Oil Shock

Energy Supply and Demand…

Past, Present & Future

"Ignore the short-term hand wringing and misinformed hypothesizing. The underlying supply and demand fundamentals of crude oil grow more entrenched each day promising to make a successful investment in the oil exploration sector the most profitable in a generation."

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Introduction

The current price 5/18/98 received by US crude oil producers is $14.50 per barrel – down from a $24 per barrel just a few months ago.

The cause of this recent price reduction is largely due to nervous speculation about three factors: (1) a modest increase in the OPEC production quota allotted to Saudi Arabia; (2) the resumption by the United Nations of Iraq crude oil sales; and (3) the potential impact of the economic crisis in Asia. As you'll read in the following pages, these are really “non-events” in the bigger trend for crude oil.

Ignore the short-term hand wringing and misinformed hypothesizing: the underlying supply/demand fundamentals of crude oil, as we head into the new millennium grow more entrenched each day, promise to make a successful investment in the oil exploration sector the most profitable in a generation. Adding urgency to the situation is the ever-present threat to vital Middle Eastern supplies, especially those of Saudi Arabia; the location of one-quarter of the world's proven recoverable oil reserves.

It is our intention in this report to demonstrate, in detail, why a sharp and sustained increase in the price of crude oil is now inevitable. It is now not a matter of "if", but "when." With the wild card of the Middle East oil producing countries such a critical factor, the "when" could come as soon as tomorrow. We believe this will prove to be true and we'll show you why.

We have also included here some of the facts on the history of the oil and gas industry, and the basics of how it all works. You will also find a fairly comprehensive review of the critically important geopolitical component of crude oil price forecasts.

Some of what you read may surprise and even shock you. That's because recent research has uncovered alarming, but little known, evidence that the consensus supply forecast - which says that the world still has 50 years or more of crude oil reserves available - is based on dangerously optimistic geologic assumptions compounded by childish expectations on the world affairs front.

It is when the weakening supply picture is overlaid with the entrenched trend towards explosive growth in global energy consumption, and the decimation of the oil services industry in the

Fast Facts On World Oil

- The world consumes 75 million barrels of crude oil every day, making it the world's biggest commodity market with transactions exceeding $400 billion per day, a number which will double to $800 billion or more in the next 20 years.
- Last year world crude oil demand grew by 3 %, the highest growth rate since 1988, and more than double the past 10 year's average.
- The U.S. consumes almost 19 million barrels of crude oil every day. Of the total, gasoline accounts for 42%, fuel oil 19% and jet fuel 9%.
- Excess global crude oil production capacity has collapsed from over 50% in the early 1970s, to under 4% in 1998; by the year 2000, demand is likely to exceed production capacity.
- Close to 70% of all proven oil reserves are located in the Middle East. Less than 3% are located in the US.
- Imports of crude oil into the U.S. have risen in recent years to 57% of all domestic consumption. The U.S. is now twice as dependent on Persian Gulf oil as it was in 1973, before the first Arab oil embargo.
- Oil production in the lower 48 U.S. states peaked in 1970 and has fallen 45% since. Alaska production peaked in 1988, and has fallen 30% since.

Oil is a vital non-renewable resource. The price of crude oil is due to increase sharply in the near future.

1980's, that the stage is set for an ***Oil Shock*** - a term we use to mean a dramatic and largely unanticipated increase in world crude oil prices at the wellhead, impacting virtually every sector of the global economy. Fortunes will be lost and, more importantly for many readers of this study, fortunes can and will be made.

Three Key Components in the Oil Picture

I. Economics - Expenditures on energy account for 7 to 8 percent of the worldwide gross economic product, and a similar fraction of the value of world trade.

Experience has shown that periods of excessive energy costs (especially rapid, unexpected price changes - "oil shocks") are associated with inflation, recession, and even worse economic accidents.

II. National Security - Energy is a pivot point in national security issues in two ways:

(1) Through increasing dependence on oil from the politically troubled Middle East, many countries - most notably the US. - are increasingly placed in the position of competing for oil resources with important trading partners in Europe and in Asia, most importantly and recently in China and Japan.

(2) The continued failure of the US's dangerous Middle Eastern policy; specifically, de facto terrorism under the guise of U.S. "peacekeeping" military missions in the region.

Perversely, these malicious diplomatic and military interventions are proving to be one of the biggest forces behind Mideast instability. Out of this instability arises the very real danger that nuclear weapons-relevant knowledge and materials will be transferred from Middle Eastern civilian nuclear programs into national nuclear arsenals or terrorist bombs.

III. Environment – Without question, the consumption of energy is the most widely debated environmental issue around the globe: from wood smoke in Third World villages... to regional smog and acid precipitation in industrialized and developing countries alike... to the risk of widespread radioactive contamination from accidents at nuclear energy facilities... to the build-up of carbon dioxide and other heat-trapping gases in the atmosphere. Ironically, many of the proposed solutions to the problems - both real and imagined - will actually serve to increase crude oil and natural gas demand and price.

Prospects for a New Oil War

As one of our oil and gas trade magazine writers recently put it so well, "Rolling a hand grenade out of a car in Saudi Arabia at the wrong time in the wrong place can make the price of oil go up for a couple of months."

It is because of the vital nature of "black gold" that, over the past 100 years, more blood has been shed and lives lost or shattered over crude oil supplies than has been for control of all other natural resources combined since the beginning of recorded history. This perpetual oil war has now escalated to the point where even rumors of Middle East supply disruptions are sufficient to panic the global economy - and mobilize allied armies for Persian Gulf military adventures. However, with each passing day the risks increase that such adventures will trigger nuclear, chemical and biological retaliations in North America and Western Europe.

The stakes in the perpetual oil war couldn't be higher. Without access to reliable crude oil supplies modern society would turn primitive in just a matter of days. Without access to reasonably priced crude oil the industrialized world can - and has - routinely fallen into the abyss of financial panic.

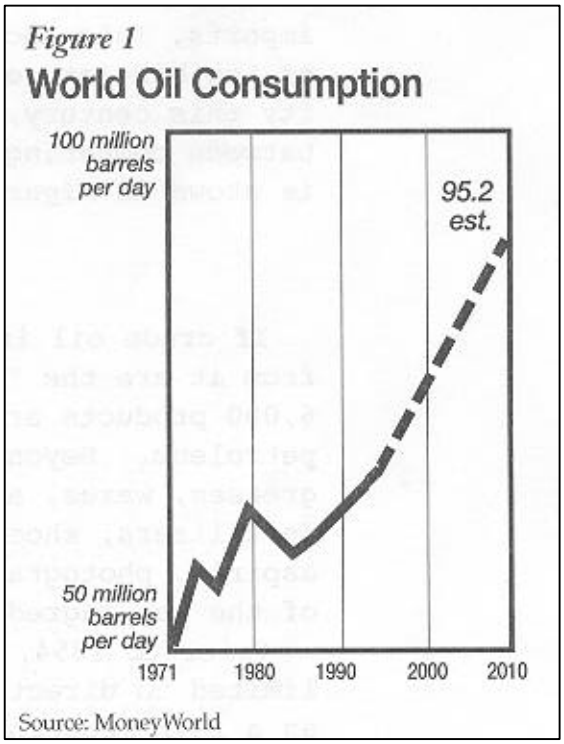
No, we are not forecasting anything so dramatic as a complete disruption of supplies, and mankind's innate creativity and force of will insure that, over time, logical and cost effective alternatives to oil will be found. However, there has never been a time when the margin of safety between oil demand and reliable supplies has been thinner... and this margin is narrowing almost daily. That puts us on the verge of a "sea change" in the oil industry, which will have a profound effect on the global economy and investment markets. The days are coming to an end when oil's availability and price are a back page story. The price paid to producers for crude oil is going up – way up. A current successful venture in crude oil exploration can and will result in incredible profits for the owners of proven recoverable reserves.

By thoroughly understanding the dynamics of oil today, you'll be able to prepare yourself to take measured steps as the oil shock unfolds. Please read on…

OIL INDUSTRY OVERVIEW

The world has a ravenous appetite for oil. At over $400 billion per day, the crude oil market already represents over 50% of the total dollar value of all commodities traded. while that is a massive number, it is expected to double in the next twenty years to $800 billion per day or more. By some point in the year 2,000, 18 months away, consumption will have risen another seven million barrels per day to at *least* 82 million barrels.

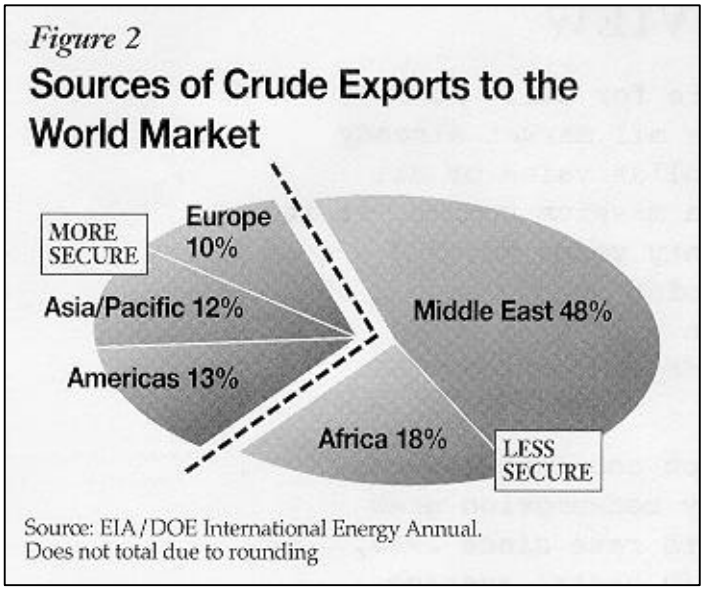
In 1996, the last year for which complete information is available, world energy consumption grew by 3%, the *highest annual growth rate since 1988, and more than* double *the past 10 years' average.*



This accelerating demand is shown in ***Figure 1: World Oil Consumption***. Should growth continue at that level, the oil industry would need to bring to market over 2 million bbls daily in new production just to keep up. For reasons discussed later in this report, these added supplies are becoming increasingly difficult to find and bring to market. Importantly, the mere fact that the global consumption trend has accelerated to the point where we have seen a doubling in demand in just one-year should set off alarms. But we get ahead of ourselves.

Crude oil currently provides about 40% of U.S. energy needs, natural gas 25%, coal 23%, hydropower 4% and nuclear 8%. Altogether, the fossil fuels - coal, oil and natural gas - are used to meet over three-quarters of the world's energy needs.

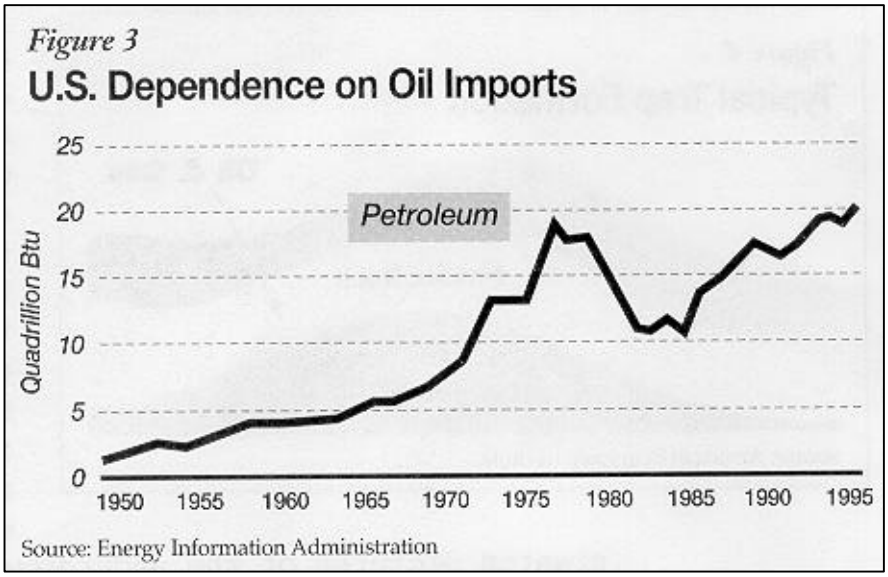
But in transportation, oil is still king, supplying 97% of the fuel used. This will not change significantly for decades, even with the new generation of cars powered by electricity and natural gas.



Meanwhile, U.S. dependence on imported oil, much of it from the political morass of the Persian Gulf, has almost doubled in just the past ten years. ***Figure 2: Sources of Crude Exports*** to the World Market, confirms that not only the U.S., but much of the rest of the world is also now highly dependent on highly unstable Middle Eastern and African countries to the tune of up to 66% of all imports. This increasing dependence on imported oil is one of the biggest supply configuration shifts for any commodity this century, and will lead to increased tensions between competing

importing nations. The U.S. situation is shown in ***Figure 3: U.S. Dependence on Oil Imports.***

The World's Lifeblood



If crude oil is "black gold," then the products derived from it are the "lifeblood" of modern society. Today, over 6,000 products are produced wholly, or in part, from petroleum. Beyond fuels there are lubricating oils, greases, waxes, asphalt, nylon stockings, plastics, fertilizers, shoe polish, detergents, medicines like aspirin, photographic film, pesticides and too many more of the key ingredients of modern life to mention here.

Prior to 1854, the use of crude oil was pretty much limited to direct burning for light, to make candles, and as a folk medicine, with supplies coming from oil seeping from the ground. By the mid-1850s, seepage supplies were growing short just as crude oil was becoming a popular substitute for coal oil (kerosene derived from coal) which, in turn, had replaced whale oil lamps following the demise of the whaling industry.

The crude oil shortage was temporarily solved in 1859 when Col. Edwin Drake drilled the first oil well at Titusville, Pennsylvania. Supplies from new oil wells were so ample that kerosene derived from crude oil entirely displaced coal oil by 1861, and started the Pennsylvania oil boom. As a point of historic interest, in 1998 dollars, crude oil was then selling for over $80 per barrel before the surge in new Pennsylvania supplies dropped the price to the equivalent of under $20 by the mid 1980's.

From Pre-Historic Birth to Your Gas Task

Crude oil, also called crude, unrefined oil or petroleum, is a mixture of thousands of different hydrogen and carbon compounds called Hydrocarbons. These occur as liquids, gases or solids. The simplest hydrocarbon unit (molecule) is methane or natural gas (CH4). The longer hydrocarbon chains are more likely to be liquids.

It is believed petroleum comes from tiny, prehistoric marine plants and animals **called Biotic (living) Material**. As hundreds of millions of years of biotic material and marine sediments

accumulated on top of each other, the resulting heat and pressure transformed the biotic material into crude oil and natural gas.

As the biotic material changed from a solid to a liquid or gas, it migrated through the overlaying porous marine sediments, some of it towards the earth's surface until stopped by non-porous, overhead rock, called a **Cap**, thus forming a reservoir.

The resulting geologic formation, called an anticlinal **Trap** or **Reservoir**, is found in areas with porous sedimentary rock layers and fossilized marine life. Finding these subterranean reservoirs is the focus of most energy company exploration. It is assumed that most of the giant reservoirs (the "elephants") in the U.S. have been discovered. However small (1 to 20 well fields), yet very profitable, continue to be discovered within the oil producing ("oil country") of the U.S.

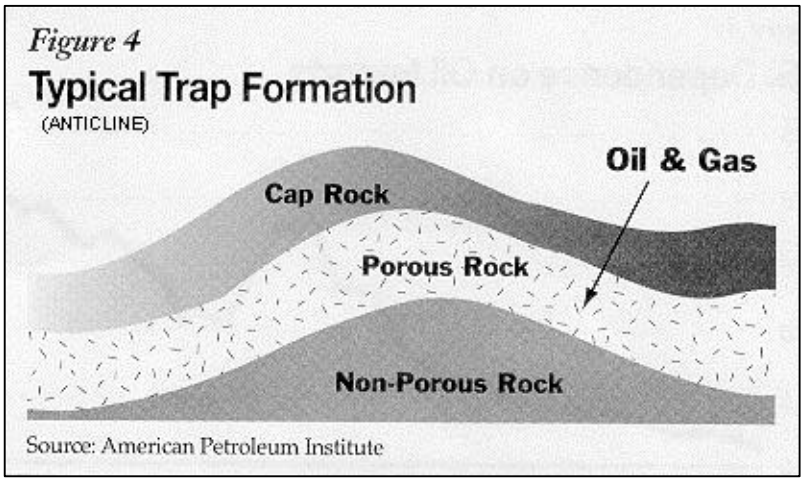


Figure 4: Typical Trap Formation shows a stylized cross-section of a trap formation (reservoir).

One of the most accurate means of detecting deposits is Seismic Technology. Sound waves, generated by explosives, are sent into the earth and reflected back by the rock layers to be recorded by seismographs - instruments similar to those used to record earthquakes. The rate at which the sound waves are reflected back creates pictures of the underground geology and possible location of an oil reservoir. Seismic techniques have been much refined through the years to include airborne surveys, computer modeling, and digital seismic technology.

Wells drilled into a site in areas where no oil or natural gas reservoir has been previously discovered (even though productive reservoirs may be close by) are known as **exploratory** or **wildcat wells**. A major discovery is defined as a multi-well field with a primary recovery of more than 100 million barrels of crude oil.

Before the drilling begins, permits and drilling rights must be obtained from the mineral and surface land owners, including the Federal government and Indian reservations. Leases must be purchased, or a development agreement reached, with the mineral owners getting royalties if oil or gas is discovered. Before drilling can commence, land clearing, road building, drill rig locations, etc. are required. Most land-based rigs are portable. They have tall **derricks** to handle the 60-90 ft. drilling pipe sections. Drill pipe is usually 4 ½" in diameter and 30 foot sections screw together. The drill bit, usually 7 7/8" in diameter, screws into the bottom section of the drill pipe.

Offshore oil and gas drilling is done from drill rigs mounted on platforms or drill ships. Offshore oil and gas drilling structures vary in size and complexity, ranging from single well platforms to 15-story "cities" with crew living quarters and warehouses for drilling and production equipment. A typical platform is designed so that 12 to 48 or more wells using directional drilling, to extend over an area of several thousand acres, as measured at the bottom of the wells. Most modern drilling is accomplished with **Rotary Drilling** tools powered by large diesel and/or electric motors.

The Egyptians used similar tools as early as 3000 BC. Much later, in 1500 AD, Leonardo DaVinci developed a design for a drilling rig which was similar to many of today's rotary rigs.

As the well is drilled deeper, 30-ft. sections of usually 4 ½ inch diameter drill pipe extensions are added to the top of the drill string. The drilling continues day and night until total depth is reached. A "deep well" is one mile or more deep. However, some wells are as deep as 30,000 feet (or more).

Rotary drilling requires "**mud**" which is a thin mixture of water, clay and several kinds of chemicals. The mud is continuously pumped, under pressure, into the top of the hollow drill pipe, down through the drill bit and back up the annulus (between the drill and the hole being drilled) to the

Gasoline Tax Facts

- The price for a gallon of gasoline in the U.S. typically includes nearly 43 cents for taxes. The federal gasoline tax is 18.3 cents a gallon. The national average for state gasoline taxes is 22.6 cents a gallon and the national average for local gasoline taxes about 2 cents a gallon.
- The federal tax on diesel fuel is 24.3 cents a gallon, six cents a gallon more than the federal tax on gasoline.
- Diesel fuel users - usually truck owners – pay $13 billion in federal fuel taxes each year.
- The total annual motor fuels tax bill for the nation is nearly $65 billion. That works out to about $240 for every man woman and child; $370 for every licensed driver, or more than $650 for a family.
- Rural Americans drive much more than urban Americans and, as a result, pay as much as two to three times in gasoline taxes.
- Clearly, any significant change in oil prices has a substantial impact on tax revenues. Should major supply disruptions and shortages develop, anticipate that the U.S. government will take the opportunity to increase gasoline taxes substantially as a way of encouraging conservation. The media will go along, pointing out that U.S. gasoline taxes are among the lowest in the world.

surface. This pressured, circulating mud cools the drill bit, carries cuttings up and out of the well. The mud coats the wall of the well and controls natural strata pressures when encountered.

As oil and gas saturated pore spaces in the strata are penetrated, reservoir pressure forces the oil and gas into the well bore and up to the surface. However, the days of **Gushers**, popularized by Hollywood - when newfound oil and gas would explode to the surface - are over. Modern operators have **Blowout Preventers** which automatically shut off and control the flow of gas and/or oil from the well.

Boosting Production from Aging Wells

When an oil reservoir is initially drilled, the natural pressure provides the energy (**Reservoir Energy**) required for the oil to flow easily into the well and up to the surface. Early in the industry, when a reservoir was drained to approximately 50% produced it had to be abandoned, as further recovery was either impossible or uneconomic. Today, a number of technologic advances are used to extend production. Using the technologies discussed below, a reservoir might be expected to yield between 50% to 75% of its virgin oil in place. This means that oil companies are regularly forced to make decisions based on projected oil prices - about the economic viability of taking measures in an attempt to produce remaining oil out of a mature, producing reservoir. In periods of low or falling prices, it is frequently necessary to simply shut-in or plug and abandon the reservoir wells.

"The great reservoirs of the Middle East, where two-thirds of the world's oil have been discovered, have been drained of about 50% of their total initial oil in place since the end of WWII, meaning that further extraction from this vital source will only get more costly."

Following are some of the current methods being used to extend production from aging reservoirs.

Horizontal Drilling allows for the lowest cost per barrel of all methods when used on geologic formations where oil and gas collects in porous, vertically configured reservoirs, such as the West Texas chalk formation fields. By drilling at acute angles from the original vertical wells for distances of up to several thousand feet, by-passed oil and gas, which would otherwise be impractical or impossible to recover by vertical drilling, can be recovered.

The costs associated with horizontal drilling are as much as 40% to 200% higher - but the additional production found usually more than compensates.

1. Horizontal drilling can penetrate more than one reservoir, producing up to six or seven times as much gas or oil from an equivalent vertical well.

2. By horizontal drilling the "traditional" primary recovery life of a well can be increased by as much 50%. Thus reducing per-barrel drilling costs as much as one-third or more in some cases.

3. Twenty or more horizontal or slanted wells can be drilled from a single drilling platform.

4. In the early day of slant drilling it required that a shaft be 2,000 ft or more in order to bend from vertical to horizontal - today's technology allows for a 90-degree bend within a *few* feet.

Enhanced Oil Recovery (EOR) techniques involve the injection of various substances i.e. water, steam, carbon dioxide or chemicals, into the reservoir to build up depleted reservoir energy, making a greater proportion of the residual oil deposits accessible with pumping. The relatively recent application of this technology has achieved significant output increases in older wells, referred to as Secondary Recovery wells.

Microbial Stimulation is a technique in which microorganisms and nutrients are injected into a dormant reservoir. The generation of the gases resulting from microbial growth builds new reservoir energy, aiding oil and gas recovery. The treated wells are then returned to production, and the injection cycle is repeated as long as production costs remain viable.

Transportation of Oil

Three-fourths of domestic crude oil and a third of all refined products are transported by over 1.2 million miles of U.S. pipelines that connect wells with refineries and other market sectors. The most famous and important is the **Trans Alaska Pipeline**. It carries crude from the North Slope of Alaska to the south Alaskan port of Valdez. This 800-mile long pipeline transports 1.5 million barrels per day. It is supplying roughly 25% of total U.S. petroleum needs. The extreme dependence of the U.S. economy on the Trans Alaska Pipeline makes it an extremely attractive target for terrorists.

Sweet and Sour Crude Oils

Light, sweet crude is preferred by refiners because of its low-sulfur content and relatively high yield of high-value products such as naphtha, gasoline, middle distillates, and kerosene. This allows it to be most efficiently processed in the typical cracking refinery.

Most of the world's crude oil supply, however, is made up of high sulfur crude, called sour crude. The sulfur content of sour crude is far greater than for sweet crude, around 2.2% and 0.4% respectively. Worldwide, about 60% of petroleum production and 80% of the economically recoverable oil reserves are sour. Sour crude is generally heavier, meaning lower yields of the high-value products and less favorable refining economics. Sour crude oil and gas are extremely dangerous to personnel – the hydrogen sulfide gas is deadly, having caused many deaths over the years of oil field personnel.

Refiners react quickly to market changes and do their best to process whatever feedstock, sweet or sour, and product mix offers the greatest return on investment, although not all refineries can process both types with equal facility. For example, most California refineries primarily process heavier California, Alaskan and Mexican crude, and have to make substantial reconfiguring changes before processing other grades.

When lower-sulfur truck diesel fuel standards were recently imposed, some refiners, rather than make the large reconfiguring investment necessary to meet the lower-sulfur standard, opted instead to leave the diesel truck market, but continued producing the higher sulfur diesel for the exempted construction and agriculture sectors,

Refiners also make seasonal changes, usually producing more heating oil in the fall and winter and more gasoline in the

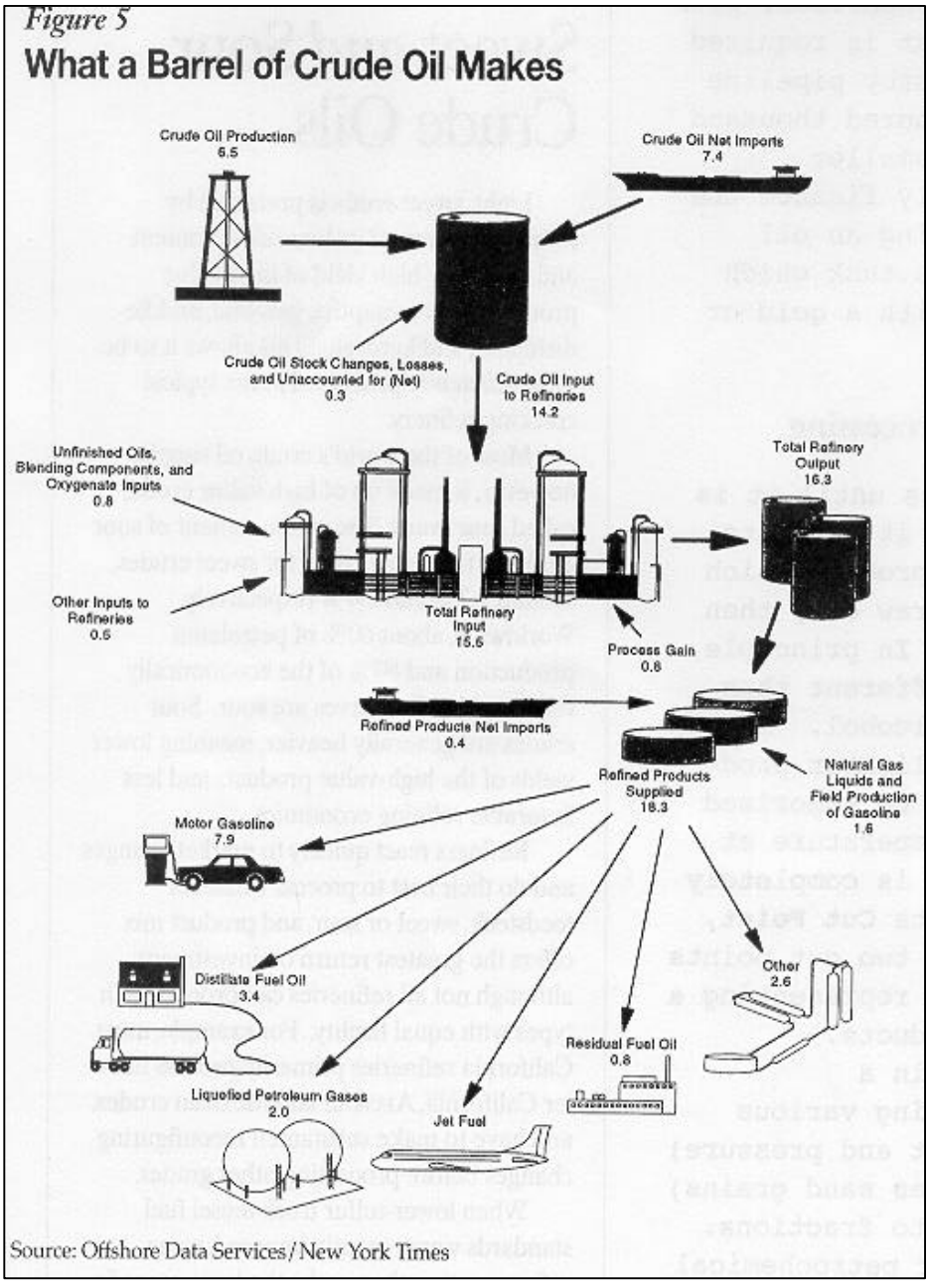
Most foreign crude oil imports are shipped in **Super Tankers**, some being over a thousand feet long - more than ten football fields - with a two million-barrel capacity. Regionally, trucks and railroad cars haul end products from refineries to distributors and end users. Trucks or pipelines usually move newly produced crude oil from the wells to the refineries.

"The extreme dependence of the U.S. economy on the Alaska Pipeline... supplying roughly 25% of total U.S. petroleum production... makes it an extremely attractive target for terrorists."

Refining & Processing

Crude oil is useless until it is refined by separating it into its components through a process which includes boiling to draw off, then condense the vapors. In principle, this process is no different than the distillation of alcohol. As the crude is heated, the lighter products are the first to be vaporized and drawn off. The temperature at which a product group is completely vaporized is called its Cut Point, and the yield between two cut points is called a Fraction, representing a related family of products.

Figure 5



Refining takes place in a **Fractioning Tower**, using various thermal elements (heat and pressure) and catalysts, (such as sand grains) to Crack the crude into fractions.

Butanes and lighter petrochemical compounds boil off at less than 100 degrees Fahrenheit; gasoline between 90 and 220; kerosene between 315 and 450 and Middle Distillate fuels - which includes No. 2 Fuel Oil (heating oil), Diesel and Jet fuel between 450 and 800F. The remainder is called Residue, which can be used for industrial fuel with little or no additional

processing. Depending on the use, it is called Heavy Fuel Oil, Residual Fuel Oil (Resid), Bunker Fuel, No. 6 Fuel Oil, Blackoil, or Dirty Product. Lighter crude yield higher percentages of the light products, so tend to be more valuable than the heavy crude, but not absolutely so, as some have high sulfur and other impurity levels which are costly to remove.

Gasoline is the single largest volume refined product sold in the US. Gasoline accounts for nearly 50% of the Nation's oil consumption – more than double the demand for middle distillate fuels including Heating Oil.

Diesel and jet fuels are chemically so similar to No. 2 heating oil that the three normally trade at stable premiums to each other, with heating oil the benchmark price. This makes it possible for the transportation sector to hedge (lock-in) fuel costs well in advance by trading the No. 2 Fuel Oil futures contract. ***Figure 5: What a Barrel of Crude Oil Makes*** tallies the end products yield from one barrel (42 gallons) of crude oil.

Oil Shocks: Past and Future

During the past thirty years, three events have dominated world history: (1) The collapse of the Soviet Union; (2) Sweeping global privatization; and (3) oil shocks. Oil shocks are defined as any unexpected and substantial change in crude oil supplies and prices, and stem from the interplay of three components found in the "energy supply profile" of a country…

1. **Reserves**. What is the size of current domestic supplies and stockpiles relative to consumption?

2. **Production**. How vulnerable is the domestic oil industry to production bottlenecks caused by drilling rig and refinery capacity shortages?

3. **Foreign Dependence**. How crucial are crude oil imports to maintaining normal economic activity, and what percentage of imports comes from political hot spots?

Although previous oil shocks were largely precipitated by events in the Middle East, rapidly unfolding trends in reserve and capacity shortfalls threaten a new type of oil shock: an oil shock caused by structural problems in the domestic industry itself. More on this in later.

Economic Impact of Coming Oil Shocks

Even the U.S. Energy Information Administration (EIA) admits that, by most measures, the country will remain at risk to oil shocks through the year 2020, in spite of 24 years of seemingly endless government programs, subsidies, deregulation and private sector initiatives. Three aspects of that dismal reality deserve special attention...

I. The common "prescription" for oil shocks, which calls for substituting imports with more domestic production, reduces the cost savings benefits from cheaper imports and does not substantially reduce damage to the economy and society. As long as oil prices are set in the world marketplace, and the U.S. is part of that market, it will still have to ante up the same higher world price, both for domestically produced and imported oil.

II. The U.S. is still paying mightily for past oil shocks, on top of footing the bill for those yet to come. A study published by the Oak Ridge National Laboratory estimates oil shocks may have cost the U.S. economy, on average, as much as $73 billion per year between 1972 and 1991. The Petroleum Industry Research Foundation estimates that the 1973 and 1978 oil shocks cost the U.S. a cumulative 2.5% and 3.5% in economic growth, and warns that, today, each percentage point loss in GDP from more shocks would cost the country $75 billion annually - an amount equal to roughly twice the total estimated overall 1997 federal deficit.

> "At current levels, supplies from alternative sources are expected to reduce oil demand by just a total of 90 million barrels annually by the year 2000.
>
> That's only ten *days of imports* at the *present per day import rate."*

Although hard to quantify with precision, research we came across suggests that on-going U.S. military intervention in the Persian Gulf is costing taxpayers up to $65 billion per year, to say nothing of what may be the ultimate price: American lives lost, both in the Persian Gulf and right here at home from anticipated retaliatory nuclear, biological and chemical attacks by terrorists.

Summing up the situation, retired **Air Force General G. Lee Butler**, Chief Air Planner for Operation Desert Storm, stated in the *Wall Street Journal…*

"When externalities such as environmental and health costs, the loss of domestic jobs and basic industries, the trade deficit, commitments of military resources to ensure the free flow of oil from the Middle East, and threats to our energy and national security are included, **the true cost of imports exceeds $100 a barrel**, according to the General Accounting Office."

What about future oil shocks? A Department of Energy forecast - and, because of

the source, this should be considered very much on the low side - puts the price tag at a whopping $600 billion between 1990 and 2020.

III. Widely touted energy substitution and efficiency programs will do little to prevent damage from coming shocks. The US transportation sector is almost 97% dependent on oil, accounting for nearly two-thirds of the nation's oil consumption.

Unfortunately, all the U.S. government programs to promote the use of alternative motor fuels (e.g., natural gas, alcohol, ocean wave action and electricity) and renewable energy technologies deriving energy from wind, the sun (**solar energy**), and the earth (**geothermal energy**) have, so far, barely made a dent. In fact, at current levels, supplies from alternative sources are expected to reduce oil demand by just 90 million barrels annually by the year 2000. That's only ten days of imports at the present per day import rate.

Likewise, according to a 1995 Department of Energy Report, the prospects for replacing crude oil with "green" energy (non-polluting) sources to forestall future oil shocks are equally dismal. Green energy currently accounts for about 5% of all electricity generated in the country, but of that amount only 2/3 of 1% is anything but hydropower which is scarcely up from 1/2 of 1% twenty years ago! The DOE report forecasted that, in 2010, green energy contributions would equal 120 million barrels of oil, a fraction of annual U.S. demand.

Causes of Oil Shocks: Past & Future

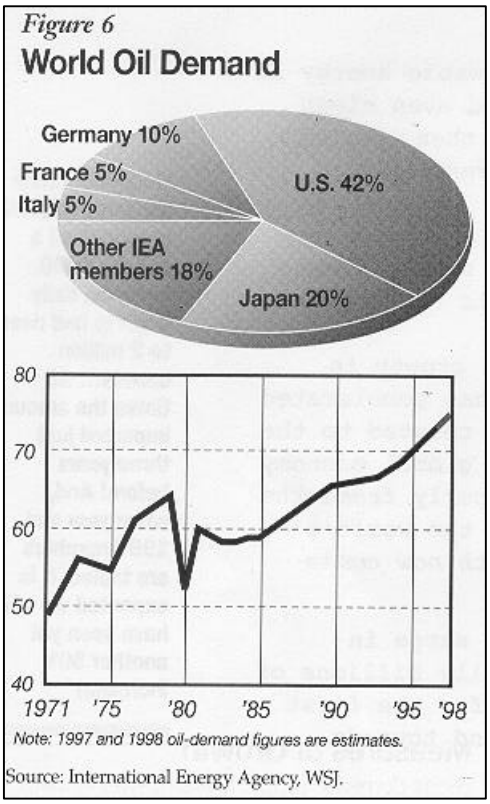
To date there have been four oil shocks, one in 1973, one in 1978, one in 1981 and the last in 1990. In all instances, instability in the Middle East was the triggering factor. This is understandable, because, as noted elsewhere, in a cruel geological joke, the Middle East holds over one-quarter of the world's oil. Thus, what happens there has a dramatic and immediate impact on oil markets.

While the Middle East continues to pose a serious and seemingly irresolvable threat to global oil supplies (to say nothing of world peace), and further herein we deal at length with the geopolitical risks inherent in that unsettled region, there are two powerful and relatively new trends which make an oil shock all but inevitable: *falling supplies and soaring demand*, the classic components of any market dislocation.

As amazing as it seems, the world is running out of fossil fuels. Oil coupled with the devastation to the oil services industries caused by a decade-long bear market, a major and irreversible shortage is developing, creating an almost unprecedented opportunity for owners and investors in oil producing properties.

Petroconsultants, a highly respected resource consulting firm based in Switzerland, recently prepared a report entitled "The World Oil Supply 1930-2050. In that report, they concluded that the world is running short of cheap oil, and that the mid-point of world oil production will be

around 2000. After the year 2000, less than eighteen months from today, the world will face a shortfall in supply and a *permanent and substantial* increase in the price of oil.



And, always hanging over the world oil scene is the on-going 3,000-year-old war in the Middle East, a war that is growing more dangerous by the day.

From this point forward, this report deals with the three primary factors that will lead to the next oil shock. Broadly stated, they are…

I. Soaring Demand

II. Supply Disruptions

III. The Geopolitics of oil

Together these three factors make the next oil shock (a) unavoidable, and (b) sure to be lengthy in duration (c) very, very costly.

Clearly, assuming we are right, we are calling attention to an oil and gas investment opportunity the likes of which comes around perhaps once in a generation.

Now, on to the mega-trends converging to make the oil shock scenario come to pass.

Soaring Demand

If all the talk in the seventies about renewable energy in the form of solar, wind, hydroelectric and even clean nuclear had actually amounted to something, then, perhaps, the supply/demand ratio of the world's *non-renewable* hydrocarbons would look different today.

However, as shown above, alternative energy sources have not made the slightest dent in supply or demand, and the world's consumption of petrochemicals (plastics) has continued unabated.

Like so many resource-related issues, the growth in demand - which in the past couple of years has accelerated to twice that of the ten-year average - is related to the modernization and economic expansion of the global economy following the

"in 1993, China imported 80,000 barrels of oil a day. By 1996, however, daily imports had risen to 2 million barrels... 25 times the amount imported just three years before! And, when year-end 1997 numbers are tallied, it is expected we will have seen yet another 100% increase!"

collapse of communism. To properly frame the issue, consider that while the U.S. remains the world's largest consumer, *two-thirds of demand growth now comes from emerging economies*.

It's pretty easy to understand the big surge in emerging market demand: There are literally *billions* of individuals in the third world who are, for the first time ever, enjoying the rewards of a trend towards freer markets. They're moving into cities, trading bicycles for cars and motor scooters, connecting up to electrical lines and plugging in billions of modern appliances - all of which combine to draw down an exponentially growing amount of the world's available energy supplies.

China Plugs In

Consider the case of China. Until 1993, China was the world's fifth largest oil producer and was a net *exporter*. Driven by a surge in economic growth, however, China's growth in oil consumption is now running close to 8% a year and, as a result, that country is now a major *importer*. In 1993, China imported 80,000 barrels of oil a day. By 1996, however, daily imports had risen to *2 million barrels... 25 times the amount imported just three years* before! And, when year-end 1998 numbers are tallied, it is expected we will have seen yet *another 100% increase!*

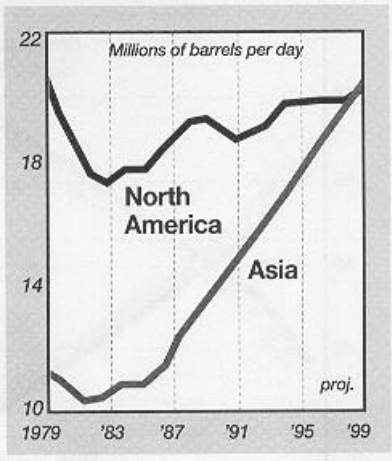
Meanwhile, India, the world's second most populous country, is also experiencing year-over-year consumption growth in excess of 8%, and has recently replaced France as the 6th largest oil consuming nation in the world. If consumption continues at that level, it will double in less than 8 years. The examples of explosive third world demand go on and on: Pakistan up 13.6%; Poland up, Japan 10.2%; Mexico up 7.4%, etc., etc.

All in all, the world is currently consuming approximately 75,000,000 barrels of oil each day, the highest level in history... by a wide margin. Most importantly, there is no end to this accelerating demand, short of the discovery of an entirely new energy source not even on the radar screen at this point in time.

Just after the year 2000, the share of total energy consumption accounted for by the rich industrial nations will have fallen under 50% for the first time. Eastern Europe and the former Soviet Union will consume 17%, but the share of developing countries will have climbed to over 40%, and will accelerate ever faster well into the millennium. Before the end of 1998, Asia, home to 60% of the world's population, will overcome North America in net crude oil demand, see ***Figure 7: Asia Pumps Up Oil Demand: 1979 - 1999***.

Figure 7

Asia Pumps Up Oil Demand: 1979-1999



Source: Fortune Magazine

To put it simply, despite short-term setbacks, Asia has and will continue experiencing explosive demand. Just three countries in the region - China, India and Indonesia - together contain 45% of the world's population, and are among the most rapidly expanding economies of all time, even during current "recessions." As the *Wall Street Journal* recently observed concerning the Asian economic troubles…

> "As Asia stumbles from one economic crisis to the next, a vital truth is often overlooked: most Asian economies continue to grow at speeds that, by the rest of the world's standards, are remarkable"

Figure 8

Measures of Growth

Gross domestic product, year-to-year growth

COUNTRY	1996	1997 — FORECAST —	1998 — FORECAST —
China	9.7%	8.8%	8.0%
Singapore	7.0	7.0	5.0
Malaysia	8.4	7.0	3.5
Indonesia	7.8	6.6	3.0
South Korea	7.1	5.7	3.0
Philippines	4.8	4.7	2.9
Thailand	6.7	0.3	-2.0
Japan	3.6	0.8	0.7
U.S.	2.4%	3.8%	2.5%
Germany	1.4%	2.5%	2.9%
U.K.	2.1	3.4	1.7
Russia	-2.8	-0.5	-0.5
Mexico	5.1%	6.8%	4.5%
Brazil	3.0	3.1	1.2

Sources: IMF (1996 data); Salomon Smith Barney forecasts.

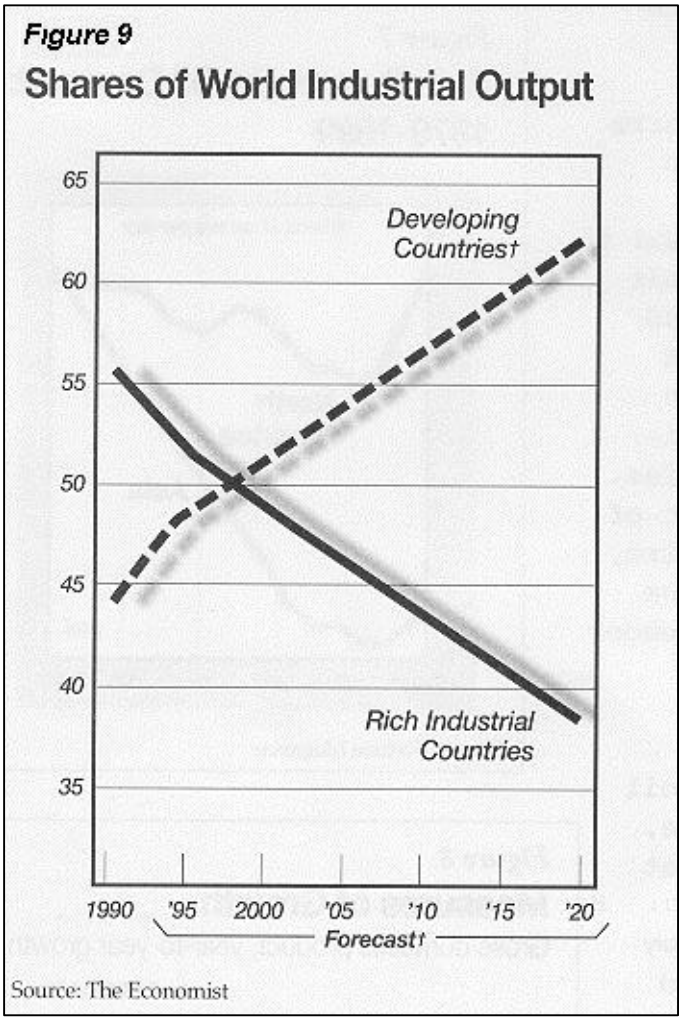
Figure 8: Measures of Growth, compares the impressive prospects for key developing Asian countries to the rich industrial Western economies.

But what will happen to energy demand if Asia doesn't meet even the lower (albeit still "high" by western standards) 1998 growth rates forecast in the table? A vital but little reported fact is that developing countries are far less efficient energy users than mature economies. For many years to come, each increment of emerging markets GDP growth will require, on average, *30% more energy than in the U.S.* This puts a big safety cushion under Asian demand projections.

As to what impact the recent Asian economic problems will have on crude prices through 1998, the insights of oil patch investment banker, Thomas Petrie, are also instructive. He estimates that the Asian problems, even allowing for spillover into Europe and the U.S., may reduce the growth in the global demand for oil from where it has been - 1.8 to 2.0 million bbls per day - to less than 1.5 million bbls, perhaps even to 1.2 million bbls. Keep in mind, this is against a back-drop of a per day current world oil consumption in the area of about 75,000,000 bbls. In other words, the demand growth might fall from the current 3% annual rate to 2% or even 1.6%, but this lower demand would remain in effect for no more than a year or so. However, Mr. Petrie notes that, even should the retrenchment occur, the increase in demand is still far above that of the early 1990s.

The Energy Information Administration conservatively projects total worldwide demand for oil to reach 103 million barrels per day by 2015. Within this forecast, which makes allowance for the ups and downs of business cycles, developing countries in Asia show the greatest growth in demand, averaging 5% per year.

Although lagging Asia, Latin America is still expected to increase oil demand at *least 75%* over the next twenty years. And so the story goes around the rest of the world, even in Africa where pockets of industrialization are starting to flourish. This unprecedented development is summarized in ***Figure 9: Shares of World Industrial Output***.



Above we mentioned the Energy Information Administration's projection for growth in demand. However, there is a very good chance that these forecasted government projections are well off the mark, and are far too conservative due to a number of other factors, the impact of which may not be fully envisioned in current forecasts. A few of these factors are discussed below.

Pollution Concerns

Government concern about pollution, which was, until recently, confined primarily to Western industrialized nations, is fast becoming a major factor in the rest of the world. Since the collapse of the Soviet Union in 1989, and concurrent revolution of privatization which is still sweeping the globe, close to three billion people have entered the private sector with the hope of achieving a higher quality of life, starting with cleaning up the environment in which they live.

This has been greatly fostered by public awareness programs, and through pressure from international agencies that are increasingly bringing resources to bear on environmental issues in developing countries.

The result has been a focus on substituting coal, the dirtiest of the fossil fuels, with cleaner burning oil and natural gas. That represents as major shift in the energy

"Developing countries are far less efficient energy users than mature economies ... This means that for many years to come, each increment of emerging markets GDP growth, including Asia, will require, on average, 30% *more energy than in the U.S.* This puts a big safety cushion under current demand projections."

consumption picture, because coal is currently used to meet up to 75% of the total energy needs of a huge landmass which includes: the former Soviet Union and China. Make no mistake, the politically mandated conversion from coal to oil and natural gas is all but certain in many of these areas, and implies far greater demand for oil and gas than implied by rising GDP growth alone. Further to this point, a Princeton University study found that after an initial decline - a nation's environment improved as its economy grows. This is in no small part due to the substitution of coal with oil and natural gas.

Soaring Automobile Demand

The *World Watch Institute* reports that, in 1950, there were 2.6 billion people and 50 million cars on Earth. However, as we near the end of the century, the human population has more than doubled, but the ***car population has increased ten-fold... to 500 million!*** Projecting this trend, the Institute worries that, within another 25 years, there could easily be one billion cars on the world's roads.

At this writing, 81% of all the world's autos are found in North America, Europe and Japan - regions within which live a *mere 16% of the world's population.* In the rest of the world, however, per capita ownership levels approximate that of the U.S. *before World War I*! And the upside demand potential is staggering. For example, China has only 1% as many cars as the U.S., and India only 2%, but together they have eight times the population of the U.S..

China has just 1.8 million passenger cars, or one for every 670 people. Peregrine Brokerage of Hong Kong estimates that 180 million Chinese may own cars by 2010, an increase of over 9,100% from 1995!

In other eye-opening examples of this powerful trend, India's automobile industry expanded 26% in *1996 alone,* and is set to double by the year 2000. Between 1960 and 1990, Brazilian car ownership rose from 500,000 to 12.1 million, and that was well before $10 billion flooded into new automotive plants in that country since 1995. The list goes on and on.

The American experience is instructive in putting the explosive global demand for automobiles into perspective. In 1907, there were only 140,300 cars in the country, but just thirteen years later, in 1920, the auto population had jumped to eight million - one car for every 13 Americans. And that was without today's modern assembly lines.

"It was recently announced that the *rate of new car sales in Europe in 1997 increased at close to twice the rate forecasted last January, including an 11% increase in Spain alone. So, even in that saturated market, there is still no sign that the human love affair with autos has lost any of its passion."*

Considered from another angle, the average Chinese consumes only about two barrels of oil per year whereas the average American consumes about 80 barrels. As this gap narrows, and it will , thanks to factors such as increased car ownership, the growth in oil consumption will go through the roof.

Stealth Demand From Gas Guzzlers

The U.S. automotive scene provides one of the best examples of why many demand forecasts may be well short of the mark. As chance would have it, right in the middle of an explosion in the global automobile population, fuel efficiency is falling.

That's because of one of the biggest automotive consumer trends of all time: the surging popularity (both in the U.S. and in developing countries abroad) of gas guzzling sport-utility vehicles, minivans and pick-up trucks. As a result of sweeping lifestyle, demographic and cultural changes, over 40% of new purchases now fall into these categories, and the percentage is climbing. In fact, in November of 1997, sales in the higher consumption categories exceeded 50% of all cars sold in the U.S. for the first time ever.

"Some analysts are predicting - in large part due to the "stealth demand" from ever more popular sport-utility vehicles - the U.S. will be totally dependent on oil imports in just 1.5 years."

The impact of this trend on fuel conservation has been, and will continue to be, alarming - more than reversing the savings achieved during the compact car era from the mid-1970s to mid-1980s.

The Consumers Union tests reveal the typical sport utility vehicle only get about 10 mpg in city driving, a marked difference when compared to the average fuel consumption of 26.2 miles per gallon when the compact car era peaked in 1987.

To exacerbate the situation, the drop in new-vehicle fuel efficiency coincides with record growth in the number of vehicles and the number of daily drives undertaken. U.S. drivers are now making a billion trips each day to work, school and for shopping, ever more of them in sport-utility vehicles. The result: a 20% increase in gasoline demand in the U.S. - to almost 10 million barrels of gasoline per day - since 1980.

The expanding market share of "gas guzzlers" takes on added meaning when one realizes that a million cars a month are coming off production lines to be added to the 200 million already on the road. Some analysts are predicting - in large part due to the "stealth demand" from the ever more popular sport-utility vehicles - that the U.S. will be totally dependent on oil imports in just 15 years.

All of this points to higher gasoline prices. With oil prices near the lowest point in history, unleaded gasoline in the U.S. is now cheaper than bottled water - and driving a compact Geo costs only $260 a year less in gasoline than a full-sized Lincoln. But as one energy analyst observed upon hearing this comparison: "It won't be long before people wake up to find their cars are running on something getting ever closer to the price of champagne than water.

Investors can expect a series of surprises on the gasoline front. One small taste of what is to come was the 1997 summer driving season, when the DOE expected gasoline demand to rise

2%, when in fact it jumped a surprising 4%, largely due to falling fuel efficiency and popularity of sport-utility vehicles.

The long and short of it is that, due to the coming oil shock, and subsequent measures taken by governments to reduce consumption, i.e. taxes, the day of cheap gasoline may be coming to a close.

Summing Up the Demand Picture

Thanks to the trend for freer world markets, and the victory of capitalism over socialist economic models, the world is undergoing an incredible and inexorable increase in demand for fossil fuels. Despite the possibility of a temporary slowing in demand growth caused by factors such as the current Asian crisis, the trend for strongly increasing demand is *locked in* for the foreseeable future, and under virtually no scenario will demand growth reverse.

In the free market, the other half of the equation is always supply. Surely, it will be the contention of some that, in order to meet soaring demand, the world can simply turn up the taps, drill more wells, and boost production - sorry, but not this time around.

Supply Disruptions

Historically, the U.S. oil industry had several options to fall back on in order to meet increasing demand:

1) Increase imports;

2) Increase drilling and exploration;

3) Take advantage of rising crude oil prices to refurbish wells, which had been closed due to falling production and low prices.

Unfortunately, this time around these options are severely limited.

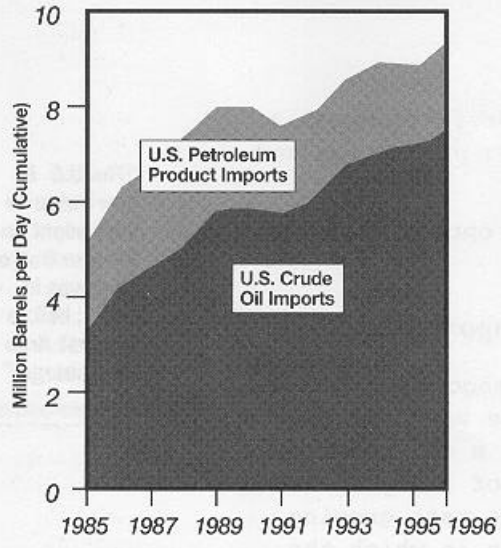
Increasing Dependence on Imports

As mentioned above, all of the oil shocks to date have come as a direct result of turmoil in the volatile Middle East, where over one-quarter of the world's oil reserves have been found. It is, therefore, the height of folly to count on increasing imports from that region to meet growing demand. Yet, that is exactly the position in which the U.S. finds itself today.

Until the mid-1950s, the U.S. was a net exporter of oil, but dependency on imports, mainly from the Middle East, reached nearly 50% by 1977. Reliance on imports then declined sharply as Alaska crude oil production came on stream, falling to 27% in 1985.

Figure 10

Crude Oil Dominates U.S. Imports



Source: Energy Information Administration

By 1996, however, the picture had changed again, with the U.S. once again importing more than 46% of its consumed oil supply. To put that number in perspective, the U.S. is now twice as dependent on Persian Gulf oil as it was in 1973, before the first Arab oil embargo.

This dependence on foreign oil is the result of two factors:

1) steadily falling U.S. production, and …

2) the tangible benefit of hundreds of billions of dollars which consumers and businesses save annually from access to relatively low-cost foreign oil ... benefits which <u>will disappear overnight</u> when an oil shock hits, causing a tremendous economic dislocation and an overnight sharp increase in the price of domestic and imported crude oil.

Total U.S. imports of crude oil and petroleum products are now at new record highs. The trend towards higher imports shows no sign of slowing. In September 1997, U.S. petroleum imports (crude and products) were 10,519,000 barrels per day, representing 57.2% of all domestic consumption. That was *1,377,000 barrels more than a year earlier, in September of 1996.*

Figure 10: Crude Oil Dominates U.S. Imports shows this accelerating import dependency for crude oil and products.

"The U.S is now twice as dependent on Persian Gulf oil as it was in 1973, before the first Arab oil embargo."

Growing Competition for Middle East Oil

Ignoring the political risks of the Middle East for the moment, any analysis of the world oil scene would be woefully incomplete without taking into consideration the huge reservoirs of oil for which that region is so well known. Assuming no politically triggered disruption in supplies, how long can the U.S. rely on the Middle East reservoirs to meet demand needs? Reality may be far different than perception.

These colossal reservoirs, located in Saudi Arabia, Iraq, Iran, Kuwait and the United Arab Emirates, were known to exist before World War II, but were only marginally produced, with most of the world's oil needs coming out of North America. After World War II, however, the situation was reversed, and the world became increasingly dependent on the Middle East reservoirs and, to a lesser degree, on those found in former USSR, where reserves were, in typical fashion, exploited carelessly, resulting in huge waste.

"North America (including Canada and Mexico) accounts for almost 30% of world oil consumption, but only 2.8% of world reserves are in the U.S. Therefore, any sustained Persian Gulf turmoil will put a big premium on the value of secure North American reserves."

By 1995, however, due to a ten-fold increase in the consumption of crude oil caused by global modernization, the great Middle Eastern reservoirs had already been drained of about half its immense reserves, and by more than half of the "reservoir energy" in each reservoir.

Discussed earlier, reservoir energy is an industry term related to the cost of extracting reserves. To be simplistic, as the reserves remaining in a reservoir falls to approximately 50%, a lot of technical problems arise, making it increasingly difficult and costly to bring the oil, remaining in the reservoirs into the wells and up to the surface.

"...the sheer number of wells drilled in the US, and the exploration that generated those drill targets, means that, <u>there are simply no more big discoveries in the U.S. to be made</u>. While there are no doubt, very many smaller, yet very profitable reservoirs (1 to 20 wells) left undiscovered in the U.S."

The bottom line is that the Middle East, whose abundant and cheap fuel has driven much of the world's industrial growth and development over the past half century, will not be the low cost abundant producer of the future. Inevitably and irreversibly, the increasing costs of dealing with the reservoir problems that occur with depletion will accelerate until they are no longer capable of economic production... certainly not at <u>anywhere near</u> today's producer prices.

Potentially adding fire to the fuel (as in creating an explosion) is the simple fact that two out of the five countries mentioned above <u>absolutely hate</u> the United States (the "Great Satan") and the other three are politically unstable and at risk from internal or external events which could prematurely interrupt supplies. This is not a happy situation.

Moreover, the coming oil shock will not solely be an U.S. phenomenon. Far from it. In the not-too-distant future, the U.S. will be forced to compete with the rest of the world - including countries like China - for the dwindling supplies of oil available in the Mid-East. Due to a history of ferocious antagonism with the Arab states, it is hard to see how the U.S. will have a competitive advantage.

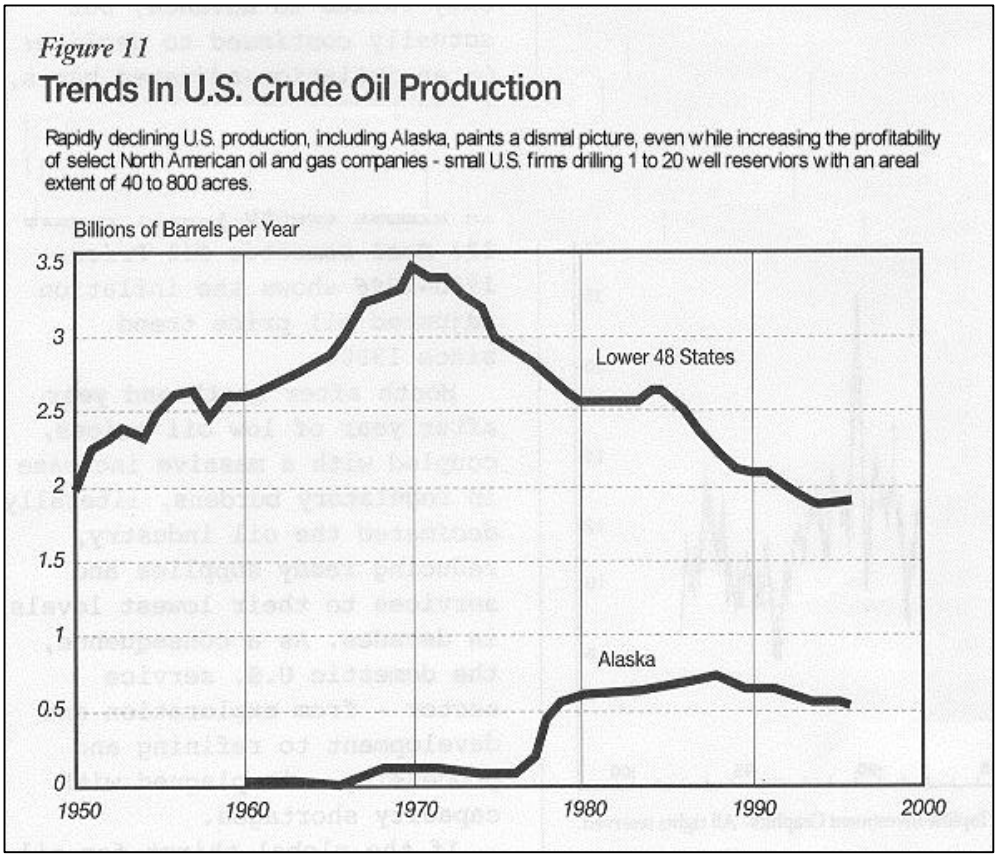
North America (including Canada and Mexico) accounts for almost 30% of world oil consumption, but only 2.8% of world reserves are in the U.S. Therefore, any sustained Persian Gulf turmoil will put a big premium on the value of secure North American oil reserves.

Unfortunately, production from those discovered reserves has been falling steadily.

Dwindling U.S. Reserves

In order to reduce at-risk imports, the only option remaining to the U.S. is to increase domestic production. However, there are two serious problems with that scenario. They have to do with dwindling reserves and with a severe bottleneck in the oil services sector. Let's deal with the first.

Having been in production for more than a century, the U.S. is one of the world's oldest oil producing regions. To give you a better sense of just how mature is the U.S. oil industry, consider that eighty percent of all oil and gas wells ever drilled on the planet are located in the U.S.



As a consequence of its maturing fields, and the resulting loss of reservoir energy, in each of the reservoirs U.S. domestic production peaked in 1970. Since then, there has been a general decline in total U.S. production, reversed from the mid-1970s to mid-1980s under the stimulus of generally rising prices and new

discoveries/production, including the many smaller fields within the larger fields and development into the Gulf of Mexico; fields off the Texas and California costs; and the North Slope of Alaska.

To give you a snapshot of how the production from an oil field drops off as its individual reservoir energy is depleted, consider that, since its peak in 1988, Alaska production has fallen by 30%. As is obvious, but always worth keeping in mind, oil is a non-renewable resource, which means, when it's gone, it's gone. The latest data shows that U.S. production will continue to decline at the rate of about 2% per year, in spite of the new fields discovered since the first oil embargo in 1973 including the new small 1 to 20 well fields currently being discovered in the U.S. ***Figure 11: Trends in U.S. Crude Oil Production*** reveals this decrease in production, a trend which will have an accelerating impact on the country's ability to meet its own energy demands.

U.S. production comes from over 600,000 wells (including the thousands of old "stripper" wells now producing 3 to 5 barrels of oil per day) with an average production of only 12 barrels per day. By contrast, in Saudi Arabia there are about 1,400 wells, but with an average production of nearly *6,000 barrels per day*.

The U.S. figure is of special interest, however, because the sheer number of wells drilled in the U.S., and the exploration which generated those drill targets, means that there are simply no more big "elephant" discoveries to be made. However, smaller (1 to 20 well) reservoirs can be (in fact are) very profitable for smaller exploratory companies and their drilling activity will accelerate as the price of crude moves up in an inevitable new Oil Shock which could begin as early as tomorrow.

More Home Front Troubles

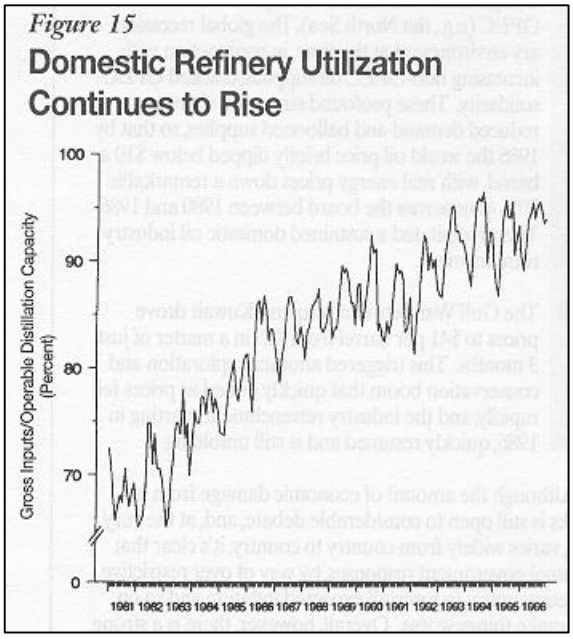
As briefly referred to earlier, an ever increasing weight of environmental regulatory burdens is adding significantly to the pressure on all segments of the U.S. oil industry (and, increasingly, on non-U.S. companies as well). The regulatory burden is severe and is growing.

- During the 1990s, the U.S. refining industry will have to make capital expenditures of about $37 billion to comply with new environmental regulations, in part to increase reformulated gasoline and ultra-low sulfur diesel fuel output.

- The cost of complying with environmental legislation is accelerating: in 1995 alone, the domestic oil industry spent $9.6 billion on environmental regulations, which is every bit as much as it spent on searching for new domestic supplies of oil and gas!

Key Point: Falling prices and increasing regulation have had a *devastating* effect on domestic oil refineries. Of 315 domestic oil refineries operating in 1982, 52% have closed, including many older ones whose improvements and re-tooling to meet new environmental laws would have cost more than they were worth. This has resulted in the loss of 65,000 jobs, or 40% of all the refining jobs held in 1982. The result? As shown in ***Figure 15: Domestic Refinery***

Utilization Continues to Rise, domestic refineries are already running at close to 100% capacity!



False Security of the Strategic Petroleum Reserve

Reviewing the soaring oil demand, falling domestic production and the instability of our Persian Gulf crude oil source, you might assume that the U.S. government must have some contingency plans to avoid the long gas lines and massive economic disruption which an ***OIL SHOCK*** will cause. The good news is that they do have a "program" called the *Strategic Petroleum Reserve* (SPR).

The bad news is that the SPR program is mostly smoke and mirrors and will provide no tangible relief to the pending oil shock. Here's why.

The U.S. federal government created the *Strategic Petroleum Reserve* as an insurance policy against future import disruptions in the wake of the 1973-74 Arab Oil embargo. In 1977, the SPR started purchasing crude oil for the US government reserve.

The SPR is a system of several subterranean salt dome storage caverns principally in the Louisiana and Texas Gulf of Mexico area. Its total capacity is 680 million bbls, and it presently holds 564 million bbls - roughly 64-days supply at the current oil import rate. The record high inventory level held in reserve was 118 days of oil imports in 1985, and the average price paid for the oil in the reserves over the past 20 years is $28.00 per bbl.

Critical is the fact that SPR oil cannot be extracted at anywhere near the daily import rate - the realistic rate is 3.2 million barrels per day - only one-third of what is needed to match the full import gap. Furthermore, and this is important, almost two-thirds of the inventory is the less desirable heavy (low gravity), high sulfur (sour) crude, useable only by refiners equipped to process it, as opposed to more desirable light (sweet) crude. These two factors drastically undermine the utility of the SPR.

Reserve drawdowns from the SPR can be authorized by the President in the likelihood of a "severe energy supply interruption," or to meet oil-sharing obligations with International Energy Agency allies. A severe energy supply interruption is defined as "of significant scope and duration," and is "of an emergency nature."

Oil Price Shocks

The past 24 years have seen four price shocks: three long-lasting and one short-lived.

1973 OPEC announced production cutbacks and embargoed oil shipments to the United States in retaliation for U.S. support of Israel in the Arab Israeli "Yom Kippur" War. By January 1974, world oil prices had quadrupled to almost $15 per barrel, helping make the 1973-75 recession the worst since the Great Depression. See Figure 16 page 27.

1978 The Iranian revolution, ousting the Shah of Iran, and the subsequent Iranian hostage crisis and Iran-Iraq war, in combination with double-digit U.S. inflation rates and collapsing dollar in world markets, shot oil to $39 per barrel in 1981, at the same time energy imports hit close to 25 % of total domestic consumption.

1981 Damage from the 1978 oil shock was so severe it greatly accelerated substitution (e.g., natural gas for heating oil), energy conservation, industry deregulation and increased oil production outside OPEC (e.g., the North Sea, etc.). The global recessionary environment at the time, in conjunction with increasing non-OPEC oil supplies, cracked OPEC solidarity. These profound structural changes reduced demand and ballooned supplies, so that by 1986 the world oil price briefly dipped below $10 a barrel, with real energy prices down a remarkable 30% -plus across the board between 1980 and 1986. This precipitated a sustained domestic oil industry retrenchment.

1990 The Gulf War between Iraq and Kuwait drove prices to $41 per barrel from $15 in a matter of a few months. This triggered another exploration and conservation boom that quickly ended as prices fell rapidly, and the industry retrenchment, starting in 1986, quickly resumed and is still unfolding.

Although the amount of economic damage from oil shocks is still open to considerable debate, and, at the very least, varies widely from country to country, it's clear that the usual government responses, by way of over restrictive monetary policy to forestall expected inflation and so on, only make things worse. Overall, however, there is a strong correlation between oil shocks and the start of recessions, as can be seen in ***Figure 16: Oil Price Shocks & Recession 1947-1992.***

During the Persian Gulf War, 33 million bbls in the S.P.R. were put on the auction block, with only 17 million bbls actually sold. Despite those sales, and though free market pricing was ensuring orderly markets without shortages, prices skyrocketed from a pre-invasion $15 to $41 a barrel by the time the bombing of Baghdad began.

Demonstrating the generally poor quality (heavy / sour) of the oil in the SPR, refiners rejected the government's initial offer for 14 million bbls of sour crude and 3 million bbls of sweet, until the government reversed the ratio and offered 14 million sweet and 3 million sour. In short, even at the onset of a serious oil conflict in the heart of the Middle East, refiners were still not interested in the poor quality oil in the SPR.

Presently, the SPR is a political football, routinely pitting the oil industry, with its desire to maintain, if not expand, the SPR, against various consumer and smaller government advocates calling for, among other things, rapid phase-out sales to reduce the federal deficit.

Federal Reserve Board economist Ronald Schmidt identified three pitfalls undermining the viability of the SPR…

1. There must be sufficient inventories to defend a non-market (artificially low) price for some time. This is not the case, even with SPR reserves at their maximum level equal to 90 days of imports.

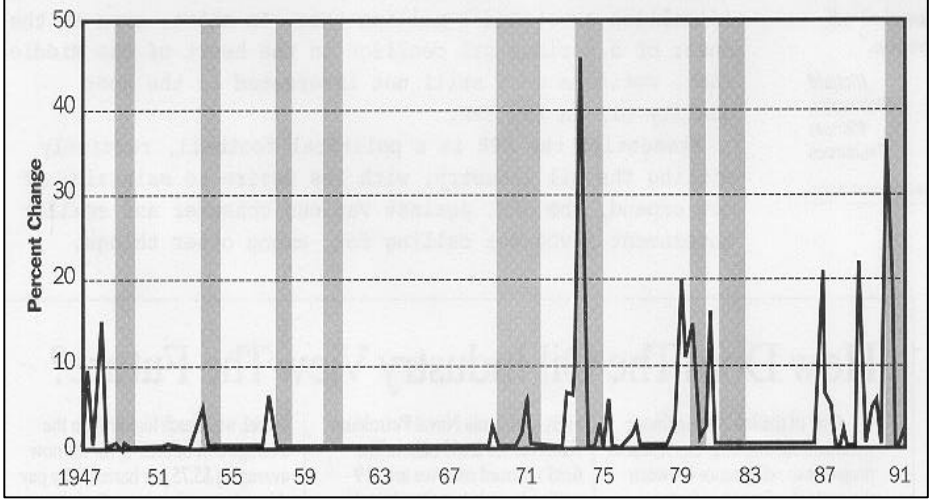
2. A stockpile strategy only works when the price level defended actually balances supply and demand in the long-term. (This has never happened in the 2,000-year history of government price controls.)

Figure 16

Oil Price Shocks and Recessions:1947-1992

Shading denotes recessions. Note the high correlation of recessions following on the heels of oil price shocks.

source: Federal Reserve Bank



3. The geology of the SPR salt domes reservoirs holding the oil imposes a final limitation on the SPR: These reservoirs can only be reused a few times before collapsing. (This precludes using SPR reserves as an ongoing price stabilization pool, as that would require continuous drawdowns and additions.)

How Does the Oil Industry View the Future?

One of the interesting things we encountered doing this research project is the difference between the outlook of many industry analysts and that of oil company executives. While oil analysts were wringing their hands nervously about the prospect of resumed Iraq sales, or about the turmoil in Asia, the big oil companies were spending heavily to position themselves for the next oil boom.

Even though oil and gas prices were flat for most of 1997, there were some 60 mergers, totaling $22 billion announced in 1997. That is a level not seen since the mega-mergers of the 1980s, when Boon Pickens' oil patch buyouts were front page news for months, Chevron bought Gulf and Texaco bought Getty Oil.

Two forces are driving this dramatic increase in mergers and acquisitions. First, buyers are betting they can get more oil and gas out of existing reserves than the acquired company - or government - was able to do. For example, Occidental Petroleum bought the government's 78% share of the Elk Hills California Naval Petroleum Reserves for $3.65 billion. The field's proved reserves are 319 million barrels, but Occidental claims that, with the latest recovery technology, it will achieve total extraction of at least 500 million barrels, with the high probability of extracting even more.

Second, is the expectation of higher oil and gas prices. Although most oil executives are reluctant to go on record with price forecasts, Richard Rainwater of Pioneer Resources did so in a recent *Forbes* magazine article. He sees oil around $35 per barrel in the next two or three years, with natural gas prices following along: "To meet energy needs, the world has to add 2 million to 3 million barrels a *day* of new production every year. Oil is not coming on stream at that rate. Starting in 1999, there will be virtually no spare capacity in the world. The price of oil will have to rise." [from its current 5/18/98 price of $14.50 per barrel]

As you can see in ***Figure 17: Oil Company Acquisitions****, in* almost every buy-out announced in 1997, the price paid per barrel of proven recoverable oil reserves, up to $9.61 per barrel, was much higher than the average cost of drilling for oil, now averaging $5.75 per barrel. Why pay this rich premium, even for lower quality oil reserves that used to sell around $4 per barrel?

The answer is that production companies urgently need to buy reserves because, even with increased drilling activity, output is *only holding steady at best. New oil and gas reservoirs, in the U.S., are now being found in smaller 1 to 20 well (40 to 800 acre fields) as larger oil and gas reservoirs in the U.S. have almost certainly all been found.*

"The bottom line impact of the SPR on exploratory oil and gas investments, and U.S. energy security in general, is almost nonexistent."

Figure 17

Oil Company Acquisitions

Buyer	Seller	Purchase Price ($mil)	Oil & Gas Reserve Value ($mil)	Proved Reserves (mil bbl)	Purchase Price Per Barrel
Union Pacific Resources	Pennzoil	$6,351	$3,841	400	$9.61
Occidental Petroleum	US Department of Energy	3,650	2,650	500	5.30
Burlington Resources	Louisiana Land & Exploration	3,212	2,930	344	8.52
Parker & Parsley Petroleum	Mesa	2,151	2,084	309	6.74
Texaco	Monterey Resources	1,436	1,424	235	6.05
Pioneer Natural Resources	Chauvco Resources	1,191	1,105	153	7.22

These smaller fields, while of little interest to the big exploration companies, are very profitable for the smaller companies and their investors. This is because of the much smaller operating expense of the smaller exploration and production companies in the U.S.

In fact, one of the biggest problems facing the SPR program is that a number of the SPR reservoirs are considered unstable, and prone to leakage. The government is actively looking for new reservoir repositories for its oil, and may have to spend hundreds of millions of dollars to move oil from unstable, leaking locations. In one recent example, fractures were discovered which threatened the integrity of one important storage site, the former salt source for Morton Salt Co.

All in all, $100 million was needed to move the remaining 72 million barrels of crude oil that had been stored at the site. Weeks Island is the second original reserve storage site to be abandoned because of the potential for leaks.

In short, contrary to wishful thinking in some government circles that the SPR can, and should, be used as an ongoing price control tool, the bottom line impact of the SPR on your energy investments, and U.S. energy security in general, is probably non-existent.

The Ominous Predictions of Hubbert's Curve

Virtually unknown outside a small circle of professionals, the most important "on-the-money" supply forecasts in the energy sector are currently provided by L.F. Ivanhoe, a geologist, geophysicist, engineer and oceanographer with more than 50 years government and private sector oil industry experience.

His forecasts reflect the work of Dr. M. King Hubbert, who made the only truly valid projection of future oil production. In 1956, Dr. Hubbert, with uncanny accuracy, forecast US production, less Alaska, would peak in 1969, give or take a year. It actually peaked in 1970.

> Based on his extensive research, Mr. Ivanhoe maintains there is overwhelming evidence for a permanent global oil shortage to begin around 2010 assuming normal oil field declines - or as early as 2000 if the world's key oil producer, Saudi Arabia, has serious political problems! (And the likelihood of that occurring increases daily. See ***Saudi Arabia: The Collapsing Tent*** page 46.)

Obviously this runs counter to today's pervasive supply optimism, which typically estimates that "reserves" are sufficient for production to continue at current rates for another 43 to 55 years. This is grounded on dangerous assumptions about peace in the Middle East and counting resources as actual reserves... while not fully appreciating the consequences of both world population and crude oil demand doubling between 1975 and the year 2000.

Figure 18

U.S. and World Oil

Area (time period)	Discovered	Extracted	Consumed
USA (1977-1991)	5 Bbo	45 Bbo	92 Bbo
World (1982-1991)	91 Bbo	221 Bbo	221 Bbo

Bbo = Billion barrels crude oil

Source: The Futurist

Additionally, demands from key sectors, notably transportation, are primed to rise exponentially well into the millennium.

But most alarming of all is the ominous and growing gap between discoveries and production – the linchpin in the Ivanhoe oil shock model. This widening disparity is readily apparent from the numbers in ***Figure 18: U.S. and World Oil***.

Conservation Masquerading as New Reserves

When oil prices rose quickly during the early 1970s, huge incentives were literally created overnight to search for new supplies and promote reduced consumption. Important new supplies came onto the market between 1973 and 1980, the result of finally bringing into production 35 giant oil fields during that period. (A *giant* oil field is defined as one yielding at least 500 million barrels). These 35 fields were primarily offshore, and had already been identified by the late 1960s, but it was only with the advances in offshore engineering technology in the 1970s that they could finally be tapped. The Alaska pipeline also came on stream during this period. These developments temporarily solved the problem.

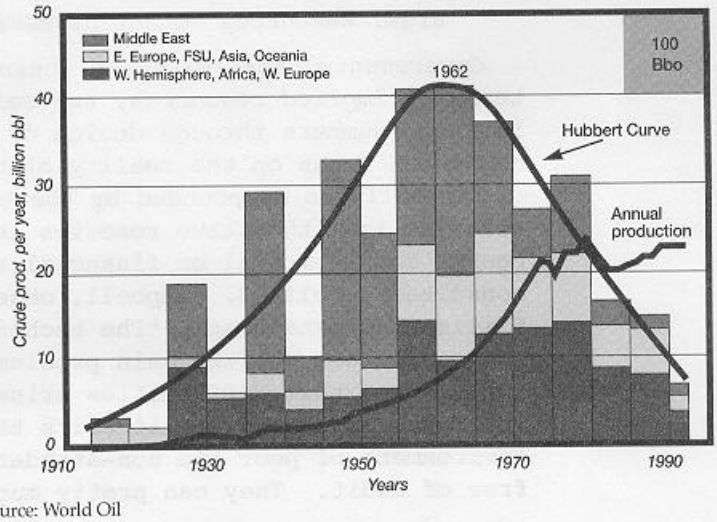
"All of the global deepwater discoveries beyond the continental shelves during the past 30 years, mostly in the North Sea and off Brazil, would provide only one year's total global production of oil at 1996's rate."

This scenario was repeated during the Iran-Iraq War/Hostage crisis starting in 1978, which led to crude oil eventually hitting $39 per barrel in 1981. This triggered the second frantic search for oil outside the Persian Gulf, by oil companies of all nations. During this period, there was also a second round of conservation efforts that dropped U.S. daily crude oil consumption from 19.5 million barrels per day in 1979 to 15.5 million barrels per day by 1984.

Figure 19

World Oil Discovery Rate, 1912-1992

World annual crude discovery rate averaged over 5-year periods, 1912-1992. Hubbert Curve is a weighted average of global oil discovered 1915-1992.



Source: World Oil

Offshore drilling, which was still new in the 1970's and early 1980's was, and still is, widely touted as a big part of the solution to ensuring permanently comfortable oil supplies. Yet, as L.F Ivanhoe recently noted, "All of the global deepwater discoveries beyond the continental shelves during the past 30 years, mostly in the North Sea and off Brazil, would provide only one year's total global production of oil at 1996's rate."

But all these intense efforts - and interim solutions to find more oil obscured a harsh reality: only a mere handful of major new fields have been found since 1980. *(A major* field is defined as

one yielding 100 million barrels or more). ***Figure 19: World Oil Discovery Rate, 1912 - 1992*** illustrates this alarming situation.

When the oil price collapsed in 1986, temporarily dipping under $10 per barrel due to intense conservation measures and expanded production, so too did oil company exploration budgets for all but the very best prospects, of which there were very few to begin with. By 1989, all major companies reported substantial downsizing of geological and geophysical staffs.

But what if there was another oil crisis, say as in 1990, when the crude oil price spiked to $41 per barrel? Even with the revolutionary advances in exploration technology since the discovery rate peaked in 1962, it is highly unlikely that a renewed exploration boom would yield many - if any - new remote discoveries of consequence.

Even the new horizontal drilling techniques, greatly enhancing recovery from known fields, are of little value in making new discoveries. For example, the recent interest in Russian oil deals stems from using Western technology to increase production from existing wells, rather than finding new large reservoirs. The same story is being played out in the rest of the world.

A potential, but costly, new extraction process might someday tap Shale Oil, of which the United States has huge deposits. Colorado's Piceance Basin alone supposedly contains more oil deposits than exist in the Middle East. Another shale oil deposit of significance is found in Alaska's National Wildlife Refuge. However, oil recovery from oil shale has so far not proved to be economical, in spite of massive investments by the U.S.G. and major oil companies in pilot recovery processes. And we won't even begin to get into the challenges which companies would have to overcome from environmental lobbies in order to enter large-scale production of this resource.

Why Are So Many Analysts Not Forecasting an Oil Shock?

Counting Apples as Oranges: Reserves vs. Resources

One of the more interesting pieces of research we came across when preparing this report resulted from asking the question, "Why have so few oil analysts picked up on Ivanhoe's work, and expressed concern about a pending and very serious oil shock?"

The reason largely hinges on confusing two critical concepts…

1. Reserves are conservative estimates prepared by engineers and relate to the quantity of oil and gas in a reservoir currently available for production given realistic costs, time frames, and production techniques. Active *Reserves* are those extractable within 20 years or less. *Inactive Reserves* are those which are known to exist, but are not extractable within 20 years, usually due to inadequate technologies, such as the enhanced recovery techniques discussed herein earlier.

2. Resources are geologists' optimistic estimates of undiscovered oil and gas theoretically present in an area. Resources do not necessarily reserves make.

Governments, academics and journalists typically talk in terms of *implied* resources, and reinforce each others' inflated numbers through design or ignorance, while oil companies focus on the reality of bottom line reserves.

"What's even more ominous, one fourth of the world's unused economically recoverable oil reserves are in just one country, Saudi Arabia, with much of the rest also in the Persian Gulf, a hotbed of racial, religious and military turmoil for over 3,000 years.

The folly is compounded by the tendency to add <u>inactive</u> reserves in with <u>active</u> reserves in order to "cook the books" for political or financial reasons. As petroleum consultant, Colin J. Campbell, observed with classic British understatement…

> *"The technical aspects of reserve estimation are not the main problem: it is in the reporting of them that difficulties arise. There are many vested interests involved, and it suits them to work in an environment of poor and non-standard definitions and to be free of audit. They can pretty much say what suits them."*

Governments, as usual, are the worst offenders. The bigger the reserves a country claims, the easier it is for them to arrange international lines of credit, float bond issues or, if an OPEC member, enlarge their cartel production quota. Such fictional *Political Reserves* have no correlation to ultimate production.

The statistical chicanery of reporting oil ministries takes many forms. One popular ploy is to convert estimate of units of natural gas reserves to *Barrels of* Oil Equivalent. But natural gas is not even close to being the economic or geopolitical equivalent of crude oil. Then there are

what appear to be outright fabrications, such as when Iraq doubled its reported reserves from 47 to 100 billion barrels of oil in 1987, and still uses that number.

There is also the pattern of reporting non-conventional or heavy oil which can just barely be produced, and which is vastly different from economically viable, high-gravity, “sweet” crude conventional oil. Reserve numbers are only supposed to incorporate conventional oil. Mexico may very well have inflated its conventional reserves by including the large Chicontepek Field heavy oil deposits to help collateralize its debt.

In 1987, Venezuela practically doubled its reserves by adding in some 20 billion barrels of low gravity, heavy oil of dubious production value, and again, may or may not prove to be produced profitably.

Likewise, some governments simply do not have the statistical and engineering wherewithal to produce sound numbers - or simply don't care. The much touted former Soviet Union reserves often do not factor in economic and technical extraction constraints, resulting in "high case" estimates, many with only 5% to 15% accuracy. Furthermore, in 1996, forty-three countries reported reserves that were unchanged for two or more years, even though production was obviously depleting reserves.

These many inaccuracies find their way into the U.S. Geological Survey's (USGS) resource estimates. These estimates are usually totaled with the widely followed Oil *& Gas Journal* reserve numbers provided annually by reporting governments, to derive a grand total the USGS calls a nation's Oil *Endowment.* L.F. Ivanhoe labels the results "The sum of the (unknown) values gives huge 'fruit salad' numbers that are routinely and incorrectly called reserves."

Although the question of when worldwide oil demand will exceed global oil supply is stubbornly ignored by the popular press, a growing number of informed U.S. and European evaluations are coming into synch with the views of L.F. Ivanhoe, and put this crisis as coming no later than 2014, and *perhaps as soon as 2000.*

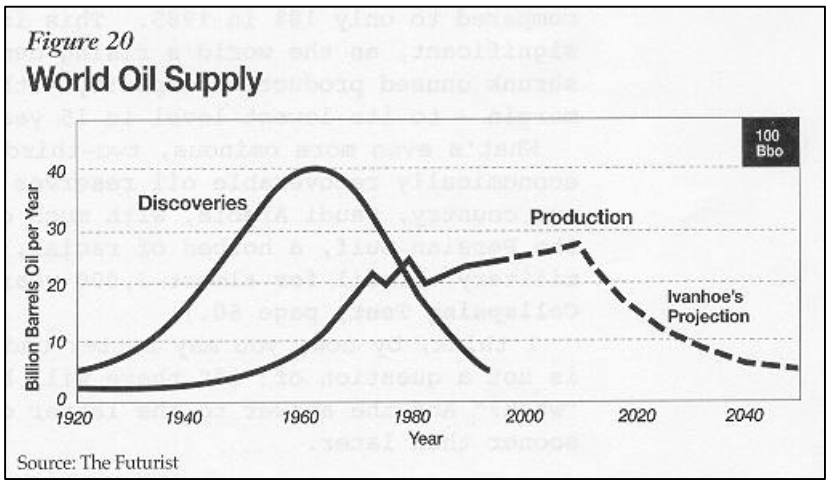


Figure 20: World Oil Supply summarizes the looming discovery and production gap which soon, with as little as an unexpected 5% crude oil shortage, could bring back the gasoline lines of the 1970’s, only this time they could be permanent.

According to Matt Simmons, a respected industry banker and Past-Chairman of the *National Ocean Industries Association (N.O.I.A)*, the shortage has already begun! U.S. petroleum product inventories are at the *lowest levels in almost 45 years*... U.S. refinery utilization is at an all time high... and crude oil imports have jumped over the past two years. To quote Mr. Simmon's speech last year at the N.O.I.A. meeting…

> *"To me, this [the looming shortage] is the only rational answer as to why our finished motor gasoline supplies are now back to 1954 levels, why heating oil in the East is 30 percent lower than a year ago, and why worldwide oil stocks are at the lowest forward day cover ever… on any measure, we have never run our hydrocarbon system so close to experiencing physical shortages"*

A Global Problem

The U.S is not the only country strapped for oil. Far from it. Western industrialized nations consume half the world's oil but possess only 10% of reserves; while the Persian Gulf producers consume only 5.8% of world oil but control collectively close to 70% of the world's proven reserves.

At the same time that U.S. reliance on imports is going over 61%, OPEC's share of world production will rise from about 40% where it is presently, to about 60%. The Middle East accounted for 30% of all global production in 1995, compared to only 18% in 1985. This is especially significant, as the world's rising demand for oil has shrunk unused production capacity - the oil shock safety margin - to its lowest level in 15 years.

What's even more ominous, one-fourth of the world's economically recoverable oil reserves are located in just one country, Saudi Arabia, with much of the rest also in the Persian Gulf, a hotbed of racial, religious and military turmoil for almost 3,000 years. (See **The Collapsing Tent**, page 45)

I think, by now, you may better understand why we say it is not a question of "if" there will be an ***OIL SHOCK***, but "when?" And the answer to the latter question may be <u>far sooner</u> than later.

What Will Replace Oil?

One thing is certain, long before the lights are turned off and we are forced to huddle around fires for warmth, a viable replacement for oil <u>will be found</u>. However, as there is little currently on the horizon that falls into this category, we will not dwell long on the subject.

As referenced earlier, attempts to date to find satisfactory alternative fuels have largely come to naught. Even nuclear power, once considered to hold the key to limitless energy, is today being looked upon as an environmental pariah, and its future - save as a fuel source of last resort - <u>is not promising</u>.

There, is, however, one technology that has the potential to make a serious dent in the world's oil dependence: White Crude, gas-to-liquid technology, about which there has been a good deal of speculation in recent months. Here are the facts.

- The gas-to-liquid (GTL) technologies used to convert coal and natural gas to synthetic petroleum have been evolving for over 70 years, but only recently do they appear to be reaching commercial viability.

- Franz Fischer and Hans Tropsch discovered the basic technology in 1923. The Fischer Tropsch process first converts a mixture of natural gas (or powdered coal) by partial oxidation with pure oxygen into synthesis gas (syngas) consisting primarily of carbon monoxide and hydrogen.

- Under heat and pressure, the syngas is then passed over a metal catalyst, such as iron or cobalt, to make a waxy liquid soup that contains straight-chain molecules ranging from short-chain kerosene to long-chain waxes. Refining of this white, waxy soup into fuels such as gasoline or diesel is then fairly simple, because the mix contains none of the sulfur, heavy metals or aromatics found in conventional crude oil. These impurities not only complicate the refining, but are also the root cause of many fossil fuel environmental problems. Even the waste byproducts are white, with the consistency of face cream or petroleum jelly. Other byproducts are water and a soot-like residue, which can be used as a soil conditioner.

- Natural gas is the ideal syngas feedstock. However, to date, the traditional procedure of making syngas from natural gas using pure oxygen - which accounts for approximately 60% of the total costs - has made the process prohibitively expensive.

- During WWII, the Germans used the Fischer-Tropsch process to supplement fuel supplies, as did the South Africans when facing anti-apartheid trade embargoes. The South Africans continue to operate those early plants to this day. Overall, however, the GTL process has been considered to be largely uneconomical when crude oil was under $35 per barrel, so government subsidies were required. That may be changing, thanks to improvements in catalysts and related processes.

- One important advantage of oil over gas is that it is far cheaper to transport. It does not have to be placed under high pressure in pipelines or cooled to extremely low temperatures to liquefy it for shipment by LNG tankers. Due to these transportation constraints, about 2,500 trillion cubic feet of natural gas (roughly half the world's estimated natural gas resources) are "stranded" in areas where it is not practical (or possible) to build pipelines or LNG plants. Over the longer-term, it is hoped that GTL plants - some of them portable - could go a long way toward mobilizing these significant pockets of isolated reserves, either to fill local demand or for export.

Various companies, laboratories and universities are involved in attempts to build the first commercially viable, full-scale GTL plant, and/or refine the ever expanding number of alternative GTL technologies. Recent developments include:

1. The **Royal Dutch/Shell Group** is operating a specialized GTL plant in Malaysia. This plant fits a particular market niche for specialty products, such as paraffin waxes, so it will not likely be duplicated, although it is providing important lessons for application to GTL fuels production elsewhere.

2. **Sasol Ltd.**, with a long history of producing synthetic fuel from coal at two small GTL plants operating in South Africa, just signed a memorandum of understanding to build the first full-scale GTL plant in Qatar in cooperation with the Qatar General Petroleum Corporation and Phillips Petroleum. Construction could begin in late 1998. Sasol also has a joint venture with Norway's Statoil to develop conversion plants for offshore gas fields.

3. **Air Products and Chemicals, Inc.**, has been chosen by the U.S. Department of Energy to head an $84 million research program, in collaboration with other groups, to develop a new membrane technology that would allow the use of ordinary, atmospheric air to make syngas. This would eliminate the need for the separation facility now required to supply pure oxygen for the process. (Someday, membrane technology might also be used to make hydrogen from natural gas for fuel cells.)

4. **Syntroleum Corporation**, a privately held company, has patented GTL technology that uses air instead of oxygen, reducing the cost of the syngas by as much as 25%. It has also concentrated on developing a proprietary catalyst that doesn't produce an initial product too waxy and thick to move through pipelines, a long-time problem. Syntroleum has signed licensing agreements with Texaco, Atlantic Richfield (Arco) and Marathon Oil Company. Using Syntroleum technology, Arco plans to build a GTL plant in Washington State, and Texaco a floating GTL plant. SLH Corporation, a venture capital concern listed over-the-counter (SLHO.NASDAQ), holds a 31% stake in Syntroleum, and is the only way for private investors to invest in Syntroleum. SLH has traded between $26.00 and $73.00 per share over the past year, and currently trades in the area of $56.00, still a whopping 92 times earnings. When you consider that the overvalued S&P 500 Index currently sells for about 19 times earnings, it is clear that an investment in this company is certainly not for the faint of heart.

5. **Exxon Corporation** recently announced its own breakthrough in GTL technology, albeit one that still uses pure oxygen, and their intention to build a large GTL facility in Qatar.

There is no question that GTL technology will, over time, come into its own. As such, it deserves careful attention by investors, but big unresolved issues still remain as to which GTL

technologies will dominate, and the timing of any measurable impact on the world energy prices. Between now and then, the best guess being ten to fifteen years if all goes well - GTL plants could start having a competitive impact on traditional crude oil refined products and natural gas, both pipeline and LNG forms, in regional markets where the transportation costs make higher cost GTL products competitive.

In the meantime, there is the cautionary Wall Street axiom for investing in new technologies to be kept in mind…

> *"You can always spot the pioneers, they're the ones laying dead by the side of the road with arrows in their backs."*

Summary Oil Supply Picture: A Coiling Spring

On balance, world oil demand is expected to *increase* through 1998 at a rate of about 2.1 million barrels per day, compared to 1.9 million barrels per day in 1997. Under these assumptions, world oil demand will grow at an average annual rate of 2.6% between 1994-1998, sharply higher than the average annual growth rate of 0.9% between 1990-1994.

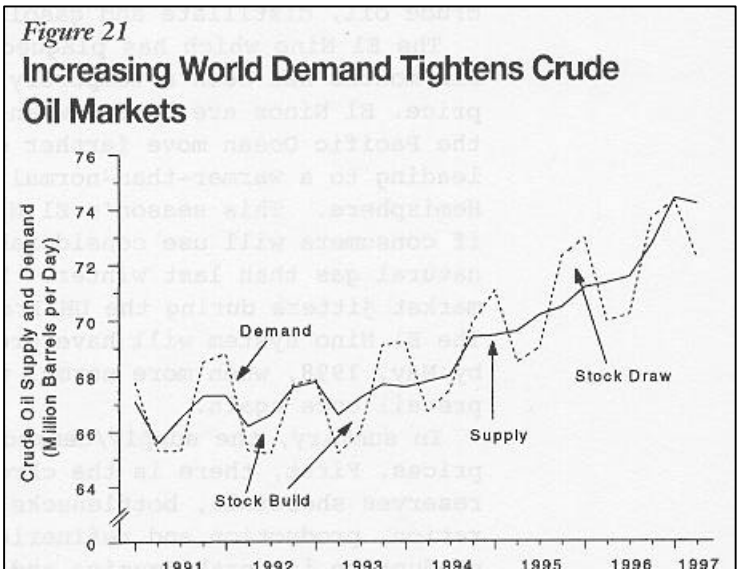
Near-term, supply levels from OPEC and all non-OPEC sources will benefit from incremental production increases. But even the big story here, North Sea production going from 6.4 million barrels per day in 1997 to 6.9 million barrels per day in 1998, does nothing to fundamentally relieve the tight supply/demand equation, with its extreme vulnerability to weather and geopolitical events.

This structural tightness bears emphasis. In the last half of 1996, crude prices rose as much as 36%, not due to any crisis, but as a result of a combination of routine factors including…

- The decision by some refineries to reduce stocks and run their operation on a "just-in-time" inventory basis, this chronic tightness that promises only to get worse.
- A winter which is unusually cold,
- Demand from Asia and Latin America which came in higher than expected,
- Iraqi exports expected to resume in June were delayed until December.

Figure 21

Increasing World Demand Tightens Crude Oil Markets

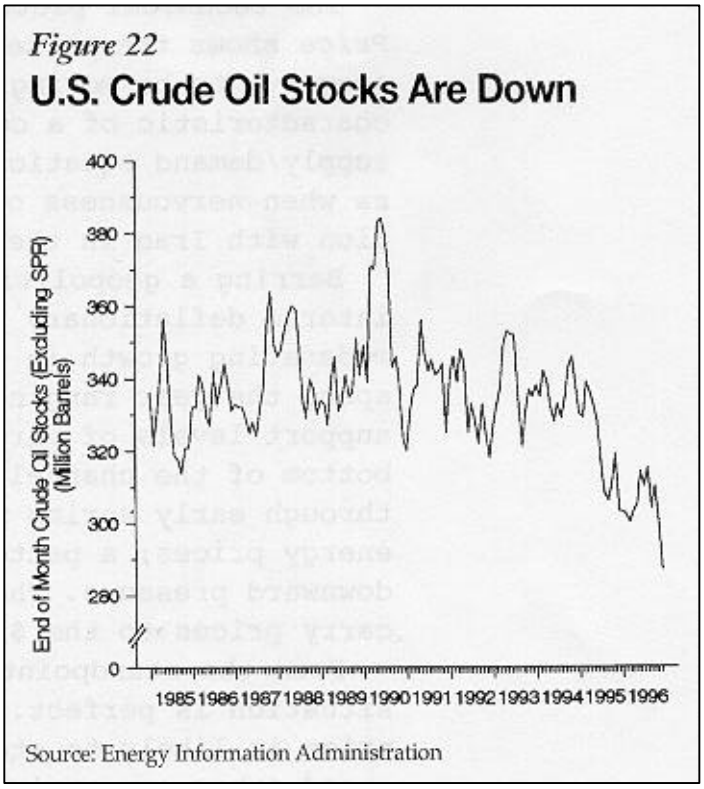


Airlines quickly raised fares, and heating bills went up so fast there were public outcries to release

stockpiles from the Strategic Petroleum Reserve. ***Figure 21: Increasing World Demand Tightens Crude Oil Markets*** reveals this chronic tightness that promises only to get worse.

Likewise, when labor problems cut Nigerian production from 3 to 1 million barrels a day (a mere 2.3% drop in daily world output), it was sufficient to rally oil $3 per barrel in short order. Then there is Iraq.

Ever changing hopes and fears about whether or not Iraq will be selling daily allotments, comprising no more than 1.5% of daily global output, are enough to cause market gyrations. Why would such small shifts in supply have such a disproportionate impact? Because along with virtually all other supply components, worldwide oil stocks (oil in storage to meet immediate refinery needs) are at new lows of approximately 16 days. This steady erosion in stockpiles is made clear in ***Figure 22: U.S. Crude Oil Stocks Are Down***. The picture is comparable for total crude oil, distillate and gasoline stockpiles.



The El Nino, which has plagued the globe over the past six months, has been a temporary moderating factor on price. El Nino is caused when the warm water segments of the Pacific Ocean move farther east than normal, usually leading to a warmer-than-normal winter in the Northern Hemisphere. This season's El Nino is making it look as if consumers will use considerably less heating oil and natural gas than last winter. This phenomenon helped calm market jitters during the UN-Iraq arms inspector stand-off. The El Nino system will have pretty well run its course as of early summer, when more normal weather patterns should prevail once again.

In summary, the supply/demand equation points to higher prices. First, there is the chronic and growing proven reserves shortfall, bottlenecks in oil services, exploration, production and refineries... coupled with declining production in North America and much of the rest of the world. Then there is the surging global demand, erosion in worldwide commercial oil inventories, and an ever more dangerous Persian Gulf situation.

Barring a geopolitical crisis this year, and factoring in interim deflationary pressures from the Far East with moderating growth in the West, prices can be expected to spend the year ranging within the channel, held up by support levels of varying strength, from $18 down to the bottom of the channel, around $12. Also, the late winter through early spring period is normally a quiet

time for energy prices; a pattern that might exert more temporary downward pressure. The next major rally, however, should carry prices to the $27 to $28 range, and probably higher.

From the standpoint of making energy investments, the situation is perfect. Over the shorter-term, the crude oil price per barrel is likely to stay quiet, keeping oil company shares – exploratory drilling ventures and corporate stock - in check.

That is the conservative outlook, which ignores a supply disruption caused by geopolitical turmoil... or the sharply higher crude oil prices which even the threat of such a disruption always cause.

It is now time to turn to the geopolitical picture, where we see that the biggest surprise of all would be if there was no disruption... and this disruption could occur at any time – yes, even tomorrow.

History of Mideast Oil & OPEC

1901 Great Britain, no longer able to depend on domestic coal supplies, was the first to tap Middle Eastern oil, starting with a 500,000 acre concession in Persia (modern Iran) where a major discovery was made in 1908 by the *Anglo-Persian Oil Company* (APOC), the predecessor of today's conglomerate, *British Petroleum (BP).*

1912 *The Turkish Petroleum Company* (TPC) was formed to develop oil fields in Mesopotamia (modern Iraq), then under the nominal control of the Sultan of the Ottoman Empire. TPC was soon taken over by APOC, Deutsche Bank, and Royal Dutch Shell (the British-Dutch firm founded to challenge Standard Oil). During WWI the British stole the Deutsche Bank's share.

1920 Fearful about British dominance of Middle East reserves and exclusion of US firms, in part due to a domestic shortage scare engineered by certain producers seeking subsidies, seven leading American producers joined with the U.S. government in lobbying the British for an open-door policy. But five soon dropped out when the "shortage" scare ended, and negotiations languished.

1928 The first agreement for U.S. participation in TPC (now Iraq Petroleum) was made. But only two companies, *Jersey Standard and Socony,* joined in with TPC and the French State oil monopoly *Compagnie Francaise des Petroles.* The Red Line arrangement, as it was known, featured a non-compete clause for the huge concessions of the old Ottoman Empire.

To amplify the Red Line arrangement, the heads of *Jersey Standard, Royal Dutch/Shell and Anglo-Persian* met secretly to pool the world oil market (less the U.S. and Russia), dividing it up according to existing shares of the majors, with any expansion required to preserve those percentages. Nicknamed the "As-Is" agreement, this was the first international oil cartel.

1938 While "As-Is" agreement partners still basically ran the oil market outside the U.S.; their cartel was starting to crack under competitive pressures. The California company *Socal* cut a deal for Bahrain oil, and *Gulf Oil* locked-up a rich concession in Kuwait. But most important, *Socal* negotiated a huge concession in Saudi Arabia that proved to be the world's largest reserves. *Socal let Texaco* join in the Saudi windfall, creating the *Caltex* joint venture, soon to be renamed *Arab American Oil* (ARAMCO) consortium.

1945 *Jersey Standard and Socony* joined the Saudi consortium. Postwar oil demand was up so sharply that finding new supplies consumed the major international producers, known as the Seven Sisters: *Jersey Standard, Socony, Socal, Gulf, Texaco, Royal Dutch/Shell, and British Petroleum.* Meanwhile, oil-producing countries started demanding a greater share of oil income, with a 50-50 split soon the postwar norm.

1953 The Iranian government, under Mohammed Mossadegh, went beyond calling for a more generous share of revenues and tried to nationalize the oil industry.
A CIA orchestrated coup overthrew Mossadegh and reinstalled the Shah on the throne. The Shah initially allowed U.S. companies a share of production, but in the late 1950s he reasserted greater control over the oil sector and cut a comprehensive deal with the Italian State-owned oil company ENI.

1960 Iran's success in the *ENI* deal encouraged eight oil producing countries to meet in Baghdad and form *the Organization of Petroleum Exporting Countries* (OPEC), with Saudi Arabia's huge reserves and production capacity making it the de facto leader.

1971 Multinational oil companies were the key players in the Middle East until the Teheran Conference in 1971, when Arab producers, under the leadership of Colonel Ghadaffi, took a greater role in setting prices in response to *Esso's* attempt to cut imported crude prices to improve their downstream margins. This caused a price jump of $1.00 to $2.75 per barrel (42 US gallons).

1974 By January 1974, in retaliation for U.S. support of Israel in the Yom Kippur War, OPEC increased their equity in, and control over, their oil sectors to about 60% and quadrupled their posted o@ price to $11 per barrel.

1978 The Iranian revolution, which ousted the U.S.-backed Shah, and the subsequent Iranian hostage crisis precipitated the second oil shock, driving Spot (free market) prices to $39 per barrel, well above the posted OPEC price of $14.56 per barrel.

1980 OPEC ownership and control reached 100%. Iran-Iraq war breaks out. Saudis set the price for light crude at $28 per barrel.

1981 The Assassination of Anwar Sadat. The Saudis raise the light crude price to $34 per barrel.

1985 In response to falling oil prices from growing non-OPEC supplies stimulated by the 1978 oil shock, the Saudis gave up trying to restrain OPEC production and opted for a bigger market share, precipitating a disastrous bear market.

1986 OPEC introduced *Netback Contracts* relating the price of oil to the total revenues derived from all products. These contracts guaranteed a refiner a profit in advance, creating the incentive to buy more crude and run at maximum throughput, even though it lead to a downward spiral in crude and product prices, culminating when crude briefly dipped under $10 per barrel.

1987 Netback contracts were outlawed, and the oil price quickly recovered by about 50% of the previous fall.

1991 In the wake of the Gulf War between Iraq and Kuwait, prices briefly retouched $41 per barrel on fears Iraq would also invade

The Geopolitics of Oil

There are few investment sectors for which the geopolitical scene is more important than for oil. Throughout this report, we have made reference to the vital role of the Middle East, and especially Saudi Arabia, in the world's oil supply equation.

With excess production capacity down to 4% - an incredible fall from the 1970's when excess capacity reached 50% - there is increasingly little room for a disruption in supplies from the Middle East. And, for all the reasons discussed here, the situation only gets tighter, and more fraught with danger, with each passing day.

Consequently, one of the most important questions for one who is considering an oil investment, is simply this…

What is the likelihood, in the near future, of a serious disruption in crude oil supplies from the Middle East?

Unfortunately, the logical answer is, "almost certain." After taking into consideration the turbulent history of this region, any other response would be hopelessly naive.

To shed light on the building dangers in the Middle East, we have included a close look at the state of OPEC and its ability to control supplies and prices of crude.

We have also included an interview with *Robert H. Meier,* entitled ***The Collapsing Tent of Saudi Arabia,*** page 45. Mr. Meier is a highly respected observer of trends and a researcher par excellence. In his interview, he explains why the blood-soaked genesis of Saudi Arabia has planted the seeds for near-term trouble. As Saudi Arabia currently possesses as much as one-quarter of the world's known oil reserves, even the slightest hint of trouble will send oil prices soaring... and the outbreak of any serious conflict, internal or external, will ignite the *Oil Shock* scenario literally overnight.

This sobering interview with Mr. Meier requires little additional commentary, as the message contained is clear and unmistakable: the world's global oil supplies have never been more at risk.

Before we get to our interview, here's some important background on OPEC…

OPEC MEMBERS

Algeria
Iran
Libya
Saudi Arabia
Gabon
Iraq
Nigeria
Indonesia
Kuwait
Qatar
Venezuela
United Arab Emirates

The Organization of Petroleum Exporting Countries

By the dawn of the 20th Century, oil was not only a valuable industrial commodity but a vital military resource as well. This focused attention on the rich resources of the Middle East,

triggering a litany of intrigue, corruption and bloodshed, which continues to this day.

The Organization of Petroleum Exporting Countries (OPEC) was formed in 1960, but OPEC countries were not initially very active in setting oil prices, nor did they have much equity in the producing properties. A complicated and lengthy story, milestones in the history of Middle Eastern oil and OPEC is summarized in the adjoining timeline: ***History of Mideast Oil & OPEC*** (page 40).

Calls for the demise of OPEC go back many years, and its discipline and image have been periodically undermined by evaded quotas, political strife and crude oil price swings. To be sure, the cartel has lost some influence along the way, and is currently more of a manager of its member's surplus production than a price setting body. In fact, on a number of occasions OPEC's prices have been below prevailing spot market prices. Those anomalies notwithstanding, from 1981 on, oil prices were almost always substantially higher than they would have been in the absence of OPEC quotas.

OPEC will remain a big factor in oil markets, as member countries still control over 40% of world production and 75% of proven recoverable crude oil reserves. Down the road, most OPEC export increases will come from the Persian Gulf. Simply put, for the foreseeable future, the world's dependency on Middle East oil will grow in both volume and share.

Overall, the Persian Gulf share of total exports is expected to go over 60% shortly after the turn of the century, gradually increase to 72% by 2015, with an outside chance of hitting 82%.

Furthermore, as an increasing number of members reach full production capacity and their total exports decline (as is already the case with Indonesia and Algeria) OPEC can be expected to use quotas more aggressively to help ration the faster dwindling reserves of such members, as opposed to trying to cap surplus production, as they do now. This shift could put substantial upward pressure on oil prices. Only in this instance, OPEC would have real, net shortages on their side, rather than needing to "create" shortages as they did in the late-1960s and early 1970s when the world's capacity to produce oil was 50% more than demand. Today, this capacity has fallen to between 4% and 6%.

"The U.S. may be competing with China for every tanker of oil, with the Persian Gulf oil exporters preferring Chinese rockets to American paper dollars."

OPEC Update

At their December 1997 Jakarta meeting OPEC members agreed to raise their four year-old 25 million barrel per day production ceiling by 10%, to 27.5 million. The 2.5 million daily increase was more than expected, implying members believe demand will continue to grow, in spite of interim bearish factors which include a mild winter, Asia's economic problems and the temporary resolution of the UN-Iraq arms inspection dispute.

Saudi Arabia, with fully two-thirds of OPEC's spare producing capacity, pushed for the increase to validate its own rising production. Dissenting members, especially Iran, Libya and Indonesia, which are already running near maximum output, wanted a smaller rise to avoid depressing prices given that they have little or nothing to gain from higher quotas.

However, even the 10% increase in quotas was largely just smoke and mirrors. That's because member's cheating on quotas had already pushed OPEC production to nearly 28 million barrels per day, even before new 27.5 million barrel agreement was reached. A conspicuous offender is Venezuela, who was already producing 700,000 barrels over its new 2.6 million daily cap. Saudi Arabia won nearly one-third of the total increase, up to 8.8 million from its previous 8 million. This is not as dramatic as some might think, as the Saudis were already pumping 8.4 million barrels a day (mbpd) and can easily close the remaining 400,000 barrel gap. So, at the end of the day, the new increase largely just served to bring the quotas into line with reality.

The big unknown is Iraq. If the UN lifts all sanctions against Iraq in early 1998, as may very well be the case, Iraq will be able to sell all of their new 1.8 million bbls per day quota, putting total 1998 OPEC in the range of 28.5 mbpd: one mbpd over the official ceiling and 700,000 bpd over current, actual production. Even without Resolution 986, Iraq would still be selling somewhere between 700,000 and 1.1 million bbls by smuggling with the aid of Iran.

Although the Jakarta agreement was widely interpreted as foreshadowing further declines in OPEC power, insightful analysis by the *Petroleum Finance Company*, Ltd., suggests the opposite: that the agreements reached were a highly calculated move by the Saudis to win the following benefits…

1. It will allow Saudi Arabia and the other core OPEC countries with excess capacity and which have generally stuck to their quotas (Iran, Kuwait and the United Arab Emirates), to step in and profit from "unused" Iraqi capacity.

2. It allows the Saudis to reassert leadership over OPEC. (The last time the Saudis took the initiative, it was in a successful bid to tighten the premium of light over heavy crude.)

3. It enhances OPEC credibility, as the 10% increase puts its official quota more in line with actual production.

4. Should Iraqi and Central Asian supplies increase markedly, OPEC will have more maneuvering room to cut quotas, keeping supply and demand in better balance.

5. Together, these results help reaffirm the geopolitical power - and solidarity - of OPEC.

Regardless, OPEC is far from dead…

As its share of global reserves grow in size, and an increasing number of economies become helplessly dependent on those reserves, you can expect that OPEC will once again use its influence as a very effective weapon on the global political stage.

OPEC'S Second Wind - Asia

Although scarcely noticed, a critical shift in the geopolitical equation of oil recently occurred. For the first time ever, China became a net oil importer, with two-thirds of those imports coming from Kuwait, Iran, Saudi Arabia, Qatar, Sudan and the United Arab Emirates. Even before becoming a net oil importer, the Chinese agricultural sector was already one of Kuwait's biggest customers for petroleum-based fertilizers. Now, however, China's crude oil imports are soaring, up 32% in 1996 on the back of a 38.4% increase in 1995.

In turn, Middle Eastern producers are looking ever more to China, not only as a customer but also for joint ventures. As an example, in Kuwait, China's state-owned oil company is building two new gathering stations (hubs) where many oil field pipelines converge, to preprocess crude oil by separating out the natural gas and water before being pumped to tankers. Plans are also well along for OPEC to reciprocate by building refineries in mainland China.

Where are these new developments heading? According to Geoffrey Kemp, a gulf policy expert, early in the next century Asian demand for Persian Gulf oil will exceed that of the US, and possibly even Europe. As the interests of OPEC and China, along with those of Japan, India, Malaysia and the rest of Asia, continue to solidify into a separate bloc, it will further diminish the already fragile ability of the U.S. to maintain the multinational coalition necessary to insure an uninterrupted flow of Persian Gulf oil to Western economies.

This evolving situation adds weight to L.F Ivanhoe's chilling observation that in future oil shocks, "The U.S. may be competing with China for every tanker of oil, with the Persian Gulf oil exporters preferring Chinese rockets to American

SAUDI ARABIA: The Collapsing Tent

The following interview was conducted January 11, 1998 with *Robert H. Meier,* a widely respected geopolitical analyst specializing in longer-term big move trends and their impact on commodities and equity markets.

Q: Let's start by discussing why Saudi Arabia is so important.

A. The easy answer is that Saudi Arabia, which is about the size of the U.S. east of the Mississippi and has only 17 million people, holds one-fourth of known world oil reserves. More to the point, even though most people aren't aware of it, it is teetering on the brink of a massive civil rebellion that will set dozens of different groups against one another.

Q: Why the instability?

A: As with so many things in the Middle East, the instability arises out of a combination of history and religion. It's important for readers to understand that Saudi Arabia only came into being in the 1930s, when one of the warring tribes in the Arabian Peninsula, led by Ibn Saudi and supported by the British, finally conquered the other tribes in the area.

Ibn Saudi then personally executed the chiefs of 18 conquered tribes, and his newly appointed provincial governors joined in the fun by executing 40,000 people and amputating limbs from another 350,000. At the time, there was a total population of only about 4 million new "Saudis," so the carnage involved about 1 in every 11 folks in the country, sowing the seeds for a lot of animosity which continues to this day.

Q: So despite the appearances of a modern society, Saudi Arabia is still pretty tribal?

A: Absolutely. The country is actually a family run business. Thanks to Ibn Saudi's 150 wives, over 6,000 princes now hold government positions, resulting in massive corruption and crippling bureaucracies.

Since Ibn Saudi's death in 1953, four of his sons, including the present 75-year-old King Fahd, have ruled. As political parties and freedom of expression are not allowed, the country is basically, make that absolutely, a police state. Without the oil the Saudi royal family would be put in the same league with other world class thugs, such as Qadaffi, Assad and Saddam Hussein.

Q: So why hasn't there been a revolt?

A: Since the 1970s King Fahd has been keeping the disgruntled tribes and the swelling royal family - and that includes not only the 6,000 princes but also thousands more aunts, uncles, cousins, nephews and nieces - placated with huge, petrodollar-funded welfare schemes including unlimited free telephone and medical services, subsidized domestic air fares, and fat government appointments, to name just a few of the goodies. One of my favorite examples is that, in 1987, King Fahd gave $300 million in spending money to his 14-year-old son. How's that for an allowance?

This largesse has been such that the per capita GNP leaped from $2,100 in 1973, to $16,000 by 1981. But with oil revenues falling after the mid-1980s, and the hugely inefficient government, the Saudi infrastructure is now collapsing, with water and electrical shortages commonplace. As a result, in spite of the risk of death, open criticism and even resistance to the government is growing. To make matters worse, Saudi external debt continues to swell, and the royal family is simply running out of the money needed to keep it all glued together.

Due to these internal pressures, the now 75-year-old Fahd declared a few years back that his successor need not be his half-brother, but should be the best prince for the job. This creates the prospect for violent internecine squabbles between dozens of hopelessly corrupt, degenerate sub-family and tribal groups, some still practicing slavery.

Q: But doesn't the fact that all the conquered tribes in Saudi Arabia are Moslem help build solidarity?

A: No. Just as Christians are divided into Catholics and Protestants and slaughter one another in the name of Christ to this day, Muslims are divided into Sunnis and Shiites and slaughter one another in the name of Muhammad. Roughly 65% of Iraqis and 95% of Iranians are Shiite. In Saudi Arabia, the Sunnis are an 85% majority against a sizable minority of 15% Shiites.

Now on the face of it, considering the fierce hatred between Shiites and Sunnis, that's bad enough, but here's the real kicker: the conquered tribes living in the Saudi oil regions are mostly Shiite, with their strongest loyalties going to their Shiite brethren in Iran and Iraq. And by the way, the Shiite minorities have been getting far less than their fair share of the petrodollar goodies for the past 20 years. They're real grumpy about that as well.

Combine the built-in religious hatred between the Sunnis and Shiites in Saudi Arabia, and the equally strong hatred that both of those groups have against the "Christian" U.S. government - which makes the very existence of the Saudi government and Israel possible - then toss in the hatred of the conquered Arabian Peninsula tribes whose forefathers were mutilated or murdered just a few decades ago by the father of the present Saudi king, and you have a prescription for complete disaster. That's a lot of hatred. Oh, and let's not forget Secretary of State Madeleine Albright, who spends a great deal of time practicing ham-fisted diplomacy in the middle of all this.

Q: What's the outlook for Saudi Arabia?

A: I know most people would sort of prefer that things just kind of go along as they have been over the past several decades, but - when it comes to Saudi Arabia - it's just not in the cards. In fact, there's a high probability that we'll see the collapse of the present government within the next several years. At the very least, as the influence of Islamic militants in the country continues to grow, we'll see some sort of fracture in relations with the U.S. Also, Prince Abdullah, first in line for the throne, is noted for his anti-American views.

Overall, I'm betting on a bloody civil war fomented and supported by Iran and Iraq. Unfortunately, the U.S. will get trapped right in the middle, with the oil fields the big prize. There is overwhelming evidence that once Saudi Arabia starts to unravel, it will have a domino effect on Kuwait and neighboring countries. <u>This all translates into higher oil prices, no matter how you cut it</u>.

Q. Not a pretty picture.

A. No, it's not. But considering the history of the area, and the roots of the current group of despots running Saudi Arabia, it is hard to envision any other scenario as being more likely to occur.

…end of interview

Conclusions on the Geopolitics of Oil

After read through this study, a fairly stark picture of the near-to medium-term future of oil, and in fact, for the world economy, begins to emerge. Oil is such an important part of we humans secure lifestyle.

Increasingly, the world must rely on available energy sources which, for historical, political and even religious reasons, are at great risk. Also it is easy to forget the balance of the 6000 oil-related items that we use every day to assure our comfort.