

Alan Greenspan: Energy

Remarks by Mr Alan Greenspan, Chairman of the Board of Governors of the US Federal Reserve System, before the Economic Club of New York, New York, 20 May 2005.

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Over the past twenty years, the American economy has absorbed the major shocks of two stock market slumps, the terrorist attacks of September 11, and debilitating corporate scandals. But we have also been subjected to other shocks, the most immediately prominent ones being the oil and gas price surges of the past two years. Indeed, most analysts attribute the economic soft spots of the past two years to energy shocks. Accordingly, I will devote the rest of my formal remarks to developments in oil and gas markets, and I will endeavor to address broader issues of the world economy in the question and answer period.

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World markets for oil and natural gas have been subject to a degree of strain over the past year not experienced for a generation. Increased demand and lagging additions to productive capacity have combined to eliminate a significant amount of the slack in energy markets that was essential in containing energy prices between 1985 and 2000.

Reflecting a low short-term elasticity of demand, higher prices in recent months have slowed the growth of oil demand, but only modestly. That slowdown, coupled with expanded production also induced by the price firmness, required markets to absorb an unexpected pickup in the pace of inventory accumulation. The initial response was a marked drop in spot prices for light, sweet crude oil. But that drop left forward prices sufficiently above spot prices to create an above-normal rate of return for oil bought for inventory and hedged, even after storage and interest costs are accounted for.

As I indicated in early April, this emerging condition could encourage the buildup of enough of an inventory buffer to damp the price frenzy. Indeed, since early April, private crude oil inventories in the United States have been accumulated at a seasonally adjusted rate of around 250,000 barrels a day, rising as of last week to the highest seasonally adjusted level in three years. A somewhat lesser, but still important, accumulation of crude oil is evident in other major countries. Inventory accumulation is likely to continue unless demand rises, output declines, or we run out of storage capacity.

In the United States, natural gas prices in recent weeks, seasonally adjusted, have come off their peak of early April, but those prices still remain significantly above the average level of 2004. Working levels of gas inventories are seasonally moderate, but domestic dry gas production plus net imports has not expanded sufficiently over the past few years to have prevented a marked rise in price. The inexorable rise in residential and utility use has priced the more marginal industrial gas users partially out of the market and has induced significant gains in gas efficiency among a number of gas users, such as petroleum refineries, steel mills, and paper and board mills. Industrial gas use overall in the United States has declined 12 percent since 1998.

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For both oil and natural gas, the inventory, production, and price outlook beyond the current episode will doubtless continue to reflect longer-term concerns. Much will depend on the response of demand to price over the longer run. Prices of spot crude oil and natural gas have risen sharply over the past year in response to constrained supply and the firming of overall demand. But if history is any guide, should higher prices persist, energy use over time will continue to decline relative to gross domestic product (GDP). In the wake of sharply higher prices, the energy intensity of the United States economy has been reduced about half since the early 1970s. Much of that displacement was achieved by 1985. Progress in reducing energy intensity has continued since then, but at a lessened pace.

This more-modest rate of decline in energy intensity should not be surprising, given the generally lower level of real oil prices that prevailed between 1985 and 2000. With real energy prices again on the rise, more-rapid decreases in the intensity of use in the years ahead seem virtually inevitable. As would be expected, long-term demand elasticities have proved noticeably higher than those evident in the short term.

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Altering the magnitude and manner of U.S. energy consumption will significantly affect the path of the U.S. economy over the long term. For years, long-term prospects for oil and gas prices appeared benign. When choosing capital projects, businesses in the past could mostly look through short-run fluctuations in oil and natural gas prices, with an anticipation that moderate prices would prevail over the longer haul. The recent shift in expectations, however, has been substantial enough and persistent enough to direct business-investment decisions in favor of energy-cost reduction.

Of critical importance will be the extent to which the more than 200 million light vehicles on U.S. highways, which consume 11 percent of total world oil production, become more fuel efficient as vehicle buyers choose the lower fuel costs of lighter or hybrid vehicles.

We can expect similar increases in oil and energy efficiency in the rapidly growing economies of East Asia as they respond to the same set of market incentives. But at present, China consumes roughly twice as much oil per dollar of GDP as the United States, and if, as projected, its share of world oil consumption continues to increase, the average improvements in world oil-intensity will be less pronounced than the improvements in individual countries viewed separately would suggest.

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Aside from uncertain demand, the resolution of current major geopolitical uncertainties will materially affect oil prices in the years ahead. The effect on oil prices, in turn, will significantly influence the levels of investment over the next decade in crude oil productive capacity and, only slightly less importantly, investment in refining facilities.

Because of the geographic concentration of proved reserves, much of the investment in crude oil productive capacity will need to be made in countries where foreign investment is prohibited or restricted or faces considerable political risk. Unless those policies and political institutions and attitudes change, a greater proportion of the cash flow of producing countries will be needed for oil re-investment to ensure that capacity keeps up with projected world demand. Concerns about potential shortfalls in investment certainly have contributed to recent record-high long-term futures prices.

To be sure, world oil supplies and productive capacity continue to expand. Major advances in recovery rates from existing reservoirs have enhanced proved reserves despite ever-fewer discoveries of major oil fields. But investment to convert reserves to productive capacity has fallen short of the levels required to match unexpected recent gains in demand, especially gains in China.

Besides feared shortfalls in crude oil capacity, the status of world refining capacity has become worrisome as well. Of special concern is the need to add adequate coking and desulphurization capacity to convert the average gravity and sulphur content of much of the world's crude oil to the lighter and sweeter needs of product markets, which are increasingly dominated by transportation fuels that must meet ever-more stringent environmental requirements.

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The extraordinary uncertainties about oil prices of late are reminiscent of the early years of oil development. Over the past few decades, crude oil prices have been determined largely by international market participants, especially OPEC. But such was not always the case.

In the early twentieth century, pricing power was firmly in the hands of Americans, predominately John D. Rockefeller and Standard Oil. Reportedly appalled by the volatility of crude oil prices in the early years of the petroleum industry, Rockefeller endeavored with some success to control those prices. After the breakup of Standard Oil in 1911, pricing power remained with the United States - first with the U.S. oil companies and later with the Texas Railroad Commission, which raised allowable output to suppress price spikes and cut output to prevent sharp price declines. Indeed, as late as 1952, U.S. crude oil production (44 percent of which was in Texas) still accounted for more than half of the world total. However, that historical role came to an end in 1971, when excess crude oil capacity in the United States was finally absorbed by rising demand.

At that point, the marginal pricing of oil, which for so long had been resident on the Gulf Coast of Texas, moved to the Persian Gulf. To capitalize on their newly acquired pricing power, many producing nations in the Middle East nationalized their oil companies. But the full magnitude of their pricing power became evident only in the aftermath of the oil embargo of 1973. During that period, posted crude oil prices at Ras Tanura, Saudi Arabia, rose to more than \$11 per barrel, significantly above the \$1.80 per barrel that had been unchanged from 1961 to 1970. A further surge in oil prices accompanied the Iranian Revolution in 1979.

The higher prices of the 1970s brought to an abrupt end the extraordinary period of growth in U.S. consumption of oil and the increased intensity of its use that was so evident in the decades immediately following World War II. Between 1945 and 1973, consumption of petroleum products rose at a startling average annual rate of 4-1/2 percent, well in excess of growth of real GDP. However, between 1973 and 2004, oil consumption grew, on average, only 1/2 percent per year, far short of the rise in real GDP.

Although OPEC production quotas have been a significant factor in price determination for a third of a century, the story since 1973 has been as much about the power of markets as it has been about power over markets. The signals provided by market prices have eventually resolved even the most seemingly insurmountable difficulties of inadequate domestic supply in the United States. The gap projected between supply and demand in the immediate post-1973 period was feared by many to be so large that rationing would be the only practical solution.

But the resolution did not occur quite that way. To be sure, mandated fuel-efficiency standards for cars and light trucks induced slower growth of gasoline demand. Some observers argue, however, that, even without government-enforced standards, market forces would have produced increased fuel efficiency. Indeed, the number of small, fuel-efficient Japanese cars that were imported into the United States markets rose throughout the 1970s as the price of oil moved higher.

Moreover, at that time, prices were expected to go still higher. Our Department of Energy, for example, had baseline projections showing prices reaching \$60 per barrel - the equivalent of about twice that amount in today's prices.

The failure of oil prices to rise as projected in the late 1970s is a testament to the power of markets and the technologies they foster. Today, despite its recent surge, the average price of crude oil in real terms is still only three-quarters of the price peak of February 1981. Moreover, the effect of the current surge in oil prices, though noticeable, is likely to prove less consequential to economic growth and inflation than in the 1970s. Since the end of 2003, the rise in the value of imported oil - essentially a tax on U.S. residents - has amounted to about 3/4 percent of GDP. The effects were far larger in the crises of the 1970s. But, obviously, the risk of more-serious negative consequences would intensify if oil prices were to move materially higher.

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U.S. natural gas prices have historically displayed greater volatility than prices of crude oil, doubtless reflecting, in part, the less-advanced development of price-dampening global trade in natural gas.

Over the past few years, notwithstanding markedly higher drilling activity, the U.S. natural gas industry has been unable to noticeably expand production or to increase imports from Canada. Significant upward pressure on prices has ensued. North America's limited capacity to import liquefied natural gas (LNG) has effectively restricted our access to the world's abundant supplies of gas.

Because international trade in natural gas has been insufficient to equalize prices across markets, U.S. natural gas prices since late 2002 have been notably higher, on average, than prices abroad. As a result, significant segments of the North American gas-using industry are in a weakened competitive position. Indeed, ammonia and fertilizer plants in the United States have been particularly hard hit as the costs of domestic feedstocks have risen relative to those abroad.

The difficulties associated with inadequate domestic supplies will eventually be resolved as consumers and producers react to the signals provided by market prices. Indeed, the process is already under way. As a result of substantial cost reductions for liquefaction and transportation of LNG, significant global trade in natural gas is developing. This activity has accelerated sharply over the past few years as profitable arbitrage has emerged in natural gas prices across international markets.

At the liquefaction end of the process, new investments are in the works across the globe. Enormous tankers to transport LNG are being constructed, even though they are not dedicated to specific long-term delivery contracts. The increasing availability of LNG around the world should lead to much greater flexibility and efficiency in the allocation of energy resources. According to tabulations of BP, worldwide imports of natural gas in 2003 were only 24 percent of world consumption, compared with 59 percent for oil. Clearly, the gas trade has significant margin to exercise its price-dampening opportunities.

In the United States, import terminals in Georgia and in Maryland have reopened after having been mothballed for more than two decades. The added capacity led to a noticeable increase in imports of LNG last year, but LNG imports still accounted for less than 3 percent of U.S. consumption. Additional

import facilities, both onshore and offshore, are being developed. A new offshore facility in the Gulf of Mexico received its first delivery of liquefied natural gas a little more than a month ago.

According to the Federal Energy Regulatory Commission, the number of approved and proposed new or expanded LNG import terminals in the United States stood at thirty-three earlier this month. Together they have capacity for 15 trillion cubic feet of imports annually, far in excess of any pending consumption needs, which in 2004 amounted to 22 trillion cubic feet. Clearly, not all of these projects will come to fruition. Some will be abandoned for economic and business considerations, and others will fail because of local opposition, motivated by environmental, safety, and other concerns.

The larger question, of course, is what will increased world trade in LNG and expanded U.S. import capacity do to natural gas prices in the United States? During the past couple of years, when U.S. prices of natural gas hovered around \$6 per million Btu, import prices of LNG in Europe have ranged between \$2 and \$4, and those in Japan and Korea have generally been between \$3 and \$5. Estimates of production and delivery costs of LNG to North America appear to hover around \$3. In the short run, exporters to the United States are likely to receive our domestic price, currently above \$6 per million Btu. But unless world gas markets tighten aggressively, competitive pressures will arbitrage the U.S. natural gas price down, possibly significantly, through increased imports.

In addition to expanded supplies from abroad, North America still has numerous unexploited sources of gas production. Significant quantities of recoverable gas reserves are located in Alaska and the northern territories of Canada. Negotiations over the construction of pipelines connecting these northern supplies to existing delivery infrastructure are currently under way.

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The dramatic changes in technology in recent years have made existing oil and natural gas reserves stretch further while keeping energy costs lower than they otherwise would have been. Seismic imaging and advanced drilling techniques are facilitating the discovery of promising new reservoirs and are enabling the continued development of mature fields. But because of inexorably rising demand, these improved technologies have been unable to prevent the underlying long-term prices of oil and natural gas in the United States from rising.

Conversion of the vast Athabasca oil sands reserves in Alberta to productive capacity has been slow. But at current market prices they have become competitive. Moreover, new technologies are facilitating U.S. production of so-called unconventional gas reserves, such as tight sands gas, shale gas, and coalbed methane. Production from unconventional sources has more than doubled since 1990 and currently accounts for roughly one-third of U.S. dry gas production. According to projections from the Energy Information Administration, most of the growth in the domestic supply of natural gas over the next twenty years will come from unconventional sources. In many respects, the unconventional is increasingly becoming the conventional.

In the more distant future, perhaps a generation or more, lies the potential to develop productive capacity from natural gas hydrates. Located in marine sediments and the Arctic, these ice-like structures store immense quantities of methane. Although the size of these potential resources is not well measured, mean estimates from the U.S. Geological Survey indicate that the United States alone may possess 200 quadrillion cubic feet of natural gas in the form of hydrates. To put this figure in perspective, the world's proved reserves of natural gas are on the order of 6 quadrillion cubic feet.

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In the decades ahead, natural gas and oil will compete in the United States with coal, nuclear power, and renewable sources of energy. As the manner in which energy is produced and consumed evolves, it is not unreasonable to expect that, in the long run, the prices per unit of energy from various sources would tend to converge. At present, long-term futures prices for natural gas are, on a Btu-equivalent basis, notably less expensive than those for crude oil.

Clearly, limited substitution possibilities across fuels have resulted in persistent cost differentials, but those very differentials inspire the technologies that, over time, reduce such limitations. A clear example is gas-to-liquids (GTL) technology, which converts natural gas to high-quality naphtha and diesel fuel. Given the large-scale production facilities that are currently being contemplated, GTL is poised to become an increasingly important component of the world's energy supply. Current projections of production however remain modest. GTL promises to add a good measure of flexibility in the way that natural gas resources are utilized. In addition, given the concerns over the long-term adequacy of liquid production capacity from conventional oil reserves, gas to liquids may provide an

attractive, competitively priced, option for making use of stranded gas, which, for lack of access to transportation infrastructure, cannot be brought to market.

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In summary, improving technology and ongoing shifts in the structure of economic activity are reducing the energy intensity of industrial countries, and presumably recent oil price increases will accelerate the pace of displacement of energy-intensive production facilities. If history is any guide, oil will eventually be overtaken by less-costly alternatives well before conventional oil reserves run out. Indeed, oil displaced coal despite still vast untapped reserves of coal, and coal displaced wood without denuding our forest lands.

Innovation is already altering the power source of motor vehicles, and much research is directed at reducing gasoline requirements. Moreover, new technologies to preserve existing conventional oil reserves will emerge in the years ahead. We will begin the transition to the next major sources of energy perhaps before midcentury as production from conventional oil reservoirs, according to central tendency scenarios of the Energy Information Administration, is projected to peak. In fact, the development and application of new sources of energy, especially nonconventional oil, is already in train. Nonetheless, the transition will take time. We, and the rest of the world, doubtless will have to live with the geopolitical and other uncertainties of the oil markets for some time to come.

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We are unable to judge with certainty how technological possibilities will play out in the future, but we can say with some assurance that developments in energy markets will remain central in determining the longer-run health of our nation's economy. The experience of the past fifty years - and indeed much longer than that - affirms that market forces play the key role in conserving scarce energy resources, directing those resources to their most highly valued uses. The availability of adequate productive capacity, of course, will also be driven by nonmarket influences and by other policy considerations.

To be sure, energy issues present policymakers and citizens with difficult tradeoffs to consider and decisions to make outside the market process. The concentration of oil reserves in politically volatile areas of the world is an ongoing concern. But that concern and others, one hopes, will be addressed in a manner that, to the greatest extent possible, does not distort or stifle the meaningful functioning of our markets. We must remember that the same price signals that are so critical for balancing energy supply and demand in the short run also signal profit opportunities for long-term supply expansion. Moreover, they stimulate the research and development that will unlock new approaches to energy production and use that we can now only barely envision.