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Prospects and Priorities

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Commercially traded energy is what classical economists used to call a "basic good": directly or indirectly, it enters the production of every other produced commodity or service. Nonrenewable fossil-fuel energy and nuclear energy are produced by first converting and then burning natural resources. Because these resources are finite and unevenly distributed, they seem to become increasingly hard to come by when global economic activity expands. The need to maintain regular access to them is the simple logic behind the concept of energy security. Recently, these traditional concerns have been exacerbated by another threat: the fear that the atmosphere's capacity to absorb carbon emissions caused by humans may be exhausted long before humans' capacity to find hydrocarbons in the earth's crust and burn them for energy is.

In many places, the main means of addressing these concerns has been to rely on markets, which make it easier to diversify supply and demand, substitute fuels, and make the most of the gains in efficiency brought on by technological change. More recently, the idea of putting a price on carbon has extended this approach to protecting the environment.

But now global energy consumers are losing trust in these pricing mechanisms. In the five years prior to the summer of 2008, oil prices

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rose by 370 percent, traded coal by 460 percent, and natural gas by 120 percent. The prices of other raw materials, metals, and even food increased in lockstep. The only other time since World War II that prices rose that much was in the early 1970s. Back then, as recently, prices were driven by a surge in global economic growth.

Yet the composition of growth differed markedly in these two instances. In the 1960s and early 1970s, economic growth—and with it growth in energy consumption—was driven by mature high-income economies; in the early years of this century, emerging-market economies got into the driver's seat. Measured at market exchange rates, the contribution to global growth of the economies outside the Organization for Economic Cooperation and Development grew from about 20 percent in the early 1990s to 50 percent today. And the rising influence of the developing world is disproportionate in energy markets: the non-OECD countries' share of the growth in global energy consumption rose faster than their share of global economic growth over the same time period; it accelerated to more than 90 percent. One reason is that developing countries are less efficient in their use of energy. Energy intensity, the energy needed to produce one unit of GDP, in the developing world is three times as great as it is in the developed world. Using other exchange-rate definitions lessens these differences, but the basic conclusion remains the same. Something will have to give over the next few decades: either energy efficiency will have to increase or growth in the emerging-market economies will slow down.

No one wants growth to slow, but how can efficiency increase, especially in light of the economic crisis of 2007–9? On the back of tremendous volatility in the energy markets, the global recession caused demand to fall, spare capacity to rise, and prices to drop for all major fuels. But in the process, the crisis has also usefully highlighted both the structural forces that are straining energy markets and these markets' relative strengths and weaknesses.

GROWING PAINS

THE SHIFT of energy demand to developing countries is a major change. At market exchange rates, the average per capita income in non-OECD economies is $2,300, compared with $32,000 in the OECD

countries. What is more, it takes (again, at market exchange rates) 3.4 barrels of oil equivalent to produce $1,000 worth of GDP in the non-OECD countries, versus 1.1 barrels of oil equivalent in the OECD countries. Developing countries are energy intensive partly because of various inefficiencies, particularly the widespread subsidization of energy. But the main explanation lies in the nature of economic growth. Comparing growth in developing and mature economies is like comparing apples and oranges: In mature economies, growth only gradually reshapes the sectoral composition of GDP and employment, and its principal effect is to expand the service sector. But in emerging-market economies over the last few years, growth has caused unprecedented structural transformation. Hundreds of millions of people have left low-energy-intensive activities, such as agriculture, for energy-intensive activities, such as construction and industry. And it is this process of industrialization that increases an economy's energy intensity.

One way to measure this increase is to look at power-generation growth. Since the late 1990s, growth in power generation has been accelerating in the non-OECD countries and decelerating in the OECD countries. Another pattern has emerged: power-generation growth in the non-OECD countries overall exceeds GDP growth, and this is not the case in the OECD countries. The need for power is one reason why coal has become the fuel of choice worldwide, especially in non-OECD countries: it is more widely available than oil and gas and is abundant and relatively cheap. Coal has been the fastest-growing major fuel on average over the last decade and every year since 2003.

With industrialization comes urbanization, too, and with urbanization, lifestyle changes. Mobility and thus transportation have increased in the developing world, leading to growth in the consumption of oil. These developments have also shifted demand growth to outside the OECD countries: in fact, the entire net increase in global oil consumption since 1999 has come from outside the OECD countries.

The environmental impact of these changes has been predictable: global carbon emissions from fossil-fuel consumption are growing. After a period of relatively moderate growth, carbon emissions accelerated noticeably after the turn of the century, driven by growing energy demand in the developing world. More important, the carbon intensity

of energy itself has increased. From 1970 until the late 1990s, global emissions per unit of energy consumed fell steadily. But then, in 1999, reflecting the increasing share of coal in the energy portfolios of the non-OECD countries, carbon emissions per unit of energy began to rise. Since the turn of the century, they have increased by about two percent globally and by almost three percent in the developing world. Not only is more carbon being emitted throughout the world as economies grow and consume more energy, but the energy consumed itself is dirtier.

OPAQUE OPEC

When the global economic crisis fully hit, in the summer of 2008, the impact on energy markets was immediate and severe. The sudden economic contraction in the second half of 2008 triggered a strong adjustment in energy prices and consumption. Prices, which had risen significantly in the first half of 2008, reached record heights in July and then dropped, some precipitously. By the end of the year, the price of oil had declined by 75 percent, the price of traded coal by 62 percent, and the price of natural gas sold in the United States by 58 percent. This was the first time global oil consumption had fallen since 1993.

Annual production began to exceed annual consumption for all fossil fuels. Inventories rose. Spare capacity emerged. Power generation experienced its lowest growth since 1992; in the OECD countries, it fell. The world economy contracted even faster in early 2009, and the decline in energy demand followed suit. Oil consumption started to fall not only in the OECD economies but also, briefly, in the non-OECD economies, causing the drop in global oil consumption to accelerate.

But the fortunes of the different global energy markets started to diverge markedly. As the world economy shrank further in early 2009, coal and gas prices continued to fall. But despite the worst deterioration in demand in a generation, oil prices stabilized and then staged an impressive recovery. They more than doubled, from a low of $34 per barrel in December 2008 to $71 in June 2009. They stayed around this level and then rose to above $75 per barrel in the fall, even though inventories stayed at record highs. But by the end of 2009, global demand was showing signs of recovery again.

This was a rather extraordinary development under the circumstances, and it is impossible to understand the behavior of oil prices during this period without looking at the role of OPEC. In 2008, the average annual crude price had increased for the seventh consecutive year—an unprecedented occurrence. The foundations of the rally had been laid in the fall of 2006, when crude prices started to retreat from $80 per barrel, then the record high. To stop the decline, OPEC stepped in and cut production twice, in late 2006 and early 2007, by almost one million barrels per day. Crude oil prices rallied—from $50 a barrel in January 2007 to $147 in July 2008, their highest level ever, in both real and nominal terms.

How could a production cut of one million barrels per day in a market of 81 million barrels per day set off such a chain reaction? Like any complex system, the global oil market needs a degree of redundancy to operate smoothly. In the short term, inventories can provide this safety cushion; in the longer term, it is provided by spare production capacity. Following strong demand growth in 2003 and 2004, spare capacity in the global oil market was hovering around record lows, at little more than two percent of global production (that is, less than two million barrels per day, almost all of it in Saudi Arabia). In other words, even after the OPEC cuts of 2006 and 2007, the global oil market was running at above 97 percent of capacity—an exceptionally high rate and one much too high to guarantee any meaningful stability in prices.

When set against the backdrop of high global economic growth, this fundamental market tightness meant that as soon as the production cuts had translated into tighter inventories, prices accelerated their journey upward. As crude prices sailed through $120 per barrel in the early summer of 2008, Saudi Arabia took the extraordinary step of announcing a unilateral increase in production—twice. This decision reflected the recognition that the U.S. economy was hurting from the adverse impact of high prices on both consumer spending and the U.S. balance of payments: it was a rational attempt to protect the goose that lays the golden egg. But crude prices jumped on the heels of each of these announcements anyway: no one seemed to believe that the Saudi national oil company would, or could, follow through.

In the event, Saudi Arabia, along with other Persian Gulf producers, increased production as early as December 2007 and did again in June and August of 2008. But their timing was exquisitely cruel. Just as the increased production found its way to inventories, in the summer of 2008, the global credit crisis broke. Global oil demand, especially in the United States and other OECD countries, fell off a cliff. Caught between rising production and falling consumption, prices fell from $147 per barrel in the summer to $34 by late December.

OPEC reacted swiftly. Racing to catch up with falling demand, it announced production cuts totaling 4.2 million barrels a day. Although implementation was solid, it lagged behind events and could not prevent prices from temporarily taking a nosedive. It took until the first quarter of 2009 for OPEC's cuts to match the decline in demand. Still, from OPEC's point of view, its supply management was a success. Oil prices stabilized soon after the Christmas holidays of 2008, on the expectation that the cartel members would follow cartel discipline, and then started to rise—even as the prices for other primary fuels and commodities continued to fall.

At the same time that OPEC was adopting these measures, Saudi Arabia was issuing statements calling $75 per barrel of crude a "fair price"—a price that would, in the words of the Saudi oil minister, keep "everyone happy," producers and consumers alike. The British and French governments were arguing for an unspecified price band to curb volatility; the Russian government announced its own fair price ($70–$80). There is, of course, no such thing as a fair price. But the debate about the issue matters nonetheless. The U.S. economy's recovery is necessary for the recovery of the global economy. And although economists are uncertain about how to quantify the impact of current oil prices on the global economic recovery, there is very strong evidence that high oil prices hurt the United States more than other countries. Low taxes on oil products in the United States mean that U.S. consumers are more directly affected by price fluctuations, and comparatively very low U.S. exports to oil-producing regions mean that the impact of oil price fluctuations on the U.S. balance of payments is greater than the impact on the balance of payments of other oil-consuming regions.

If prices are held above market levels, they will be detrimental to economic recovery, and in the United States more so than elsewhere.

And so the question is, can OPEC keep them above market rates? Basic economics would suggest that successful cartels sow the seeds of their own destruction: supply cuts lead to above-market prices and generate spare capacity, a combination that generally gives cartel members a reason to stop complying with the quotas. OPEC has cut supplies during a recession on two occasions—in 1998 and 2001—and both times, cartel discipline held for 24 months. OPEC's spare capacity increased from around two million barrels per day in the summer of 2008 to six million by the end of 2009. This overhang increases the risk of noncompliance, especially since one-third of it is outside Saudi Arabia. On the other hand, the rising oil prices in 2002–8 left important cartel members in a strong financial position. Even if high economic growth were to return tomorrow, it would still take three years to burn through the six million barrels a day of spare capacity and to wind up markets as tight as they were last year. Prices are thus unlikely to spike over the next two to three years. In other words, the forecast for the immediate future (through 2010) is more of the same.

Not only is more carbon being emitted as the economies of the developing countries grow, but the energy consumed is dirtier.

This is assuming, of course, that the deeper structural changes that are occurring in the oil market comply. Three factors are especially worth keeping in mind. The first is the fact that OPEC retains inordinate power over the oil market even though it directly controls only about 40 percent of global crude output. The quick explanation for this is lack of supply growth outside OPEC. Until the mid-1990s, non-OPEC supply growth reliably increased by about one million barrels per year (if one puts aside the momentary collapse in Russian production in the early years of the country's economic liberalization). But it has now almost come to a standstill. The rising price of oil in 2002–8 did not boost production outside OPEC. One reason is that large fields in the North Sea and Alaska are declining. Another reason, more important than geology, is politics. After this long period of high prices, barriers to private-sector investment sprang up even in regions that had previously been open. That left OPEC in de facto control of investment as much as production and helps explain the surprising amount of control the cartel maintains over the market.

The second important structural change in the oil market is the shift in oil demand growth from the mature economies to the developing world. In late 2005, long before anyone was worried about an economic crisis, demand from the OECD countries started to fall in response to high prices. It continued to drop in 2006 and dropped even more in 2007, two years when economic growth was strong. And then the global economy contracted. Since 2007, oil consumption in the OECD countries has shrunk by eight percent. Demand from the OECD countries has peaked. Non-OECD consumption is now the only source of growth in global demand.

The third major shift in the oil market is related, and it pertains to energy efficiency. When it comes to oil, to say that the entire increase in global oil consumption has come from outside the OECD countries so far this century is also to say that almost all of it has come from countries that subsidize oil products. Estimates of future shifts in demand will therefore have to determine how subsidies are likely to affect demand outside the OECD countries, for example, in China or the Middle East.

In energy markets more broadly, subsidies in industrializing countries have kept demand, and hence prices, up. This is not only a costly fiscal problem; it can also create long-term distortions in the capital stock and the vehicle fleet. If, on the other hand, industrializing economies bear no such burdens, energy efficiency can become a comparative advantage. The governments of several non-OECD economies, not least that of China, are starting to realize this, and such competitive pressures are likely to force more non-OECD economies to eliminate subsidies down the road. The oil market is a good example of a more general economic principle: when the prices of end products increase (because subsidies are eliminated), energy efficiency improves and growth in global oil demand softens. In fact, the relationship between higher end-user prices and energy efficiency is one of the most reliable relationships in long-term data on energy.

FUELS' FUTURES

OIL PRODUCTION is concentrated geographically, and the market for oil is dominated by geopolitical considerations. Not so for coal.

Aside from the fact that global coal consumption is led by China—which in 2008 accounted for 43 percent of global coal consumption and 85 percent of global coal consumption growth—the market for coal is much less concentrated than that for oil. Coal trades internationally in a smaller but highly competitive market, the size and sophistication of which is increasing quietly while its efficiency remains underestimated. During 2008, the price of coal rose until the summer and then collapsed. It fell longer and further than that of oil because no coal cartel was there to stabilize it. The market had also become very competitive: in response to a rise in transport costs, Europe, for example, substituted imports from the Indian Ocean basin with imports from the United States.

Coal also matters thanks to the fact that it can substitute for natural gas in power production. In the European Union, relatively low gas prices and the existence of a carbon price meant that it was more expensive to generate electricity from coal than from gas in early 2008. As a result, electricity production from gas rose by eight percent, and electricity production from coal fell by nine percent.

The ability of natural gas to serve as a substitute for coal is important for its future. During the economic crisis, natural gas prices followed the same pattern as that of other fuel prices: the economic downturn caused global gas production (which was at a record level then) to exceed gas consumption, depressing prices from the summer of 2008 well into 2009. Natural gas markets, both for piped gas and for liquefied natural gas (LNG), also got hit by the same double whammy that affected other fuels: an increase in production that happened to coincide with a decline in demand.

That increase in gas production was partly the result of fundamental technological advancements in U.S. gas production. In response to tight supplies and rising prices, technological advances, such as horizontal drilling (which eases access to layers of oil or gas) and hydraulic fracturing (which uses water pressure to release gas from hard rocks), were employed to make unconventional gas resources, such as tight gas, shale gas, and coal-bed methane, accessible on a large scale. As a result, production from unconventional gas deposits in the United States has almost doubled over the past decade, and the share of these deposits in total U.S. gas production has reached about 50 percent.

Unconventional resources are becoming conventional. And as production has risen, prices have declined. The recession has only exacerbated this effect: falling demand has further brought down prices. Domestic production has had to be scaled back. Imports into the United States, of piped gas and LNG alike, have decreased as well.

For consumers, there is an additional positive effect of comparatively low gas prices: gas can compete with coal as an input fuel for power generation again. In the few years before the economic crisis, gas prices had been rising with the price of oil, chasing parity with residual fuel oil, another substitute in power generation. The last time natural gas prices were close to coal prices for a prolonged period was back in the 1990s, when the advent of the technology for combined cycle gas turbines increased the capacity of gas-fired power generation. But that did not last: as gas consumption grew and supplies tightened, gas prices rose, eroding the competitiveness of gas over coal. Thanks to its regained price advantage, coal continued to dominate power generation until very recently.

Now that gas prices are once more competitive relative to those of coal, U.S. power generation is changing again. And thanks to the first "dash for gas," in the 1990s, gas-fired power-generation capacity in the United States today is very well developed; in fact, it exceeds coal-fired power-generation capacity. The share of gas in total power generation in the United States reached an unprecedented 28 percent in the fall of 2009, up from 20 percent in the first half of 2008.

Another major development regarding natural gas is the emergence of a globally integrated market for LNG. About eight percent of all internationally traded gas today is LNG. Traditionally, the relationship between LNG producers and LNG consumers has mirrored that between piped-gas producers and consumers, which are connected by pipelines. In the case of LNG, on one end, there is a liquefaction plant, and on the other, a regasification plant; in between, cargo ships transport the LNG. As with the typical bilateral monopoly between a gas producer and a gas consumer connected by a single pipeline, there was no market mechanism to set a price for the LNG transaction. Instead, the volume and the price of the LNG traded were covered by long-term contracts, whose terms typically tracked oil prices.

This system is changing. Spot markets have been emerging, thanks partly to buyers who have tried to secure additional LNG by purchasing

single cargoes. An increasing share of the LNG sold is now fungible, in other words. This, in turn, has improved the global integration of the LNG market. The economic crisis, with its falling demand and oversupply of cargo, reinforced this development. Facing oversupplies, producers discovered the advantages of flexibility. As the LNG market continues to expand and become more integrated, the system of long-term contract pricing will continue to erode.

The emergence of a competitive global LNG market will have some obvious effects. The first will be to link prices between the regional gas markets in Asia, Europe, and North America, which have historically been segmented. The second consequence is that with long-term contract pricing under pressure, competition will increase and efficiency will improve. Consumers will benefit if the price of natural gas is progressively delinked from the price of crude oil. Finally, the advent of a globally integrated LNG market will improve energy security by fostering diversification.

Examples of these consequences are already visible. Russian and Central Asian gas deliveries to Europe are being affected by LNG prices. The "take or pay" terms of existing contracts for pipeline deliveries force Russia's European customers to take or pay for more than 80 percent of the volumes they have contracted to buy even if they can now find cheaper supplies elsewhere or no longer need as much gas. But to the extent that they have been able to, under the terms of these contracts, European customers have switched to LNG. Moreover, Europe uses only around 60 percent of its LNG-degasification capacity, which means that were it not for its prior commitments under the long-term contracts with Russia, it could rely on LNG imports even more.

It is easy to see how, down the road, long-term LNG contracts will come under pressure as consumers and producers start to benefit from more flexible contractual arrangements. Pipeline gas may be affected by LNG competition as well, although these effects will take place over decades rather than years.

Looking further into the future, as the technology that allowed the United States to so successfully tap unconventional gas resources spreads around the globe, unconventional gas resources may become increasingly available, including in the large consumer regions of Asia

and Europe. These still untapped resources have the potential to become game changers in global energy. This will be especially true even further into the future if their development dovetails with the liberalization of the LNG market. Indonesia, for example, is about to complete the first-ever LNG export terminal to use unconventional gas (coal-bed methane) as its feedstock.

Whether these changes in natural gas markets will have strategic significance will depend on two factors. The first is whether more unconventional gas resources can actually be developed and where this occurs. The primary reason that coal has emerged as the static fuel of choice over the last decade—in particular in the emerging markets—is that it is available locally. In contrast, natural gas is highly concentrated: 60 percent of the natural gas consumed is consumed in regions that collectively control 14 percent of the reserves. If unconventional natural gas can be developed, it could become the local fuel of choice and supplant coal.

The second factor is that gas burns much more cleanly than coal. Producing one kilowatt-hour of electricity with natural gas emits a little more than half the amount of carbon that producing the same amount of energy with coal does. With both growing concern about carbon emissions and, one hopes, a growing awareness that fossil fuels cannot immediately be replaced with carbon-free alternatives, sooner or later, politicians and the public will start calling for replacing coal with gas. In the United States, unconventional gas already competes with coal, and it does so without the help of a carbon price. A price for carbon would increase and stabilize the share of gas in power production even more, in the United States and elsewhere.

FACILE FUELS

BECAUSE OF the long lead-times in energy projects, one can make reasonable estimates ten, or even 20, years ahead. By all accounts, the foreseeable future in energy markets will remain dominated by fossil fuels. Oil currently accounts for 35 percent of global primary energy consumption, coal for 29 percent, and gas for 24. (Hydropower and nuclear power together account for 12 percent; renewable energy for less than one percent.) Most reasonable forecasts do not expect the

global energy mix to be substantially different in 2030. But with the share of renewable energy expected to reach not much more than five percent, there is more uncertainty about the shares of coal and gas.

By hitting the energy markets hard, the economic crisis has both depressed high commodity prices and brought back into focus the question of how energy prices are linked to economic growth. The various fuel markets reacted differently to the crisis, highlighting their respective strengths and weaknesses. From the consumers' perspective, the more competitive markets coped better. Of the major fossil-fuel markets, it is the market for coal that is the most competitive; the international gas market is becoming more competitive, too; the market for crude oil sits at the less competitive end of the spectrum. The crisis also revealed the cyclical elements of energy markets, highlighting how long gestation periods in capital-intensive industries—such as the LNG industry and the refining industry—can translate into an unfortunate conjuncture, in which production grows just at the time that demand declines.

Adjusting to the economic crisis has provided lessons about which energy markets adapt quickly in the short term, and it has exposed major structural shifts already under way in these markets. No matter how severe the current recession, its effects on global energy markets are likely to be dwarfed by the long-term impact of the industrialization of the emerging-market economies. The pressure on energy and commodity markets may have been relieved for a short time, but over the medium and long terms, the task of improving energy efficiency is likely to remain paramount. What the crisis has demonstrated is that the competitive energy markets are the ones most capable of maintaining energy security in turbulent times. This is a lesson for how to meet long-term challenges as well.

Another important lesson has to do with the prospects for restricting carbon emissions. Climate-change policies are typically portrayed as a means of transitioning from a carbon-based to a carbon-free world. The problem is that the ability to generate a sizable amount of carbon-free energy is still very far away. The question is thus whether a bridge fuel, such as natural gas, could help minimize carbon emissions in the meantime. Fossil fuels will be part of any solution to ensure energy security and stem climate change—and this will be true for much longer than many would like to think.