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The Changing Oil Industry: Will it Affect Oil Prices?

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The petroleum industry is far different today from what it was two decades ago, when oil started flowing from Alaska's North Slope. Huge improvements in technology, increased competition (despite recent mergers), large new discoveries, and opening of areas that were formerly closed to exploration have all changed the face of the industry worldwide.

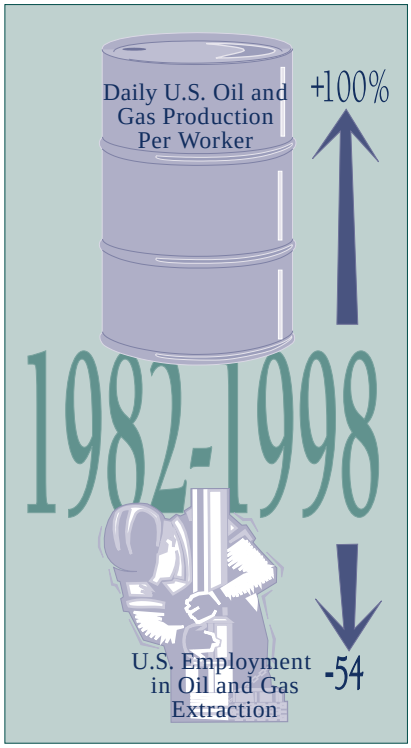
An important question in Alaska, where oil has driven economic growth and supported government since the 1970s, is what industry changes might mean for future oil prices. As ISER noted in 1998, Alaska is less vulnerable to low oil prices than it used to be, because the state government has invested much of its oil income to build huge financial reserves and has sharply cut spending.[1] But oil remains by far Alaska's principal basic industry and the mainstay of its government and economy.

Oil prices collapsed to near historic lows in 1998, with the Asian recession and increased Iraqi oil production taking most of the blame. Yet in the spring of 1999, East Asian economies had not recovered and exports from Iraq continued to grow — but oil prices had nearly doubled from their lows, following an OPEC agreement to cut production.

Still, many analysts question whether OPEC has the discipline or the market power to boost oil prices for long. The oil industry is vigorously competitive, and we can expect oil prices to continue fluctuating widely and often unpredictably. But major structural and technical changes within the oil industry itself may influence *average prices over the long term*. This paper discusses those changes for the industry worldwide and for Alaska.

The latest development in Alaska's oil industry is that BP has proposed to buy ARCO, citing improved efficiency and reduced costs. The merger would make BP overwhelmingly dominant in production, reserves, pipeline capacity, prospects, and undeveloped lease acreage on the North Slope. BP would have huge power in lease sales, dealings with other operators, and negotiations with workers, suppliers, and contractors. But Alaska could also benefit, if North Slope oil became more competitive on world markets, if more marginal fields were developed, or if the basis for the state government's oil revenues increased. Government regulators have yet to approve the merger, but if it goes through, it will add to the string of dramatic changes in the oil industry since the 1970s.

• *Contrary to official doctrines of twenty years ago, the world is not running out of oil*—as evidenced by growing reserves, enhanced recovery methods, increased non-OPEC production, and huge discoveries in South America and the Caspian Basin. Scientists are also investigating the possibility that oil is far more abundant than previously thought.



• *Total U.S. petroleum production dropped slightly since 1982, but better technology doubled production per worker*—and cut total employment in petroleum extraction by half.

• *Technological advances have not only shrunk the costs of finding and extracting oil from new fields*—they have potentially added hundreds of billions of barrels to recoverable oil from known fields and from previously abandoned fields.

• *Alaska's North Slope operations have especially benefited from improved technology,* with onshore drilling costs per foot dropping nearly 75 percent in constant dollars since 1976.[2]

• *Control over global oil reserves and production is not more concentrated,* despite the mergers sweeping American and British companies. These old-line majors have already yielded much of their global market share to national oil companies and other producers in exporting countries.

• *Revolutionary advances in communications and data processing* mean that oil markets now react instantly to big and small events.

• *As long as oil prices stay above $5 per barrel—roughly the variable cost of producing and transporting oil from developed fields*—North Slope operators will not stop production. But sustained low prices, or *anticipation* of sustained low prices, do threaten investments needed to maintain or expand production.

Figure 1. Tracking Oil Prices, 1968-1999 (U.S. Crude Oil, Domestic First Purchase)

Alaska and Oil

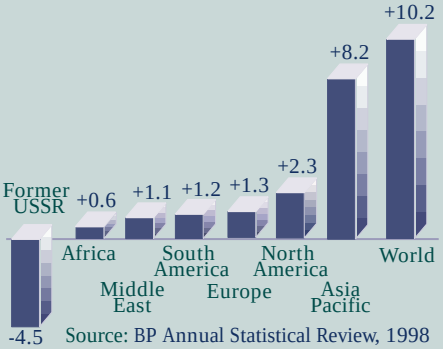
The 1.1 million barrels of oil Alaska produces daily amount to about 18 percent of U.S. and 2 percent of worldwide production. Petroleum has been Alaska's engine of economic growth for almost 30 years. Petroleum revenues have paid most general government expenses and supported thousands of public and private jobs since the late 1970s. The most volatile influence on Alaska's economy is thus the price of crude oil.

Alaska's economic growth and ascent to wealth in the last generation are largely due to exceptionally fortunate timing. The peak flow of oil from the huge Prudhoe Bay field—which the state government owns—coincided almost exactly with the all-time peak in world oil prices that attended the Iranian revolution and war between Iran and Iraq. Since the start of North Slope production in 1977, Alaska has seen prices rise to all-time highs and fall to modern lows. (See timeline above.)

At their peak in 1981, oil prices were triple what they had been in 1978 and 10 times higher than in 1968.[3] The high prices increased exploration and the number of prospects industry judged feasible to develop. But they also set the stage for a big decline in the first half of the 1980s. When oil prices soared, demand dropped as consumers and industry focused on conserving energy and moved with unexpected speed to lower-priced fuels. Oil prices crashed in 1986, but after that prices hovered mostly between $15 and $20 per barrel until 1997.

Figure 2. Changes in Petroleum Consumption, 1987-1997

(In Millions of Barrels per Day)



Source: BP Annual Statistical Review, 1998

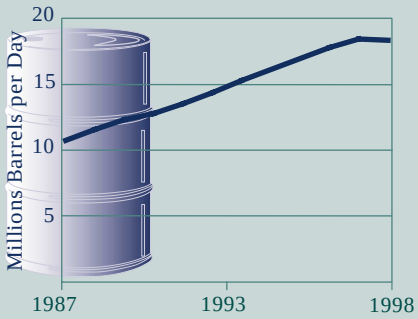
1997-98 Price Collapse

Then in mid-1997, a severe recession began in East Asia. That region had been responsible for most of the growth in oil consumption worldwide for the previous decade (Figure 2). Asian demand for oil, which had nearly doubled between 1986 and 1997, flattened between 1997 and 1998 (Figure 3).

And even as demand from Asia leveled off, Iraqi oil production was nearly quadrupling (Figure 4). For most of the 1990s, Iraqi oil production has been constrained by economic sanctions the U.N. imposed at the end of the Gulf war. Those sanctions have been eased in recent years.

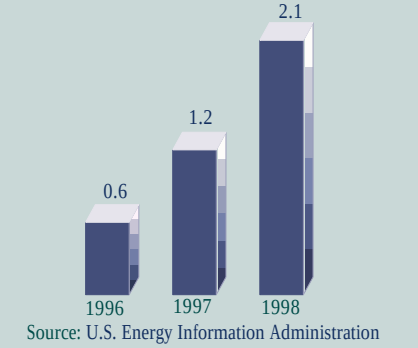
Other countries also boosted production in 1998. As a result, the world oil supply grew by 3.1 million barrels per day in 1997 and 1998, while demand grew only 2.4 million. Oil prices fell throughout 1998, averaging about $11 per barrel for the year. In today's dollars, that was the lowest oil price since before the discovery of Prudhoe Bay. Since oil quantities respond slowly when there is a supply-demand imbalance, price change is the mechanism for clearing the market.

Figure 3. Asian Demand for Petroleum, 1987-1998



Source: U.S. Energy Information Administration

Figure 4. Growing Iraqi Oil Production (In Millions of Barrels per Day)



Source: U.S. Energy Information Administration

Proposed BP-ARCO Merger

Even as oil prices began a sharp rebound this spring, British Petroleum (while still in the process of absorbing Amoco) announced plans to buy ARCO. Until now, ARCO, Exxon, and BP (under its own or the Sohio name) have been the North Slope's biggest producers, competitive rivals with hydrocarbon holdings of roughly similar sizes, taking into account both oil and gas and both producing and prospective reserves.

If the sale goes through, BP would be by far the largest Alaska operator and Exxon a distant second. The proposed merger would be extraordinarily profitable for BP, giving it substantial concentration of market power both on the North Slope and downstream on the West Coast.

The merged company would control almost half the crude-oil supply to California and the West Coast—ensuring that federal regulators will give the merger close scrutiny. Such substantial market power might, in the view of some analysts, raise prices of Alaska North Slope (ANS) crude for West Coast refiners—and therefore costs of gasoline for California consumers. Long before this proposed merger, California's state government was already concerned about the market's dependence on Alaskan oil and on BP in particular.

Other analysts, however, believe that ANS prices cannot rise much as a result of the merger, because the substantial share of crude oil that is imported from other countries puts a ceiling on West Coast oil prices.

Operating efficiencies from the merged company could make ANS crude more competitive on world markets, and therefore encourage more North Slope development. But at the same time, consolidating BP and ARCO operations will cost hundreds of oil industry workers in Alaska their jobs and make it more difficult for competitors to gain a market foothold.

Savings from consolidating Alaska operations is only one goal of the proposed merger of these international companies, but it's an important one. If federal regulators approved the sale only on the condition that BP sell a major part of the companies' combined producing assets in Alaska, the remaining deal might not be attractive enough for both parties to go through with.

The Changing Oil Industry

Oil prices have stubbornly failed to show the upward trend many analysts have been predicting for 20 years, and in 1998, prices flirted with all-time lows. Might a host of structural upheavals in the oil industry be changing the fundamental long-term orientation of prices?

The Heritage of High Prices: Lots of New Oil

Throughout the 1970s and early 1980s, official opinion held that acute price fly-ups triggered by conflicts in the Middle East were symptoms of a world running out of oil. Members of OPEC were the principal beneficiaries of this belief. The resulting economic climate allowed Saudi Arabia, the group's largest producer, and OPEC as a whole, to boost prices several times over, simply by withholding the increases in exports needed to cope with growing world energy demand and to fill the gap left by the war between Iran and Iraq.

The high prices of the seventies and early eighties encouraged conservation, drove industry and consumers to cheaper alternatives (such as coal and natural gas as substitutes for heavy fuel oil), and stimulated exploration in non-OPEC countries. The result, 20 years later, is that "oil is coming into the market from new sources in every corner of the globe."[4]

Proved oil reserves worldwide increased 60 percent in the past two decades—from 653 billion barrels in 1977 to 1,037 billion barrels in 1997.[5] (Table 1.) Most of that increase was in the Middle East—where reserves are undoubtedly much bigger than these figures reflect. Indeed, because Middle East reserves were already so much bigger than needed to meet current demand, the recent additions in that region have been virtually irrelevant in the present market.

It is, rather, the more modest growth of reserves outside the Middle East—25 percent in the past 20 years—that has been supporting the expansion of global production and restraining oil prices. Today it is unlikely that any producer or cartel has the power to restrict supply for long: if one cuts back, there are numerous others with the capacity to increase production and thereby gain market share and revenue at the expense of others.

OPEC's share of current world production is around 40 percent, as compared with 55 percent in 1974. OPEC could, however, easily produce far more than it does today. Saudi Arabia, with its massive oil reserves, could quickly add millions of barrels per day to its production. Iraq, with known reserves second only to those of the Saudis, hopes to more than double its daily production within a decade after U.N. sanctions are lifted.[6]

As analyst Michael Lynch of the Massachusetts Institute of Technology recently pointed out, widespread forecasts of ever-increasing oil prices and ever-shrinking production in non-OPEC countries have repeatedly proven wrong. While oil supplies are still subject to disruption during political crises, and there are a number of uncertainties about future oil development, he asserts "it is clear that petroleum is far more abundant than mainstream forecasters anticipated." [7]

Table 1. Proved World Oil Reserves
(In Billions of Barrels)

	Middle East	Other	Total
1977	366	287	653
1987	565	335	900
1997	677	361	1,038
Change, 1977-1997			+59%

Source: BP Statistical Review of World Energy 1998

Globalization and Increased Competitiveness

At the start of the 1970s, the oil industry was highly regulated and centralized. Despite the ongoing merger trend among the major international companies, oil markets are now far more decentralized and competitive than ever.

The legendary "Seven Sisters" may soon shrink to only four (Exxon, Shell, BP, and perhaps Caltex[8]), after absorbing Gulf and Mobil and a host of second-tier producers. However, against these largely *horizontal* mergers between integrated companies we must weigh the massive *vertical* split of crude-oil production from refining and marketing.

That split occurred mainly in the 1970s, when OPEC nations expropriated oil concessions of British and American companies and returned them to the world markets as new major oil and gas companies, now trading independently as Saudi Aramco, Kuwait Oil, Petromin, Pertamina, and others, including three Venezuelan entities.

In the two decades or so since the OPEC expropriations, some national oil companies have been privatized, notably including British Petroleum. These changes mean that the line between producers and marketers of oil, like the line between government and privately-owned "national" oil companies, is becoming less and less clear, undermining the incentive and ability of producers to restrain global production in an attempt to support crude oil prices. National oil-producing entities have increasingly reached downstream into refining and marketing. Examples include Kuwait Oil, which markets gasoline in Europe under the brand Q-8 and Saudi Aramco, which with Texaco is co-owner of the ubiquitous StarMart stations and convenience stores.

The collapse of the Soviet Union in the early 1990s led to another massive realignment of control over petroleum resources, spawning another handful of new petroleum companies whose holdings qualify them as "majors"—not to mention Russia's megalithic Gazprom, which by itself is the world's biggest producer and marketer of hydrocarbons.

Many national oil monopolies (with a notable exception in Mexico) have collapsed, opening the way for competition. Most oil-producing countries that still have government-owned oil companies nevertheless allow domestic or international private companies to participate in the market.

Revolutionary advances in communications and data processing have been essential to this competitive restructuring of oil markets—because those advances allowed creation of highly efficient cash and forward markets for crude oil and petroleum products.

Together, these changes have resulted in an industry that is not only much more competitive but more fluid and responsive to big and small events—like crashes in financial markets, pipeline failures, or huge discoveries—which now reverberate instantly through markets worldwide.

End of the Cold War: New Areas Open

With the collapse of the former Soviet Union, and the separate but related collapse of many national oil monopolies, large areas that were previously closed have now been opened to exploration and development. Specifically, most of the world is now open to American and British oil companies. The recent massive discoveries in the Caspian Sea region are the most obvious example of the potential for much higher oil production.

The Caspian Sea region, bounded by Iran and several nations from the former Soviet Union, has proved reserves of 16 to 32 billion barrels, but could, according to the U.S. Department of Energy, have additional "indicated" or "probable" reserves in excess of 160 billion barrels—an amount equal to one-quarter of the proved reserves in the Middle East.[9]

These huge discoveries invite comparison with discoveries that brought prices down after both World Wars. Until 1998, the low point for oil prices since World War II had been in 1969, when a global recession coincided with the coming onstream of unparalleled Middle East crude-oil reserves. Before the discovery of huge Middle East fields, rising demand had pushed up prices, which in turn had spurred drilling and exploration—resulting in big finds that pushed the bottom out of the market.

The recent Caspian discoveries thus mark another phase in the cycling long familiar to the oil industry: new discoveries push prices down and increase the amount demanded—and growing demand, over time, tends to pull prices back up.

Improved Sensing, Drilling, and Well Operations

Technological advances have made oil easier to find and cheaper to produce. The most conspicuous improvements are (1) advanced computer analysis and monitoring of geophysical and geological features, especially in three and four dimensions (i.e., displaying the movements of fluids within formations); and (2) directional drilling and coiled tubing, which make it much easier to drill and get the casing to the oil.

The combined effect of these improvements has been a huge increase in the efficiency of drilling. Improved computer processing of more precise locational, density, magnetic, gravitational, chemical, and other data from seismic surveys and well logs can tell engineers where the oil and gas actually are and provide a map of how to get there. In turn, coiled tubing, improved bits, motors, and steering mechanisms, downhole sensors, and other drilling and well-completion hardware make the drilling and completion of wells faster, more accurate, and more effective. Over the operating life of a field, moreover, many other kinds of technical improvements help enhance the percentage of "oil-in-place" that can ultimately be produced from a given pool.

Such innovations in drilling and well operations since about 1980 have effectively expanded the amount of oil recoverable from known formations worldwide by a factor of two, three, or more times. That total includes oil in long-aban-

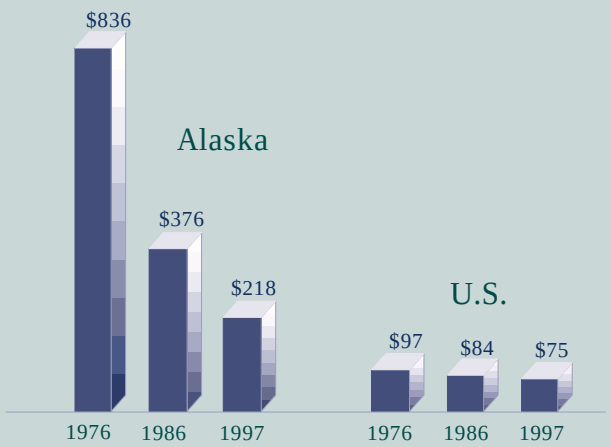
doned pools, as well as new volumes that can now be extracted from formations that are currently producing or are being developed. However, this new oil will be added to "proved reserves" only gradually, as industry applies its new techniques to the hundreds of billions of barrels of oil that older practices have been leaving behind.

Another sign of improved productivity in the oil industry is falling drilling costs per foot (Figure 5). Drilling costs vary somewhat from year to year, depending on the kinds of wells drilled. If oil prices are especially high (as in 1981), oil companies will spend more to drill for less accessible, lower-quality oil and, at the same time, bid up oil field wages, prices of tubular goods, and contract rates for drilling rigs. But if prices are especially low (as in 1987 and 1998), companies are much more conservative about how many wells they drill and in what locations, while market prices of inputs to drilling tend to fall.

Still, drilling costs for onshore oil wells in the U.S. and in Alaska in particular have fallen in the past 20 years. Real (1998 constant-dollar) drilling costs for onshore wells in the U.S. fell from $97 per foot in 1976 to $84 in 1986 and to $75 in 1997. In Alaska, the drop was far more dramatic: from $836 per foot (in 1998 dollars) in 1977 to $376 in 1986 and to $218 in 1997.[10]

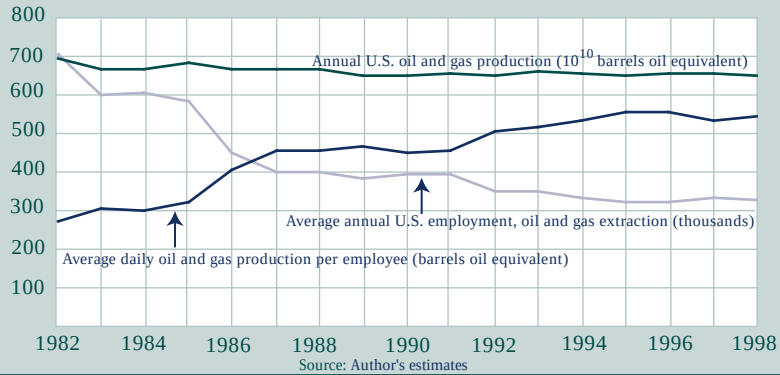
A more general measure of improved technology is the ratio of industry employees to volumes of oil and gas produced, which in the U.S. has fallen by an average of 4.5 percent annually since 1982, or a decline of nearly 50 percent in 16 years (Figure 6). That sharp decline in the U.S.—the world's most exploited (and presumably most depleted) petroleum province—certainly calls into question the assumptions that petroleum sources are nearing exhaustion and that petroleum costs will therefore rise inexorably.

Figure 5. Onshore Drilling Costs Per Foot
(In 1998 Dollars)



Source: American Petroleum Institute, Basic Petroleum Data Book. Figures adjusted to 1998 dollars with U.S. city average CPI.

Figure 6. U.S. Oil and Gas Production Per Employee, 1982-1998



Source: Author's estimates

Origins of Petroleum: New Hypothesis

Throughout the twentieth century, forecasts of petroleum production and prices have been based on the premise that petroleum is a fossil fuel of fixed quantity, derived from organic refuse formed millions of years ago. Most forecasts still start from that premise, but many analysts now recognize the potential for improved technology to stretch the resource boundaries.

An alternative hypothesis that is becoming increasingly respectable among earth scientists is that some, if not all, hydrocarbons derive not from organic refuse originating at the earth's surface, but from methane and carbon dioxide percolating up from its core. That hypothesis goes a long way toward explaining the unanticipated growth of the world's proved oil reserves, as well as such phenomena as gas reservoirs in the North Sea and the Gulf of Mexico that seem to replenish themselves; wells in Russia that produce oil from granite bedrock; huge quantities of "methane hydrates" under the seabed and in permafrost; and the enormous volumes of methane and carbon dioxide that escape from the earth during earthquakes and volcanic eruptions.[11]

Holdouts for the more pessimistic view include Colin Campbell and Jean Laherrere of Petroconsultants Inc., who predict that "within the next decade" the supply of oil will be inadequate for demand—with resulting "radical" price increases.[12] But the consistent failure of this story as a predictive tool now warrants scepticism, at the very least.

Alaska's Oil industry

Alaska's petroleum industry today is far different from what it was 20 years ago, when North Slope production started. As we discuss more below, producers have invested billions of dollars in North Slope facilities and equipment. They have, over the years, made organizational changes—such as sharing facilities among operators and forming alliances with service companies—that have improved operating efficiency. They have sharply cut their costs by investing in improved technology. And in the past decade, they have settled most of their long-running tax and royalty disputes with the

state government, controlling uncertainty from that source about future costs. Crucially, state and federal regulators have cooperated with the industry in speeding up the design, planning, permitting, and construction of facilities, which together have shrunk the typical spread between decision and operation by more than half.

Huge Existing Investments

The North Slope producers have a huge incentive to continue production, even at historically low prices. The vast preponderance of the cost of producing North Slope oil at a given time is "sunk" or "fixed." Once made, the investment in wells, processing facilities, roads, and other infrastructure cannot be undone. Also, the salvage value of most of the equipment is less than the cost of transporting it to some other part of the world.

The North Slope's largest producers are in the strongest position to withstand market slumps. They have production and development cost advantages because of their existing infrastructure and also because of their ownership shares in the trans-Alaska pipeline and feeder pipelines. Developments of the smaller North Slope producers are much more likely to be jeopardized, and prospective new entrants more likely to be deterred, by prolonged episodes of low prices.

Lower Costs and Improved Technology

Alaska's North Slope producers have reduced their costs dramatically in the past two decades, with the greatest savings from improvements in technology. Economies of scale and organizational changes—like shared facilities and alliances with service companies—have also helped oil producers reduce costs.

New technology has reduced industry costs worldwide, but has had particularly dramatic effects on the North Slope. Horizontal drilling with coiled tubing and multilateral completions have probably been the most significant technological influences on North Slope costs in recent years and will continue to be so for the foreseeable future. This new technology allows for the development of numerous pools and pay levels, at some distance from the wellhead, from the same surface location.

For North Slope operations this advance is particularly significant, because drilling wells on the tundra or under shallow Arctic seas requires first constructing gravel drilling pads. By allowing more wells in a smaller area, directional drilling substantially cuts costs. Figure 5 shows the steep decline in drilling costs on the North Slope since the 1970s.

Enhanced three-dimensional seismic testing has also helped reduce the cost of development drilling. Efforts are accelerating to improve 3-D seismic data acquisition and interpretation to maximize recovery.

Costs of Producing North Slope Oil

When all the "incremental" or "true variable" costs of producing and moving North Slope oil to market from existing fields are added up, the total is substantially less than $5 per barrel. This means that the world market price for North Slope oil would have to fall below $5 per barrel, and stay there for an extended period, before the operators would become convinced there was so little chance of a reversal that they would permanently shut down.

Moreover, the leaseholders will be obliged to clean up sites once production ceases and they abandon the leases. Once fully shut down, wells are often prohibitively expensive to re-start, particularly if the crude oil is heavy and difficult to produce.

The principle of continuing to operate as long as oil prices are above production costs also holds for operators of the trans-Alaska pipeline that carries North Slope oil south to tankers at Valdez. Because the percentage ownership of the pipeline just about matches the ownership of North Slope oil reserves, the full variable cost of production to ARCO, BP, and Exxon is very low indeed. (That is, the incremental, and thus variable, cost of shipping a barrel of oil for a given producer is not the pipeline's tariff rate for that barrel, since the shipper receives substantially all that tariff rate as pipeline owner. Indeed, the vast majority of the per-barrel pipeline charge recovers fixed costs the owner would incur whether or not the incremental barrel moved.)

Could Prices Hold in Single Digits?

Is a price of $5 per barrel a realistic possibility in world oil markets (including the Lower 48) over any sustained period? If it is, it has no historical precedent in the U.S. In over a century of recorded prices of crude oil at the wellhead, the average has been $15.05 per barrel, in constant (1998) dollars. The lowest price was in 1931, at $7.50 per barrel (again, in 1998 dollars).[13]

It is useful to consider what $5 per barrel for crude oil in major Lower 48 refining centers would mean. Residual prices would then be materially less than $5 per barrel ($1 per million Btu). Electric utility and industrial boilers could then be fired with oil at prices one third to one half below the present cost of coal. The resulting variable cost for generating electric power from oil in conventional steam plants would be substantially less than 2 cents per kilowatt hour.

Competition, together with the rules of electric-utility ratemaking, would cause lower prices to be passed on to consumers. The demand for energy would grow worldwide and would shift from gas and coal back to oil and to electricity generated with oil. Supplies of crude oil from developed fields and the lowest-cost new prospects would be inadequate to meet such growth in demand—and rebounding oil prices could therefore soon be expected.

"No Decline After '99"?

Expectations of prolonged single-digit oil prices would undoubtedly cause operators to shut in and abandon "stripper" wells and other high-cost oil production in the Lower 48. On the North Slope, however, the costs of producing and transporting oil from fields *that have already been developed*

do not exceed $5 per barrel. But while low oil prices are unlikely to shut down much of the established production on the North Slope, price expectations do have a powerful influence on future output. Future production levels—from both existing and undeveloped fields—depend heavily on new investments. If North Slope producers became convinced that single-digit oil prices were permanent, they would undoubtedly take a hard look at any continuing investments. Oil production is dynamic—and without new investments in well workovers and new development wells, North Slope production would decline more rapidly than is currently forecast.

So far, the major North Slope operators have indicated that they expect oil prices to be lower than long-term averages—but not in single digits. With the general decline in operating costs (and the further decline expected if BP and ARCO merge), prices at those levels will be adequate to justify new investment to maintain North Slope output at close to current levels—or, in the slogan popularized by ARCO, "No decline after '99." The Alaska Department of Revenue currently forecasts that oil production for the next few years will be slightly lower than it had forecast last year, because low prices in 1998 delayed some North Slope developments.[14]

The stability of North Slope operations, despite widely fluctuating prices over the last decade, supports the assertion that North Slope investment will continue. On average, the price of crude oil during the last ten years has been one third less than that of the previous ten. In response, oil industry investment on the North Slope fell by half (in nominal dollars), and field development slowed but never came close to ending. Despite lower oil prices, North Slope production continued, new fields were brought on stream, and virtually all the facilities and equipment carried on the 1985 tax rolls have remained in service.

Since the 1986 oil price collapse, the level of investment on the North Slope has been in the vicinity of $1 billion per year. The *Anchorage Daily News* reported in February 1999 that BP and ARCO together plan to spend $850 for exploration and development on the slope in 1999.[15] With the April announcement that BP intends to buy ARCO, the two companies pledged investment of $5 billion in North Slope development over the next five years. On an annual average, that would be more than the two companies together planned to spend in 1999 and more than they spent on average in the previous five years.[16]

At the end of 1998, when oil prices were falling toward single-digit levels, Dudley A. Platt, a petroleum engineer who often acts as a consultant to the Alaska Department of Revenue, gauged some of the likely effects of low prices. He foresaw a drop in the number of operating drilling rigs from 18 in 1998 to as low as 6 in 1999. Heavy oil developments (like New West Sak and Schrader Bluff) would be suspended, pending stronger oil prices. The Badami field, where production has failed to meet industry expectations, is in a "warm shutdown." Further exploratory work on the eastern North Slope would be needed to justify the $300-million investment in Badami, whose stand-alone potential BP appears to have overestimated. Development at some other fields (such as Northstar and Alpine) would continue but with some work delayed. Joint field development, like that at Sourdough/Pt. Thomson/Flaxman, would become more prevalent if oil prices remained lower than average.[17]

Conclusion

Despite historically low oil prices in 1998, the petroleum industry remains the largest and most financially powerful of all goods-producing industries. Petroleum markets are the most integrated, transparent, and reliable of any based on natural resources. Their robustness in the face of revolution and economic upheavals (as in Iran and the Soviet Union); civil disorders (for example, in Iran and Indonesia); wars (including Suez, Yom Kippur, Iran-Iraq, and Iraq-Kuwait); and physical embargoes by either producers or consumers (the 1973 Arab Embargo and western boycotts of Iran, Libya, and Iraq) is without parallel.

Since the late 1970s, the price of a barrel of crude oil—in today's dollars—has risen as high as $50 and plunged below $10. This price variation has been substantial, and the worldwide consumption of petroleum has been more than trivially affected. Nevertheless, from year to year, the shape of the industry has been affected more by weather in North America and Western Europe and by secular trends and macroeconomic business cycles than by short-term gyrations in prices. Throughout this period of economic turbulence, the petroleum industry has focused on the fundamental role its products play in industrialized economies. It has managed to invest its way through (and prosper despite) the price crashes, the expropriations and confiscations, and the punitive energy and tax policies of governments worldwide.

The predominance of fixed costs in the petroleum industry, combined with the fact that demand for oil doesn't immediately adjust when oil prices change, creates ample opportunity for erratic and unpredictable movements of prices. But such movements should not be confused, as was common in the 1970s and early 1980s, with a long-term price trend based on terminal scarcity of oil. Supplies are not on the cusp of exhaustion.

So what can we conclude about the effects on oil prices of the many technical and structural changes the oil industry has seen over the past 20 years? We don't know enough right now to draw firm conclusions, and clearly many things besides structural changes will influence world oil prices. But a scenario in which oil prices lurch erratically toward a new long-term course significantly lower than the historical average is sufficiently plausible to demand serious consideration by investors and policymakers, both worldwide and in Alaska.

ENDNOTES

1. See "From Oil to Assets: Managing Alaska's New Wealth," by Scott Goldsmith, *Fiscal Policy Paper* Number 10, June 1998, Institute of Social and Economic Research, University of Alaska Anchorage.

2. Source: American Petroleum Institute, *Basic Petroleum Data Book* (annual); adjusted to 1998 dollars with the U.S. city average Consumer Price Index.

3. For more discussion of the conditions that brought prices to their peak, see "Reflections on the End of the OPEC Era," by Arlon Tussing, *Alaska Review of Social and Economic Conditions,* Volume XIX, No. 4, December 1982, Institute of Social and Economic Research, University of Alaska Anchorage. Also published as "An OPEC Obituary," in *The Public Interest*, Winter 1983.

4. Daniel Yergin and Joseph Stanislaw, "How OPEC Lost Control of Oil," *TIME*, April 6, 1998, Vol. 151, No. 13.

5. *BP Statistical Review of World Energy,* 1998.

6. U.S. Energy Information Administration, "Iraq," *Fact Sheet,* November 1998.

7. Michael Lynch, "Oil Scarcity, Energy Security and Long-term Oil Prices—Lessons Learned and Unlearned," in *IEAA Newsletter*, First Quarter 1999.

8. At this writing, Chevron and Texaco have proposed to merge—but there has been no indication what the merged company would be called.

9. U.S. Energy Information Administration, "Caspian Sea Region," *Fact Sheet*, December 1998.

10. Note that 1997 drilling costs *per foot* in Alaska remained three times higher than the U.S. average—a statistic which, by itself, does not indicate whether costs *per barrel* were higher or lower than the national average.

11. For a recent review of research along these lines, see Thomas Gold, *The Deep Hot Biosphere,* New York: Springer-Verlag, 1999. Also, several addresses on Cornell University's Web site (http://www.people.cornell.edu/tg21) provide relevant summaries.

12. See, for example, "The End of Cheap Oil," by Colin Campbell and Jean Laherrere in *Scientific American*, March 1998.

13. Adapted from U.S. Department of Commerce, Bureau of the Census, *Historical Statistics of the United States: Colonial Times to 1970* (current prices 1899-1970) and U.S. Department of Energy, Energy Information Administration, *Monthly Energy Review* (current prices 1971-1998). Prices were deflated to constant dollars using the implicit deflator for the gross domestic product (1929-1998) from U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business,* and the wholesale price index (1899-1933) from *Historical Statistics*. The deflators were linked at 1929-1933.

14. Alaska Department of Revenue, Spring 1999 oil production and price forecast.

15. "Oil Industry Gears Up for Hard Times," by Ben Spiess, *Anchorage Daily News*, February 28, 1999, page A-6.

16. Press release, BP Exploration and ARCO Alaska, April 1, 1999.

17. E-mail communication, December 24, 1998.

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