Analysis Version 11.0, DBS Bank

Wind LCOE trend in the US



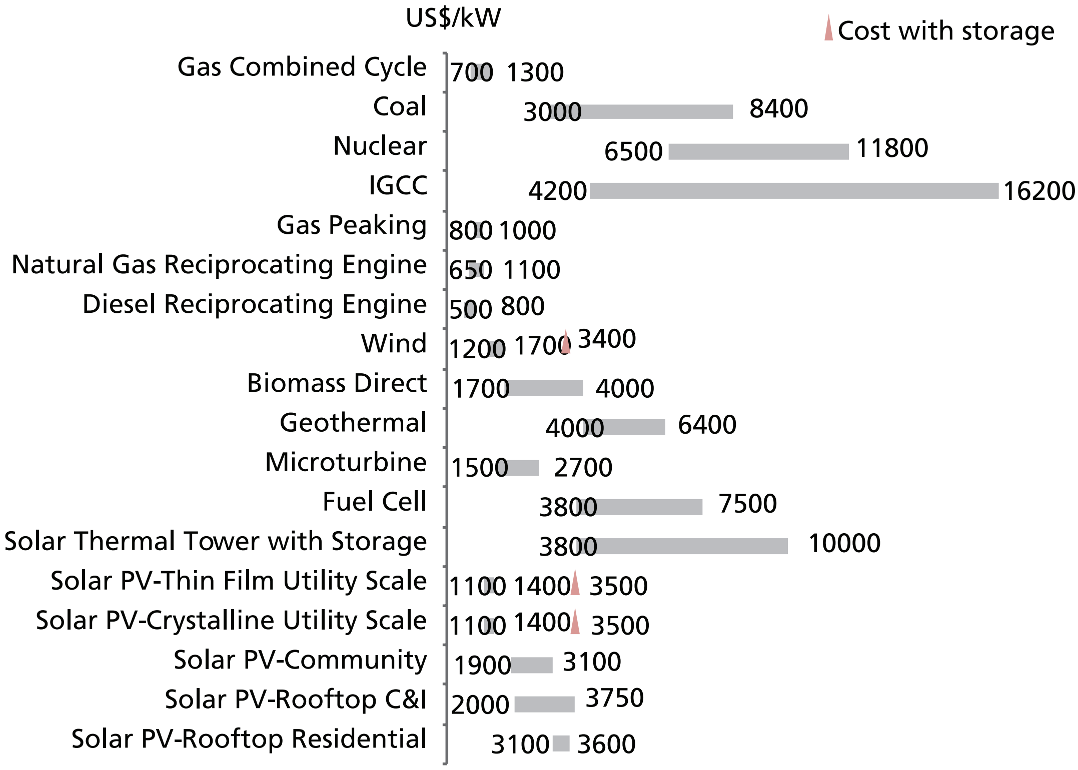
Source: Lazard's Levelised Cost of Energy Analysis Version 11.0, DBS Bank

Solar PV LCOE trend in the US



Source: Lazard's Levelised Cost of Energy Analysis Version 11.0, DBS Bank

Capital cost comparison in the US market (US$/ kW basis)



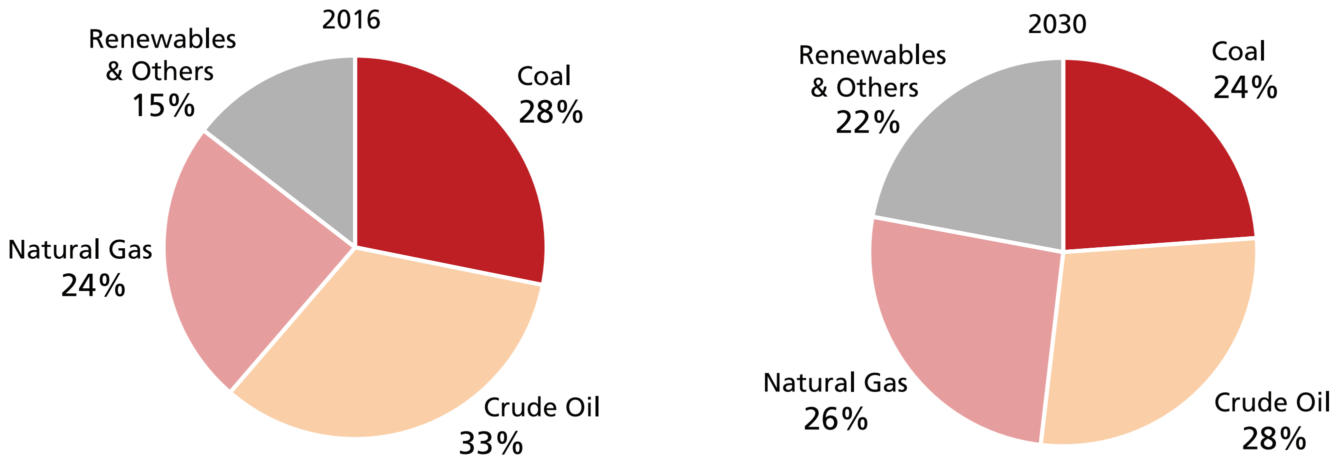
Source: Lazard's Levelised Cost of Energy Analysis Version 11.0, DBS Bank

Global Energy Mix Forecasts

Clear trend toward renewables, but fossil fuel demand to continue growing nonetheless

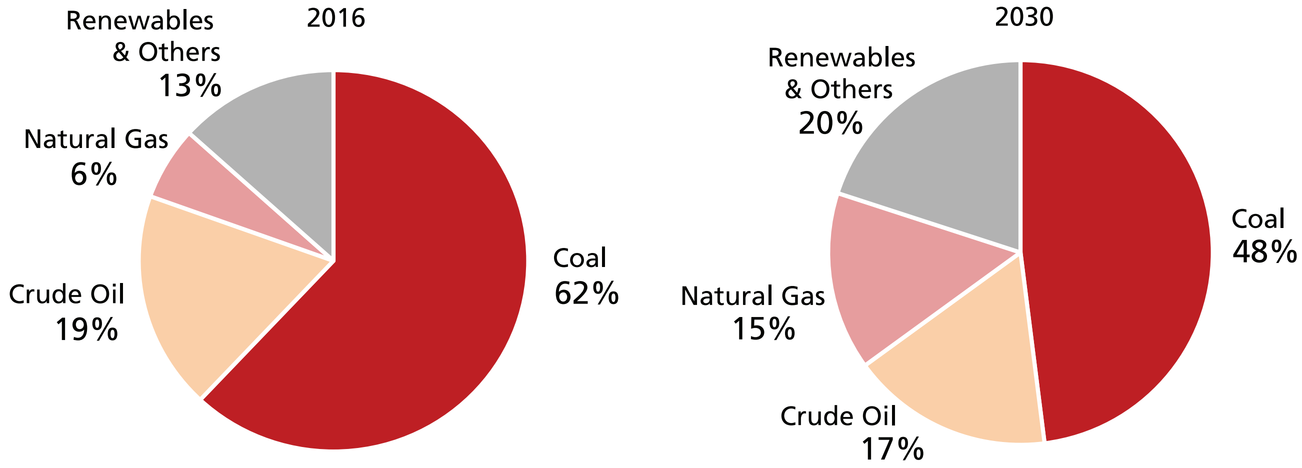
We expect global energy demand to increase at an average rate of about 1.5% p.a. from 2017 to 2030, which is premised on the back of around 3.25% p.a. growth in global GDP, offset by improvements in energy efficiency (i.e. declines in energy intensity). Despite a clear shift toward renewables in the energy mix, from 15% in 2016 to 22% in 2030, we believe demand for the three key fossil fuels – coal, oil, and natural gas – will not peak until 2030, though demand will grow at differing rates. Natural gas demand will be strong and in 2030 is expected to be about 33% higher than 2016 levels, while demand for coal and oil will grow much slower.

Change in global energy mix – 2016 vs. 2030 (DBS expectations)



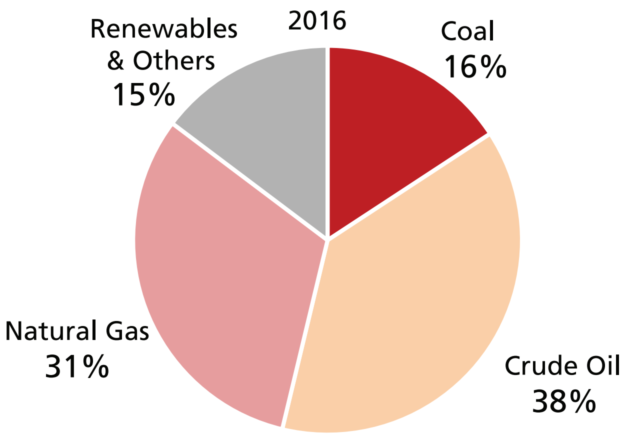
Source: BP data, DBS Bank forecasts

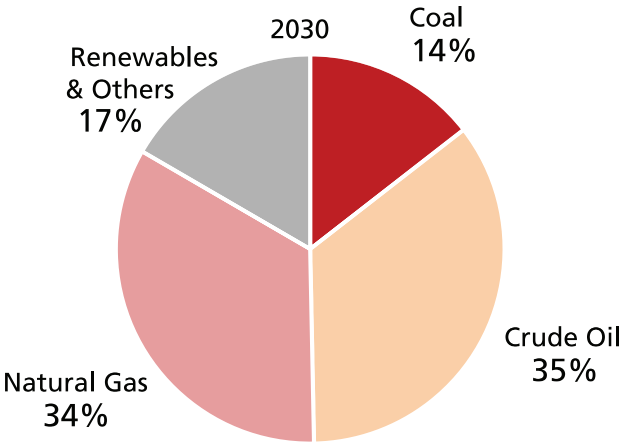
Change in China energy mix – 2016 vs. 2030 (DBS expectations)



Source: BP data, DBS Bank forecasts

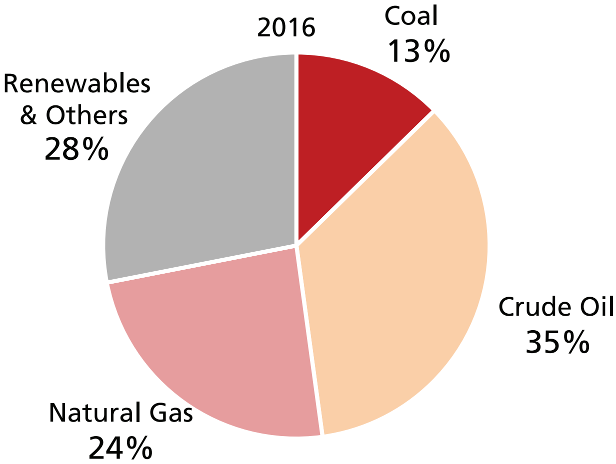
Change in US energy mix – 2016 vs. 2030 (DBS expectations)

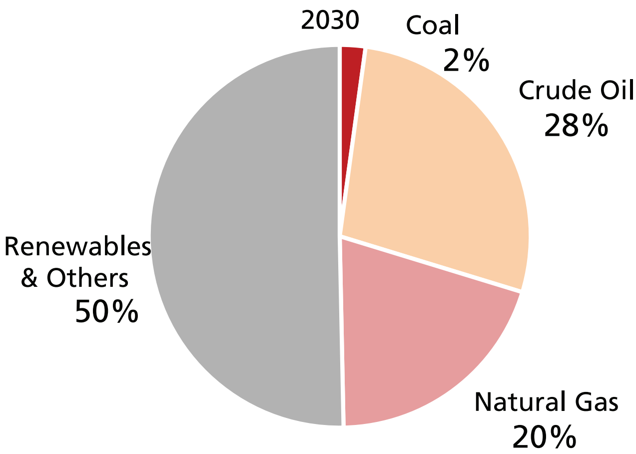




Source: BP data, EIA, IEA, DBS Bank forecasts

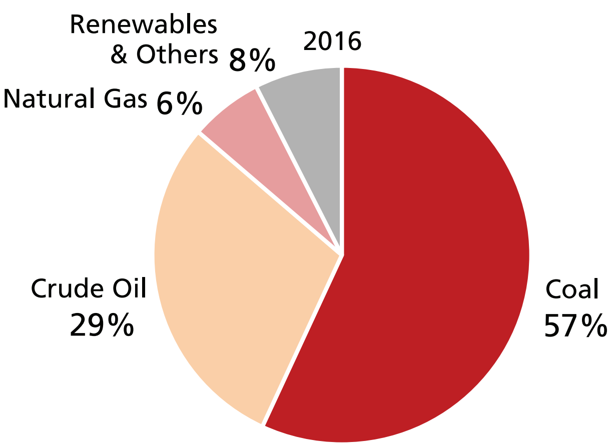
Change in EU-3 (Germany, France, UK) energy mix – 2016 vs. 2030 (DBS expectations)

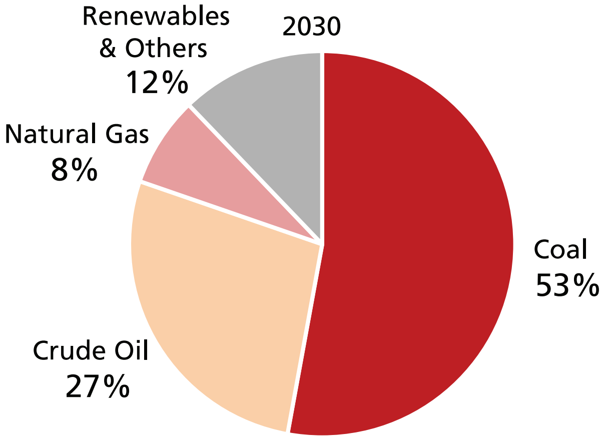




Source: BP data, IEA, respective government data, DBS Bank forecasts

Change in India energy mix – 2016 vs. 2030 (DBS expectations)

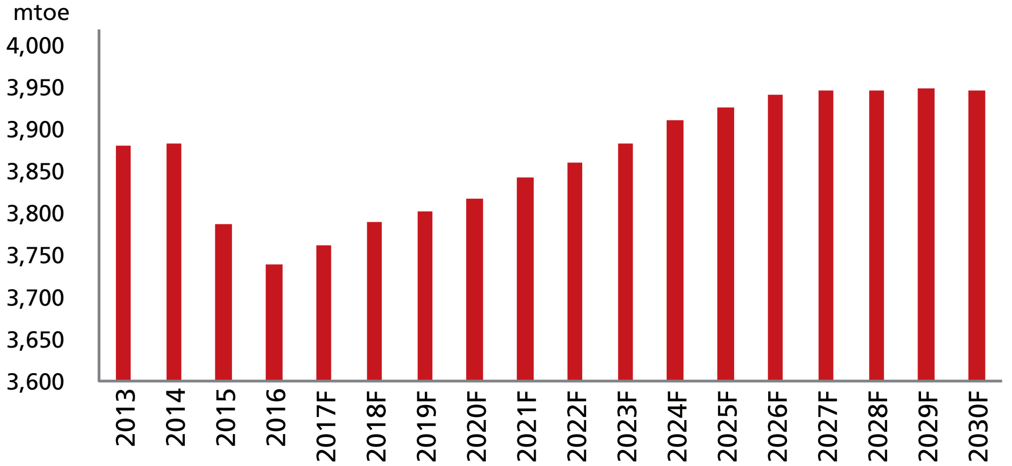




Source: BP data, Government data, DBS Bank forecasts

Coal: New coal-fired power plant projects can be reduced, but scrapping existing operating capacity and capacity under construction is highly unlikely, as there is still a need to ensure the availability of stable electricity supply to power industrial activities. We estimate global coal demand will still exhibit slight growth over FY17-30, with declines in Europe and flattish growth in China offset by demand from India and ASEAN countries, mainly Thailand and Indonesia.

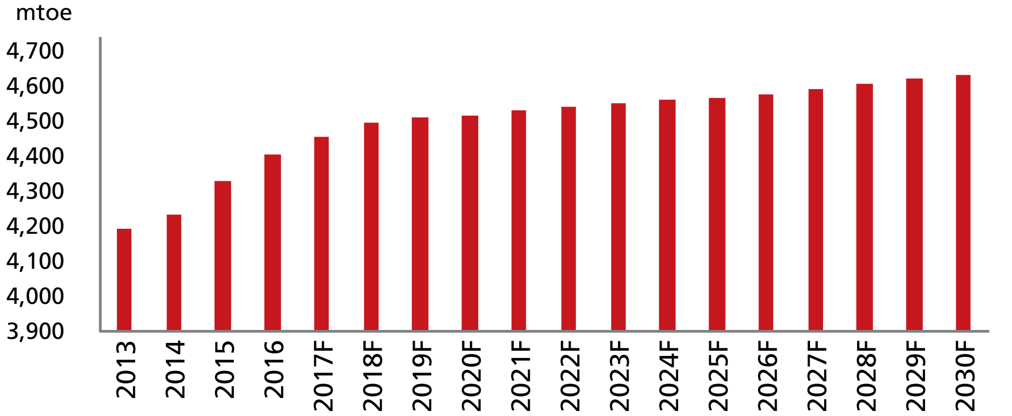
Global coal demand forecast



Note: mtoe: million tonnes of oil equivalent
Source: DBS Bank Forecasts

Crude oil: The biggest movers in the crude oil picture through 2030 are India and Japan. On one hand, we see significant additions to oil demand from India, on the back of strong growth in energy demand as its economy grows at a clip of close to 6% from 2017-2030, while efficiency gains remain modest. In addition, India's Draft National Energy Policy (2017) – which lays out the expected energy mix until 2040 – actually sees oil assuming an increasing role in the energy mix (from around 24.5% in 2012 to 27% by 2040). Meanwhile, Japan is expected to significantly lower its exposure to oil and is targeting for 20-22% of its energy mix in 2030 to come from nuclear, and 22-24% from renewables, which is a significant change from 2016 levels where just 9.2% of primary energy demand was from nuclear and renewables.

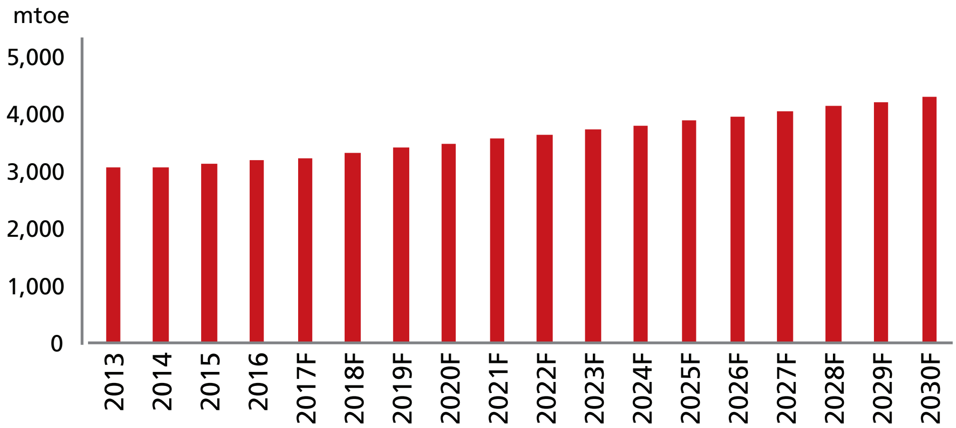
Global crude oil demand forecast



Source: DBS Bank Forecasts

Natural Gas: By our estimates, China will be the single largest driver of natural gas demand through 2030, accounting for almost 40% of total incremental natural gas demand in 2030 as compared to 2016 levels. This is driven by China's desire to combat domestic environmental pollution levels. China has set a target for natural gas to account for 15% of its energy mix by 2030 (up from 6-7% currently). Notably, out of the top 15 energy-consuming countries, 12 of them are looking at growth in natural gas demand on a 2030 timeframe, mainly as an intermediate substitute between clean energy and dirtier fuels. Of the remaining three countries, Germany's natural gas demand could fall as it is replaced by renewables under its Energiewende policy, and Saudi Arabia and Mexico only see slight declines in gas demand.

Global natural gas demand forecast



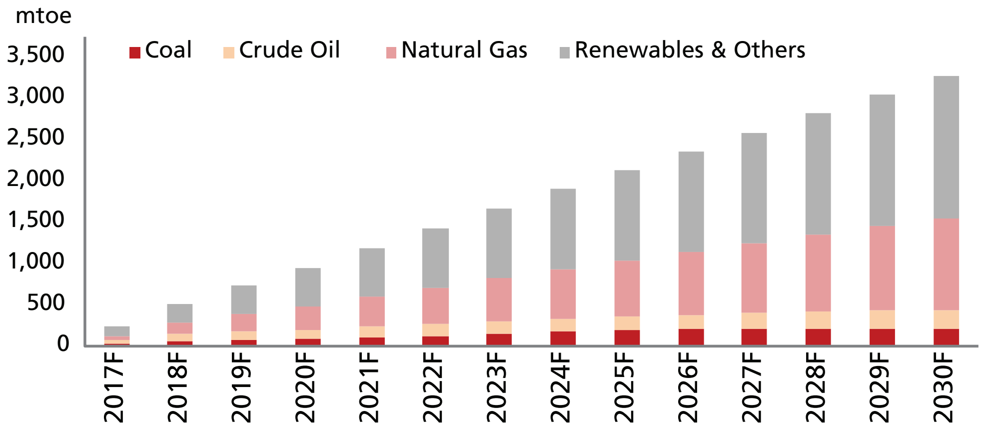
Source: DBS Bank Forecasts

Renewables and Nuclear: Every country we have studied has policies in place targeting higher proportions of renewables within their energy mix; the trend is clear. In aggregate, we expect demand for clean energy to grow at a CAGR of around 4.6% from 2017 to 2030, depressing the share of coal and oil in the global energy mix in 2030.

Global renewables and nuclear forecast

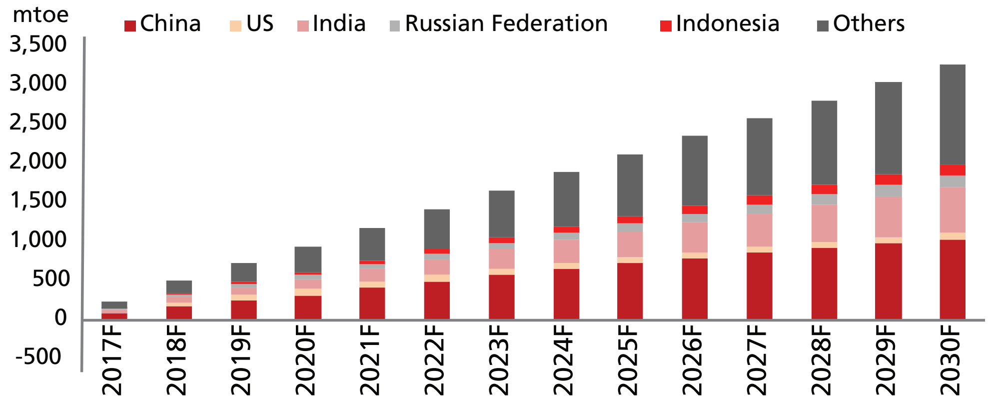
Source: DBS Bank Forecasts

Contribution to cumulative global energy demand by energy source



Source: DBS Bank Forecasts

Contribution to cumulative global energy demand by country



Source: DBS Bank Forecasts

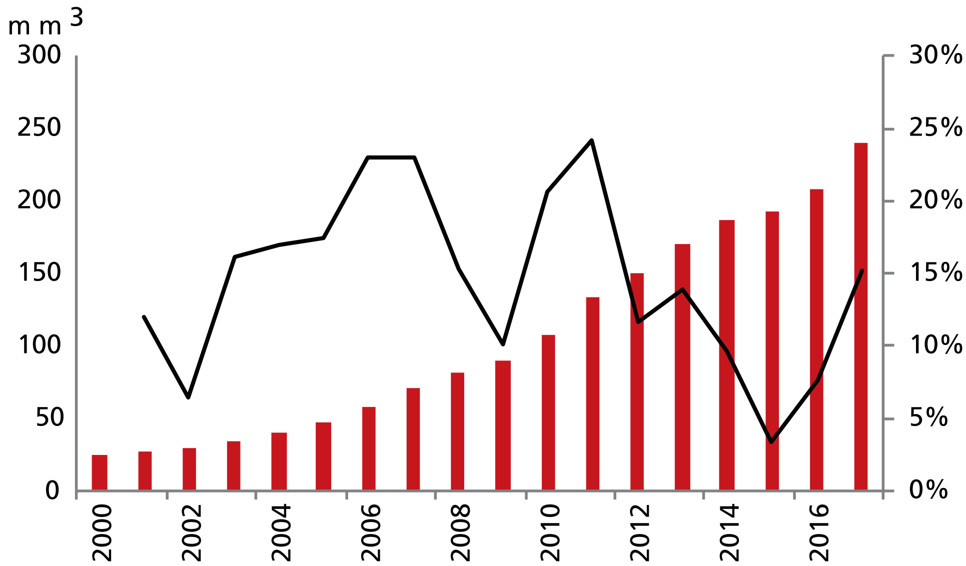
Key Global and Regional Energy Trends

1. Increasing Importance of Gas in China's Energy Mix

Demand for natural gas in China has enjoyed strong growth over the past few years

China's natural gas consumption CAGR was a robust 16% from 2005 to 2015. However, the proportion of natural gas in the energy mix has lagged behind the average of 23.7% seen in international peers' energy consumption. Moreover, demand for natural gas slowed down since the collapse of the oil price during 2014 and gas consumption growth recorded a CAGR of only 5% from 2014 to 2016.

Natural gas consumption



Source: CEIC, DBS Vickers

Lack of supportive government policies and law enforcement are main reasons China has fallen behind international peers

There were not enough punitive and incentive measures in place for market participants. Also, the development of storage facilities and transmission pipeline network were slow, which is mainly due to the lack of return regulation.

The demand for natural gas has accelerated since 2H2016

This is when the Chinese government started to strictly enforce environmental regulations and issued favourable policies to stimulate clean energy usage. The NDRC issued the 13th Five Year Plan (FYP) for natural gas, which includes detailed targets for upstream, midstream and downstream segments of the value chain. The target is to increase natural gas as a proportion of primary energy consumption from around 6% in 2015 to 10% in 2020. Moreover, the government is also targeting a further increase in the proportion to above 15% by 2030. We believe the target set is achievable given that the government is determined to boost clean energy consumption in China.

13th Five-year plan: Main targets

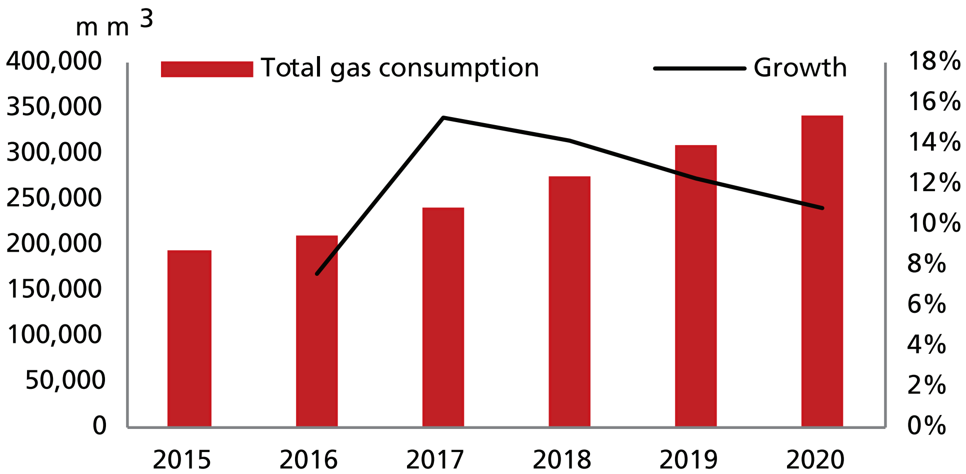
	2015	2020	CAGR
Cumulative proven reserves (m m3)	13,000,000	16,000,000	4.2%
Production (m m3 / year)	135,000	207,000	8.9%
Proportion of energy consumption (%)	5.9%	10.0%	
Total population using gas (m)	330	470	7.3%
Proportion of population above town level using gas	42.8%	57.0%	
Pipeline length ('000 km)	64	104	10.2%
Pipeline transmission capacity (m m3)	280,000	400,000	7.4%
Underground storage capacity (m m3)	5,500	14,800	21.9%

Source: NDRC

Good growth expected in natural gas volumes

By the end of 2017, the natural gas consumption increased 15% y-o-y to 239.5bn. In order to reach the government's target, we expect the natural gas consumption to reach above 340bn m3 by 2020, representing a CAGR of 13% from 2016-2020.

China natural gas consumption estimate

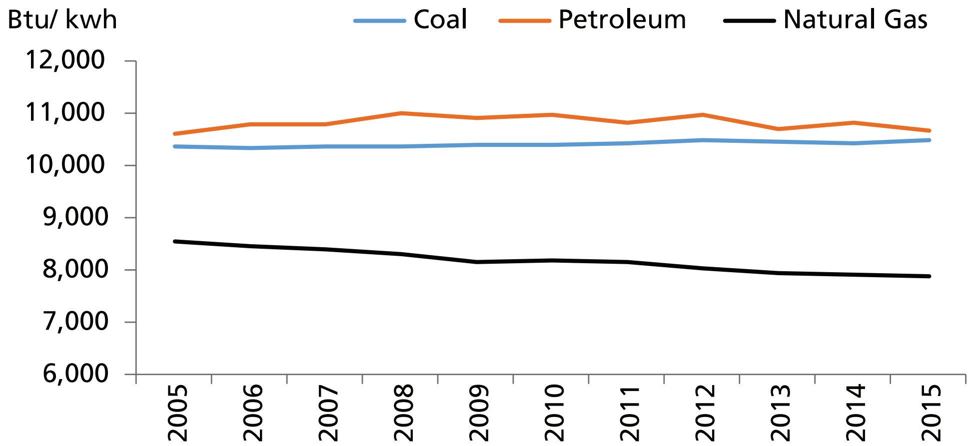


Source: DBS Vickers

Natural gas is an attractive alternative fuel for China as it emits fewer pollutants and could act as base load energy source other than coal

Natural gas enjoys higher efficiency and lower carbon dioxide (CO2), nitrogen oxide (NO), and sulphur dioxide (SO2) emissions compared to some of the traditional fossil fuels. Natural gas emits 50%, 80%, and 99% less CO2, NO, and SO2, respectively, than coal, and 30%, 80%, and 99% less than oil. In addition, natural gas power plants operate at around 25% lower heat rate (more efficient) than coal and petroleum power plants.

Average operating heat rate



Source: EIA

The conversion of industrial coal boilers to gas is one of the major growth drivers of natural gas consumption

China's State Council aims to convert 189,000 steam tonnes/hour (t/h) of industrial coal-fired boilers by 2020, which is expected to boost natural gas demand by 42bn m3. The central government will penalise local governments if they cannot meet the target. Thus, in order to strengthen policy implementation, local governments have rolled out subsidies for industrial/ commercial players to conduct the conversion. As a result, most targets to eliminate coal boilers below 10 steam t/h by 2017 were met. Looking forward into 2018 to 2020, we believe the pace of coal-fired boilers conversion will keep momentum. In fact, many provinces have issued additional policies to eliminate coal boilers between 10 and 35 steam t/h.

Selective coal-boiler conversion subsidies

Province	City	Subsidy
Gansu (甘肃)	Lanzhou (兰州)	• Rmb100,000 per steam tonne for coal boilers above 0.7MW • Rmb100 per m^2 for coal boilers below 0.7MW used by public facilities (such as hospital, school, local government building)
Henan (河南)		• Finish conversion before Oct 2018: >Rmb60,000 per steam tonne • Finish conversion after Oct 2018 but before Oct 2019 : >Rmb40,000 per steam ton
Hebei (河北)		• Disposal only: Rmb30,000 per steam tonne • Replacement with clean energy : Rmb80,000 per steam tonne
Jiangsu (江苏)	Suqian (宿迁)	• Rmb0.76 per m^3 of gas consumption for two years
Jilin (吉林)	Changchun (长春)	• Rmb20,000 per steam tonne for coal-boilers above 20 steam tonnes/hour
Shandong (山东)		• Rmb35,000/MW for coal-boilers below 100MW

Source: NDRC, DBS Vickers

Continued future growth from industrial coal boiler conversions

The Action Plan on Prevention and Control of Air Pollution promulgated by the State Council seeks to take measures to reduce air pollution in China. As stated earlier, one of the main targets is to shut small coal-fired boilers (<10 t/h) in cities above the prefecture level by 2017 and replace these with cleaner sources including natural gas. Strong execution to shut down or convert coal-fired boilers started in 2H2016 and strong volume growth of 15% was achieved in 2017.

After closing down the smaller boilers, the government started to tighten the policy to shut down or convert coal-fired boilers generating between 10 steam t/h to 35 steam t/h. Core cities such as Tianjin and Shijiazhuang have already implemented tighter policies. According to China's General Administration of Quality Supervision, Inspection and Quarantine, there were more than 460,000 industrial coal-fired boilers in the country by 2015. The proportion of small-medium industrial coal-fired boilers below 35 steam t/h accounted for 91.7% of the total. Small industrial coal-fired boilers below 10t/h account for 46%, indicating that there is plenty of room for for closing down medium sized boilers of between 10-35 steam t/h, which will further boost natural gas demand.

More natural gas for winter heating as well

Winter heating is believed to be one of the main contributors to air pollution in China. The Chinese government has issued multiple policies to tackle the use of scattered coal for heating purposes and local governments have introduced subsidy schemes to subsidise gas usage and installation costs. Given increasing environmental and health awareness, we believe the subsidy schemes provide sufficient incentives for natural gas usage, despite slightly higher costs for rural users. The subsidy schemes will last for three years to help users reduce costs during the transition period. In addition, coal-free zones were established to prevent companies from selling/using coal, which will push up local coal prices, and reduce the attractiveness of a possible switch back to coal.

The first focus region is the Pan Beijing-Tianjin-Hebei area, where the smog is the most severe. The government issued has also the Clean Winter Heating Plan for Northern China" ("北方地区冬季清洁取暖规划") to tackle winter heating in the whole northern part of China, showing its determination to shut down coal usage.

Clean winter heating in Northern China: Main targets

	Year	Target
Overall Northern regions		
Clean energy coverage rate	2019	50%
	2021	70%
Replacement of scattered coal boilers	2019	74m tons
	2021	150m tons
2+26 core areas		
Clean energy coverage rate	2019	> 90% for core city > 70% for county > 40% for rural area
	2021	> 80% for county > 60% for rural area
Replacement of scattered coal boilers	2021	eliminate capacities < 35 steam t/h for city eliminate capacities < 20 steam t/h for county
Gas consumption	2017-2021	boost gas consumption by 23bn m3 from natural gas heating

Source: NDRC

Selective rural incentives by local governments

Province	City	Subsidy
	Beijing (北京)	• 30% equipment cost subsidy for maximum of Rmb12,000 (villages <500 households) and Rmb24,000 (villages > 500 households)
	Tianjin (天津)	• Municipal Ministry of Finance provided total subsidy of Rmb320m
Hebei	Handan (邯郸)	• Gas equipment : 70% cost subsidy for maximum Rmb 2,700 • Gas pipeline discounted installation fee of Rmb2,600 • Natural gas tariff (heating) subsidy : Rmb1 / m3 for maximum Rmb1,200
	Hengshui (衡水)	• Installation subsidy : Rmb2,600 • Natural gas tariff subsidy : Rmb1.5 / m3
	Xingtai (邢台)	• Natural gas tariff subsidy : Rmb1 /m3 for maximum Rmb900
	Shijiazhuang (石家庄)	• Installation and equipment : Rmb3,900 • Natural gas tariff subsidy: Rmb1 / m3 for maximum Rmb900
	Baoding & Langfang (保定&廊坊)	• Gas equipment : 70% cost subsidy for maximum Rmb 2,700 • Coal-forbidden zones will no longer adopt tier-pricing system • Natural gas tariff (heating) subsidy : Rmb1 / m3 for maximum 1,200 m3 • Gas pipeline connection subsidy Rmb4,000

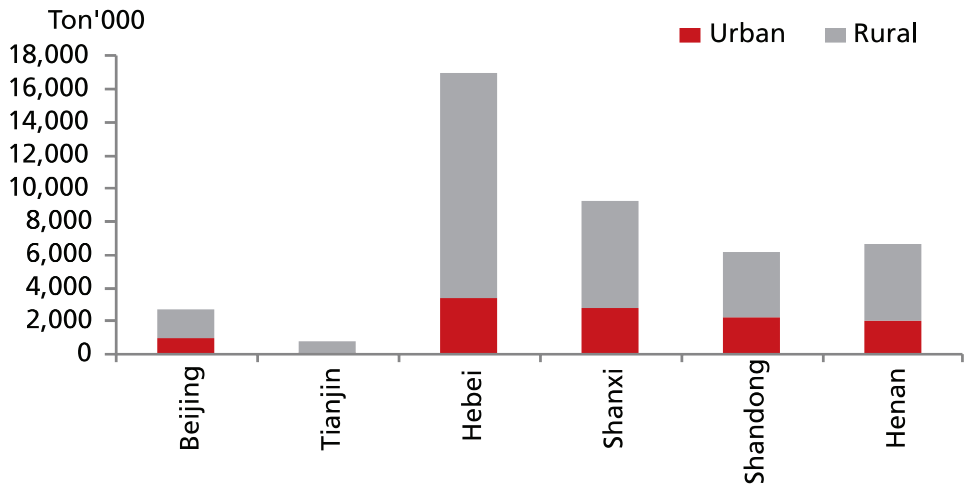
Source: NDRC

Large market in rural coal-to-gas conversion

We are positive on rural coal-to-gas conversion, as it will be one of the major drivers for the Chinese government to reach its gas consumption target in 2020. We expect rural coal-to-gas conversion to account for over 8% of the increase in natural gas consumption during 2015-2020. Furthermore, we believe there will be implementation and expansion of coal-free zones as part of the measures to ensure that policies are successfully executed. The establishment of coal-free zones will prevent companies or residents from selling or using coal.

The government moved its focus to tackle coal usage in rural areas starting in 2017, as rural residential coal consumption is believed to be one of the major contributors to air pollution. The Beijing-Tianjin-Hebei region will be the focus as rural residents use scattered coal as a primary heat generation fuel. Scattered coal has the characteristics of low efficiency and high pollution. The emission intensity of scattered coal is 17.5 times more than coal for electricity generation. As a result, rural households accounted for over 70% of total residential coal consumption.

Household coal consumption



Source: CEIC

In 4Q2017, the government issued the "Clean Winter Heating Plan for Northern China" ("北方地区冬季清洁取暖规划"). The plan aims for the clean energy-heating rate to reach 70% by 2021, from around 17% in 2016. The plan targets coal-to-gas conversion for heating to boost 23b m3 of gas demand from 2017 to 2021 in the core "2+26" cities in the Pan Hebei-Tianjin-Beijing area.

Rural coal-to-gas conversion can greatly contribute to the increase in gas consumption, as coal consumption for rural households is higher than urban households due to the lack of central heating systems. We estimate there are about 62m rural households in the Beijing-Tianjin-Hebei areas, which could boost natural gas demand by 31.2b m3 assuming 40% convert to gas heating.

The government has also imposed policies trying to lower the end selling price to stimulate demand

As a result, intermediate costs including long/short distance pipeline transmission fees and distribution margins were lowered.

In October 2016, the NDRC issued a document on the trial implementation of a natural gas pipeline transmission pricing scheme. The return on assets for inter-provincial pipelines (long distance) is set at 8% based on a minimum utilisation rate of 75%, which means that a utilisation rate below 75% will have lower returns. The tariff mechanism is set for the pipeline company and it will be adjusted every three years. Local governments have started to limit the return on intra-provincial (medium to short) pipeline transmission recently, lowering the transmission fee.

The NDRC released a regulatory guidance opinion on gas distribution prices in June 2016 to clarify its stance and removed industry concern over a potential steep cut in distribution margin. According to the guidance opinion, the return on attributable assets (ROA) for a city gas distribution business cannot exceed 7%. This will have a negative impact on projects with a high dollar margin and ROA >7%, though there are not many projects with high returns. The average ROA for major gas distributors in China ranges from 3-5%. Therefore, we do not expect a significant impact on the earnings growth of gas distributors.

Natural gas price in China

City-gate price

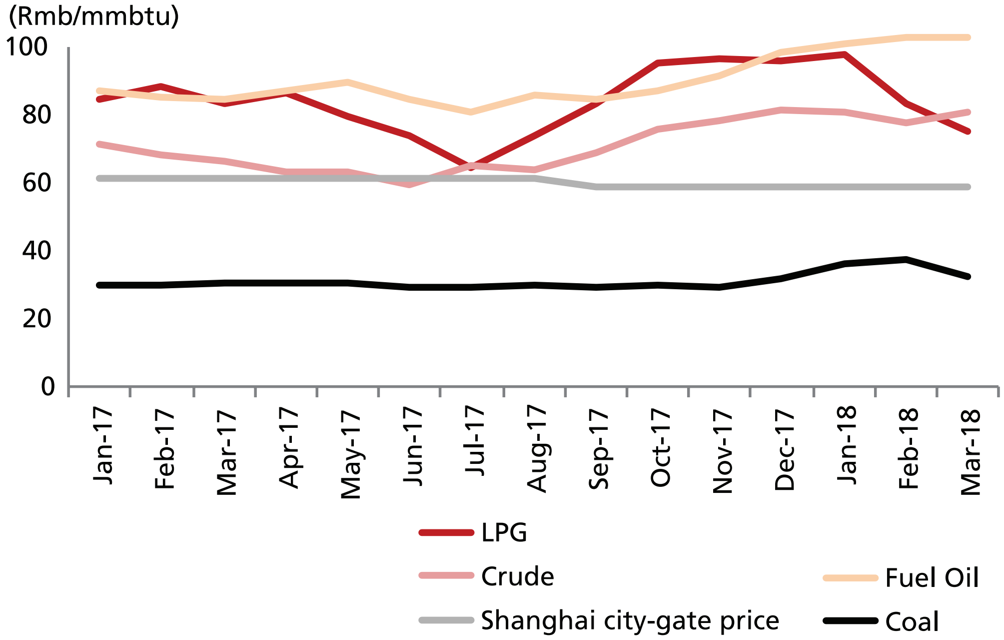
Upstream ex-plant price	+ Long distance pipeline transmission tariff	+ Short-medium distance pipeline transmission tariff	+ Distribution margin	= End selling price
- Government hopes to liberalise upstream selling price; to be market driven over the long run - Increase production/import capacity	- ROA < 8% requirement limits the tariff upside - latest Rmb0.1 city-gate price cut was mainly from the c.15% decline in long distance transmission tariff	- Government intends to intensify the regulation of midstream and lower tariff	- ROA < 7% requirement limits dollar margin upside, but most distribution projects have yet to reach the requirement - Some regions are exposed to higher risks	- Lower price to end users will boost demand

Source: NDRC, DBS Vickers

Lower gas price to stimulate demand

We expect the end-user gas price will be more competitive in the next few years as the government tackles intermediate costs, which is positive to demand growth. The lowering of the end selling price for natural gas will be borne by a cut in pipeline transmission fees and distribution margin.

Alternative fuel price vs natural gas price



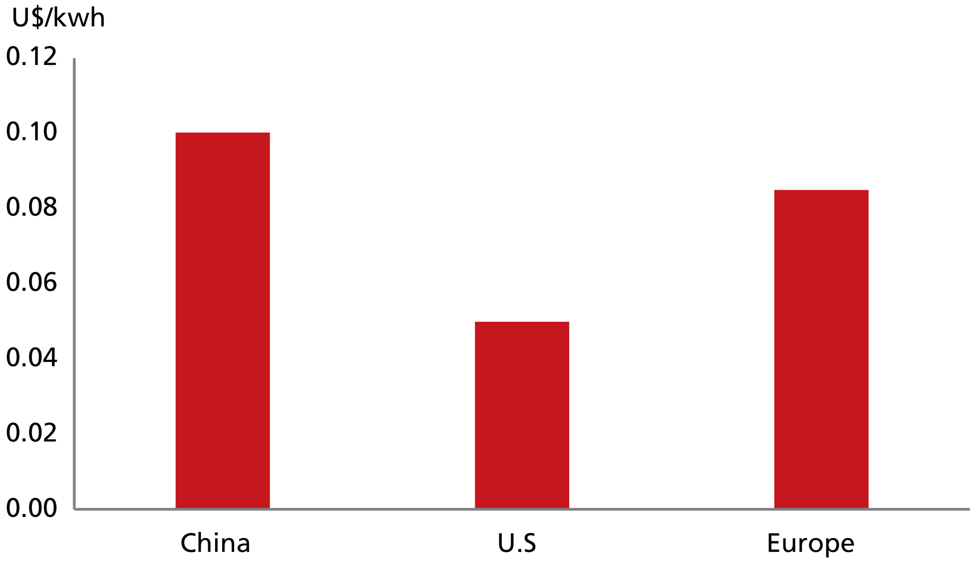
Source: DBS Vickers

Gas power plants will also be more competitive

The LCOE for gas power plants in China consists of 62% fuel costs, 7% capex, 17% operations & maintenance costs, 7% finance costs and 7% tax. Therefore, the LCOE is largely dependent on the upstream natural gas price. Since the natural gas price in China is relatively high compared to some international peers in the U.S and Europe, its LCOE is also comparatively higher.

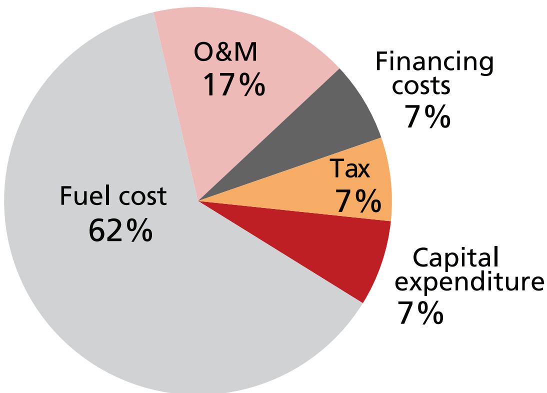
Prior to the oil price decline in 2014 and the cut in city gas prices in 2015, the LCOE of gas power projects was much less competitive compared to coal-fire plants. The city-gate price was revised down by Rmb0.7/m3 in 2015 and another Rmb0.1/m3 in 2017, which has helped to drive down the LCOE by about Rmb0.1/kwh to around Rmb0.76/kwh. As the Chinese government seeks to lower the gas price by cutting midstream transmission fees and restrict distribution margin, the gas price is expected to remain at low levels, which is positive for the sector.

LCOE of gas power plants - Global



Source: BNEF, DBS Vickers

LCOE structure



Source: DBS Vickers

We believe there is more downside to pipeline transmission tariffs

After the approximately 15% cut in the long distance pipeline transmission tariff, we expect more provinces to announce a tightening of intra-provincial transmission tariffs, which would help to further reduce the end-user selling price, and boost gas sales volume growth. Pipeline transmission fees are one of the major cost components of gas distributors, and are estimated to account for around 30% of the selling price. We have seen a few provinces such as Shandong and Zhejiang start cutting intra-provincial gas pipeline transmission tariffs, and we expect other provinces will follow suit. We expect the intra-provincial tariff to be cut by an average of 15% in FY18, implying around Rmb0.03 to Rmb0.06 reduction in the city-gate price. This could help to alleviate distribution margin pressure, reduce the end-selling price, and stimulate demand in the long run

The provincial governments have issued the local distribution return requirement documents in correspondence to the NDRC's document on distribution return. We expect the local governments will start to conduct reviews on city gas projects in 2H18 and1H19. This will cause a cut in the distribution margin for projects with ROA of less than 7% or a high dollar margin, but we don't expect this to have significant impact on earnings for gas distributors as most projects are still below the return requirement.

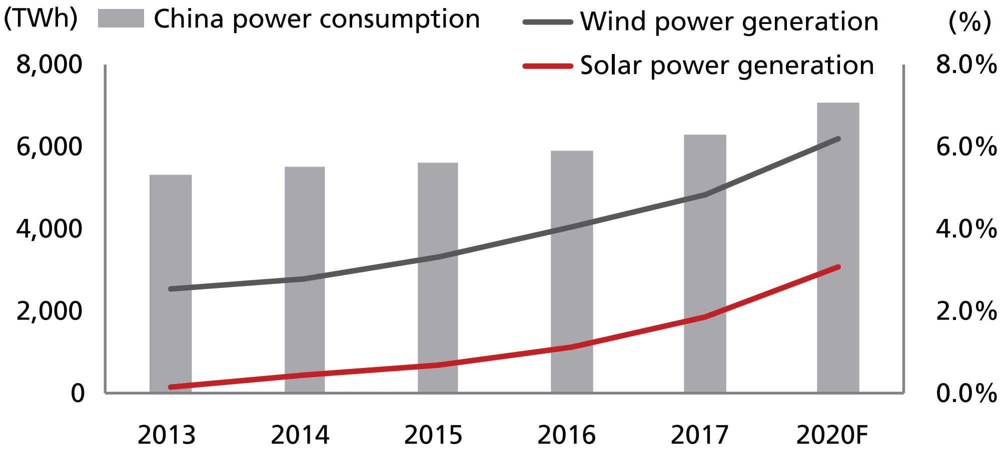
2. Increasing Clean Energy Sources in China's Electricity Mix

Chinese investment in renewables a big chunk of global investment levels

According to Bloomberg New Energy Finance (BNEF) statistics, global investment in renewable energy edged up 2% y-o-y to US$279.8b in 2017. Wind and solar power accounted for 38% and 58% of the total RE investment respectively. According to BNEF, China's wind and solar power contributed to 34% and 54% respectively of this world's total investment in RE.

A strong buildout of 53GW new solar capacity (up 54% y-o-y) was fuelled by a significant rollout of distributed generation (DG) projects, which recorded 3.6-fold y-o-y growth. This was underpinned by the government's favourable tariff subsidy policy for DG projects. China's solar DG development is benefiting high power tariff payers, such as industrial and commercial customers, who get a cheaper tariff rate against the backdrop of China gradually liberating its power market.

Renewable contribution in Chinese power generation and overall power consumption growth

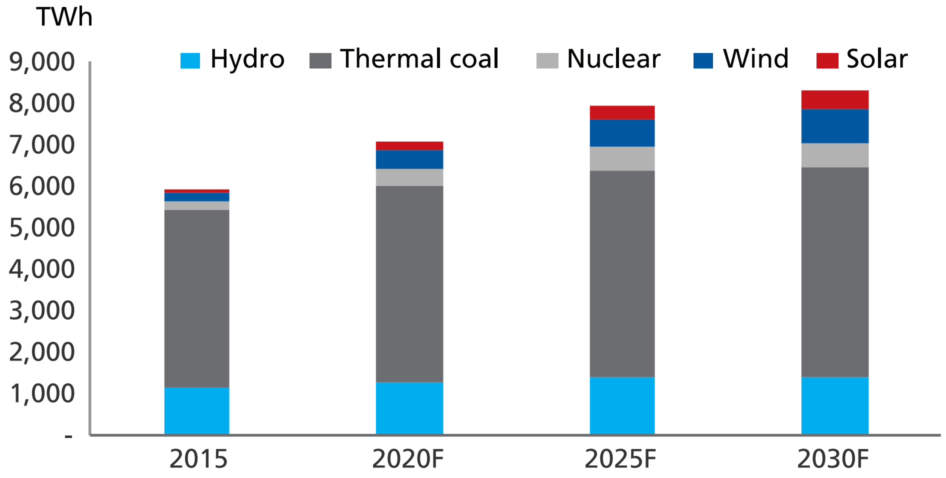


Source: NEA, China Electricity Council, DBS Vickers

In China, energy supply has been dominated by coal but fuel mix is shifting to include more wind and solar

In 2017, coal power generation accounted for 73% of China's total power generation versus 80% in 2013. The proportion for RE (wind and solar) increased to 6.7% in 2017 from 2.7% in 2013.

China power generation fuel mix



Note: TWh : Tera Watt hours
Source: GREENPEACE, CEWA, China Electricity Council, DBS Vickers

From 2020 to 2030, non-hydro renewable energy will account for 53% of increased power generation

We forecast national power generation to grow at a 1.7% CAGR from 2020 to 2030, to reach 8,366 TWh. China aims for non-fossil fuels to account for about 15% of total energy consumption by 2020 and 20% by 2030, with non-hydro renewable energy generation to account for no less than 9% by 2020. We project aggregate wind and solar power generation to account for 9.3% (wind: 6.2%; solar: 3.1%) of the country's power generation in 2020 and expect the non-hydro renewable ratio could further rise to 14.5% (wind: 9.4%; solar: 5.1%) in 2030.

This assumes China's cumulative grid-connected capacity for wind power to expand to 220GW and 415GW by 2020 and 2030, respectively, compared to 164GW in 2017. Also, China's cumulative grid-connected solar power is expected to rise to 182GW and 388GW by 2020 and 2030, respectively, compared to 100.6GW in 2017. We expect the wind power industry's utilisation to range bound between 2,000 hours and 2,100 hours during 2020 to 2030. We forecast the solar power industry's utilisation to be maintained at 1,200 hours on average during the period.

Supportive government policy for existing projects still intact

China's wind power cumulative installed capacity had increased to 188GW in 2017 from 91GW in 2013, while solar cumulative installed capacity had expanded to 130GW in 2017 from 19GW in 2013. This growth was supported by the government's RE policies including the feed-in-tariff (FiT), the buildout of ultra-high voltage (UHV) transmission lines, and guaranteed utilisation hours to promote usage of wind and solar power.

Feed-in-tariff policies

Earlier in 2009, the NDRC introduced an on-grid tariff policy for wind power, also known as FiT, based on project zonings. Solar power in China also adopts a FiT policy. The FiT has a rate higher than the coal power tariff to help recover the costs of investment in RE generation. All FiTs are fixed for 20 years from the start of commercial operation of wind and solar power projects. The payments of RE FiTs are composed of two parts: i) A provincial coal-fired tariff is paid by the grid company monthly and ii) a subsidy, representing the difference between the FiT and the coal-fired tarif, is paid by the National Renewable Energy Development Fund. China's wind power FiT has been cut three times since 2014. The latest tariff cut for wind power took place in December 2016 when the FiT for projects approval after 2018 was reduced by 15%, 10%, 9%, and 5% for Tier I, Tier II, Tier III, and Tier IV resource zones, respectively.

On 31 May 2018, the NEA announced it would cut the solar FiT for projects connecting to the grid after 30 June 2018. The FiT for Tier I, Tier II and Tier III resource zones will be cut by Rmb0.05/kWh each to Rmb0.50/kWh, Rmb0.60/kWh and Rmb0.70/kWh, respectively. Before this, China's solar power FiT had been reduced four times since 2011. The downward adjustment in RE FiT predominantly reflects reduction in construction costs and improvement in technologies (please see the following pages for more information on RE construction cost and technologies).

Construction of UHV lines

China's rollout of UHV transmission lines, to a certain extent, helps promote usage of RE, by transmitting power from RE resource-rich Northwest China to demand centres such as East, Central and North China. Since 2014, China has commenced the commercial operations of at least seven lines of UHV (distinguished by alternating current), which are helping China to improve its high curtailment of wind power.

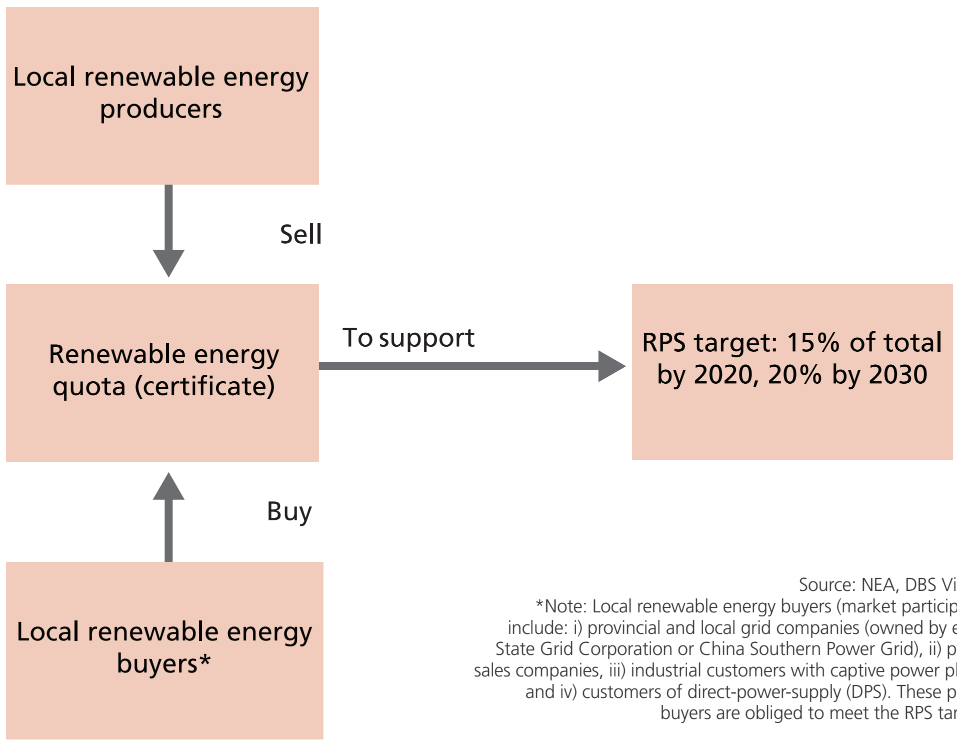
"Guaranteed utilisation hours" policy

In response to the high curtailment of wind and solar power during 2015-16, the Chinese government announced its "guaranteed purchase utilisation hours" policy in May 2016 to mandate a minimum power purchasing agreement between the grid company and RE producers. This has led to an improvement in RE utilisation from 2017 to date.

Renewable Portfolio Standards – new policy prioritises promotion of RE usage

On 23 March 2018, the NEA announced the "Renewable Portfolio Standard (RPS) and Assessment Methodology (Draft on Soliciting Opinions)". It aims for 15% of total power generation from RE by 2020, and the ratio is expected to reach 20% by 2030. The mandatory target stipulates non-hydro RE to account for total power generation of between 3.5% to 25.5%, depending on province. This is a long-awaited development for China's RPS following a previous proposal in April 2016. Given China's government is currently promoting adoption of RE, we expect the RPS to be officially implemented no later than 2019.

Renewable Portfolio Standard quota system



Source: NEA, DBS Vickers
*Note: Local renewable energy buyers (market participants) include: i) provincial and local grid companies (owned by either State Grid Corporation or China Southern Power Grid), ii) power sales companies, iii) industrial customers with captive power plants, and iv) customers of direct-power-supply (DPS). These power buyers are obliged to meet the RPS targets.

RE tariff parity with coal power to come earlier

On 24 May 2018, the NEA released its "Notice regarding 2018 requirement of wind power construction management" to stipulate that new quotas for wind power projects pending approval from 2018 onwards (including the new 2018 provincial quotas for wind projects not yet announced, as of 18 May 2018) will be awarded via an electricity tariff auction rather than FiT. This is to accelerate the pace for the wind power tariff to reach tariff parity with coal power. The Notice was announced to promote consumption of RE while rationalising installation of new wind power capacity. This policy was introduced against the backdrop of China's RE subsidy shortfall having extended to Rmb100b by end-2017.

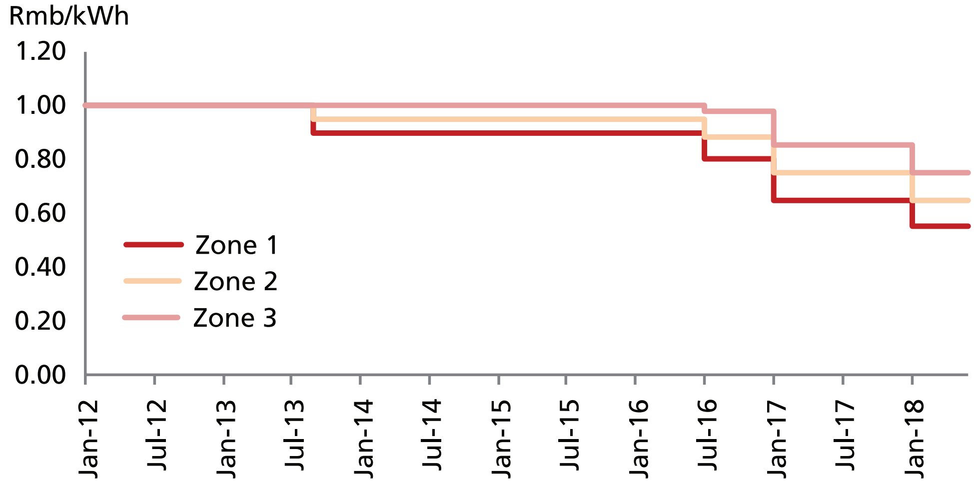
On 31 May 2018, NDRC, MOF and the NEA jointly published the "Notification on photovoltaics power generation for 2018", which stipulated that, in 2018: i) There will be no new installation quota for centralised solar power projects; ii) new installation of distributed generation projects is not to exceed 10GW; and iii) installation of photovoltaics poverty alleviation (PVPA) is to be supported. The Notification has reduced subsidies for DG projects by Rmb0.05/kWh to Rmb0.32/kWh while the FiT for PVPA (village-level with unit project not exceeding 0.5MW) has remained unchanged.

China wind power sector: Renewable Portfolio Standards - 2018 and 2020 targets, by province

	2018 target	2020 target	Previous 2020 target announced in April 2017	New 2020 target vs previous 2020 target (%)	2016 Actual	Gap between 2020 target and 2016 actual (%)
Zhejiang	10.5%	13.0%	10.0%	3.0%	9.0%	4%
Tianjin	10.5%	13.0%	10.0%	3.0%	9.0%	4%
Hebei	10.5%	13.0%	10.0%	3.0%	9.0%	4%
Shanxi	13.0%	15.0%	10.0%	5.0%	10.0%	5%
Inner Mongolia	13.0%	13.0%	13.0%	0.0%	15.3%	-2%
Liaoning	9.0%	9.0%	13.0%	-4.0%	8.6%	0%
Jilin	16.5%	20.0%	13.0%	7.0%	13.7%	6%
Heilongjiang	15.5%	22.0%	13.0%	9.0%	12.4%	10%
Shanghai	2.5%	3.5%	5.0%	-1.5%	2.0%	2%
Jiangsu	5.5%	6.5%	7.0%	-0.5%	4.2%	2%
Zhejiang	5.0%	6.0%	7.0%	-1.0%	3.6%	2%
Anhui	11.5%	14.5%	7.0%	7.5%	6.1%	8%
Fujian	5.0%	7.0%	7.0%	0.0%	3.7%	3%
Jiangxi	6.5%	14.5%	5.0%	9.5%	3.8%	11%
Shandong	8.0%	10.5%	10.0%	0.5%	5.6%	5%
Henan	8.0%	13.5%	7.0%	6.5%	4.4%	9%
Hubei	7.5%	11.0%	7.0%	4.0%	4.7%	6%
Hunan	9.0%	19.0%	7.0%	12.0%	4.1%	15%
Guangdong	3.0%	3.8%	7.0%	-3.2%	1.9%	2%
Guangxi	3.0%	5.0%	5.0%	0.0%	1.3%	4%
Hainan	4.0%	5.0%	10.0%	-5.0%	4.5%	1%
Chongqing	3.0%	3.5%	5.0%	-1.5%	1.6%	2%
Sichuan	4.5%	4.5%	5.0%	-0.5%	2.3%	2%
Guizhou	4.0%	4.8%	5.0%	-0.2%	4.6%	0%
Yunan	10.0%	10.0%	10.0%	0.0%	12.5%	-3%
Tibet	13.5%	17.5%	13.0%	4.5%	10.1%	7%
Shaanxi	8.5%	11.5%	10.0%	1.5%	3.8%	8%
Gansu	15.0%	15.0%	13.0%	2.0%	12.5%	3%
Qinghai	21.0%	25.5%	10.0%	15.5%	18.3%	7%
Ningxia	21.0%	21.5%	13.0%	8.5%	19.1%	2%
Xinjiang	14.5%	14.5%	13.0%	1.5%	11.1%	3%

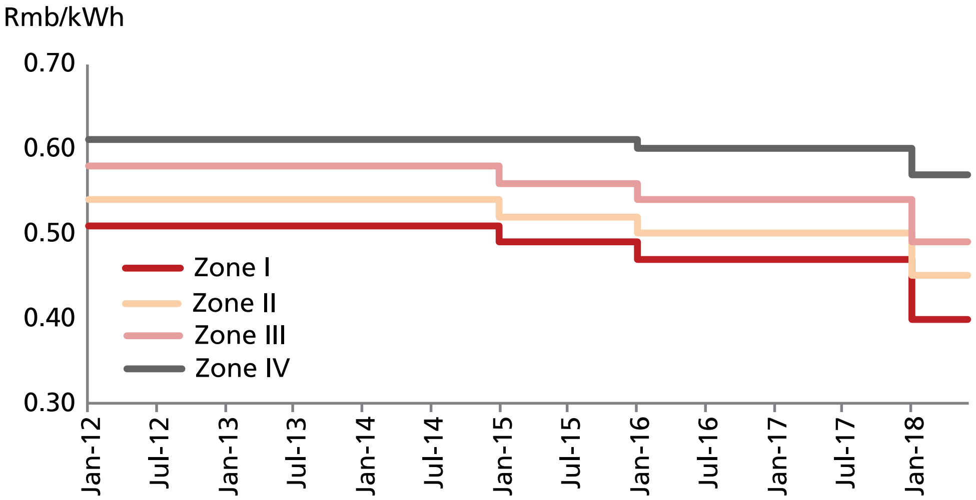
Source: NEA, DBS Vickers

China Solar Power: Feed-in-tariff



Source: NEA, NDRC, DBS Vickers

China Wind Power: Feed-in-tariff

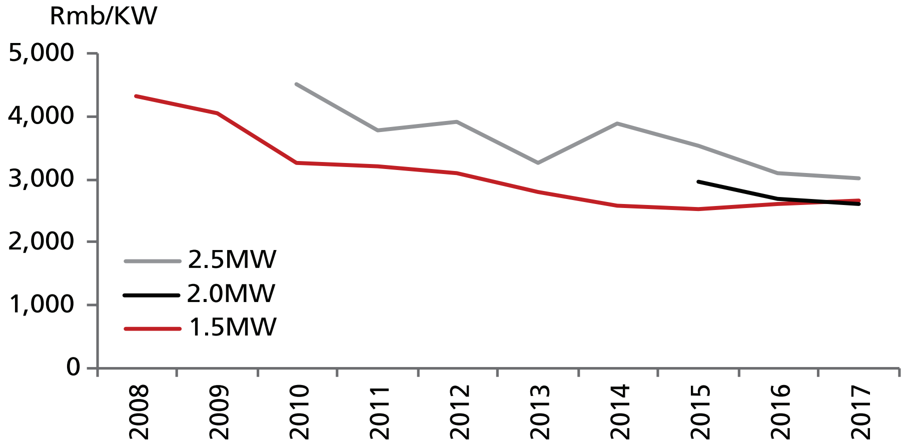


Source: NEA, NDRC, DBS Vickers

Advancement of technology to drive down RE construction costs – Wind Power

Advances in wind power technologies primarily reflect a development toward larger rated capacity wind turbine generator (WTG) units with higher operational efficiency. WTG units usually account for around 70% of an onshore wind farm's unit investment cost. Industry studies reveal that with every doubling in cumulative capacity of wind power, the LCOE for wind power could come down by 10%, due to the fall in wind turbine equipment cost arising from economies of scale and more efficient technologies. For example, China's largest WTG manufacturer Xinjiang Goldwind's unit production cost for a 1.5MW WTG decreased by 44% from 2007 to 2017, while that of a 2.0MW WTG declined 12% from 2015 to 2017 and that of a 2.5MW WTG dropped 33% from 2010 to 2017. As a result, in Tier I resource zones, the per unit capital expenditure (capex) of wind farms declined to around Rmb6,000-6,500/kW in 2017 from Rmb7,180/kW in 2016. In Tier III resource zones, unit capex declined to around Rmb7,000/kW in 2017 from Rmb7,950/kW.

China wind turbine generators unit production cost



Source: Xinjiang Goldwind, DBS Vickers

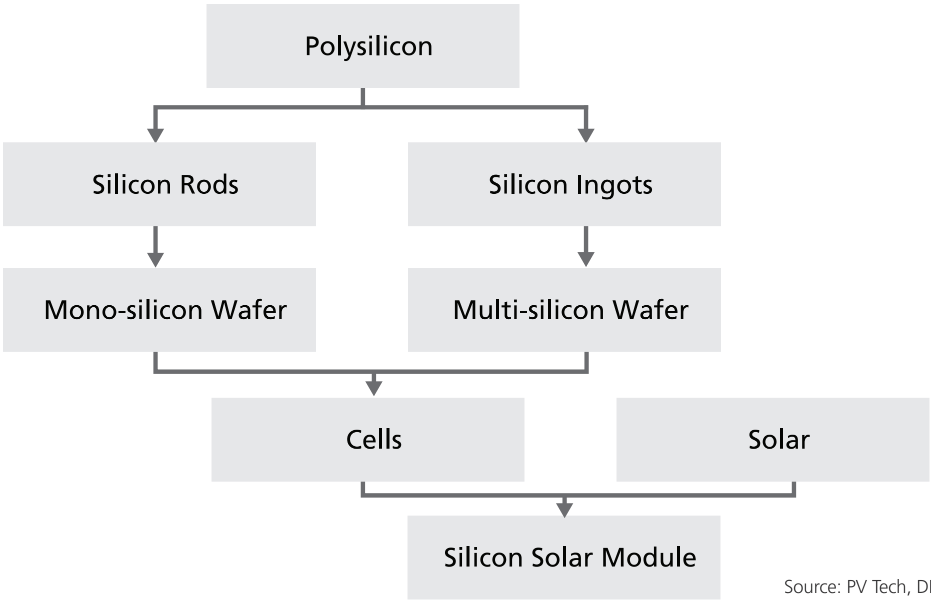
Lower costs in solar power

There has been a substantial fall in the unit construction cost of solar power in the past decade thanks to advancement of technology along the whole supply chain of photovoltaic (PV) modules, including polycrystalline silicon, wafer and cell. Industry studies reveal that for every doubling in cumulative capacity of solar power, the LCOE for solar power could come down by around 15%.

Falling costs of modules, inverters and balance of system

These account for around 50%, 10% and 40% of unit capex, respectively, for new solar farms in China. China's unit construction cost for solar farms dropped to around Rmb6.3-6.9/W in 2017 from around Rmb15.9/W in 2010, representing a decline of 56%, mainly due to the falling cost of modules. Silicon solar module prices fell to US$0.33/W in 2017 from US$1.75/W in 2010, representing a decrease of 81%, owing to a 74% decline in the price of polycrystalline silicon.

Photovoltaics supply chain



Source: PV Tech, DBS Vickers

The unit construction cost to decrease by at least 30% by 2030

This is attributed to an expected decline of 33% in the cost of modules and a decrease of 50% in the cost of inverters, according to a study by the International Technology Roadmap for Photovoltaic.

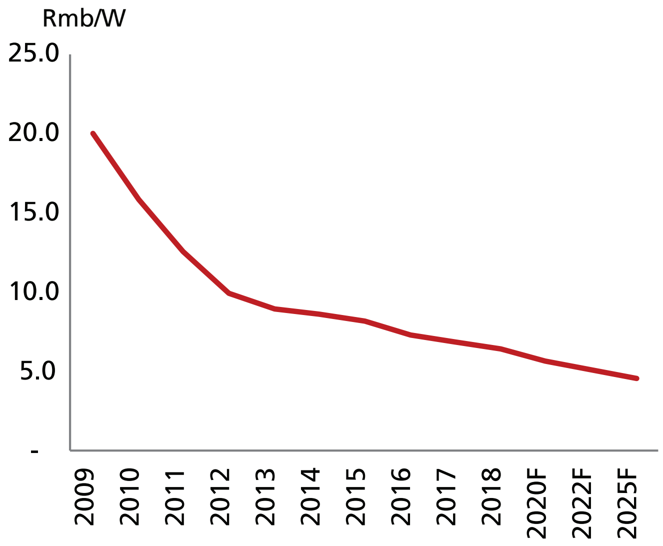
Advancement of technology in solar manufacturing

Wafer accounts for around 42% of the production cost for PV modules. We estimate that the introduction and adoption of diamond wire cutting (or diamond wire saws) technology, which wastes less silicon in the form of "kerf" and consumes less energy, has reduced the waste of silicon by around 22%.

In 2017, in China, module efficiency of monocrystalline may have reached 20.0% (from 17.5% in 2010) and that of polycrystalline may have reached 18.7% (from 16.5% in 2010).

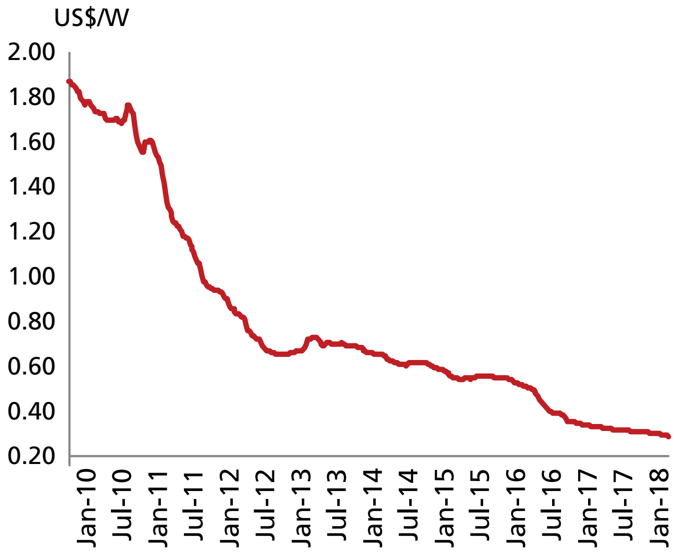
Cells accounts for around 62% of production cost for PV modules. The introduction of new processes to texture the surface of cells (also known as black cell) helps to improve module efficiency, while the passivated emitter rear contact design is also a higher efficiency cell design. These two technologies could lead to further improvement in module efficiency by 0.7-0.9%.

China Solar Power: Unit construction cost of solar farms



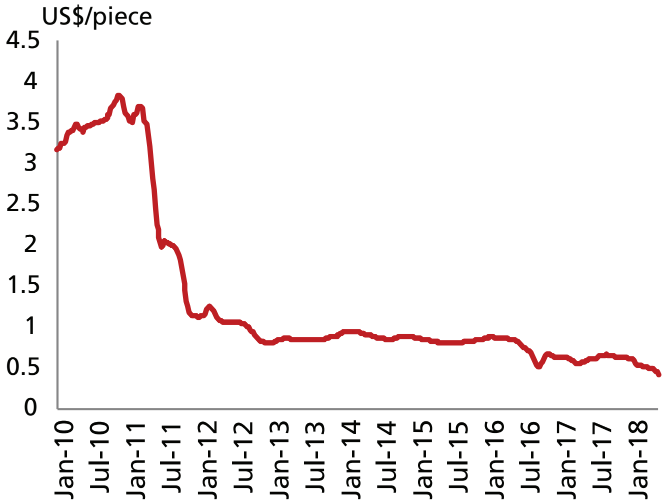
Source: China Photovoltaic Industry Association, DBS Vickers

China Solar Power: Average silicon solar module spot price



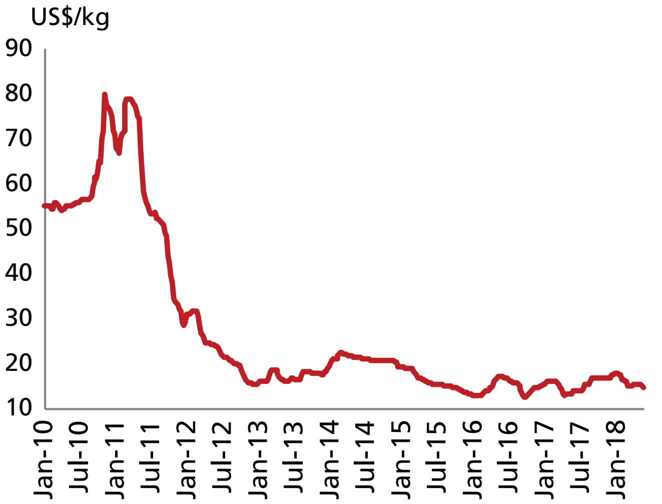
Source: Bloomberg Finance L.P., DBS Vickers

China Solar Power: Average 156mm multi solar wafer spot price



Source: Bloomberg Finance L.P., DBS Vickers

China Solar Power: Average PV grade poly silicon spot price



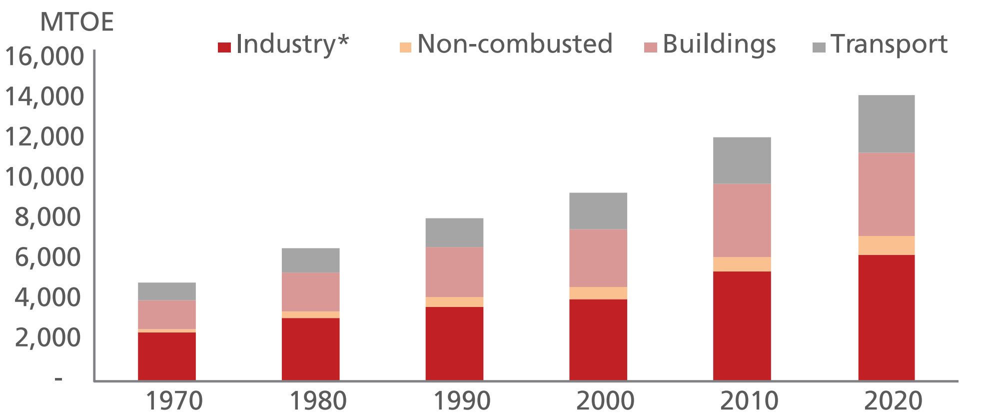
Source: Bloomberg Finance L.P., DBS Vickers

3. Rise of Electric Vehicles and Impact on Oil Demand

Transport end-use sector is a major component of global energy demand

Industry has been the biggest consumer of energy over the last five decades, as can be seen below, with a share of almost 50% since the start of the period; but the share of transport in the energy consumption pie has increased from about 17% in 1970 to around 20% currently. Increasing prosperity in developing economies has been the major driver for this, as the demand for transport has increased manifold. Demand for both passenger and freight services has driven an increase in energy demand of close to 2.5% CAGR since 1970 from the transport sector.

Primary energy consumption by end-use sector

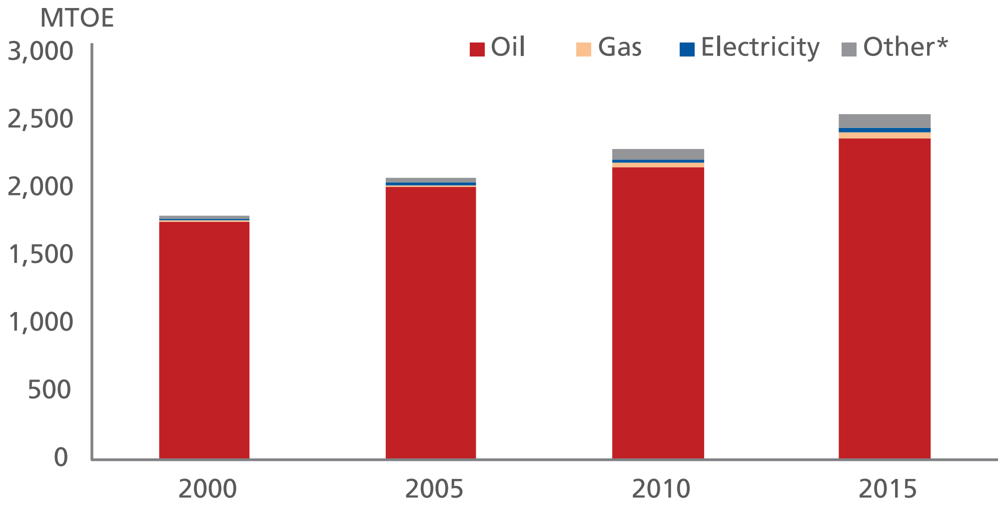


* Industry excludes non-combusted use of fuels
Source: BP Energy Outlook 2018, DBS Bank

Oil continues to be the dominant energy source demanded by the transport sector

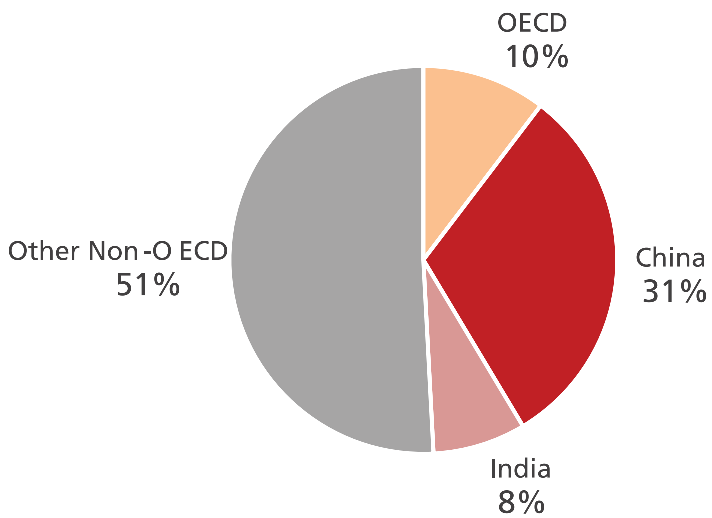
Until the start of the 21st century, before the emergence of concerns over emissions sparked the move toward cleaner options, oil was the predominant source of energy demanded by the transport sector, typically passenger vehicles, trucks, aviation, marine and rail. However, while the proportion of oil-powered transportation has fallen from around 98% in 2000 to around 92% currently, oil is still clearly the dominant fuel. Electricity, as a power source, has not made much of a dent on oil's dominance for now. The use of gas has picked up, but, again, does not present much of a challenge to oil yet. As the adoption of electric vehicles increases over the next ten to 15 years, this is likely to change, especially as much of the increase in electric vehicle adoption is likely to be in China, which has been one of the key drivers of transport energy demand over the last 15 years.

Transport energy consumption by fuel type



* includes bio-fuels, gas-to-liquids, coal-to-liquids, hydrogen
Source: BP Energy Outlook 2018, DBS Bank

Contribution to incremental energy demand over 2000-2015

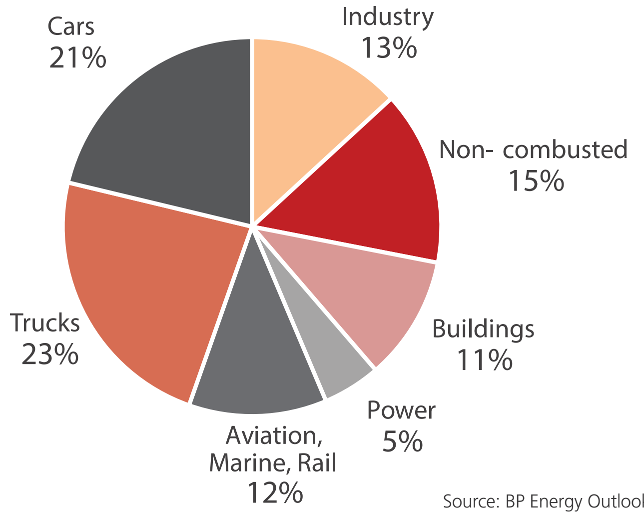


Source: BP Energy Outlook 2018, DBS Bank

…and the transport sector is the largest source of demand for oil

As of 2015, BP estimates that close to 56% of oil demand is driven by transportation – which includes cars, trucks, and non-road transport (aviation, marine and rail). Around 13% is used in industry, 15% as feedstock for petrochemicals, 11% for buildings (heating) and 5% for power generation. We do not expect demand from the trucks, aviation, marine, or rail segments to be significantly affected by the electrification of vehicles; hence, in our opinion, oil demand from the cars segment – or around 20% of oil demand – will be vulnerable to the rise of electric vehicles.

Contribution to demand for liquid fuels (oil and condensates)



Source: BP Energy Outlook 2018, DBS Bank

Demand from cars and trucks the highest growth drivers for oil

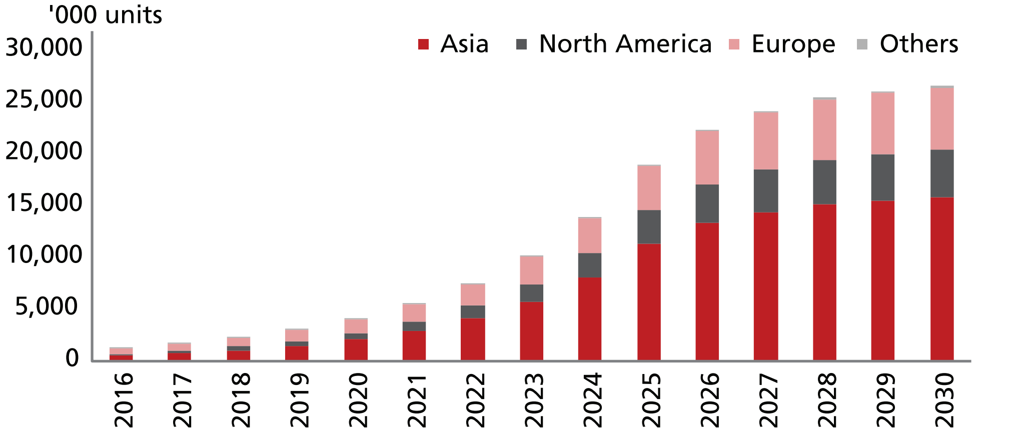
While global oil demand has risen at a CAGR of around 1.4% over the last 15 years, demand from cars and trucks has been rising faster at CAGRs of 2.5% and 2.0%, respectively, and hence, their share of the pie has been increasing. Demand from industry and buildings is largely flattish, while demand growth from the power generation sector has been negative, owing to the high costs involved, and the increasing use of natural gas.

Expected strong growth in electric vehicle unit sales could result in loss of 6% of annual oil demand

Our autos analyst, Rachel Miu, expects global electric vehicle (EV) yearly unit sales to grow from around 1.26m units in 2016 to over 26m units in 2030, representing an almost 15 times increase in yearly sales volumes. Much of the increase in sales will come from Asia, with China in particular being the dominant driving force.

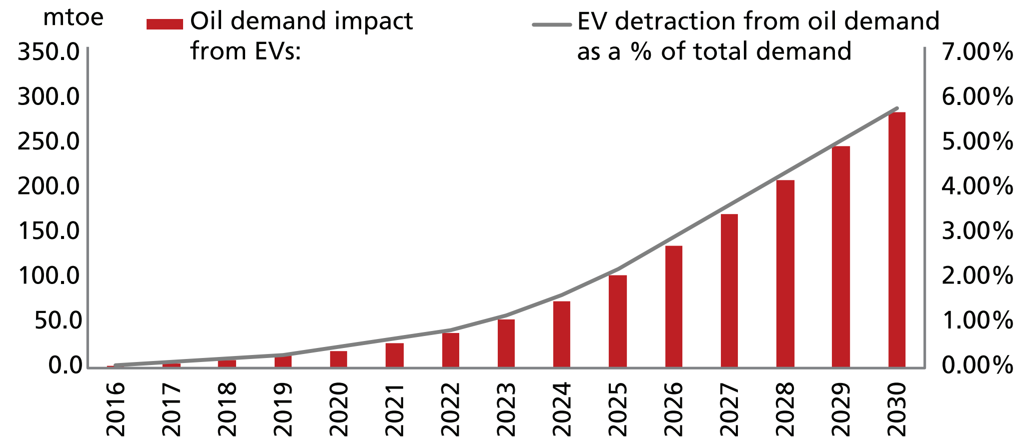
We estimate EVs will absorb around 285 million tonnes of oil equivalent (mtoe) or around 5.3 million barrels per day (mmbpd) of oil demand by 2030, which represents around 6% of the total demand for oil in that year, assuming that EVs were non-existent. That is not insignificant. But when you consider that global energy intensity is expected to improve every year from 2017 until 2030 – we expect a global energy demand CAGR of 1.7% compared to global GDP growth of 3.2% over the same timeframe – we believe that changes in energy intensity trends and policies are as, or more, important than sales of EVs, which tend to dominate news headlines with regard to future oil and energy demand.

Forecast Electric Vehicle unit sales



Source: DBS Bank forecasts

Impact of Electric Vehicles on oil demand



Source: DBS Bank forecasts

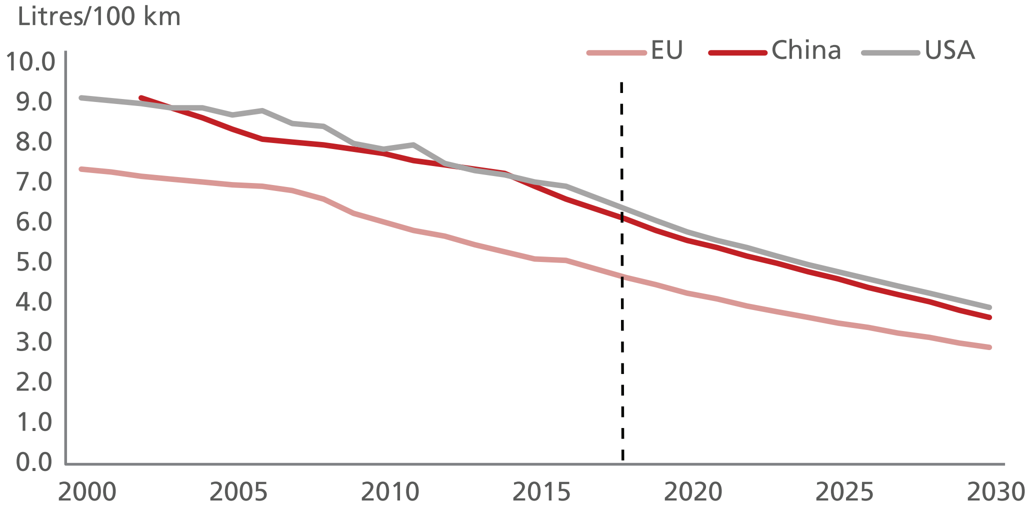
Energy intensity trends are very important in determining oil demand

Energy intensity is defined as the primary energy consumed per unit of GDP. A diverse number of factors can influence energy intensity, including a secular shift away from energy-intensive industries in certain countries, technology improvement and evolution (e.g. the proliferation of smart metres, which enable more accurate control of consumption; or a shift to EVs, which are more energy efficient), government policies, and so on. Energy intensity has declined at a CAGR of 1.55% from 1990-2015 (based on World Bank data), with that number accelerating to 2.4% from 2010 to 2015, led by the middle- and high-income countries. Notably, China and Japan, which are two of the top ten consumers of energy, saw their energy intensity decline by 23% and 21%, respectively, over that five-year period. Numbers by the International Energy Agency indicate 2016 saw a further 1.8% decline in energy intensity globally; that is US$2.2t when translated to dollar-savings – a sizeable figure. There is a similar trend in the growth of oil consumption vis-à-vis global economic growth, and this will increasingly be felt for passenger vehicles' oil consumption, which has been the key driver of oil demand in recent years, as highlighted earlier.

Increasing fuel efficiencies of passenger vehicles will be a limiting factor for oil demand

Fuel efficiencies of cars have been improving in developed countries, especially in the European Union (EU), with its tougher emission norms, as can be seen below. This trend is expected to continue in the future and we believe will be a bigger driver for oil demand than the evolution of EVs. In our estimation, oil demand from passenger vehicles will be flattish or slightly lower in 2030 than the reference 2016 levels of 18.7mmbpd (BP Energy Outlook data).

Fuel economy of new cars



Source: BP Energy Outlook 2018, DBS Bank

Oil demand from cars forecast to 2030 (all numbers in mmbpd)

2016 oil demand from cars	Growth in demand for travel till 2030	Tightening in vehicle efficiency standards	Impact from switch to EVs	2030 oil demand from cars
18.7	10.8	6.1	5.3	18.1

Source: BP Energy Outlook 2018, DBS Bank estimates

Thus, overall, we are projecting oil demand will grow quite slowly until 2030

Despite the impact on oil demand from cars/passenger vehicles owing to improving efficiencies, and shared mobility and EVs, we must remember that this accounts for only 21% of global oil demand and other drivers of oil demand – trucks, aviation, marine, rail, and petrochemicals – will continue to grow as the global economy expands over time. India, for one, will be a bright spot for oil demand, and we see significant additions to oil demand from India, on the back of the strong growth in energy demand as its economy grows at a clip of close to 6% from 2017 to 2030, while efficiency gains remain modest. In addition, India's Draft National Energy Policy (2017) – which lays out the expected energy mix until 2040 – actually sees oil assuming an increasing role in the energy mix (from 24.5% in 2012 to 26.8% in 2040). Thus, we see slow growth in overall oil demand, with no signs of decline or plateau up until 2030. However, a peak in oil demand cannot be ruled out in the 2030 to 2040 timeframe.

Global crude oil demand forecast

Source: BP Energy Outlook 2018, DBS Bank Forecasts

Demand growth being muted; supply will be the key determinant for oil prices in medium- to long-term

We do not expect a huge spurt in oil demand growth over the 2030 timeframe, as explained above. Neither do we expect a demand shock from EVs as the evolution, growth and adoption of EVs is unlikely to be an overnight phenomenon suddenly wiping out a couple of million barrels of oil demand from the world. Thus, restraints or constraints in supply as a result of industry investment trends and geopolitics will be the major factor in determining oil prices in the future.

In the near-term, we expect the 2018 Brent crude oil price to average in the range of US$70-75 a barrel…

and our 2019 average forecast for Brent is slightly lower at around US$65-70 per barrel, as we expect some moderation from increasing US shale supplies as well as a gradual exit from the Organization of Petroleum Exporting Countries (OPEC) production cuts in 2019. OPEC and its allies recently agreed, at their Vienna meeting, to raise production caps to offset losses from Venezuela and Iran, but supply shortages could dominate news flow in the near-term, which could keep oil prices elevated and pose upside risks to our oil price estimates for 2018/19 .

Longer-term forecasts remain sanguine owing to huge underinvestment over 2014 to 2018

Capex budgets worldwide have been cut substantially since the onset of the 2014 oil price collapse. Capex budgets for 2015 and 2016 declined by an average of about 25% each year across our sample of super oil majors, and even 2017 saw around 10% decline in capex eventually, though we were initially expecting 2017 capex to remain flat. In 2018, projections from global oil majors point to only minor increases in capex – low single-digit growth, which is not exciting. In any case, we do not expect oil capex levels to recover back to the highs seen in the 2012 to 2014 timeframe anytime soon. This represents quite an unprecedented period of low capex compared to the years preceding 2014, when oil & gas capex grew at a CAGR of 12% between 2000 and 2014 for an almost fivefold increase.

As a result, industry consultant Wood Mackenzie believes close to US$1t of capex meant for the 2015 to 2020 timeline has been taken out of the system so far, since the oil price crash of 2014, and while project sanctions activities are seen to be picking up now, all the deferrals will mean that more than 3mmbpd of supply that was supposed to come onstream by 2020 will now only come in the years after that. This will help the supply-demand equation in the medium- to long-term. Also, the need to develop oil production in more expensive areas – as the most expensive last barrel may need to be called upon to meet robust demand – will continue to support oil prices. According to estimates from independent oil & gas consultancy Rystad Energy, the marginal sources of supply in 2020 will be currently non-producing shale fields (new shale) and oil sands, with a weighted average breakeven price of around US$63-66 per barrel. Imputing some cost inflation to these numbers, we peg our longer-term oil price forecast to around US$65-70 per barrel.

Brent Crude oil price – DBS view

(US$ per barrel)	2013	2014	2015	2016	2017	2018F	2019F
Average Brent crude oil price	109	99	54	45	55	70-75	65-70
Long-term Brent crude oil price							65-70

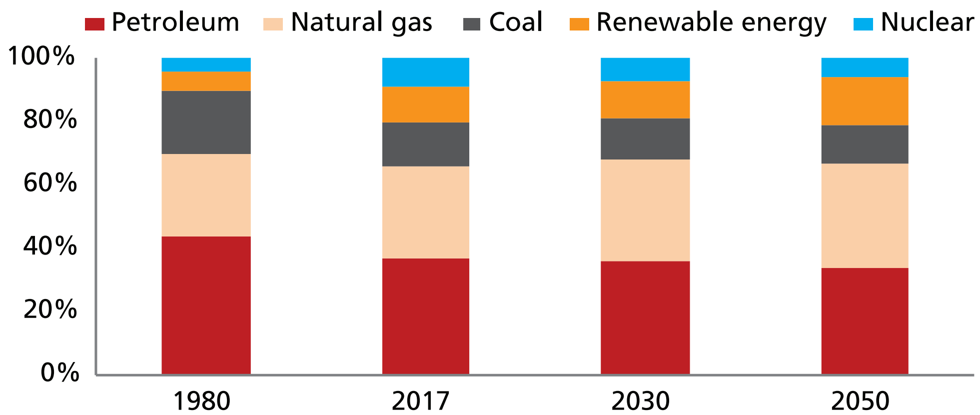
Source: Bloomberg Finance L.P., DBS Bank Forecasts

4. US as Net Energy Exporter

Petroleum will be less important to US energy basket over time

Although petroleum is still the largest primary energy source used for energy consumption, it has lost a certain market share to natural gas and renewable energy. Data from EIA showed that the percentage of petroleum in US energy consumption declined from 44% in 1980 to 37% in 2016, while that of natural gas and renewable energy climbed from 26% and 6% in 1980 to 29% and 10% in 2016, respectively.

US energy consumption by primary energy source



Source: US Energy Information Administration

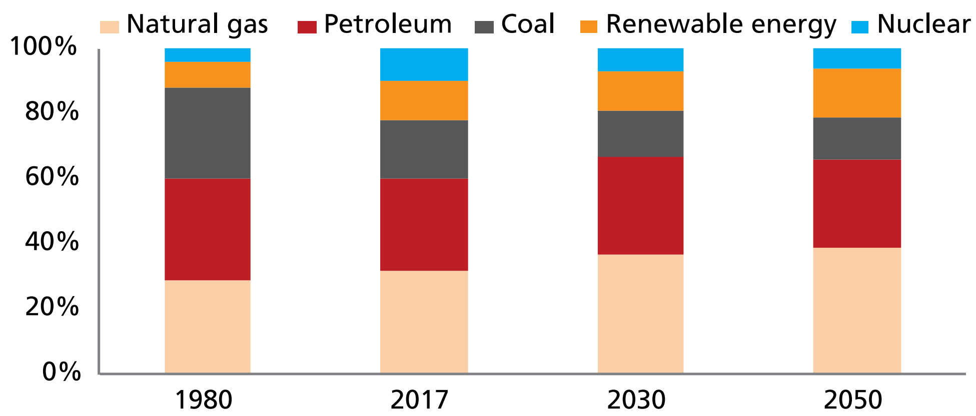
The uptrend of natural gas and renewable energy in the primary energy mix is expected to continue

EIA estimates that petroleum and natural gas will each account for around one-third of energy consumption by 2050.

However, the picture with regard to the mix of energy production is slightly different, as natural gas already had the highest percentage in the total production of energy in 2017. The EIA estimates that the proportion of natural gas in the energy production mix will continue to climb in the next 20 to 30 years.

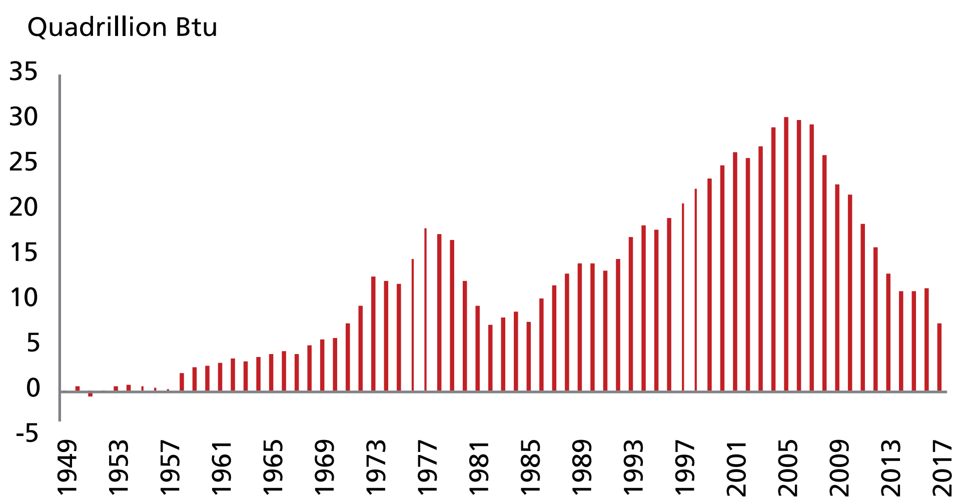
In addition, more cost-effective drilling and production technologies have helped boost crude oil production, especially in Texas and North Dakota. Thus, strong domestic production coupled with relatively flat energy demand has allowed the US to become a new energy exporter.

US energy production by primary energy source



Source: US Energy Information Administration

US primary energy net imports

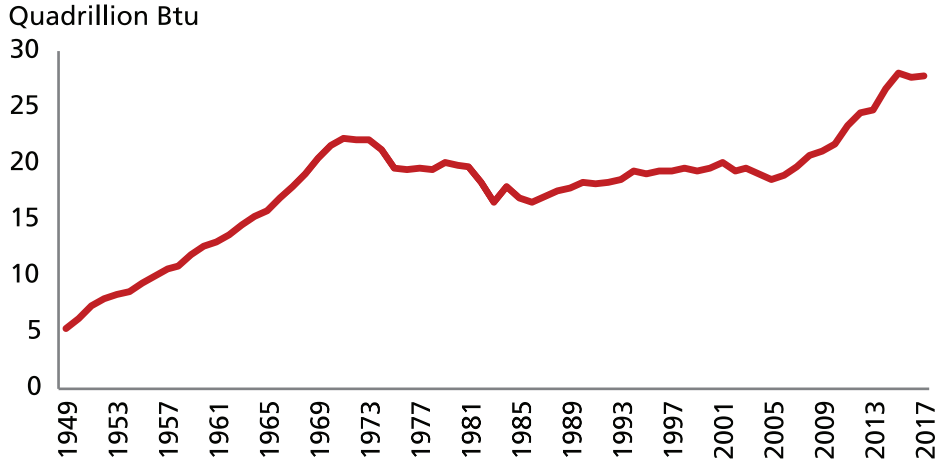


Source: US Energy Information Administration

Excess supply of natural gas

Thanks to higher efficiency in hydraulic fracturing and horizontal drilling technologies, which make it possible to extract gas from shale formations, US natural gas supplies remain abundant and cheap. The US has one of the largest lowest cost gas resources in the world. In fact, proven reserves in the US were already up 5% last year to 341t cubic feet, a 60% jump since 2006. According to the CIA World Factbook 2017, the US ranked fourth in proven natural gas reserves, following Russia, Iran, and Qatar. Thus, production is expected to continually outpace demand.

US natural gas production



Source: US Energy Information Administration

Excess production is absorbed by strong demand from the export market

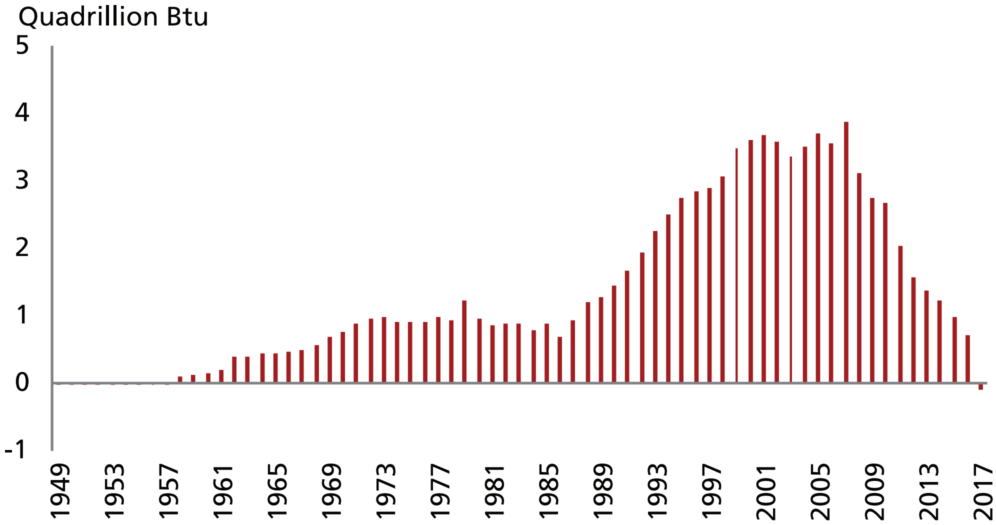
Last year, the US became a net natural gas exporter, with exports quadrupling from 0.5b cubic feet of gas per day in 2016 to 1.94b cubic feet per day in 2017. Around 53% of the export went to Mexico, South Korea, and China. In addition, an increasing share of US LNG exports are expected to go to Europe as EU member states look to diversify from their growing dependence on Russian gas.

With the consumption boost resulting from the global trend of shifting the energy mix toward natural gas to combat carbon emission, US LNG exports are set to quintuple by 2019 from 2017 levels to 9.6b cubic feet per day. If this materialises, the US will become the world's third-largest natural gas exporter by 2020, following Australia and Qatar.

The robust growth in LNG exports is also underpinned by a wave of investment in infrastructure

The Kenai LNG export facility was the first and the only export plant in the US until it was shut down in 2016 due to depressed global LNG prices. But Sabine Pass LNG export terminal in Louisiana came online the same year and has expanded subsequently. After a series of delays, Dominion Energy finally shipped out its first LNG cargo from Cove Point export terminal in Maryland in April 2018. A few more terminals are expected online within the next two years, such as Sempra Energy's Cameron LNG project in Louisiana, Elba Island LNG project in Georgia, Cheniere Energy's Corpus Christi project, etc.

US natural gas net imports



Source: US Energy Information Administration

Nevertheless, the booming LNG market is not without risk

Many industry players have warned of a supply deficit in the medium- to long-term due to a lack of investment in the sector. There is no concern over supply in the short- to medium-term but a shortage is likely to emerge by the mid-2020s if investments in LNG facilities are inadequate.

Some underinvestment due to a change in arrangements with customers

LNG export terminals have traditionally been massive with heavy investment of tens of billions of dollars, and long-term contracts are usually signed with customers to justify such heavy investment. But buyers from the emerging market now prefer smaller volumes on shorter and more flexible contracts. This new trend has prompted new LNG facilities to be smaller and in new modular-style designs where plants can be snapped together like Lego bricks and can be expanded if and when demand grows. However, it has also deterred big players – who still favour the traditional set up – from making new investments.

US can be an oil exporter too

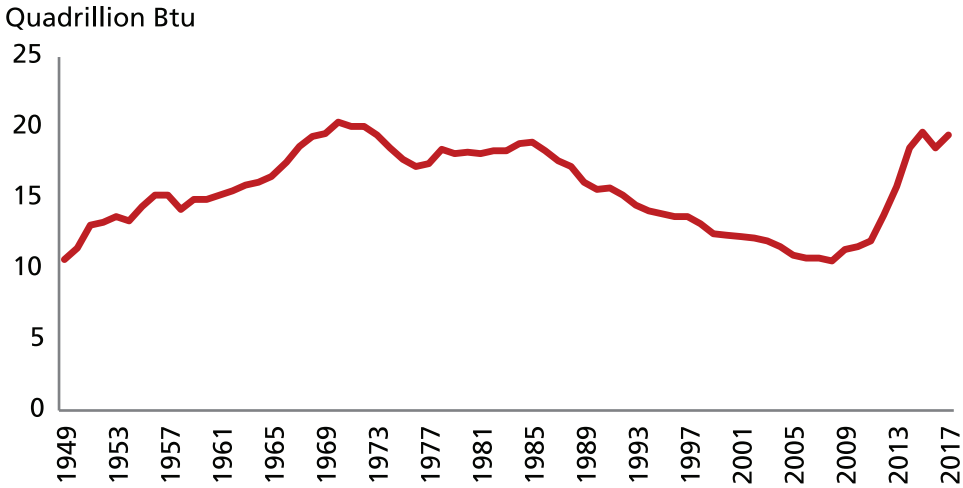
It has been a couple of years since Washington lifted a 40-year ban on oil exports, and US crude oil exports have taken off in the past year, on the back of rising shale production, the upgrade of export terminals, strong growth in global demand and geopolitical concerns in Saudi Arabia and Russia. In 2005, before the shale revolution, the United States had net imports of 12.5mmbpd of crude and fuels - compared to just 4mmbpd today. Gross crude imports have dropped to 7.6mmbpd from a peak of 10.6mmbpd in 2006.

US is likely to be the world's largest oil producer soon

OPEC members have curtailed output since 2016 to support oil prices and eliminate extra inventories from the system. While they have recently agreed to boost supplies to an extent, to counter the shortfall from Venezuela and export restrictions on Iran following the reintroduction of sanctions by the US, the level of spare capacity from these members is low. Saudi Arabia and Russia may be able to increase production by 200,000-300,000 barrels per day over the next few months.

But in the meantime, US crude production has been reaching record highs, with production up about 27% since mid-2016 to 10.7mmbpd currently – thereby starting to close the gap between US crude production and that of Russia, the top producer, which pumps about 11mmbpd. The rising US production is also supported by the rising number of rigs that US drillers have added. The only concern is the rise of pipeline bottlenecks in the Permian Basin, which could restrict production in coming months from this prolific area. Otherwise, the US is very likely to take over the number one producer spot from Russia by the end of the year or at least in 2019.

US crude production



Source: US Energy Information Administration

US oil will find new customers and keep pricing and competition in check

US producers now export around 1.5-2.0mmbpd, which could rise to 4.0mmbpd over the next five years, as most of the incremental shale production is likely to be exported, owing to lack of domestic refineries able to handle the light sweet oil and demand for these grades from countries like China and India. While global demand for oil will slow down up to 2030 and likely peak in the 2030s, growth in the next 15-20 years will undoubtedly come from fast-growing developing economies. In particular, China and India alone are estimated to account for half of the total growth in global energy demand through 2030. For Asian buyers, the main attraction of US oil has been price. Thanks to the shale boom, US crude is more price-competitive, with West Texas Intermediate currently trading at a significant discount to Brent, allowing the US to gain market share from OPEC and Russia.

Infrastructure providers will play a big role in boosting exports

In February, the only terminal that can handle supertankers on the US Gulf Coast, the Louisiana Offshore Oil Port, started export operations. In April, Nave Quasar arrived at the Port of Texas City to test the supertanker capability for crude exports. Corpus Christi is also exploring the possibility of receiving very large crude carriers at its port. Pipeline and logistics firms in the US Gulf Coast will be big beneficiaries of this export boom, with demand for both storage and export infrastructure rising.

5. Coal: Usage Yet to Peak in Asia

Coal will continue to be in demand in the Asian region

Coal accounts for around 50% of Asia's energy mix, and we believe that it will continue to be one of the most important energy components going forward given its affordability and availability. As coal has one of the lowest costs of production (US$ per MWh) in the conventional and renewable energy space, replacing coal means that governments need to brace for higher energy costs across the board, which may entail wide implications for the macroeconomics of their respective countries.

The relatively close proximity of Indonesia and Australia to the main purchasers of coal also reinforces the popularity of this energy source among Asian countries

Thailand's plans to shift its energy mix to higher coal content will also boost the demand for coal in the ASEAN space, besides Indonesia. ASEAN will be one of the largest markets for coal beyond China and India, and we believe this is sufficient to offset any demand deceleration potential from EU countries.

Moreover, replacing coal entirely may require multi-decade efforts, as it currently comprises half of the region's energy mix. Energy security is another factor that will ensure that coal demand does not disappear anytime soon. As electricity generation is crucial for maintaining the growth of industrial activities, replacing coal's position in the energy mix requires careful planning and execution in the long-term to avoid unpleasant economic disruptions.

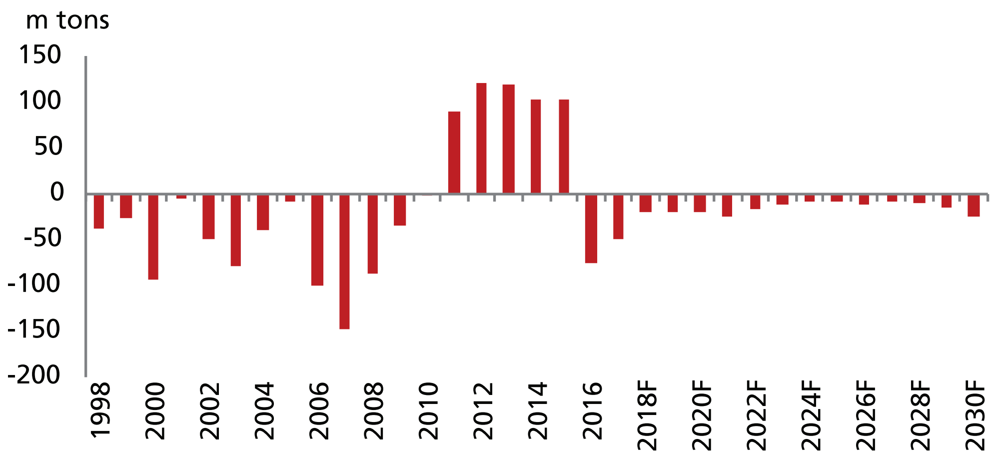
In our view, renewable and alternative energy still face reliability and scalability challenges

Such energy sources have yet to enter the phase of large-scale operations, especially in Asian countries, given their infrastructure is still developing. Natural gas, which is cleaner than coal, also requires additional investment in piping facilities, storage tanks, regasification facilities, and power plant upgrades for gas-enabled power plants.

Coupled with a rational supply outlook, we reiterate our coal price benchmark of US$75 per ton in FY18-20F, and US$70 per ton in FY21F and beyond

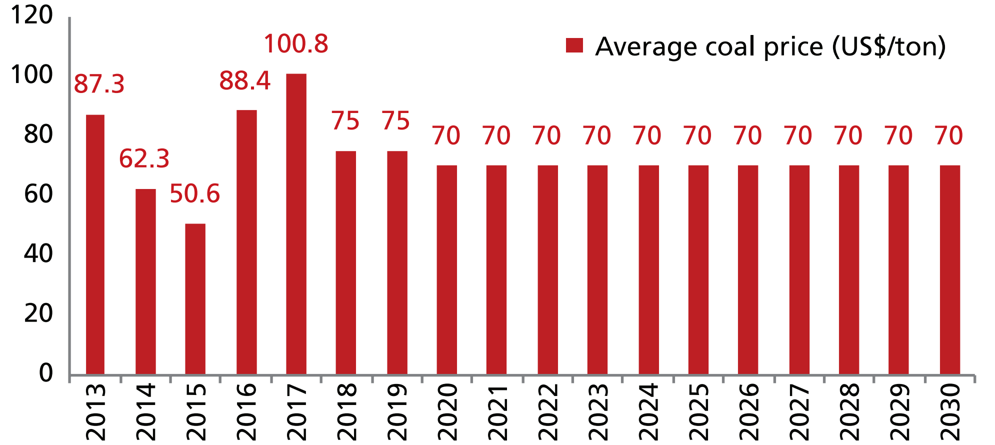
We are expecting the supply and demand dynamics to remain tight, thus providing the impetus for the coal price to stay above US$70 per ton – which we believe is a win-win level for both coal miners and users (mainly power plant operators).

Coal supply/demand surplus/ deficit summary and forecast



Source: BP Statistics, DBS Bank

DBS Newcastle coal price estimate (US$/tonne)



Source: Bloomberg Finance L.P, DBS Bank

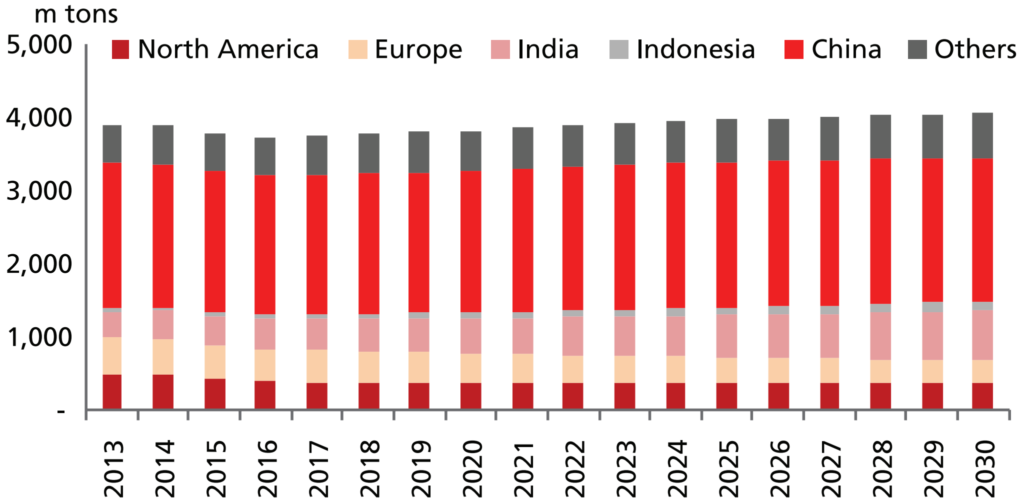
Demand outlook: Replacing coal is challenging

Despite the pressure to embrace a cleaner energy mix, which may cause developed countries to continue limiting or even cutting their coal-fired power plant generation capacity, we believe replacing coal entirely could entail huge challenges. Looking at the global project pipeline, coal still plays an important role in ensuring energy security. There is also a need to ensure the availability of stable electricity supply to power industrial activities

We expect new coal-fired power plant projects will be reduced, but scrapping existing operating capacity and capacity under construction is highly unlikely, as doing so will have a massive impact on economic and industrial activities.

We estimate global coal demand will still exhibit slow growth overall over FY17-30, with declining demand from Europe and flattish demand from China offset by growing demand from India and ASEAN countries, mainly Thailand and Indonesia.

Global coal demand outlook (m tonnes)



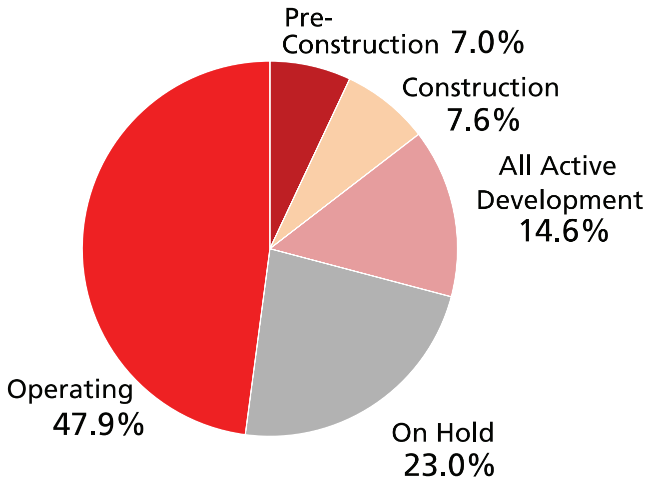
Source: DBS Bank estimates

China coal demand expected to be flattish at worst

China will continue to have to rely on coal, in our view, despite its intention to reduce pollution. China has 921,000MW of coal-fired power plants in operation, with another 280,000MW still in active development and 145,000MW under construction, not to mention 134,400MW in the pre-construction stage. Despite the capacity addition, 441,800MW of coal-fired power plant projects are on hold to prevent power oversupply conditions and comply with environmental rules.

Looking at the additional 50% of total installed capacity, we believe China's coal consumption will remain healthy. We expect flattish coal consumption growth in China over FY17-30F, which we believe is fairly conservative, as coal-fired power plant projects under construction come online gradually. We assume the use of cleaner technology and more efficiency in the new power plant projects.

China's coal power plant project status



Source: Greenpeace, DBS Bank

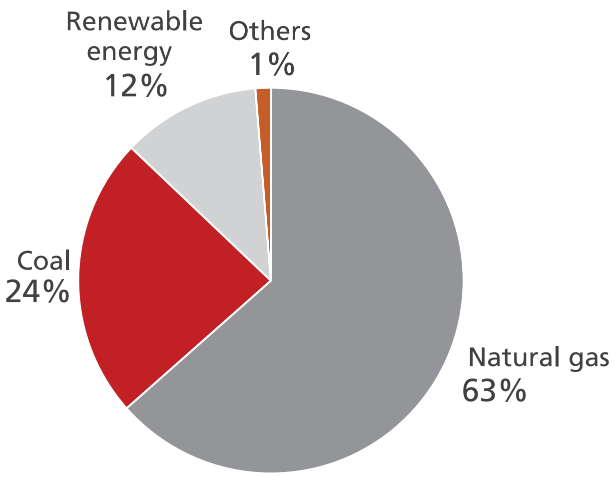
Beyond China, strong demand from ASEAN

Beyond China, we see strong demand coming from ASEAN countries such as Indonesia and Thailand, as both countries rely on affordable and reliable energy to grow their economies.

Thailand's shift to coal for energy security

Thailand is expected to increase the share of coal in its energy mix in order to diversify its fuel mix for power generation. Currently, coal accounts for around 24% of Thailand's energy mix. Thailand relies mainly on natural gas to generate power, but its domestic gas supply growth is expected to slow down in the face of reserves depletion.

Thailand's 2016 energy mix



Source: EGAT, DBS Bank

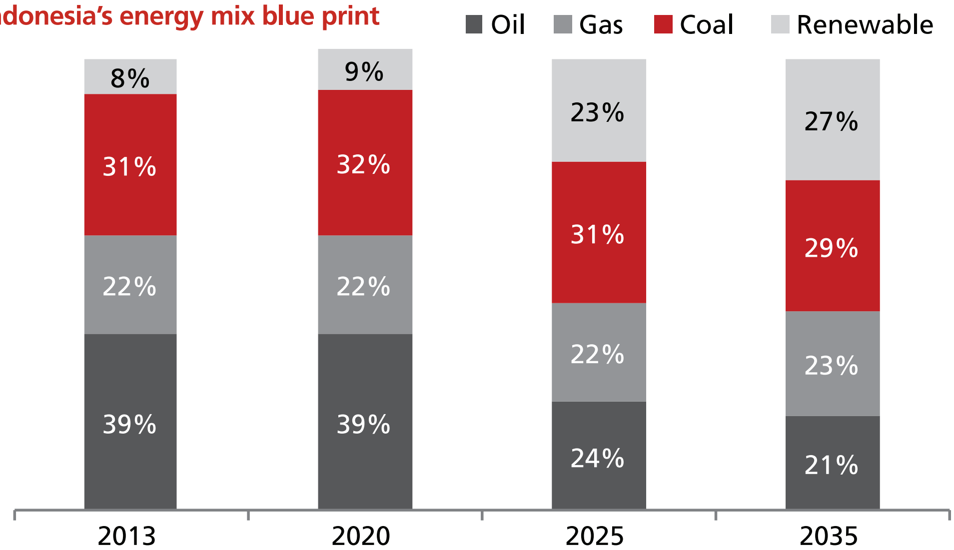
Importing gas from Myanmar may be a short-term solution

…but this entails higher costs than domestically produced natural gas. Moreover, renewable energy in Thailand has not reached meaningful economies of scale to make it cost competitive against conventional energy. While Thailand's government seems to be heading toward cleaner renewable energy sources with its launch of several pilot project initiatives, the Electricity Generating Authority of Thailand (EGAT) has signed a long-term contract of 25 years with Adaro Energy to secure Thailand's long-term coal supply. The intention to diversify beyond natural gas presents the opportunity for coal consumption to grow in the country.

Despite plans to add more renewable energy to its 2025 energy mix, Indonesia still relies on coal to a large extent

Indonesia's upcoming power plant projects are dominated by coal-fired capacity, followed by gas and diesel. Since Indonesia is one of the world's largest coal producers, tilting toward coal power is also wise in its attempt to maximise the country's electrification ratio going forward.

Indonesia's energy mix blue print



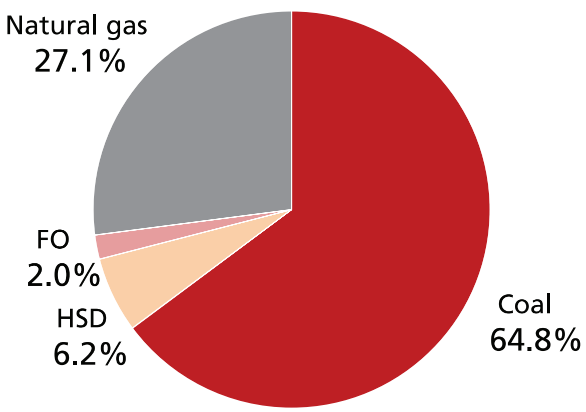
Source: Ministry of Energy and Mineral Resources, DBS Bank

Coal currently accounts for close to two-thirds of Indonesia's current energy consumption

Indonesia National Electricity Company (PLN) relies on coal to fulfil the nation's electricity demand and we believe the trend will not change drastically going forward. In 2016, coal accounted for 64% of PLN's total energy consumption.

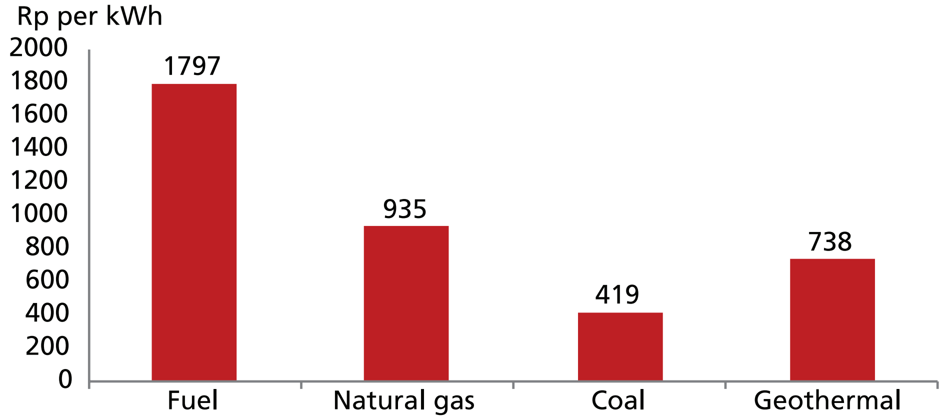
PLN is able to generate power at the lowest cost per kWh using coal as its primary energy source over other energy sources.

PLN's energy consumption (2017)



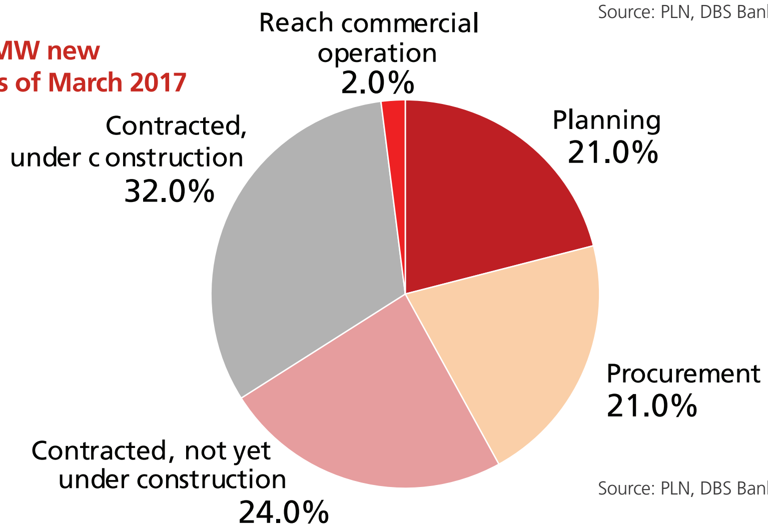
Source: PLN, DBS Bank

PLN's power generation cost (Rp per kWh, 2016)



Source: PLN, DBS Bank

Progress of 35,000MW new capacity addition as of March 2017



Source: PLN, DBS Bank

New power capacity of 35,000MW planned in Indonesia; coal-powered plants under construction globally as well

The well-planned execution and gradual delivery of 35,000MW of new power capacity will be the key critical factor determining how well Indonesia can boost its domestic coal demand. There could upside risks to our coal demand forecast for Indonesia and long-term coal price projection, as we have assumed only 60% completion for the 35,000MW new capacity in 2030.

Coal-fired power plant project list – global (2016)

Countries	Pre-Construction (MW)	Construction (MW)	All Active Development (MW)	On Hold (MW)	Operating (MW)
China	134,480	145,573	280,053	441,749	921,227
India	128,715	48,168	176,883	82,495	211,562
Turkey	66,852	2,640	69,492	17,654	16,362
Indonesia	38,450	7,820	46,270	8,385	27,399
Vietnam	29,580	15,177	44,757	2,800	13,394
Japan	17,343	4,256	21,599	-	44,078
Egypt	17,240	-	17,240	-	-
Bangladesh	15,685	275	15,960	3,935	250
Pakistan	10,418	4,860	15,278	5,310	190
South Korea	8,760	5,917	14,677	1,160	33,417
South Africa	6,290	7,940	14,230	1,500	40,513
Philippines	9,293	4,476	13,769	926	7,282
Poland	5,820	4,245	10,065	1,500	27,761
Russia	8,706	180	8,886	700	48,435
Thailand	7,306	600	7,906	600	5,457
Mongolia	5,700	1,400	7,100	250	706
Zimbabwe	6,480	-	6,480	1,200	980
Myanmar	5,130	-	5,130	6,455	160
Taiwan	800	4,000	4,800	7,600	17,407
Botswana	3,904	432	4,336	-	600
United Arab Emirates	1,470	2,400	3,870	-	-
Malaysia	-	3,600	3,600	-	10,008
Malawi	3,520	-	3,520	-	-
Bosnia & Herzegovina	3,500	-	3,500	500	2,065
Cambodia	3,040	135	3,175	1,200	370
Germany	2,020	1,100	3,120	660	53,060
Serbia	2,900	-	2,900	320	4,294
Chile	2,272	375	2,647	375	5,101
Mozambique	2,600	-	2,600	1,620	-
Nigeria	2,200	-	2,200	1,000	-
Rest of the World	19,127	7,371	26,498	17,473	472,382
Total	**569,601**	**272,940**	**842,541**	**607,367**	**1,964,460**

Source: Greenpeace, DBS Bank

Supply outlook: Rational global output will support prices

Global output is heading toward the consolidation phase, led by China

The Chinese government's plans to scrap inefficient national capacity, and to merge and put its coal capacity into the hands of several super-large coal miners are also positive – thus enabling the government to keep domestic supply in check and prevent the coal price from slumping again.

Seaborne coal miners, mainly those from Indonesia, also do not plan to expand their capacity to elevated levels in the face of heavy equipment supply constraints and limited access to financing. We expect global coal supply to grow only at a 1% CAGR in FY18-30.

Other than China and Indonesia, coal supply growth will be muted

This is due to supply rationalisation efforts and the phasing out of mining concessions. Investments in the coal sector will remain tepid due to the cyclical factor, coupled with limited demand expansion potential in the future.

Output behind schedule in Indonesia

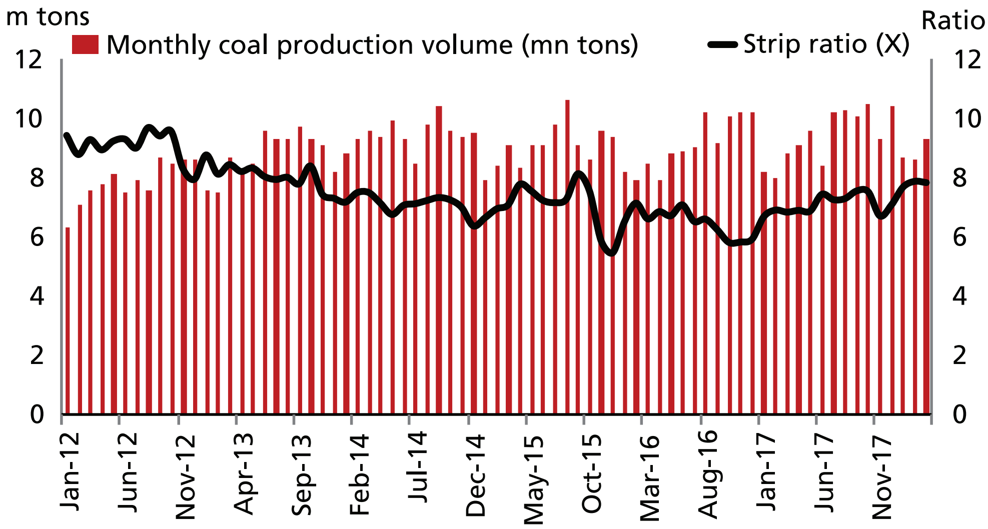
Though we have not seen any consolidation among coal miners in Indonesia, we believe the government's warning that Indonesia's coal production could reach only 400m tonnes by 2020 versus the 2018 output target of 420m tonnes, indicates that Indonesia's coal production is changing structurally. Efficiency-boosting efforts among coal miners back in 2012 to 2015 have led to idle coal reserves, which put their profitability and mineable coal at risk. Reinvigorating production involves more than just restarting the machines and digging the soil for coal. The miners need to reorder the divested machineries, rehabilitate the unused soil and regain the confidence of bankers to finance the aforementioned activities. We reckon that returning to the productivity levels of the 2008 to 2012 era will be a tall order.

On the other hand, we also detect a still-cautious stance among miners due to their reduced appetite for ramping up their operations aggressively (unlike four years ago). This means that the coal miners will not significantly increase their output to potentially cause a slump in coal prices. United Tractors' (UNTR) monthly Pamapersada (the mining contractor subsidiary's statistics) also do not show any behavioural changes among its clients.

We believe the same trend will also persist globally

One example is China, the largest coal producer in the world, which intends to keep its output pretty much flat until 2020. China plans to maintain its supply rationalisation programme by actively controlling the working days of miners. Its consolidation plan is positive for the long-term coal supply-demand balance.

UNTR's overburden removal and coal production volume



Source: UNTR, DBS Bank

Output consolidation taking place in China

The output consolidation that is happening in China is positive for coal supply-demand dynamics. As China accounts for 46% of the 3.6b tonne global thermal coal output in 2016, domestic coal miners' consolidation plans (which will allow the government to have more control over coal output going ahead) will have a positive effect on global coal prices. Such output consolidation is also part of the plan to cope with the downside potential that may come with declining coal-fired power plant capacity, as it can prevent an excessive decline in coal prices that can hurt the coal miners.

The consolidation plan mainly revolves around merging the coal mines into several super-large coal mines with an annual production capacity of 100m tonnes

This will eliminate any excess capacity and improve the operational efficiency of the coal miners via mergers and acquisitions. The Chinese government is aiming for a coal production capacity of 3.9b tonnes versus 2017's total coal output of 3.4b tonnes. So far, China's coal sector reform has reduced the total number of coal mines to 7,000 from 10,800 in 2015. China's Shanxi province has already set output and total capacity targets of 1b and 1.2b tonnes by 2020, respectively – similar to its 2016 output of 1b tonnes. Shanxi province accounts for more than half of China's total production capacity and we believe such a capacity cap will prevent the recurrence of excess supply conditions, especially when coal demand growth is expected to be flat until 2022, according to EIA forecast.

6. India: Energy Consumption and Reforms Story

Policies aimed at incentivising investment in generation capacity

A host of power sector related reforms and schemes have been carried out over the years in order to encourage private sector participation and thus enhance investment in the capital intensive power sector. The key ones include the Electricity Act, Village Electrification, Discom Bailout plans, UDAY scheme, 24x7 Affordable 'Power for All', Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY), Integrated Power Development Scheme (IPDS), Gas Pooling Mechanism, SHAKTI scheme, SAUBHAGYA scheme, Competitive bidding for PPAs, emphasis on the renewable sector, coal block auction, etc. Highlights of some of these policies are tabulated below.

Power sector policies aimed at increasing power generation

Policy	Details
Electricity Act, 2003	• This watershed Act delicensed generation, facilitated open access, introduced power trading and encouraged private participation with an aim to enhance competition in the sector. The Act also laid more emphasis on promoting renewable technology based generation and also mandated that distribution companies (discoms) purchase the same. • The Act also allowed industries to set up captive generation plants for their own consumption and also gave them the option to select their own power supplier through an open access mechanism. • The Act provided flexibility to the discoms to enter into PPAs with the generators and procure power through either competitive bidding or through the Cost-Plus regime under which the regulatory commission approves and evaluates the prudence of capital cost and determines tariff on an annual basis with fixed return on equity. • On account of these factors, capacity addition saw a major boost, especially across the coal segment which witnessed more than twofold jump over FY10-16.
Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY)	• Scheme designed to provide continuous power supply to rural India. • The government plans to invest Rs756 billion (US$11 billion) in rural electrification under this scheme. • Focuses on feeder separation (rural households & agricultural) and strengthening of sub-transmission & distribution infrastructure including metering at all levels in rural areas. This will help in providing round-the-clock power to rural households and adequate power to agricultural consumers.
Integrated Power Development Scheme (IPDS)	• IPDS is basically a new avatar of the Restructured Accelerated Power Development and Reforms Programme (R-APDRP) scheme in which funds are provided for reduction of AT&C losses, upgrading of infrastructure, IT-based billing and auditing system and collection efficiency. • Under this scheme, all discoms, including private ones, are eligible for government support. Power Finance Corporation is the nodal agency for this scheme.
SAUBHAGYA Scheme	• The Indian government announced this scheme in September 2017 with the aim to provide electricity to each and every household in the country. • The deadline is December 2018 and the total outlay of the project is Rs163b while the gross budgetary support is Rs123.2b.

Source: Relevant Government Ministries, Emkay Global Research

Challenges exist on the ground

While the above schemes led to a significant capacity addition on the generation side, negligence and improper management across the distribution and fuel supply segment led to various cost and viability issues across the sector. Much of the gas-based capacity is stranded for want of fuel and many of the coal-based competitively bid projects are seeking post-facto revision of the tariffs on various grounds. Concern over ecological imbalances and delays in project execution have stalled growth across hydro projects and those under construction are witnessing huge cost overruns, making it economically unviable for distribution companies to enter into purchase power agreements (PPAs).

Thus, while the last decade witnessed huge interest and investment by private companies and public financial institutions in the capital-intensive power sector, the past few years have become challenging for all stakeholders in the sector. Power projects are turning into non-performing assets (NPAs) based on a multitude of issues plaguing the sector including policy paralysis, mismanagement in coal mining, delays in project execution, deteriorating financials of distribution utilities and lack of revival in industrial power demand. The absence of long-term PPAs, the lack of gas supply, poor coal inventories, policy paralysis, delays in reform execution and cost overruns have led to almost 60GW of thermal projects being stranded.

Power sector policies aimed at addressing distribution and other challenges

Policy	Details

Ujwal DISCOM Assurance Yojana (UDAY Scheme)	• Financial Turnaround - States will take over 75% of the discom debt as of Sept 30, 2015 - 50% in FY 2015-16 and 25% in FY 2016-17.
	• States to issue non-SLR including SDL bonds, to take over debt and transfer the proceeds to discoms in a mix of grant, loan, equity.
	• Borrowing not to be included for calculating fiscal deficit of the State
	• The balance 25% of debt to remain with discoms and would be renegotiated with the lenders at rates not more than bank base rate +0.10%
	• States to take over future losses of discoms in case efficiencies fails to improve.
	• Targets to be achieved under UDAY:
	  • To bring down AT&C loss to 15% by 2019 vs 24% nationwide as on 2015
	  • 100% Feeder and Distribution metering
	  • Elimination of ACS-ARR gap by FY19
	• Impact of the scheme: Financially & operationally sound discoms, increased demand for power, improvement in load factor of generating plants, reduction in stressed assets and availability of cheaper funds

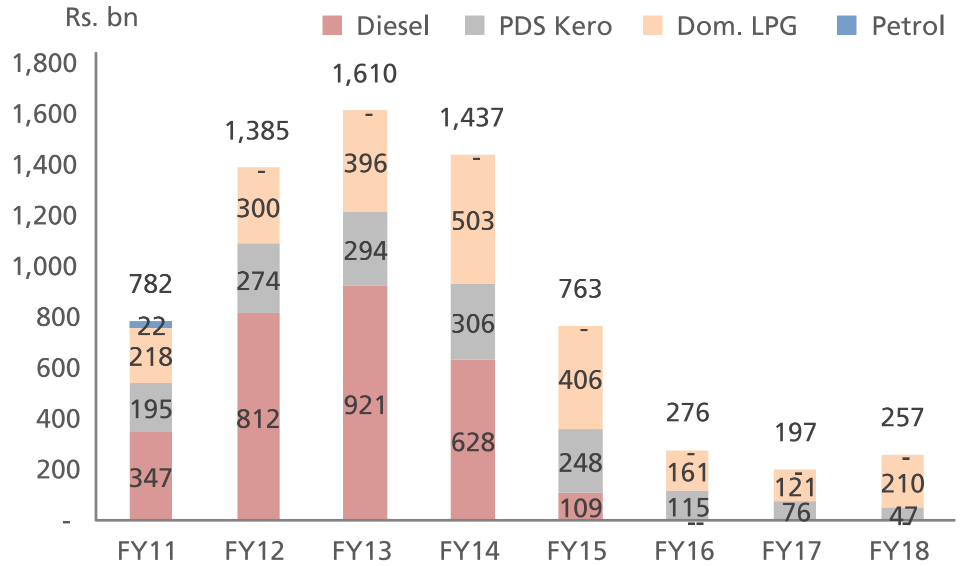
Shakti Policy	• Objective: To auction long-term coal linkages to power companies which will ensure adequate fuel supply to plants which are facing supply constraints. • The move will improve plant utilisation and also lower the power tariffs due to access to domestic coal, coupled with better plant utilisation. • The move will also help banks exposed to the power sector to cut down on NPAs.

Source: Relevant Government Ministries, Emkay Global Research

There has been an overall sea change in the Indian landscape for energy and fuels in the last three to five years, with major government reforms supported by the decline in oil prices

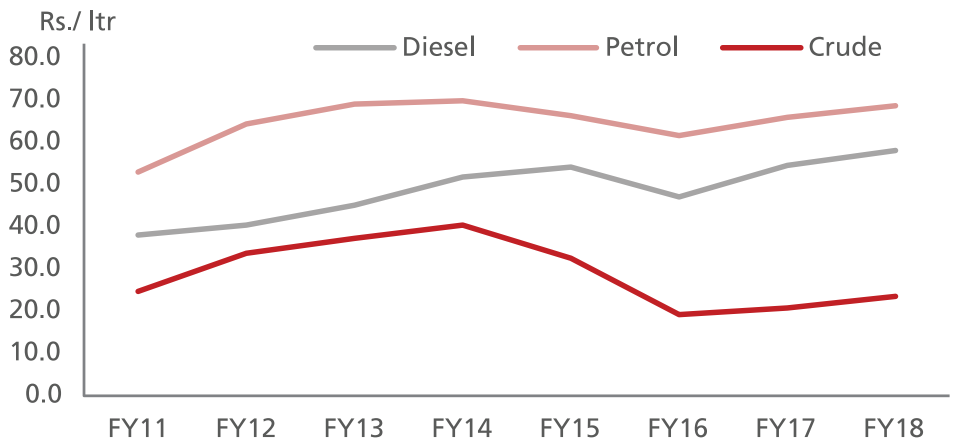
Pricing for petrol and diesel was deregulated while kerosene usage was discouraged through reduced allocation and small monthly price hikes. Liquefied petroleum gas (LPG) was brought under a targeted subsidy system where subsidies are channelled through bank accounts with a proper "Know Your Customer" system in place, thereby stemming leakages. Small monthly hikes in the LPG price were also initiated, but were stopped with the government's push to promote cooking gas among lower income groups, in order to encourage LPG adoption. Consequently, under-recoveries/subsidy losses, which peaked at Rs1.6t in FY13, fell to Rs200-300b annually during FY16-18. Oil marketing companies were given autonomy in petrol and diesel pricing and barring a few political event-based instances, rates were in line with international prices.

Under-recoveries have fallen significantly



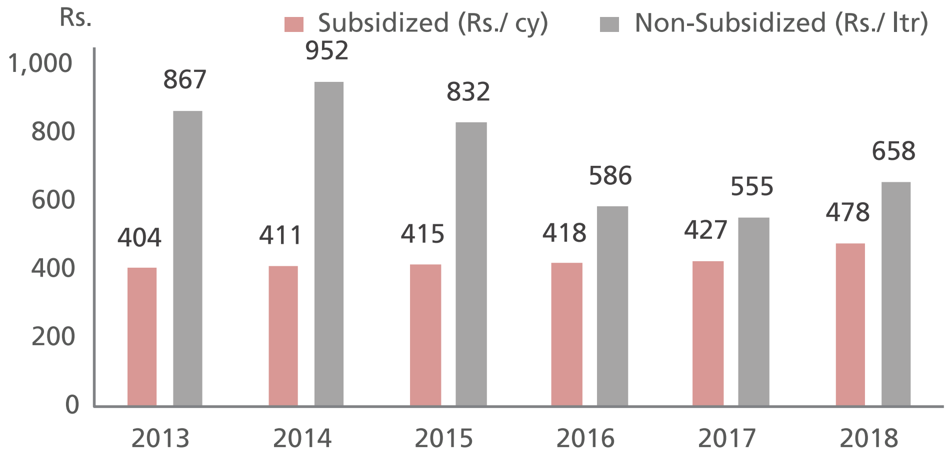
Source Government data, Emkay Global Research

Petrol-diesel and global crude prices largely in tandem



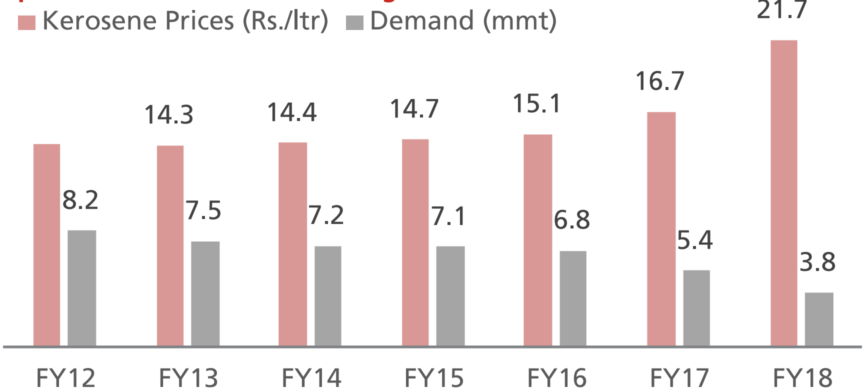
Source Government data, Emkay Global Research

Subsidised LPG prices were also hiked for some time



Source Government data, Emkay Global Research

Kerosene prices hiked, demand discouraged



Source Government data, Emkay Global Research

A host of upstream related reforms were also carried out in order to enhance exploration and production activities and domestic oil and gas output

This include new regimes like Discovered Small Fields (DSF) and Hydrocarbon Exploration Licensing Policy (HELP), where complete pricing and marketing freedom is given for all kind of hydrocarbons with perennial bidding and a simpler revenue sharing mechanism. The gas pricing reforms include linking conventional natural gas pricing to global hubs like Henry Hub, NBP, Alberta and Russian domestic gas; access has been freed for difficult-to-access fields; with a ceiling linked to alternate fuels like LNG, fuel oil, coal, etc. This has renewed interest in the fledgling deepwater reservoirs and local majors like Reliance and ONGC have expedited development of their acreages in the Krishna Godavari Basin.

Upstream reforms:

1. Discovered Small Fields auction (DSF) in 2016
2. Hydrocarbon Exploration Licensing Policy (HELP) in 2017
3. Domestic Natural Gas Pricing Guidelines in November 2014
4. Deepwater, high pressure high temperature, difficult gas price ceiling in 2016.

The gas midstream-downstream sector has also been a focus area as the government aims to promote gas usage in order to meet pollution control commitments as well as save on energy costs, as gas is comparatively cheaper than liquid hydrocarbons. This includes grid development, expansion of city gas distribution (CGD) and policy measures to restrict polluting fuels (where courts have also played an important role). Taxation is already lower on gas.

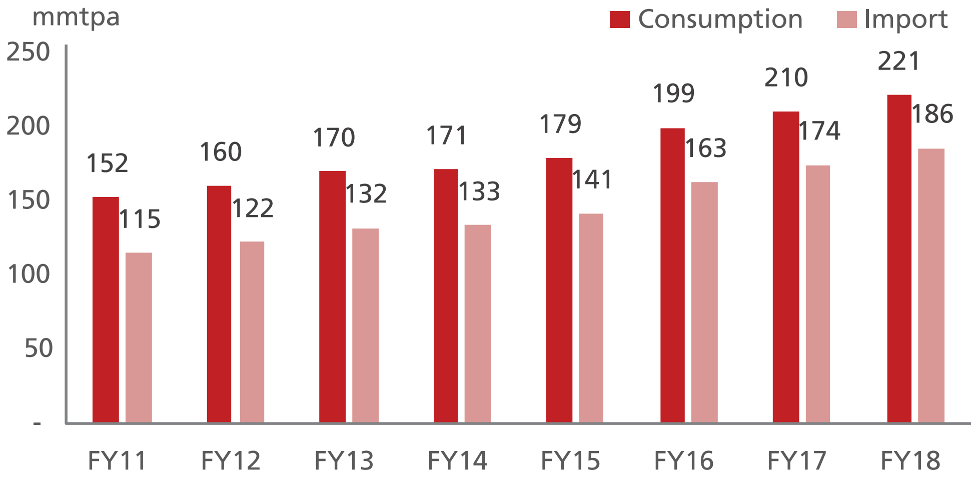
Gas downstream measures:

1. Promoting gas grid development with target to double pipeline network to 30,000km.
2. Viability gap funding is done for frontier pipelines like the newly developed eastern grid.
3. Allocation of cheap domestic gas for compressed natural gas and domestic piped natural gas sectors which are prioritised and are alternatives to petrol/diesel and LPG where import dependency is high.
4. Expansion of CGD through new area allocations. India's government along with the sector regulator has put up cities/areas for CGD bidding. The latest round covers 86 areas. Development of the eastern grid was also accompanied by a complementary CGD area allocation to the developer GAIL along the pipeline network.
5. Courts and tribunals have promoted gas usage in high pollution areas by banning liquid and solid fuels.

Policies are also in place regarding the fuel mix

In this regard, the government's prime targets are to reduce oil import dependency by 10% in the next five years and increase the share of natural gas in the primary energy basket to 15% from less than 7% currently. Thus, policy and reform measures are aimed at boosting domestic hydrocarbon output, promoting gas usage and reducing subsidies to achieve above objectives, which in turn are based on broader objectives like foreign exchange savings and energy security, along with environmental protection.

India's oil import dependency is high at 80%



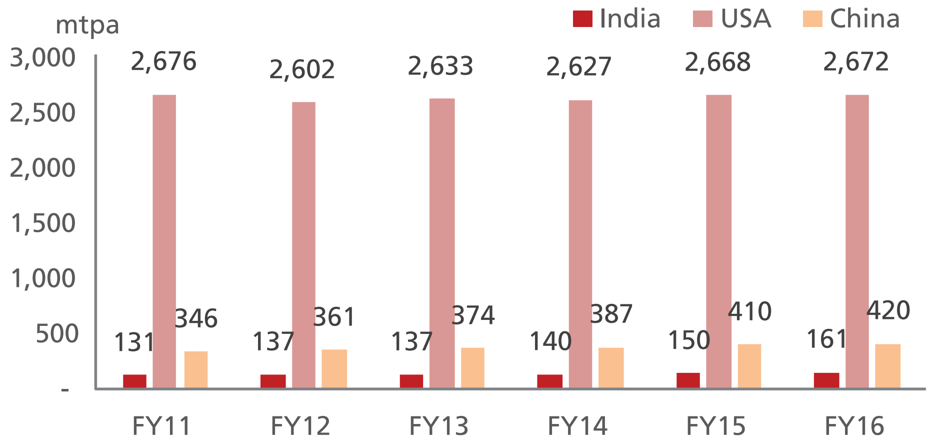
Source Government data, Emkay Global Research

India's energy consumption growth is healthy, with oil consumption CAGR at around 5% over last five to ten years

The oil demand-to-GDP growth multiplier has gone up in the last few years driven by rapid urbanisation, LPG cooking gas penetration and driving populace. Vehicle sales growth has picked up and India's per capita oil consumption is much lower than developed countries and even emerging country peers like China. Overall, India is one of the fastest growing major economies and, with higher income levels, industrialisation and freight activity, oil demand growth is likely to be in a similar range.

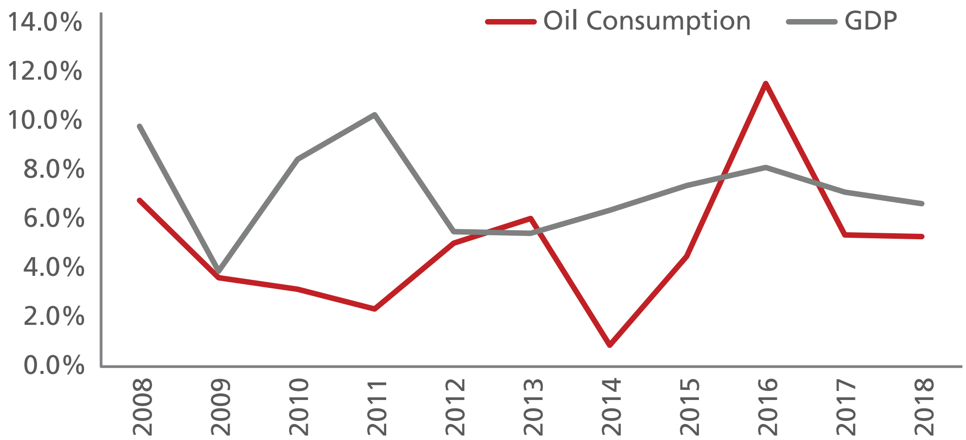
The IEA estimates Indian oil demand will grow by a 4% CAGR up to CY40 which would lead to absorption of planned refining capacity expansions, though the government's target to lower import dependency will be challenging unless there are major oil discoveries or aggressive adoption of gas as an alternate fuel.

India's per capita oil consumption is very low



Source: Government data, company statements, Emkay Global Research

Oil demand to GDP multiplier is up



Source: Government data, company statements, Emkay Global Research

Refining capacity growth in the works

Refining capacity addition targets have also been set by domestic companies - particularly public sector undertaking (PSUs), which have shortfalls compared to their marketing volumes, hence their reliance on private refiners and imports. With a healthy demand outlook and private players themselves getting into marketing, PSUs are aggressively protecting their market share and have captive capacity available. Against current refining capacity of 250 million tonnes per annum (mmtpa), the target is to achieve 440mmtpa by CY30. Currently 15mmtpa of capacity expansion is underway, and is expected to be commissioned by CY21.

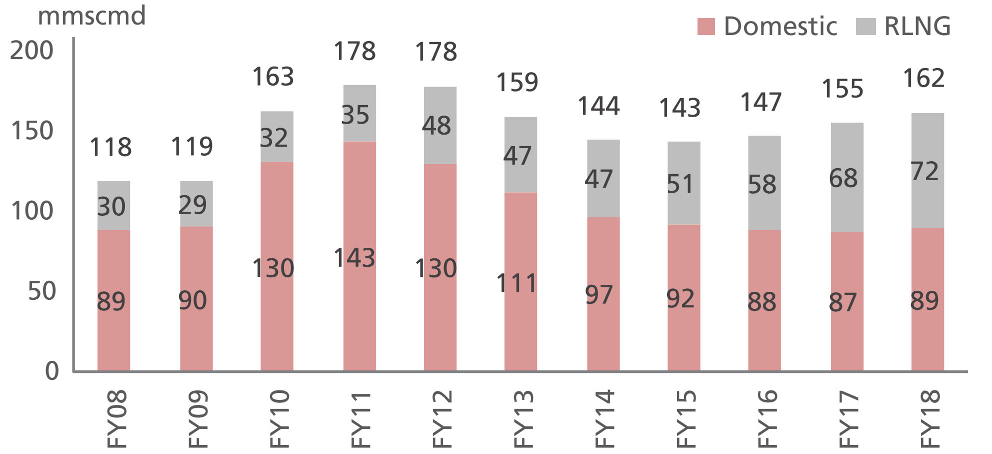
Indian refiners are also integrating into petrochemicals as a diversification move

This is particularly due to the perceived long-term threat to transportation fuels from the use of gas and adoption of electric vehicles. Of course, India, being a strong growth economy, will generate a robust petrochemical demand outlook by itself as well. As high value products, petrochemicals would also enhance refining margins. Already, refiners like Reliance Industries Limited (RIL) and Indian Oil Corporation Limited (IOCL) have sizeable petrochemicals exposure, though new projects are being developed by other players and are expected to be commissioned from 2018-21.

Gas demand has been affected by domestic production issues

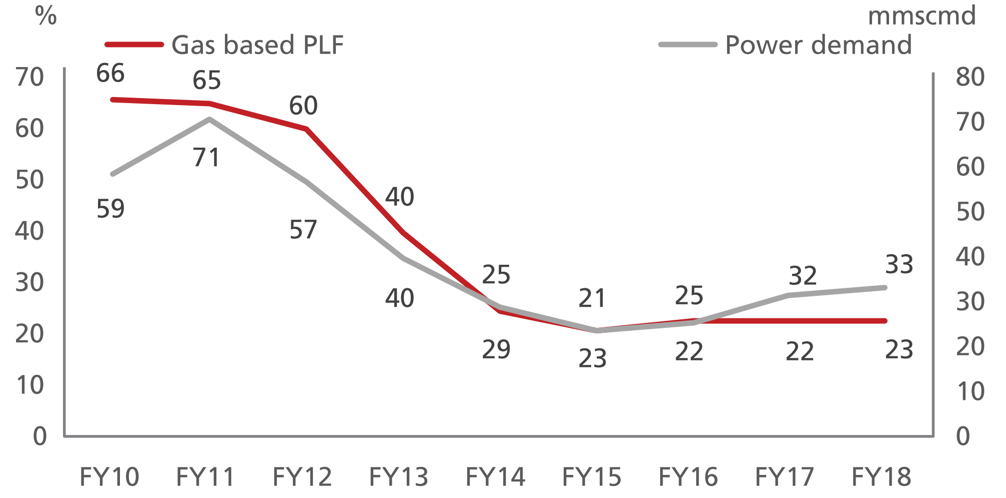
This has led to a sharp fall in power sector demand as low prevailing spot electricity tariffs restrict the chances of gas-based power plants using pricier LNG. The ten-year gas output CAGR has been 3% while the five-year CAGR was flat. Against the decline in domestic output, LNG supplies have grown as sectors other than power have switched to it. Overall gas consumption volumes bottomed in FY15 though, as LNG imports grew significantly; but domestic gas output rose in FY18, led by Oil and Natural Gas Corporation (ONGC), and despite Reliance fields continuing to decline.

Gas consumption volumes bottomed out in FY15



Note: mmscmd: Million Metric Standard Cubic Metre Per Day
Source: Government data, company statements, Emkay Global Research

Entire gas demand destruction from power sector



Note: PLF refers to plant load factor for power plants
Source: Government data, Company statements, Emkay Global Research

Future outlook for gas is better though

In FY18, volumes grew by 4% y-o-y and we believe the outlook is better going forward – with sectors like fertilisers, refineries, industries and city gas demanding more gas. We expect gas demand to grow by 5-6% under our base case scenario, though success of large number of new City Gas Distribution (CGD) areas and any revival in the power sector could boost it further.

Sources of gas looking up, could help boost consumption

Against current domestic gas production of around 90 million metric standard cubic metre per day (mmscmd), players like Reliance and ONGC are targeting almost 50mmsmcd of new output from deepwater fields by FY23. With such a large quantity of local gas, demand can grow significantly. New LNG terminals are also planned. Against 25-30mmtpa

(100mmscmd) of LNG capacities currently, another 30-35mmtpa of capacities are likely to come from six to seven new terminals over the next five years. Hence, with higher available supply, infrastructure expansion, and policy measures, gas demand growth can be stronger. If we assume 50mmscmd of the additional domestic gas output target is met with full domestic absorption and new LNG terminals operating at 50% capacity utilisation, the gas demand CAGR in the next five years would be closer to 9% under a blue skies scenario.

New LNG terminals on the radar

	Commissioning	Capacity (mmtpa)
Dahej	Existing	15.0
Kochi	Existing	5.0
Hazira	Existing	5.0
Dabhol	Existing	5.0
Mundra	FY19	5.0
Jaigarh	FY19	4.0
Ennore	FY19	5.0
Dahej Expansion	FY20	2.5
Jafrabad	FY21	5.0
Dhamra	FY22	5.0
Chhara	FY22	5.0

Source: Company statements, Emkay Global Research

New supplies can lead to almost 10% demand CAGR over next five years

mmscmd	Domestic	LNG	Total
Current Supply	90	70	160
New Gas	50	36	86
FY23 Supply	140	106	246
CAGR	9%	9%	9%

Source: Company statements, Emkay Global Research

Gas is still unlikely to cause a major shift in energy mix in near-term; oil will decline slightly

With a 5-6% CAGR expected for gas demand, the share of gas in the primary energy basket would grow by less than 1% in the next five years; while the government target is doubling of the share of gas in energy basket. That seems unrealistic, as it would require gas demand to grow at a CAGR of 20-25%. However, at our best case 9% CAGR expectation, the share of gas in the energy mix would be better at 10%. Thus aggressive policies can make a difference; otherwise, there would not be much change in the energy mix . Oil's share is also expected to reduce by 1% assuming a 10% CAGR in renewables and 4% in coal, yet import dependency would remain high.

Primary energy basket and energy mix for India

mmtoe	CY16	CY22E
Oil	213	269
Gas	45	64
Coal	412	521
Others	54	96
Total	724	950
Share in Primary Energy Basket		
Oil	29%	28%
Gas	6%	7%
Coal	57%	55%
Renewables	7%	10%
Total	100%	100%

Source: BP, Emkay Global Research

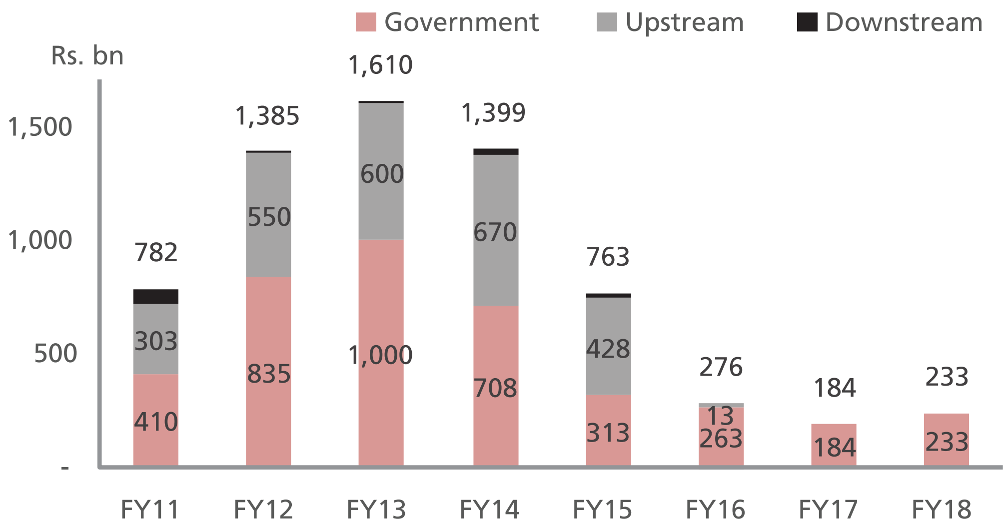
Challenges to growth

Import prices and subsidy risks, fiscal challenges and land acquisition difficulties are all challenges faced by the oil and gas/energy space.

Oil & Gas price risks

Being an import dependent economy, India feels the impact of volatile crude and imported gas (LNG) prices – more so due to socio-political sensitivities and controlled pricing in sectors, such as cooking gas, electricity, fertiliser, etc. This leads to a significant subsidy burden, which becomes unbearable for companies and also pressures the fiscal deficit. Hence, a prudent formulaic subsidy-sharing mechanism needs to be in place, besides eventual decontrol of all these items.

Petroleum subsidy burden sharing

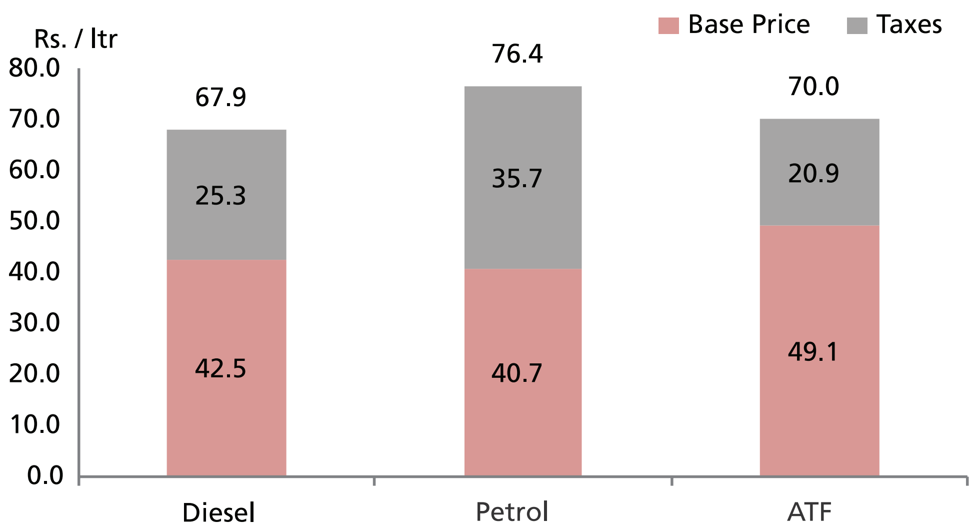


Source: Govt data, company statements, Emkay Global Research

Fiscal challenges

The sector is heavily taxed, and certain items like crude oil, natural gas, petrol (gasoline), diesel and jet fuel are kept out of the ambit of the goods and services tax (GST), as they are significant revenue drivers for both centre and states. This has led to dual regimes for industry players, resulting in input tax credits not being available, in addition to high prices. Additionally, fiscal overtures like the Cairn Energy income tax demand are also dampeners which makes foreign and private players cautious to invest in India.

Taxation is very high in major fuels like petrol, diesel and jet fuel



Source: Govt data, Company statements, Emkay Global Research

Land acquisition issues

Local protests have had an impact on land acquisition for projects such as pipelines, refineries, terminals, etc., leading to considerable time and cost overruns. Farmers are unwilling to part with their lands, while political elements also play a part.

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