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# Energy security: is the wolf at the door?

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**Abstract**

Energy security has again become an important public issue amid concerns about high energy prices and the occurrence of regional supply shortfalls. An assessment of the current state of oil security indicates that the risks of supply disruption have not diminished. The oil market outlook for the next two decades suggests an even greater need for oil security protection. With growing significance of global gas demand and trade, gas security is also becoming increasingly important.

In conclusion, although no global energy crisis appears to be on the horizon, some serious security concerns do exist and will likely intensify in the future. This means that there is no room for complacency on energy security. The existing oil emergency measures need to be extended to cover the developing countries and other energy sources. 

*Keywords:* Energy security; Security of supply; Oil crisis; Emergency response; Spare capacity; Oil stocks; Demand restraint; Fuel switching; Surge production; Oil market; Oil and gas reserves; Diversity of supply; Price elasticity; Energy efficiency; Market liberalization

## 1. Introduction

For decades, energy security has been one of the main goals of public policy, coexisting and often competing with such other fundamental goals as economic development and environmental protection. The issue is of paramount importance to the global economy

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because energy is one of the key inputs into all economic processes. It is a source of power, heat and mobility that are indispensable for normal functioning of any modern society.

The need for strong and effective public policies in this area stems from the fact that, just like a healthy environment, energy security is a public good which is not properly valued by the market and the benefits of which are available equally to those who pay for it and to those who do not. Consequently, the market may tend to produce a level of energy security that is less than optimal from the society's point of view.

Concerns over energy security have probably reached their peak during the 1970s when the world economy struggled to overcome the damaging effects of the oil crises of 1973–74 and 1979–80. These were triggered by inflation, which ultimately led to economic recessions involving substantial losses of Gross Domestic Product (GDP) and high unemployment.

The issue has returned to the public eye on the heels of dramatically higher energy prices, regional supply shortfalls and new predictions of imminent depletion of oil reserves. These were related to several factors, including successful efforts by the Organization of the Petroleum Exporting Countries (OPEC) to control its oil production, the bottlenecks in oil and gas supply chains, the ill-conceived methods of market deregulation (for example, California electricity crisis of 2000) and, until recently, robust economic growth that led to strong energy demand.

Concerning oil supply, consuming countries responded first by urging OPEC members to produce more oil. Subsequently, under pressure from their domestic consumers, they resorted to direct interventions; in the US through releasing some stocks from the Strategic Petroleum Reserve (IEA Governing Board, 2000) and in Europe through tax and other concessions. Some western governments have called for a revised approach to the use of emergency stocks. The US has decided to establish heating oil reserves in the Northeast whereas the European Commission has proposed the creation of additional oil stocks for price intervention purposes (European Commission, 2000).

As for the electricity sector, local authorities and industry players in California began implementing an emergency program involving increased caps for consumer rates, accelerated construction of new power plants, less stringent siting and environmental regulations and reduced reliance on short-term markets.

Is this renewed public concern over energy security a temporary fad that is likely to disappear with OPEC's waning production discipline and the ensuing downturn in oil and energy prices? Or is this the beginning of a new era marked by persistently higher prices, growing vulnerability of consuming countries to future oil and energy supply disruptions? Is the current state of energy security adequate and if not, how can it be improved?

This article revisits these and related oil and energy security issues. First, it defines the concept of energy security and describes its various dimensions. Secondly, it reviews the evolution of oil and energy markets and the implications for security. It then attempts to assess the current state of oil security by examining the changes in geopolitical situation and in emergency response potential. Furthermore, it examines the oil market outlook and its implications for existing and emerging security challenges. The final two sections discuss key strategic initiatives to meet these challenges and point out some emerging concerns about the security of gas and electricity supply.

## 2. The concept of energy security

Energy security is commonly defined as reliable and adequate supply of energy at reasonable prices. The meaning of reliable and adequate supply is rather straightforward: it simply means uninterrupted supply that fully meets the needs of the global economy. The interpretation of reasonable prices is somewhat less clear as it changes over time and is perceived differently by energy producers and consumers. In general, however, it means that prices are cost-based and determined by the market based on supply/demand balances.

Since these balances can swing in either direction, security concerns may equally relate to inadequate supply or demand. However, most public discussions, this article including, concentrate on the supply side and, particularly, on the external supply sources over which the consuming countries have much less control compared to their domestic supply sources. In this context, an oil crisis becomes tantamount to a disruption in oil supply on a scale that is large enough to significantly affect the international oil markets.

Furthermore, the concept may have many different dimensions, ranging from political and military to technical and economic. For the economists, the concerns are primarily about the macroeconomic impacts of high energy prices and the danger of economic losses resulting from potential shortfalls in energy supply. This latter dimension is the main focus of this article.

Last but not least, the energy security issues may entail various time dimensions such as the short and the long-term. Short-term security covers the risks of disruption to existing supplies due to technical problems, extreme weather conditions or political disruptions. By contrast, the long-term security focuses on the risks that new supplies may not be brought on stream on time to meet growing demand. This may be due to economic, financial or political factors that inhibit necessary investment in production and transport capacity. This article deals primarily with the prevention of and response to the short-term security challenges.

Energy security concerns continue to be determined mainly by the oil security concerns. First, oil remains by far the largest source of primary energy, accounting for about 40% of energy consumption Secondly, oil is the most massively traded source of primary energy accounting for two-thirds of international energy trade (all figures based on IEA statistics). Thirdly, oil reserves are less abundant and less evenly distributed than those of coal or natural gas. Moreover, oil demand is concentrated in the developed countries, whereas production is concentrated in a small number of developing countries. This makes the oil market much more amenable to cartel controls compared to most other commodity markets. Indeed, OPEC has a substantial market power thanks to its 40% share in global oil production and an 80% share in proven oil reserves (BP Amoco, 1999). My observations will therefore focus primarily on oil security issues.

## 3. Evolution of the oil markets

In order to better understand the changing nature of oil security concerns, it will be instructive to examine the evolution of the oil markets in the past few decades. The recent history of the global oil markets can be broken down into three distinct periods.

### *3.1. The period of 1960–73*

The first period from 1960 to the oil crisis of late 1973 was characterized by low and stable oil prices, burgeoning oil demand due to robust economic growth, oil supply controlled by a handful of multinational companies, and little concern for security of oil supply. During that period, world oil demand tripled from 20 million barrels per day (Mb/day) to almost 60 Mb/day, of which demand in countries of Organization for Economic Co-operation and Development (OECD) accounted for two thirds. With most OECD countries without domestic production, and North American oil production stagnating, OECD countries became heavily dependent on imports from the Middle Eastern OPEC countries.

### *3.2. The period of 1973–86*

The first major oil crisis of 1973–74 crisis had profound damaging effects on the global economy, ending earlier rapid growth and triggering a period of turbulence and structural adjustments. This second period lasted until the mid-1980s, and was characterized by the nationalization of oil industries in most major Middle East oil producing countries, rapidly rising oil prices, and ensuing economic slowdown. These developments have given rise to strong concerns not only about oil security but also about the general depletion of natural resources that was strongly articulated in the declaration of the Club of Rome (The Limits to Growth, 1972).

Against this background, the developed countries of the OECD decided in November 1974 to create the International Energy Agency (IEA) [see IEA (1994), Volume 1, Appendix IV]. The Agency's member countries undertook to reduce their dependence on oil imports through increased domestic oil production, substitution away from oil and improved energy efficiency. New oil fields came on stream in Alaska and the North Sea, nuclear energy and coal replaced much oil in electricity generation and energy saving measures were steadily introduced. As a result, OECD net oil imports were reduced from a peak of some 27 Mb/day in the mid-1970s to 16 Mb/day in the mid-1980s. The supply security of IEA countries was also improved with the building of emergency stocks, the development of demand restraint and other emergency measures.

### *3.3. The period of 1986–2000*

The price collapse of 1986 marked an end to the falling trend of oil demand and imports. Since then, with low oil prices over much of the period, and steady economic growth, OECD oil consumption has again risen to some 48 Mb/day and net imports have exceeded the 1973 level [IEA statistics]. Concerns about the security of oil supply have largely dissipated in the light of rising oil reserves, abundant supplies and serious disagreements within OPEC. Instead, there have been intermittent concerns about security of oil demand as OPEC members were faced with low oil prices and much reduced call on their crude oil. In the most recent years, the energy sector has also become increasingly concerned about the climate change and other environmental issues.

During this last period, the oil markets have also undergone radical structural changes affecting oil security. They have become more global and integrated across the regions and sectors, with some producing countries now owning refineries in the consuming countries and opening themselves to international investment in their upstream and downstream sectors. They have become more open and competitive thanks to reduced government regulation and a shift from public ownership to private enterprise. They are also much more diversified and transparent after having evolved from a set of bilateral arrangements between a small number of players to a complex web of transactions involving large numbers of players.

The overall economic context has changed as well. There has been a shift from energy-intensive manufacturing to services in the developed countries. Secondly, technological progress, greater productivity, deregulation and economic liberalization have contributed to reducing energy spending and improving energy efficiency. Thirdly, the tax component in oil product prices has been dramatically increased in most countries (particularly in Europe), driving an ever-greater wedge between crude oil prices and retail product prices. In the EU countries, taxes reached on average about two-thirds of petroleum product prices in 1999. In the OECD as whole, taxes presently account for almost half of oil product prices (based on a study by OPEC Secretariat discussed in Arab Oil & Gas, 2000).

### *3.4. Current economic importance of oil*

These changes in the global economy have led to a somewhat diminished economic importance of oil. This can be illustrated with several measures. Firstly, the share of oil in developed countries' energy consumption declined from 55% in 1980 to 40% today, as natural gas became an important substitute in home heating, petrochemical industry and power generation. Secondly, oil imports now represent only 4% of the total value of OECD imports compared to 13% in 1981. Thirdly, developed countries need only half as much oil as in the early 1970s for the equivalent unit of GDP (all figures based on IEA statistics).

The evolution of the oil markets has clearly enhanced their transparency, efficiency and ability to cope with potential supply disruptions. As a result, the adjustments to higher oil and energy prices over the past two years were somewhat less painful than would have been the case 20 or 25 years ago. Nonetheless, these higher energy prices and resulting inflationary pressures did contribute markedly to the slowing down of global economic growth. A recent study by Oak Ridge National Laboratory [see Green and Tishchishyna (2000)] anticipated that the U.S. GDP could be reduced by about 1% in 2000 as a result of higher oil prices.

Let us now examine how the supply risks have changed against the background of institutional, geopolitical and other circumstances.

## 4. Institutional security framework

The creation of an institutional security framework with sizeable strategic oil stocks has been one of the major accomplishments, providing both a deterrent to deliberate, politically

motivated reductions in normal oil supplies and a powerful instrument to respond to such reductions. Since 1974, the IEA has been the main pillar of this framework. The IEA member countries have a legal obligation to hold oil stocks equivalent to at least 90 days of their net oil imports. In addition, they have at their disposal other response instruments such as demand restraint, fuel switching capacity and surge production capacity.

The IEA system has continued to evolve alongside the changing markets by increasing its flexibility and reliance on market mechanisms. The mix of IEA emergency response measures would depend on the nature and severity of supply disruptions. In the past, stockdraw tended to dominate the actual or simulated IEA responses. This is illustrated by the IEA's 1991 Gulf War plan in which stockdraw accounted for three-quarters of the 2.5 Mb/day response [IEA (1994), volume 1, Appendix VI].

Another major accomplishment has been the success of the developed countries in replacing oil with other energy sources in power generation and other stationary uses. Oil's share of total OECD power generation fell from more than 20% in 1974 to around 7% recently (IEA Electricity Information, 2000). Oil-fired electricity generation is now used mainly to meet peak and intermediate load demand.

The European Union (EU) is also an important element of the energy security framework. It has a comprehensive set of related obligations and regulations for its member countries, including the obligation to maintain stocks of petroleum products covering at least 90 days of average daily consumption in the preceding calendar year. Three categories of products are taken into account: (a) motor spirits and aviation fuel, (b) middle distillates (gas oil, diesel oil, kerosene and jet fuel of the kerosene type), and (c) fuel oil.

The main differences between the two systems are that: (a) the EU uses, as the basis of its calculation of the 90 days, the oil consumption for three product categories rather than total net oil imports; and (b) the EU does not apply the IEA's 10% deduction for stocks deemed unavailable in a crisis. Moreover, the IEA exempts the net exporting countries entirely from the stock obligation whereas the EU grants to such countries only a 25% derogation to reflect their indigenous oil production. For countries having little or no domestic production, the IEA method generally implies a stockholding obligation that is higher than the EU obligation.

Most EU countries currently have more than 90 days of stocks. They can count these stocks toward the fulfillment of both the EU and the IEA stockholding obligations. However, unlike the IEA, the EU lacks the necessary powers to manage the stocks in a crisis. There is no centralized decision-making mechanism at the Community level through which oil could be released to the market. Instead, the member states fully own and control their own stocks, and are only obliged to consult other members if they intend to release stocks from the 90-day reserve. To remedy this shortcoming, the EU now considers establishing additional strategic oil reserves and managing them on a Community basis. In its latest Green Paper, the European Commission (2000) makes a rather controversial proposal to use these additional stocks to "make prices more stable or respond to exceptional demand."

The EU has also developed a number of programs for energy co-operation that aim at enhancing energy security, improving competitiveness of the industries and promoting sustainable development. Synergy is one such program with a mandate to promote energy

co-operation in relation with third countries. Specific objectives of this program in the area of energy security include:

- dialogue with energy producing and exporting countries;
- support in creating favorable environment for investment in third countries in the production and transit of energy; and
- assistance to energy transit countries in the implementation of the Energy Charter Treaty.

The Energy Charter process is the latest addition to the energy security framework. It is supported by the Brussels-based Secretariat that was established in 1996. The idea behind the process is to create a single Euro-Asian energy market that could make Europe largely self-sufficient by stimulating western investment in oil and gas resources of the Former Soviet Union (FSU) countries. The first concrete result of these efforts was the Energy Charter Treaty (ECT), which was signed by 51 countries from Europe and FSU, as well as Turkey, Australia, Japan and Mongolia, and entered into force in April 1998. The ECT establishes a legal framework for international energy co-operation, including exploration, production, transit and trade, the protection of investment and transfer of profits. The key objectives are to: facilitate East-West energy co-operation; improve the security of energy supply; maximize the energy efficiency; and minimize environmental problems.

In the Asian energy scene, the Association of Southeast Asian Nations (ASEAN) is the most significant organization dealing with oil and energy security. Since 1986, its member countries have the so-called ASEAN Petroleum Security Agreement that was initially signed by Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand, and subsequently ratified also by Viet Nam, Laos, Maynamar, and Cambodia when these countries joined ASEAN. Under the Agreement, member countries established the ASEAN Emergency Petroleum Sharing Scheme for crude oil and petroleum products in times of both shortages and oversupply. When members experience a serious shortage, the oil exporters of ASEAN are committed to supply necessary quantities of oil. In times of oversupply, the net importers are obliged to purchase oil from the exporting countries in distress to increase their level of exports to at least 80% of normal levels.

OPEC is another international body that plays a major role in energy and oil security. The supply policies of OPEC, and especially the use of its spare oil production capacity, have been, and will continue to be, the key factors in major international oil disruptions. For instance, during the 1990–91 Gulf Crisis about 4.3 Mb/day of crude oil exports were lost as a result of Iraq's invasion of Kuwait. Within weeks, however, the bulk of this loss was eliminated as other OPEC producers increased production by using available spare production capacity.

Since 1973, OPEC countries have developed significant spare capacity, initially by restricting production and subsequently by expanding capacity at the time of falling demand. After reaching a peak level of 11 Mb/day in 1985, OPEC spare capacity declined gradually to only 2 Mb/day at the end of year 2000, the lowest level in the past three decades. Most recently, OPEC spare capacity has increased to just above 4 Mb/day as a result of production cutbacks (IEA estimates).

## 5. Current state of oil security

Are the existing security arrangements adequate? The question is difficult to answer for several reasons. Firstly, it is impossible to predict the timing, magnitude or duration of oil crises as they usually come by surprise. Secondly, there are no reliable formulas for estimating precisely the impact of any given supply loss on oil prices or the impact of higher oil prices on oil demand, GDP or inflation. Finally, the effect of stockdraw and other crisis response measures on oil prices is rather uncertain. Replacement of a given volume of lost supply may not return the price exactly to the original level. For all these reasons, it may be somewhat easier to assess whether security has improved or deteriorated over time.

### *5.1. Traditional security concerns*

Some traditional security considerations still hold, despite the changed circumstances. For instance, oil resources remain heavily concentrated in the Middle East. Six Middle East OPEC countries control two-thirds of the world's proven oil reserves (BP Amoco, 1999). OPEC Middle East producers account for only 27% of world oil supply today, but that figure could almost double over the next two decades as production in other areas peaks and begins to decline. The region also accounts for 40% of global crude oil trade (all figures based on IEA statistics). This in itself would not necessarily constitute a security problem if these countries were politically and economically stable and if they pursued market-oriented policies. Instead, they often attempt to influence oil markets through concerted cartel actions such as the 1998–99 agreements to restrain oil production.

Secondly, portions of the Middle East remain politically and economically unstable. Experience of the past oil crises indicates that temporary supply disruptions can still occur in oil markets. Over the past half a century there have been at least 14 significant disruptions involving a loss of 0.5 Mb/day or more of crude oil. Almost all of these disruptions were related to political or military problems in the Middle East. Some of them can be categorized as unintentional shocks, caused by internal unrest in oil-producing countries (for example, the Iranian revolution) or wars involving key oil states (for example, the 1990 Iraqi invasion of Kuwait).

Until 1973, the supply losses caused by these disruptions were typically minor except for the one caused by the Suez War of 1956. Since 1973, four major crises—the 1973 Arab-Israeli War, the 1978/79 Iranian Revolution, the 1980 Iran-Iraq War and the 1990/91 Gulf War—resulted in initial monthly shortfalls of between 3.0 and 5.6 Mb/day. In the light of this historical record, and given that internal stresses in some oil exporting countries have grown in recent years, it would be imprudent to discount the possibility of large disturbances in the region.

History also shows that temporary disruptions are a common occurrence in oil markets. Most have not had a major price impact due to the existence and use of spare production capacity at the time. While most non-OPEC countries typically do not maintain any spare capacity, some OPEC countries do for historical and strategic reasons. At this writing (July 2001), OPEC spare capacity was estimated at around 4.0 Mb/day. This security cushion remains low by historical standards. It is also concentrated heavily in three Middle East

countries—Saudi Arabia, Kuwait and the United Arab Emirates—and therefore might not be readily available in case of any disturbances in the region.

### *5.2. New security concerns*

There are also new security concerns that relate largely to recent geopolitical developments and the remaining potential of available security measures. One of the main new geopolitical factors has been the collapse of Soviet Union which resulted in reduced oil production and concerns about the region's political stability. On the positive side, this allowed the newly independent states in the Caspian and elsewhere to pursue independent oil and energy policies. This has also affected the balance of power in the Middle East, giving the US and its allies a much greater ability to influence local politics.

Another geopolitical development with an energy impact has been the growth of the Asian economies and their political weight. Particularly important in this context has been the rise of China, helped by economic reforms. As it gradually becomes a major energy importer, China has a growing interest in diversifying from dependence on Middle East oil. China may also contribute to greater political instability in the region, if it becomes more aggressive in asserting its territorial claims in the South China Sea.

One potent argument against complacency on security issues is that stocks in IEA net importing countries have been declining steadily over the past 15 years; from a 1986 peak of nearly 160 days of net imports to around 110 days at present (IEA, 2001). The decline in total stocks reflects a tendency for industry to hold progressively lower margins of stocks since the early 1980s, combined with a stagnation of public stocks since 1986. In recent years, the decline in industry stocks has accelerated, reflecting rationalization, cost cutting, and increased reliance on short-haul crude oils. Recent OPEC production cutbacks contributed to a rapid decline in industry stocks to their lowest levels in the 1990s.

The downward trend in oil stocks clearly reduces the flexibility in responding effectively to supply disruptions. With such a low cushion of stocks, the oil market has become quite vulnerable to potential supply shocks such as, for instance, occasional interruptions of exports by Iraq.

The IEA's internal analyses conclude that global strategic stocks seem adequate for an oil disruption of medium-scale and duration. However, in case of larger-scale and/or longer lasting disruptions stockdraw would have to be supplemented by other measures such as demand restraint, fuel switching or surge production. However, the scope for these supplementary measures, particularly fuel switching and surge production, is now very limited. The surge production potential exists only in a small number of countries with significant oil production such as Canada, Norway, the UK and the US. However, these surge production capacities are negligible compared to those of key Middle East producers.

Moreover, there is growing concern about a sustained and rapid growth in transport demand that has led to an even more pronounced concentration of oil use in the transport sector. Since demand for motor fuels is less price elastic, oil prices may have to rise by more than in past supply disruptions to choke off a relatively modest amount of demand in future disruptions. Over half of oil supply is now used by that sector, with no readily available substitutes in sight. This share is expected to grow further in the future (IEA, 2000). None

of the currently available alternative fuels has the potential within the next 10 to 15 years to displace a significant portion of the transport sector's demand for oil.

What can we then conclude regarding the current state of oil security? On the one hand, OECD economies seem to be somewhat less vulnerable to oil price shocks and the oil markets are better equipped to deal with potential supply disruptions. On the other hand, high concentration of oil reserves in the Middle East, rising oil consumption and import dependence, declining trend for strategic stocks, and limited scope for fuel switching in some sectors contribute to continued vulnerability of oil markets to supply disruptions. This suggests that the need for oil security measures has not diminished as many traditional security concerns persist and are accentuated by some new concerns. Although oil supply disruptions may be somewhat less likely to occur in the future, their economic effects on certain economic sectors (for example, transport) and regions of the world (for example, Southeast Asia) may still be quite severe.

## 6. Future oil security needs

The coming decades will see many changes in the energy sector, as the environmental concerns and the progressive depletion of hydrocarbon reserves start to alter the energy scene. What is the outlook for the energy and oil market and what are its security implications?

Recent energy forecasts predict that fossil fuels will provide the bulk of additional global energy demand over the next two decades, despite the gradually increasing role of renewable energy. Oil will continue to be the largest energy source with its share in total energy use remaining relatively constant around the present level of 40%. The share of natural gas will increase at the expense of coal and nuclear energy. The bulk of the projected growth in energy demand will take place in the developing countries which may account for close to half of total energy use by 2020.

Recent forecasts, including those of the IEA (IEA, 2000) and the US Energy Information Administration (EIA, 1999), project world oil consumption to rise from 77 Mb/day in 2000 to about 95–100 Mb/day in 2010 and 110–115 Mb/day in 2020. The bulk of this incremental oil demand will come from the fastest growing Asian countries and will be led mainly by transport. The security concerns will be heightened by the expected growing reliance of the main consuming countries, including the OECD and Asian countries, on imported oil.

World oil supply will be sufficient to meet this growing demand, at least in the short to medium term. However, it is less certain whether oil reserves (particularly in non-OPEC countries) will be sufficient to satisfy demand in the long term. Some experts (for example, Campbell) predict that the world may face a serious oil shortage in the next decade or so. They base their argument on the declining trend for new discoveries and the Hubbert model that predicts a steep long-term decline in production after reaching the midpoint of depletion. They argue that the amount of oil reserves is basically fixed and that any advances in technology will only act to speed up its extraction.

However, the pessimists are outnumbered by those who think that the obstacles to development are not geologic, but political and regulatory and, therefore, more easily

surmountable. These optimists (for example, Adelman) believe that advances in technology and higher oil prices will increase the amount of oil that can be extracted economically from reserves. They assume that the production rate will stay steady until the supply runs out.

The nature of future debate on oil resources will likely be affected by the latest assessment by U.S. Geological Survey (USGS) that was released in June 2000 (U.S. Geological Survey, 2000). The study has increased its estimate of undiscovered oil by 20% worldwide compared to the 1994 study. More significantly, it suggests for the first time that oil reserve growth could be almost as much as that from undiscovered fields. If these estimates are accurate, the much-feared decline in world oil production may be a more distant prospect.

The IEA's latest energy outlook views the world oil-resource base as adequate to meet global demand over the next two decades. However, it is certain that non-OPEC production will peak long before OPEC production, implying a greater reliance on OPEC supply, particularly from the Middle East. The IEA anticipates that non-OPEC production will increase by about 5 Mb/day in 2010, but will mature and flatten thereafter. This implies that after 2010, OPEC will have to meet virtually the entire incremental global oil demand. To satisfy this incremental demand, OPEC will have to significantly increase its production capacity. The lifting of sanctions against Iran and Iraq would facilitate the required massive investment in the Middle East.

The OECD's oil import dependence is set to rise inexorably from 54% in 1997 to around 70% in 2020. This dependency may stabilize towards 2020, as liquid fuels from unconventional sources (for example, oil sands, biomass or gas) begin to play an increasingly important role. Although renewables should gradually become increasingly competitive, their major impact seems likely to come after 2020.

Another trend with important implications for oil security will be a growing role of oil use in the transport sector, at least until 2020 when alternative fuels start reducing this role. Furthermore, the share of developing countries in global oil use is projected to grow rapidly. Most new demand for oil is expected to come from Asian developing countries most of which have no significant amounts of strategic oil stocks. This implies that IEA's emergency stocks will inevitably become a smaller proportion of global oil supply.

One major wild card is the impact of current and future environmental initiatives, including the Kyoto Protocol on global warming that calls on industrialized countries to reduce emissions below the 1990 level by 2008 to 2012. There seems to be virtually no chance for the agreement to be ratified by the US and several other countries in its current form. Moreover, the policies and measures taken to date are clearly insufficient to meet the Kyoto commitments. Nonetheless, it is reasonable to expect that the initiatives to combat global warming will continue and intensify, thereby limiting future oil demand growth.

## 7. Strategic initiatives to enhance security

This outlook seems to suggest that over the next two decades the oil market will need more, rather than less, oil security protection. How can then future oil security be enhanced?

Prudent risk management requires diversification, investment in flexibility and the maintenance of response options. The international community needs to be able to respond

effectively to oil supply emergencies with a wide array of measures, including stock drawdown, demand restraint, fuel switching and surge production. To this end, the existing oil security system needs to be maintained and strengthened. More specifically, this means increasing the stock levels and periodically testing the stock drawdown and emergency response procedures.

Since the share of developing countries in global oil demand is expected to increase substantially, it is becoming necessary to develop a global approach to long-term oil and energy security. Some fast growing developing countries show growing interest in establishing emergency stocks and are now assessing the feasibility of establishing regional strategic stocks. A study by Asia Pacific Energy Research Center (APERC, 2000) assessed the growing oil import dependence of the Asia Pacific Economic Co-operation (APEC) economies and the costs and benefits of expanding oil stocks. The study suggested that a minimum stockholding of 30 days of net imports should be established as a first step, and that APEC stocks should eventually reach up to 1 billion barrels by 2030. Building obligatory emergency stocks in these and other developing countries would contribute greatly to making the global response system more robust.

Strategic stocks can be effective only against short-lived supply disruptions. They should be complemented by efforts to diversify supply sources. The oil industry should continue efforts to develop new oil producing regions. The Caspian basin alone could add 3 to 4 Mb/day to global oil supply by 2010 (IEA, 1998). The recent discovery of the giant Kashagan field may further boost the region's long-term oil export potential. Excellent growth potential also exists in Latin America, driven by new deepwater fields in the Campos Basin, and West Africa, driven by new offshore fields of Angola. These two regions are expected to add about 3.5 Mb/day by 2010 (IEA, 2000).

Some of these new sources will require new transport routes. By the end of this decade, several additional pipeline routes for the Caspian oil to the Black Sea may become operational. Supply security considerations would dictate diversified routing, but this has to be balanced against economic feasibility, as too many routes would mean smaller economies of scale and higher costs for each project.

The economic risks of energy supply disruptions can also be reduced by governmental policies that promote competition, free trade and investment in the energy sector. The framework of Energy Charter Treaty is playing a leading role in this area. To mitigate the risks of disruptions in transit countries, the Energy Charter launched in February 2000 an initiative to establish an international legal framework to facilitate transit of energy products through the third countries. Talks between 51 governments on a legally-binding international agreement concerning energy transit issues are expected to lead to an adoption of the Transit Protocol in the near future.

The key provisions under negotiations include the obligation on states to ensure that: (a) energy flows in transit are not interrupted in the event of a dispute; (b) access to available capacity for transit shipments is granted on a transparent and nondiscriminatory basis; and (c) tariffs charged for energy in transit are objective, reasonable and nondiscriminatory. The resulting clear and transparent framework for energy transit should help to create a more favorable legal climate for investors in energy projects in the Caspian region and Central

Asia. It would also enhance the long-term security of energy supply for import-dependent countries of Western Europe.

Another major new strategic initiative is a special energy partnership between the EU and Russia that was launched at the EU-Russia Summit in Paris in October 2000. Russia already accounts for 21% of EU's oil imports and 41% of EU's gas imports. Since this dependence is projected to grow substantially in the coming decades, the EU has an obvious interest in ensuring that energy imports from Russia take place on a stable and predictable basis. For its part, Russia estimates that it needs some $670 billion of investment in its energy sector, a large part of which may have to come from foreign sources (all figures taken from EC's Press Release, 15 May 2001).

The objective of the EU-Russia dialogue is to improve energy relations and market integration, to enforce energy security of both sides, to improve the investment climate in Russia and to boost EU investment in the Russian energy sector. The main themes of the dialogue are: energy strategies; technology transfer; investment; and energy efficiency. This dialogue is seen as a complement to the existing multilateral framework of the Energy Charter process.

Future security of oil supply will depend, to a large extent, on the ability to maintain internal political and economic stability of major Middle East oil producers. A lasting peace between Israel and its neighbors and improved U.S. relations with Iran and Iraq would contribute significantly to reducing the tensions in the region. Also important in this context are efforts to improve the understanding between oil producers and consumers through dialogue and co-operation, and to encourage the elimination of investment barriers that hamper greater economic integration of the two sides of the dialogue.

The ultimate solution to oil dependence lies in creating low-cost alternatives to petroleum. In this context, there is a need for greater support for research and development, as they are indispensable to develop technologies that will advance long-term energy efficiency and security. In the oil sector, the R&D programs should focus on the development of alternatives to oil-based transport fuels in order to arrest the projected trend of growing concentration of oil use in the transport sector. By 2020, this trend may be arrested or even reversed through the development of alternative transport technologies and fuels.

Hybrid cars are currently the prime candidates to lead the transition away from the gasoline engine. These cars combine a small primary engine powered by diesel, gasoline or ethanol with an electric motor. Electric and hybrid cars still cost substantially more than conventional ones, and are more expensive to operate. The fuel cell technology may provide the ultimate solution for breaking the current near monopoly of oil-based fuels in the transport sector. Fuel-cell cars are still much more expensive than conventional cars and would require new infrastructure to supply hydrogen or hydrogen-bearing methanol. But mass production is expected to cut their costs and improve their market penetration.

## 8. Emerging concerns for gas and electricity

Over the past decades, public security concerns focused almost exclusively on oil supply. Most recently, however, the traditional concept of supply security is being expanded to cover

also energy sources other than oil. This is reflecting the globalization of energy trends and greater degree of fuel switching and trade. The debate concerning the millennium bug demonstrated vividly that oil, gas and electricity markets are becoming more interconnected and integrated.

Global availability of gas is not a significant problem as world gas reserves are abundant. However, the concentration of gas reserves is of some concern. Over 70% of proved gas reserves are located in FSU and the Middle East with two countries—Russia and Iran—holding half of the reserves (BP Amoco, 1999). The second challenge is the distribution of reserves relative to demand centers. The expansion of regional gas markets will require the development of more distant reserves and their transportation over longer distances. According to IEA estimates, up to one-third of reserves are "stranded" that is, located in remote inaccessible areas or in excessively deep waters. For these reserves, high production costs and uncertain transit conditions are the main risks.

Some regions are heavily dependent on external imports, often from rather unstable areas. For instance, Western Europe holds only 2% of world gas reserves and imports 40% of its requirements, mainly from Russia and Algeria. The European Commission projects this dependence on gas imports to grow to two-thirds by 2020 (EC, 2000). IEA studies of gas security issues (for example, IEA, 1995) concluded that most member countries are in general well placed to withstand potential gas supply disruptions, but noted that supply sources become more remote, transport routes more risky, and gas infrastructure less flexible than that for oil.

This implies a need for more diversification both by supply sources and by modes of transport (e.g., more pipelines and terminals for liquefied natural gas) as well as higher levels of underground storage. Eventually, it will also be necessary to establish in some regions the coordinated systems of emergency response, similar to those already existing for oil. These systems could be based on the obligations to hold strategic stocks and develop demand restraint programs for gas.

As global gas demand and trade are expected to grow significantly, gas security will become increasingly important, not only for the gas industry but also for the energy industry. In particular, there will be a need to assess the impact on the oil market of disruptions in gas supply. The expected increase in gas demand does not in itself have to constitute a security problem, provided that adequate security measures are in place. However, the larger the share of gas in the fuel balance, the more important gas security becomes.

To cope with supply disruptions, the gas industry has several technical and economic measures at its disposal. Technical measures include underground gas storage, diversification of gas and energy supplies, integration of gas networks and cross-border pipelines. Economic measures entail contractual flexibility in supply contracts, backup contracts, interruptible consumers and co-operation with transit countries and suppliers. Governments also have a key role to play, particularly in setting the regulatory framework for investment, trade and transit, as well as for dealing with emergency situations. Governments also have an influence on pricing which is a key factor in mobilizing new gas supplies. Eliminating the remaining gas subsidies, and ensuring that gas prices fully reflect all costs, would encourage not only more upstream investment but also more efficient use of gas.

One related development affecting energy security is the process of liberalization of gas

and electricity markets. Governments in Europe and other parts of the world are introducing gas-on-gas competition based on third party access to gas supply infrastructure and, in some cases, by privatizing public gas utilities. Although the main goal of reforms is to improve the economic efficiency of gas and electricity supply, other goals, such as security of supply, remain important. This process of liberalization is creating new security challenges as the role of new participants in securing supplies is not yet clearly defined.

The reduced diversity in electricity input fuels is rapidly becoming another important challenge. One aspect that needs to be watched carefully is whether gas and electricity markets continue to provide the required level of fuel diversity after they become deregulated. Diversification also requires that all energy options be kept open, including the nuclear power that is now facing a moratorium in several countries. Last but not least, efforts should be made to maintain sufficient operating margin, increase interconnections and technical compatibility among various networks and reduce barriers to cross-border trade in gas and electricity.

## 9. Concluding remarks

The current situation can hardly be characterized as a serious global energy crisis and there are no compelling reasons to fear that such a crisis is imminent. The energy resource base is large and the existing energy security arrangements seem to be quite adequate to handle most of the reasonably foreseeable small to medium-scale disruptions. Governments and the industry have at their disposal a wide range of means to minimize the risks of any disruptions and to reduce their potential negative effects on the global economy.

Nonetheless, the present public concerns about energy security are largely justified by the concentration of market power in some sectors and by the existence of supply bottlenecks in some regions. The long-term energy outlook also raises security concerns related primarily to the expected decline in non-OPEC oil supply and greater share of fast-growing developing countries in global oil use. These countries have no significant emergency stocks and are economically more dependent on oil than the developed countries.

The energy policy-makers must therefore not be complacent about the issue. Instead, they should aim at preventing supply shortages and reducing the dependence on imports from most vulnerable energy sources. The existing oil security framework should be extended to cover more fully the developing countries and other energy sources, especially gas. Since some regions, including Western Europe, are expected to become increasingly dependent on gas imports, the efforts should be made to encourage supply diversification and higher levels of gas stocks. There is also a need for long-term programs aimed at diversifying across energy sources and making the use of energy more efficient. The wolf is not yet at the door but it is prudent to take the precautions to keep it at a safe distance from the house.

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