World Energy Trends: Recent Developments and their Implications for Arab Countries

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Contents

Figures

Tables

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1. Introduction

Arab countries have 56% and 30% of the world's conventional oil and gas reserves respectively. In 2003 they accounted for over 30% of world oil and NGL production, 11% of gas production, 16% of gas exports and 37% of LNG trade. This hydrocarbon endowment and rapidly expanding role in oil and gas trade conveys onto Arab countries a special responsibility and implies a growing role in the broader international discussions of the political economy of oil and gas, given these fuels' dominant and growing share of global primary energy consumption. Arab countries thus are predestined to play an increasingly central role in the world economy.

This brings responsibilities, opportunities and risks. Conversely, what the rest of the world does in terms of economic and industrial policies and other actions designed to address various concerns and priorities both nationally and through multilateral institutions, will impact on Arab countries. Because the economies of most Arab countries are dependent on oil and gas exports, what other producing and consuming countries do to affect their energy balances becomes of paramount concern to the economies of Arab states.

This paper examines facets of this mutuality and interdependence of interests between Arab countries and the rest of the world in energy, principally with respect to oil and gas.

The purposes of this paper are to review the key international energy developments, principally in oil and gas markets, examine the principal drivers or determinants of demand and supply and assess implications for, and impacts on, Arab countries. The paper also examines the outlook for the demand and supply of oil and gas. The historic point of departure for much of the analysis here is early 2002, the date of the last Arab Energy Conference.

Besides this introduction, the paper comprises four Parts. Part II starts with a review of the principal drivers of energy demand and supply then examines seven key developments since the 7th Arab Energy Conference (AEC) of 2002 and notes some of the implications for Arab countries. Part III provides an outlook for oil and gas demand and supply to 2020. Part IV examines in further detail some of the implications of international developments such as the role of Asian national oil companies, developments in Russia, the pursuit of market stability and predictability and a narrower examination of examples of other countries' polices and how they might affect Arab countries. In Part V conclusions are drawn and propositions made for Arab countries.

2. World Energy Trends: Developments since the last Arab Energy Conference

Much has happened in world energy markets and industries since 2002—to the extent that some observers of the industry are convinced that energy in general and oil in particular have entered a new era. In response to surging global economic growth last experienced in the seventies, and the attendant rise in demand for virtually all commodities, the prices of major fuels have increased: oil (WTI) by 125%; coal import prices to Japan by 100%, natural gas in North America by 200% and in Europe, by 100%.

This chapter begins by reviewing the main determinants of energy demand and supply as a backdrop for examining the following principal developments since the last Arab Energy Conference:

1) The dramatic acceleration in primary energy demand growth and especially for oil.
2) The role of China and the rest of Asia.
3) The increase in oil prices and the principal factors—economic, technical and geopolitical—behind this increase. An extended section examines the question, "Is this 1973 all over again?"
4) The continued structural changes in the global oil industry.
5) The shifts in Non-OPEC oil production, with a focus on the Former Soviet Union.

6) Developments in Natural Gas markets.
7) The Peak Oil Debate

Since time immemorial mankind has made judgements about the future based on the most recent past and the present. The propensity and fashion to attempt forecasts and to debate future outcomes is greatest after a significant departure from what was generally accepted as the norm. We have recently gone through a 'significant departure from the mean'. The question now is will markets revert to mean and if so how quickly and when?

The expectation that seemed to emerge from the last Arab Energy Conference was that oil prices would stay in the $25 to $16 range, especially in the period out to 2010. The Institute's paper for that conference stated that *"exporters are likely to go through some tough times and enjoy some relief in other instances but prices will not produce wealth in the period under consideration"* (out to 2015). It was suggested that a period of low prices might be coming because of anticipated new non-OPEC supply projects. Many have been delayed. Also, the major surge in world oil demand, especially in the United States, China and the rest of Asia caught most analysts by surprise, even though the region had accounted for most of the net growth in annual world oil demand since the late eighties. We take this experience, although not really

needed, to simply remind us that the ease of making forecasts is only exceeded by the difficulty and rarity of their coming true.

We therefore try to avoid making hard statements of expectations in this report. Where we do, we stand ready to accept the judgement of time. The approach taken is to start from what we observe today in markets, industries and in governments' policy discussions, then tenuously lay out some propositions for the future, but only as far as the observations and data allow. Mostly we point to the great uncertainties that lie ahead, and unfortunately uncertainty has not decreased since the last Arab Energy Conference.

2.1. Determinants of Energy Demand and Supply

Energy demand and supply are derived, that is, they are a consequence of mankind's desire for the multitude of services energy provides (lighting, heating, cooling, mobility, etc). Our demand for energy is driven by the interplay of population and incomes (economic growth). The more people with higher incomes the more energy services they want—of course, to a limit.

The supply of energy to meet these demands depends on the availability and acceptability of fuels and how easily they can be delivered. Technologies are critical—not just for the supply, but also for the transportation and transformation of primary energy into final energy. More than anything else, the key determinant of

energy demand is the gearing of population and economic growth (GDP)—this couplet constitutes the engine of the energy economy.

The engine's throttle is micro-adjusted and its workings lubricated by policies set by governments and international institutions. For example, economic growth tends to be favoured where governments have established clear framework conditions providing for the protection of private property rights, banking and financial institutions, enforceable and effective laws governing investment and markets, and the provision of public services such as health care, education and transportation infrastructure. Equally, on the other hand, bad policies can make the engine function poorly or even stall it.

Econometricians calibrate their models for making projections by measuring relative changes among parameters of demand, supply and price, relative to incomes and population and technological improvements. We have only the past to go by in such exercises but as will be emphasized through anecdotes, we must avoid becoming trapped by the past. While for sure the same fundamental forces are at work today, their relative importance and that of different players has evolved, and therefore so must our assumptions and analysis of their current and likely effects today and for tomorrow.

Demand obviously is the starting point, and as noted it clearly depends on incomes (economic growth) and population. Consuming countries' economic, fiscal, strategic and socio-environmental policies influence consumption patterns and demand cycles. The migration of rural populations to urban centres, as has happened in China for example, is accompanied by a shift from traditional (biomass) fuels to commercial fuels. Micro-economic policies such as appliance and vehicle efficiency standards, competition regulations, liberalization of markets and privatisation of energy supply and distribution industries and consumer taxes all influence demand.

Energy demand can be broken down into three distinct types or groups: electricity, mobility and stationary. Electricity demand and mobility—use of vehicles—are essentially hard-wired with GDP, with a linear relationship through time: the higher the GDP the more demand for these energy forms.

Electricity use is captive: once connected to the wires, customers rarely switch to alternatives. Prices for final electricity consumers are generally not volatile. But as will be seen this could be changing as extreme volatility in gas markets will flow through to electricity prices in certain markets where natural gas accounts for a large share of power generation. This change in circumstances could stimulate a resurgence in growth in coal and nuclear for power generation.

Electricity is fundamental to a modern economy. In developing economies there is enormous pent up demand for the service it can provide. Not surprising most projections see electricity growing faster than any other fuel in final consumption. Because of the host of modern conveniences electricity provides right across a modern economy, politicians are loathe to implement policies designed to reduce its use, thus its continued growth in step with incomes would seem reasonably assured.

Mobility is similar to electricity in the sense that it too is captive; oil is dominant and has no serious prospect of being displaced by another fuel. Its final price (gasoline and diesel) is not that volatile in most final markets owing to end-use taxes in many countries and price controls in others. Personal mobility has become associated with individual freedom and convenience; as with electricity, this makes it 'politically sensitive' and somewhat immune from direct policy action.

Stationary uses of energy on the other hand tend to be more sensitive to price. Here, industry is the primary consumer and governments have other fiscal measures such as capital cost allowances to induce industry to shift or reduce fuel use. And, industry can (and does) migrate to other countries to take advantage of lower cost inputs they might offer. Not surprising,

the use of oil in stationary uses has declined or hardly grown in most OECD countries.

Technology is one of the most enigmatic factors in making energy demand and supply projections. As we have had steady improvements in the efficiency of technologies for both supplying and transforming/consuming energy, we normally assume this trend will continue. Clearly, prices are important in driving technological change. Linked to technology and prices are resources; here we tend to assume that there will be no constraint on their availability, an assumption that is increasingly being challenged.

The energy system is dynamic and the determinants of economic growth, demand and supply vary through time. Policies, technologies, structural change and geopolitics ensure a constantly evolving picture.

Structural change. The low prices through the late eighties and nineties had a major influence on the management of the international oil companies and on their choices of where they spent shareholders' capital. The upstream or E&P culture that drove the international Private Oil Companies (POCs) during the seventies and early eighties gave way in the subsequent low price environment to a culture of financial engineering and asset squeezing. The period culminated in the late nineties with mergers

and acquisitions of dozens of oil and gas companies. This changed the business profiles of the resulting very large firms. For example, their materiality thresholds had increased in some cases two-fold; they now seek much larger prospects in order to replace reserves. Therefore the geographic focus of their development strategies has changed to countries whose resources are large enough to offer such prospects. These are very limited.

After the fall of the Soviet Union, during the period of low energy prices and ample spare oil capacity, many countries with hydrocarbon potential opened to the POCs, and competed to provide terms to attract their capital, efficiency and project management expertise. With the recent rise in oil and gas prices, some countries have changed their policies as their need for this foreign capital has reduced. This is not the case for all countries. Some continue to actively seek the involvement of the POCs because the latter, with activities all over the world in diverse technological settings, have the expertise required by producing countries as they shift their focus to increasingly technologically complex or difficult reservoirs and field development environments. In addition, there are new international players in the form of other state-owned companies, primarily from the east, willing to accept lower terms of entry. While structural change in the industry is a constant—its *nature* varies and the consequences for Arab countries also vary with time.

Policy changes can affect the whole supply chain and influence how industry produces, transports, transforms and markets fuels, and importantly how industry organizes itself to carry out these functions within a set of market conditions. A recent vivid example is the implementation of policies in many countries to reduce the sulphur content of automotive fuels.

In the United States significant reductions in sulphur content of fuels came into effect in January 2004 and January 2005. The Ultra Low Sulphur Diesel spec is due to be implemented in mid 2006. Refiners must reduce inventories to ready tanks for cleaner products. The 2004 and 2005 changes occurred precisely when they normally would have been building inventories. The 2006 spec will come at the peak of the driving season. Because not all refiners were equipped to produce sweet product, there was an added demand for sweet crude, which increased prices and widened price differentials between sweet and sour crudes. The problem will be further complicated by the phase out of MTBE (an example of policy error), the tight supply of ethanol and limited availability of offshore spec gasoline (partly limited by policies to protect U.S. ethanol producers) and by the complications of contamination in product pipelines and tankage. The repercussions will take many more months to play out as export refineries elsewhere reconfigure to conform. Also, if US gasoline inventories are not restored in time for the 2006 driving season, prices could again soar affecting crude oil prices. Finally, at the margin, the

regulations have prompted decisions to develop ultra-clean diesel from natural gas (Gas-to-Liquids or GTL) and perhaps have made biofuels relatively more competitive in some markets. Thus the dislocation caused by this set of policies in one country designed to improve urban air quality will reverberate through the global refining industry and oil markets for some time.

An important international development since the last AEC has been the ratification of the Kyoto Protocol. Every major international body from the G8 down has stressed the importance of addressing climate change. This report does not address in any detail the implications of Kyoto and any successor agreement on Arab countries as this vast subject is analyzed in other papers for the Conference.

Finally, besides economic and regulatory policies, the enduring factor of geopolitics continues to affect international trade of all fuels, but especially of oil and increasingly natural gas. While some sources of geopolitical uncertainty have changed little, there are new developments that need to be analysed and monitored carefully for they have the potential to create tensions and misunderstandings that could impair investment.

One such development since the last Arab Energy Conference is unfolding in Latin America. The rise of populist regimes has tended to unnerve investors and undermine confidence in the

continent's economic prospects in the near term. This uncertainty partly derives from persistent failure by successive governing elites to address the huge disparity in the distribution of benefits from economic development and of resource extraction in particular. Throughout the Americas from Alaska to Tierra del Fuego legitimate land claims by the original peoples remain unresolved. These communities are increasingly disenchanted with the status quo. Economic reforms involving the simplistic transplant of OECD economic models have only served to compound the disenchantment. Some countries have addressed the land claims issue more than others. Nonetheless, even in the most progressive countries, hydrocarbon development and pipeline construction face potential native resistance because they affect the natural environment on which native communities depend. Also, in part as compensation, native communities will seek a greater share of resource rent. Examples include Canada (Mackenzie and Alaska gas pipelines), Mexico, Ecuador, Peru, Bolivia and Brazil. Border disputes between countries (Peru, Bolivia, Chile) will delay gas development. There is the risk that the United States will perceive these developments as inimical to its perceived hemispheric interests broadly defined. This is just one example of increasing political tensions that could affect oil and gas markets and therefore the prospects for Arab countries.

On a much broader and more positive note, since the last Arab Energy Conference, the dialogue between producers and

consumers, formalized in the International Energy Forum, has strengthened notably with the establishment in Riyadh of a Secretariat to facilitate dialogue and the launch of the Joint Oil Data Initiative (JODI) in late 2005. We hope that this initiative will improve the transparency and therefore our understanding of oil markets.

While we can expect energy demand to be affected by the same generic factors: economic growth, demographics, technological change, structural change, policy and geopolitics, changes in the specifics and their relative weight at any time continue to elude prediction, especially the extent they will affect prices and how prices affect them. More than a little humility is required when attempting to forecast the outcome of this constantly evolving set of much-analysed but still poorly understood forces. We base our plans for the future on the past at our peril.

2.2. Primary Energy Demand: recent developments.

The recent acceleration in growth of global primary energy demand perhaps hints that we are entering a new era in global energy developments. We can gain a measure of this 'step-jump' by comparing the increase in Primary Energy Demand for the period between the 6th and 7th Arab Energy Conferences (1998 and 2002) with the period since 2002 up to 2004 (the latest year for which we have data). From 1998 to 2002, global Primary Energy demand increased by 7%, about the same as the previous four years (from

1994). Yet, in less than half the time since 2002 (to 2004), primary energy consumption increased by nearly 8%; oil demand grew by 4.5% between 1998 and 2002 yet by 5.2% since 2002. Demand for coal, while uncertain owing to poor statistics covering coal industry changes in China, increased by over 7% in the earlier period, yet by more than 15% since 2002.

A key driver behind this growth has been Asia. In the simplest of terms, it is as if a clutch controlling two rather large flywheels—China and India—was released and they are now fully geared, adding to the momentum of the global engine of economic growth. Growing incomes in these two major populaces have inoculated growth in global demand for commodities and goods and may be underpinning what some believe is the beginning of another 15 to 20 year commodities cycle (Financial Times, Nov 22/05). Because they will have to import increasing volumes of oil and gas, we can anticipate that their foreign policies will be aligned to strengthen their security of supply of these essential inputs to their expanding economies. This development is already changing the geopolitical map as seen in the global activities of their national oil companies (see below).

The global economy's performance in the face of higher energy costs has surprised many analysts. Notwithstanding fuel price increases in the US beginning in 2003, the US economy continues to expand. Consumer spending accounts for nearly three-quarters

of U.S. GDP, yet higher energy prices have so far not dampened demand. U.S. crude oil demand broke through a record level of 22 mb/d in early December, 2005. Even Japan shows signs of coming out of its deflationary slumber, helped by a stronger yen diluting the effects of higher prices. The Euro zone's economy was also insulated to some extent from higher oil prices by a stronger Euro, yet it remains relatively stagnant. As of the end of 2005, the U.S. dollar strengthened as the Federal Reserve increased interest rates.

2.3. China

The case of China's transformation provides a useful reminder of the long lag time between policy change in a consumer country and the eventual impact on commodity-exporting countries. It should not have been a surprise. Its impact on world energy demand had been anticipated in the early nineties (IEA *World Energy Outlook* 1993, p. 164). Ironically, the seeds for this growth were sown by Mao's policies and programmes aimed at developing the production sectors and distribution infrastructure (*The Changing Face of China: From Mao to Market*, John Gittings, 2005). By the early nineties China's industrial sector accounted for an uncharacteristically high (for developing countries) 60% of its demand for commercial fuels. Thus the basis for growth was largely in place. Through most of the nineties China and the rest of Asia accounted for the lion's share of the net growth in world oil demand—that is until the Asian Financial Crisis in 1997/98.

Coming out of that crisis, China's annual increases in oil demand doubled from its previous trend. Then with its continued growth, stimulating oil demand in the rest of Asia, the region's oil demand surged by 1.35 mb/d in 2004 over 2003.

After a relatively long 'taxi' China's economy finally 'took off' as the economic freedoms introduced by Deng Xiaoping in the late seventies began to drive consumption. China is the top consumer of copper, zinc, tin, rubber, raw wool, cotton, oil seeds, wheat, rice and coal. It produces a quarter of the world's steel. Transforming these raw materials into manufactured products requires energy, primarily from coal and oil. China consumes one third of the world's coal and is now the second largest oil consumer after the United States.

It took nearly a quarter century for these changes to register in the 2003/2004 oil demand surge, the largest since the seventies. This increase (0.85 mb/d for China alone) was last equalled by the U.S. in the seventies

The key message here is that energy systems have great inertia: it takes a long time for policies to have an influence; often the consequences of policies are not necessarily as originally announced. A second important message is uncertainty: our understanding of China's oil demand is not much clearer today than four years ago and our ability to predict outcomes of its oil

consumption are as impaired today as a decade ago, mostly because of poor data.

However we can expect that China's policies aimed at continuing its current growth will increasingly impact on commodity exporting nations; but how and to what extent is difficult to ascertain. China, obsessed with security of supply, will fill its Strategic Petroleum Reserve; but we do not know what its policies will be with respect to use of those reserves. Other factors compound the uncertainty. For example, the growing economic disparity between the urban rich and rural poor, widening income gap between rich and poor (50% of income earned by 20% of the people), the breakdown of governance between the central government and local authorities and the tide of environmental protests and demonstrations in the face of ecological despoliation, raise questions whether China's continued growth in energy demand can necessarily be taken for granted (J. Gittings, *ibid*).

2.4. Rising Oil Demand and Prices

The surge in global economic growth, as noted, stimulated demand for oil. Since 2002 oil prices have climbed to new levels not seen in real terms for 25 years. Market analysts ask, "Are these prices here to stay?" "Have we entered a new paradigm?" Does a shift from excess capacity to tightness all along the production and delivery system constitute a fundamental structural change in the market? Is it permanent or is this temporary and prices will revert

to the mean of the last fifteen years? Before attempting to look to the future, we need to examine, 'How did we get here?'

Three generic groups of factors as implied earlier—Economic, Geopolitical and Technical—influenced to a greater or lesser extent the rise in oil prices and therefore other energy prices. We can better understand these in terms of how they gave momentum and durability to the price rise if we overlay them with a fourth; namely, 'Information'. In other words, how market agents perceived the first three sets of factors and interpreted or misinterpreted their importance influenced their actions in the market and determined market outcomes. Because these factors and events are generally well known and have been discussed and analysed at length over the past three years, they are reviewed only briefly here. Table I lists some of the events and factors that caused dislocations in the market. Key however was the disappearance of spare capacity.

Table I. **Some factors that influenced the increase in oil prices between 2003 and 2005**.

Economic	Technical	Geopolitical
• Record World GDP • Rising costs of inputs	• Japanese nuclear reactor shut-down • Production and Refining capacity pinch • Inventory management • Quality of marginal crude • Fuels specs • Hurricanes • Fires & upsets (refineries, upgraders, platforms and pipelines)	• Strikes in Venezuela, Nigeria and offshore Norway • Invasion of Iraq and affect on production and 'expectations'. • Terrorist attacks in other producing countries • Lukos Affair in Russia • Threat of sanctions against Iran

2.4.1. Economic Factors

It is generally held that this price 'shock' (it is debateable whether it can be called a 'shock') was demand-led and Asian-based. As noted earlier it is sometimes forgotten that since the late eighties most of the net growth in global oil demand occurred in the Asia

Pacific region. This was perhaps understandably forgotten as the Asian Financial Crisis reversed this trend and, combined with the fallout from OPEC's internal differences at the time over production strategy, led to the price crash of (2000). Global economic growth in 2004 approached 5%, a level not experienced since the seventies, and world oil demand surged, led by China, North America, the rest of Asia and the Middle East. To remind us of some elements behind that growth;

- North America, principally the United States economy, came out of a post-9/11/2001 slump, lubricated by pre-election year fiscal gifts in 2003/04 and historically low interest rates that in turn stimulated a mortgage boom, which together with a recovery in equity markets triggered a so-called wealth effect surge in household consumption (and ominously, record household debt).
- This surge in consumption saw increased U.S. imports of consumables and merchandise especially from China. China's expansion at or near double-digit levels was registered in a sharp increase in oil demand, mostly diesel and LPGs (Liquid Petroleum Gases, used as petrochemical feedstocks). Diesel demand was driven by increased transport by barge, rail and truck, certainly to move goods, but also to ship coal to power plants to alleviate congested rail transport. On top of that, fuel oil and diesel demand increased owing to the installation of independent oil-fired

generation sets to make up for shortfalls in grid-based electricity supply.

- China's growth stimulated growth among its Asian neighbours including Japan.
- China and India, with a combined population approaching 2.5 billion people, experienced dramatic increases in incomes adding momentum to the global economy and therefore oil consumption.

As this new demand absorbed some spare capacity, political and technical developments removed supply; the result was the virtual disappearance of spare capacity. The carry over of years of under-investment all along the delivery chain predisposed the system to geopolitical and technical stresses.

2.4.2. Technical Factors

The oil industry is a complex and integrated technical system. When it has excess capacity along the chain from production, transportation, refining and distribution, and in the associated industries that supply and service various links in the chain, the system is generally capable of absorbing and offsetting upsets, fires or interruptions along the chain. But when the chain is tight, when capacity has no margin or swing, upsets can generate major dislocations in the market and thereby affect prices.

An early technical development that put pressure on oil prices had an ironic origin: a problem in the nuclear accidents of Japan's largest power utility, TEPCO. In May of 2003 TEPCO was required to shut all 17 of its nuclear reactors to verify if the problem was a generic fault. During the shut-down over the peak summer period, Tokyo faced electricity shortages and oil imports increased by 200 kb/d. The irony of this incident is that part of the rationale behind Japan's nuclear power program was to reduce its dependence on oil imports.

The erosion of spare capacity over 2003 to 2005 was of central importance to the market dislocations. Reduced to as little as 0.6 mb/d, and mostly heavy sour grades, the world spare crude production capacity was inadequate to make up for upsets. Hurricanes Ivan in 2004 and Katrina and Rita in 2005 struck the US Gulf Coast, the world's largest single refining centre, at a critical time in the annual oil demand cycle. The 2005 storms removed over 1.5 mb/d of crude oil production and 75% of the region's gas production equal to 10% of U.S. gas supply, and shut in 20% of U.S. refining capacity. Their repercussions lasted for months.

Earlier in the summer, some observers blamed price increases on the tight US refinery capacity, but US refining capacity had been as tight in the mid nineties without increasing prices. But in 2004/05, global refining capacity was tight; specifically, capacity to process

the marginal heavy barrel. This was the bottleneck: inadequate upgrading capacity to process the available sour crudes to produce 'sweet' products.

This 'mismatch' between the quality of available crude and the refining equipment available to process it to meet the product slate demanded in the market helped drive prices above $70.

Under tight market conditions even accidents to non-producing equipment can influence the market. When the Thunder Horse platform, nearing completion in the Gulf of Mexico, was damaged during hurricane Dennis earlier in summer 2005, the forward oil price increased because it was expected to start producing a quarter million b/d in the fourth quarter.

It is not a new insight and therefore not surprising that tight capacity or even the perception of tight capacity can compound price volatility. While political and technical upsets are inevitable they are not predictable. Reducing volatility then comes down to increasing capacity; increasing capacity raises many other issues including the long standing question of who should bear the responsibility and cost of doing so.

2.4.3. Geopolitical Factors

The list of geopolitical developments that played a role in strengthening the rising price trend is long and not easily

disentangled from their technical consequences. The invasion of Iraq and its impact on that country's oil supply not meeting analysts' expectations, the strikes in Venezuela and Nigeria, which removed supply, the Yukos Affair and the dampening of the rise in output from Russia, all either eroded the margin of spare capacity or sent signals that increased the nervousness of buyers. The thinner the spare capacity became, the greater was the psychological impact of each event on the market.

There is a tendency to view developments in the history of oil markets through a political lens. There may be good reasons for doing so and, while no additional evidence was needed of the continuing importance of geopolitics, since the last AEC in 2002, as noted earlier we have several significant examples of how it impacts oil and gas both here in the region and elsewhere, notably the former Soviet Union. While the political forces influencing supply and demand of hydrocarbons might well be the most interesting for political scientists and provide a fecund source of speculation regarding motives, interests and intrigue, we risk drawing the wrong conclusions about the future path of oil and gas if we ignore other factors, not the least of which are technical/scientific, social and economic. Pivotal is information about the industry and how that information is interpreted or misinterpreted in decision-making.

Much has been written and said about the role of 'speculators' through this period. As noted, the fact that spare capacity in crude production was whittled down to historic lows and that much of that crude was heavy sour grades unsuitable to the refining stock and product quality specs had a significant influence on market participants' actions. The relationship between forward days' inventory and prices has been examined in detail. But if spare production capacity—essentially a form of inventory—is taken into account along with actual inventories, it is not surprising that prices increased. In other words, at the end of the day tight supply conditions prevailed—these were fundamentals, which commodity traders took into account in their assessment of the market's direction, and prices were bid up.

These oil market developments since the last Arab Energy Conference underscore how economic, technical and political factors and events elsewhere in the world can impact on oil and gas producing countries everywhere.

The price of the key benchmark or reference crudes continued to rise, given further momentum by news and events. Just one example underscores the importance of information, in this case, information from governments. The statement by the US Vice President in early 2005 that the SPR would only be used in the event of a major oil supply cut of 5 or 6 mb/d gave market players some upside price comfort, while OPEC's credible defence of an

implicit floor price provided protection on the downside. This was undone in the wake of hurricanes Katrina and Rita when IEA countries released strategic stocks. This merely underscores the importance of not getting locked into views of the future based on the past—the market and the forces acting on it are dynamic and evolving.

Analysts will be writing about the 2003 – 2005 price surge for years to come. It is unlikely that tight capacity along the supply chain and the mismatch of crude with refining capacity will be dislodged as the most critical on the long list of factors that drove up the price. The roots of that tight capacity can be found in the distant history of the oil market, and reflect the considerable inertia in the energy delivery system.

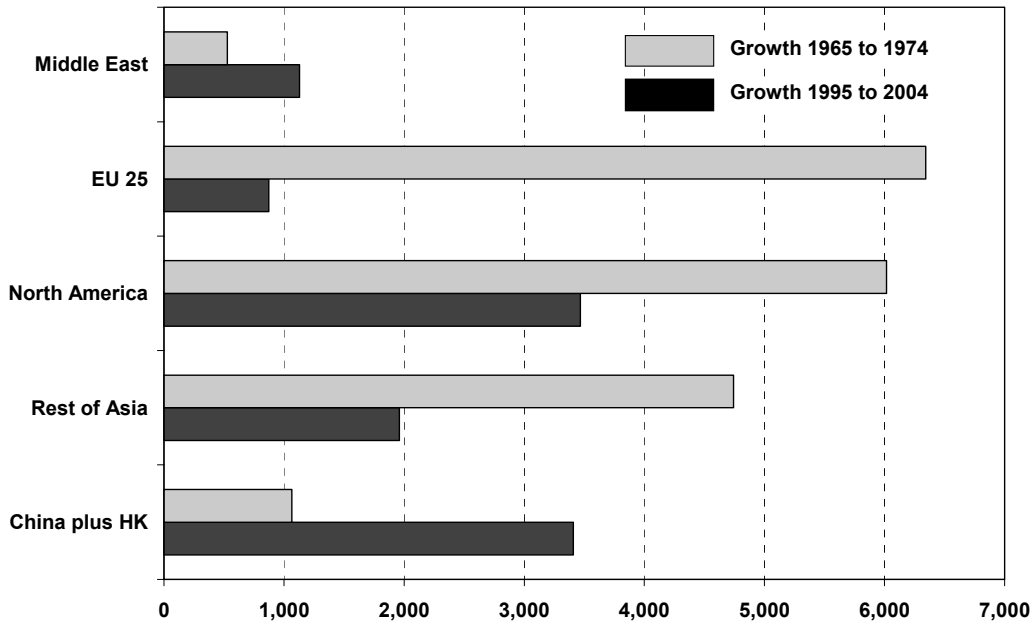
2.4.4. "1973 all over again?"

There might be an understandable inclination in the circumstances to wonder if the recent run-up in oil prices heralds a repeat of market developments after the 1973 oil price shock. On closer examination this would appear to be simplistic.

As we have seen, the susceptibility of the oil market to a shock is determined by pre-conditioning over many years. Therefore it is helpful to look at the years leading up to the 1973/4 and 2003/5 price increases.

Compared to the recent increase, leading up to the 1973/74 price shock, demand growth differed markedly in rate and loci. Figure 1 compares the different growth in oil demand for five key regions of the world for the 9-year periods leading up to 1974 and 2004.

Figure 1: Growth in oil demand in five regions over nine year periods prior to the 1974 and 2004 (1,000 b/d). Source: BP, 2005.



The following points are worth noting:

1. Leading up to 1974 World oil demand was growing at 6.6% or nearly four times the rate between 1995 and 2004; annual increments of oil demand averaged 2.7 mb/d (over 3 mb/d if the 800 kb/d *decline* in 1974 is

excluded). From 1995 to 2004, annual growth was 1.7% or 1.2 mb/d/year, essentially equal to the average annual growth over the last 40 years. However, as with most 'averages', this conceals much important detail

2. The OECD region (as defined today) accounted for 85% of the growth in oil demand of these five regions pre-1974, yet only 37% of the growth post 1995.
3. China added over three times as much oil demand in the recent period compared to the pre-1974 period (3.4 mb/d vs. 1.06 mb/d) when Japan accounted for over 70% of the rest of Asia's growth in demand.
4. What is now EU 25 accounted for a third of these five region's growth in oil demand over the earlier period; it hardly counted (8% of the five) in the post 95 period (increasing consumption by only 6%).
5. North America remains a core oil demand region—unchanged in accounting for 32% of the growth in the five regions over both periods.
6. The Middle East has become an important oil consumer.

These observations help explain the past as well as enable us to perhaps draw some propositions for the future. First of all, considering the higher oil intensity of their economies, we see why in 1974 the OECD countries may have felt the need to come together as a group of consuming nations in the face of rapidly rising oil prices. It is obvious why the United States led in that

initiative (particularly to develop strategic reserves), why it continues to play a central role in the geopolitics affecting global oil and especially why the original OECD Europeans along with Japan were so keen to support the US in this project—a project that for many reasons sterilized for some time any prospect of improving mutual understanding and cooperation between consumers and producers. Finally, the fact that oil is today superficially at least stable or declining in share in Europe's energy balance, while gas is increasing perhaps explains why Europe's preoccupations with 'security of supply' tend to focus more on natural gas—particularly given recent actions by Russia in its dispute with Ukraine.

The question arises whether Arab countries now face the prospect, as they did after 1974, of rising Non-OPEC supply and falling world demand. First of all supply prospects differ today. In the late sixties, the world oil industry had just been handed a whole new scientific framework for looking at the earth's mineral and hydrocarbon resources—Plate Tectonics. This led to a series of exploration models. New technologies such as better seismic, offshore exploration and drilling technologies and electronic data management systems permitted the industry to conceive of and pursue a series of new exploration plays that, within a higher price environment, soon added several million b/d of new supply outside OPEC, and with a demand collapse, an equal amount of OPEC capacity was idled. As we shall see later, some of these geological

concepts are about to soon feed through to the world's supply/demand balance, but they are unlikely to have the same relative impact as did post 1974 plays, and their pursuit was not in any way prompted by the recent rise in prices.

Virtually all the non-OPEC countries that increased production post 1974 have either stable or declining production today:

- Mexico's production increased from 0.5 mb/d to over 3.8 mb/d, but now faces major challenges to avert decline in output.
- Alaska reached nearly 2 mb/d; it is now at less than 0.9 mb/d and declining.
- The North Sea rose to over 6 mb/d in 1999 and is now declining rapidly, particularly on the UK side.
- Other countries such as China, Egypt and India whose production contributed to the growth in post-1994 Non-OPEC output are struggling to maintain production or are declining.

However, there are new suppliers today.

- Russia, while not a new player *per se*, has more or less returned to production levels achieved prior to collapse of the Soviet Union. Indeed, had Russian output not recovered, it is likely oil prices would have risen before 2003 as output increases in the rest of Non-OPEC did not keep up to the growth in world demand.

- New continental margin and ultra deep-water plays off West Africa, Brazil and the Gulf of Mexico are yielding new production but on a relative basis they are unlikely to have the same impact as the new supply in the earlier period.
- The Caspian, considered to have high potential, is increasing production, but is not expected to exceed 3.5 mb/d and is significantly delayed compared to expectations.
- Unconventional oil is the only source of new supply that will continue to increase.

As discussed in greater detail later, while new plays and new sources are certainly contributing supply they are unlikely to do so at a pace to offset decline of conventional oil from mature fields, which is faster than it was in the seventies, nor are they apt to represent a comparable share of total production.

Turning to demand, the underlying macroeconomic conditions are markedly different for the two periods. It usually takes a year to eighteen months for a price shock to feed through into lower economic growth so it is still too early to tell at time of writing. Certainly, another fundamental difference today is that China and India with surging demand do not in any way resemble the inflated, energy-intensive and energy-wasting OECD economies of the early seventies, poised to shed a great deal of energy fat.

What is perhaps most important is the 'learning curve' of principal players in the world oil market. Industry, government, consumers and producers all 'learned' something through the 1970's and early eighties period of higher prices. International oil companies, responsible for about 15% of world output, implicitly do not all believe that higher prices will endure. While their level of investment has certainly increased over 2000 levels, they prefer to return most of their incremental earnings to shareholders. In the seventies on the other hand consumers and producers all believed that oil prices would continue to increase and they behaved accordingly.

The list of differences is long:

- Two billion more people.
- Higher incomes and lower oil intensities today;
- Expectations today that prices will not stay high versus almost universal expectations in the seventies that prices would continue to increase (the principle of contrariety of consensus must not be forgotten—if everyone believes prices will fall, they will not invest in new supply and consumers will continue to consume in the expectation that lower prices are around the corner: prices are maintained or increase as a consequence);

- The recent price increase has been relatively gradual over nearly three years versus a quadrupling of prices in less than 6 months in 1973/4;
- Today's price increase occurred as OECD economic growth was rebounding post 9/11 and Asian growth recovering from the Asian Financial Crisis in 1997/8;
- Depreciation of the dollar muted the effects of the oil price increase in many countries;
- Record low interest rates, although more recently increased in the U.S., have increased spending;
- Demographics and job flexibility in the OECD region differ—today the 'baby-boomers' are beginning to retire and as a cohort have relatively low debt, whereas in the seventies they were taking on debt; today the aging population is apparently consuming and generating job creation (health care);
- Active trade unions successfully demanded wage increases in the seventies, whereas unions are virtually silent today;
- Industries most affected by energy prices readily restructure and/or migrate today compared with the seventies, and those that migrated twenty years ago are generally in countries with offsetting lower input costs (petrochemicals in the Middle East and labour in Asia);
- Government expenditures are increasing today as opposed to contracting in the seventies;

- Today, producing countries in particular are directly involved in and therefore more sophisticated in their understanding of markets and more importantly better positioned to influence the market.
- The policy responses of consuming countries have so far been muted; there simply is less scope and desire to repeat the 1970s policy errors, such as price controls, that actually compounded the problem (although many poor countries have not passed through the recent increases).
- Consuming countries have strategic stocks and they coordinate with each other and with producing countries regarding their release—even if not used, knowledge of their existence and that they could be used sends an important signal to the market.
- Finally monetary policy in the face of the inflationary effects of higher energy prices resulting from oil price shocks has evolved over the years. Today there are more central banks that are more independent and they have 'learned' their way through the various price shocks and now take a more measured approach to oil price increases and their inflationary effects. A significant change occurred after 1980 when the US Central Bank turned to money supply rather than interest rates to fight inflation. The economic impacts of energy price changes since have been significantly muted (see for example, J.D. Hamilton, 2004, *Oil Prices and Economic Downturns*; John B.

Taylor, 2002 *A Half Century of Changes in Monetary Policy*). An exhaustive review of this much-analysed subject is beyond the scope of this paper but new research is needed.

The global economy has changed dramatically since the early seventies. Given that market participants have a new suite of risk management instruments to deal with price volatility, there may not be such a thing as 'conventional wisdom' especially if that 'wisdom' is grounded in the seventies; of if there is, it needs to 'catch up' with current developments.

While OECD regions are still important, especially North America, the new players that will most influence growth and in turn impact on oil and gas markets and therefore on the Arab countries are outside the OECD, changing the world's geopolitical landscape for these commodities. Many of these players have relatively poor economic statistics, political regimes of doubtful stability and internal tensions that could lead to disruptions, thus uncertainty is more likely to increase rather than decrease.

2.5. Structural Change in the Energy Industry

An enduring theme in the history of energy is the changing structure of the industry as it responds to business cycles and changes in regulations, government policy and the general business

environment. The surplus capacities in most fuels and in power generation in the wake of the recessions in the early eighties and the crash in oil prices in 1986 created an environment into which two significant interrelated themes were let loose, with major impact on energy to this day: these were regulatory/microeconomic reform and industry consolidation.

With unemployment in the OECD region exceeding thirty million by the late eighties, governments launched reforms of the input industries—energy, telecoms, transport and banking among others. The idea was simple: in a rapidly globalizing economy, competition in the input industries would reduce costs and improve productivity, bolstering competitiveness of firms, enabling them to retain or employ workers. In a world of surpluses, this set of microeconomic policies met little political opposition in most OECD countries.

After the collapse of the Soviet Union and the waning of its influence in many developing countries, the international financial institutions enthusiastically advocated this model—the so-called 'Washington Consensus'—for developing countries and economies in transition. Many countries opened their energy (electricity in particular) sectors to direct investment by foreign firms. Countries for awhile at least competed with each other to attract investors. For a variety of reasons mostly owing to poor policy design and macroeconomic failure, this reform failed in many countries. Now

a new cycle of government retrenchment is underway, coming at a time of rising commodity prices.

The oil industry also restructured in the face of weak oil and gas prices during this period. With the oil price bouncing off a floor of around $16/bbl, most private oil companies (POCs) used this price to test the commerciality of potential investments. They could best improve returns to shareholders by growing through mergers and acquisitions and cutting costs rather than through organic growth via the drill bit. Little exploration took place apart from some new potentially high impact plays in the deep offshore, in newly opened areas in the Former Soviet Union and in unconventional oil, induced by generous fiscal terms.

With the largest POCs now having to replace in some cases twice the volume they needed to replace in 1990, materiality correspondingly increased while the number of areas offering such opportunities shrunk. This has driven the industry to seek access to new, high risk, high impact ventures in the FSU and in unconventional liquids (discussed later). At the same time new players have entered the game of international exploration in the form of the National Oil Companies (NOCs), principally from Asia.

There are many types of National Oil Companies. Their remits vary considerably: they range from remaining strictly domestic; domestic in the upstream and international in the mid and

downstream; to integrated domestically and internationally. And, the degree of state ownership and direction varies among NOCs. There is no 'typical' NOC, although what typifies all NOCs is the strategic influence of their state shareholder, an influence that is more direct in some than in others.

There has been considerable discussion recently on the international activities of the state-owned oil companies from China and India. Their foreign activities reflect conscious government policies of their home states aimed at establishing global firms developing equity oil to offset the import bill at home. While there is anecdotal evidence they are under-bidding the POCs in upstream bid rounds, it remains to be seen whether they will be more or less successful than the POCs in discovering and developing oil.

It is too early to tell whether this phenomenon has much relevance to the international oil market. So far, the combined international production of the Asian national oil companies is minor. These companies might of course learn their way into the international upstream and resemble in every way their private counterparts. On the other hand, they would alter the geopolitical landscape of international oil and gas if their government owners backstop them with policies and activities that go beyond the realm of hydrocarbons. Certainly the case of the attempted acquisition by a Chinese state company of the American company, UNOCAL,

brought into focus the political sensitivity of these activities in the United States, while making a mockery of U.S. policy avowing open markets. Mixing oil and foreign policy is of course not a new game—the difference today is how it is played, by whom and to whom and to what ends and whether the new arrivals' goals are any different from those of the traditional masters of the game. But this is a new dimension that will impact on oil and gas producing Arab countries.

2.6. Oil Production in the Former Soviet Union

Estimating non-OPEC oil production (along with world oil demand) eighteen months to a year in advance is important to OPEC in order to set its production policy. Non-OPEC production outside the Former Soviet Union (FSU) has only met a quarter of the increase in world demand since the mid-nineties. The FSU has met nearly half of the remainder, OPEC the rest. Since 2002 non-OPEC supply outside the FSU has actually declined while FSU supply increased by nearly 2 mb/d. However since the 4th quarter 2004, year on year FSU production each month has declined. These trends have prompted many observers to conclude that the FSU is a spent force, at least until they can develop major new fields, and that the rest of Non-OPEC will struggle to reverse or even stem its decline rates.

Russia accounts for over 80% of FSU production. Therefore, its policies will be pivotal to world oil markets and thus the prospects

for Arab countries. Since the last AEC, structural changes in the Russian oil industry and in particular the Kremlin's relationship with the oil and gas industry, have unnerved markets and investors. The Yukos Affair, besides tightening world prices during the spring and summer of 2004 (when its managers said they would have to halt rail shipments of oil to China), signalled much stronger control by President Putin's government over the oil industry. Secondly, the manner by which state-owned Rosneft acquired Yukos's principal asset, Yuganskneftegaz, and subsequently Gazprom's acquisition of Sibneft in September 2005, signalled unequivocally that the Russian state intended to reassert its control over the country's oil production. This was reinforced by deliberations over the sub-surface law restricting foreign ownership to less than 50%. Finally, taxes continue to exert downward pressure on Russian oil production: heavy excise taxes on exported crude appear to have had a dampening effect on oil development. The government is considering differentiated tax rates depending on the age and depletion of oil fields, but this kind of arrangement requires a very sound and transparent framework of resource governance and cost accounting to make it effective.

At the same time, developments in the Caspian region continue but they have failed to live up to expectations of some analysts in the early nineties. Development of the major discoveries and pipelines to move oil to market has been delayed. Here too (Kazakhstan) government has altered the terms of hydrocarbon taxation and

ownership, delaying projects and undermining confidence of investors in pursuing further prospects.

As China presents uncertainty on the demand side, the FSU and Russia in particular pose the principal question marks on the supply side of oil markets. For Arab oil and gas producers, second-guessing what OECD countries might do to affect hydrocarbon demand and to a certain extent supply, has given way to the challenge of estimating market balances determined by far more complex forces and manifestly less transparent countries.

2.7. Developments in Natural Gas

2.7.1 Introduction

The Institute's report to the 7th AEC took a pessimistic view of prospects for Arab gas*: "The USA* (gas market) *is out of reach because of distance, and Europe is surrounded by gas suppliers... (*leaving) *Asia…the major option*." This situation has changed fundamentally. First of all, LNG costs have continued to decline. Moreover the tripling of gas prices in North America, one of the most significant 'surprises' in global energy since 2002, has dramatically changed LNG's prospects. On the other side of the Atlantic, the UK became a net gas importer. While not a 'surprise', its onset has generated an energy policy debate with some familiar themes, notably whether to replace nuclear power

plants with new ones or rely on increased volumes of imported gas for power generation. Also, western European gas markets remain largely dominated by national champions as liberalization has not proceeded as far as expected. In the Asia-Pacific region, Japan's gas consumption continues to take the lion's share of the world's LNG but has not grown significantly, while China and India still remain as large potential markets for gas, growing slower than some observers had anticipated. India however has received its first volumes of LNG from the Middle East.

These and other developments are examined in this section. Considering the increasing prominence of Arab countries in international gas trade, the implications of these developments in the markets will be self-evident.

2.7.2. A Global Gas Market

Since the last Arab energy conference, a frequent theme at natural gas conferences is whether a global natural gas market will develop. To summarize a book by the Institute on the subject (J. Jensen, *The Development of a Global LNG Market, 2004*), while there are increasing numbers of short term cargoes arbitraged in the Atlantic Basin, these sales do not necessarily constitute a global spot market; given the contractual nature of LNG projects with most of the output committed under off-take contracts, it is unlikely that a market for LNG resembling the North American

pipeline gas market, let alone the world oil market, will evolve in the foreseeable future.

2.7.3. North America

Consuming 30% of the world's gas with only 4% of world reserves, North America epitomizes the geographic market/resource 'mismatch' in hydrocarbons that will increasingly dominate the global energy sector. The persistent gas bubble in North America has ended marking a fundamental shift that will reverberate to other gas markets and, given inter-fuel price dynamics in North America, to oil markets as well. The key North American reference (basis) price at Henry Hub, having languished around $1.60/mmBtu through the nineties, moved up above $2.00 in 2001. However, a warm winter caused prices to sag and drilling immediately declined as the industry assumed the market had reverted to its historic mean, characterized by over-supply. But by the following spring (2003) the situation had changed dramatically; forward prices were in double digits and it was clear, at least to the Chairman of the Federal Reserve if not to others, that America faced serious problems in natural gas supply.

The Secretary of Energy called on the National Petroleum Council (NPC) to provide an analysis of future natural gas supply. Its subsequent report in fall 2003 stood in stark contrast with its very bullish and optimistic outlook just four years earlier. Within that

short period of time, using prices *twice* as high as in 1999, the industry's projection of Lower 48 gas production for 2005 was *reduced* by >20%, an amount nearly equal to the total world LNG production at the time. The principal sedimentary basins serving the continent were performing seriously short of expectations and their prospects were now seen by the NPC as poor.

To put some dimensions to the North American gas supply problem, compared with 1990, in 2003 with gas prices three times higher, drilling three times as many wells up to 20% deeper, the industry found one third less gas; while initial production per well increased owing to application of new technologies, first year decline rates had increased by 50 to 100%. Because the base is declining so rapidly, the U.S. industry now has to add twice as much deliverability just to stand still. In the Western Canada Sedimentary Basin (WCSB), the second largest source of North American gas, compared with 1990, three times as many wells in 2002 found just one sixth as much gas.

The Council predictably called on governments to lift drilling moratoria in offshore and Arctic areas, to expedite approvals of LNG terminals and be more flexible on emissions regulations that influence fuel-switching in power generation.

The Council projected that, given the proper regulatory framework, the continent's future demand can be met by LNG, unconventional

gas (coal bed methane, shale gas, and tight sands gas), frontier regions (deep offshore and new offshore areas) and the Arctic (Mackenzie Delta and Alaska). A long-standing project to move gas from the Prudhoe Bay oil field in Alaska (into which associated gas has been re-injected) is under active consideration. A critical market concern is that its start-up volumes of 4.5 Bcf/d, equivalent to America's current LNG import capacity, would overwhelm the market, significantly reducing gas prices (and therefore LNG netback prices) for two or three years until the Alaskan volumes are absorbed in market growth. In that the marginal LNG supply to North America is from the Middle East, several Arab countries have a particular interest in the timing of the Alaskan gas pipeline.

Mexico, up to recently, imported from the US a volume of gas nearly equivalent to US imports of LNG. Apart from serving as a somewhat reluctant bridge for LNG imports to serve the U.S., Mexico will probably remain largely irrelevant to North American natural gas balances as it is not likely to undertake the difficult but necessary regulatory, fiscal, structural and industrial governance reforms that could begin to create the necessary conditions to stimulate exploration and development of significant new gas resources.

A measure of the abrupt turnaround in North American natural gas prospects can be found by comparing the US DOE/EIA's Annual Energy Outlooks of 2002 (AEO 2002) and 2005. In 2002 the EIA

projected Canadian imports to continue to fill the gap between rising US demand and falling domestic supply out to at least 2020 while LNG imports were projected to rise from a very low base of 9 bcm in 2002 to 25 bcm by 2010 and stay at that level to the end of the projection period. By 2005 LNG imports had already reached 21 bcm and in its 2005 report the EIA increased its projection of required imports for 2020 to 154 bcm—over 6 times the volumes it projected in 2002 for 2020.

Further underscoring the uncertainty of the continent's gas prospects, the EIA's preliminary 2006 outlook (AEO 2006) reduced expected LNG imports for 2020 to 104 bcm). This reduction is equivalent to 36 million tonnes of LNG, the output of 4 or 5 world scale LNG plants. The Agency attributes the reduction to projected higher LNG prices owing to increased global LNG demand making its price less economic in US markets.

As of the end of 2005 North America has five terminals (capacity 45 bcm), nineteen proposed and approved by federal authorities (230 bcm) and another 20 terminals (265 bcm) proposed. While inadequate terminal capacity was thought in 2003 to be a concern, today analysts worry that LNG supply is not, nor will be, available in time to meet growing demand. Forward natural gas prices above $10 reflect this perception and record front month prices in late 2005 above $15 underscore a fundamental driver of natural gas prices in North America—weather.

Large natural gas supply projects have important political features, whether pipelines or LNG, international or even domestic. From local approvals for LNG regasification terminals, pipeline routing to large-scale transit pipeline projects, resolving the political elements is essential. Therefore we might anticipate that the United States' growing dependence on LNG imports will add to the already considerable geopolitical dimensions of natural gas. On the supply side, the emergence of the Gas Exporting Countries Forum has been interpreted by some commentators as contributing to the further politicization of international gas trade, in particular of LNG.

The United States' vulnerability to the tight continental natural gas supply was underscored by the repercussions of hurricanes Katrina and Rita, which reduced Lower 48 gas supply by 5.6 Bcf/day, more than the total gas consumption of France. This came at a critical time in the annual natural gas cycle, when storage injections normally need to accelerate. Over fifty percent of U.S. homes that require heating use natural gas. The production of nitrogen fertilizers, the largest industrial use of natural gas in the United States, has been reduced placing US agriculture increasingly reliant on imported sources of nitrogen, compounding the strategic and geopolitical dimensions of gas in North America. In 1993 13% of US electricity was fuelled by natural gas; in 2005, after the addition of over 200 GW of gas-fired capacity to 25% of total capacity, gas generated 19%. Even though gas prices increased by more than

40% from 2004, gas use in power grew by 8%. Higher gas prices are flowing through to consumer electricity prices and are affecting heating oil prices, which affect diesel and jet fuel prices and therefore influence the volatility of crude prices.

Finally, as noted, the principal determinant of natural gas price volatility in North America is weather. Relatively local weather events such as a cold snap in New England causing a spike in prices of heating oil, a reduced snow pack in the Rocky Mountains leading to greater summer use of gas, or a mild winter in the WCSB that reduces drilling and new gas deliverability can affect international fuel prices, in turn influencing trade and markets. Therefore while we might not expect a global gas market, we should anticipate increased global effects of upsets and shocks in the very weather-driven North American natural gas and power generation market.

2.7.4. United Kingdom

If the UK experiences a colder than normal winter of 2005/06, especially towards the end of the season, it could tip the public debate currently underway regarding future energy supply in the UK, regarding fuel for power generation. At time of writing, the government has launched a review of policy in which it will examine replacing nuclear plant scheduled to close starting in 2008. As in the United States recent Energy Policy Act, a re-examination of the nuclear option is expected.

The debate so far in the United Kingdom regarding natural gas has emphasized the security of supply elements of relying on foreign sources of gas for both direct uses and indirect use in electricity generation. Because new pipeline connections with Norway and the continent as well as LNG import terminals are under development, a tight gas supply situation if it develops is likely to be temporary. But, as noted, its policy effects could be long-lasting. In this context, the mid-winter timing of Russia's gas price dispute with Ukraine and Russia's decision to cut off supplies has only added to the UK's and western Europe's concerns about security of supply.

2.7.5. Russia

Russia, with the largest natural gas reserves, the largest producer and exporter is increasingly exerting its influence and weight with some of its buyers and with transit states, the most important of which is Ukraine. To alleviate its frustrations with transit states, Russia has built a pipeline (Blue Stream) across the Black Sea to serve south eastern Europe and is commencing the North European pipeline across the Baltic Sea to serve northern Europe.

In eastern Russia, while the Sakhalin gas development projects continue, significantly over budget, there appears to be no movement on what might appear to be the most logical development; namely, pipeline gas to China to help meet its clean

fuel requirements. However, China proceeded with an uneconomic pipeline from western China, into which it might in the future receive gas from Kazakhstan. China also continues to plan LNG terminals along its coast but there are few contracts signed for delivery at the prices China seems to expect.

Russia's Gazprom, the largest gas producer in the world with 20% of the world's gas reserves, has indicated its intent to enter the LNG business and companies have lined up to participate in projects in Northwest Russia and Barents Sea (Shtokmanovskoye and Ust Loga on the Baltic Sea). If this strategy comes to fruition, Russia will compete with Arab LNG producers in the Atlantic Basin market. But Gazprom faces huge challenges. With stagnating growth in its traditional and premium market of Western Europe, while obliged to subsidize domestic gas prices, its cash flow has declined at a time when it faces major new investments required to sustain production, while costs are rising.

The New Years 2006 cut-off of gas to Ukraine has been widely interpreted as politically motivated demonstrating Russia's readiness to use its gas and perhaps its oil resources as instruments of international influence and power. As Russia readies to host the 2006 G8 Summit in St Petersburg—a summit billed as an 'energy summit' with the theme of 'global energy security'—the world will be watching to see whether the G8 partners share Russia's vision let alone its tactics in dealing with 'energy trade'. Certainly the use

of energy as a political weapon by Russia, if that is its game, will only serve to cause some leaders to question increased reliance on gas imports, if the world's principal exporter is prepared to act in this way. Russia's action also raises old ghosts of the oil weapon and rekindles debate about 'energy self-sufficiency'.

2.8. The Peak Oil Debate

Periodically since the dawn of the 'mineral oil' era in the mid nineteenth century, there have been warnings of the impending peak and decline of oil production. In the last few years this old debate has re-surfaced. Perhaps different this time, its adherents seem to have managed to catch the attention of major news organizations and of governments. Their view has been strengthened by the decline of oil production in many countries, notably the North Sea.

Without re-opening the debate here, suffice it to say that this issue will continue to be on the international energy agenda. At the centre of the debate is the subject of reserves. At one level, reserves, their measurement and reporting is an important matter for private firms and for securities regulators whose responsibility it is to ensure transparency and accountability of firms to their shareholders. It may seem like a metaphysical subject to those only interested in the political economy of state-owned and controlled resources, but it has real commercial relevance to the valuations of private firms, it affects their business strategies and therefore

potentially influences oil market dynamics and by implication affects investment strategies of Arab countries.

The Securities Exchange Commission (SEC) of the United States continues to use criteria for reserves measurement and reporting (December 31st) that were promulgated in the late seventies when for example 3- and 4-D seismic did not exist to estimate reserves without delineation wells. Also, oil prices were posted; the daily volatility experienced today makes a mockery of the SEC's end-of-year price date. The SEC's rules with respect to certain unconventional oil are both dated and have extra-territorial effect. It is likely the SEC will change its rules but it is not clear what effect this will have on the pace, scope and location of exploration and development.

The subject of 'reserves' in the broad context of 'peak oil' and in the narrow commercial area of measurement for purposes of valuation of firms and for their capital development programs could persist as a source of misunderstanding and even an irritant within the context of producer consumer dialogue. Certainly when it comes to making projections of supply out twenty years and beyond, having confidence in reserves numbers becomes important.

3. Oil and Gas Supply and Demand Outlook to 2020

3.1. Introduction

In this chapter we look to the future, out to 2020. We have not used an econometric model to do so. Rather, we examine the recent projections of respected institutions that make it their business to publish energy outlooks on a regular basis. In the analysis that follows we use the OPEC Secretariat's 2004 *Oil Outlook to 2025*, (OO 2004); IEA's *World Energy Outlook* for 2004 (WEO 2004 and WEO 2005, which focussed on the Middle East and North Africa oil and gas outlook) and the US DOE/EIA's *International Energy Outlook* for 2005 (IEO 2005). References are also made to projections by certain banks and consultancies and the Institute of Energy Economics of Japan (IEEJ). The following discussion draws on analyses of the reference cases in these outlooks and updates our own oil supply outlook from early 2005 (http://www.oxfordenergy.org/pdfs/WPM29.pdf).

The overwhelming message when taking this approach is that there is enormous uncertainty as reflected in the wide range of outcomes projected by competent and seasoned practitioners of the difficult art of making energy projections.

3.2. Overview of Primary Energy Demand and Supply

Recent energy demand and supply projections provide a basis for discussing how future conditions of the global energy sector in general and oil and gas in particular might be expected to influence Arab countries.

Energy projections by these institutions and others over the past quarter-century generally concur on the following stylised propositions:

1) World primary energy demand will continue to grow in line with economic growth, at a coefficient of between 0.53% (IEA) to 0.78% (IEEJ).
2) Emerging economies, especially Asian, will underpin the largest share of the growth in global primary energy demand.
3) Fossil fuels will continue to account for over 80% of primary energy supply and an even greater share of the growth in supply; in other words, a fossil fuel future;
4) Oil will continue to account for the largest share of primary energy, followed by coal and natural gas, but of these three fuels natural gas supply will grow the fastest, eventually surpassing coal's share.
5) Oil consumption will continue to concentrate in the transport sector where no significant alternative to oil is likely to be deployed within the timeframe of most outlooks; oil demand remains relatively inelastic to price.

6) Oil growth will be led by non-OECD transport demand; by 2020 Non-OECD oil demand will probably equal that in the OECD.
7) The growth in natural gas supply will be largely underpinned by demand by the power generation sector, expected to account for sixty to seventy five percent of the growth in demand in most markets;
8) Increasing shares of oil, gas and coal will be traded internationally.
9) The shift from the use of traditional fuels to commercial fuels in developing countries will accelerate; together with transition economies, developing countries will account for more than half of the world's primary energy consumption by 2010.

These outlooks rest on several general but important assumptions and biases:

1) There will be no significant change in government policies aimed at the energy sector;
2) Resources of all fuels are assumed adequate to meet demand at least out to the ends of projection periods (2025 to 2030).
3) Prices are assumed (exogenous), however in reviewing the history of projections, when prices are low, analysts tend to project prices to remain low and then slowly rise; when prices are rising, they tend to project rising, then higher prices at a stable level.

4) Agencies tend to project shares of non-fossil fuels, such as nuclear, hydro and wind, in line with the experience and policy-preferences of the agencies or of their overseeing government(s).

These perspectives on the future raise a set of questions and uncertainties relating to the geopolitical and international context for energy trade, the nature of markets and prices, the pace of technological change for the production, transmission, transformation and consumption of fuels and the associated environmental and social impacts. But in terms of planning, especially for countries dependent on hydrocarbon export revenues, it is the quantitative details that raise the most important questions and challenges.

3.3. Oil and Gas Demand and Supply

The table below presents several key assumptions and projected outcomes from the IEA, OPEC and EIA/DOE. Such outlooks should not necessarily be used as planning tools per se. Rather they are an indicative basis for discussion of possible futures depending on the assumptions behind them and some understanding of how changes might affect outcomes. Respected analysts can project significantly different outcomes even over very short periods. For example, between projections for 2010, only 5 to 6 years from the date of the projection (well within the

industry's planning and decision framework for deploying capital for new developments), the expected world demand for oil varies by as much as 5.6 mb/d; the call on OPEC varies by 4.4 mb/d and natural gas demand varies by 113 bcm, equivalent to nearly two thirds of the total LNG traded in 2004 (which is relevant given that LNG is the marginal supply for most gas markets).

Projections for world oil demand in 2005 made just three years before (2002) by the DOE, DRI/WEFA, PEL, PIRA and Deutsch Bank varied by 4.3 mb/d (85.4 – 81.3 mb/d). Including the IEA's, they ranged by 5.6 mb/d for 2010, 7.7 mb/d in 2015 and 8 mb/d in 2020. In other words, projections out to the end of the next decade (2020) varied by an amount nearly equal to Russia's oil production in 2004.

Table II. **Comparison of key assumptions and outcomes of different energy projections**

	IEA	OPEC	DOE/EIA	Range
Global GDP to 2010 (Average Growth)	3.2%	3.8% ppp	3.9% ppp	0.7%
To 2020	3%	3.7% ppp	3.9% ppp	0.9%
World Oil Demand 2010 2020 Rate over period	 90.4 106.7 1.6% to 2030	 88.7 105.8 1.8% to 2025	 94.3 110.7 1.9% to 2025	 5.6 mb/d 4.9 mb/d 0.3%
OECD Share of Oil Demand 2010 2020	mb/d (%) 49.7 (54.9) 54.4 (50.9)	mb/d (%) 51.2 (57.7) 54.5 (51.5)	mb/d (%) 47.7 (50.4) 52.2 (47.0)	 3.5 mb/d 2.3 mb/d
OPEC Share of Supply 2010 2020	mb/d (%) 33.3 (36.8) 49.8 (46.6)	mb/d (%) 34.1 (38.4) 48.9 (46.2)	mb/d (%) 37.7 (40) 46.8 (42.2)	 4.4 mb/d 3.0 mb/d
Oil Price Assumed	*$22 to 2010 $29 by 2030	**Fall to $20 - $25	***$31 by '10 $35 by 2025	
Gas Demand (bcm) 2010 2020 Growth Rate over period	 3,225 4,104 2.3%	 3,112 4,231 3%	 3,156 4,011 2.3%	 113 220 0.7%

Source: IEA WEO 2004; OPEC Oil Outlook to 2025, 2004; DOE/EIA IEO 2005 (Conversions using BP factors, .028 bcm/bcf and 1.111 bcm/mtoe. * Average IEA import price; ** OPEC basket price; * Average refiner acquisition cost to U.S.**

3.4. Comparison of main elements of different energy projections.

In terms of end-uses of energy, the transportation and industrial sectors are expected to grow faster than residential and commercial sectors although in the emerging economies, growth in consumption of commercial fuels is expected to be strong across all end-use sectors as larger shares of the population migrate from rural areas to urban centres. This migration is accompanied by a shift from reliance on traditional biomass fuels to commercial fuels.

When economies modernize they tend to rely on increasing amounts of electricity. With the continued globalisation of trade and the migration of a greater share of manufacturing to developing countries, the increased global utilization of information technologies and penetration of electrical appliances in households, electricity is expected to register the highest rates of growth in final consumption among all forms of energy (with the exception of certain renewables). The share of final energy delivered by wires will increase by 25% (from 16% to 20.3%) (IEA WEO 2005). Developing countries are expected to register the greatest growth in electricity use; more than doubling by 2030 with a 65% jump in wires-delivered final energy, from 12% to nearly 20% of final consumption.

The fuel that is expected to provide the greatest share of power generation is natural gas; where gas is available it will be the fuel of choice for power generation owing to its operating efficiency, ease of development, flexibility, modularity, and lower costs compared with other fuels. In most outlooks gas for power generation accounts for 50% to 60% of the growth in global gas demand and up to 70% in some regions. However, rising natural gas prices in certain markets (North America, southern cone of Latin America and Western Europe) could see an easing off in the development of gas-fired power in favour of coal and nuclear. Some governments are realizing that gains in energy efficiency and renewables (principally based on wind power) are not likely to be sufficient to meet their national and international environmental goals. Thus, changes in policies and public attitudes along with government's 'double security of supply' concerns—dependence on imported gas for both direct uses and for electricity generation—could result in less gas in power than expected.

The industrial sector is the next largest sector for gas demand growth, as it is expected to be under pressure to use cleaner burning fuels to meet local, national and international environmental policy objectives.

Notwithstanding expectations based on environmental perspectives, coal consumption is projected to continue to increase, primarily in power generation, direct use in industry (steel) and in

other heavy industries. The largest single fuel use in the world is China's consumption of coal (957 Mtoe), accounting for 34% of the world's coal consumption in 2004. [The world's second largest single-country fuel-use is the United States' consumption of oil (938 Mtoe)—25% of world oil demand in 2004.] Coal will maintain its share of world power generation of over 40%. In no region of the world is coal expected to decline in power generation out to 2020. In China over 80% of power will be generated by coal; in India over 70%.

Few indicators are more compelling in terms of what is happening to China's and India's energy demand growth than is the pace of connection to electricity systems—by 2030 the amount of final energy consumed as electricity will have increased in China by 65% and in India it will have more than doubled. By 2025 these two countries are expected to increase their combined population by today's total population of North America. The gearing of projected population growth with continued urbanization and the highest economic growth rates in the world help tell the future story of energy demand (and implicitly future energy trading and investment patterns, environmental challenges and geopolitical tensions affecting energy trade and markets).

Most forecasters do not expect an increase in the use of oil to generate electricity. Continuing decline of oil in power generation in the OECD countries will be offset to some extent by increases,

in particular in the Middle East, which today has the highest ratio of oil-fired power operating at some of the highest load factors for any oil fired plant in the world. However, even in the Middle East, the share of oil-fired power is anticipated to decline giving way to much greater use of natural gas for power. This trend will be reinforced in a scenario of higher oil prices as oil has greater value exported than burnt in boilers to generate power that is sold in many Arab countries at prices below cost.

Assessing the prospects for oil-fired power is invariably complicated by uncertainties and inevitable surprises. Since 2002, notwithstanding higher crude oil prices, the use of oil in power generation has increased in some markets. Three examples illustrate the complex factors behind this counter-intuitive development.

A) Japan had to revert to oil in power when TEPCO had to close its nuclear reactors;

B) China's increased demand for oil since 2003 is well known. Most of the demand growth was attributed to the transport sector, and much of that to truck coal to power stations as the rail system was over-loaded. But a significant share of the increased oil demand in 2004 was to fuel diesel-fired generation sets to meet industrial power requirements as peak power demand growth outstripped capacity additions in the grid-based system. The IEA estimates that some 250 to 300 thousand b/d of extra oil

demand growth in 2004 was attributable to these back-up power generators. It is assumed by most analysts that this was a one-off event and that oil in power generation in China will decline once adequate grid-based capacity (coal, nuclear and gas) is available. But this remains an assumption.

C) In the United States since 2002/3, as natural gas prices increased from $3.37 to $13.25 (3Q/05), the demand for residual fuel oil increased by over 200,000 b/d. On the one hand, high natural gas prices favoured HFO in power generation. Working from the other side, the mismatch in refining capacity and crude quality led to HFO inventories far exceeding historical levels by 2004; then the mismatch was further exacerbated by the 2005 hurricanes. This is expected to be a temporary aberration; as more heavy crude conversion capacity is added, including in producing countries, HFO use should decline as a marginal fuel in power generation.

Of course most oil is used in transport, particularly road transport and in private vehicles. The underlying driver of demand for transport services is economic growth (incomes). A key measure of oil use and potential depends on vehicle penetration or ownership rates—that is, the number of vehicles per 1000 people and the rate of change in this indicator. The United States has the highest ownership (775). This may well be close to saturation. On

the other hand, Western Europe with nearly 450 cannot be expected to reach US levels. Nor, more starkly, could we anticipate that China, at 12 would reach current U.S. levels—the Earth's resources simply could not achieve it, let alone sustain it if based on the internal combustion engine.

Besides saturation levels per country, oil demand in vehicles will be influenced by intermodal shifts, vehicle efficiency improvements, vehicle mix (large vehicles versus small vehicles), vehicle utilization rates and trends, car stock turnover rates, and the utilization of alternative fuels. These factors will be influenced by transport, urban planning, industrial, environmental, health and fiscal policies and automotive trade agreements. One can therefore readily appreciate the complexity of estimating transport oil demand as these factors tend to vary through time, within and between countries.

Generally however, the rate of growth in vehicle ownership in the non-OECD countries is expected to exceed that in the OECD region, but the OECD region will have the greater share of vehicles for the next fifteen years at least. Therefore to begin to estimate transport fuel demand growth we need to have a view on the economic prospects for both regions and consider factors, such as prices and policy changes that could reduce vehicle use. Also, will OECD governments help developing countries to leapfrog in the

development of their transport infrastructure to reduce the rate of growth of oil demand in the latter?

A detailed analysis of future transport demand is beyond the scope of this report. The reader is referred to OPEC's oil market outlook for an excellent survey of this subject. Suffice it to say, changes in transport demand are at the heart of oil demand and will therefore affect Arab oil producing countries.

3.5. Natural Gas Demand and Supply

There is almost a universal presumption that the demand for natural gas will continue to lead all primary fuels in the rate of growth over the next quarter century. The fastest growth in gas demand will be in the developing markets. Asia will account for about a fifth of the global growth, increasing its consumption in 2020 by more than 2.5 times. By 2020 the OECD region will consume 47% (IEA WEO 04). Nearly a third of global growth is expected in these mature markets of the OECD, half of which in turn in North America.

The fundamental factor that will dominate gas investment and its geopolitics in the coming decades is the mismatch between the distribution of gas reserves and gas markets. The total OECD region consumes over half of the world's gas yet has 8% of the world's reserves. This geographic reserves/market mismatch will

see a tripling in inter-regional gas trade by 2030, and LNG will account for most of the growth.

As illustrated in Table III projections for future supply of natural gas do not vary by much more than 5% for 2010 and 2020. All project gas demand to nearly double by 2020. However regional details vary. For example, compared with the IEA, the US DOE/EIA projects lower gas demand in the OECD region, especially Europe, and in the developing countries, and significantly higher gas demand in the transition economies. These differences stem from different assumptions of pricing and economic growth for these regions.

Table III also indicates that Arab countries are positioned to play an increasing role in LNG trade, led by Algeria and Qatar. Six Arab countries export LNG today with 33% of the world's LNG capacity; by 2010 there will be seven with 45%. The Middle East is expected to become the largest gas exporting region in the world, exporting most to the Pacific, followed by Europe, the rest of Asia and finally, to North America (IEA WEO 04). Qatar will be the leading LNG exporter by far and is also expected to have several world scale Gas to Liquids (GTL) plants operating by 2015, producing over 400 kb/d. North African LNG exporters will target both Western Europe and North America.

It is important to stress that this rosy outlook for natural gas, which holds great promise for certain Arab countries, is predicated on assumptions of continued electrification of all economies, and the overwhelming favouring of natural gas in power generation. Moreover, most electricity growth is expected to take place in developing countries, which presumes investment, which in turn presumes reform in their power sectors to attract the necessary capital. This outlook is also predicated on the continued emphasis in all consuming countries on reducing emissions of pollutants including greenhouse gas emissions. Thus, the drivers behind this gas outlook are continued economic growth and policy reform. These are neither assured nor certain to be smooth

Table II: Natural gas supply & demand projections and LNG outlook (LNG data from Deutsche Bank, 2005).

Natural Gas Supply Projections (bcm)									
	2000		**2002**	**2003**	**2004**	**2005**	**2010**	**2015**	**2020**
IEA (04)			2,622				3,225		4,104
IEA (05)				2,709			3,215		4,061
OPEC (04)	2,334						3,110		4,230
EIA (05)			2,611				3,156		4,011
	LNG Supply & Demand Projections (bcm)								
Supply Capacity	148.4				192	209	382	447	
Demand	140.5				188	207	373	520	
	LNG Supply (Mt)								
Global Supply	107.5				138.9	151.5	277.0	324.0	
Arab Countries									
Abu Dhabi	5.1				5.4	5.5	5.5	5.5	
Algeria	23.6				21.0	21.0	24.4	28.4	
Libya	0.6				0.7	0.7	0.7	6.0	
Oman	2.1				7.4	7.4	11.1	11.1	
Qatar	6.6				8.7	9.2	64.2	76.5	
Egypt						6.4	12.4	12.4	
Yemen							6.7	6.7	
Total	38				43.2	50.2	125	146.6	
Share of World	35%				31%	33%	45%	45%	

3.6. Oil Supply

Arab countries hold well over half the world's oil reserves. Many Arab economies are dependent on the development and export of petroleum. Because some have few other alternatives for creating the wealth that petroleum can, these countries must ensure that it will contribute to their economic well-being for as long as possible. It is pivotal to not over-produce and drive the price of oil down and deprive their economies of revenue essential to their socio-economic development. On the other hand, they do not wish the price of oil to be so high that it accelerates the shift away from oil. Therefore estimating the world's future demand for oil and the likely production of other countries is of central importance to the oil investment and development policies of Arab countries.

Table IV: Comparison of oil supply projections. Note: For 'Other', the rates of growth in the right hand column refer only to the unconventional component of this group—not to Processing Gains.

	Demand					
	2002	**2004**	**2010**		**2020**	**Growth Rate**
IEA (04)	77.0		90.4		106.7	1.6%
IEA (05)		82.1	92.5		104.9	1.3%
EIA (05)	78.2		94.6		111.0	1.9%
OPEC (04)	77.0		88.7		105.8	1.8%
	Supply Capacity					
IEA (04)						
Non-OPEC	45.3		51.3		47.9	-2.0%
FSU	9.5		14.6		15.4	1.8%
OPEC	28.2		33.3		49.8	3.0%
Other*	3.4		5.8		9.0	6.7%**
	* Unconventional and Processing Gains ** Unconventional only					
IEA (05)						
Non-OPEC		46.7	51.4		49.4	0.0%
FSU		11.4	14.5		15.6	1.4%
OPEC		32.3	36.9		47.4	2.2%
Other*		3.1	4.2		8.1	6.1%**
Total		82.1	92.5		104.9	
	* Unconventional and Processing Gains ** Unconventional only					
EIA (05)						
Non-OPEC	49.4		56.6		63.9	
FSU	11.4		13.9		16.9	
OPEC	30.6		39.9		49.7	
Total	80.0		96.5		113.6	
OPEC (04)						
Non-OPEC	47.8		54.6		56.7	
FSU	9.5		13.5		15.3	
OPEC	29.2		34.1		48.9	
Total	77		88.7		105.6	

The supply outlook presented here begins with a brief review of recent long-term projections by the IEA, EIA and OPEC. The key elements of these outlooks are summarized in Table IV. These projections, as noted above, vary a great deal, especially for the medium term (2010) and in particular for the call on OPEC (33.3 to 39.9 mb/d, 6.6 mb/d or 20% variation). It might be relevant that the IEA and US DOE/EIA, especially the latter, see a much higher call on OPEC than does the OPEC secretariat itself.

The key question is how much supply will come from Non-OPEC countries? Here there is a wide variance of views, especially for the longer term, in 2020—47.9 to 63.9 mb/d, 16 mb/d or 33%. In the medium term, 2010, the variation is less, 5.3 mb/d or 10%.

So, what are the key elements of Non-OPEC supply? These projections use different geographic breakdowns, therefore they are difficult to compare, apart from the aggregate and even then some do not explicitly include Natural Gas Liquids (NGLs) and processing gains. The expected increase in heavy crudes and the associated upgrading needed to process them should see processing gains increase. Also we can expect an escalation of output from wet gas fields (particularly for LNG production) over the outlook period so expected supply of NGLs should accelerate.

Well over sixty countries produce some crude oil. Most Non-OPEC countries are producing from mature basins. Rather than go

through a country-by-country description of potential output on which to base a projection, we break down Non-OPEC supply as follows:

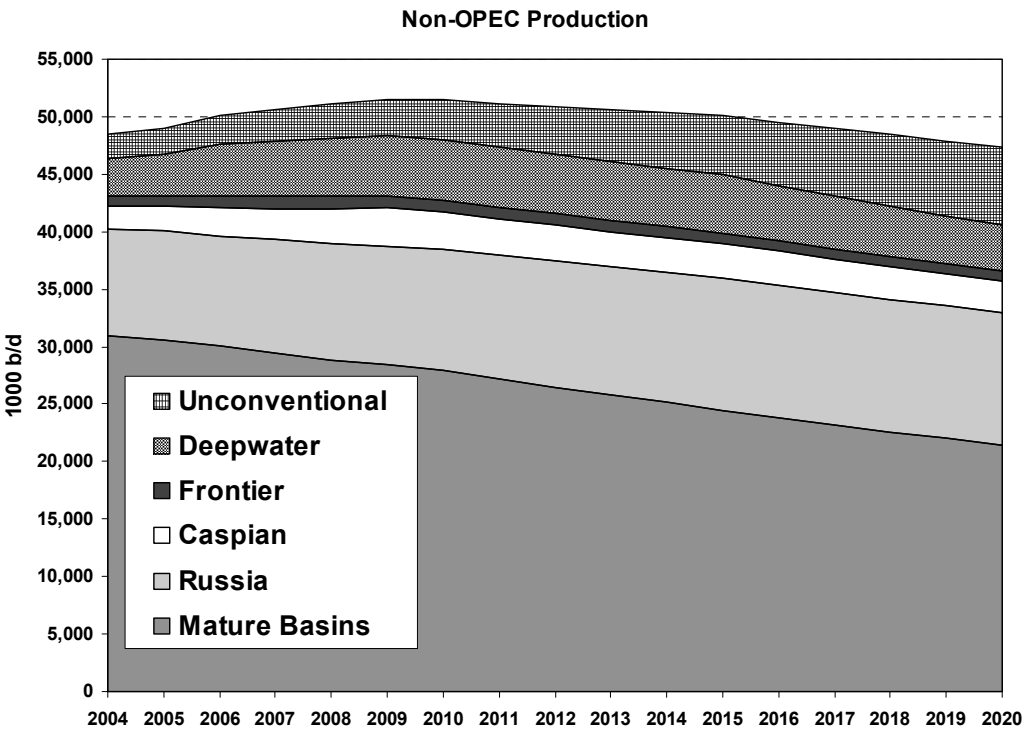
1) **Mature**: these include the North Sea, onshore U.S., Alaska, conventional oil in Canada, Mexico, Egypt, China and so forth; namely, those countries where there is generally believed to be little prospect of a sudden reversal of decline in output.
2) **Russia**.
3) **Caspian region**. Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan (although not strictly a Caspian country); excludes Russia and Iran.
4) **Deepwater**. This 'play' constitutes one of the most important plays in Non-OPEC regions with the potential to increase output over the next decade, thus it is pulled out from the conventional, shallow and onshore production in the countries concerned.
5) **Frontier regions** include Arctic regions (but not Sakhalin) Chad and Sudan and new offshore areas such as Vietnam only recently explored,
6) **Unconventional** 'oil' or liquids.

The outlook is illustrated in Figure 2 and the data are summarized in Table V. This approach to assessing the future supply from Non-OPEC is admittedly subjective but it permits discussion of the main

countries hosting these key generic 'plays' and developments that hold the greatest potential to delay the decline in Non-OPEC supply or even reverse it (unlikely).

3.6.1 Mature Basins. The mature basins as a production 'set', due to infill drilling and investments in response to the recent increase in oil prices, are assumed to slow decline from 2% to 1.7% and briefly level off later in the decade. Then as a group they resume their decline at 2.6% per year to the end of the period.

Figure 2: Non-OPEC supply outlook to 2020. This excludes some NGLs production from OPEC and ignores processing gains.



3.6.2. Russia. The recent dramatic year on year monthly increases in Russia's production have eased off since early 2005. We assume that Russia's production will not exceed 11.5 mb/d during the outlook period. First of all we do not believe that Russia will want to go for market share by increasing production above this level even if it could. Government intervention and uncertain tax and resource management/ownership policies will continue to undermine confidence among investors. Government-owned upstream companies have under-performed their private counterparts and this is unlikely to be reversed any time soon. Additional investment would be required to expand the export facilities to handle any increased production from the traditional basins (Sakhalin output has direct access to the sea). Since the pipeline system is mostly state-owned, and most expansion projects would be multi-billion dollar mega projects, it is doubtful the government would dedicate the resources to them. Finally, we assume that Russia will want to exert control on exports; its current method of doing so—taxation—will tend to serve as a disincentive to investment.

Table V: Supply Outlook for non-OPEC countries. Supply from the Orinoco and most GTL will come from OPEC members but would not be subject to OPEC Quota Policy (1,000 b/d)

	2004	2005	2006	2007	2008	2009	2010	2015	2020
Mature Basins	30,949	30,578	30,046	29,470	28,855	28,416	27,913	24,470	21,450
Unconventional	2,206	2,195	2,556	2,741	2,946	3,094	3,415	5,221	6,883
Oil Sands Canada	994	960	1,263	1,413	1,572	1,678	1,884	2,500	3,300
Orinoco	590	590	590	600	615	630	650	850	1,100
GTL	52	52	86	86	86	86	152	800	1,000
Biofuels	450	473	497	522	548	575	604	771	983
Shale and Coal	120	120	120	120	125	125	125	300	500
Deepwater	3,242	3,631	4,401	4,816	5,032	5,247	5,300	5,040	4,000
Frontier	896	925	1,105	1,100	1,060	1,055	1,035	900	800
Russia	9,285	9,475	9,600	9,850	10,100	10,300	10,538	11,500	11,500
Caspian	1,968	2,180	2,395	2,625	3,065	3,375	3,255	3,000	2,800
TOTAL	48,546	48,984	50,103	50,602	51,058	51,487	51,456	50,131	47,433

3.6.3. Caspian Region. New supply from the Caspian region is being delayed for a variety of reasons. Production from these countries for 2010 is estimated by others to range from 2.9 mb/d to more than 4 mb/d. We are inclined to be in the lower part of this range at 3.2 mb/d until we see evidence of new discoveries and more rapid rate of development of existing, very technically challenging structures and reservoirs.

3.6.4. Deepwater Play. The Deepwater play comprises the US Gulf of Mexico, offshore Brazil and the Gulf of Guinea off West Africa (Angola and Equatorial Guinea; Nigeria also has a deepwater play however it is excluded here as it is part of OPEC). The play worldwide could have up to 50 billion barrels of recoverable oil, although this estimate is considerably less than earlier estimates when the play was first confirmed. Half of the undiscovered reserves attributed to the play are in the Gulf of Mexico (GOM). Approximately 6 billion barrels have been produced to date; the rates and sizes of discoveries for all basins so far do not show much sign of maturing. However, it appears that the prospects in the very or ultra deepwater environment are smaller than hoped, but still significant (>500 million barrels).

Excluding Nigeria, this play is assumed to reach a maximum of 5.3 mb/d around 2010 and decline very rapidly thereafter. There remains the possibility, however, that the Mexican side of the GOM if explored could extend this peak production, but

exploration there is not expected to start before 2010. There are other deepwater basins such as off Mauritania, Morocco, the deep Nile Delta and the east coast of India that could add to the deepwater play between 2010 and 2020.

Frontier regions are a set of new exploration ventures off Vietnam, the Sudan, Chad and potentially in the Barents Sea and other marine areas off northern Russia, and off East Greenland, parts of Alaska (those not yet open) and northern Canada. Most of these regions have uncertain potential at this stage and apart from Chad, Sudan and Vietnam are not likely to add much production before 2015 or even 2020.

3.6.5. Unconventional liquids. This category loosely captures 'difficult-to-produce' oil and gas—'difficult' in that recovery requires stimulus or technology not applied in conventional production schemes, or the technique employed transforms usually solid carbon-rich resources, but also (hydrogen-rich) methane, into marketable hydrocarbon liquid products. These include the following resource transformations:

- CTL (Coal to Liquids)
- STL (Shale to Liquids)
- BTL (Biomass to Liquids—Ethanol and Biodiesel)
- GTL (Gas to Liquids; can include methanol and Dimethyl Ether, a substitute for LPG and Diesel)
- Ultra-Heavy Crude Oil (primarily Venezuela)

- Bitumen (primarily Canada)

The technical potential of most of these hydrocarbon sources has been appreciated for a long time, but most have not been economic to produce. The convergence on the one hand of improved technologies from years of research and pilot projects and on the other, higher oil prices prompts the question, 'are all these unconventional liquids now economic?' The answer has to be a qualified 'yes', with the exception of STL and some ethanol schemes, in particular those based on maize in the United States (but these will expand with generous government subsidies).

These categories of hydrocarbons currently comprise about 2.2 mb/d of oil production. This excludes about 1.2 mb/d of ultra or very heavy crude, of which 1 mb/d are produced with the assistance of steam injected into the reservoir (California, China, Venezuela and Indonesia). These long-running projects are included in the 'Mature' category.

3.6.5.1. CTL

Sasol of South Africa has the only CTL production in the world. It promotes its technologies but coal to liquids is only being considered in a significant way in China where they expect to produce 1 mb/d by the middle of the next decade.

3.6.52 STL

Shale-to-liquids have received renewed attention in the recent US Energy Policy Act. The largest deposit of 'oil shale' in the world is in Western U.S. in essentially a desert environment. Oil shale development requires considerable volumes of water; Shell has an experimental project that employs electrical resistance heating to produce liquids in situ in these shales. Brazil is producing about 3 kb/d from shale, while the Australian demonstration project in the Stuart Shales has been shut down. We assume that CTL and STL production will reach 0.5 mb/d before 2020.

3.6.5.3. BTL

While mostly uneconomic with the exception of sugar cane-based ethanol production, with the rise in oil prices governments are increasing their support for Biofuels. Both the US and EU have announced Biofuels percentage targets for 2010. Bioethanol accounts for most biofuels, currently estimated to be nearly 500 kb/d on a gasoline equivalent basis.

3.6.5.4. GTL

There are many projects proposed, with perhaps a total capacity of 2 mb/d. The principal host state for GTL will be Qatar. Notwithstanding their improved economics at higher oil prices GTL projects are experiencing delays, partly owing to the over-heated demand for Engineering, Procurement & Construction

(EPC) contractors, vessels and specialty and alloy steel components. Operators face complex challenges in scaling up from the present fleet of pilot projects. GTL production is a chemical process, unlike LNG, which is physical, and its process engineering is orders of magnitude more complex. Also LNG tends to be easier to finance and, as discussed earlier, is perceived as having promising prospects in the Atlantic Basin. Consequently GTL output is not expected to exceed 165 kb/d by 2010 but will soon after increase to 800 kb/d by middle of the next decade, primarily from projects in Qatar.

3.6.5.5. Ultra-Heavy Crude Oil

The principal resource of interest in this category is the Orinoco in Venezuela. Changes to the fiscal regime for the Orinoco notwithstanding, several major oil companies have declared their interest in proceeding with additional projects. Probably the most attractive of all the unconventional liquid resources, the Orinoco investments are currently perceived by some POCs as too risky politically. A resumption of significant investment in new greenfield projects in the Orinoco is not expected much before 2010, with perhaps two or three additional projects producing fully upgraded synthetic crude by 2020.

3.6.5.6. Bitumen

In the last year three new major oil sands projects have been announced in Canada. Perversely the greater the interest the more

costs have increased as competition tightens for skilled manpower, EPC contractors, large vessels and equipment. Operating costs are also rising with higher prices for natural gas, an important input for fuel and hydrogen in extracting and transforming bitumen. Higher prices for steel and specialty metal components, necessary for the severe operating conditions involved in producing these liquids, have also added to the costs. Skilled and semi-skilled manpower supply is a serious impediment to rapid expansion of the oil sands. Rising natural gas prices, geological complexity and market access are reducing the enthusiasm for the steam-based in-situ production of bitumen; companies are focussing more on integrated mining projects. A recent spate of pipeline proposals underscores the importance of diversifying away from the traditional Midwest U.S. market, to the US Gulf Coast, west coast and Pacific markets, even including China.

Total supply from unconventional liquids is not expected to reach 7 mb/d by 2020, however this outlook could change dramatically as it is the only category of Non-OPEC oil that has far more long-term upside than downside under current oil price conditions.

3.7. Call on Arab oil supply

What does this supply outlook imply for the call on OPEC in general and on Arab countries in particular? To address this question, we assume the following for non-Arab OPEC members, Nigeria, Venezuela, Iran and Indonesia. Nigeria reaches 4 mb/d by

2010 then declines at 3%; Venezuela maintains conventional production and the only increments come from the Orinoco taking it to 3.5 mb/d by 2020; Indonesia declines at 1.5% from today, and Iran reaches 4.5 mb/d by 2010 and 4.7 by 2013 and remains at that level to 2020. As for Iraq, we implicitly assume it recovers but this is admittedly very optimistic in the current circumstances.

We also have to project growth in oil demand. It is perhaps instructive to remember that on average since 1965 oil demand has increased by 1.27 mb/d per year. However, this covers a great deal of 'noise' between 1974 and 1982. Since 1982, oil demand increments have been fairly steady averaging 1 mb/d per year. Since 2003 (including estimated 2006) demand growth has increased by 1.5 mb/d or more per year.

These past demand growth paths (in increments, not 'rates') are used as scenarios in Table VI as follows: 'Historic', 1.27 mb/d/y starting in 2006; 'Post-1982', 1.0 mb/d starting in 2007 and 'Post-2003', continuing at 1.5 mb/d in 2006. As can be seen, under the Non-OPEC supply projection here, if demand growth follows this latter path or even the long term average of 1.27 mb/d/y, the call on OPEC would greatly exceed any of the above projections of the IEA, EIA or OPEC and would seriously test the major Middle East suppliers.

Table VI: Comparison of oil supply for Arab countries under different oil demand growth scenarios. Source: OIES; 2004 base year from BP Statistical Review 2005

		Historic 1.27 mb/d/year			Post 1982 1.0 mb/d/year			Post 2003 1.5 mb/d/year		
	2004	2010	2015	2020	2010	2015	2020	2010	2015	2020
World Demand	80.8	88.6	95.0	101.3	87.8	92.8	97.8	89.8	97.3	104.8
Non-OPEC	48.0	50.7	48.5	45.4	50.7	48.5	45.4	50.7	48.5	45.4
Call on OPEC	32.8	37.9	46.4	55.9	37.0	44.2	52.4	39.0	48.7	59.4
Arab Countries	25.0	28.0	36.6	46.3	27.2	34.4	42.7	29.3	38.9	49.7

Admittedly, the Non-OPEC supply scenario is pessimistic. However, many commentators recently seem to share this pessimism. In essence, this approach assumes that Non-OPEC countries will produce what they can. The implications then for Arab countries are self-evident should we accept the proposition that we are in a new oil demand paradigm, where world demand grows at 1.5 mb/d (or more) per year.

4. International Developments and Their Implications for Arab Countries

In Part II we discussed some of the principal developments in international energy and oil and gas in particular since the last Arab Energy Conference and noted how some of these affected or could affect Arab countries.

The important consequence of course is how events affect prices and therefore revenue prospects of Arab exporting countries. It

appears that oil prices have moved up from cycling within the $16 to $28 range since the mid-eighties. Also, natural gas prices, buoyed by tightness in the North American gas market and oil-linked prices in Western Europe appear to have strengthened. If the overall welfare of the Arab region increases due to higher prices, non-hydrocarbon exporting Arab countries benefit through intra-regional investments and repatriation of funds by migrant workers, although this migration can also result in loss of skilled manpower needed within the home countries.

The increase in hydrocarbon prices, besides restoring the balances and even creating surpluses in national budgets of some Arab countries, has attracted pressure on producers to increase investment in new capacity. When the market is tight, Arab and other oil producers will be looked to 'to save the day', yet when the market is slack, little attention will be given by politicians of consuming countries to the challenges faced by Arab oil and gas producers. This is illustrated in communiqués from the IMF: in 2002 they "underscored the importance of stability in oil markets at prices reasonable for consumers and producers" and last fall expressed the need for "greater stability in the oil market" and called for "improved dialogue between oil producers and consumers to promote greater oil market stability". However, in 1998/99 when oil prices had collapsed the IMF merely worried that low commodity prices would "decrease financial flows and delay adjustment" to the precepts offered by the 'Washington Consensus' (a set of neo-economic reforms promoted by the World Bank and

IMF that included monetary, fiscal and structural reforms such as privatization, liberalized markets and trade, fiscal and regulatory reform. For a description see for example, http://en.wikipedia.org/wiki/Washington_Concensus)

The entry of the Asian National Oil Companies in the upstream of other countries poses uncertainty for the industry and the market. First of all, this shifts international oil and gas exploration and development onto a more state-to-state and therefore political level. This can offer advantages for Arab countries. For example, this could afford reciprocal access to the downstream of these Asian countries, which offer more upside potential in downstream investments than do OECD markets. This is happening in the case of China.

However, it is unlikely that fusing foreign policy with activities that are normally done through commercial arrangements will add to the transparency or smooth working of the market. Such arrangements can entail attempts to link non-related interests not always of equal concern to both states.

Russia's leader, Vladimir Putin, has demonstrated his intent to use oil and gas strategically. The recent dispute with Ukraine, while pointing to the political and marketing ineptness of the Kremlin, certainly reflects the strategic importance Russia attaches to its hydrocarbon exports but more importantly it underscores its interest in maximizing financial returns. It is no secret that the

benefits of the oil and gas bonanza have not trickled down to cities and towns outside Moscow and St Petersburg. Russia must address this disparity as it threatens social cohesion and stability. It follows that the Kremlin will not want to see the oil price sink and would likely cooperate with OPEC if and when the time comes to this end. Whether it can physically control all the private oil companies and their exports, however, remains an open question.

The gas dispute between Russia and Ukraine has also elevated 'energy security' to the top of the world agenda. That Russia cut off the gas the same day it assumed the presidency of the Group of Eight economic powers, a group that espouses open unfettered markets and free trade, sets up a tension that the international community hopes will be resolved in the final communiqué in July.

While this dispute may have resurrected in the minds of some OECD countries the old issue of 'the oil weapon', it has strengthened European resolve to diversify its sources of natural gas. This will benefit Arab countries especially those on the Mediterranean. At the same time, North America's need for LNG imports will impact on Arab countries, particularly North African LNG producers, Algeria, Egypt and Libya, but also Middle East producers.

Finally, the actions by Russia as noted in Part II would not seem to be conducive to continued increase in its oil production. But Russia's oil production capabilities remain very difficult to project and will require extra vigilance by Arab countries, particularly

OPEC members, in order to develop their own investment strategies. These however confront the long-standing concern with price volatility and the difficulty OPEC has in balancing the market.

4.1. The pursuit of Price stability and predictability

Many political leaders and international institutions (G8, IMF, OPEC, IEA) have recently appealed for stability and predictability in the oil market. The volatility of oil prices can have serious impacts on producing countries especially on those whose economies depend on revenues from oil exports. It is quite understandable why many Arab leaders and institutions call for stability and predictability in the oil market and appeal to other producers and consumer governments for cooperation towards this goal. Therefore, it is worth examining the sources of price volatility to understand whether there might be scope for its reduction.

Much has been written about past volatility of oil prices and how swings in prices that endure for a year or more can be injurious to consumer and producer economies alike. They are especially harmful for poor, import-dependent developing countries. More often than not, these countries do not pass on the full increases in oil import costs, leading to serious national debt with all its implications for economic and social development. Even commodity exporting OECD countries suffer; hundreds of communities in Australia, Canada and the United States rely on the

extraction and processing of single commodities and their welfare swings with global commodity prices. Thus volatility or commodity cycles are a universal concern.

OPEC countries, which must supply the residual of world oil demand that non-OPEC suppliers do not meet, face a complex challenge. How can they accurately predict world oil demand and non-OPEC supply in order to have the right capacity available? The difficulty is best portrayed by looking at the recent record of respected agencies in projecting these two important market variables.

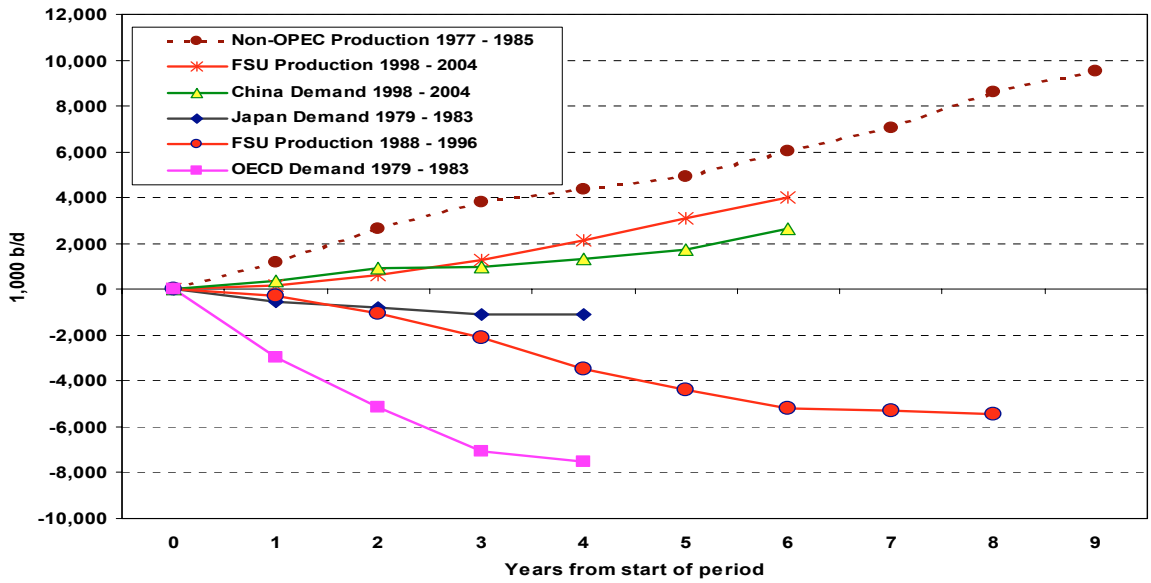
In the third quarter each year, the IEA and others start projecting the principal elements of global demand and supply for the following year. Since 1998, the residual variation—the call on OPEC six quarters ahead—between what they began projecting and what was actually required has ranged from +1.6 mb/d to –2.1 mb/d. This 'surprise' call on OPEC provides a sense of the magnitude of uncertainty from year to year. Experts in the IEA, OPEC, US DOE/EIA and Barclays Capital can differ by over 100% in their estimates of growth in non-OPEC supply for next year. Their projections of growth in world demand can differ at any point in time by more than a half million b/d. This is not a criticism: it is merely testimony to the intractable uncertainty of markets.

Demand is highly variable and is exceedingly difficult to predict. There are several levels or degrees of variability.

- Daily and weekly variations occur in petroleum product demand and are managed by distributors through tertiary stocks.
- Seasonal demand swings are managed by refiners through inventories and refinery changeovers to produce products suited to the changing seasonal demand patterns. The seasonal swing in world demand (between 2Q and 4Q—the low and peak demand quarters) has ranged from 1 to 4.5 mb/d over the last 15 years or 1.5% to 6.5% of annual demand. Generally the trend is declining; that is, the amplitude of seasonality in demand is now around 3.5% of total annual demand reflecting the increasing dominance of transport in oil demand.
- Longer-term multi-year variations in demand are driven by macro-economic dislocations and, less often, major policy shifts. These are very difficult to predict and even more so to ascertain their impacts on oil supply and demand. An example of policy shift occurred in Japan in the seventies when it made the conscious decision to shift power generation from oil to coal and natural gas (LNG-based) and to accelerate the expansion of nuclear power while aggressively promoting energy end-use efficiency. Japan's oil consumption fell by over 1.6 mb/d between 1973 and 1987; the use of oil in power generation was cut by half. The magnitudes of various transients of cumulative oil

supply and demand changes over several years are compared in Figure 3.

Figure 3: Transients of oil supply and demand comparing their magnitude of increases or decreases over time (years) from a common starting point.



All supply systems need spare capacity because upsets are inevitable. Oil and gas supply systems need spare capacity all along the chain. This is self-evident. By comparison, in the grid-based energy systems of electricity and natural gas, producers and consumers are co-dependent. Meeting peak demand is critical. In other words, assurance of deliverability is key. Neither consumer nor producer has the same flexibility to switch counter-parties as they can in oil markets. Although competition for supply occurs, competition to provide wires and pipes is not practical. Co-dependency and lack of flexibility in grid-based energy compels suppliers to make significant investments to assure deliverability

(in gas storage, back-up capacity, interruptible contracts, reserve power, interconnections, etc).

In power pools, all producers agree to a system of dispatch in order to meet the daily, weekly and annual power demand or 'load' curves. Plants, depending on their marginal cost of power are dispatched, if they can be dispatched. (Wind power for example, cannot be dispatched; i.e., called upon when needed by the grid operator.) Unlike electricity that arrives instantly, oil arrives sometimes nearly two months later so the utility model would not be practicable.

This 'utility' line of thinking has from time to time prompted the proposition that producing countries should design and agree on an alternative policy that backs up the quota system, namely a policy for co-ordinating investment plans in capacity. This is seriously flawed because it would:

- Presuppose far greater equality or uniformity than exists between oil producers in terms of technical flexibility, reserves endowment, resource type (on-, off-shore, unconventional), industry structure, oversight and governance;
- Require states to subordinate to an international body or process a fundamental sovereign right, namely the right to decide on the pace of development of natural resources;
- Risk compounding volatility because it would shift focus from what exists to what doesn't exist; that is, from

production coordination decisions (as done through OPEC's quota system) to investment and development decisions where mis-judgements would take months or even years to resolve or correct; the consequences of over-investment would differ starkly with those of under-investment; whereas a miscall on quota adjustments can be re-examined in short order.

- Introduce greater uncertainty in production capacity because it would separate accountability for capacity from responsibility for its deployment;
- Require sovereign states to accept a secondary status in a merit order that would inevitably entail political factors.

Investment plans are generally not a secret. What is uncertain is when new production capacity will actually come on stream. Many projects are delayed for a whole range of reasons. Coordination of plans would not help this situation.

Our hope for predictability presupposes that we can have perfect knowledge of global macro and micro economic developments, policies and politics and their outcomes, the pace and direction of scientific discovery and technological change, societal preferences and, alas, be able to predict the weather and natural disasters such as earthquakes, volcanic eruptions and pandemics. We should expect volatility and therefore continue to develop better and more transparent industry and market information and statistics and strive to improve our economic models.

4.2. Implications for Arab countries of other countries' policies

Following is a review of potential implications for Arab countries of some recent policies in other countries.

4.2.1. United States

The United States Energy Policy Act of 2005 provides a useful example of the complex and uncertain feedback effects of international developments on oil and gas exporting countries. After a long and heated debate in the legislative bodies of Washington, the Act was finally passed and signed into law in early August, 2005.

The Administration started developing the policy soon after the 2000 election. The 9/11 attacks renewed political emphasis on 'energy independence' and this theme was reinforced in the draft legislation. However, owing to disputes over proposed opening of the Alaskan National wildlife refuge (ANWR) to drilling, Biofuels and liabilities for MTBE contamination, electricity market reform and other issues, the bill died in 2002 prior to the mid-term elections. Discussions resumed a year later. Just prior to the bill's final passage, the US DOE/EIA was requested by legislators to assess the bill's impact on among other things oil import dependence.

The Agency compared the bill's impact to the reference case in its AEO (see http://www.eia.doe.gov/oiaf/servicerpt/hr/hrprovisions.html). The agency found that the bill would have no or little impact by 2010 and not much even by 2015 (no decrease in oil demand while production increased by less than 100 kb/d and imports reduced by 135 kb/d). By 2025, the bill in theory would have greater bite: 1 mb/d less imports of oil, attributable mostly to assumed production from ANWR. On the other hand, natural gas imports by 2025 would increase by a minor amount due to expedited approvals for LNG import terminals. The world oil price (in 2003 dollars) in 2025 would be $0.57 lower than projected in the reference case, and gas prices would be $0.03/mcf lower.

Other incentives, such as for deep drilling, would raise cumulative lower 48 oil production by 0.5% between 2006 and 2025; mandated ethanol production would reduce net gasoline imports by about 100,000 b/d by 2015, however this does not take into account the hydrocarbon-based inputs (partly imported) required to grow the corn to produce the ethanol. Later in the periods, cellulose-based ethanol (requiring less oil inputs) is projected to increase but is not expected to be significant. The theoretical impact on gasoline imports would be less than the range of variation from year to year in current gasoline consumption so the effects of the policy would be so trivial as to be unnoticeable.

The total effects of all policies would reduce the imported share of oil consumption in the US from 68% to 64% by 2025. The bill would actually result in an *increase* in overall energy consumption; oil consumption in industry and transport would *increase* versus the reference case (demand in other sectors would decline).

This example offers the following reminders:

1) Major policy efforts can have very minor market impacts: the policies resulting from nearly five years of legislative debate in the largest oil and gas consumer in the world would have, in theory, little impact on world hydrocarbon trade.

2) Policies take a long time to bite: elements of the bill aimed at accelerating domestic oil and gas supply, if fully implemented on schedule, would take at least a decade to begin to take effect.

3) The impact on world oil prices would be relatively minor and on gas, hardly at all.

4) Environmental policies of consuming countries can cut both ways for Arab countries—in the end ANWR was struck from the bill owing to environmental concerns, thereby removing the single most important feature with any potential for backing out oil imports. A late 2005 attempt to re-open the issue by inserting it in a spending bill also failed.

4.2.2. United Kingdom

Another recent example of policy change in another consumer country that is also a producer is the increase in the supplementary corporation tax on North Sea oil producers by the Chancellor of the Exchequer of the United Kingdom. While at least one company has reduced its 2007 drilling commitment in the North Sea attributing the change to the tax, it is too early to ascertain the exact effects of this tax. Directionally it would reduce the exploration and development activity in the North Sea, reducing marginal Non-OPEC supply, or more specifically, not offsetting the decline rate as much as would be expected, thereby resulting in a greater call on OPEC production.

4.2.3. Russia

Russia, the most important non-OPEC producer, applies a very onerous export tax on crude oil when the price exceeds $25/bbl. This has the effect of reducing investment in new capacity in Russia, which is favourable to OPEC (and to Russia as the marginal price of Russian oil is increased). President Putin has stated that the revenue windfall from oil prices should be used to pay down debt rather than expanding oil export facilities.

Russia also subsidizes its domestic customers' natural gas prices. This has the effect of reducing Russian domestic oil consumption, increasing oil exports and therefore marginally reducing demand for oil from Arab countries. On the other hand the policy results in

increased domestic gas consumption, which reduces in theory gas exports, increasing demand for LNG from Arab countries selling gas to western Europe. This may soon occur in practice as Gazprom faces enormous investment challenges to replace and expand production capacity, build the North European (Baltic) pipeline and launch at least one major LNG project based on Barents Sea gas.

4.2.4. Sustainable Development Policies and Measures

Increasingly developing countries are adopting policies and measures to promote sustainable development. They comprise sets of measures that vary between countries and are designed to achieve a variety of policy objectives ranging from energy security, economic development, poverty reduction, increased employment, electrification, improved infrastructure and access to commercial energy, but with the over-arching objective of reducing the impact on the environment. Their effects may include reductions in greenhouse gas emissions permitting the country to claim a virtue out of a necessity. (See World Resources Institute's website for report; http://climate.wri.org/growingingreenhouse-pub-4087.html) These measures can also affect international oil and gas trade.

One of the clear examples of this is the Biofuels programme in Brazil. Started in the seventies during the fuel crises, the Brazilian government subsidized the development of a sugarcane-based ethanol fuels programme, including vehicles that could run on

100% ethanol. Ethanol now supplies about a third of Brazil's transport fuels. While it initially caused problems in the oil industry, which had to export gasoline, the oil industry is now using its skills in product transport, blending, refining and trading to reduce costs and make profits. It has generated balance of payments and employment benefits; electricity generated from the biomass waste is increasing and yielding benefits to the industry and air emissions. The programme is under expansion, apparently without direct government subsidies, and is partly directed at the growing international trade in ethanol for fuel blending. The technology is also being transferred to other developing countries with tropical climates suitable for growing sugar cane. Meanwhile, new flexfuel vehicles have been developed and improved since the seventies and these will accelerate the penetration of ethanol in other transport sectors. While these programmes did not start out with the aim of reducing greenhouse gas emissions, they have tangible benefits in this regard.

Over 100 countries produce sugar from beet and cane. The real price of sugar has declined at an average rate of 1.5% for half a century however it has recently increased, partly in response to increased demand for production of fuel ethanol. However, as energy prices increase, the logic of converting more sugar to premium fuels is compelling for cane sugar producers in particular.

4.2.5. China

China (along with India) has enormous potential to generate significant differences among analysts for projected global energy demand. When we examine the energy demand growth assumptions for China by different government agencies and consultancies, we find the greatest variation, not only between agencies but also within agencies from year to year. A significant component of the variation between projections for world oil demand is attributed to different assumptions used for China. This is a serious challenge for those producers seeking improved predictability of oil demand in order to assist in planning production expansions.

Clearly, China remains a relatively opaque market in terms of statistics. With respect to oil in particular we have poor and unreliable data. The expectation of most analysts is that China's energy demand will continue to grow faster than the rate for the rest of the world. But analysts' estimates of growth rates vary considerably and for different fuels.

a. Primary Energy: The IEA in 2004 projected China's supply of primary energy to grow at 2.6% out to 2030, whereas the EIA in 2005 projected growth at 4.1%. Moreover, the EIA increased its assumed growth rate by 17% between its outlooks of 2004 to 2005.

b. Oil Demand: The IEA (04) expected China's oil and gas demand to grow by 3.4% and 6.3% respectively over

the outlook period 2002 to 2030. In 2020 Chinese oil demand would be 10.6 mb/d. However, a year later the IEA assumed a *lower* rate of oil demand growth, 2.9%, over the period 2004 to 2030, yet China's oil demand in 2020 would be 11.2 mb/d—600 kb/d *greater*. The difference between forecasts for 2010 was 800 kb/d. This difference is presumably mostly due to the 1 mb/d difference in the base years (2002 and 2004), itself a major surprise. The EIA assumes a growth rate of 2.4%/year to 2025 and projects China's oil demand to be 9.2 mb/d in 2010 and 12.3 mb/d in 2020. Thus for two agencies and four projections for 2010, made within 12 months, oil demand in China varies by 1.6 mb/d and 0.8 mb/d within agencies between projections and 0.3 mb/d and 0.5 mb/d between agencies for the same year (of projection).

c. Natural gas demand: Because China consumes such a small amount of gas at the moment projections will tend to vary considerably. For some time most analysts have expected China's insatiable demand for electricity to register in a rapid ramping up of gas imports in the form of LNG. So far this has not happened. As long ago as 1990, the expectation was, for example, that by 1995 China's demand for oil and coal would not grow by much but gas demand would accelerate. The DOE/EIA turned out to be dramatically off in this projection—underestimating oil demand by up to 25% just three years ahead, coal by 15% and overestimating gas consumption by 14%.

Today, the two greatest sources of oil market uncertainty are arguably China on the demand side and Russia on the supply side. Just as the Kremlin watchers failed to see the coming collapse of the former Soviet Union, so did the West's Sinologists under-estimate the pace of the post-Mao transformation of China. It is odd that experts living in pluralist, western market economies did not seem to expect that a billion Chinese would not increase their consumption if they were freed from state sanction for self-enrichment. These two regions will continue to keep oil market analysts guessing in the years to come, and Arab countries will be affected.

China has great potential to continue to surprise. While we acknowledge its potential to be an engine of energy demand, especially of coal and oil and to a lesser extent, gas, there are several potential sources of fragility that could undermine bullish expectations. There include, the growing disparity in incomes between rich and poor; the still large under and un-employed rural poor; the growing discontent among local populations and protests against pollution and land expropriation. The Chinese state's handling of these tensions so far does not give one cause for optimism.

4.3. Technological Change

One of the most difficult variables to calculate in econometric models is the rate of autonomous technological improvement in the supply, transformation and use of energy. This matters little over the very short term given the very slow turnover in most capital stock in the energy supply/use chain. However over a decade or more, technology is a key driver of both energy demand and supply. It is impossible to predict because discovery is accidental and most often occurs in a totally unrelated area from energy. A case in point is the combined cycle gas turbine. This technology grew out of the need for long-running, reliable jet turbines for submarine surveillance during the Cold War. Within less than a decade they virtually transformed the electric power sector and are largely responsible for the ascendancy of natural gas.

The oil industry is replete with examples of technological breakthroughs that have dramatically transformed the course of oil exploration and development. Three and four-dimensional seismic, horizontal drilling, logging while drilling, formation fracturing and flexible tube drilling systems are just some examples. Failure to appreciate this technological evolution leads some observers of the industry to draw erroneous conclusions. A recent example is Matthew Simmons's observation in his book, *Twilight in the Desert*, that Saudi Aramco's application of sophisticated modern multilateral well technology and reservoir modelling indicated imminent decline if not collapse of its older oil fields, whereas it meant just the opposite—longer field life and greater oil recovery.

Finally most of the new non-OPEC supply coming on stream over the next two or three years has very deep technological and scientific roots that go well back in time. The recent price increase had absolutely nothing to do with their inception. The deepwater play has its roots in the 1960s scientific breakthrough of seafloor spreading and plate tectonics. Scientists conducting shallow drilling studies were surprised to discover coarse-grained sediments in the deep marine margins off continental shelves. This led to the hypothesis that at depth they could be oil-bearing. This eventually led to discoveries off West Africa. The Gulf of Mexico deepwater discoveries similarly were driven by scientific discovery and technological breakthrough in seismic techniques to enable detection of potential hydrocarbon-bearing structures beneath salt layers, previously seismically opaque. Dozens of technological breakthroughs and improvements led to the development of technologies to produce bitumen and ultra-heavy oil from the Athabasca and Orinoco respectively. Finally, the explosion in data management capacity and sophistication in computer technology has been an essential enabling technology for most of these advances.

Technological discovery will continue and it is a double-edged sword. While it improves supply and increases the efficiency of energy use, it also makes energy and the services we get from it cheaper, increasing their demand. The advent of the hybrid electric/gasoline and flexfuel engines extends the future prospects

for hydrocarbons. By increasing mileage significantly they have moved the goal posts for alternatives such as hydrogen (a carrier, not a fuel), which continues to face serious technological challenges.

The over-arching conclusion from these examples is that when it comes to understanding what might reduce the demand for oil and gas from Arab countries, micro-economic or energy sector policies in consuming countries, particularly in the OECD countries, do not pose as great a risk as they did three decades ago. First of all most OECD countries have exhausted a lot of policy scope—what is left would require fairly draconian and politically unpalatable measures such as significantly higher consumer taxes, strict standards, subsidized mass transit, fuel use restrictions and the like.

On the other hand, Non-OECD countries (those generally not subject to international environmental commitments that would reduce fossil fuel use) will experience the greatest rate of growth in oil demand. Even though they might develop alternative fuels [the countries with the most compressed natural gas (CNG) vehicles are non-OECD—Argentina, Brazil and Pakistan, with India aggressively introducing CNG in major cities such as New Delhi], there is little expectation that developing countries' oil demand will decline as they are just beginning to accelerate their ascent of the oil-use/income curve.

So, for Arab countries, a sudden decline in global GDP, especially of the United States, would be the most important threat to oil and gas demand. If we want to understand this threat, we need to map out the soft spots in the global economy. This subject is discussed in the conclusions of this report.

5. Conclusions and Propositions for Arab countries

A principal conclusion that emerges from this report is that the oil market appears to have risen to a new level in terms of demand, supply tightness and therefore prices. However, another conclusion is that uncertainty has not been reduced; only the probabilities of the future direction of prices have been rearranged. There are basically three future courses that prices can take at any time: up, down or more or less level. When prices were at $25, few assigned a high probability of their rising. Now that prices have risen, some analysts and important market players assign a higher probability of their reverting to mean than they do of their remaining where they are, and very low probability that prices will rise further. Paradoxically consensus of market players around any probability tends to conflate to a different if not contrary outcome. When an industry leader signals a view and others 'buy into it', the leader can sometimes be (pleasantly) surprised by the outcome.

Higher prices have generated increased interest in energy and oil in particular among international institutions. Some worry whether the necessary investment will take place to assure adequate supply capacity. This theme was most recently stressed for the Arab region in the IEA's WEO (2005), *Middle East and North Africa Insights*. Investment will take place but whether enough in time to maintain price stability remains to be seen. Some view the rise in prices as a shift to 'market instability'. It could be argued that we have moved from a situation of market unsustainability (low prices, low investment, rising demand) to one where the chances of stability have actually increased (more investment, stable prices, slower growth in demand, restored spare capacity).

To sharpen market knowledge, producers and consumers have made important strides to improve transparency on markets (JODI) and investments. OPEC is presumably now in a stronger position to manage supply should the market show signs of softening. This directionally implies that the risk of volatility has been reduced. But as suggested by the wide variation in perspectives of future demand and supply as reviewed in this report, the dynamics and relative importance of the underlying drivers of the market are still poorly understood and calibrated.

In simplest terms, data are not enough: far more important as we have seen is their analysis and interpretation. While some might conclude that the wide variation among forecasters calls for

coordination and agreement on their assumptions and outlooks, this would be a mistake. Only with a diversity of views can we hope to have a debate whereby we can compare our assumptions and hopefully develop a better understanding of different possible outcomes. However, what *is* called for is convergence on the architecture of forecasts; namely, geographic breakdowns, consistency in terms of which countries are included in each region, treatment of NGLs, processing gains, units, and projection period.

While such consistency in approach would assist the debate, we should not be deluded into thinking the results should be used as our only planning tools. The lesson we can take from failure to forecast accurately and from the recent surprises in both demand and supply, is not that we should stop forecasting, but rather we should forecast *more often*. The knowledge that the future will certainly differ from our projections today compels us to develop strategies that can respond to surprises and therefore enable us to live with uncertainty.

Another conclusion is that micro-economic policies in other countries pale in comparison with changes in the global macro-economy when it comes to impacting revenues of Arab oil and gas exporting countries. Fragilities in the global economic system are key to the uncertainty in energy markets. At the beginning of 2006, the global economy appeared to be sustaining its strength. The US economy continued to appear robust on the basis of

continued household consumption and business optimism partly enhanced by post-hurricane reconstruction. The rest of the OECD region also appeared in good health albeit not expanding significantly. The general expectation was for stable oil prices in 2006 with a slight easing back of the boom in commodities.

However, there remain numerous clouds or question marks on the horizon for the world economy:

- The United States is critically important to the global economy; consumer spending accounts for 70% of its GDP; its fiscal and trade deficits, record household debt, exhaustion of the wealth effect of rising real estate values, lack of private savings while interest rates increase, together present a constellation of concerns. Whether these will be countered by more stimulative interest rates and by business re-investment in capacity and by the restoration of inventories, remains to be seen.
- The reliance on U.S. consumers to continue buying goods from Asian manufacturers puts too much faith in an unbalanced global economy—other countries such as Western Europe need to stimulate growth and demand.
- Increasing U.S. interest rates, if mirrored elsewhere, could burst real estate bubbles in several key economies.
- The threat of a flu pandemic originating where institutional capacity is too weak to detect, control and contain such an outbreak remains a concern.

- China and Russia: large consumers and producers of commodities are opaque and are going through political change; growing income disparities in these and other countries undermine political stability.

Geopolitics will continue to be a source of tension and uncertainty affecting Arab countries directly and indirectly. Geopolitical developments outside the Arab region that will impact on Arab countries are numerous and varied and examples include:

- The changing geopolitical landscape accompanying China's and India's pursuit of equity in other countries' resources, especially oil and gas.
- The future path of China's political evolution and relations with its neighbours is uncertain and has huge potential to deliver jolts to the world economy.
- Russia's recent strong-armed but unsophisticated handling of its gas dispute with Ukraine alarmed governments around the world.
- Growing uncertainties accompanying the expanding populism and changing political scene in Latin America remain a question mark in terms of the medium term contribution of the region to global oil and gas supply.
- Tensions developing over Iran's nuclear program remain a constant threat to stability in the Middle East and to oil markets.

The most serious geopolitical event since the last Arab Energy Conference has been the invasion of Iraq and the long and destructive occupation by foreign troops. This debilitating war only adds to the perception of instability that continues to retard development in the region. It creates the pretext for the further build-up of military and defence infrastructure draining away necessary public money that could be better used in socio-economic development.

Also within the region, a just settlement of the Palestine–Israel problem is so long overdue.

The changes in Russia and China that have impacted on oil supply and demand respectively over the last 15 years, almost universally unanticipated, simply remind us that the events or developments that change the world the most dramatically are those that we cannot (or refuse to) see coming. Perhaps a downturn in the economy because of high commodity prices is something that we refuse to see, but this would be business as usual. Cycles have not been abolished.

Therefore the most compelling message for countries dependent on the revenues of commodity exports is to aggressively pursue polices to diversify their economies. This has been a consistent theme or message at previous Arab Energy Conferences. Much has been achieved in some countries. But efforts need to be redoubled and not just in those not blessed with hydrocarbon

reserves. Obviously in the oil and gas rich countries, diversification must be built on this endowment and comparative advantage. And this is manifestly taking place in many Arab countries. It is imperative that the recent improvement in national accounts does not lull governments into taking the easy course and slipping back to earlier attitudes that worked against economic diversification.

There is no single set of policies suitable for all Arab countries in their pursuit of economic diversification. Each has to move forward building on its particular resource endowment, whether based on oil, gas, agriculture, tourism, banking, minerals and metals, human resources or a combination.

It has been said before that reform is required in more than just the economic sphere in order to improve the development prospects of Arab countries.

- Education must be sufficiently diverse to equip youth with the necessary skills to participate fully in a pluralist diversified economy. It is noteworthy in this regard that Saudi Arabia has recently dramatically increased funding in the education sector toward this goal.
- With reform of education that emphasizes development of skills appropriate to the particular economic makeup of countries, governments need to ensure that the labour market is reformed in such a manner that there is space in

the labour pool for these newly trained citizens; thus the reliance on imported labour needs to be reduced hand in hand with greater emphasis on education and skills development.

- Increased employment improves the prospects for personal fulfilment and a greater sense of participation in society and therefore contributes to political stability.
- Inclusion goes beyond the workplace; transparency and accessibility to, and participation in, government institutions and accountability to citizens is essential to social cohesion.

With continued economic diversification and cooperation, reform of labour and administrative practises, as well as continued dialogue with consumer countries, the conditions are pointing to a positive future.