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Energy implications of China's transition toward consumption-led growth

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China has been one of the most watched economies over the past several decades. Not only has it been an engine of economic growth, but increases in Chinese energy consumption have also been very important in shaping global energy market trends. This article considers the uncertainty associated with how energy markets might be affected by the speed at which the Chinese economy shifts from investment- and export-led growth toward consumption-led growth, which is supported by a number of the objectives in China's 13th *Five-Year Plan* (FYP). This analysis presents sensitivity cases related to transition paths for the Chinese economy.

The two side cases presented in this analysis assume China's growth in real gross domestic product (GDP) averages 5.7%/year from 2015 to 2040, but the growth paths in these two cases differ by whether or not the Chinese economy transfers from an investment- and export-led growth path to a consumption-led growth path. The average annual growth rate in these cases is also larger than the average 4.5%/year rate in the *International Energy Outlook 2018* (IEO2018) Reference case.¹

The results of the sensitivity analyses indicate that overall Chinese GDP growth is the most important factor in determining the country's level of energy consumption. The No Transition case increases energy consumption relative to the IEO2018 Reference case in 2040 by 25% compared with only a 20% increase in the Fast Transition case. This outcome is the result of lower levels of personal consumption in the No Transition case as compared with the Fast Transition case, which results in more investment and production for a longer period of time in the energy-intensive manufacturing sector rather than in the services sector.

Across all cases considered in this article, China remains, by far, the world's largest producer of energyintensive goods at the end of the projection period, and its economic development has a measurable impact on energy markets in other countries. In particular, more growth occurs in other countries to meet growing purchases from Chinese citizens who have rising incomes.

Background

China experienced double-digit growth in real gross domestic product (GDP) over much of the 1980s through the 2000s, and its energy demand more than tripled during that time. In the past seven years, however, economic growth has slowed into the single digits, and the rate of increase in energy demand has also slowed (Figure 1).

Over the past decade, the industrial composition of China's economy has moved toward the production of more highly-refined manufactured goods and general services. This transition has been supported by elements in China's 13th FYP, which was adopted in March 2016. For example, the 13th FYP sets several goals to improve innovation and boost research and development spending as a share of GDP and to accelerate China's transition to more refined manufacturing processes by focusing on innovation, such as in high-end equipment and biomedicines.² The 13th FYP also aims to raise the service sector's share of GDP to 56% by 2020.

¹ The IEO2018 Reference case referred to in this document updates the IEO2017 Reference case with macroeconomic information, but no modeling changes were made to other end-use sectors.

² Katherine Koleski, "The 13th Five-Year Plan," U.S.-China Economic and Security Review Commission Staff Research Report.

A shift toward the production of more services rather than manufacturing goods often occurs as countries develop economically. In addition, a common strategy to promote economic growth and raise the average standard of living within a country is to encourage the transition of economic activity toward the production of higher value, finished products.

The 13th FYP continues a shift that began with the 11th FYP to transition the Chinese economy away from investment and export-led growth and toward more consumption-led growth.



Figure 1. China total primary energy consumption and real gross domestic product growth rates

Source: U.S. Energy Information Administration, International Energy Statistics database (as of April 2018), World Energy Projection System Plus (2018)

Because service industries are generally less energy-intensive than manufacturing—meaning less energy is consumed per dollar of GDP, and more energy-efficient machinery has been adopted through new investment—energy intensity in China has steadily declined in recent years. This decline occurred even as economic activity and energy consumption continued to increase.

In the IEO2018 Reference case, this general trend is expected to continue in the future (Figure 2). In particular, Chinese energy intensity is projected to decline by almost 60% from 2015 to 2040, similar to the decrease of more than 55% from 1990 to 2015. This drop is larger than the 36% decrease for U.S. energy intensity between 1990 and 2015. In the later part of the projection period, however, the trend decelerates as the energy intensity in China approaches and then falls below the average for countries of the Organization for Economic Cooperation and Development (OECD).

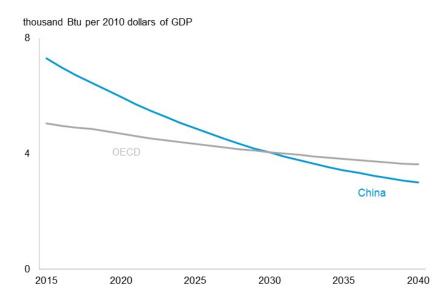


Figure 2. Chinese and OECD energy intensity in the IEO2018 Reference case

Source: U.S. Energy Information Administration, World Energy Projection System Plus (2018)

These recent and projected reductions in China's energy intensity are driven in part by a gradual shift in the economy's structure from manufacturing toward services. Delivering economic services, which are products that cannot be stored and are consumed at the place and time of their purchase, is generally less energy intensive than the production of goods. Manufacturing includes energy-intensive industries such as basic chemicals and iron and steel. Services includes comparatively less energy-intensive industries such as legal and engineering services. Energy intensity also declines because of assumptions about steady efficiency gains in equipment and processes.

Results

To better understand the uncertainty associated with future energy consumption in China, two different high-growth cases are examined. In both cases, China's economy grows 5.7% per year on average through 2040 instead of the IEO2018 Reference case average of 4.5%. These cases are placed in the context of expenditure shares, which are the ratios of the individual expenditure components of GDP (personal consumption expenditures, gross fixed private investment, government expenditures, and net exports) to total GDP.

Figure 3 shows the expenditures on GDP in 2040 for the Reference case and each growth case, as summarized below:

- **Fast Transition case** The expenditure share of consumption rises to 60% by 2040, compared with 50% in the IEO2018 Reference case. In addition, the production structure of the economy shifts to services faster than in the Reference case.
- No Transition case The expenditure share of investment in 2040 is 51%, compared with 32% in the Reference case. The shift in the production structure of the economy to services is slower than in the Reference case.

The rest of this section discusses the projections for the Chinese economy before turning toward the projections for other countries. The next section discusses the way growth in China affects its trading partners.

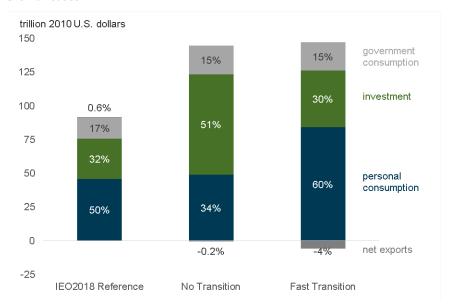


Figure 3. Expenditures on each component of GDP in 2040 for the IEO2018 Reference case and China High Growth cases

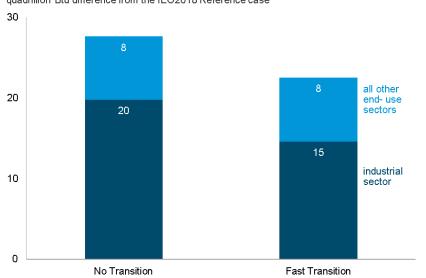
Source: U.S. Energy Information Administration, World Energy Projection System Plus (2018)

China

The IEO2018 Reference case and two growth cases demonstrate how higher economic growth leads to changes in China's energy consumption. Delivered energy demand in the two side cases is between 20% and 25% higher than in the Reference case in 2040 (Figure 4). Although stronger economic growth in the transition cases clearly results in higher energy demand, the pace of economic transition from investment- to consumption-led growth affects Chinese energy consumption over the longer term.

The difference in energy demand between the No Transition and Fast Transition cases is primarily the result of industrial sector demand, which is the largest energy consuming sector in China in the two high economic growth cases and in the IEO2018 Reference case. The industrial sector includes the country's output from the agriculture, construction, mining, and manufacturing industries.

Figure 4. Increase in Chinese energy consumption in the China High Growth cases compared with the IEO2018 Reference case in 2040



quadrillion Btu difference from the IEO2018 Reference case

The change in industrial energy consumption is highest in the No Transition case—where Chinese energy consumption is 20 quadrillion British thermal units (Btu) more than the IEO2018 Reference case level in 2040. Delivered energy use in the buildings and transportation end-use sectors increases because of higher economic growth, but the value of this increase remains the same across the two cases because the buildings and transportation sectors are less sensitive to the way economic growth occurs.

In terms of energy intensity, Figure 5 shows that the Fast Transition case results in an additional 11% reduction in energy intensity in China compared with the IEO2018 Reference case. This drop is about 2.5 percentage points larger than in the No Transition case because less energy is consumed and the level of economic growth is the same. Both cases, however, have lower energy intensities in the long run than the Reference case.

Source: U.S. Energy Information Administration, World Energy Projection System Plus (2018)

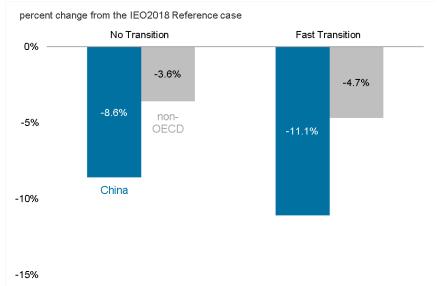


Figure 5. Change in Chinese energy intensity in 2040 for the China High Growth cases relative to the IEO2018 Reference case

Source: U.S. Energy Information Administration, World Energy Projections System Plus (2018)

Figure 6 shows that, although some sectors differ, the manufacturing output shares are relatively similar across all the cases in 2040. Because manufacturing production tends to be more energy intensive than other sectors, the two-percentage point difference between the No Transition and Fast Transition cases drives most of the energy consumption differences seen in Figure 4.

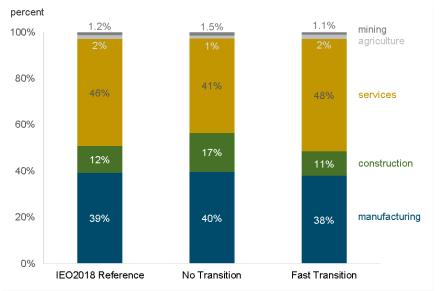


Figure 6. Gross output share of each major sector in 2040 for IEO2018 Reference case and China High Growth cases

Source: U.S. Energy Information Administration, World Energy Projection System Plus (2018)

The fact that such a small difference in the manufacturing share results in a more than 5 quadrillion Btu difference in 2040 in energy use demonstrates the size of the Chinese manufacturing sector and its

concentration of energy-intensive industries.³ Even in the Fast Transition case, where the manufacturing share of output declines relative to the IEO2018 Reference case, China remains, by far, the world's largest producer of energy-intensive goods (Figure 7).

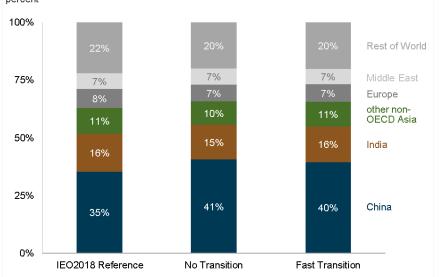


Figure 7. Share of world energy-intensive manufacturing gross output by region in 2040 percent

Other Countries

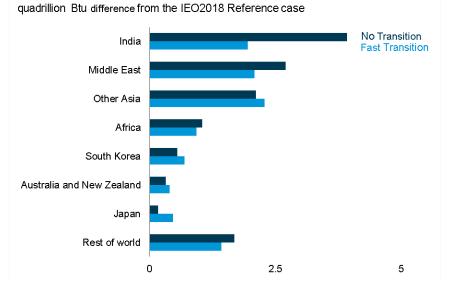
India is the next-largest producer of energy-intensive goods in the IEO2018 Reference case—the country has slightly less than half of China's global share. India's share falls to about one-third of China's global share in the two transition cases, where about 40 cents of every dollar of energy-intensive output in 2040 comes from China.

These energy-intensive goods are also highly tradable and link China to a large global supply chain. As a result of these links, changes in assumptions about China also affect other countries. Figure 8 shows how energy consumption in selected countries changes relative to the IEO2018 Reference case in 2040 because of faster economic growth in China.

Source: U.S. Energy Information Administration, World Energy Projection System Plus (2018)

³ Energy-intensive industries include food, pulp and paper, basic chemicals, refining, iron and steel, nonferrous metals, and nonmetallic minerals.





Source: U.S. Energy Information Administration, World Energy Projection System Plus (2018)

India, the Middle East, other Asian nations outside the OECD, and Africa see increases in energy consumption in 2040 because of faster Chinese economic growth. One reason energy use is higher in these countries is because faster Chinese economic growth allows them to export more—both to China and to each other. This increase in exports leads to increased domestic production of goods and services, which also increases energy use. More production also means higher income, and higher GDP further raises energy consumption in each of these countries.

India and the Middle East show greater increases in energy use under China's No Transition case than in the Fast Transition case because exports from both regions support the production of energy-intensive manufactured Chinese goods and construction, rather than the production of goods for consumption. Under the No Transition case, the Chinese shares of manufacturing and construction output both grow (Figure 6). Other Asia, South Korea, and Japan all have greater increases in energy use under China's Fast Transition case. These regions all supply intermediate goods for Chinese production that are the output of nonenergy-intensive manufacturing industries.

The energy impacts from the two Chinese high economic growth cases are magnified by trading links with the rest of the world. China's economic growth is central to global trade, and the energy effects of the cases in China have an impact on the rest of the world. China's role in the global trading system reinforces the importance of accurate projections of Chinese economic growth because of its direct and indirect impacts on global projected energy consumption.