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**Article**

## World energy prospects and challenges

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# ENERGY SECURITY

## WORLD ENERGY PROSPECTS AND CHALLENGES

FATIH BIROL\*

In recent years, demand for energy has surged. This unrelenting increase has helped fuel global economic growth but placed considerable pressure on suppliers buffeted by geopolitics, violent weather conditions and other potentially disruptive factors. On the demand side, increased energy security and environmental concerns may lead to changes in consuming countries' energy policies. These uncertainties have been reflected in the market through volatility and high prices. Is the world running out of energy? Where will future supplies come from? Will adequate investment be made to make energy supplies available to meet future demand? What role will governments play?

The oil and gas resources of the Middle East and North Africa region (MENA) will be critical to meeting the world's growing appetite for energy. A large share of the world's remaining reserves lie in that region. They are relatively under-exploited and so there is considerable potential for increasing production. But there are significant uncertainties surrounding the pace at which investment in the region's upstream industry will actually occur, how quickly production capacity will expand and, given rising domestic energy needs, how much of the expected increase in supply will be available for export. The implications for both MENA producers and consuming countries are profound.

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<sup>1</sup> The next edition of the World Energy Outlook series, due on November 7th 2006, will contain the latest projections as well as an enhanced World Alternative Policy Scenario, analysis of the potential of nuclear power and the economics of biofuels, among other topical energy issues.

This paper draws on the main findings of the World Energy Outlook 2005, published by the International Energy Agency. The 2005 Outlook assessed quantitatively the prospects for global energy markets through to 2030, with a special focus on the Middle East and North Africa. In addition, it analysed the possible impact of deferred investment in the region's energy sector and also considered the potential effects of changing policies in consumer countries to address energy security and environmental concerns.<sup>1</sup>

### Global energy trends

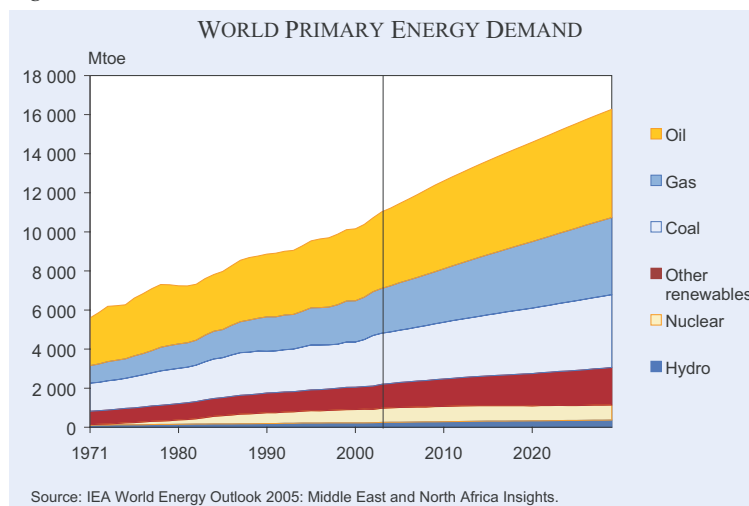
Global energy needs are likely to continue to grow steadily for at least the next two-and-a-half decades. If governments stick with current policies – the underlying premise of the *World Energy Outlook's* Reference Scenario – the world's energy needs would be more than 50 percent higher in 2030 than today, an average annual growth rate of 1.6 percent. More than two-thirds of the growth in world energy use will come from the developing countries, where economic and population growth rates are highest.

Fossil fuels continue to dominate energy supplies, meeting more than 80 percent of the projected increase in primary energy demand in this scenario. Oil remains the single largest fuel, with two-thirds of



Uncertainties about supply conditions and consuming countries' energy policies have led to greater volatility and higher prices

Figure 1



the increase in oil use coming from the transport sector. Demand reaches 92 mb/d in 2010 and 115 mb/d in 2030. Natural gas demand grows faster, driven mainly by power generation. It overtakes coal as the world's second-largest primary energy source before 2015. In this scenario, the share of coal in world primary demand declines a little, with demand growth concentrated in China and India. Nuclear power's market share declines marginally, while that of hydropower remains broadly constant. The share of non-hydro renewables, including biomass, geothermal, solar, wind, tidal and wave energy, will remain flat at 11 percent.

The world's energy resources are adequate to meet the projected growth in energy demand in the Reference Scenario. Global oil reserves today exceed the cumulative projected production between now and 2030, but more reserves will need to be "proved up" in order to avoid a peak in production before the end of the projection period. The exact cost of finding and exploiting energy resources over the coming decades is uncertain, but will certainly be substantial. Cumulative energy-sector investment needs are estimated at about \$17 trillion (in 2004 dollars) over 2004-2030, with about half of that in developing countries. Financing the required investments in non-OECD countries is one of the biggest challenges facing the energy industry.

In the reference scenario, the world's energy resources will be able to meet demand until 2030

### Middle East and north Africa energy prospects

Rapidly expanding populations, steady economic growth and heavy subsidies will continue to drive up MENA energy demand. In the Reference Scenario, demand is projected to grow on average by 2.9 percent per year over 2003 to 2030. As a result, demand more than doubles. The biggest contributors to demand growth will be Saudi Arabia and Iran. Between them, they will account for about 45 percent of MENA energy demand in 2030, the same as today.

Most MENA countries will continue to rely almost exclusively on oil and natural gas to meet their energy needs. Gas will overtake oil by 2020 as the region's main energy source for domestic use, thanks partly to policies aimed at freeing up oil for export. Despite rapid growth in MENA energy use, average per capita consumption projected for 2030 will still be barely half the current level in OECD countries, though consumption will remain very high in the

Gulf states. The power and water sectors will absorb a growing share of the region's total primary energy use as electricity and desalinated water needs expand rapidly. Heavy subsidies to both services are accentuating this trend.

Output of oil and natural gas in the MENA region is poised for rapid expansion. Reserves are large and costs are lower than in most other parts of the world. In the Reference Scenario, oil production (including natural gas liquids) is projected to rise from 29 mb/d in 2004 to 33 mb/d in 2010 and to 50 mb/d by 2030. Saudi Arabia, which has the largest proven reserves of oil in the world, will remain by far the largest supplier. Its output will rise from 10.4 mb/d in 2004 to 11.9 mb/d in 2010 and just over 18 mb/d in 2030. Iraq is expected to see the fastest rate of production growth, and the biggest increase in volume terms after Saudi Arabia. In some countries, including Iraq, increased production will hinge on large-scale foreign investment. These trends will boost MENA's share of world oil production from 35 percent in 2004 to 44 percent in 2030.

MENA oil production will outpace the growth in domestic demand, allowing the region's net oil exports to rise by three-quarters from 22 mb/d in 2004 to 39 mb/d by 2030. Most exports will still be as crude oil in 2030, but refined products will account for a growing share. Exports to developing Asian countries will increase most, but will grow to all the major consuming regions.

MENA production of natural gas is projected to grow even more rapidly than that of oil, trebling over the projection period to 1210 billion cubic metres in 2030. The biggest volume increases in the region occur in Qatar, Iran, Algeria and Saudi Arabia. The bulk of the increase in MENA output will be exported, mostly as liquefied natural gas. Demand for the region's gas will be driven by strong global demand and dwindling output in many other gas-producing regions.

Net gas exports from MENA countries to other regions are projected to more than quadruple to 440 bcm in 2030, with a marked shift in sales to Europe and the United States. Europe will remain the primary destination for North African gas exports. Major oil and gas importers, including most OECD countries and South Asia, will become ever more dependent on imports from MENA countries.

MENA oil- and gas-export revenues, which have surged in the last few years, will remain high. Aggregate MENA oil and gas revenues are projected to rise from about \$310 billion in 2004 to \$320 billion in 2010 and \$635 billion in 2030. Natural gas will make a growing contribution. Cumulative revenues will far exceed the investment needed to make them possible. Total oil and gas investment is projected to amount to about \$1 trillion over the period 2004 to 2030 (in year-2004 dollars), or \$39 billion per year.

### The impact of deferred oil investment

Securing reliable and affordable energy will hinge on adequate investment. The rate of investment in developing crude oil production capacity in the Middle East is particularly important for world energy markets. Current rates of investment in that region are not high enough to meet the gap that is expected to open up between global oil demand and oil-production capacity in other parts the world. Without urgent and sizable increases in Middle East investment, a shortfall in production capacity will emerge and prices will rise and become more volatile – to the long-term economic detriment of both producers and consumers. Under-investment also carries short-term security risks. The relatively low level of spare oil-production capacity currently available to counteract any unexpected loss of supply has resulted from many years of under-investment. This increases the likelihood that the sudden loss of even a modest volume of oil will lead to a very sharp increase in prices.

A major shortfall in MENA investment in upstream oil would radically alter the global energy balance. Our Reference Scenario projections involve a doubling of the rate of upstream investment in MENA countries. It is far from certain that all that investment will be forthcoming: MENA governments could choose deliberately to develop production capacity more slowly than we project in our Reference Scenario. Or external factors such as capital shortages could prevent producers from investing as much in expanding capacity as they would like. The Deferred Investment Scenario analyses how energy markets might evolve if upstream investment in each MENA country were to remain constant as a share of GDP at the average level of the past decade. This would result in a \$110 billion, or 23 percent, drop in cumulative upstream MENA investment over 2004 to 2030.

Lower investment on this scale would cause MENA oil production to drop by almost a third by 2030 compared with the Reference Scenario. Production falls further than investment by the end of the projection period because of the cumulative effect over the projection period. In 2030, total MENA output reaches 35 mb/d, compared with 50 mb/d in the Reference Scenario. MENA's share of world oil production drops from 35 percent in 2004 to 33 percent in 2030 (it rises to 44 percent in the Reference Scenario). As a result, MENA oil exports are almost 40 percent lower in 2030. By contrast, higher prices stimulate an 8 percent increase in non-MENA oil production. The average IEA import price increases gradually over time relative to the Reference Scenario and is almost one-third higher in 2030. The prices of gas and coal also increase. Gas production in MENA countries also falls significantly, due to lower global demand and lower output of associated gas, causing the region's gas exports to fall by 46 percent.

As a result of higher prices and lower world GDP, global energy demand is reduced by about 6 percent in 2030, compared with the Reference Scenario. On average, demand growth is 0.21 percentage points lower over the projection period. World GDP growth, the main driver of energy demand, is on average 0.23 percentage points per year lower. Among the primary fuels, global demand for oil falls most. At 105 mb/d in 2030, world oil use is 10 mb/d lower. Demand for both gas and coal also falls, mainly as a result of lower demand for fuel inputs to power generation.

Our analysis suggests that MENA producers would lose out financially were investment to be reduced in the way assumed in the Deferred Investment Scenario. Over 2004 to 2030, the cumulative value of aggregate MENA oil- and gas-export revenues would be more than a trillion dollars lower (in year-2004 prices) than in the Reference Scenario. The loss of revenues is almost four times more than the reduction in investment. Revenues also fall in terms of net present value.

Uncertainty about future supply-side infrastructure investments is by no means limited to the Middle East or to crude oil production. The prospects for urgently needed investment in new refining capacity are clouded by environmental restrictions and local opposition, especially in OECD countries. Under-investment in gas-production facilities and transmis-

Sizable increases in investment in the MENA region are needed to prevent a shortfall in crude oil production

sion pipelines in Russia and Central Asia threatens to create a supply crunch in the next few years. The lack of competition in the Russian gas sector is an impediment to the efficient and timely development of Russian and Central Asian gas resources. And current capital flows to the electricity sector in many countries – notably in the poorest developing regions – cannot even maintain system reliability, let alone meet the increasing demands of economic and population growth.

### Growing energy security and environmental concerns

Over time, consuming countries will grow increasingly reliant on oil and gas imports from an ever-smaller group of suppliers – notably Russia and the big Middle East producers. Expanding trade is to be welcomed as it binds suppliers and customers in mutually beneficial relationships. But, at the same time, the risk of a major supply disruption – whether from terrorism, piracy, accidents, severe weather, political tensions or war – will undoubtedly increase. The terrorist attack on the processing facility at Abqaiq in Saudi Arabia provided a graphic illustration of the terrorist threat to energy infrastructure. Russia's decision to cut off gas supplies to Ukraine in early 2006 called into question its reputation as a reliable supplier and raised doubts about how Europe would deal with a more prolonged disruption.

Reliance on an ever smaller group of oil and gas producers increases the risk to energy security

Further cause for concern is the growing reliance on strategic transportation channels through which almost all the oil and gas exported by Middle Eastern countries must flow. Consuming countries' vulnerability to a disruption in supplies from that region will, therefore, grow – as will the risk that some producing countries may use their dominant market position to raise prices or to withhold supplies for political reasons. Diversity of sources, of suppliers and of routes is crucial.

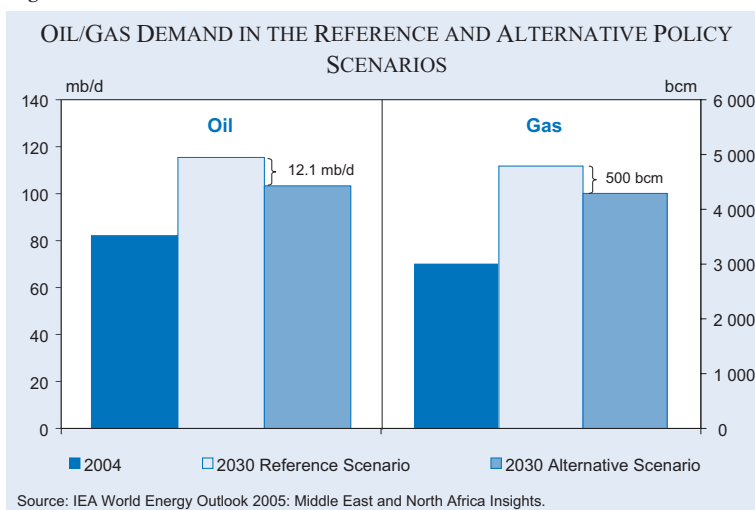
Consuming countries must identify policies and measures aimed at reducing the risk of disruptions and higher prices, as well as mitigating their consequences. They need to strengthen their

ability to handle a supply emergency, including maintaining adequate volumes of strategic stocks. For example, total oil stocks in the OECD would need to rise, in the Reference Scenario, to 3.7 billion barrels in 2030 for them to be equal to 90 days of net imports – 1.1 billion barrels more than in 2003. Consuming-country governments also need to consider long-term policies that promote further diversification of their energy supplies as a means of both lowering their vulnerability to supply disruptions and of addressing environmental challenges, including rising greenhouse-gas emissions. Reducing dependence on oil and gas through diversification of fuels and their geographic sources and more efficient use of energy must be central to long-term policies aimed at enhancing energy security.

But consumer country concerns are not limited to energy security. Because energy consumption accounts for approximately 80 percent of global GHG emissions, consumer governments are under increasing pressure to take steps to reduce or mitigate the effects of domestic energy consumption. The G8 leaders, meeting with leaders from several key developing countries at Gleneagles in July 2005, acknowledged as much when they called for stronger action to combat rising consumption of fossil fuels and related greenhouse-gas emissions.

The World Alternative Policy Scenario takes into account all the new measures that governments are currently considering to curb energy use and to reduce emissions for energy-security and environmental reasons. Under these new assumptions, primary energy demand grows by 1.2 percent per year to 2030, 0.4 percentage points less than in the

Figure 2





Reference Scenario. Demand for oil would be 10 percent lower in 2030 than in the Reference Scenario, but oil would still account for 34 percent of world primary energy demand. Two thirds of the savings would come from the transport sector. Natural gas demand in 2030 would also be 10 percent lower in 2030 than in the Reference Scenario. Most of the savings would come from power generation.

The results suggest that importing countries' aggregate dependence on MENA could be sharply reduced in the long term. In this scenario, world energy demand in 2030 falls even more relative to the Reference Scenario than in the Deferred Investment Scenario. The fall in the share of oil and gas in primary energy demand in oil-importing regions – an indicator of vulnerability to supply disruptions – is also larger in most regions than in the Deferred Investment Scenario. MENA oil production is lower than in the Reference Scenario, but still grows by more than 50 percent, or 16 mb/d, between 2004 and 2030.

In practice, the policies of producing and consuming countries will change over time in response to each other, to market developments and to shifts in market power. If MENA upstream investment falters and prices rise, the more likely it becomes that consuming countries will adopt additional policies to curb demand growth and reliance on MENA. This would have the effect of tempering the long-term impact on prices of lower MENA investment. It would also amplify the depressive effect of higher prices on oil and gas demand. The more successful the importing countries' policies are, the more likely it is that the producing countries will adopt policies to sustain their production and their global market share. Lower prices would result.

### Deepening the consumer-producer dialogue

These interactions illustrate the case for improving market transparency, for more effective mechanisms for exchanging information between oil producers and consumers, and for a more profound dialogue between them.

The uncertainty surrounding the outlook for global energy markets has rarely been greater. For as long as the world economy continues to expand, demand for oil and other forms of energy will increase commensurately. But the rate of growth in primary

energy needs and the mix of fuels will depend on what action governments decide to take to curb demand and emissions and on developments in energy technology. Other factors, including extreme weather, natural disasters and geopolitics, will complicate our ability to anticipate energy-market developments with confidence. Energy security is more than ever a matter of managing risk and coping with uncertainty.

Deepening the dialogue between oil and gas producers and consumers would help all energy players handle uncertainty and help industry to mobilise much-needed investment. The aim should be to improve market transparency, by developing more effective ways of exchanging information, and cooperating on policies to enhance the efficiency of the oil and gas sector. Producing countries are as much concerned about security of demand as consuming countries are about security of supply. Working together, consumer and producer governments can improve the mechanisms by which we meet our common challenges and achieve mutually beneficial outcomes. But they need to identify this objective as a priority and take the first steps. And they should start now.

The policies of energy producing and consuming countries are interdependent, calling for a deepening of the dialogue