

Middle East Oil Production and Export Risks

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I. Introduction

The worldwide economy is built upon a petroleum foundation, with hydrocarbon-based energy resources forming the backbone of worldwide transportation, transit, and power generation. As such, a serious study of resource availability and security is a crucial component of any forward looking economic or security analysis for individual countries and the world at large.

Over the course of the semester the class has focused predominantly on long-term supply and demand trends. While this long range analysis is crucial, the goal of the following paper is to focus on more tangible, specific short-term risks to crude oil production and exports from one key producing region – The Middle East. It is well established that, at present, Middle East oil production dominates worldwide crude markets. What may be less well known is that, according to industry projections, this region will continue to grow in strategic importance over the next several decades.

This strategic importance necessitates thoughtful consideration of potential production and export risks, especially in a region like the Middle East that is particularly susceptible to potential supply shocks. This paper provides a brief exploration of those supply risks. While it is by no means an exhaustive list, it captures the most visible and glaring

regional oil production and export risks and should serve as a baseline for conversations regarding the dangers of placing the world's economic eggs in the Middle East's basket.

II. Middle East Oil Production Profile and Projections

Current

According to the EIA (Energy Information Agency), current oil production from the six key OPEC Persian Gulf countries (Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and UAE) represents 24.8% of worldwide oil production, 21.2 million barrels per day (mmbpd) (See *Figure 1 – Current Crude Oil Production, Projections, and Required Supply Additions* below for details). More importantly, particularly with respect to oil price and market volatility, the region represents essentially 100% of excess capacity, all of which is located in Saudi Arabia (See *Figure 2 – World Oil Surplus Production Capacity* below for details). The EIA estimates that Saudi Arabia, which produced an average of 9.6 mmbpd in April 2006, maintains production capacity of 10.5 – 11.0 mmbpd, implying 0.9 – 1.4 mmbpd worldwide excess oil production capacity.

Current excess capacity represents between 1.1% and 1.6% of total worldwide oil production (EIA 2006E: 85.2 mmbpd worldwide oil production), near historic lows and the lowest levels since just after the Gulf War in 1991. In the absence of the supply buffer offered by excess production capacity, all supply disruptions must be absorbed by price. This makes the global crude market and worldwide economy particularly susceptible to short-term supply disruptions in any producing region, and especially vulnerable to disruptions or shocks in the vital Middle East producing region.

Figure 1 – Current Crude Oil Production, Projections, and Required Supply

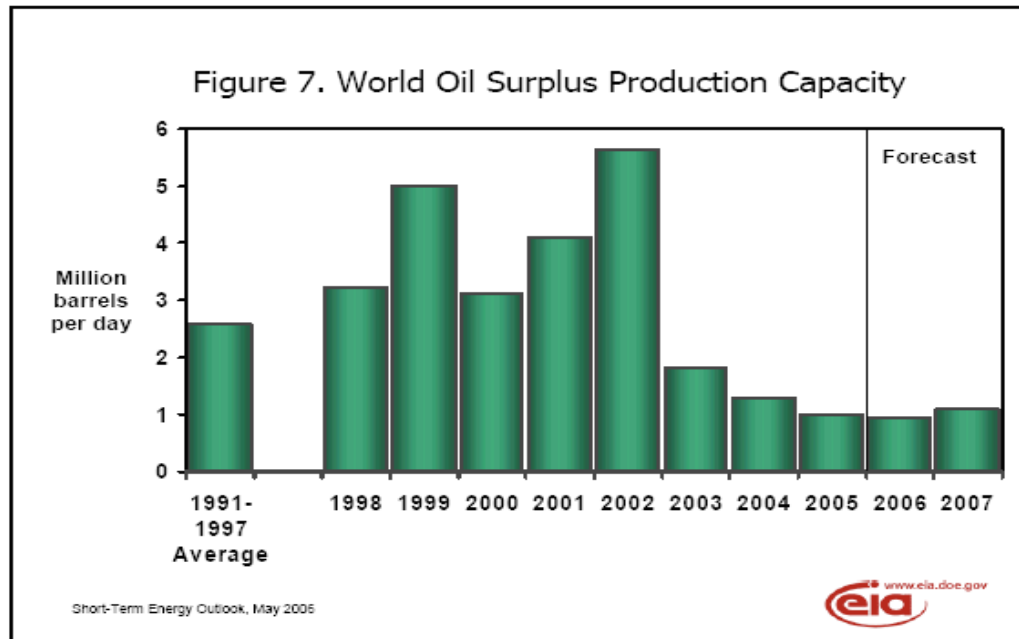
Additions

	Current - 2006		Projection - 2025		Required Supply Additions	
	(mmbpd)	(% of Total)	(mmbpd)	(% of Total)	(mmbpd)	(% of Total)
Persian Gulf						
Iran	3.8	4.5%	5.0	4.1%	1.2	3.2%
Iraq	1.9	2.2%	6.6	5.4%	4.7	12.7%
Kuwait	2.6	3.0%	5.2	4.3%	2.7	7.2%
Qatar	0.8	0.9%	0.8	0.7%	-	0.0%
Saudi Arabia	9.6	11.3%	16.3	13.3%	6.7	18.1%
UAE	2.5	2.9%	5.4	4.4%	2.9	7.8%
Total Persian Gulf	21.2	24.8%	39.3	32.2%	18.2	49.1%
Total World Supply	85.2	100.0%	122.2	100.0%	37.0	100.0%

Source: EIA

Note: All figures in mmbpd. Current – 2006: Actual April 2006 average daily production figures for individual countries; Total World Supply is EIA estimate for average 2006 daily production. Projection – 2025: EIA Reference Case forecast, July 2005.

Figure 2 – World Oil Surplus Production Capacity



Source: EIA

Projected

Figure 1 (*Figure 1 – Current Crude Oil Production, Projections, and Required Supply Additions*) above also provides a break down of the EIA projections for future oil production capacity by country. Note that production from the Middle East is expected to remain pivotal in world oil markets. EIA projections call for worldwide production totaling 122.2 mmbpd by 2025, an increase of 37.0 mmbpd over 2006 production levels. While the projections call for incremental supply additions from a number of countries, most notably the Former Soviet Union (6.4 mmbpd), the majority of this increase is expected to come from the Persian Gulf countries (18.2 mmbpd, 49.1% of total supply additions). Further analysis reveals that over 30% of those supply additions are expected to come from just two countries – Iraq and Saudi Arabia.

Clearly there are a number of reasons to regard these estimates with skepticism. For example, there is a conspicuous absence of any declining production figures. Only one producing region is forecast to decline over the next two decades – the North Sea. Bear in mind that this is a basin for which, in stark contrast to the majority of those listed in the table, the world has ample production and field level data. The EIA is a top notch organization that puts a great deal of time and effort into their projections. Even so, one could reasonably assert that the EIA would concede that with the benefit of detailed production and reserve data, many of these projections would change, perhaps dramatically.

In spite of any such reservations, it is clear from the figures above that the Middle East will continue to play a crucial role in meeting the world's energy needs. Bear that context in mind throughout the following discussion regarding specific risks that could disrupt the supply, and projected growth, of oil production and exports from the region.

III. Middle East Production and Export Risks

A. Potential Overstated Reserves

A brief review of basic definitions of proved reserves generally applied to western or publicly traded oil and gas companies will provide a baseline for further discussion.

Proven Reserves

Defined as the estimated quantities of oil and gas which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions

The area of a reservoir considered proved *includes*:

- Portions delineated by drilling and defined by gas-oil and/or oil-water contacts; and

- Immediately adjoining portions not yet drilled, but which can be reasonably judged as economically productive on the basis of available geological and engineering data.

Estimates of proved reserves typically *do not include* the following:

- Crude oil, natural gas, and NGLs, the recovery of which is subject to reasonable doubt because of uncertainty as to geology, reservoir characteristics, or economic factors; and
- Crude oil, natural gas, and NGLs that may occur in undrilled prospects.

Clearly the above definitions are rigid and well defined; however, even under these assumptions the estimation of oil reserves is a matter of probability. Reserve estimates are continually monitored and revised to reflect ongoing information acquisition on specific producing reservoirs and basins. There are numerous examples of fields booked as proven reserves which experienced production surprises (such as unanticipated high water cuts early in the production life cycle) that led to subsequent reserve restatements.

While most western or publicly traded oil and gas companies are subject to strict reporting guidelines, national oil companies typically operate under no such supervision. There is no data required to support reported reserve figures. There are also no clearly defined definitions to contextualize reported reserve figures – Do reported reserves represent original oil in place, ultimately recoverable reserves, or something else? National oil companies are also not forced to write off reserves when wells or fields experience disappointing or surprising production results. In short, there is a tremendous amount of uncertainty surrounding the reported reserve numbers that much of the world accepts at face value.

History

Throughout the 1970s and early 1980s oil producing countries in the Middle East assumed control over their oil production from major international oil companies. This transition marked a pivotal moment in the history of the industry, the ramifications of which were felt immediately and still reverberate on global crude markets to this day. This transition was accompanied by the rise of the power of OPEC and the quota system, a system which many argue had real consequences for proven reserve estimates.

OPEC is nothing more than a cartel – a group of suppliers who cooperate to artificially restrict supply with the intention of inflating prices beyond their natural market clearing price. All cartels face the challenges of member cheating and overproduction, and OPEC is no different. If a given country's quota is substantially below its production capacity, there are considerable incentives to overproduce because the marginal cost of producing an additional barrel of oil is well below the market price. This behavior has been observed throughout much of OPEC's history.

Beyond simply producing above the stated quota, there evolved another means of gaming the quota system. While the OPEC production quota is a function of many factors, the principal driver is each country's reported reserve estimate. The implementation of the quota system, therefore, introduced incentives for individual countries to overestimate their reserves in an effort to claim larger pieces of the pie via larger export quotas.

A cursory glance at historical proved reserve figures is instructive. Figure 3 (*Figure 3 – OPEC Historical Proved Reserves*) below details the reported proved reserve estimates for six key OPEC oil producers from 1980 to 1991 as well as current reserve estimates as recent as 2004.

Highlights (denoted by shading):

- Kuwait: 1984 – Reserves increased from 66.7 Gb (Billion barrels) to 92.7 Gb. There have been no major discoveries since 1962
- Iraq: 1982 – Reserves increased from 29.7 Gb to 41 Gb; 1987 – Reserves increased from 47.1 Gb to 100.0 Gb while the country was at war with Iran and oil exploration was static
- Iran: 1987 – Reserves increased from 48.8 Gb to 92.9 Gb
- UAE: 1987 – Reserves increased from 32.4 Gb to 96.2 Gb
- Saudi Arabia: 1989 – Reserves increased from 172.6 Gb to 257.6 Gb

There is little doubt that these increases were motivated, at least in some part, by OPEC quota considerations. This doubling, and in some cases tripling, of reported reserve estimates in the 1980s added some 300 Gb to total worldwide proved reserves virtually overnight. While it is probable that the companies operating in the Middle East prior to nationalization took a conservative stance with respect to reserve reporting, is it reasonable to assume that their estimates missed the mark by such a substantial margin? It is also important to note that across the board, reserve estimates for 2004 are larger than reserve estimates in 1991, despite the nearly 15 year's worth of interim production.

The addition of reserves typically involves exploration success or the acquisition of new data or information on existing reservoirs. The former does not apply here, as there were no giant or super giant oilfield discoveries that would explain the large reserve increases. The latter typically involves a time and capital intensive process of proving up probable and possible reserves, something that is not typically accomplished overnight.

Figure 3 – OPEC Historical Proved Reserves

	<u>Proved Reserves</u>					
	<u>UAE</u>	<u>Iran</u>	<u>Iraq</u>	<u>Kuwait</u>	<u>Saudi Arabia</u>	<u>Venezuela</u>
1980	30.4	57.5	30.0	67.9	168.0	18.0
1981	32.2	57.0	29.7	67.7	167.9	20.3
1982	32.4	55.3	41.0	67.2	165.3	21.5
1983	31.8	51.0	43.0	66.7	168.9	24.9
1984	31.9	48.5	44.5	92.7	171.7	25.8
1985	32.4	47.9	44.1	"	171.5	25.6
1986	32.4	48.8	47.1	94.5	169.2	25.0
1987	96.2	92.9	100.0	"	169.6	56.3
1988	"	"	"	"	172.6	58.1
1989	98.1	"	"	97.1	257.6	58.5
1990	"	"	"	97.0	260.0	59.0
1991	"	"	"	96.5	260.3	59.1
2004	97.8	132.5	115.0	99.0	262.7	77.2

Source: BP Statistical Review

Note: All figures in billions of barrels.

Lack of Data

Information is power, and the imposition of information asymmetry is an effective means of altering the balance of power. In 1982, OPEC countries discontinued the process of releasing detailed field-by-field production and reserve data. At present, there is virtually

no data available on production rates, volumes, or even number of producing wells. This absence of data makes a bottom's up, fundamental analysis of any specific country's reported production or reserve data nearly impossible.

While the world accepts as fact the reserve estimates quoted for the Middle East, these numbers are not subject to the rigid definitions described above. Even if they were, there would be no means for the world at large to verify those assertions in the absence of field and well specific data. Clearly there is no concrete evidence that would suggest that, without question, the reported reserve figures for Middle East producers are inflated. Even so, there is reasonable cause for skepticism as there exists today a system with considerable incentives for overstating reserves and no effective system of checks and balances. In a game played according to those rules, economic theory and behavioral science would predict inflated reported reserves.

B. Internal Instability

Resource Curse

Middle East oil producing countries suffer from many of the classic resource curse symptoms. (Section below adapted from The Encyclopedia of Energy; *Oil-Led Development: Social, Political and Economic Consequences*; by Terry Lynn Carl).

These include:

- Inflation of domestic currency driven by a large influx of petrodollars;
- Lack of economic diversity and overdependence on the volatile oil industry, with accompanying economic shocks, which makes state planning and development difficult;
- Capital intensive industry with minimal local job creation;

- Governance challenges with economic and political power highly concentrated, the lines between public and private enterprise blurred, and rampant government inefficiency; and
- Demographic challenges – Population booms accompanied by diminishing per capita income and the creation of welfare states.

The combination of these factors, unique to countries that have experienced oil-led development, creates a culture of instability that must be monitored and managed.

Social Challenges

The oil producing countries in the Middle East must also face tremendous social challenges over the coming decades, adding a number of additional destabilizing forces such as: (The ideas below are adapted from the following paper: Center for Strategic and International Studies; *Saudi Arabia Enters the 21st Century*; by Anthony Cordesman; October 30, 2002; http://www.csis.org/media/csis/pubs/s21_01.pdf)

- Rich vs. Poor Gap;
- Denial of human rights and political participation;
- Religion: The clash between the modernization of religious practices and traditional or fundamental adherence;
- Culture Shock: Traditional societies forced to interact more frequently with Western society and developed nations;
- Education Reform: Much of the education at present is religious in nature or characterized by low quality teachers, poor performance metric measurement, and a lack of instruction in problem solving or creativity. The next generation will not graduate with the skills necessary to build a diversified economy or to compete on a global scale;
- Legal System Reform;

- Role of Women: A source of global contention and a source of labor inefficiency and underproductivity.

Saudi Arabia: A Case Study

Saudi Arabia is an instructive case study as there is a great deal more information available on conditions within the country.

Internal Context:

Domestic discontent rose steadily after the largely unpopular Persian Gulf War placed foreign troops on Saudi soil. Many argued that the necessity of bringing in outside armies to protect the kingdom constituted a de facto breach of the social contract (desert tradition) whereby weaker tribes offer loyalty to a stronger tribe, here the Sauds, in exchange for protection.

The country's abundant natural resources are owned and controlled by the royal family, and there is little or no limit on royal family spending at home or abroad. More troubling, many family members are now muscling in on private business, alienating a class of citizens that has been exceedingly loyal to the Sauds. This, coupled with the steady deterioration in per capita GDP and standard of living, highlights a growing divide between the haves and have nots.

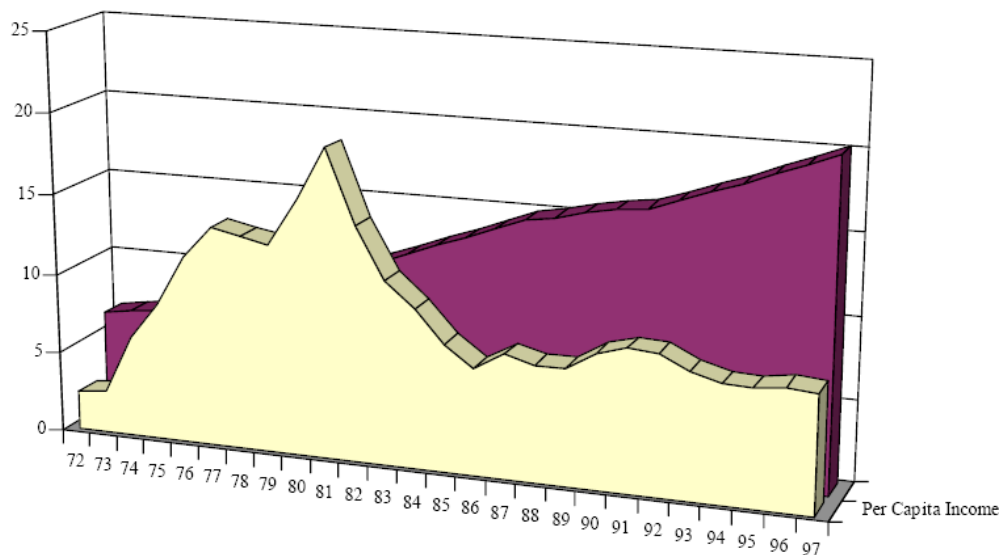
Local reformers and religious extremists have called for an end to the Saud family's corruption, greed, and imitation of the West. Some have gone further, seeking measures that would curb the absolute power of the family such as "public accountability, equality before the law, an independent judiciary, and popular participation..." (Source: Foreign Affairs, *The Storm and the Citadel*, by Milton Viorst; January/February 1996). While there is no large popular movement behind the dissidents, there remains a fear that the

attitude is spreading. The government has also been accused of rough treatment of dissidents, and on occasion countrywide arrests have been reported.

Demographics:

The last three decades have seen an explosion in the population of Saudi Arabia from 6.5 million in 1972 to approximately 24 million in 2003. Growth rates were nearly 5% in the 1970's and 1980's, with more modest current and projected growth rates of approximately 3% (Source: *Demographics: The Downfall of Saudi Arabia*, by Adam Goetz, December 2003). As Figure 4 (*Figure 4 – Saudi Arabia: Population Growth vs. Per Capita Income*) below makes clear, this combination of explosive population growth and minimal growth in real GDP has led to a dramatic reduction in per capita GDP.

Figure 4 – Saudi Arabia: Population Growth vs. Per Capita Income



Source: Saudi Arabia Enters the 21st Century, Adapted by Anthony Cordesman

The country must also deal with a looming employment crisis. “The presently employed generation of 25-34 year olds is currently unemployed at 27% and 33% for males and females respectively. The up and coming workforce of 15-25 year olds represent half of

the entire Saudi population, most of which reside in the country's educational system. Over the next ten years an additional 10-12 million workers will have to be accounted for and gainfully employed.” (Source: *Demographics: The Downfall of Saudi Arabia*, by Adam Goetz, December 2003). The Saudi economy will need to undergo dramatic restructuring in order to absorb this large influx of workers.

Welfare State:

The country now spends a disproportionate amount on entitlement programs, foregoing potentially beneficial long-term economic capital investments in diversifying the domestic economy or upgrading and maintaining basic state infrastructure. The mid 1990s oil downturn led to a dramatic economic downturn in Saudi Arabia, and the country caught a glimpse of the dangers of heavy domestic subsidies and social programs. The US State Department in 1995 reported that “Tighter government budgets have reduced employment opportunities for young Saudis, frozen wages and slowed the private sector...” The report goes on to highlight the impact that domestic economic strains had on shaping popular opinion, highlighting the rich-poor distinction and adding to resentment of the Saudi royal family’s profligate spending.

Conclusion

Obviously Saudi Arabia faces a number of country specific challenges, but there is insight to be gleaned from their example which can be applied to much of the Middle East, such as:

- Across the region, there are bloated welfare states straining to support ever larger population bases;
- Each country must cope with the instability caused by religious differences both internally and across the region;

- Each country must deal, according to their unique situations, with the social challenges created by interactions with the largely secular international community;
- Popular movements for political and economic reforms, and some means to bridge the growing economic divide between rich and poor, must not be ignored;
- Education systems must be improved to equip the coming generations to compete in the global marketplace and diffuse future potential causes of instability; and
- Economic diversity must be pursued to minimize the impacts of cyclical oil booms and busts and provide employment opportunities for future generations.

In short, these are countries and societies in various stages of transition. They each face a multitude of complex challenges, many with roots in their oil-led development, with few easy answers. The outside world can offer guidance and support, but lasting solutions must come from within. The outside world ignores these potential causes of instability at their own peril.

C. Shipping Chokepoints

Throughout the world there exist a number of critical shipping chokepoints or narrow channels through which cargo vital to the worldwide economy passes daily. These chokepoints present security challenges because they are narrow and are therefore at greater risk from blockage, piracy, or shipping accidents. According to the EIA, two thirds of the world's oil transport is conducted via tanker (approximately 43 mmbpd) and is therefore subject to the dangers inherent in transport through these chokepoints. With respect to Middle East oil transportation, three chokepoints warrant careful consideration: The Strait of Hormuz, the Bab el-Mandab passage, and the Suez Canal / Sumed Pipeline Complex.

The Strait of Hormuz

This narrow point between the Gulf of Oman and the Persian Gulf, the only route to the open sea for much of the petroleum exporting Persian Gulf, is the world's most critical shipping chokepoint. Strait traffic estimates range between 14 and 17 million barrels of oil per day (16–20% of worldwide daily production, 65–80% of Middle East production), which is bordered on the north by Iran and the south by the UAE and Oman. At the narrowest point, it consists of two 1-mile wide channels for inbound and outbound tanker traffic, plus a 2-mile wide buffer.

Iran is of particular concern with respect to the Strait of Hormuz given its strategic position at the entrance and increasingly strained relations with the rest of the world. Iranian troops occupy Abu Masa, a small island in the middle of the Strait. Iranian forces are reported to have anti-ship missiles and a fleet of boats (many armed with torpedoes and mines). (Source: Foreign Policy, *The List: The Five Top Global Chokepoints*, May 8, 2006, http://www.foreignpolicy.com/story/cms.php?story_id=3457)

The Strait of Hormuz



Bab el-Mandeb

Bab el-Mandeb is a 17 mile wide strait linking the Red Sea with the Gulf of Aden and the Arabian Sea, separating the Arabian Peninsula from East Africa. The strait is a vital passage on the Indian Ocean-Mediterranean Sea shipping route via the Suez Canal. Any disruptions could keep Persian Gulf tankers carrying an estimated 3 million b/d from reaching the Suez Canal / Sumed Pipeline complex. In the event of closure, Saudi crude could be rerouted via the East-West pipeline (capacity 4.8 million b/d). (Source: EIA)

Bab el-Mandeb



Suez Canal / Sumed Pipeline

North bound petroleum flows via the Suez Canal and the Sumed Pipeline are estimated at 3.8 mmbpd: crude oil 2.5 mmbpd via the Sumed Pipeline, 0.8 mmbpd via the Suez Canal; petroleum products 0.5 mmbpd via the Suez Canal. Oil has historically represented approximately 25% of Suez Canal revenue. The Sumed Pipeline serves as an alternative to passage through the canal, transporting oil from tankers too large to pass fully laden through the canal. Closure of the canal and/or the pipeline would force tankers to travel

around the southern tip of Africa, dramatically increasing shipping time and transportation costs. (Source: EIA)

Suez Canal / Sumed Pipeline Complex



D. Infrastructure Vulnerability

There also exists a number of inviting infrastructure targets for terrorists or destabilizing elements within various producing countries.

Saudi Arabia

In Saudi Arabia, the following infrastructure targets represent potential points of vulnerability:

- Export Terminals – Saudi Arabia operates two primary export terminals on the Persian Gulf and one on the Red Sea:
 - Ras Tanura – Persian Gulf; Capacity 5 mmbpd
 - Juavmah – Persian Gulf; Capacity 3 mmbpd
 - Yanbu – Red Sea; Capacity 3 mmbpd
- Abqaiq Processing Facility – Approximately two thirds of Saudi crude is processed here prior to export. The importance of this facility with respect to worldwide crude

oil markets was underscored when, in February 2006, a failed terrorist attack at Abqaiq caused a 3.4% spike in crude oil prices around the world.

- Pipelines:

- East–West Pipeline (Petroline) – Connects Abqaiq to the Yanbu port, 750 miles,
Capacity 4.8 mmbpd

A terrorist attack on any one of these facilities, or a concerted attack targeting multiple targets, could instantaneously take a large portion of Saudi crude exports offline for an extended period of time. As the analysis above shows, any supply disruptions in Saudi Arabia would wipe out all worldwide excess production capacity and trigger a dramatic price spike in worldwide crude markets. The economic impacts of such an attack would be crippling. It is worth noting here that there is growing fear among security experts that al-Qaeda terrorists operating in Saudi Arabia, reinforced by veterans of the insurgency in Iraq, will be able to more effectively target Saudi export and production infrastructure in the future.

Iraq

Points of vulnerability in Iraq include:

- Export Terminals:

- Basra – Persian Gulf; Capacity 2 mmbpd

- Khor al-Amaya – Persian Gulf; Capacity 1.2 mmbpd post repairs

- Pipelines:

- Kirkuk-Ceyhan (Turkey): 600-mile, 1.1 mmbpd fully operational

Iraq-Saudi Arabia (IPSA): 1.65 mmbpd capacity, connects to Red Sea, expropriated by Saudi Arabia after Iraq's invasion of Kuwait

The Iraqi insurgency has identified oil infrastructure as a primary target. They are averaging eight attacks targeting the oil industry, predominantly pipeline bombings, per month.

Kuwait

Points of vulnerability in Kuwait include:

- Export Terminals:

Mina al-Ahmadi – Persian Gulf; Capacity 2 mmbpd

IV. Conclusions

The US currently imports over 50% of its domestic oil consumption (approximately 10 mmbpd), a figure that is projected to grow to approximately 70% over the next two decades. Clearly oil will continue to play a crucial economic role, not just in the United States, but worldwide. The Middle East, despite the potential uncertainty surrounding ultimate recoverable reserves or future potential rates of production, will invariably play a pivotal strategic role in delivering that oil to worldwide consumers. This strategic importance makes examination of potential downside scenarios critical.

This paper addressed several high profile potential causes for supply disruptions:

- Potentially overstated proved reserves;
- Internal Instability;
- International Shipping Chokepoints; and
- Export and Production Infrastructure Vulnerability.

Policy Implications

Uncertainty with respect to reserves is a fact of life, as there is no guaranteed method for identifying ultimate recoverable reserves from any producing basin or region. Even so, the international community and industry experts can and should continue to exert pressure on producing countries to release detailed field and well specific data. Only with this degree of granular detail can the international community begin to accurately assess production decline rates, field maturity, signs of aging, and future exploration potential. The stakes are too high to continue to make decisions and build policy around imperfect information.

Regional instability is a far more difficult issue to navigate. The world has clear incentives to maintain order in the region, but there is no clear mandate or means available to the international community to accomplish that goal. In the end, it is the individual countries who must find their own way through the challenges of the next several decades, with the clear understanding that the international community is willing (and economically obligated) to help in any way.

On the subject of security for petroleum transport and infrastructure, the presence of US and international military and security personnel in places like Saudi Arabia and Iraq is a double edged sword. On the one hand, their presence provides a measure of protection that might not otherwise be attainable. As the analysis above makes clear, this security is vital for the worldwide economy. On the other hand, their presence incites feelings of hostility and provides a focal point for the anger of dissidents, terrorists, and other potential regional destabilizing forces. These costs and benefits must be weighed carefully, and cannot be decoupled from the ultimate regional stability challenges alluded to above. Policy makers must continue to struggle to strike a difficult and delicate balance between sovereignty and intervention.