

## THREE GAME CHANGERS FOR ENERGY

New sources, mobility, and industry fragmentation are set to disrupt the system.

*by Nikhil Patel, Thomas Seitz, and Kassia Yanosek*

Change is afoot in the energy system. Soaring demand in emerging markets, new energy sources, and the likely growth of electric vehicles (EVs) are just some of the elements disrupting the status quo. It is hard to discern how the aftershocks will affect the extraordinarily complex network of sectors and stakeholders. New research by McKinsey and the World Economic Forum has identified the game changers for companies and policy makers, as well as their implications.

### **A proliferation of new energy sources**

An array of energy technologies seems poised for a breakthrough. Within two decades, as many as 20 new energy sources could be powering the global economy, including fuel cells; small, modular nuclear-fission reactors; and even nuclear fusion. Fossil fuels will still be part of the mix, but renewables' share is likely to grow owing to environmental concerns, further cost reductions that make renewable energy more competitive, and demand for electricity. Electricity demand is expected nearly to double by the middle of the century,

propelled primarily by economic development in China and India (Exhibit 1). By 2050, electric power, which can be generated by low-carbon energy sources such as wind and solar, could account for a quarter of global energy demand.

An economy based on so many technologies is unprecedented. The Industrial Revolution relied on steam engines powered by wood, water, or coal. In the 20th century, oil and gas were added to the mix, then nuclear fission. The abundant choice on the horizon raises new dilemmas. For example, where should governments focus investment and research efforts? Most are minded to keep their options open for the time being in order to satisfy demand, as well as for cost and environmental considerations. Over time, though, they might have to choose. Uncertainty about how funding will be shared between new technologies could slow their development. And if technologies are in contention, governments might struggle to secure reliable energy supplies. Securing those supplies, however, will no longer necessarily depend on access to oil, gas, and coal reserves—access that has long

colored geopolitics. In tomorrow’s world, access to the technologies that harness resources such as wind, sun, water, or heat from the earth’s core is likely to matter most.

## Mobility

The way we move around our ever-spreading cities is set to be transformed by technology and the drive to reduce pollution, congestion, and carbon emissions. Center stage is the electric vehicle. EVs still have high upfront costs compared to conventional vehicles, but thanks in part to the falling price of batteries, they may be competitive by the mid-2020s. By the mid-2030s, our

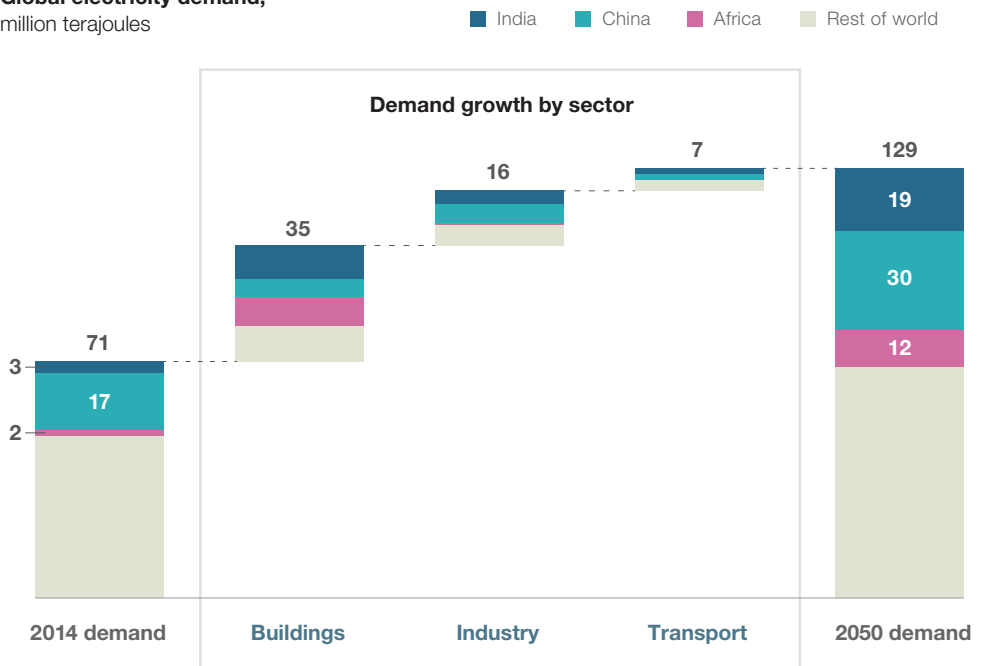
research shows they could account for between 27 and 37 percent of new-vehicle sales, depending on the extent to which regulation, technology, ride sharing, and self-driving vehicles further reduce costs and boost EV popularity.

These factors present a range of potential consequences. For example, global demand for liquid fuel used in light vehicles could fall by between two million and six million barrels a day (a drop of between 8 and 25 percent), helping to make the chemical industry, not transportation, the source of demand growth for these fuels (Exhibit 2). Oil companies might need to rethink their strategies as a result, perhaps acquiring

Exhibit 1

### Global demand for electricity will nearly double by 2050, propelled by growth in China and India.

Global electricity demand,<sup>1</sup>  
million terajoules



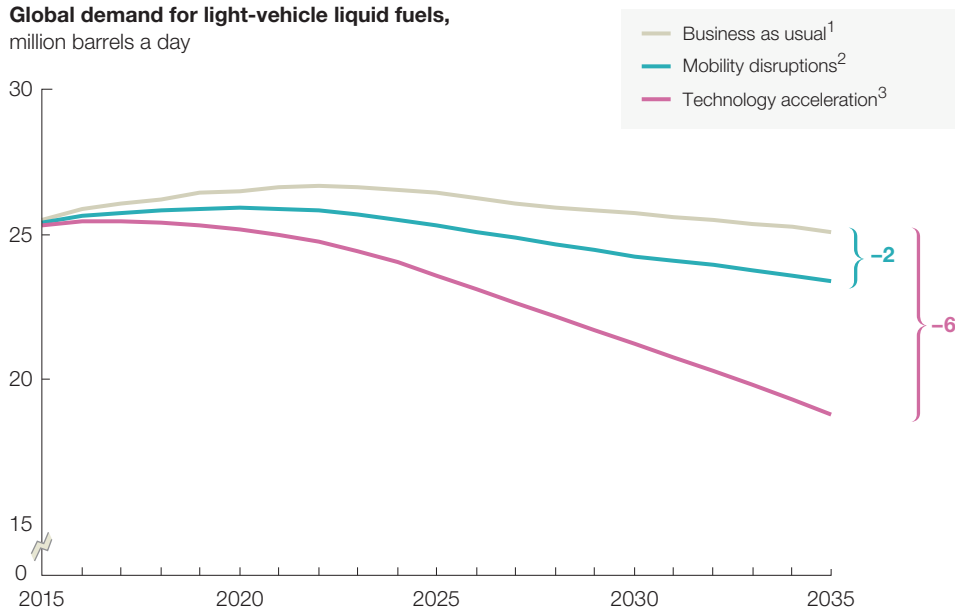
<sup>1</sup> Figures are rounded; 2050 data are projected.

Source: “Global Energy Perspective 2016,” Energy Insights by McKinsey

## Exhibit 2

### Demand for liquid fuels will fall as more electric vehicles take to the road.

**Global demand for light-vehicle liquid fuels,**  
million barrels a day



<sup>1</sup> Assumes current regulatory and technology developments result in electric vehicles representing 27% of new-vehicle sales in 2035.

<sup>2</sup> Includes impact of shared and autonomous vehicles.

<sup>3</sup> Assumes 37% of new-vehicle sales are for electric vehicles as a result of an acceleration in technological developments and more ride sharing and autonomous vehicles.

Source: "Global Energy Perspective 2016," Energy Insights by McKinsey

more acreage to support production of naphtha or natural-gas liquids—key feedstocks for chemical plants. If mobility patterns change rapidly, city planners could find themselves in a matter of years with expensive parking lots that stand empty. And if the cost of moving around cities in self-driving, shared vehicles falls to the point where it matches the cost of using public-transport systems, passenger numbers and revenues for these systems could fall, potentially making them harder to maintain.

### Fragmentation

For the past half century, large players have dominated energy markets.

Today, technology is spawning many smaller operators at the same time as new sources of capital emerge. Public markets and governments were once the only investors in the energy sector. But with many governments now cash-strapped, pension funds and private-equity firms are taking up the slack. In the past five years, private-equity firms invested more than \$200 billion in the sector, matching new ideas and business models with capital hungry for returns. This fragmentation is diminishing the power of scale to shape markets.

A large number of shale gas and oil producers in North America, for example, make uncoordinated decisions about


supply, challenging the ability of the Organization of Petroleum Exporting Countries to influence prices. Large utilities have to factor into their strategies the growing number of cities, businesses, and households that generate their own energy from renewables, often selling surplus back to the grid. And governments could find it harder to implement effective regulation. Rules around drilling, water disposal, and public health and safety are already being tested in North America because of the speed at which the number of oil and gas producers has grown. And distributed power generation has sparked regulatory questions about how to charge grid users equitably. Assuming it is wealthier consumers who can afford to install solar panels, the cost of maintaining the grid falls to a smaller number of less affluent households.

As scale in some areas diminishes in importance, agility takes precedence. With so many players interacting in so many different ways in so many different locations, it is harder than ever to predict the future. Billion-dollar investments in assets that must be productive for three decades or more become far too risky. Instead, companies will need to make smaller initial investments and be able to adjust their strategies rapidly as circumstances change or local conditions dictate. Local differentiation carries increasing competitive weight. In oil and gas, service providers increasingly tailor their offerings not at the country or even regional level, but basin by basin; power companies may need to consider different strategies for different cities

depending on the choice of feedstock and the numbers of residents and businesses producing their own energy.

Ironically, fragmentation is likely to encourage more partnerships. While these are already commonplace in oil and gas, where companies split the cost and risk of large capital projects, one might assume that smaller assets with lower costs and risk would have less need of them. Yet with a rising number of participants in an energy system where local differentiation counts, the reverse could be true.

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The speed and scale of change in the energy system will depend on the pace of technological advancement—in establishing cheaper, more efficient power storage, for example—and on government policies and regulation. Unless system participants start to plan now, they could find themselves left adrift. 

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