McKinsey Global Institute

Curbing Global Energy Demand Growth: The Energy Productivity Opportunity

Executive summary

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McKinsey&Company

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In an era of high oil and gas prices, concerns about CO_2, and uncertainty about the security of supply, energy policy has come to dominate political discourse around the world. To date, the energy debate has centered largely on how to secure future energy supply and how to finance research into alternative sources of fuel. While these are important, no energy policy can be complete without a comprehensive understanding of the size of the demand abatement opportunities—and how these can be captured in an economically sound way. After all, what's the point of increasing supplies that are destined to be wasted?

The good news is that there is a very large opportunity to contain energy demand growth in economically attractive ways—and, in the process, cut CO_2 emissions. Research by the McKinsey Global Institute (MGI) and McKinsey's Global Energy and Materials Practice finds that a concerted global effort to boost energy productivity—or the level of output we achieve from the energy we consume—would have spectacular results. By capturing the potential available from existing technologies with an internal rate of return (IRR) of 10 percent or more, we could cut global energy demand growth by half or more over the next 15 years.

Our yearlong research project examined energy demand in major regions and sectors, how company and consumer behavior affect demand, and the impact of existing energy policies. We then built a model of global energy demand and productivity evolution to 2020. With current policies, we find that energy demand growth will accelerate significantly across all scenarios. In our base case, energy demand will grow 2.2 percent annually to 2020—significantly faster than the 1.7 percent growth rate observed since 1986. However, our research also shows that enough opportunities are available to boost energy productivity by 135

quadrillion BTUs (QBTUs)—the equivalent of 64 million barrels of oil per day, or almost 150 percent of the entire US energy consumption today. Capturing these opportunities would reduce energy demand growth to less than 1 percent annually—without compromising economic growth.

While market forces alone will not lead to this outcome, targeted policies can overcome the policy distortions and market imperfections that are currently acting as barriers to capturing higher levels of energy productivity.

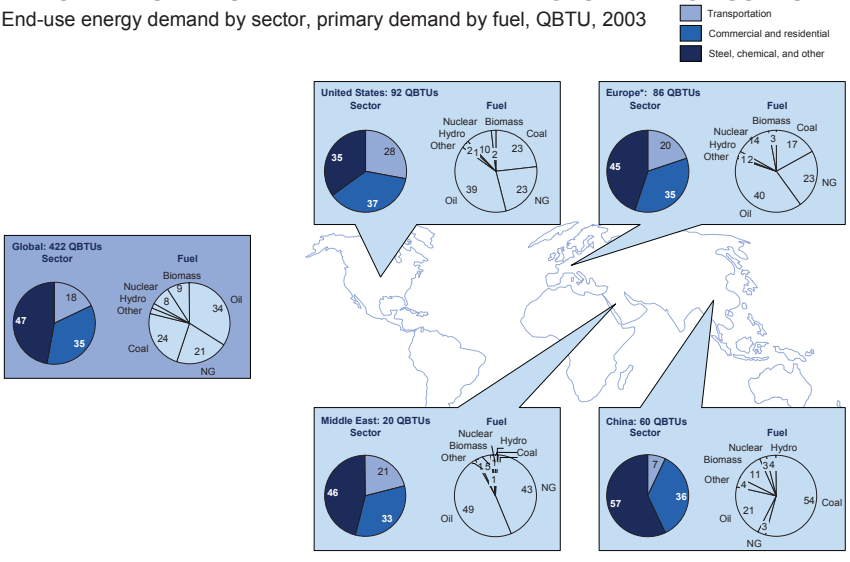
GLOBAL ENERGY DEMAND GROWTH WILL ACCELERATE

In 2003, global energy consumption reached 422 QBTUs of energy—the equivalent of 200 million barrels of oil per day. The United States and China were the two biggest consumers, with four of the largest end-use sectors worldwide (Exhibit 1). Consumers are increasingly the driving force of energy consumption as the world economy has shifted away from industry and toward less energy-intensive service industries. Sectors that have the characteristics of consumer goods—such as residential and commercial buildings and road transportation—will drive 57 percent of energy demand growth to 2020.

Exhibit 1

THE UNITED STATES AND CHINA ARE THE LARGEST ENERGY USERS

End-use energy demand by sector, primary demand by fuel, QBTU, 2003



* Includes Northwestern Europe, Mediterranean, North Africa, Baltic and Eastern Europe.

Source: IEA; MGI analysis

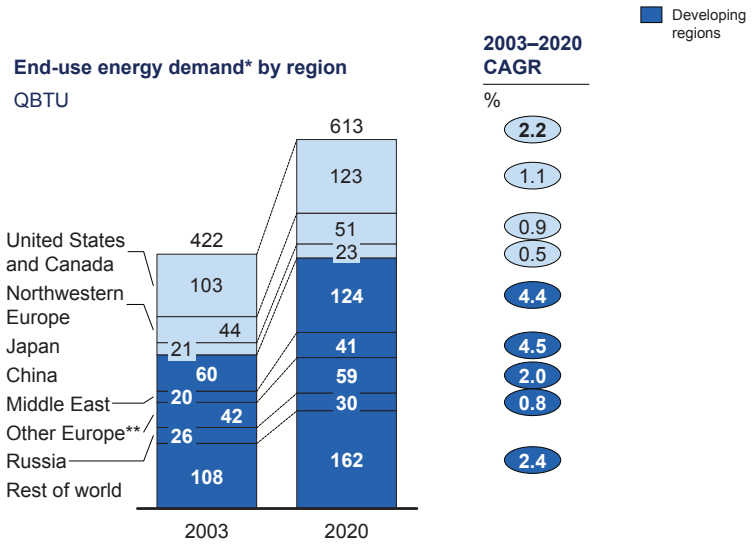
The world has also learned how to get more from the energy we consume. Energy productivity grew by 1.3 percent a year between 1980 and 2003. Going forward, we calculate that it will continue to grow by some 1 percent a year to 2020,

leaving it 18 percent higher than it is today. Shifts toward less energy-intensive activities will account for just over half of this growth; rising energy efficiency for the rest.

Yet this "business-as-usual" increase in energy productivity is not enough to stop energy demand growth from accelerating. We see demand growth averaging 2.2 percent a year to 2020 in our base-case scenario, with faster growth across all scenarios than that observed since 1986 (Exhibit 2).[1] Rapidly growing developing countries will account for an overwhelming 85 percent of energy demand growth to 2020. China alone represents one-third of the total growth, due to high demand for cars and appliances from its burgeoning middle class and the sustained strength of industrial energy demand. Another fast-growing region is the Middle East, where oil revenues are boosting GDP growth and energy subsidies encourage energy-intensive development.

Exhibit 2

ENERGY DEMAND GROWTH ACCELERATES TO 2.2 PERCENT A YEAR TO 2020



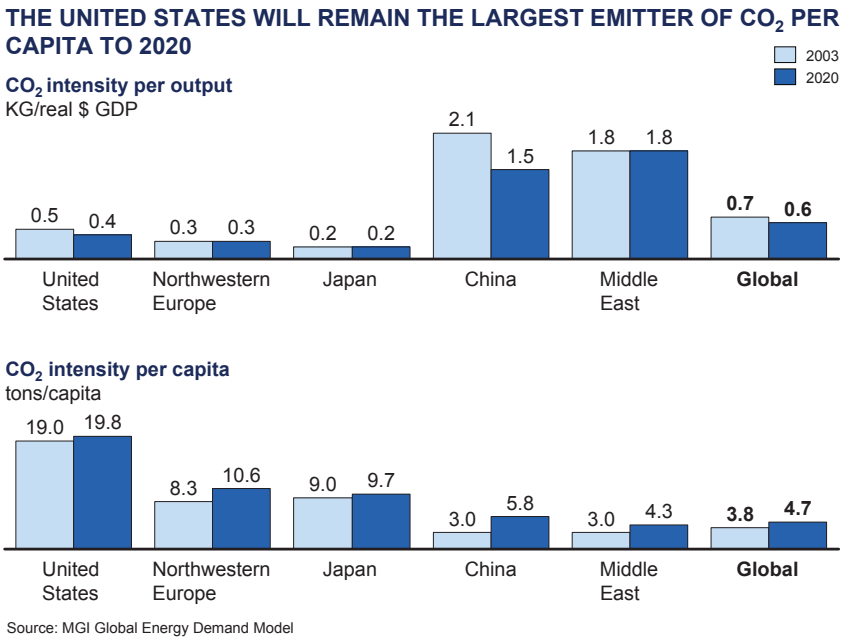
* Transformation losses (power generation. refining) allocated to end-use segments.
** Includes Baltic/Eastern and Mediterranean Europe and North Africa.
Source: MGI Global Energy Demand Model

By 2010, China will have overtaken the United States and Europe as the world's leading CO_2 emitter. However, the United States will remain the world's largest emitter on a per-capita basis in 2020, and the Middle East the most energy-intensive (Exhibit 3). Global CO_2 emissions will grow by 2.4 percent annually

1 Our base case assumes a 3.2 percent annual global GDP growth rate and a $50 per barrel oil price. With alternative GDP growth and oil-price assumptions, our global energy demand growth projections to 2020 range from 1.7 to 2.8 percent annually.

to 2020—more quickly than global energy demand—because of a shift to a more CO_2-intensive fuel mix, notably, fast-growing coal-intensive power demand in developing economies.

Exhibit 3



Source: MGI Global Energy Demand Model

IMPROVING ENERGY PRODUCTIVITY COULD CUT ENERGY DEMAND GROWTH BY AT LEAST HALF

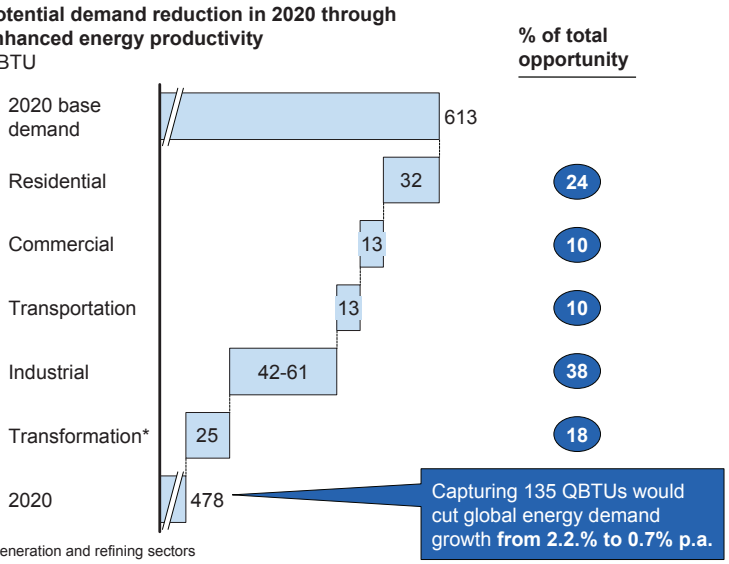
There is a great opportunity to reduce worldwide energy demand growth to less than 1 percent annually—simply by using energy more productively. We identify a potential to reduce demand of between 125 and 145 QBTUs, the equivalent of 20 to 24 percent of projected end-use demand in 2020 (Exhibit 4). Rather than being expensive, these investments to boost energy productivity use existing technologies with an IRR of 10 percent or more. They thus free up resources to increase consumption or investment elsewhere. Capturing this opportunity would contribute up to a half of the greenhouse gas (GHG) emission abatement required to cap the long-term concentration of GHG in the atmosphere at 450 to 550 parts per million (a range that experts suggest is required to prevent the global mean temperature from increasing more than 2° Centigrade).

The most substantial productivity improvement opportunity is in the global residential sector, which is also the world's largest consumer of energy with 25 percent of global end-use demand. By implementing available technologies such as high-insulation building shells, compact fluorescent lighting, and high-

efficiency water heating, the sector's energy demand growth would more than halve, from 2.4 percent a year to only 1.0 percent a year. This alone would reduce the sector's 2020 energy demand by 32 QBTUs—or 5 percent of global end-use energy demand in 2020.

Exhibit 4

LARGE OPPORTUNITIES FOR IMPROVING ENERGY PRODUCTIVITY ARE AVAILABLE ACROSS SECTORS…



* Power generation and refining sectors
Source: MGI analysis

Electricity generation and distribution is another area with significant potential. Investing in the most efficient technologies could increase conversion rates to up to 55 percent. Implementing only those investments with an IRR of 10 percent or more would reduce this sector's demand growth from 2.3 percent to 1.7 percent. This would reduce global energy demand in 2020 by 21 QBTUs, the equivalent of 3 percent of the total.

Developing regions can contribute more to improving energy productivity, largely because they tend to start from a much lower base, grow more rapidly than developed economies—and thus can adopt the latest technologies for new capital at a lower cost (Exhibit 5). We estimate China's overall energy productivity opportunity to be 28 QBTUs in 2020, or close to 5 percent of global energy demand. The choices it makes will therefore be crucial.

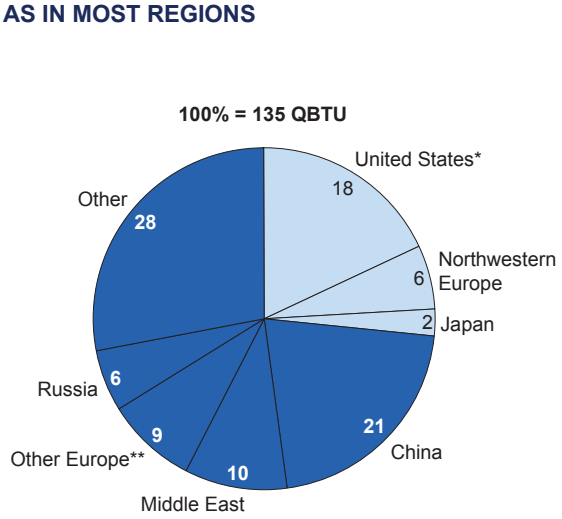
TARGETED POLICIES CAN OVERCOME MARKET IMPERFECTIONS

Market forces alone will not capture the substantial potential for higher energy productivity and lower energy demand growth. Our research shows that even a

sustained oil price of $70 a barrel would not have a significant impact on energy demand. This is because most energy prices that consumers pay don't reflect global oil prices and because higher oil revenues tend to boost energy-intensive consumption in oil-exporting countries, which counteracts the decline in oil-importing regions in some end-use segments like road transportation.

Exhibit 5

... AS WELL AS IN MOST REGIONS



* Includes Canada (2.4 QBTU opportunity)
** Includes Baltic / Eastern and Mediterranean Europe and North Africa
Source: MGI analysis

Global energy markets are rife with market inefficiencies and distortions that explain why consumers and companies fail to capture the savings from higher energy productivity. Consumers lack the information and capital they need to become more energy productive, and tend to make comfort, safety, and convenience priorities. The small and fragmented nature of energy costs tends to deter businesses from seeking higher energy productivity. In addition, a range of policies dampen price signals and reduce incentives for end users to adopt energy productivity improvements. These include, for instance, fuel subsidies in many oil-exporting countries; lack of metering in residential gas usage in Russia and elsewhere; and widespread energy subsidies to state-owned enterprises.

Targeted policies to remove distortions and overcome market imperfections can help capture the opportunities that are available to improve energy productivity—and reduce energy demand growth. We highlight the impact of some of the policy options below:

- Ending fuel subsidies would cut demand for transportation fuels by 3 million barrels a day. In the Middle East, for instance, average fuel consumption per vehicle is more than double the average that prevails in countries without fuel subsidies. Iran spends some 16 percent of GDP on energy subsidies. Removing the region's subsidies would cut its demand for road-transportation fuel by almost half.

- Tightening fuel-economy standards would accelerate the introduction of fuel-saving technologies. Europe and Japan already plan a progressive increase in standards. If the United States were to match these efforts, global fuel economy would increase by four miles per gallon by 2020, equivalent to cutting demand for petroleum products by 4 million barrels per day.

- In the residential sector, standby power consumption ranges from 20 to 60 watts, equivalent to 4 percent to 10 percent of total residential energy consumption. Yet the technology is available to reduce standby power to 1 watt and a global standard could mandate this reduction. Governments could mandate compact fluorescent lighting as is the case in Australia. If CFL reached 30 percent penetration, this alone would capture up to 3 percent of the sector's potential for higher energy productivity.

- China has recently introduced specific policies for commercial buildings, including building codes, office equipment standards, and labeling. However, the government could further enforce implementation—through audits targeting largest builders, for example—to increase the impact of the policy, given that estimated compliance for new construction is less than 5 percent.

- Innovative power companies and energy intermediaries such as energy service companies in the United States can help consumers make more-informed energy choices and profit from the positive-return energy savings not fully captured today. To enable this, utilities can implement technologies that allow consumers to see the actual cost of their appliance choice, say, in a more disaggregated utility bill.

- Industrial companies sometimes apply IRR hurdle rates of 20 percent or more to energy-saving investments. Governments can encourage higher energy productivity through demonstration projects and energy audits, as well as consider subsidies or tax credits to companies implementing certain energy-conservation technologies. They might also opt to finance energy-conservation projects at low rates.

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The challenges of climate change and the security of energy supply often appear so huge as to be insurmountable. However, we already have in our hands the potential to abate accelerating energy demand in a practical, economically attractive way.

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