Five key questions clients ask about our energy demand outlook to 2050

Article by Jasper van de Staaij, Bram Smeets, Ole Rolser, James Eddy, Namit Sharma, and Christer Tryggestad | May 2018

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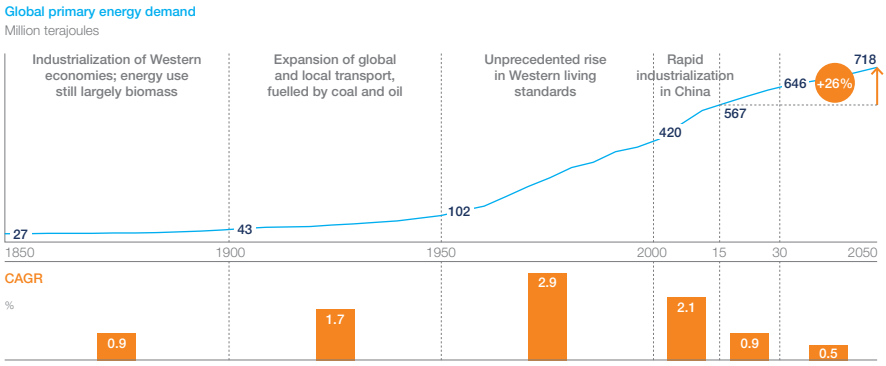
In January 2018, we published our Global Energy Perspective 2018 Reference Case, which summarizes our fundamental energy demand outlook and shows our projections for how the energy transition will unfold over the next few decades. Since its release, we've spoken to clients around the world about the implications of these expected trends and how they should navigate this energy transition. Based on these discussions, we're answering five key questions that provider greater insight into our forecast.

1 Why do you expect global energy demand growth to slow down, and do you believe it is a structural phenomenon?

For the first time in recent history, global energy demand growth is decelerating to below 1% p.a. until 2030 and to around 0.5% p.a. from 2030-2050. In many economies, this is driven by shifts from products to services and improvements in energy intensity from more energy-efficient fuels and technologies.

Exhibit 1

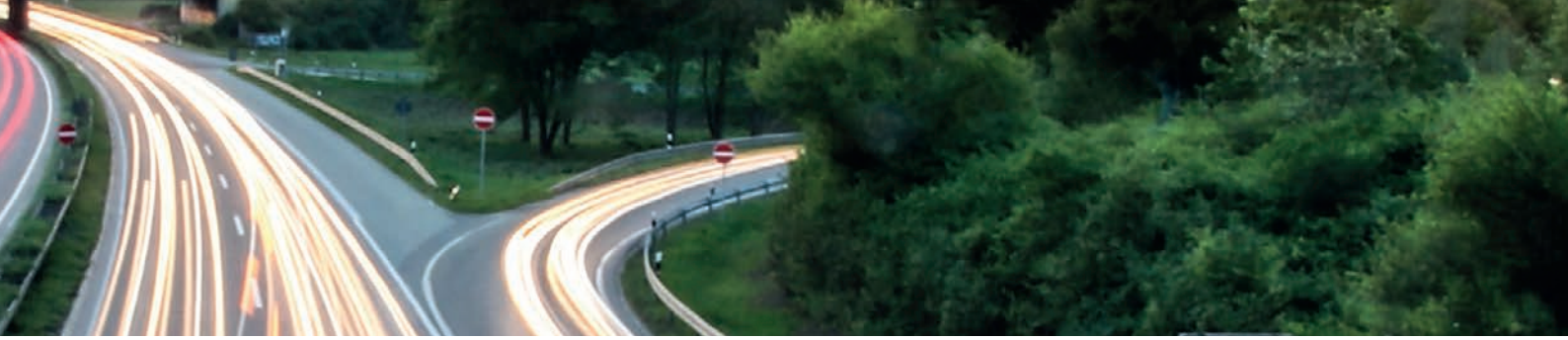


Sources: McKinsey Energy Insights' Global Energy Perspective, December 2017; IEA Energy Balances (Historical); Smil, V. (Historical)

At an aggregate level, we see that, while global energy demand continues to grow, the rate of growth decelerates rapidly. Following several decades of primary energy demand rising in excess of 2% p.a., we expect the world will experience a period of subdued growth—0.9% p.a. from 2015-30 and just 0.5% p.a. from 2030-50.

If we look at the drivers underlying these developments, we see that the continued growth is driven by population and economic expansion, particularly by the rising middle class in emerging economies.

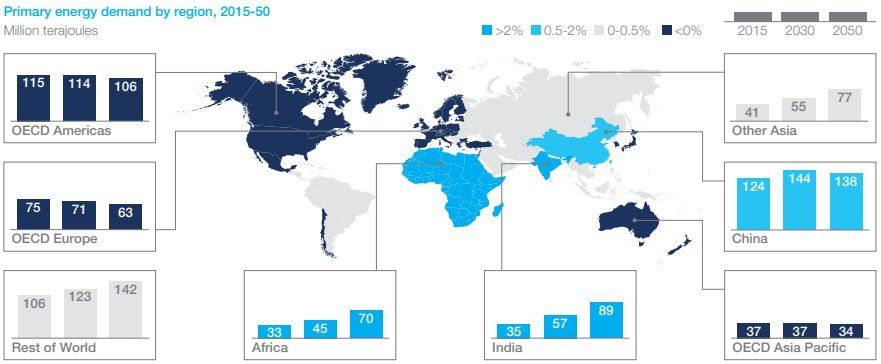
At the same time, there are two structural developments that will cause this growth to decelerate. First, there will be a shift in the structure of the economy in many countries, with ageing populations and an overall transition



from industrial to service-based. We have seen this development already in many high-income countries and now anticipate the same in, for instance, China. Second, there will be strong improvements in energy intensity because of shifts towards more energy-efficient fuels and technologies. Examples include electrification, where electricity is used as a substitute for conventional fuels, and better energy efficiency in the equipment and machines used by households and the industrial sector.

From a geographical perspective, we expect the energy demand in OECD countries (which make up 40% of the global figure in 2015) to decline at an accelerated rate and China (22% of the 2015 total) to experience a peak in demand around 2030. The regions experiencing the strongest growth, notably Africa and India, are starting from a low base (each at ~6% of the 2015 total) but will exceed Europe's demand level by 2050.

Exhibit 2



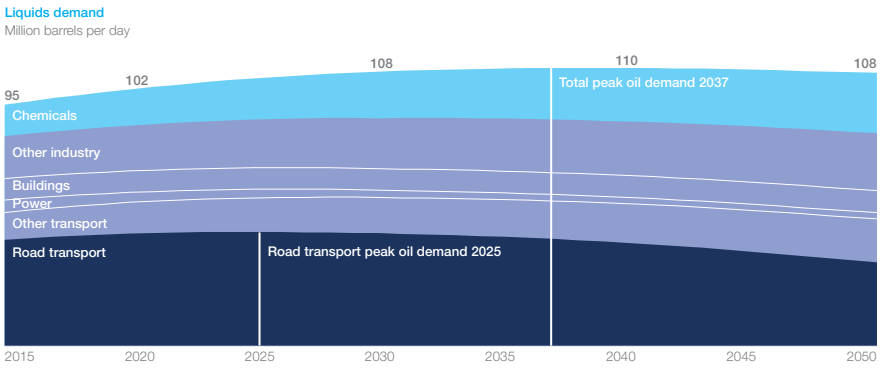
Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

The continued growth is driven by population and economic expansion, particularly by the rising middle class in emerging economies

2 Why do you expect oil demand to peak, even as you expect the population and GDP per capita to increase?

We expect oil demand to peak in 2037 at around 110 MMb/d. The key drivers behind the inflection point are related to road transport and include improving fuel efficiency, the rising share of electric vehicles, and passenger car market saturation in high-income economies.

Exhibit 3



Sources: McKinsey Energy Insights' Global Energy Perspective, December 2017; IEA Energy Balances (Historical)

We see petroleum liquids demand peaking nearly 180 years after Edwin Drake struck oil by Titusville and spurred explosive growth of the industry, which has since revolutionized transport and numerous other branches of the economy.

Currently, we are on the verge of another revolution, with electric vehicles making bold inroads into passenger and even commercial road transport. The stakes are high, as road transportation not only makes up roughly 45% of total petroleum liquids demand but it also consumes the products with the highest margins (e.g., gasoline, diesel). In our view, electric vehicles will steadily win market share from ICE vehicles in the coming decades, as further technology developments make them more economically attractive and government policies put restrictions on use and sales of ICE vehicles, while encouraging zero-emission vehicles. With the parallel transition towards cleaner power generation, we expect the push for electric vehicles only to increase.

In the short term, efficiency improvements and peaking car ownership in developed countries will play a key role behind the peak liquids demand for road transport, which we expect to see in 2025—a decade before overall peak oil demand itself.

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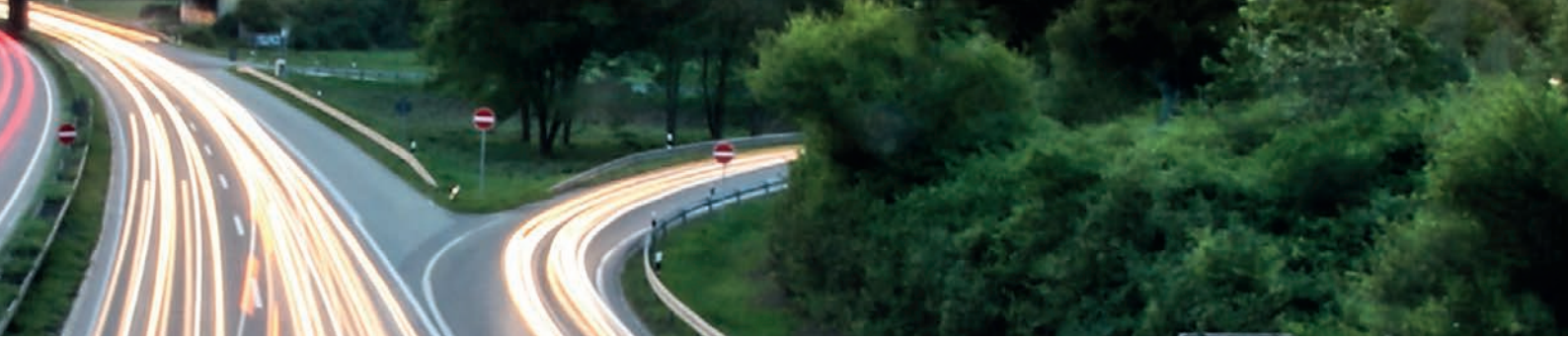
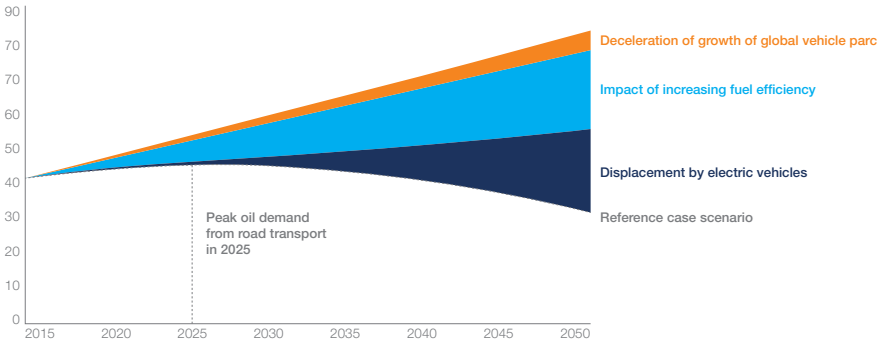


Over the past years, the cost of renewables has reduced to a fraction of its former levels. Solar PV has experienced an 85% cost decline in the past decade

Exhibit 4

Impact of road transport drivers on liquids demand
Million barrels per day



3 How do you expect the power sector to deal with demand variations and supply intermittency given your assumptions of rapid growth of solar and wind power generation?

The role of solar and wind power will increase substantially towards 2050, though the extent to which it grows will vary considerably between countries. In Germany, for instance, their combined share in the generation mix will exceed 60%. This will require investments in energy storage technology development and transmission infrastructure, as well as appropriate updates to system regulation.

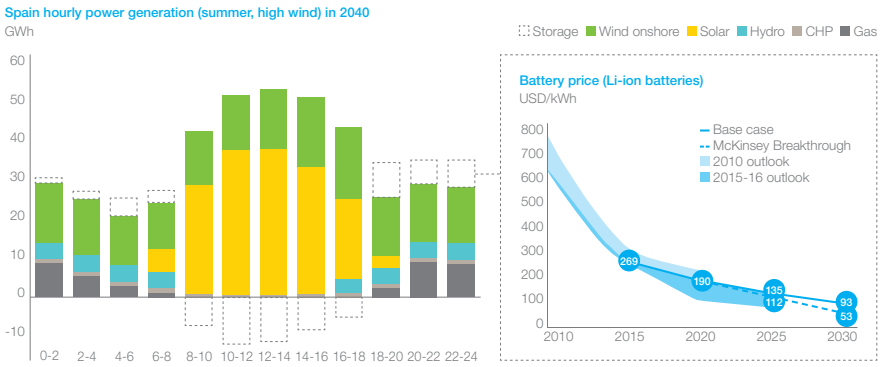
Over the past years, the costs of renewables has reduced to a fraction of its former levels. Solar PV has experienced an 85% cost decline in the past decade. The impact of falling renewables cost has been further strengthened by equally strong decline in battery cost. There is a possibility of battery pack cost below USD100/kWh by 2020.

Consequently, we expect the power sector to deal with intermittencies in three ways:

First, battery storage will play a large role. Particularly in geographies with optimal solar conditions, we believe that the combination of battery storage and solar PV will become cost-competitive in the next 10-15 years—depending on local conditions (see the graph below).

Alternative flexibility instruments such as hydrogen storage could play an increasing role, which will be particularly important for seasonal storage

Exhibit 5

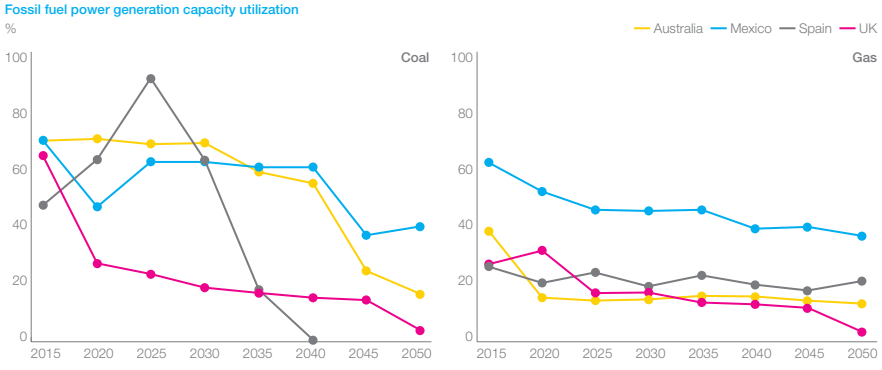


Sources: McKinsey Energy Insights' Global Energy Perspective, December 2017; SNE research; Navigant; Bernstein Research; expert interviews

Second, some fossil fuel capacity—especially flexible gas capacity—will remain online to provide stability. The utilization of that capacity will inevitably drop, accelerated by renewables and storage becoming cost-competitive faster (see graph below). For some time, covering more expensive peak capacity will still provide sufficient revenues to keep the capacity online. At some point, capacity markets might become necessary (where they do not exist already) to maintain stability.

In addition, we expect grid interconnectivity to increase, which will further support the balancing of intermittent loads. Further down the road, alternative flexibility instruments such as hydrogen storage could play an increasing role, which will be particularly important for seasonal storage. However, the magnitude and speed of such developments remain uncertain as technologies need to advance futher and associated costs need to decrease to make these solutions economic.

Exhibit 6



Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

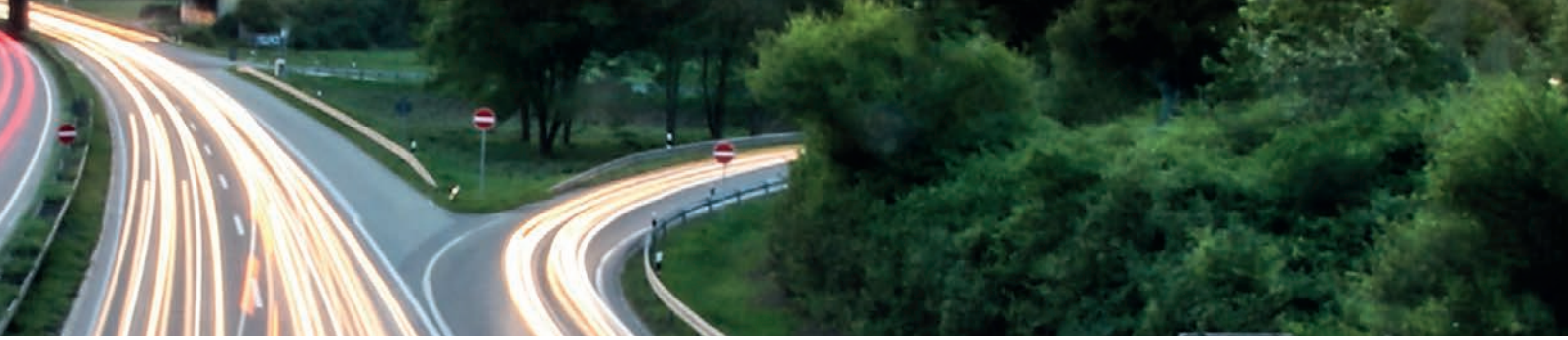
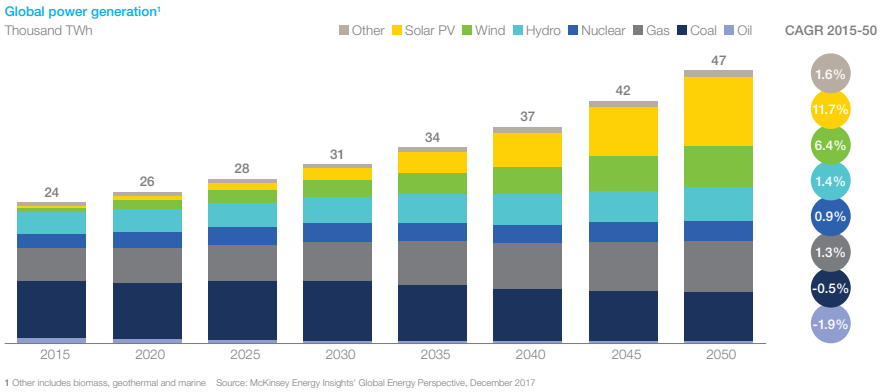


Exhibit 7

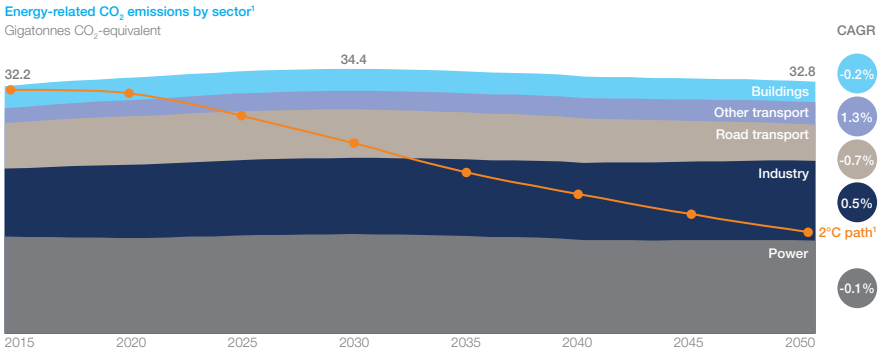


1 Other includes biomass, geothermal and marine Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

4 Why don't you anticipate a more rapid decline in CO_2 emissions as low-carbon technologies, such as renewables and EVs, become more widespread?

We expect to see an unprecedented period of stabilization in energy-related CO_2 emissions over the next 30 years. However, the forecast emission level remains far from a 2-degree trajectory. The main reason for this is continued reliance on coal in a number of large emerging economies, particularly for power generation.

Exhibit 8



1 IEA Sustainable Development Scenario emissions pathway consistent with a 1.5-2°C long-term global average temperature increase; extrapolated for 2040-50
Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

We see energy-related greenhouse gas (GHG) emissions plateauing at around 32-34 GT CO_2 equivalent in the coming decades. We expect the peak and the subsequent decline to be driven by rising electrification and the decarbonization of the power generation mix. However, the projected trajectory remains far above the 2-degrees pathway laid out in the IEA Sustainable Development Scenario. To reach this goal, emissions would need to decline to ~25 GT CO_2 equivalent in 2030 and ~13 GT CO_2 equivalent by 2050.

We expect to see an unprecedented period of stabilization in energy-related CO_2 emissions over the next 30 years

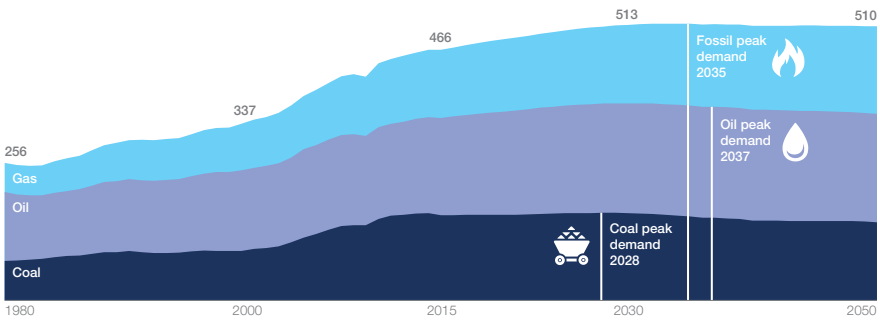
There are two main reasons for this. The primary reason is the ongoing growth of global populations and GDP, which drives higher overall energy demand and a continued reliance on fossil fuels in certain industries and geographies.

The secondary reason relates to lock-in effects despite a relatively rapid shift towards electric vehicles for new sales and renewables for new power generation capacity. Although, for instance, new renewable capacity will be cheaper than new fossil generation in most places in the world within a matter of years, in many places existing fossil fuel plants will continue to be cheaper than new renewables for a long time. So, although more than 80% of power capacity additions until 2050 will be renewable, it will take a while before existing capacity is completely phased out. These lock-in effects also exist for ICE vehicles and industrial equipment.

The implication is that overall fossil fuel use flattens from 2035 onwards, but in our current perspective we do not see a drastic decline.

Exhibit 9

Global fossil fuel demand
Million TJ



Sources: McKinsey Energy Insights' Global Energy Perspective, December 2017; IEA Energy Balances (Historical)

Coal demand is expected to peak within the next decade. Although we expect a decline in power generation from coal in OECD countries, local abundance and favorable economics could cause it to remain a key fuel powering growth in the power, iron and steel, and cement industries in non-OECD Asian countries.

Oil demand is expected to peak in 2037, but might maintain a crucial role as chemical feedstocks and will likely remainas a primary fuel used in transport, especially in sectors like marine and aviation in the following decade.

Natural gas, the least carbon-intensive of the fossil fuels, might experience the most sustained growth of the three. This relates to its favorable economics and relatively modest pressure from policy measures due to its lower carbon intensity.

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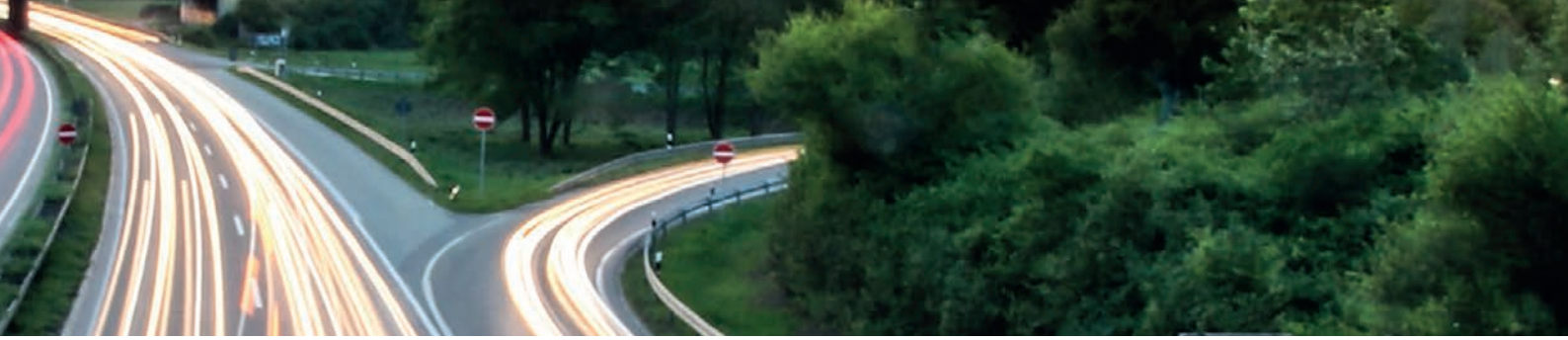

The chemical industry's fossil fuel consumption will drive nearly half of the demand growth for oil and more than a quarter of gas demand growth until 2030

5 Why is fossil fuel demand in the chemical industry growing so quickly compared to the rest of the economy?

The chemical industry's fossil fuel consumption will drive nearly half of the demand growth for oil and more than a quarter of gas demand growth until 2030. The reason is its high correlation with global GDP growth and a limited number of cost-competitive alternatives for petrochemical-based feedstocks.

The chemical industry will be the key driver of oil and gas demand growth over the next few decades. Despite representing only 13% of oil and 9% of gas consumption in 2015, it will contribute 46% and 28% of demand growth for these two fuels respectively until 2030. We expect the chemical sector to maintain this trend in 2030-50, even as global oil demand peaks in 2037.

Exhibit 10

Global liquids demand, 2015-30 delta
Million barrels per day

▽2015 ◿2030 >1 0.5-1 0.1-0.5 0-0.1 <0

	China	India	Non-OECD Asia	Africa	Other non-OECD	OECD Americas	OECD Europe	OECD Asia Pacific	Total	CAGR
Chemicals									12.4 / 18.3	2.6%
Other industries									14.3 / 17.0	1.2%
Road transport									41.9 / 44.5	0.4%
Aviation									6.0 / 8.4	2.3%
Marine									4.9 / 5.8	1.1%
Other transport									1.4 / 1.6	1.0%
Buildings									9.4 / 9.6	0.1%
Power									5.2 / 3.2	-3.2%
Total	12.4 / 15.7	4.2 / 6.6	8.1 / 10.8	3.9 / 5.6	20.2 / 23.7	25.0 / 25.3	13.8 / 13.0	7.8 / 7.7	95.5 / 108.4	
CAGR	1.6%	3.0%	2.0%	2.4%	1.0%	0.1%	-0.4%	-0.1%		0.8%

Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

Exhibit 11

Global gas demand, 2015-30 delta
Million TJ

▽2015 ◿2030 >1 0.5-1 0.1-0.5 0-0.1 <0

	China	India	Non-OECD Asia	Africa	Other non-OECD	OECD Americas	OECD Europe	OECD Asia Pacific	Total	CAGR
Chemicals									11.6 / 16.9	2.6%
Other industries									30.8 / 37.2	1.3%
Transport									4.1 / 4.5	0.6%
Buildings									25.3 / 26.8	0.4%
Power									50.5 / 56.1	0.7%
Total	6.6 / 14.0	10.2 / 13.1	21.7 / 23.5	16.3 / 18.5	10.2 / 12.3	33.4 / 36.3	16.5 / 17.2	7.4 / 6.5	122.3 / 141.5	
CAGR	5.2%	1.7%	0.5%	0.8%	1.3%	0.6%	0.3%	-0.9%		1.0%

Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

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Steady hydrocarbon demand growth from the chemical sector is explained by the strong correlation between chemicals demand and growth in GDP and population, as well as the large share of oil and gas that is used as feedstock rather than as energy (~80% of oil and gas in chemicals is used as feedstock). Anticipated energy efficiency improvements will mostly reduce the fossil fuel demand that is not feedstock.

To understand the future of fossil fuels in the chemicals sector, three trends will be important to watch.

1 Demand for chemical products, especially plastics

There is increasing regulatory pressure on the use of plastics. We expect a decoupling of virgin plastic consumption—which uses the majority of liquids-based feedstock—and GDP growth due to reduced use and substitution after 2030

2 Plastics recycling

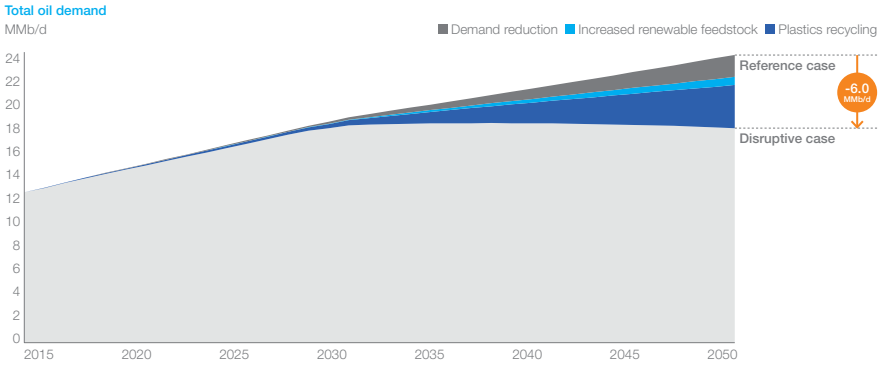
There is currently a lot of attention on circularity and recycling. However, to increase the recycling uptake of hard-to-recycle plastics, improvements in consumer waste collection, technological breakthroughs, and industry scaling are still necessary

3 Biobased alternatives

Demand for renewable feedstock might lead to uptake in selected production routes

Sensitivity to these trends is high. In a disruptive scenario where we assume a doubling for each of these trends versus our reference case, chemical oil demand would peak by 2030, and demand in 2050 ends up ~25% lower than in our reference case.

Exhibit 12



Source: McKinsey Energy Insights' Global Energy Perspective, December 2017

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