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King Abdullah Petroleum Studies and Research Center

Gas Demand Growth Beyond Power Generation

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About KAPSARC

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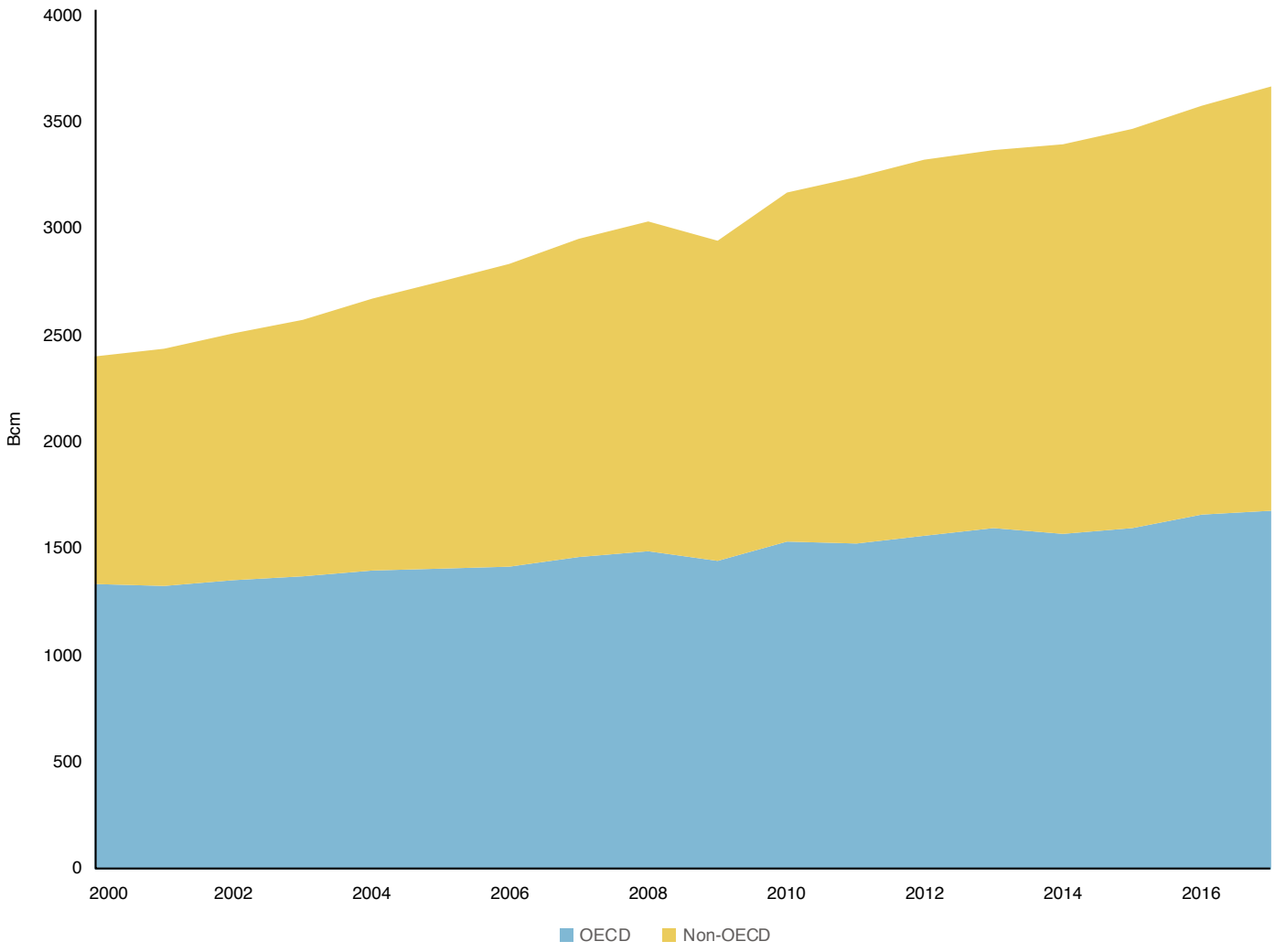
Key Points

Global energy consumption in 2017 returned to its trend growth rate from before the financial crisis in 2009 and natural gas contributed the largest increment to this growth. Natural gas remains the fastest growing fossil fuel and is on track to overtake coal and close the gap with oil in the next few years in the global energy mix.

At the country level, China and the United States (U.S.) have dominated growth in gas consumption since 2000, even as growth continues to be strong in many other parts of the world, especially in countries that are not part of the Organization for Economic Cooperation and Development (OECD). Even in Europe, where falling energy demand, along with the rapid increase in renewables, has squeezed gas's role in the energy mix, there has been a partial reversal and gas consumption has increased since 2014.

Figure 1. Growth in global gas consumption (2000-2017).



Source: BP (2018).

Key Points

Electricity generation has dominated growth in gas consumption, accounting for just over half of the total growth in gas use since 2010. The industrial sector was second. This pattern will change and much of the demand will come from outside the electricity sector over the next few decades, with rising gas demand in industry in Asia, petrochemical applications in the U.S. and the Middle East, and rising mobility needs driving growth in consumption.

The growth in gas consumption outside resource-rich countries has been largely motivated by the better environmental credentials of natural gas compared to other fossil fuels. Countries such as China and India have aggressively promoted the use of natural gas, using mandates and subsidies with a view to achieving local air quality improvements. The success of these initiatives illustrates that policy support is sometimes necessary to promote gas in the energy mix.

Summary

This paper highlights the main trends in gas consumption that have made it the fastest-growing fossil fuel. It identifies sectors and regions where gas demand is likely to grow in the coming years, especially outside the power sector, in the industrial, petrochemicals, road and maritime transportation sectors in countries that are not part of the Organization for Economic Cooperation and Development (OECD). Highlighting advances in China and India, the paper shows that long-term government support anchored in environmental standards would enable gas to increase its market share over time.

Global energy consumption is set to increase even as growth rates slow, while the centers of global energy demand shift from the OECD to the non-OECD countries, led by China and India. Within this transformation, gas will overtake coal in the next few years and will likely close in the gap with oil by 2040. This rapid growth in gas consumption globally can be traced back to continued industrialization in non-OECD countries, with rising populations and GDP in the developing world generating the vast majority of the growth in gas consumption. Non-OECD countries have accounted for more than half of global gas consumption every year since 2006 and will likely continue to increase their share.

In terms of the sectoral contribution to gas consumption, electricity generation and industry currently account for the largest percentages of gas demand, followed by buildings. The transport sector remains a minor consumer of gas.

However, the pattern of growth in gas demand is set to change: in the past larger increments to gas consumption came from the power sector. With rising competition in the power generation sector, from coal at one end and renewables at the other, the drivers for gas consumption are likely to shift to other sectors, in particular toward industry and transport. Here the environmental advantages of gas compared to other fossil fuels and the consequent role of policy support becomes increasingly important.

Introduction

In 2017, global growth in energy consumption returned to its long-term trend, with natural gas providing the largest share of the increase of any fossil fuel type. The growth in gas consumption was driven mostly by demand for gas from the electricity sector. It is expected that this stimulus from the power sector will moderate, however, as demand growth for gas shifts toward industry and transport. Another transition currently affecting gas markets is the shift in global growth from the developed to the developing world, that is, from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries.

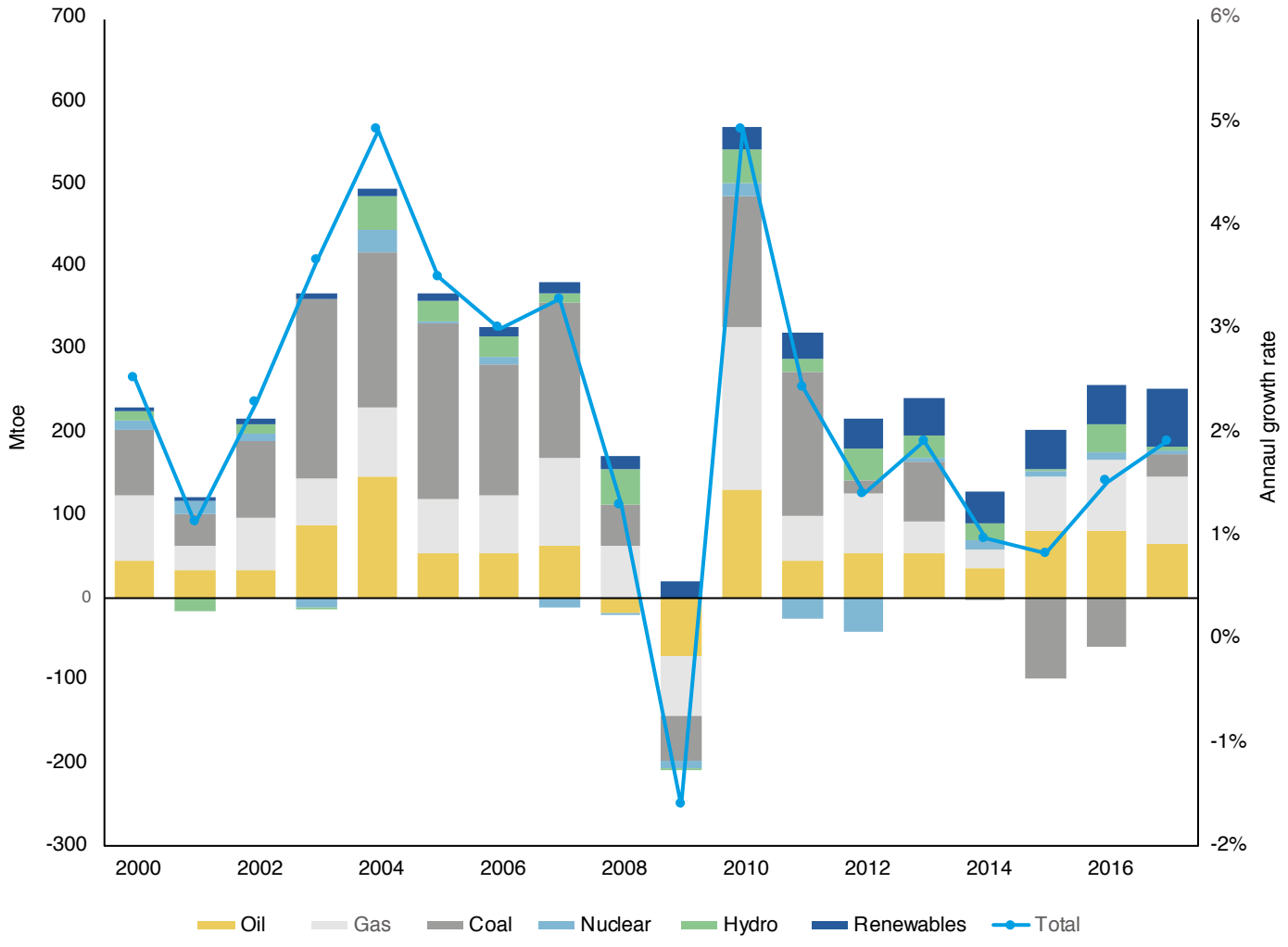
This paper explores the trends in gas consumption over the last decade and identifies sectors and regions where gas is likely to grow in the coming years, especially outside the power sector.

Natural Gas in the Global Energy Mix

Global energy consumption grew by 1.9% in 2017, faster than the average growth of 1.7% per annum during the previous 10 years (2006-16) (BP 2018). This was the largest increase in global energy consumption since 2011, with the growth rate in 2017 returning to values not seen since before the financial crisis in 2009 (Figure 2).

Indeed, gas contributed the largest increments to global energy consumption for six of the 17 years between 2000-2017. This is more than any other fuel except coal which has contributed the largest increment in nine years of this 17-year period. Gas consumption in 2017 grew by 2.7%, marginally slower than in 2016, but higher than the previous 10-year average of 2.3% between 2006-2016. As a result, natural gas was the fastest growing fossil fuel globally, with only renewables growing faster. This higher growth rate of gas compared to overall energy consumption resulted in gas's share of the

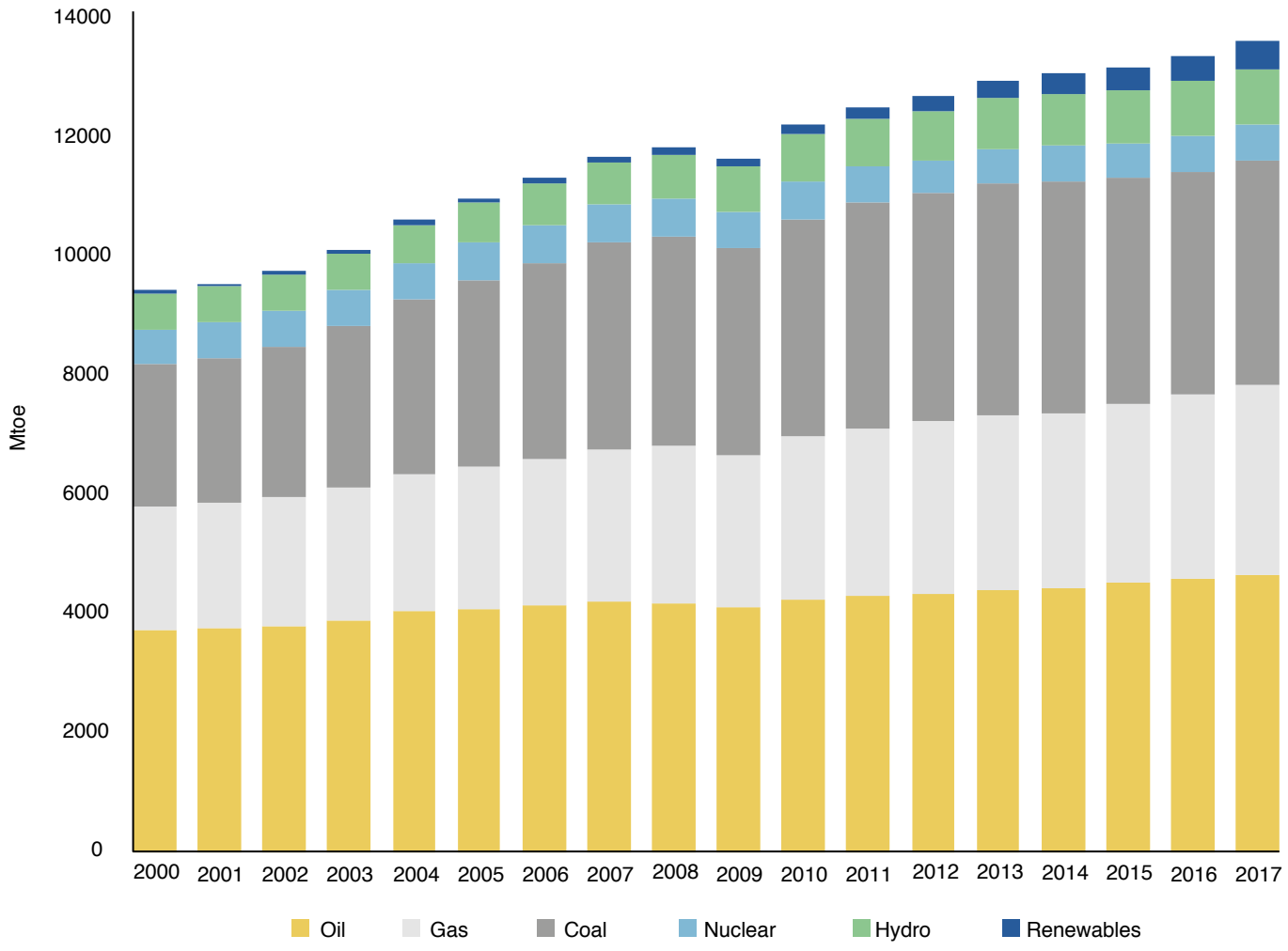
Figure 2. Growth in global energy consumption, 2006-2017.



Source: BP (2018).

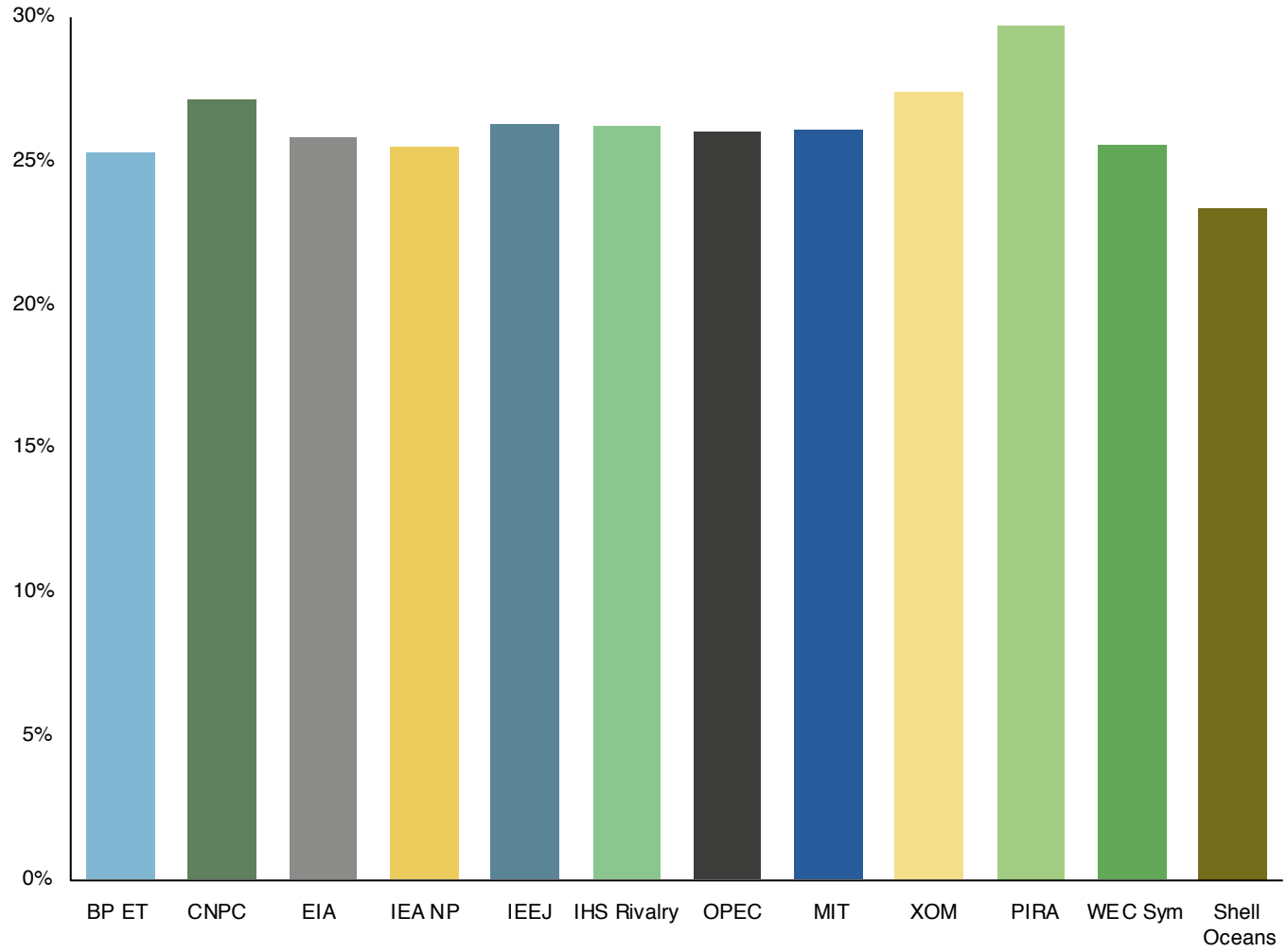
global energy mix increasing from 21.7% of total primary energy in 2006 to 23.4% in 2017 (Figure 3). Nevertheless, these gains were slow to arrive, with competition from coal at one end and renewables at the other — especially in the power sector. A number of commentators have characterized this slow progress as evidence that the 'golden age of gas' prophesized in the early 2010s would not be realized (KAPSARC 2016). The International Energy Agency (IEA) in 2011 described such a scenario, where gas consumption would grow twice as fast as overall energy consumption, resulting in the share of gas in the energy mix rising to 25% by 2035, with gas overtaking coal and approaching oil in terms of overall market share by then (IEA 2011). In comparison to such a scenario, while overall gas consumption has grown more slowly, gas does appear to be on track to overtake coal and close the gap with oil in the next few years, and its share of total energy consumption is predicted to reach between 23% and 30% by 2035 in almost every forecast of the global energy system (Figure 4).

Figure 3. Market share of fuels in the energy mix, 2000-2017.



Source: BP (2018).

Figure 4. Forecasts of the share of natural gas in the energy mix by 2035*.



Sources: EIA (2016), IEA (2018), BP (2018), GECF (2017), and OPEC (2018).

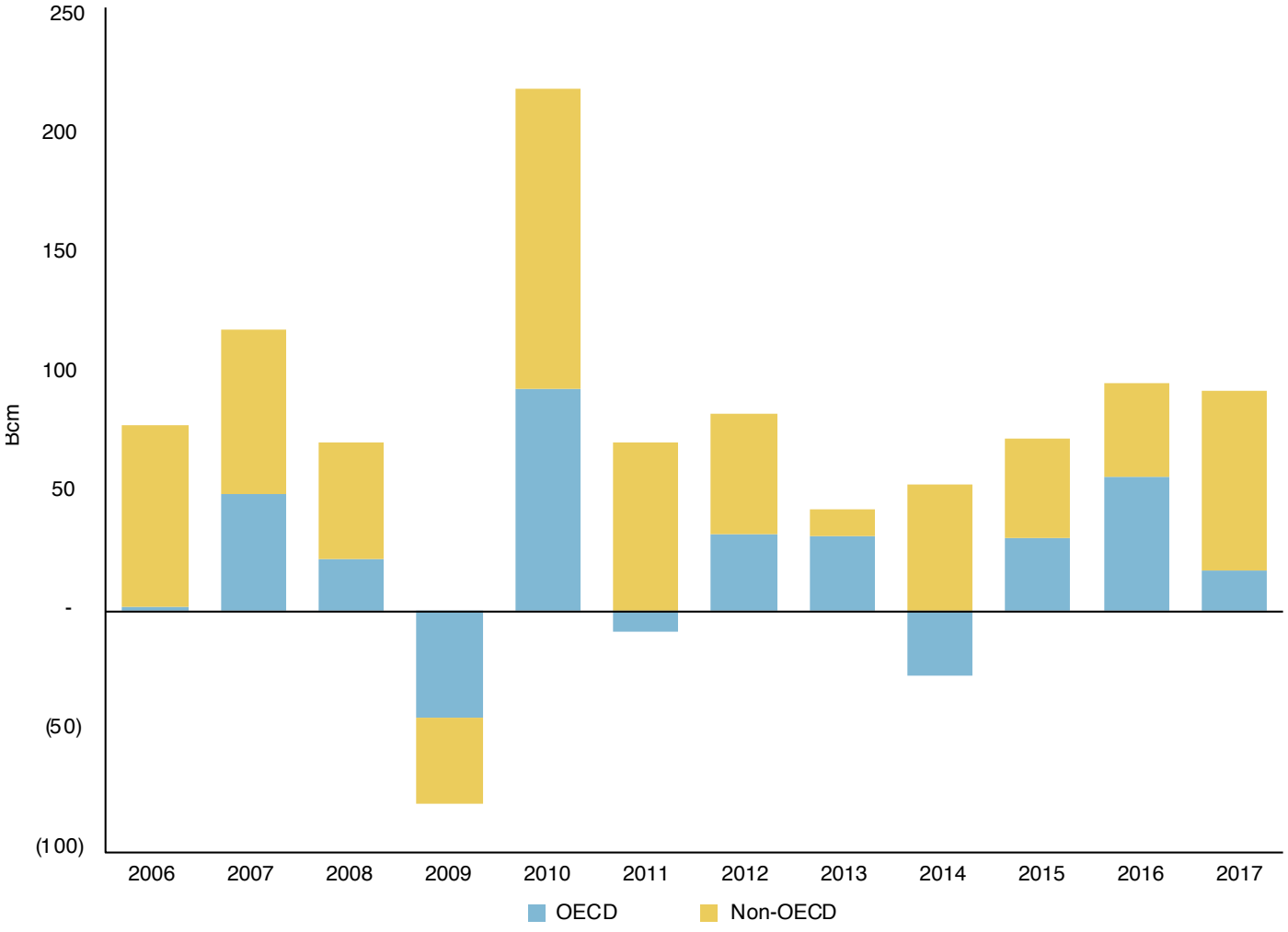
BP ET	BP Evolving Transitions
CNPC	China National Petroleum Corporation
EIA	U.S. Energy Information Administration
IEA NP	International Energy Agency New Policies Scenario
IEEJ	Institute of Energy Economics, Japan
OPEC	Organization of the Petroleum Exporting Countries
MIT	Massachusetts Institute of Technology
XOM	ExxonMobil
PIRA	PIRA Energy Group
WEC Sym	World Energy Council Unfinished Symphony

A Regional Lens on Gas Consumption

A key element of the IEA's 'golden age of gas' scenario is its forecast that about 80% of the growth in gas consumption to 2035 will come from developing or non-OECD countries (IEA 2011). This was true in 2017, with over 80% of the increase in gas consumption coming from non-OECD countries; from 2006-2016, the figure was 70% (Figure 5). Since 2006, non-OECD countries have accounted for more than half of global gas consumption, have provided nearly 80% of the growth in global GDP, and are responsible for over 90% of global population growth. It is not surprising, therefore, that as developing countries industrialize and become more populous they are leading the growth in gas consumption.

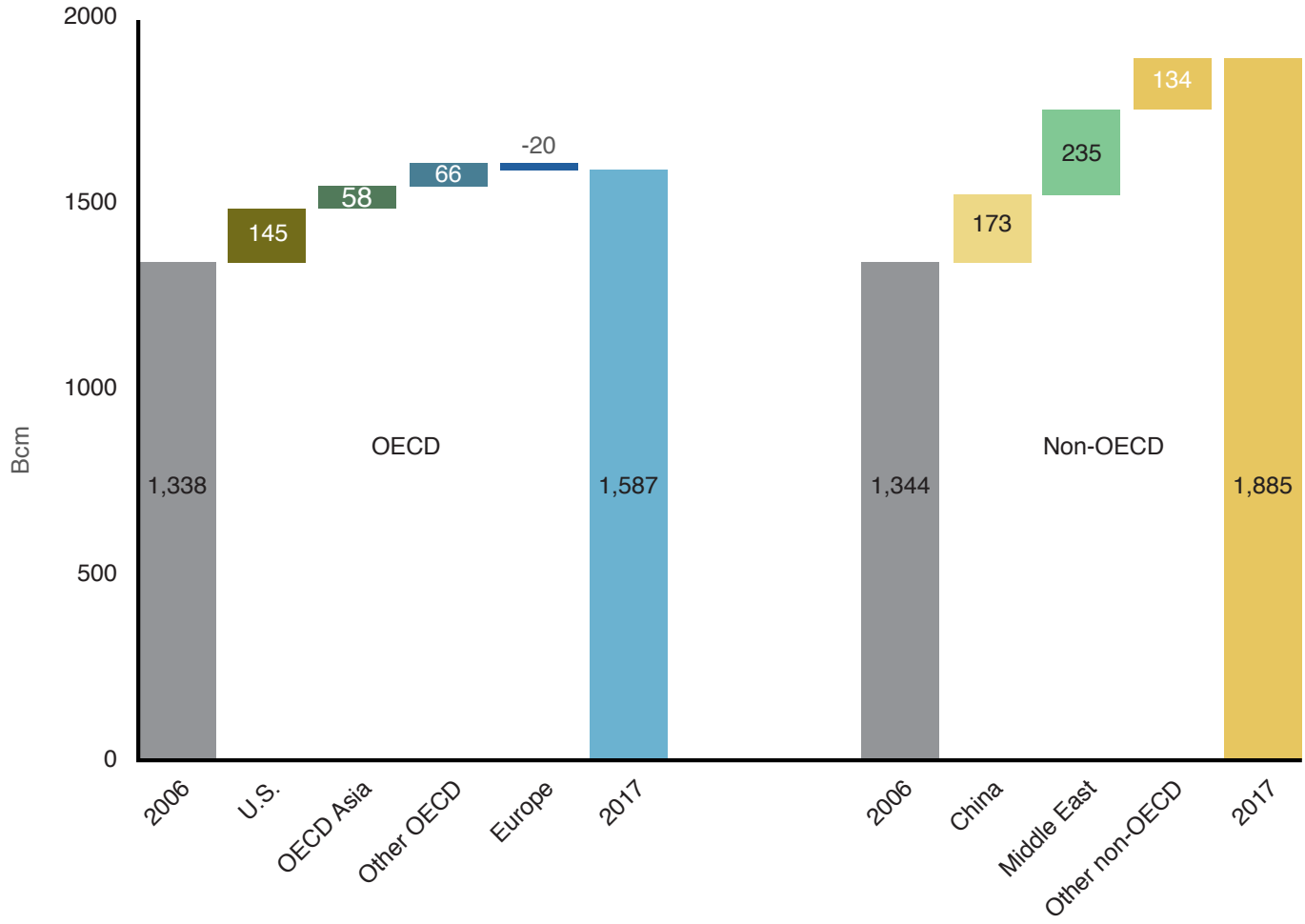
China and the United States (U.S.) together accounted for over 40% of the increase in global gas consumption between 2006 and 2017 (Figure 6). Another 30% of the total increment came from the Middle East; and Iran, Saudi Arabia, and Qatar accounted for nearly all of the increase in the region. The only region of the world where gas consumption has fallen in volumetric terms since 2006 is Europe, where decreasing energy demand and a rapid increase in renewables penetration has crowded out gas in the power sector.

Figure 5. Contribution of OECD and non-OECD countries to growth in global gas consumption, 2006-2017.



Source: BP (2018).

Figure 6. Growth in gas consumption by major regions and countries, 2006-2017.

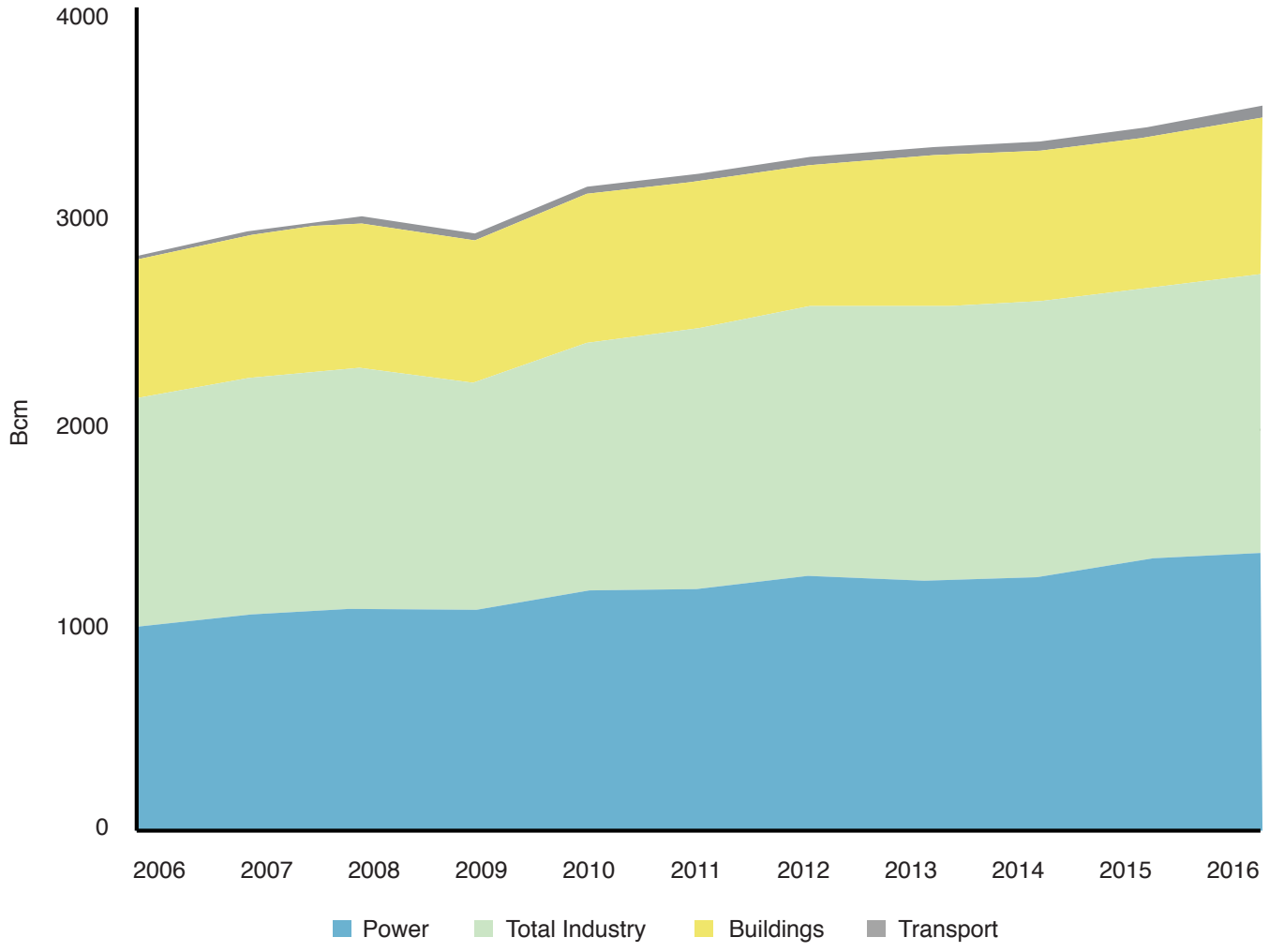


Source: BP (2018).

Gas Consumption by Sector

In 2016, electricity generation and industry (including feedstock for petrochemicals) each accounted for 40% of global gas consumption. Almost all of the remainder was consumed by the buildings sector, with transport accounting for only about 1% of global gas consumption (Figure 7). Electricity generation accounted for just over half of the global growth in gas consumption from 2006-2016. In 2006 the power sector accounted for only 36% of global gas consumption. Industrial consumption was the second largest source of growth, accounting for 35% of the increase in consumption from 2006-2016, barely maintaining its share of total consumption. More significantly, the use of gas as a feedstock for petrochemicals plants (as opposed to its use for combustion purposes) rose by 3.2% per annum between 2006 and 2016, compared to just 1.8% per annum in other industrial sectors. The fastest growth in gas consumption was from the transport sector, although it still consumes very small volumes.

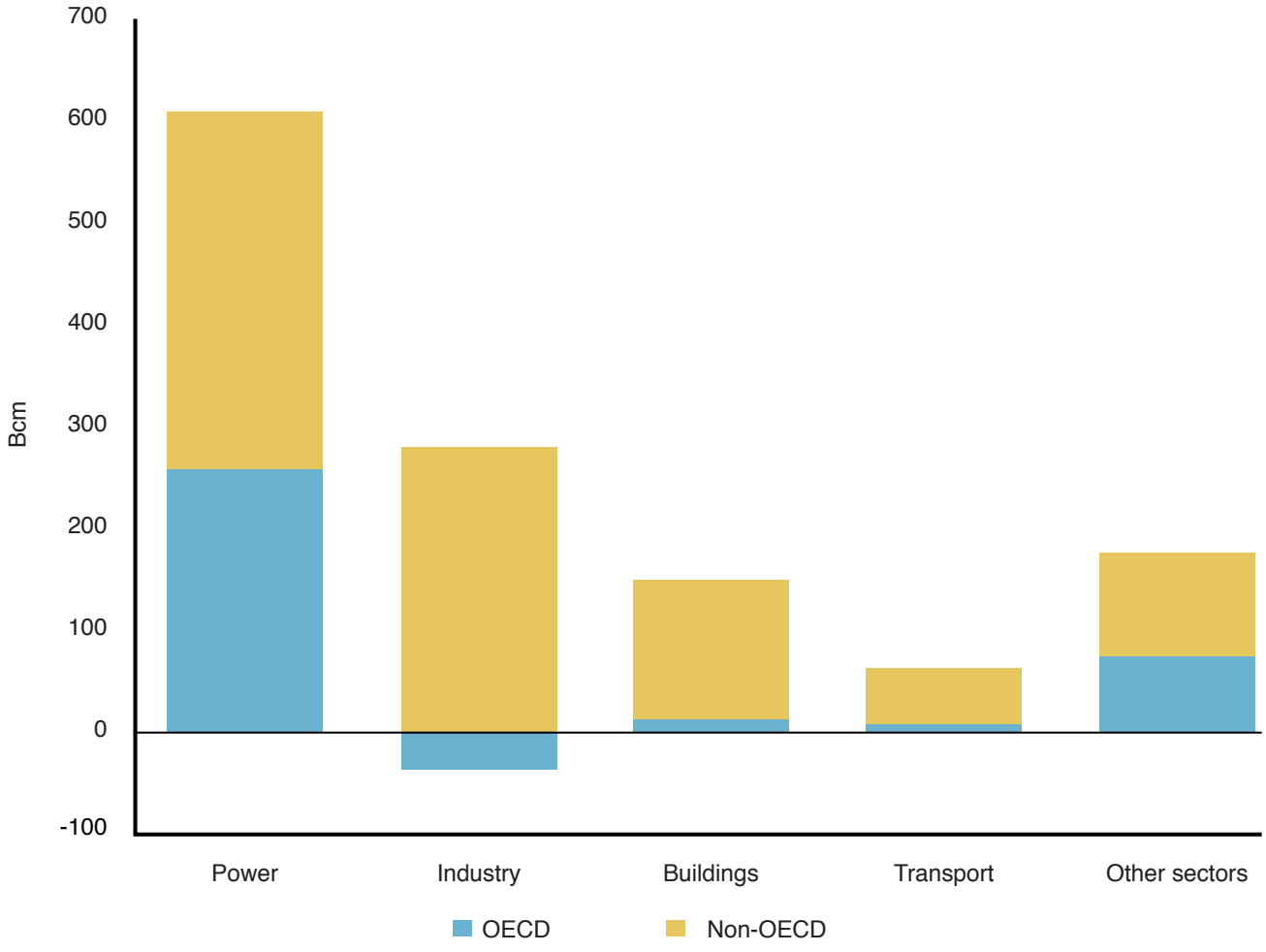
Figure 7. Gas consumption by sector, 2006-2016.



Source: IEA (2017) and BP (2018).

Between 2000-2017, nearly 60% of the increase in gas consumption by the electricity generation sector was in non-OECD countries (IEA 2018). However, the contribution of non-OECD countries to growth in other sectors during this time is even more significant. Almost all of the growth in gas consumption in the transport sector was in non-OECD countries. And all of the increases in gas consumption in industry and buildings came from the developing world. The shift in the growth of gas consumption during this period, from OECD to non-OECD countries, is attributable to the latter's higher growth in industrial activity and increasing urbanization (Figure 8).

Figure 8. Growth in global gas consumption, 2000-17*.



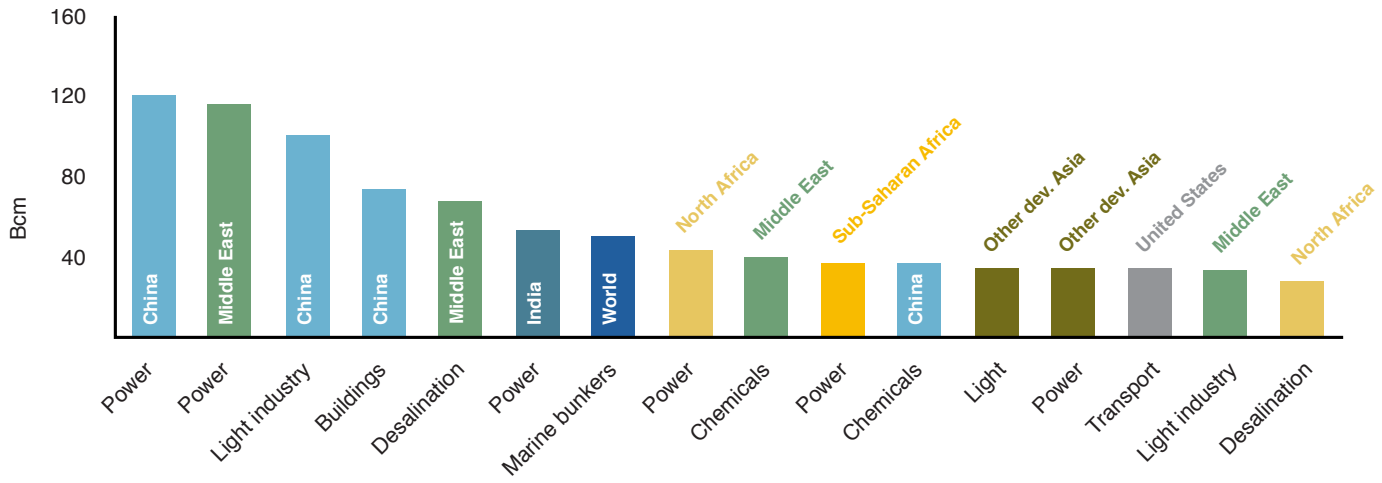
Source: IEA (2018).

**excluding international bunker fuel demand*

Gas Consumption by Sector

The IEA forecasts that industry will account for more than 30% of incremental gas consumption from 2017-2040, with an annual growth rate of over 2%. This is followed by annual growth in gas consumption for power generation of just 1.2% during this period. The remainder is accounted for by buildings (1%) and transport (4.1%) (IEA 2018). Thus, more than 70% of the growth in gas consumption is forecast to come from outside the electricity sector, with rising industrial gas demand in Asia, petrochemicals growth in the U.S. and Middle East, and rising global mobility needs driving overall demand (Figure 9).

Figure 9. IEA forecast for growth in gas consumption, 2016-40.



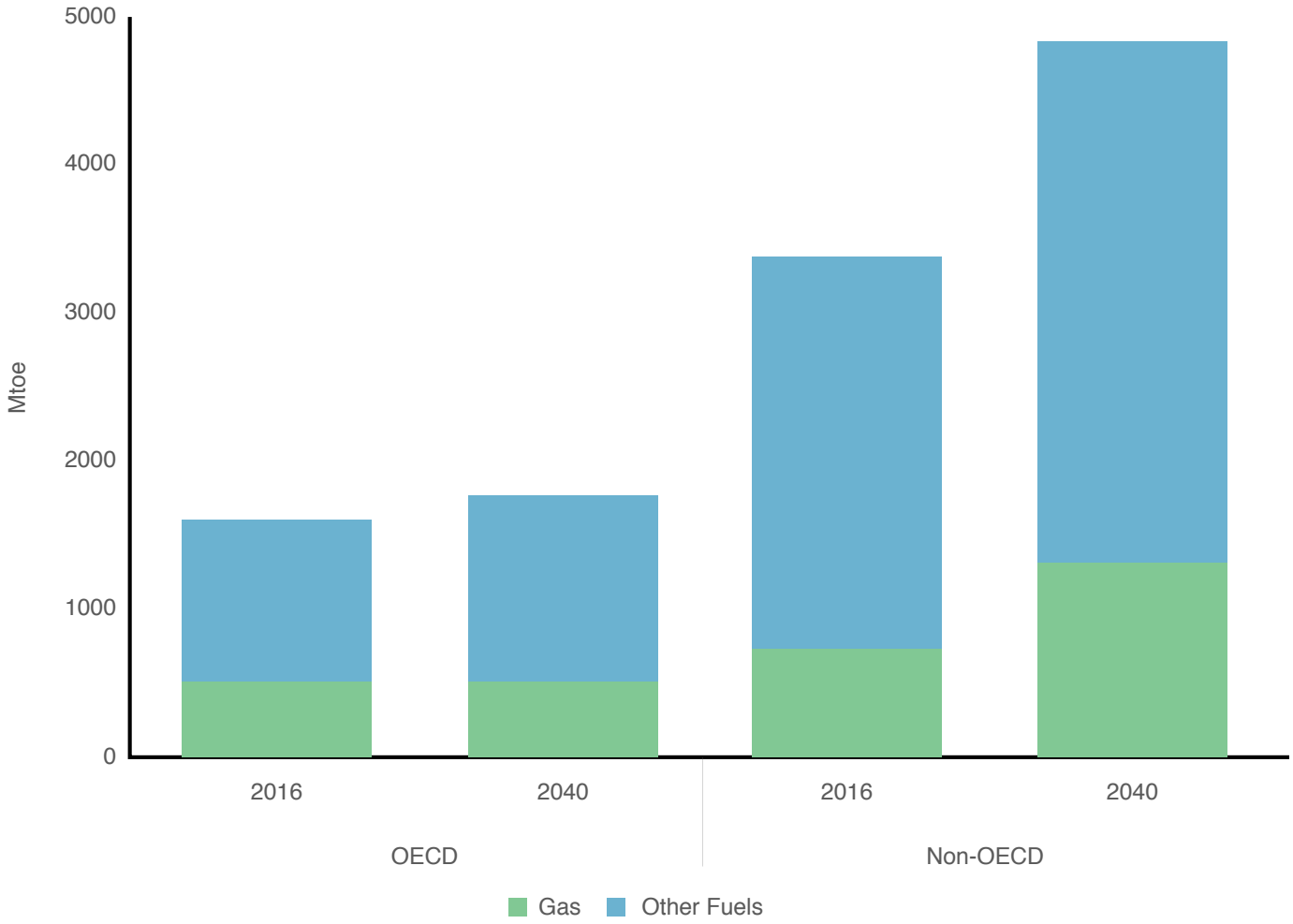
Source: IEA (2017).

Growth Prospects in Industry

Energy is used in industry for a wide range of thermal, lighting, and feedstock purposes. The IEA forecasts that industrial energy consumption in non-OECD countries will grow three times faster than in OECD countries. As such, it forecasts that industrial consumption in the developing world will rise from 66% of global industrial consumption in 2016 to nearly 75% by 2040 (EIA 2016).

Natural gas consumption in industry is forecast to grow more rapidly in non-OECD compared to OECD countries, with gas barely maintaining its share of OECD industrial energy consumption, at around 30% between 2016 and 2040. Forecasts estimate the share of gas in total energy consumption in non-OECD countries will rise from about 20% in 2016 to 27% by 2040 (Figure 10). This includes the use of gas not just for combustion purposes but also as feedstock to produce, among other things, fertilizers, chemicals and plastics. Petrochemical feedstock is forecast to be the fastest growing source of incremental gas demand (BP 2018) and used for manufacturing plastics, industrial chemicals, fertilizers, etc.

Figure 10. Forecast for growth in gas consumption in industry, 2016-2040.



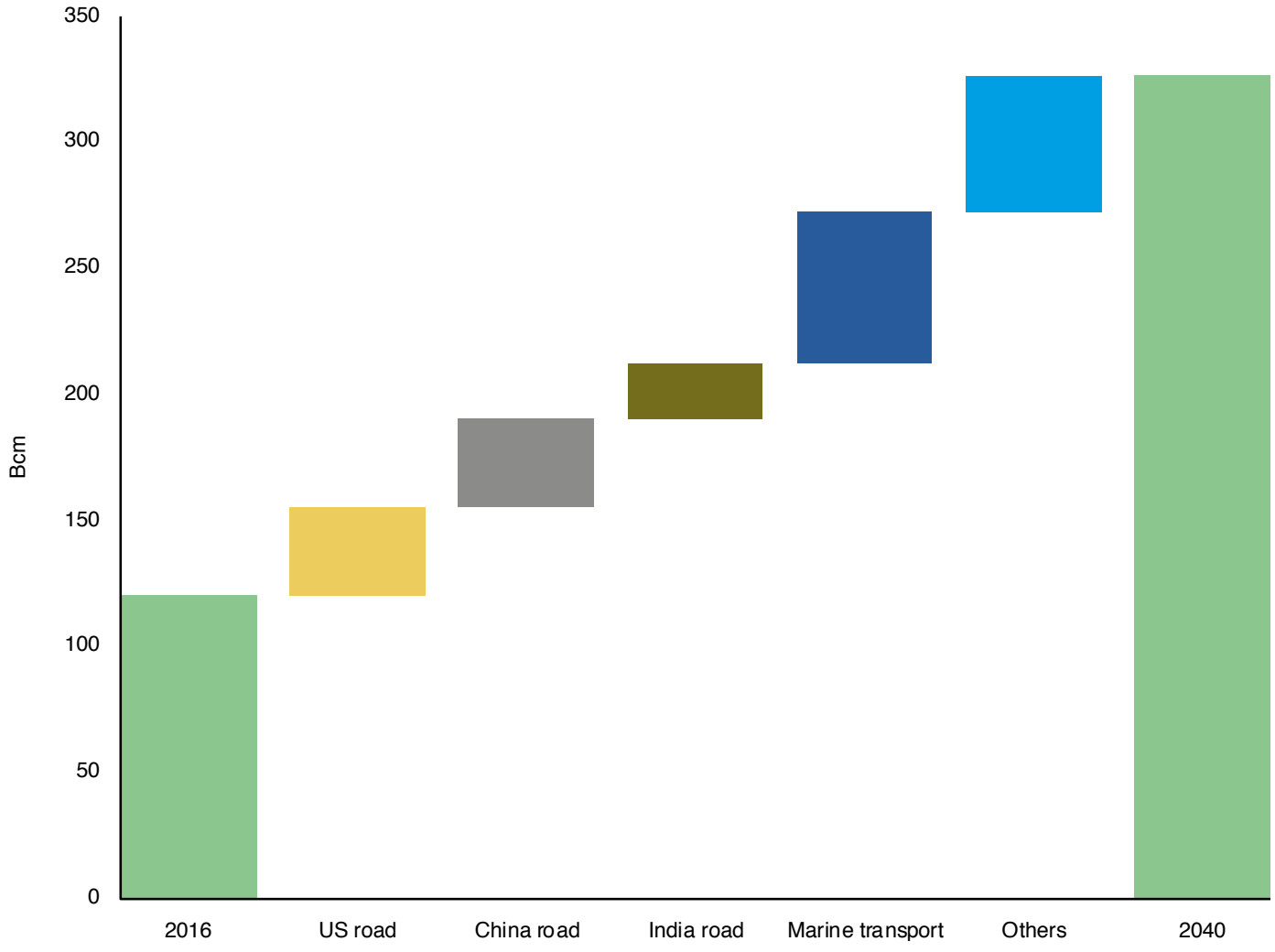
Sources: EIA (2016) and BP (2018).

Gas Demand in the Transport Sector

Gas demand in the transport sector is forecast by the IEA to nearly treble between 2017-40 (IEA 2018). In the previous edition of IEA's World Energy Outlook (2017), road transport demand in the U.S., China, and India accounted for over 40% of the forecasted growth during 2016-2040 (IEA 2017). The single largest source of growth in gas use for transport is predicted to be marine fuel, with the International Maritime Organization's regulations on sulfur emissions from shipping vessels and energy efficiency targets encouraging a shift toward gas and away from liquid fuels (Figure 11).

The U.S. Energy Information Administration (EIA) has forecasted that the share of natural gas used in transportation will grow from 3% in 2012 to 11% by 2040 (EIA 2016). This increase will largely be due to a move away from heavy duty diesel engines: the EIA forecast that 15% of large trucks, 50% of buses, 17% of freight rail, and 7% of light-duty vehicles will be fueled by natural gas in 2040. This trend is echoed in the BP Energy Outlook where liquefied natural gas (LNG) accounts for most of the growth in natural gas used in transport for long distance road haulage and marine transportation (BP 2018).

Figure 11. IEA forecasts for growth in gas demand, 2016-2040.



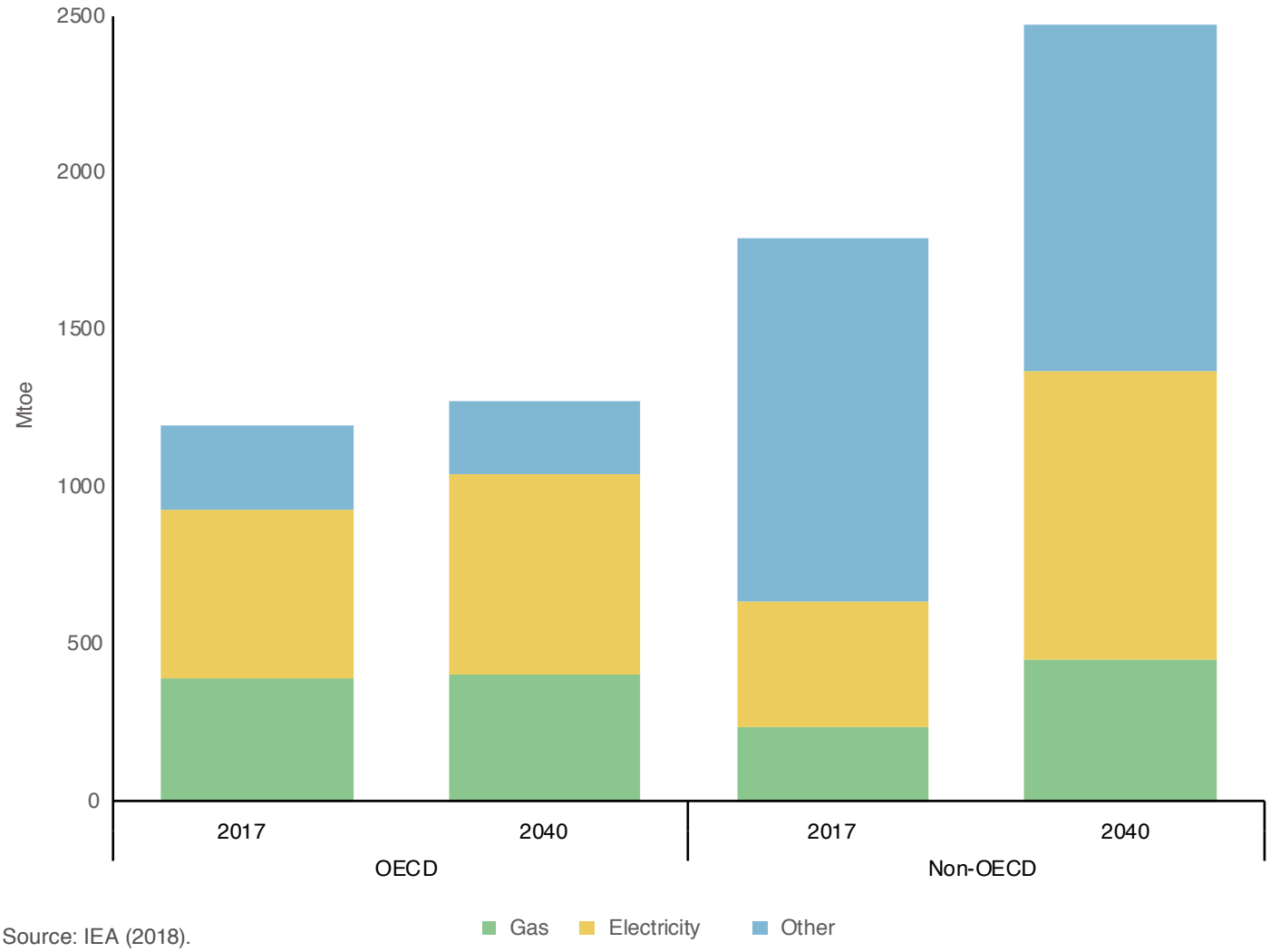
Source: IEA (2017).

Gas Demand From the Buildings Sector

Energy consumed in the buildings sector (residential and commercial end users) accounted for 21% of the total delivered energy consumed worldwide in 2017 (IEA 2018). In its International Energy Outlook 2016 (EIA 2016), the EIA forecasted global energy consumption in buildings worldwide would increase by an average of 1.5% per annum between 2016-2040; the IEA now forecasts a more modest increase of 1% per annum between 2017-2040. In both forecasts, the increase in energy consumption in the non-OECD is significantly larger than in the OECD, with rising population and urbanization in the developing world increasing the demand for energy.

The IEA also forecasts that the use of gas in the buildings sector will increase from 21.8% of total buildings' energy consumption in 2017 to 22.3% in 2040 (Figure 12). The IEA forecasts that electricity will become a more important energy source for buildings in future, with its share of overall buildings' energy consumption rising from 32.2% in 2016 to 42.6% by 2040 (IEA 2018). The increased growth in buildings' electricity use will be due to a greater demand for space cooling, lighting and electrical appliances (BP 2018). Growth in energy consumption in buildings is forecast to come mostly from non-OECD countries, with a rise in the consumption of electricity for space cooling dominating growth in this sector.

Figure 12. IEA forecast for energy consumption in buildings, 2017-2040.



Source: IEA (2018).

The Environmental Case for Natural Gas

The growth in gas consumption outside resource-rich countries has been largely motivated by the better environmental credentials of natural gas compared to other fossil fuels. Countries such as China and India have actively encouraged the use of natural gas to improve local air quality through government mandates and subsidies. The role natural gas could play in reducing carbon emissions has also been emphasized in various national policies. The success of these initiatives illustrates the kind of policy support needed to promote gas in the energy mix.

Reducing reliance on coal in China

In the early part of the 2010s, addressing urban air pollution became an increasingly urgent issue in China, with the rising use of coal and rapid growth in industry being blamed for poor air quality, especially in eastern and central China (Yana, Andersson, and Zhang 2016). The Global Burden of Disease project estimated that air pollution led to 1.2 million premature deaths in China in 2010. In response, the Chinese government launched its Action Plan for Air Pollution Prevention and Control in 2013, providing a "roadmap at [the] provincial level for efforts to improve air quality over the period 2013-2017," (Rafaj et al. 2018) in three regions: the Beijing-Tianjin-Hebei area, the Yangtze River Delta and the Pearl River Delta (IEA 2017). China expanded the scope of its Action Plan in its subsequent 13th Five-Year Plan for Ecological and Environmental Protection (2016-2020) to over 300 large cities, with the stated objective to limit incidences of poor air quality to "20 percent of the time" by 2020 (Zhan et al. 2017).

A large part of China's effort to improve air quality has focused on moving away from coal and increasing the diversity of its energy mix. Natural gas has been a beneficiary of this policy drive, with its share in the country's energy mix more than doubling, from 3.1% in 2006 to 6.6% in 2017. China aims for gas to account for 10% of its energy mix by 2020 and 15% by 2030. As a result, the use of natural gas has risen in all sectors in China, with power generation and buildings accounting for a large part of the increase. To meet this additional demand, China has augmented its gas import infrastructure by building pipelines and LNG regasification terminals, linking the country with new sources of gas. China built its first LNG import terminal in 2006 and by August 2018 the country had 20 LNG regasification terminals with a total capacity of over 90 billion cubic meters (bcm) per year (IHS Markit 2018). Similarly, pipeline trade began in 2010 with the opening of the Central Asia Gas Pipeline and by 2017 this had grown to three pipelines with a combined capacity of over 70 bcm/year (IEA 2018). The construction of the Power of Siberia pipeline from Russia is expected to add another 38 bcm/year to China's pipeline import capacity by 2020 (Gazprom Export 2018).

Continuing the policy support for natural gas, the National Development and Reform Commission in July 2017 published a paper titled "Opinion of Accelerating and Advancing the Utilization of Natural Gas" (NDRC 2017). This furthered the theme of increasing access to imported gas by encouraging private companies to participate in LNG procurement and in developing LNG regasification terminals. On the demand side, there is a greater emphasis on increasing the use of gas for residential heating in northern China by increasing household connectivity to the gas grid, moving industrial boilers from coal to gas, increasing the use of gas in specific industries such as glass and textiles, and accelerating the development of a gas-based transport fleet. The IEA recognizes this focus on increasing gas use in the energy mix in China and forecasts that gas will be the fastest growing fossil fuel in China with a growth rate of between 4.3% and 4.7% per annum until 2040 (IEA 2018).

Mitigating Delhi's air pollution

The compressed natural gas (CNG) revolution in Delhi lies in regulatory and judicial mandates. A small and voluntary CNG program started in Delhi during the early 1990s when the Hazira-Vijaipur-Jagdishpur Gas Pipeline was extended to Delhi to supply industrial users in the region. In 1998 the Indian Supreme Court, responding to a public interest litigation on air pollution, issued a series of directives invoking the constitutional principle of the 'right to life,' and precautionary principles for public health protection (Roychowdhury 2010). The Environment Pollution (Prevention and Control) Authority, a multi-stakeholder body, was created to advise the Supreme Court on pollution control measures and also monitor the implementation of court orders. The Authority recommended an expansion of the city bus fleet and that the entire public transport fleet in Delhi be converted to CNG or any similarly clean fuel, based on input from the city government among others. Taxis and other intermediate public transport vehicles were also mandated to convert to CNG. This directive, in conjunction with another to expand the CNG supply network in the city, resulted in the entire city's public transport fleet running on CNG by the mid-2000s. Today, Delhi has some 450,000 CNG vehicles and over 400 CNG filling stations (Cornot-Gandolphe 2017).

The improvement in Delhi's air quality has been notable. India's Central Pollution Control Board reported that, after the implementation of the CNG program, Delhi's particulate levels dropped by about 24% from 1996 levels. The think tank Resources for the Future also reported that, as of 2007, the CNG program had made the most significant impact on air quality in Delhi (Narain and Krupnick 2007). The CNG program has been extended to other polluted cities in the country with the Supreme Court directing that "The Union of India will give priority to the transport sector including private vehicles all over India with regard to the allocation of CNG," (Roychowdhury 2010).

Conclusion

Growth in world energy consumption is set to slow considerably, with future global energy demand, led by China, likely to shift from OECD to non-OECD countries. Gas will remain the fastest growing fossil fuel, with its share in the global energy mix set to overtake coal and close the gap with oil by 2040. The rapid growth in global gas consumption can be traced to continued industrialization, rising populations and growing GDP of non-OECD countries. These countries have accounted for over half of global gas consumption since 2006 and will continue to increase their share.

Electricity generation and industry were the main drivers of gas consumption in 2017, followed by buildings. The transport sector is a minor consumer of gas. However, the pattern of growth in gas demand is set to change. With rising competition in the power sector, from coal on the one hand and renewables on the other, the drivers for gas consumption are likely to shift to industry and transport. Here the environmental advantages of gas compared to other fossil fuels and the consequent role of policy support becomes increasingly important. In addition, with gas consumption stated to rise much faster in non-OECD countries and outside the power sector, it is necessary for governments and energy companies to assess and respond to these new growth centers.

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Notes

About the Author

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Kaushik Deb is a research fellow in the Markets and Industrial Development program. He is an applied economist who previously worked in the Economics team at BP, leading the analysis of global natural gas markets and development of long-term perspectives on transitions towards a lower carbon energy system. Kaushik's earlier roles include policy research and advocacy on infrastructure and environmental economics issues at India's IDFC bank. Kaushik has also guided and implemented research in applied economics at India'TERI University, and was the university's MBA program director.

About the Project

The paper is part of the Future of Natural Gas Markets initiative at KAPSARC, and is an outcome of the collaboration between the International Energy Forum (IEF) and KAPSARC aimed at enhancing synergies between the two organizations in accordance with the conclusions of the IEF16 Ministerial International Energy Forum meeting in New Delhi, in April, 2018. The collaboration will help to inform the IEF energy dialogue with IEF member countries and industry stakeholders in the areas of energy security, energy transition and energy transparency by leveraging resources and capabilities of KAPSARC in these areas.

An earlier version of this paper was presented as the IEF-KAPSARC Dialogue Insight Paper to inform the 6th International Energy Forum and the International Gas Union Ministerial Gas Forum Panel Session 2 on Gas Demand Growth beyond Power Generation, held in Barcelona, Spain, in November 2018.

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