The *Amazing* Tale of U.S.

BY PHILIP K. VERLEGER, JR.

A leading expert claims the United States within a decade will be an energy exporter. And it's all happening by accident.

In little more than a decade, the United States will find itself as an energy exporter and this amazing outcome will have happened by accident.

The United States will then have low-cost energy supplies for decades. If oil prices remain high, America will benefit from the difference. Today, South Korea pays around $14 per million Btus for natural gas; the United States will pay less than $4. The situation is, and will be, the same in China and Europe. They will pay more, and the comparative advantage will make it possible for the United States to remain the global economic leader. I have been studying energy issues for forty years and the data are difficult to believe. But facts are facts. U.S. energy independence, as controversial as it sounds, will lay the groundwork for the New American Century.

Specifically, the United States will be energy-independent by 2023, the fiftieth anniversary of President Richard M. Nixon announcing his "Project Independence." By energy independence, I mean the United States will export more energy than it imports. In 2023, America will be exporting natural gas, petroleum products, coal, and possibly crude oil if the federal government lifts prohibitions on the latter. The United States will also be importing some oil. On balance, though, America will be a net exporter.

The United States will reap enormous economic benefits in achieving energy independence by not following the approach proposed by President Nixon and his advisers. That plan can be described as the *high-cost dirty path to energy independence.* Nixon advocated an aggressive boost in offshore resource development, pursuit of the extraordinarily expensive fast-breeder reactor, increased coal use, and expanded shale oil development in

Philip K. Verleger, Jr., is president of PKVerleger LLC and a visiting fellow at the Peter G. Peterson Institute for International Economics. This article is an excerpt from Dr. Verleger's forthcoming book on the economic benefits of low-cost energy.

THE INTERNATIONAL ECONOMY
THE MAGAZINE OF INTERNATIONAL ECONOMIC POLICY
220 I Street, N.E., Suite 200
Washington, D.C. 20002
Phone: 202-861-0791 • Fax: 202-861-0790
www.international-economy.com
editor@international-economy.com

Energy Independence

Colorado using the very expensive techniques now at work on Canada's tar sands. Implementing Nixon's strategy would have saddled the United States with high-cost energy supplies and very high emissions of harmful global warming gases.

The path actually taken is very different. It might be called the *low-cost clean path to energy independence.* The United States came upon this course by accident. By luck, in other words, the United States is beginning to reap the benefits of large, low-cost supplies of clean natural gas. By luck, the firms developing these resources were able to take advantage of new financial instruments created by Wall Street, instruments that let them continue expanding even when prices collapsed. By luck, the United States is profiting from dramatic increases in auto fuel economy, a change that came after the 2008 gasoline price surge and GM and Chrysler's subsequent bankruptcies. By luck, the United States is also benefiting from technological advances that make lower-cost shale oil production possible.

No one can claim that our energy independence—achieved thanks to horizontal drilling, fracking, futures markets, and the auto industry's deathbed conversion to fuel economy—was planned. In 2023, the United States will just have to explain, happily, that it blundered into energy independence.

Energy independence could make this the New American Century by creating an economic environment where the United States enjoys access to energy supplies at much lower cost than other parts of the world. Such an advantage, combined with construction of new advanced manufacturing facilities and competitive domestic labor costs, could give the U.S. economy an unprecedented edge over other nations, particularly China and northern Europe. The energy cost advantage was highly visible in January 2012, when U.S. firms paid less than $3 per million Btu for natural gas while South Korean buyers paid $13.50.

Ironically, America's edge will be strengthened by energy exporters such as Russia and OPEC members. Their success in holding up crude oil and, especially, natural gas prices will strengthen the United States' twenty-first century economy. These exporters demand that buyers in Europe and China pay natural gas prices linked to crude

No one can claim that our energy independence was planned.

as they work to keep crude prices high. The greater their success in this, the greater the U.S. competitive advantage will be.

The contrast between the path Nixon proposed forty years ago and the path taken is stark. If Nixon had realized his plan, the United States would now be vulnerable to competition from countries with low-cost supplies. Fortunately, just the opposite occurred. The approach America took has left it with low-cost clean energy. This could substantially decrease U.S. vulnerability to global economic cycles, particularly those tied to energy price fluctuations.

Efforts to limit greenhouse gas emissions could further strengthen the U.S. economic hegemony. Those countries now relying on coal, such as China, will be forced to make significant reductions and will seek, among other solutions, to replace coal with natural gas.

The U.S. advantage will be strong, although not permanent or impregnable. Other countries will follow our example and pursue shale oil and gas. Eventually they will succeed in developing these resources. Until then, however, they will be saddled with long-term contracts for high-cost natural gas supplies delivered as liquefied natural gas. Many countries, particularly those in Europe, will also be stuck with long-term pipeline agreements for natural gas with prices tied to crude.

It is wrong, however, to believe the U.S. experience can be replicated just by importing U.S. technologies. The United States' breakthrough came through new technologies, entrepreneurs freed from the multinational oil industry's high-cost yoke, and the development of financial markets. It is not clear that large bureaucratic organizations, such as the multinationals or state-run oil and gas companies, can replicate the success achieved by the smaller, far more agile firms that brought about the U.S. energy revolution. Experience suggests that countries such as China and the major oil companies will not be able to duplicate the success of American entrepreneurs. Yes, shale oil and gas reserves will be developed elsewhere, but the costs involved could be much higher.

Ironically, America's edge will be strengthened by energy exporters such as Russia and OPEC members.

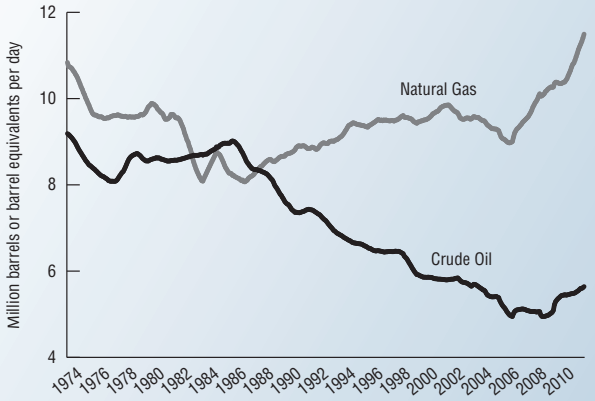
The United States may experience a New American Century because entrepreneurs flourished here first and because no other country has the economic flexibility needed for such a development.

My basic conclusion is that achieving energy independence will revolutionize the U.S. and global economies over the next decade. As a consequence, many firms that have played an important role in the energy sector for the last forty years will diminish in importance or vanish.

Last June, when celebrating its first century of existence, IBM published an advertisement that read, "Nearly all the companies our grandparents admired have disappeared." Twenty years from now, I expect most large energy firms, which seem so important today, will have disappeared as well. It is even possible that a person born in the United States or Europe in 2020 will never know about Exxon.

Figure 1 U.S. crude oil and natural gas production, 1974–2011

Twelve-month moving average



Source: PKVerleger LLC.

THE COMEBACK OF NATURAL GAS

The rebound in natural gas output was the greatest surprise in terms of policy assumptions being wrong. President Carter's energy advisers, led by James R. Schlesinger, were convinced U.S. natural gas output would decline. The National Energy Plan, a study published by the Carter White House just as he announced his "moral equivalent of war" program, explained that natural gas accounted for only 4 percent of U.S. energy reserves but represented 30 percent of U.S. energy consumption in 1973, equivalent to more than eleven million barrels of oil per day. The White House analysts were certain output would decline. Between 1976 and 1985, they predicted, U.S. gas production would decrease from the equivalent of 9.5 million barrels of oil per day to 8.2 million barrels. They noted, though, that they expected consumption to increase, especially if supply was available.

The Carter administration did not expect supply to increase: "By 1985, gas from existing reservoirs will be able

to satisfy only 55 percent of natural gas demand. *It is doubtful that even substantial price increases could do more than arrest the decline in gas production* [emphasis added]."

Carter's advisers noted that additional supplies would have to come from sources such as Alaska, offshore drilling, tight gas formations, synthetic gas from coal, or liquefied natural gas. These sources would not be available.

Carter's counselors were not alone. Harvard Professor Robert Stobaugh and Harvard research associate Daniel Yergin, in the forward to their 1979 book *Energy Future: Report of the Energy Project at the Harvard Business School,* were sure the United States lacked the resources to satisfy its needs:

> In fact, the United States will be fortunate if it finds enough new oil to keep production at its current levels. Entrepreneurs have searched the continental United States for so long (120 years), so thoroughly (over two million wells) that it would be foolish to base a policy on the supposition that the absolute quantity of U.S. production could increase beyond what it is today—ten million barrels daily of oil and gas liquids, and the equivalent of nine million barrels per day of natural gas.

Other authorities were equally certain. A group of experts assembled by the nonprofit organization Resources for the Future concluded "conventional oil and gas resources would not last much beyond the year 2000" if consumption grew at 2 percent per year from 1980 to 2000 and imports remained at 40 percent of consumption. The authors, though, had the common sense, unlike the Harvard group, to add the following caveat:

> We do not really know the true ultimate dimensions of our resources. Future discoveries, and the economic restraints on resources we now recognize, will be influenced by new geological knowledge, as well as by price and *technological developments* [emphasis added]. (*Energy in America's Future,* RFF, 1979)

Experience suggests that countries such as China and the major oil companies will not be able to duplicate the success of American entrepreneurs.

Another group of experts assembled by the Ford Foundation was even more prescient. Writing in 1979, they made this observation:

> Barring misguided public policies, nations will presumably proceed from conventional to unconventional resources along a path that minimizes the rate of increase of costs. This means, for example, that nearly conventional oil and gas resources are likely to be exploited before there is large-scale production of synthetic fuels from coal, while timing of the entry of shale remains as uncertain as it has been for a long time. (Lansberg et al, *Energy: The Next Twenty Years.*)

The Ford Foundation authors also included a comment regarding oil and gas development that can be found in many news dispatches today:

> The picture is complicated not only because we need the wisdom to recognize the optimal path and the time to proceed on it, but also because so much is yet to be learned about the production costs of unconventional supplies and *even more about the social, environmental, and health costs associated with their exploitation* [emphasis added].

Thirty years later, the myopia of Carter's adviser Schlesinger, as well as the Harvard Business School researchers, is obvious. U.S. natural gas production, predicted to never exceed nine million barrels per day in oil equivalents, reached 11.9 million barrels per day in 2010 and will likely pass 15 million barrels per day by 2020 (see Figure 1). The consulting firm Wood Mackenzie projects that U.S. liquids production (crude oil plus natural gas liquids) will increase from 7.4 million barrels per day, reached in November 2011, to 9.4 million barrels per day in 2015.

The unanticipated increase in oil and natural gas production will make a major contribution toward reaching Nixon's goal of energy independence. The rise in supply can be attributed to three sources: the application of new technologies to exploration and production, the aggressive approach to exploration and production taken by small, independent firms, and the development of energy futures markets.

NEW TECHNOLOGIES LAY THE GROUNDWORK

New technologies noted by the authors of the 1979 Ford Foundation report laid the groundwork for expanded oil and natural gas output. As mentioned above, conventional thinkers such as Stobaugh and Yergin believed new technologies would not contribute to growth in U.S. oil and gas production. They were wrong. Advanced computer technologies have helped companies develop better techniques for visualizing subterranean oil and gas reserves. Evolving

Continued on page 54

Continued from page 11

computer techniques also gave exploration companies better control over drill bits, allowing them to drill vertically and horizontally. These improvements made it possible to explore for oil further offshore and to drill deeper.

New techniques for hydraulic fracturing of oil-bearing rocks ("fracking") also allowed explorers to expand production. While controversial, this method has led to a dramatic increase in U.S. natural gas production. (A recent paper from Charles G. Groat and Thomas W. Grimshaw of the University of Texas surveys the controversy.)

Independent producers, that is, producers unaffiliated with major oil companies, deserve all the credit for the increase in U.S. natural gas output and much of the credit for the increase in oil production. The majors had abandoned the United States and only began to expand efforts seriously here following the independents' success.

Four firms—Chesapeake Energy, Devon Energy, Mitchell Energy, and Newfield Exploration—are typical of the independent firms that remained in America to help reverse the domestic production decline and move the country toward energy independence. George Mitchell, founder of Mitchell Energy (a company later sold to Devon) is famous for his pioneering development of horizontal drilling techniques.

Independent producers deserve all the credit for the increase in U.S. natural gas output and much of the credit for the increase in oil production.

Newfield Exploration, founded by Joe B. Foster in 1989, became a significant oil and gas supplier in the United States by applying horizontal drilling techniques to explore for oil and gas reserves in the shallow Gulf of Mexico areas abandoned by the integrated oil companies. Previously, Foster had headed Tenneco's oil and gas company. When Tenneco abandoned exploration and production, Foster created Newfield with financing provided by the endowment funds of Yale, Harvard, and CalPERS (California Public Employees' Retirement System).

Aubrey McClendon created Chesapeake Energy the same year. McClendon's focus was developing gas from shale reserves through fracking. Devon, founded eighteen years earlier, has had a similar focus.

It is the success of these independent firms, rather than the large integrated majors, that has contributed to the surge in U.S. natural gas production as well as the stabilization in oil production. Going forward, the investments made by these firms in shale oil production will add to the rise in U.S. oil production.

In contrast, the major oil companies stopped searching for oil and gas in the United States. A 1993 *Wall Street Journal* article described the shift:

> The entire petroleum industry is elephant hunting in varying degrees. Between 1988 and 1992, the world's 234 largest publicly traded oil companies spent $157 billion on exploration and development outside the U.S., 49 percent more than in the U.S., an Arthur Anderson & Co. study shows.
>
> "What's happening now is the efforts by these companies to secure their future in the 21st century," says Daniel Yergin, author of "The Prize," an oil-industry history.

The *Wall Street Journal* writer, Caleb Solomon, noted that companies were looking for large fields abroad. Repeating comments made by Stobaugh and Yergin, Solomon observed that the United States had been worked over. His article focused in particular on Amoco's effort to find new oil supplies in countries such as the Congo, Romania, Qatar, and the UAE. Other firms made similar decisions.

To be fair, the majors did continue to invest heavily in large projects, most involving deep-water oil and gas exploration in the Gulf of Mexico or Canada's tar sands. As Exxon executives would say time and again, their firm focused on large, capital-intensive projects with very low labor-to-capital ratios. Other major firms such as Shell followed the same model.

Recently, though, the majors realized that their capital-intensive approach to exploration and production was not yielding the results achieved by the independents. Consequently, ExxonMobil purchased XTO Energy, a Fort Worth firm that had concentrated on developing unconventional onshore reserves in Texas. Other large companies such as Shell are again following suit. Twenty years after leaving the United States to look for large fields abroad, these firms have discovered, to their sorrow, that they had missed many opportunities at home.

FUTURES MARKETS AS CATALYST

Financial engineering underpinned the renewal of U.S. oil and gas production. While most writers and analysts credit

The NYMEX was seen as a failing exchange in those days. Its primary contract was a potato future once used by Maine farmers to hedge production.

petroleum, chemical, and computer engineers for developing technologies that led to the rebirth of American oil and gas output, the initial catalyst was the developers of futures markets. The financial engineers who brought the risk management techniques devised originally for agriculture to energy provided a system that allowed smaller firms to operate successfully despite very large swings in oil and gas prices. Using classic hedging practices—selling output forward at a fixed price—these companies could weather price volatility and continue to grow. The expansion rate in natural gas and oil production would have been much lower had these financial instruments not been present.

Risk management techniques first came to the energy sector in the late 1970s in New England. At that time, the New York Mercantile Exchange offered futures contracts for distillate fuel oil (heating oil). The NYMEX was seen as a failing exchange in those days. Its primary contract was a potato future once used by Maine farmers to hedge production. The trade in potato futures was in decline, though, in part because of more than one proven case of manipulation.

By luck, the NYMEX members benefited from major oil companies exiting the heating oil supply and distribution business. Previously, allocation regulations introduced by President Nixon in 1973 had locked companies such as Shell, Texaco, Chevron, and Gulf into contracts with local distributors. From 1973 to 1980, these firms had to supply heating oil. In 1979, they were also ordered by the U.S. Secretary of Energy to accumulate excessive distillate inventories in the fall. It was a purely political ploy to prevent high prices or shortages in the winter of 1980 just as President Carter campaigned for the Democratic nomination for president in New Hampshire against Senator Edward Kennedy.

In addition, under their pre-1973 contracts, the large companies were required to finance the inventories accumulated by distributors during the summer. These agreements were based on the historical practice of "summer fill." With summer fill, a major company such as Exxon would deliver large heating oil volumes to the distributor terminals. Exxon would then be paid when the distributors brought the oil to consumers six, seven, eight, or even nine months later.

The summer-fill system had worked when integrated companies owned much of the crude they produced. Exxon, for example, might extract crude oil in Saudi Arabia in May, move the crude to its refineries by June, process it into heating oil in late June, and deliver the oil to a dealer in Boston in August. Exxon would receive payment for the oil in February of the next year. As noted, this process worked satisfactorily if the crude oil produced in Saudi Arabia belonged to Exxon, in which case the payment of $6 per barrel for heating oil that cost $0.25 to produce, transport, and refine offered a very large reward.

The situation became unsatisfactory when Exxon had to pay $20 per barrel for the crude produced in May 1979, absorb transportation and processing costs of $1 to $2 per barrel, and then wait until February 1980 to be paid perhaps $23 per barrel for the product. The interest rate increase to more than 15 percent tied to Federal Reserve Chairman Paul Volcker's efforts to curb inflation made the transaction's economics even less favorable.

For this reason, the larger oil companies pulled out of the heating oil business as soon as permitted. Heating oil markets were partially deregulated in 1979 and fully deregulated in 1980.

The exit of the large oil companies created a very significant problem for distillate fuel oil suppliers. These firms needed to build inventories in the summer to assure adequate stocks during peak winter weather. The companies lacked the capital to acquire needed inventories with oil prices above $40 per barrel. They also could not obtain financing from banks because the institutions feared, correctly, that heating oil dealers would not perform on loans if oil prices dropped substantially, as they might during a warm winter.

The futures market provided the solution. Major New York and French banks such as BNP Paribas stepped in to offer financing to heating oil distributors. These loans were conditioned on the distributors selling heating oil futures to hedge inventories. This practice, while new to oil, was conventional. Distributors would borrow from a bank, say Chase, buy the oil from a supplier such as Exxon, put the delivered oil in storage, and sell futures on the NYMEX for delivery in January or February. Such transactions provided the financial insurance required for these businesses to function.

The heating oil contract was an immediate success. Regulations made trading superfluous initially. In 1979, only 33,000 contracts changed hands. (Each contract covers 1,000 barrels of heating oil.) By 1986, however, trade had increased one-hundredfold as 3.2 million contracts changed hands. Open interest (the number of barrels covered by trading) rose from two million contracts at the end of 1979 to

eighty million contracts by the end of 1986 (see Figure 2). In effect, then, New England heating oil users, who once relied on the majors to assure them that oil inventories would be accumulated in summer to protect them in winter, had a new protector: Wall Street.

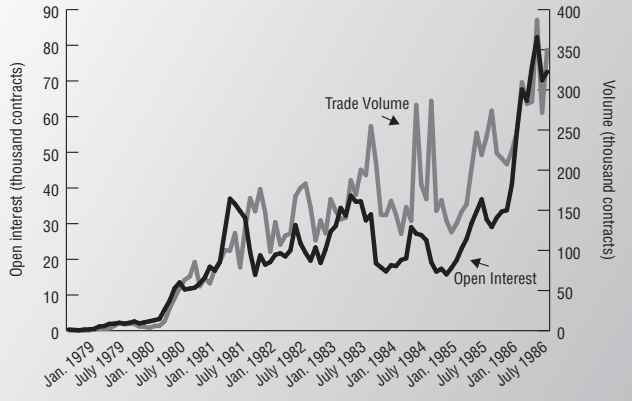
The integrated oil companies' decision to exit the summer-fill program and stop supplying heating oil to New England was correct given the economic circumstances that existed in 1980. However, the choice turned out to be one of the most costly blunders made in the oil industry's history. By leaving, the oil companies effectively transferred control of the market from a few large integrated firms to traders in financial markets. Once this happened, there was no going back. After heating oil, futures contracts were also created for West Texas Intermediate crude and natural gas.

The WTI contract further broke the market control held by integrated oil. Historically, crude oil produced from land wells in the United States had been owned by thousands of smaller firms and individuals. Larger oil companies bought the oil, often at the wellhead, at prices they published or posted. Chesapeake Energy founder Aubrey McClendon had been a "landman," someone who would visit owners in Oklahoma, Kansas, Texas, and New Mexico and convince them to deal with his company rather than another.

The posted price system worked to the larger companies' advantage. In litigation during the early 1990s, economists demonstrated that these firms often were able to pay individuals significantly less for oil than they might have received from shipping their production to a gathering center such as Cushing, Oklahoma.

NYMEX representatives saw an opportunity to create a futures contract denominated in relatively small amounts of crude (1,000 barrels). As trade in futures developed, the individual owners could see a clear indication of their crude price. In addition, they could sell forward if they chose, thereby assuring or "locking in" revenues that could be used to invest in additional exploration and development. Through hedging, they could also convince banks to lend more money for their projects. The WTI contract grew quickly and the posted price system that once generated extra profits for the large companies ended.

Figure 2 Open interest and trade volume in heating oil futures contracts, 1979–86



Source: NYMEX.

The natural gas futures contract became the most successful of all energy futures contracts.

FUTURES FOR NATURAL GAS

Trading in natural gas futures took off when natural gas was deregulated in 1990. In fact, the natural gas futures contract became the most successful of all energy futures contracts. This happened because the market is composed of large producers who want to sell production forward and large consumers, such as DuPont and Dow, seeking to fix their raw material costs.

The demand for natural gas futures was boosted further by the deregulation of electricity generation. Independent firms that generated and sold electricity to traditional electric utilities needed a mechanism to establish the cost of their output when bidding to sell electricity at a fixed price. The natural gas futures market provided the necessary tool. The firms could contract with a natural gas supplier to pay a price tied to the market level (spot price), buy futures to convert the uncertain market price in the future to a specific level, and bid.

Independent exploration companies such as Newfield, Devon, and Chesapeake all became significant users of futures contracts. By selling gas forward, they could increase funding of exploration programs, which boosted supply and moved the nation ever closer to energy independence.

The substitution of natural gas for gasoline is one of the key ways independence will be achieved. The potential for using natural gas in internal combustion engines has been known for years. From time to time, manufacturers such as General Motors and Honda have even offered vehicles with the capacity to switch from natural gas to gasoline or from natural gas to diesel. In recent years, several rapid transit systems have converted buses to operate on natural gas.

Table 1 Comparison of natural gas and regular gasoline prices by state, end-February 2012

	Regular ($ per gallon)	Natural Gas ($ per gallon equivalent)
Alabama	3.51	1.37
Alaska	4.00	n/a
Arizona	3.58	2.50
Arkansas	3.46	1.44
California	4.14	2.30
Colorado	3.10	3.89
Connecticut	3.89	2.60
Delaware	3.60	2.19
District of Columbia	3.78	n/a
Florida	3.69	2.19
Georgia	3.59	2.49
Hawaii	4.25	n/a
Idaho	3.20	n/a
Illinois	3.59	2.00
Indiana	3.54	0.79
Iowa	3.52	1.87
Kansas	3.45	1.69
Kentucky	3.56	1.30
Louisiana	3.51	1.79
Maine	3.71	n/a
Maryland	3.64	2.14
Massachusetts	3.65	2.38
Michigan	3.58	2.64
Minnesota	3.48	2.97
Mississippi	3.49	1.44
Missouri	3.38	1.89
Montana	3.17	1.90
Nebraska	3.57	1.93
Nevada	3.63	2.55
New Hampshire	3.60	1.60
New Jersey	3.54	2.00
New Mexico	3.36	2.60
New York	3.90	2.59
North Carolina	3.67	2.03
North Dakota	3.48	1.95
Ohio	3.55	n/a
Oklahoma	3.41	1.29
Oregon	3.77	n/a
Pennsylvania	3.69	2.00
Rhode Island	3.71	n/a
South Carolina	3.47	1.65
South Dakota	3.48	n/a
Tennessee	3.51	2.03
Texas	3.51	2.00
Utah	3.13	1.50
Vermont	3.70	n/a
Virginia	3.56	1.40
Washington	3.72	2.20
West Virginia	3.71	n/a
Wisconsin	3.43	2.08
Wyoming	3.06	1.48

Source: AAA and CNGPrices.com.

The key problem with natural gas is storage. Compared to gasoline or diesel, it takes a much larger tank to contain the volume needed to move a vehicle an equivalent distance. Transit districts resolved this problem by placing natural gas tanks on bus roofs. Delivery services and others using large vans can switch because they use vehicles that have room for natural gas tanks. Using natural gas in smaller vehicles has been more problematic because buyers are often unwilling to sacrifice trunk space.

Still, natural gas has been very popular where it is available. In 2008, the *New York Times* reported that consumers in Utah were rushing to acquire natural-gas-powered vehicles. The article explained the surge by noting that natural gas sold for the equivalent of $0.87 per gallon while gasoline sold for more than $3. The piece by Clifford Krauss described the frenzy in Utah:

> Residents of the state are hunting the Internet and traveling the country to pick up used natural gas cars at auctions. They are spending thousands of dollars to transform their trucks and sport utility vehicles to run on compressed gas. Some fueling stations that sell it to the public are so busy they frequently run low on pressure, forcing drivers to return before dawn when demand is down.

As noted, the large price difference between natural gas and gasoline spurred the switch to natural gas. Now, compressed natural gas is available at fueling facilities in most states. However, the cost savings are rarely as great as in Utah. Table 1 compares gasoline and natural gas prices by state.

The penetration of natural gas vehicles has also been slowed by their scarcity. Of the major automakers, only Honda offers a CNG vehicle. Recently General Motors began manufacturing vans that run on natural gas, but only Honda has produced a natural-gas-powered passenger car. Quite simply, the auto industry has not jumped at the market opportunity.

AUTO INDUSTRY RESISTS CHANGE

Our slow slog toward energy independence has been impeded by the auto industry's resistance to improving vehicle fuel economy. The industry's opposition was also supported for more than thirty years by economists—first in the Reagan administration and then in those of George H.W. Bush and Bill Clinton.

Mileage standards were first imposed by the Energy Policy and Conservation Act of 1975. This legislation was passed by a Democratic Congress and signed by President Gerald Ford in December 1976 over the objections of his economic advisers. The CAFE (Corporate Average Fuel Economy) standards set requirements for automakers for model years from 1978 to 1985. Congress instructed future administrations to adjust the standards upward in a way that

UTAH CLEAN CITIES

Left, a CNG station in Scipio, Utah. Natural gas has been very popular where it is available. In 2008, the New York Times *reported that consumers in Utah were rushing to acquire natural-gas-powered vehicles. The article explained the surge by noting that natural gas sold for the equivalent of $0.87 per gallon while gasoline sold for more than $3.*

would not unduly harm the auto industry. As noted below, the Reagan, Clinton, and first Bush administrations chose not to act on this instruction despite significant deficiencies in the original law.

Over the next twenty-eight years, resistance to tightening fuel economy standards came first from the auto industry, second from the auto industry's strongest defender in Congress (Democrat John Dingell, who chaired the House Energy and Commerce Committee), and third from the philosophical hostility toward regulation in the various administrations. The standards would likely have been tightened absent this last element.

The philosophical antagonism toward regulation was stated boldly by President Reagan's Council of Economic Advisers in its first annual report. Chapter 2 of that document puts forward a declaration of economic independence, arguing that cultivating the free market and removing regulation increases economic growth rates. The advisers also took a particularly strong anti-regulation approach toward energy.

The U.S. Department of Energy's approach to energy conservation echoed this view. In its 1985 report to Congress on the national energy policy, DOE stated that conservation was the nation's largest single "resource," noting that use had declined almost 30 percent from levels that would have obtained had the pre-1973 trend continued. However, in the view of Reagan's DOE, conservation would be encouraged as a voluntary rather than mandated activity.

In 1986, the Council of Economic Advisers argued further that the standards had not been effective. It noted that fuel economy improved 43 percent between 1973 and 1979 before the CAFE standards took effect. In another report, a Reagan economist added, "One recent study [not identified] suggests that given actual gasoline price increases, the automobile firms responded precisely as they would have without CAFE."

Four years later, George H.W. Bush's Council of Economic Advisers offered a stinging criticism of energy use standards such as CAFE reminiscent of the Reagan-era reports:

> *The costs of efficiency standards are often hidden.* For example, a higher average fuel economy standard might force consumers to buy only the more fuel-efficient and generally cheaper vehicles in the existing product line, thereby actually reducing their purchase and gasoline costs. However, out-of-pocket costs do not reflect costs imposed by denying consumers the option to purchase other valued attributes such as safety, performance, and comfort. Higher fuel efficiency without higher fuel prices also lowers the per-mile cost of driving, which encourages more trips, more fuel consumption, and emissions. *Because fuel economy labels already inform consumers about energy consumption, and few apparent institutional rigidities exist, the economic rationale for stringent auto efficiency standards is doubtful at best* [emphasis added].

Fifteen years later and twenty-two years after Ronald Reagan's Council of Economic Advisers issued its diatribe against regulations, George W. Bush's economic advisers suggested that maybe, just maybe, regulations could yield economic benefits:

> Regulations can improve the performance of energy markets by addressing market failures such as externalities and market power. However, it is essential to design regulations to address these potential market failures without reducing benefits from markets.

Later, President Bush's advisers offered a frank, detailed, and almost impartial examination of the defects of the CAFE standards:

> The fuel economy of new vehicles rapidly increased over the first eight years of CAFE. In part, this was a market response to the dramatic increase in gasoline

Policymakers in the administrations over the last twenty-eight years had no interest in tightening regulations. In fact, their goal was just the opposite.

prices between 1973 and 1981. By the late 1980s, however, overall fuel economy had stagnated. While the fuel economy of cars has continued to increase slowly over time and has been above the CAFE standard since 1986, consumers have bought an increasing number of SUVs and light trucks whose fuel economy has remained close to the mandated level of the light truck standard. Half of all vehicles sold in 2005 were light trucks, including SUVs, compared to 20 percent when CAFE was put in place. *This shift in consumer preferences is a rational response to more than a decade of low gasoline prices, rising household incomes, and incentives created by CAFE requirements.* Manufacturers also responded to changing consumer preferences and CAFE requirements. For instance, while station wagons and minivans have similar fuel economies, the former are counted as cars and the latter as light trucks. In the late 1980s, many manufacturers took advantage of the difference in CAFE standards across cars and light trucks to phase out station wagons—a relatively fuel-inefficient car—and replace it with the minivan—a relatively fuel-efficient light truck. *This shift improved the individual fuel economy of both the car and light truck fleets but did little to change overall fuel economy* [emphasis added].

Data published by DOE validate this point. Fuel economy of cars, vans, light trucks, and SUVs improved from 1975 to 1990 and then plateaued. The fleet's economy did not increase because buyers shifted from more efficient vehicles (cars) to SUVs.

The difference in efficiency improvement between passenger cars and the entire fleet can be explained by the increased SUV purchases, as noted by the 2007 Council of Economic Advisers report. In the Council's view, the CAFE regulations did not reduce gasoline consumption because consumers shifted to trucks. It was, in their view, "a matter of consumer choice."

THE FAILURE OF CAFE STANDARDS AND THE FAILURE TO REGULATE

The proponents of free markets who dominated economic policymaking for the last twenty-eight years assigned the lack of improvement in fuel economy to consumer choice. Others would explain this absence as a failure of governments to regulate. As the 2006 Council of Economic Advisers report noted,

> For three decades, Corporate Average Fuel Economy (CAFE) standards have mandated separate average fuel economy targets for passenger cars and light trucks sold in the United States, and each domestic and foreign manufacturer must meet these same targets in every model year. Congress has established a default level of 27.5 miles per gallon for passenger cars, and passenger car standards *have remained at this default level since 1990* [emphasis added].

The report did not explain that Congress also gave the president the right to raise the standards after 1985. The authors of the Energy Policy and Conservation Act anticipated that such adjustments would be made as technology improved when they wrote the law in 1975. However, as the text above makes clear, policymakers in the administrations over the last twenty-eight years had no interest in tightening regulations. In fact, their goal was just the opposite.

These "Chicago School" policymakers assumed consumers would make rational choices if offered the opportu-

George W. Bush

The mixing of only 500,000 barrels per day of ethanol would do little to reduce U.S. oil imports. In 2006, President George W. Bush noted this fact, asserting that the United States was "addicted to oil." Speaking to Congress in his State of the Union address, he announced the "Advanced Energy Initiative," a program intended to replace 75 percent of U.S. oil imports from the Middle East with ethanol and other fuels. "By applying the talent and technology of America," Bush asserted, "this country can dramatically improve our environment, move beyond a petroleum-based economy, and make our dependence on Middle Eastern oil a thing of the past."

—P. Verleger

nity. However, they neglected to consider that automakers, left to their own devices, would not provide a spectrum of vehicles that offered a real opportunity to achieve fuel savings. As noted by many authors, U.S. auto manufacturers focused entirely on minimizing first costs to hold down the vehicle purchase price. These same firms put forward an entirely different set of choices to buyers in Europe, where regulations and horsepower taxes encouraged production of efficient vehicles.

The Chicago School policymakers' desire to avoid regulation was reinforced for all of the last twenty-eight years by the House Energy and Commerce Committee. This committee had jurisdiction over fuel economy standards. For much of the time, it was chaired by Democrat John Dingell from Michigan. As noted, Dingell used his position to block legislative proposals that would cause economic harm to the auto industry. Changes to fuel economy standards fell into this category. His views were matched by Congressman Joe Barton (R-TX), who chaired the committee during much of the Republican majority period from 1996 to 2006.

The twenty-eight-year failure to regulate fuel economy allowed U.S. gasoline and diesel fuel use to spiral higher. By 2008, U.S. gasoline consumption reached almost ten million barrels per day. Use likely would have been less than seven million barrels per day had a consistent policy of tightening fuel economy standards been maintained through the period. Put another way, the date of the United States reaching true energy independence has probably been deferred five to ten years by the hands-off approach of Presidents Reagan, George H.W. Bush, and Clinton.

TIGHTER FUEL ECONOMY STANDARDS

The General Motors and Chrysler bankruptcies in 2009, as well as the extreme financial difficulties experienced by Ford, can be traced directly to the government's failure to tighten fuel economy standards and the auto industry's unwillingness to recognize the consequence of its laziness. U.S. auto firms laid the foundation for disaster by pushing larger and larger vehicles while doing little to improve drive train efficiency. Foreign companies such as Toyota made a greater effort in this regard, but all firms were caught in a race to the bottom, seeking to produce large vehicles for low initial costs. The result was poor mileage.

Consumers were happy to accept large, fuel-inefficient vehicles until gasoline prices surged. However, sales of such vehicles collapsed as gasoline prices rose between 2006 and 2008. Dealers and automakers were left with hundreds of thousands of them on their lots, and these became unsellable when gasoline prices reached $3 per gallon. Bankruptcy became the only option for General Motors and Chrysler.

The Obama administration arranged to bring both companies out of bankruptcy with controversial legislation that punished the companies' bondholders more than would normally be the case. In return, the government became the firms' largest shareholder. In that position, the Obama administration required automakers to pursue increased fuel economy. This effort culminated in July 2011 when executives from U.S. and foreign auto manufacturers agreed to increase average vehicle fuel economy to 35.5 mpg by 2016 and 54.5 miles per gallon by 2025. In announcing the agreement, the White House noted that it would reduce fuel expenditures by $1.7 trillion and cut U.S. oil use by 2.2 million barrels per day in 2025.

U.S. auto firms laid the foundation for disaster by pushing larger and larger vehicles while doing little to improve drive train efficiency.

The standards were negotiated with great care with automakers, who extracted concessions from the White House. *New York Times* reporter Bill Vlasic explained that the actual standard in 2025 would be closer to 43 miles per gallon, given the standard discrepancy between actual fuel economy and the estimates derived from EPA testing techniques. He also noted that actual fuel economy would be lower because the standards offered credits to automakers for building vehicles with advanced technologies to reduce fuel use.

Still, the agreement marks a clear reversal by the auto industry. Firms that for years had trusted the oil industry to supply the fuels needed to power their products indicated they were moving beyond oil. Their acceptance of tighter standards will make a major contribution to achieving energy independence.

INCREASING RENEWABLE FUEL USE

The substitution of renewable fuels such as ethanol for gasoline will complete the transformation of the United States from an energy importer to energy exporter. Ironically, this last development will occur more by accident than intention.

The requirement to use renewable fuels in gasoline began with the Clean Air Act amendments passed in 1990.

These revisions required the introduction of oxygenates such as ethanol into some gasolines. The authors of the act expected refiners to use ethanol. Lobbyists for the agricultural industry (also known as the renewable fuels industry) had pushed this view.

The oil industry had objected to the oxygenate requirement on the basis that Congress's environmental goal—reducing emissions that contributed to photochemical smog—could be achieved by a gasoline composition change more effective than oxygenates. The industry's science was correct, but as usual the political forces were aligned against it.

Even so, refiners responded initially to the requirements by blending methyl tertiary-butyl ether instead of ethanol. MTBE had several advantages. The most important of these was it could be blended into gasoline at the refinery and the product shipped by common carrier pipelines, which also carried jet and diesel fuel. Ethanol's water content, on the other hand, required it to be blended into gasoline at the terminal just before being loaded for shipment to service stations.

No doubt, oil companies also chose MTBE because it was a petroleum product. The industry had no interest in allowing large agricultural conglomerates such as Archer Daniels Midland into the fuels business. In addition, MTBE was an ideal additive because it allowed firms to increase fuel octane cheaply without threatening evaporative characteristics.

The oil industry's strategy failed, though, because MTBE contaminated water supplies if spilled. A number of communities experienced such pollution, prompting lawsuits against the oil industry. These were eventually resolved when oil companies paid billions in damages. MTBE was replaced by ethanol.

Congress addressed the ambiguity regarding which oxygenate to use in the Energy Policy Act of 2005. This law required refiners to blend a minimum of 7.5 billion gallons of ethanol into fuels by 2012. At the time, this would have amounted to 500,000 barrels per day and accounted for perhaps 5 percent of the nation's anticipated gasoline use in 2012. Responsibility for this program was delegated to the Environmental Protection Agency, which proceeded to develop a very complicated trading system. This system allowed those refiners choosing not to use ethanol in fuels to purchase credits from firms electing to use ethanol. The theory, no doubt, was that firms selling gasoline where ethanol supplies were abundant would use more ethanol and sell credits for the amounts above their requirement to firms operating where ethanol was in short supply.

The term "anticipated use" is important. The legislation set the standard when gasoline use was expected to total roughly 10.5 million barrels per day in 2012, according to the Energy Information Administration. Few expected problems with blending 500,000 barrels per day of ethanol into ten million barrels of gasoline. The resulting blend, on average, would be around 5 percent.

However, the mixing of only 500,000 barrels per day of ethanol would do little to reduce U.S. oil imports. In 2006, President George W. Bush noted this fact, asserting that the United States was "addicted to oil." Speaking to Congress in his State of the Union address, he announced "The Advanced Energy Initiative," a program intended to replace 75 percent of U.S. oil imports from the Middle East with ethanol and other fuels. "By applying the talent and technology of America," Bush asserted, "this country can dramatically improve our environment, move beyond a petroleum-based economy, and make our dependence on Middle Eastern oil a thing of the past."

U.S. auto manufacturers put forward an entirely different set of choices to buyers in Europe, where regulations and horsepower taxes encouraged production of efficient vehicles.

One year later, in his 2007 address to Congress, President Bush raised the target from 7.5 billion gallons to 35 billion gallons while calling for increased fuel economy.

> To reach this goal, we must increase the supply of alternative fuels, by setting a mandatory fuels standard to require 35 billion gallons of renewable and alternative fuels in 2017—and that is nearly five times the current target. At the same time, we need to reform and modernize fuel economy standards for cars the way we did for light trucks—and conserve up to 8.5 billion more gallons of gasoline by 2017.

Congress codified President Bush's goal in the Energy Independence and Security Act of 2007. The legislation, intentionally or not, gave the United States the final push

needed to achieve energy independence. This law, in combination with tighter fuel economy standards, will effectively force gasoline from the U.S. market, probably by the middle of this decade. Gasoline will become so expensive that motorists will convert vehicles to use alternative fuels or replace existing vehicles with more efficient ones. The old vehicles will no doubt become a significant U.S. export thanks to the renewable fuel requirements proposed by President Bush and enacted by Congress.

THE END OF GASOLINE

The regulatory banishment of gasoline will occur because the new rules mandate a fixed volume of renewable fuel use—thirty-six billion gallons or 2.35 million barrels per day—by 2022. This volume would have represented 20 percent of U.S. gasoline consumption if the 2007 forecast of twelve million barrels per day in 2022 were realized. However, circumstances have changed.

Market forces will drive the substitution.

Gasoline use in the United States will not come close to twelve million barrels per day in 2022. Use will be reduced substantially by the improved vehicle fuel economy pushed by the Obama administration. Use will also be cut by the substitution of natural gas discussed above. Total gasoline demand, including renewable fuels, will in all likelihood be less than eight million barrels per day in 2022 and could quite probably fall to six million barrels per day. In this scenario, the average fuel mix would be around 40 percent ethanol and 60 percent conventional gasoline.

The problem is that most vehicles cannot operate with this blend. Today most can operate on 10 percent mixes. Some can use blends of up to 25 percent ethanol if this fuel is available. The solution, then, would be to manufacture vehicles that can run on an 85:15 ethanol/gasoline mix (E85). Such vehicles are already sold in the United States. In addition, Congress seems poised to require half of the cars sold in the United States to operate on such fuel.

So the fuel mix issue can be solved by encouraging consumers to purchase and use E85-capable vehicles. (Such vehicles can also run on conventional gasoline). The Bush goal can be reached if 30 percent of the fuel Americans consume in 2020 is E85. In this scenario, consumers would use 2.3 million barrels per day of renewable fuels and five million barrels per day of conventional gasoline.

Market forces will drive the substitution. Manufacturers of conventional fuels such as the 90:10 gasoline/ethanol mix will be forced to purchase ethanol credits. As the price of the credits rises, the price divergence between conventional fuel and E85 will increase. Sometime after 2015 a situation will develop where retail conventional gasoline prices hover around $5 per gallon as the E85 price drops below $1.

Conventional gasoline will be squeezed from the market as the price difference widens. While no model will predict it, one can foresee a situation where the drop in gasoline consumption pushes more refineries into bankruptcy and leaves larger and larger areas of the United States with no local source of gasoline supply. Indeed, such a trend has already begun in the mid-Atlantic United States. In 2005, the area's operable refinery capacity was 1.5 million barrels per day. By the end of 2012, 60 percent of this capacity will have closed.

ENERGY INDEPENDENCE BY ACCIDENT

The inadvertent consequence of the Bush regulations, combined with increased natural gas supply and the push for greater fuel economy, will dramatically depress petroleum-based fuel use in the United States. By 2020 or 2025, consumption could be limited primarily to diesel and jet fuel. The few remaining refineries will be reconfigured to produce more of these fuels and less gasoline. At the same time, refiners will export larger volumes of products. The United States may even become an exporter of crude oil.

As this adjustment occurs, the United States will become a net energy exporter. We will have reached the goal of President Nixon's Project Independence. However, few if any of the measures proposed by Nixon or his immediate successors will have contributed to this accomplishment. The United States will not have achieved energy independence by building nuclear reactors, nor by converting shale rocks in Colorado to oil, nor by drilling in offshore waters in the Pacific or the Atlantic. The large integrated oil companies will also have contributed little to the success. Indeed, none of the measures proposed by Nixon save the construction of the Trans-Alaska pipeline will have done anything. (Production in Alaska may have stopped due to the field's exhaustion by the time we declare success.)

Instead, the United States will have realized energy independence by accident, thanks in large part to aggressive efforts by entrepreneurs who defied custom and pursued gas and oil using new technologies. George W. Bush, the former Texas governor, will also have contributed by demanding increased renewable fuel use. Lastly, the individuals working on Wall Street who are so widely detested will deserve significant credit for creating the institutions that enabled new oil and gas firms to expand without assistance from the majors. ◆