HELIUM–HOW MUCH IS ENOUGH?

Richard L. Stroup and Jane S. Shaw

THIS SEPTEMBER the secretary of the interior is supposed to write a check to the Treasury Department for about $790 million. That is the principal and interest now due on loans the department took out years ago to establish a conservation program for helium. Unfortunately, the secretary will not be able to write that check. Instead of paying for itself as originally planned, the program has gone more deeply in debt. And the Interior Department finds itself with an underground storage reservoir containing enough helium to supply the government's needs, at current rates of use, for the next 140 years.

By usual standards, helium is a nonrenewable resource. In the late 1950s many influential people worried that it would disappear, that the country would "run out." Congress responded with the Helium Act of 1960, creating a government program to extract and store the gas. Both when the program was initiated and while it was deteriorating, a number of questions were ignored: Was the Interior Department's Bureau of Mines relying on dubious forecasts of helium supply and demand to justify government intervention? Would the private market really have depleted helium supplies if the government had not intervened? More broadly, was the money being invested in the helium program well spent? Twenty-five years later, it is long since time to address those questions.

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Inflating the Regulatory Balloon

Helium is a gas whose distinct physical properties give it many space-age uses. Because it is inert, for example, helium can be used to purge rocket engines of contaminants. Because it has a low melting point—it freezes only under pressure—it can be used to cool materials to superconducting temperatures and to test spacecraft and hardware under extremely cold conditions. Because it is lighter than air, it is useful for lifting balloons and blimps.

As government space and defense programs burgeoned in the 1950s, government scientists were sure that the need for helium's special characteristics would grow. And some experts thought the gas had few if any substitutes. A 1959 Bureau of Mines study forecast that U.S. demand for helium—which was then running at about 360 million cubic feet a year—would exceed 1 billion cubic feet a year by 1967 and reach nearly 2 billion by the year 2000. Cumulative demand would total 65.8 billion cubic feet by the year 2000. Actually, demand did not hit 1 billion till 1978.

The lavish demand forecasts were accompanied by anxiety-provoking estimates of supply. At the time, natural gas wells were the only economic source of helium, and there were few natural gas streams that contained enough helium—a concentration of at least 0.3 percent—to make extraction economically viable. Indeed, in 1960, it appeared to the Interior Department that the only natural gas in the world with economically recoverable helium was in the Hugoton-Panhandle field, located where Texas, Oklahoma, and Kansas meet. The U.S. government, with five plants extracting helium from Hugoton-Panhandle gas, was at that time the world's only supplier. (Late in the 1930s it had bought and dismantled what appears to have been its only competitor.)

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As demand increased during the 1950s, shortages of helium were already beginning to appear, and projections indicated that the Panhandle field would run out of natural gas by the 1990s. The use-it-or-lose-it dynamics of helium at the well-head lent a special sense of urgency to the perceived supply-demand imbalance. If helium is not extracted from natural gas as it is produced, it is lost into the atmosphere. At congressional hearings in 1960, mining experts stressed that nearly 4 billion cubic feet were being lost each year—about ten times what was being consumed. A valuable, nonrenewable resource was apparently being wasted. Also at the hearings, several large natural gas producers—the ones likely to benefit from government contracts for helium—pushed for the proposed conservation program, saying that they were waiting only for a go-ahead from government. The U.S. Chamber of Commerce gave its support as well. And the regulatory balloon took off.

Coming Back to Earth

But not without a little help from the taxpayers. Although the program was ultimately expected to pay for itself, the 1960 act authorized the Bureau of Mines to borrow up to $47.5 million a year to finance helium purchases under long-term supply contracts with suppliers. With twenty-two-year sales contracts in hand, four companies—Cities Service Helex, Inc., National Helium Corp., Northern Helex, Inc., and Phillips Petroleum Co.—built helium extraction facilities at the Hugoton-Panhandle field; and the Bureau of Mines built a pipeline to carry its helium purchases to an underground reservoir at Cliffside, near Amarillo, Texas.

The bureau paid the contractors $11 per 1,000 cubic feet for the helium. To cover its full costs for the gas, storage facilities, and interest on the Treasury loans, it set a resale price of $35 per 1,000 cubic feet—more than twice the $15.50 that federal agencies had previously been paying and 80 percent more than the $19.50 that commercial users had been paying. Government officials apparently did not think that a higher price would have an effect on supply or demand.

For a few years, the department did indeed succeed in selling helium at $35 to both federal and private users. But the $35 price was high enough to attract competition from strictly private extraction plants. By 1969, seven new suppliers had sprung up to serve private users, and they had not only dropped their helium price to $20–23 per 1,000 cubic feet but had captured over 45 percent of the total market. (These private suppliers had another advantage in addition to price: they could also supply helium in liquid form, while the government could not—it had no liquefier.) Yet the government refused to change its price, and the Bureau of Mines lost all its customers except for the federal agencies, which were required by law to buy from it. The secretary of the interior went to court (unsuccessfully) to force federal agencies to require their contractors to buy government helium.

Then some of the captive federal users began to cut back. The Weather Bureau and the Atomic Energy Commission found $35 helium not quite as vital to them as $20 helium and turned to alternatives such as hydrogen and argon. Federal demand shrank for other reasons, too. The Defense Department shifted from

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Atlas missiles, which had used helium to pressurize fuels, to Minutemen, which did not. In 1969, Hollis M. Dole, assistant interior secretary for mineral resources, told the House Subcommittee on Mines and Mining that when the conservation program was authorized, "there was a strong feeling that helium was unique in all its applications, instead of being unique only in some, such as reaching the lowest ranges of temperature. There was also the feeling that price was not too important a factor in its use." As early as 1969, these assumptions had been proven wrong.

But the space program still kept alive hopes for strong helium demand. A Bureau of Mines study presented at the 1969 House hearings forecasted that federal use would top 1 billion cubic feet by 1976 and reach a cumulative total of 47 billion between 1970 and 2000—a less bullish forecast than the 1959 study's, but bullish nonetheless. The bulk of this demand—42 billion cubic feet—was to come from the National Aeronautics and Space Administration. Two years later, when NASA's programs were being axed right and left, a more accurate study by the bureau cut the estimate of cumulative federal demand by 85 percent, from 47 billion cubic feet to 7 billion, with annual usage topping out at 272 million cubic feet. Actual federal usage in the 1980s has in fact been running at about 265 million cubic feet a year—compared with 277 million in 1959.

Even as federal demand for helium slumped, supply was turning out to be unexpectedly abundant. In 1961 a new, helium-rich natural gas field was discovered in southwestern Wyoming—the Riley Ridge or "Tip Top" field. Its potential proved to be extremely large. Today, the federally owned part of the field is estimated to contain between 93 and 200 billion cubic feet of helium—that is, at least two-and-a-half times and perhaps as much as five or six times the current federal stock of crude helium. At present rates of federal use, the Riley Ridge field could supply the government's needs for at least 372 years and perhaps as many as 800 years. An additional factor boosting helium supply was the development of technology making it economically feasible to extract leaner streams of helium from natural gas.

To be sure, it took a while for officialdom to change its policies. Three companies that had built plants on the basis of the twenty-two-year government contracts argued in 1969 before a House subcommittee that the program was still needed. And even so eminent an economist as Alan Greenspan, a consultant to these companies, claimed that by 2010, the price of helium would be $140 per million cubic feet, so the program would ultimately pay for itself and should be continued. But Congressman Wayne Aspinall, chairman of the House Committee on Interior and Insular Affairs, labeled the program "a weight around our necks"; the taxpayers, he said, "just cannot be expected to pay for this kind of conservation." In 1973, after buying 32.2 billion cubic feet and storing most of it, the Bureau of Mines canceled its contracts with helium producers. (A number of them

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quickly filed breach-of-contract suits, setting off years of litigation, only recently settled.) Thus the main activity of the program now is to store helium supplies, which currently amount to 35 billion cubic feet.

One might think that the question today would be not whether to conserve helium but how the government should get rid of its stocks. But no. Edward Hammel, Milton Krupka, and K. D. Williamson, Jr., writing in *Science* magazine in February 1984, point out that new exotic helium-using technologies continue to crop up. Even though the need to develop technologies such as fusion energy has decreased with the price of oil, the "eventual need" for those technologies and "the large amounts of helium they require" have not disappeared. Moreover, for many technologies, "helium is a sine qua non." These scientists warn that when Riley Ridge is exhausted, someday, the only source of helium might be the atmosphere itself, where helium exists in huge quantities but minuscule concentrations. And they estimate that extraction from the air would cost $10,000 to $20,000 per thousand cubic feet of helium, compared with $10 to $20 under current methods. But, they argue, it is "unlikely that private industry could be persuaded to conserve any of the Riley Ridge helium for future sales, primarily because the costs of so doing could not be recovered in less than 10 to 20 years." Thus, if helium is to be conserved, "it will have to be done by the federal government."

Regulation vs. a Market Scenario

The string of unanticipated outcomes of the government's helium program offers reason to be cautious about enlarging the government's role in helium conservation—or even about continuing it at the present level. The obvious, visible cost of the 1960 Helium Act is the $790 million that Interior is supposed to repay to Treasury and plainly cannot. But the larger cost is a less apparent one. Too much conservation can be every bit as bad as too little. Using scarce resources—engineering talent, steel, construction crews, and so forth—to extract, transport, and store helium, for example, diverts those resources from other, possibly more valuable uses. Economists call this trade-off the "opportunity cost" of investments. The helium conservation advocates have consistently failed to acknowledge the "opportunity cost" of investing in helium.

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Suppose you expect $100 of today's helium to be worth $500 fifty years hence. Invested elsewhere at, say, 10 percent a year, the same $100 will yield $500 in a mere sixteen years and $11,700 in fifty years—clearly a much better payoff and therefore one that your heirs should applaud. Only when the real (inflation-adjusted) price of a good rises faster than the real rate of interest (which measures the productivity of investments put to other uses) will it make sense to hold a resource. Dennis Epple and Lester B. Lave note in a 1982 article in *American Scientist* that, based on historical experience, it is far more likely that the return on other investments will exceed the return on investment in helium. Declining real prices have "been observed over the last half century for almost all depletable resources. . . ." This suggests that faster use of the resources would have served society better. However, they fear that "the tangle of legislation resulting from government storage of helium" will make producers afraid to store helium privately. So they suggest modest government storage and no further venting of the richest helium streams.

But *who* holds the resource also matters—a fact that Epple and Lave fail to note. To analyze opportunity cost, the holder of helium must forecast future price, and most price forecasts—as helium has vividly demonstrated—prove wrong. A government program, based on a single bureaucratic forecast, is far more likely to be wrong than right. Moreover, a government plan is far more difficult to change, once error is recognized, than a private plan. The glut of government helium was apparent by the late 1960s but helium purchases were not halted until 1973. All investors hate to send good money after bad, but the aversion is far stronger when the money is the investor's own, not the taxpayers'. Private investors simply have more incentive to ask painful questions, swallow their pride quickly, and correct their errors as information changes.

What would have happened without a government conservation program for helium? The immediate demands of the government for helium would have been met by entrepreneurs using private investment funds. At least one potential helium producer, Eastern Petroleum Co., would have done so in 1959, according to congressional testimony, had the government not set up a monopoly. Thereafter, private investors would have positioned themselves for profit by building extraction plants or negotiating for extraction facilities at gas production plants, as the investors judged that demand from federal or private consumers was likely to increase. Alternatively, larger consumers like the Defense Department and NASA could have contracted for helium development in stages, as DOD does with a new bomber, or could have operated extraction facilities tailored to their own needs.

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Longer-term needs would have been protected by the greed of speculators. Speculators, after all, are like distributors, except that they transfer the goods along the dimension of time, not geographical distance. Wholesale distributors buy oranges in Florida, where they are cheap and plentiful, and sell them in Montana, where they are scarce and more expensive. Speculators buy resources now, when they are cheap and plentiful, and hold them for sale in the future, when they are expected to be scarcer and to command a higher price.

During the early years of the helium program, bold investors were funding such expensive, risky, and speculative ventures as Outer Continental Shelf oil and gas exploration, wildcat oilwells, and speculative office buildings. *Credible* forecasts of large demand and dwindling supply of helium would certainly have spurred private investment in helium, too. Even forecasts *not* credible to most people (such as that by the Bureau of Mines) might also have spurred investment, but then private speculators—not the taxpayer—would have paid the price.

And a final irony of the government "conservation" proposal is worth noting. One of the greatest pressures for venting helium at Riley Ridge is that the gas wells there are located on federal land, and companies that hold federal gas leases are not allowed to lease the rights to the associated helium. The 1960 Helium Act kept those rights in federal hands. Thus, if the Bureau of Mines does not take the helium or sell the rights to it, the producers are obliged to vent it as a waste gas, since they cannot sell it. The leasing regulations, in other words, ensure there will be a "problem" for the government to step in and solve.

Looking Ahead

History suggests that most fears of running out of nonrenewable resources are vastly exaggerated. Dire forecasts of the depletion of valuable raw materials have always been proven wrong. When a valued material becomes scarce, its price rises, cutting demand and spurring entrepreneurs to search for new supplies and substitutes. In the nineteenth century, for example, whale oil became scarce and petroleum quickly filled the gap. As Julian Simon reminds us in *The Ultimate Resource*, the noted economist W. Stanley Jevons predicted in 1865 that England could not continue its "present rate of progress" because the nation would run out of coal. Yet coal is more plentiful than ever today.

Often resource forecasts that are ultimately wrong gain temporary credence because of precipitous short-term rises in price, as in the case of oil in 1973 and again in 1979. Yet the price increases that cause the concern are themselves the means of bringing the situation more or less back to normal. Today in the United States, in spite of the dramatic increase in oil prices, the price of gasoline is only 21 percent higher, in real terms, than it was thirty years ago. During this period, real per capita disposable income went up over 90 percent.

There are many other examples of prophecies of scarcity going awry, and in all likelihood helium will continue to be one of them—provided its future is left in private hands. If scarcity is anticipated, the price will rise, which will stimulate the creation of substitutes and exploration for new supplies. Even the authors of the *Science* article acknowledge that there are alternative, though more expensive, supplies of helium, including low concentrations of helium in other natural gas fields, air separation plants now producing other gases, and liquid natural gas. While these sources are not economical today, they could be tapped long before we would have to build plants to draw helium out of the air at $10,000 to $20,000 per thousand cubic feet.

And then again, we may never see the extraordinary increases in demand that some people anticipate. Some way may be found to develop fusion energy and superconducting power transmission lines without helium. Or those technologies might never be developed at all. History is littered with promising technologies that flopped. Lighter-than-air dirigibles, for example—which got the federal government into the helium business in the first place.

At this stage, the government should do what even the Hunt brothers would do after being burned to the extent of hundreds of millions in the commodities market. It should cut its losses. That means renting or selling outright the storage facility and selling off the helium, retaining at most a quantity sufficient for emergency use.

Helium still in the natural gas at Riley Ridge deserves no less. The law should be changed to permit the government to lease the helium along with the gas. Natural gas firms could then strike their own deals with private helium suppliers and speculators. Better still, speculators, not just natural gas firms, should be allowed to buy and hold natural gas (and the associated helium) if they so desire. At present, companies that lease rights to federally held natural gas are required to develop it within a certain amount of time. This seems a trifle ironic. It means that the government is requiring producers to bring helium to the surface sooner than they would wish, so that the government can pump it back into the ground and store it, both at great expense. Why not allow helium to be stored henceforth at private expense in nature's own reservoirs? Both Adam Smith and the Sierra Club should approve. ■

Selected Readings

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Telephones and Computers

William J. Baumol and Robert D. Willig

THE TECHNOLOGIES of computers and telecommunications have fused. Computers call each other over telephone channels to exchange information and coordinate their operations. Telephones have evolved into miniature computers, and telephone switchboards into bigger, more powerful ones. The telephone network is itself a giant computer, with its intelligence spread throughout its length and breadth instead of concentrated at one site.

Although the marketplace eagerly accepts this fusion of technologies, the Federal Communications Commission (FCC) has been standing athwart the tide of history crying "halt." The FCC's rules require the nation's largest phone company, AT&T, to keep its telecommunications operations entirely separate from its computer business. Thus, whenever AT&T offers telecommunications services that are "enhanced" to include a variety of data processing services, it must supply the latter through a separate part of the company, out of a separate location, and using a separate computer, instead of through the same computers and locations that comprise its telecommunications network.

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The "separation" rules are responsible for a host of other inefficiencies as well. For example, many large Japanese companies maintain internal libraries of the computer software their divisions produce, so that expensive programming need not be done twice. But the FCC rules hamper AT&T's efforts to do the same thing. AT&T's incomparable research arm, Bell Laboratories, invests millions every year to design software for the company's long-distance network—software that it is not allowed to share with the company's commercial computer activities.

The rules in question—issued in 1980, three years before the court-ordered breakup of AT&T—force the firm to separate its operations into two compartments. Under those rules, one compartment provides basic telecommunications services and is regulated; the other sup-