

UNITED STATES ENERGY POLICY: The Translucent Hand and the Art of Muddling Through

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Introduction

The United States has been searching for some years for a viable energy policy. Energy policy became a matter of prominence in the early 1970s, when world oil prices began to climb and OPEC emerged as a front-page phenomenon and a familiar topic on the evening news. This is not to say that there were no substantive energy policy issues that antedated the oil price explosion and the takeover of the world oil market by the producing nations. Indeed, such energy policy problems as natural gas pricing, oil import policy, the tax treatment of income from oil and gas production, public lands and the leasing of the Outer Continental Shelf, and interfuel competition, for example, already had a long history before energy became a fashionable issue. But energy policy had seemed to involve arcane issues that were often submerged in a general perception that world oil supplies were available in unlimited quantities at bargain-basement prices forever.

In the quarter century after World War II, the output of the principal petroleum-exporting countries increased at a sustained compound rate that was a double-digit phenomenon. Oil exports from the countries that became OPEC doubled and redoubled every six or seven years. Abundant world supplies of oil were the major driving force in the determination of energy prices. The United States, once an oil exporter, became increasingly dependent on oil imports as the incremental source of energy consumption and evolved into the largest single demander of oil in the world market.

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Gasoline is such a commonly used product that it is a convenient reference point. The inflation-adjusted real price of gasoline in the United States steadily declined up to 1972, the year before the oil embargo, an experience typical of oil products. Faced with this competition and subject to a regulatory freeze, the real wellhead price of natural gas in the United States also declined during the 1960s. In addition, although competition with oil and gas forced down its real price, coal lost market share.

The world oil market was undergoing profound changes prior to the oil embargo in 1973, but it was the embargo that interrupted supplies whose security had been generally taken for granted and whose prices had been regarded as *foreordained to remain low*. The shortages and price increases that accompanied the embargo were met with shock, outrage, suspicion, disbelief, and anger. It was not an opportune time for rational discussion of energy policy issues.

By coincidence, the regulation-induced shortage of natural gas in the interstate gas market, an inevitable legacy of wellhead ceiling price controls, was also beginning to pinch. Also, further improvements in the thermodynamic efficiency of electric generation had been exhausted, and the promise of nuclear power as an energy source too cheap to meter had failed to materialize. In addition, environmental and safety regulation of the production of coal and environmental restrictions on coal use began to make coal a more costly fuel. The public was thus confronted with higher electricity prices in addition to gasoline lines, higher oil prices, suddenly perceived insecurity of supply, and natural gas curtailments. Across the board, the illusion that inexpensive energy in relatively unlimited quantities was a birthright of the American public was being destroyed.

Coming to grips with these new realities has not been a happy experience. The uncongenial air of recrimination and scapegoating created an atmosphere that stifled positive policy responses. The situation was further complicated by ill-conceived general price controls inspired by an unworkable attempt to cope with inflation. Perversely, when general price controls were lifted, specific controls as a vestige of the economic stabilization package were left in place on *crude oil and refined products alone*. Together with Federal Power Commission wellhead ceiling price controls in place in the interstate natural gas market, crude oil price controls meant that the vast majority of U.S. primary energy supplies were artificially restrained from responding to new realities in the energy markets.

At the same time that crude oil price controls were settling into place, the problem of coping with a resolution to two decades of inhibition of U.S. natural gas supplies due to wellhead ceiling price controls was proving to be nearly insurmountable for Congress. In addition, regulation of electric and gas utilities was mired in hearings at the state and federal agencies, where the problems were only dimly understood and old remedies were proving useless.

In a sudden rush and with an intense focus that derived from events in the world oil market, the problems of energy had emerged from an era of benign neglect into one of distressed concern. And as if all this were not enough, America was then visited with two consecutive winters that were among the hardest in recorded history.

In retrospect it is perhaps surprising that we coped as well as we did. But there was ample room to do better. One should be allowed a quiet smile in looking back on a program to achieve energy independence that was rooted in a system of price controls that suppressed the domestic supplies of oil and gas and encouraged consumption and imports.

These policy shortcomings were rooted in more than social inertia and short-run political expediency, however. The conventional wisdom of the moment was that world oil prices—rather than rebounding from a long slump of unusually low levels at \$1 to \$2 per barrel f.o.b. the Arabian Gulf—were abnormally high at \$12 per barrel. A parallel strain of this wisdom was that the OPEC “cartel” would shortly collapse, which in turn led many to believe that immediate coping was a short-run “management” problem and that a new normalcy was just around the corner. Although we could not completely return to a blissful state of relative indifference to questions of energy supply and demand, it was hoped that the long-run equilibrium world oil price might be in the range of \$7 to \$8 per barrel (in, say, 1974 dollars), and the longer-run problems involved insecurity of imported supplies and phasing-in of liquids from shale and gas from coal at costs somewhat, but not greatly, above the landed cost of imported oil.

These hopes have proved illusory. The present, perhaps temporary, “softness” of the world oil market at current dollar prices in the \$30 to \$40 per barrel range is unlikely to be a delayed vindication of these hopes. We have been continually surprised at almost every turn of events in energy supply and demand. World oil prices have risen, and risen again. Domestic conventional natural gas production has held steady against expectations of declines, although reserve additions have not yet caught up to production. Domestic

coal is gaining in absolute and relative terms without the necessity of binding artificial restrictions on other fuels. Simple economics has slowed the rate of growth of nuclear power, and as a result anticipated shortages of uranium and enrichment capacity have not yet materialized. Higher energy prices than planned for have not caused the economy to crater, and long-run, inflationary pressure is increasingly, and correctly, being recognized as a monetary and fiscal, rather than an energy, policy problem. Price-induced conservation has reduced demand pressures more rapidly and significantly than was initially thought possible. Higher domestic crude oil prices have caused a record surge in drilling activity and created productive exploration plays in heretofore untested geological prospects. In light of these surprises, it is appropriate to develop a new perspective on where we have been and where we may be going.

A Basic Perspective

It is perhaps an overstatement to say that all the critical policy interconnections radiate from world oil prices and the relationship of U.S. energy markets to the world oil market. Nevertheless, it was the explosion of world oil prices and the oil embargo that dramatized energy policy problems. And oil is the most versatile substitute fuel for a wide range of uses in which other forms of energy compete. Thus it is helpful to have a perspective on world oil prices and the world oil market as a vantage point from which to address domestic energy policy issues.

The initial shock of substantially higher world prices produced the unfortunate but understandable reaction that higher world prices were somehow not real, did not exist, would go away, or could be ignored by the United States in charting its own domestic energy policies. One can have sympathy with these feelings, but they were naive. The United States was, is now, and for the foreseeable future will be, critically dependent on imported oil as an important component of our mix of energy supplies. The very versatility of oil as a fuel means that the prices we pay for oil imports in the world market penetrate into almost all facets of our use of energy.

Although it would be convenient if we could magically insulate ourselves from the effects of increases in the world price of oil, we cannot. Because we import so much oil, any attempt to do so is ultimately a subterfuge with greater long-run costs than short-run benefits. Whatever the world price of oil is, and however it is determined, it ultimately permeates all the economic choices that we make in energy production and consumption, lifestyles, and the

selection of capital equipment. It is concise and correct to say that the best first approximation of the minimum social opportunity cost of energy consumption in the United States is the landed cost of oil imports.¹ If energy markets are to operate efficiently in allocating scarce energy, capital, and labor resources through our individual, decentralized consumption and production decisions, they must be free to reflect this reality.²

This reality is central regardless of the nature of the price determination process in world oil markets. It has been argued that we should cushion our domestic energy economy from the full brunt of higher world oil prices because these prices are monopoly prices set by a "cartel" of producing countries. It makes no difference. Whether OPEC is a cartel or a discussion club, the world price of oil is the critical variable that sets the standard of cost effectiveness for our domestic decisions.

The recent decontrol of U.S. crude oil prices was a belated recognition of this principle. But the excise tax on U.S. crude oil production that accompanied price decontrol drives a wedge between the marginal social benefits and the marginal social costs of exploration, development, and production activities directed toward maintaining or increasing U.S. oil supplies. Since, contrary to popular belief, a large majority of gross producer incremental revenues from crude oil production accrue to governments as federal and state income taxes, severance taxes, and royalties, the "windfall profits" tax bulks large in comparison to the net incremental revenues after tax and costs, which are the rewards that motivate producers to pursue additional domestic oil production. It is likely that before the crude oil "windfall profits" tax runs its statu-

¹More sophisticated analyses attached a security premium of \$10 per barrel, or more, to the landed cost. See for example James M. Plummer, "The Oil Import Reduction Premium and Oil Stockpile Premium: Modeling and Policy Implications," Presidential Address delivered at the second annual North American meeting of the International Association of Energy Economists, Washington, D.C., October 6-7, 1980.

R. Lemon, "The Direct and External Benefits of Reducing Oil Imports," *Energy Topics*, October 1, 1979; idem, "The Externalities of Oil Imports Revisited," *Energy Topics*, September 1, 1980, Institute of Gas Technology.

U.S. Department of Energy, *Reducing U.S. Oil Vulnerability: Energy Policy for the 1980s*, prepared by the Assistant Secretary for Policy and Evaluation, November 10, 1980, DOE/PE-0021.

²It is noteworthy that such producing countries as Norway, the United Kingdom, and the Netherlands already incorporate this reality into their energy policies. It is also reported that OPEC countries such as Saudi Arabia are also proposing to evaluate the costs and benefits of internal uses of energy on the basis of world market oil prices.

tory course, it will be in the social interest to revisit it and accelerate its termination.

Two other major areas of domestic energy supply and demand exist in which production and conservation decisions are not free to reflect the new energy realities: natural gas and electricity. Natural gas and the Natural Gas Policy Act of 1978 are topics to which I will return in more detail subsequently. With regard to electricity, the major problem is that state utility commissions have not allowed rates of return that permit companies to earn their costs of capital. This problem has been compounded by earnings erosion that has prevented companies from earning even their allowed rates of return. Price-induced conservation has delayed the appearance of a national shortage of generating capacity, but this is an industry with long lead times for new plant construction. If current trends continue, it is likely that a considerable amount of new demand growth will be met with oil-fired internal combustion peaking turbines that have lower capital costs than coal-fired or nuclear base-load generating capacity, but which benefit more from automatic fuel adjustment clauses. In addition, older oil-fired base-load generating capacity will be kept in service for a longer period of time. Consequently, the U.S. demand for imported oil—the incremental source of supply to the U.S. energy economy—will be greater than would be the case if electrical utilities were allowed to earn their actual costs of capital and optimize their capacity additions against expected demand growth.³ Any level of U.S. demand for imported oil greater than that which an unfettered domestic energy supply and demand balance would create increases our vulnerability to an oil supply interruption and puts upward pressure on world oil prices. Again, even from the standpoint of domestic electricity generation, we come full circle to the relationship between U.S. energy policy, oil imports, and the world price of oil.

In this regard it is worthwhile to consider in somewhat more detail the price formation process in the world oil market and the trends and circumstances that influenced its development. A number of additional observations, therefore, are relevant here. First, the initial explosion of world oil prices was a discontinuous release

³There are at least two further matters of policy significance concerning electrical utilities. The first is the possibility of deregulating the power generation stage of the industry. The second is how cogeneration would fit into the power grid were generation deregulated. In addition, there is the problem of forecasting load growth in a deregulated environment where users and suppliers were receiving the correct price signals and cogeneration was a part of the supply mix. These questions are beyond the scope of this review.

of pressures that had been building up for some time. This discontinuity was primarily a politically determined event associated with the circumstances surrounding the embargo, but the upward pressure on world oil prices would have resulted in a general price rise in any event, and—although the rise would not have been so sharp and traumatic—it is likely that the resultant prices would have been about the same. The pressure that gave impetus to the realignment of the world oil market was the integration of the tremendous oil resources of the Middle East into the world energy demand system. When that integration was completed in the early 1970s, the framework of pricing and tax policies, production decisions, and quasi property rights dramatically changed. No longer were the revenues of the producing countries primarily determined by a doubling and redoubling of production at relatively static tax yields. Instead, production has become relatively static, and we have now seen doublings and redoublings of prices as political turmoil and a general unavailability of alternative, lower-cost supplies have shaped the market.

Second, although it is convenient and fashionable to speak of OPEC as a "cartel," there is a growing body of opinion that the world oil price is an approximation of the competitive cost of energy in an unstable and uncertain world.⁴ OPEC has no formal or informal system of production controls. Prices are discussed at periodic meetings, but each country acts in its own best interest to get whatever it can. Saudi Arabia generally appears to have lower price preferences than other countries, but there are both political and economic explanations for this preference in a market where Saudi Arabia is the largest producer among many other sellers. Furthermore, alternative supplies of energy do not appear to be available at such low costs or in sufficient quantities to pose a serious threat to world oil prices at their approximate current levels. All of these considerations suggest that an appropriate way to view world oil prices is as the competitive world cost of energy. Were this view to become widely held, it would greatly simplify the process of formulating and executing national energy policy.

Third, however the price formation process in world oil markets is characterized, it is in the interest of the United States for the upward trend in world oil prices to be restrained as much as possible because the United States is the largest single importer of oil in the

⁴See for example Walter J. Mead, "A Skeptical View of OPEC as a Cartel," forthcoming in the *Proceedings of the University of Calgary Conference "Energy: Coping in the 1980s"* held in Calgary on October 21-22, 1980.

world. Because domestic energy supplies compete with imported oil in all uses, the larger the fraction of U.S. energy demands that are met with domestic supplies, the less will be the demand pressure on world oil prices and the more restrained they are apt to be. This principle also applies to price-induced conservation. A million cubic feet (MCF) of natural gas, or a barrel of oil, or a kilowatt hour of electricity, which is conserved by one user and therefore available for use by another, ultimately displaces imported oil. In each case, the particulars may vary and the immediate effect is not necessarily a one-for-one transposition. In general, however, the average mix of energy displaced by price-induced conservation will be heavily weighted toward imported oil. Thus rationalization of U.S. energy markets to increase domestic supplies and encourage efficient use has a two-edged effect on U.S. oil vulnerability and the world price of oil.

Fourth, in historical perspective, the current world price of oil and the product prices that derive from it are not unusually high. If we again use gasoline as the standard of comparison, the current real price of regular-grade gasoline at the pump is approximately equal to the real price per gallon in 1929.⁵ This suggests, again in historical terms, that the United States and the world are not entering an era of unusually high energy costs but leaving an era of unusually low energy costs. This perspective, together with the perspective that current and expected world oil prices are both the standard of social opportunity cost for increased U.S. energy consumption and the result of a rough competitive process, are important touchstones for evaluating the formulation of policy with respect to questions of prospective energy supply and demand and for appraising whether it is likely that energy costs will be a seriously limiting constraint on economic growth.

With regard to the latter appraisal, it is my opinion that the various doomsday scenarios that center on energy unavailability at unacceptable costs are seriously exaggerated. With regard to the former evaluation, it is my opinion that market forces and private initiatives are much more likely to generate the required energy availability at acceptable costs than interventionist strategies. Taking the U.S. policy world as we find it, less intervention is better than more intervention, and strategies that decrease the level of intervention dominate those that increase the level of intervention.

⁵In fact, if one explicitly adjusts for increases in gasoline excise taxes and implicitly adjusts for quality improvements, it is easily arguable that the current tax-free real price of gasoline is lower than in 1929.

But these opinions and perspectives, particularly regarding the historical view of energy costs, must be put into context. This context has a simple name: Ghawar, the principal oil field of Saudi Arabia.⁶ The occurrence of mineral deposits in nature tends to follow approximately what statisticians call a lognormal distribution, which differs from a standard normal distribution in a particular way: In a standard normal distribution, the average is also the representative value and deviations from the average are distributed around it—both above and below—in a symmetrical way, but in a lognormal distribution there are a few very large observations and many relatively smaller observations. The distribution is thus unsymmetrical and the representative, or typical, observation is much smaller than the statistical average—which reflects the disproportionate weight of the few very large observations. (In fact, the distribution is only made symmetrical by translating the raw observations into the logarithms of themselves; hence the name lognormal distribution.)

Ghawar is the dominant brute fact in the lognormal size distribution of the world's known oil fields. A measure of this dominance can be understood by recognizing that Saudi Arabia—and principally Ghawar—accounts for 25 percent of the proven world crude oil reserves. Moreover, many believe that were it motivated to do so Saudi Arabia could substantially increase its productive capacity above the current 10 million barrels per day by a program of relatively low-risk exploratory and developmental drilling—perhaps to 15 to 20 million barrels per day. Therefore the 25 percent of world-proven reserves accounted for in Saudi Arabia by Ghawar and the lesser fields is apt to be an underestimate of the prominence of the Saudi crude oil potential in the distribution of the world oil resource base.

Oil was discovered in Saudi Arabia in the 1930s, but Saudi oil production did not begin to be a significant factor in the world energy supply and demand balance until after World War II. Initially, in terms of production statistics, the output of Ghawar was indistinguishable from the output of the other large oil fields in the Middle East—and all were increasing output at prodigious rates. But gradually the lesser fields, although all giants in their own right, fell by the wayside, and Ghawar emerged preeminent.

The unusually low energy costs that we experienced in the period

⁶This context is global. Were the context limited to the United States of a particular era, its name would be East Texas. But the force of the principle would be the same, although its details would differ.

from the end of World War II through the early 1970s were determined by the accommodation of the world energy supply and demand balance to the integration of the Middle East crude oil resources—and especially Ghawar—into the equation. As observed earlier, that integration is now complete, although many of our policies and perceptions are still conditioned by that experience. To this we will shortly turn. As a final matter of background, however, it is appropriate to speculate concerning prospective conditioning factors for the development of energy markets.

Driven by Ghawar and the Middle East, we have recently enjoyed several decades of unusually low energy costs. In the 1970s, although nominal dollar world oil prices rose sharply, the real prices of refined products such as gasoline now approximate levels circa 1929 and are, therefore, not unusually high in historical terms. This does not mean that the transition to a new market balance has been smooth and easy, but neither has it been a calamity. And the new market balance will principally differ from the old in matters of degree rather than kind. Oil will still be the fuel to beat. The market-tested triangle of oil, coal, and natural gas will overwhelmingly dominate world energy usage for the balance of this century and well into the next. The great, blind, groping, callous, but unmalevolent simultaneous equation system that determines prices, quantities, and market shares for these three fossil fuel contenders will continue to perform the iterations that spell success or failure and ease or hardship for this or that market participant.

The fundamental circularity of simultaneous systems befogs the question of whether coal and natural gas will set the ceiling that oil cannot exceed, or whether oil will set the target to which coal and natural gas can rise.⁷

The lessons inherent in this perspective are, I think, clear. There are limits beyond which the price of oil cannot rise on a sustained basis. Those limits are set by the alternative costs of competing fuels and the interaction of total energy supplies with demands that reflect the full effects of price-induced conservation. Attempts to cushion consumers from the full opportunity costs of their use of energy are apt to distort consumption and production patterns in ways that do more harm than good.

In historical terms, current and prospective world energy prices

⁷However one thinks of the target/ceiling problem, of course, the wellhead and minemouth prices of natural gas and coal must be net of transportation, storage, handling, and environmental costs and benefits.

are not unusually high and are not inconsistent with major advances in the well-being of mankind. Nevertheless, the world energy economy has recently been through a shock. That shock, from the long view, was less the popular trauma of the 1970s and more the insidious seduction associated with the integration of Ghawar into international commerce. That integration is now complete, although its progress was accompanied by various episodic policy responses such as mandatory oil import quotas and market demand prorationing in the United States.⁶ There is, however, one major U.S. primary energy policy problem remaining from this era: the question of natural gas pricing.

U.S. Natural Gas Pricing Policy: An Unrealized Opportunity

For natural gas, the interventionist hand is very visible. The Supreme Court ruled in the *Phillips* decision in 1954 that the Natural Gas Act of 1938 applied to the wellhead prices of natural gas sold in field markets by producers in addition to applying to interstate pipeline transmission company tariffs. Since then, a regime of wellhead ceiling price controls for natural gas sold in interstate commerce has been in place. The litigation involved in the struggles of the Federal Power Commission (FPC) to come to grips with the responsibility of formulating and administering a scheme of regulation to apply to the thousands of gas producers and tens of thousands of contracts for the production and sale of natural gas in interstate commerce is part of the arcane lore and tradition of U.S. energy policy.

In addition, since the time of the *Phillips* decision, a number of attempts have been made in Congress to remove ceiling price controls from the wellhead price of natural gas, but so far none have succeeded, including the Natural Gas Policy Act of 1978 (NGPA). The NGPA is actually a more byzantine set of ceiling price controls than the obsolescent FPC system it replaced. Further, it is a serious misnomer to call the NGPA a deregulation bill. To understand the origins and regulatory reach of the NGPA, and the potential mischief it may do, one must understand the historical relation between the interstate and intrastate markets.

At the same time that wellhead ceiling price controls applied to

⁶These and other policy questions are addressed in considerable detail in Craufurd D. Goodwin, ed., *Energy Policy in Perspective* (Washington: Brookings Institution, 1981). With the exception of Neil DeMarchi's sparkling chapters, this is a somewhat uneven book that suffers from a "who-was-on-first" point of view rather than a "what-was-the-game-all-about" perspective.

sales on natural gas in the interstate market, there existed side-by-side with the interstate market a set of unregulated intrastate markets. Gas produced and consumed in the same state (i.e., intrastate) was generally not subject to FPC wellhead ceiling price controls. For years the regulated interstate ceiling prices acted as a *de facto* cap on unregulated natural gas sales in the intrastate markets. Industrial growth in the intrastate markets increased the demand for natural gas in the producing states, and in the late 1960s some sales of natural gas in the intrastate markets were made at wellhead prices in excess of the interstate market ceiling prices. In the early 1970s the interstate market ceiling prices became more and more out-of-date, and as demand for natural gas continued to increase in the intrastate markets, wellhead prices in the intrastate markets broke sharply away from the FPC interstate market ceiling prices.

Supplies increased in the intrastate markets, and the natural gas markets in the producing states were clearing at price levels for new gas supplies that exceeded interstate ceiling prices by more than one dollar per MCF. At the same time, it had become clear that the interstate market was not clearing at the FPC ceiling prices, production was exceeding reserve additions, and a shortage of natural gas in the interstate market had been created. The combination of new intrastate supplies and price-induced conservation, particularly in the intrastate industrial sector, resulted in an intrastate productive capacity that exceeded intrastate demand. This was in stark contrast to the interstate market in which deep curtailments were being experienced. Thus we had on the one hand a set of unregulated intrastate markets that were working smoothly and a regulated interstate market in which shortages, queues, end-use controls, curtailments, and hook-up moratoria were endemic. The maxim that second to bombing, the best way to destroy a city is rent controls was being illustrated by ceiling price controls on interstate natural gas.

One FPC response to this problem was to begin to revise upward the interstate ceiling prices, but the initial price adjustment responses were too tentative and timid to provide a solution. A second avenue of regulatory response initiated by the FPC was to create certain categories of emergency sales through which intrastate gas could temporarily flow into the interstate market, but various legal and jurisdictional questions, together with the fact that emergency sales did not directly address the underlying question of regulation-induced shortage, made emergency sales an inadequate procedure.

At the same time, a series of legislative initiatives in Congress

began again to address the question of whether ceiling price controls in the interstate natural gas market were in the broad public interest. In 1976 deregulation legislation passed in the Senate but failed by two votes in the House. That left the ball in the regulatory arena. In 1976 in Opinions 770 and 770-A, the final general action by the FPC in establishing interstate ceiling prices at the wellhead for natural gas sales was to raise the price for new gas to approximate parity with the average new gas prices being paid in the intrastate markets.

The NGPA of 1978 built on the price adjustment initiatives taken by the FPC in Opinions 770 and 770-A. In addition, the NGPA imposed a framework that removed many of the ambiguities about interstate market access to the temporary surplus of natural gas in the intrastate markets. In his 1976 campaign for the presidency, Jimmy Carter proposed to work with the Congress to achieve deregulation of the price of natural gas, but his legislative proposals in 1977 did not reflect this proposal and instead extended ceiling price regulation to the intrastate markets.

This extension solved many of the legal and jurisdictional issues that had plagued the old emergency sales procedures. The shortages in the interstate market were temporarily ameliorated by the NGPA as a result of giving interstate pipelines access to new reserves and existing productive capacity in the intrastate markets at prices that had allowed the intrastate markets to clear. But the NGPA has not solved the larger and longer-run problem of inadequate U.S. natural gas reserve additions.

In round numbers, total natural gas production in the United States has been about 20 trillion cubic feet (TCF) per year in recent years. This has been divided approximately 60/40 between interstate and intrastate sales, with interstate sales of about 12 TCF per year and intrastate sales of about 8 TCF per year. In addition to being about 50 percent larger than the intrastate markets, the legacy of ceiling price controls and regulated contract provisions meant that the interstate market was much further out of equilibrium than the intrastate markets. Thus it is not surprising that replicating the intrastate markets' price adjustments in the interstate market — which is a principal, approximate effect of the NGPA — has been insufficient to allow the larger, more disequibrated, interstate market to clear. In addition, because the two markets are now together within the framework of the NGPA, there is a possibility that future natural gas shortages may be disproportionately shared by the previously well-functioning, historically unregulated intrastate markets.

The United States has recently been producing and consuming about 20 TCF of natural gas a year while adding only about 10 to 15 TCF per year to reserves. This ultimately untenable relationship has been the focus of the regulation-induced shortage. Since 1970 production has exceeded reserve additions every year. In effect, we have been living on our inventories. In fact, the U.S. inventory of proved reserves has fallen from about 290 TCF at the beginning of the 1970s to about 190 TCF at the close of the decade. Obviously this trend cannot continue indefinitely. Either reserve additions must soon be brought up to parity with production, or production and consumption will be inexorably constrained by reserve additions.

The current "bubble" of natural gas deliverability does not make this prospect less sobering. One can think of natural gas production, development, and exploration as rather like a supermarket. Production is analogous to consumers taking goods off the shelves; development is moving goods from the stockroom to the shelves; and exploration is the arrival of new delivery trucks. The current deliverability bubble is the equivalent of putting stock clerks on roller skates so that inventories can be moved more rapidly from the stockroom to the shelves. But not enough trucks are arriving at the loading dock to keep the stockroom from becoming increasingly bare. This is the longer-run shortage of reserves additions for which the NGPA is an insufficient remedy.

There is no fundamental geological reason why the balance between current production and reserve additions cannot be restored at a level that permits domestic conventional natural gas to continue to make at least its present contribution to the overall U.S. energy supply and demand balance. Natural gas now accounts for over 25 percent of total U.S. energy consumption and is the largest single domestic source of primary energy production with nearly 40 percent of U.S. production (after excluding oil imports). Estimates of the undiscovered resource base are very large. Drilling and drilling capacity respond positively and significantly to economic incentives. Private geophysical estimates are that less than 5 percent of the potential gas- and oil-bearing sedimentary deposits in the United States have been tested by the drill bit.⁹

In response to crude oil price decontrol, over 3,800 drilling rigs were active in the summer of 1981, a 100 percent increase relative

⁹See for example the testimony of Dr. Harry C. Kent, Director of the Potential Gas Agency, Colorado School of Mines, before the Subcommittee on Fossil and Synthetic Fuels of the Committee on Energy and Commerce, United States House of Representatives, June 9, 1981; United States Department of the Interior Geological

to the average rig count in 1977. New records for rig activity are being set nearly every week. The industry is adding rigs at a rate in excess of 2.5 per day, or nearly 1,000 per year, but this current surge in drilling is in response to higher economic incentives for domestic oil production and is not now spilling over into gas well drilling. Less than 20 percent of U.S. natural gas production comes from oil wells. The vast majority of gas production comes from gas wells intentionally drilled as gas wells, so an increase in oil well drilling will not solve our gas supply problems.

There is, however, a particular area of exploration for domestic natural gas where activity has been increasing and which simultaneously illustrates responsiveness to economic incentives, the potential of the natural gas resource base, and the problems of the NGPA. This is deep gas. Deep gas from gas wells completed below 15,000 feet is deregulated under the NGPA. The cost of drilling is an exponential function of depth, but there is no magic in an arbitrary line at 15,000 feet. Deep wells now account for about 1 percent of total gas production. Because so much of the demand pressure for new reserve additions is concentrated on this tiny sliver of deregulated supply, and because prices paid for deep gas are "rolled-in" with low-priced gas under price controls, pipelines can bid very high prices for deep gas and still remain competitive with alternative fuels at the burner-tip with the weighted average cost of their mix of gas supply. As a result, some of the wellhead prices being paid for some deep gas are in the range of \$6 to \$8 per MCF.

Not surprisingly, drilling targeted at high-cost deep gas has been increasing rapidly, although it is still a very small fraction of total drilling activity, and very impressive deep gas finds are being made.

The problem with the NGPA that this good news illustrates is very straightforward. In July of 1981 the "incentive" ceiling prices for ordinary new gas supplies ranged from \$2.45 to \$2.85 per MCF. The average gas well is 5,000 feet deep. It defies geologic and economic logic and commonsense not to believe that there are substantial new natural gas supplies that lie between 5,000 and 15,000 feet and would be cost-effective at prices above current NGPA ceiling prices but well below prices now being paid for deep gas.

If deep gas had to compete with increased supplies of medium-depth gas, deep gas would not now command the pathological

Survey, *Estimates of Undiscovered Recoverable Resources of Conventionally Producing Oil and Gas in the United States*, Open File Report 81-192; Pitts Energy Group, map of untested potential sedimentary deposits in the United States, 1977.

prices being generated by hothouse economics. The NGPA in effect creates a self-imposed embargo on access to many geological prospects that are less than 15,000 feet and would be cost-effective at deregulated prices. As a result of the regulatory distortion of market prices for deep gas, society will expend a greater level of resources to achieve any given level of gas supply than would be the case under a more universal price-deregulation strategy.

In addition to deregulating deep gas, the final version of the NGPA enacted by Congress contained provisions for deregulation of certain other categories of gas in 1985 but prolonged ceiling price controls until that time. The categories of gas to be deregulated in 1985 include some, but by no means all, of the new gas discovered and developed under the NGPA and some gas flowing in intrastate commerce prior to the passage of the NGPA. According to various estimates, somewhere between 40 and 60 percent of gas production will be deregulated *if* the deregulation provisions of the NGPA are allowed to operate as scheduled on January 1, 1985. In addition, after a six-month hiatus, controls may be reimposed by the president for a subsequent eighteen-month period. Thus in terms of both the magnitude of gas production remaining under ceiling price controls and uncertainty concerning the operation of those deregulation provisions contained in the NGPA, the popular conception of the NGPA as a deregulation mechanism is inappropriate.

The ceiling price regime for new gas contained in the NGPA was pegged to a projection of world oil prices of \$15 per barrel in 1985 (in 1977 dollars). This projection has proved to be far too low, and is an impediment to the operation of those partial deregulation provisions that do exist in the NGPA. The actual prices for new natural gas established under the NGPA can best be viewed as a continuation of the regulated ceiling price trajectory established by the FPC in Opinions 770 and 770-A. Courageous and admirable though Opinions 770 and 770-A were, they were essentially a regulatory attempt to play catch-up ball with the intrastate prices for new gas in the mid-1970s. In terms of world oil prices, the energy market circumstances of the 1980s are not those of the mid-1970s. The 1980s are a new ballgame.

Deregulation of wellhead prices for natural gas, however, is the appropriate strategy to bring new discoveries into balance with production. New discoveries of natural gas can be made only as a result of drilling wells. The record of the 1970s has several broad lessons for us to consider. First, as is indicated in table 1, successful gas completions respond to higher economic incentives. Second, although the increase in economic incentives that occurred during

TABLE 1
SOME PERSPECTIVE ON DRILLING

Year	Successful Gas Completions	Annual Increase	Comment
1970	3,840		
1971	3,830	- 0.3%	Intrastate prices break away from FPC ceiling prices
1972	4,928	+28.7	
1973	6,385	+29.6	
1974	7,240	+13.4	Intrastate market clears
1975	7,580	+ 4.7	
1976	9,085	+19.9	Opinions 770 and 770-A spur total drilling
1977	11,378	+25.2	
1978	13,064	+14.8	
1979	14,681	+12.3	Movement toward market-clearing prices moderated by NGPA
1980	15,730	+ 7.1	

the 1970s was sufficient to arrest the downward trend in reserve additions that began in the late 1960s, it has not been sufficient to create reserve additions equal to the rate of production. The result has been continued year-to-year declines in the level of proved reserves.

Under the NGPA, year-to-year percentage increases in gas well completions have been steadily winding down. The first quarter of 1981 is actually down 5 percent from the first quarter of 1980. To be sure, these most recent gas well drilling data reflect a short-run oil tilt in the allocation of drilling effort, but the longer-run trend was clearly apparent prior to the decontrol of crude oil prices.

Finally, the Natural Gas Policy Act of 1978, titanic legislative struggle though it was, can best be viewed as a congressional ratification and extension of the policies established in 1976 by the FPC in Opinions 770 and 770-A. The record of year-to-year declines in the percentage increases of successful gas completions displayed in table 1 indicates that the movement toward national market-clearing prices for natural gas has begun to moderate under the NGPA. It is unlikely that the market will clear under the NGPA.

Conclusions

U.S. energy policy in the twenty-five years after World War II was driven by the responses required to accommodate the integration of Ghawar and the other large oil fields in the Middle East into

the world energy supply and demand network. Although there was no overarching rationalization in terms of a "national energy plan," there was a visible hand of piecemeal intervention. By the early 1970s the Middle East was integrated into the system, and the stop-gap U.S. policies of mandatory oil import quotas and market demand prorationing were no longer necessary and became defunct. The 1970s, then, became a period of searching for a new, now explicit, rationale for U.S. energy policy. Despite the best efforts of our political leadership, we muddled through the 1970s and may now be moving toward a consensus. The linchpin of that consensus is the recognition that the world price of oil is a fact of life, our domestic production and conservation decisions should be geared to that fact of life, and the costs and risks of our participation in the world oil market can be reduced by acting accordingly.

Thus in the past decade we have dealt with our energy policy problems in an incomplete and unsatisfactory way. It is true that substantive progress has been made, in that we see more clearly the nature of the required solutions. But much of the same agenda with which we entered the 1970s remains before us. Our energy policy problems are real problems. New supplies cannot be cheaply and instantaneously created. The transition to efficient energy markets that rely on market-clearing prices, competitive allocation, and price-induced conservation to achieve the best and highest-valued uses will not be painless. Nowhere in the regulatory arena is the immediate potential for benefit from reform greater and more apparent than for natural gas.

The Natural Gas Policy Act of 1978 can best be viewed as a way station on the journey to a future resolution of the national energy policy issues involved in the pricing of natural gas at the wellhead. In addition, how we deal with the NGPA will be an indication of how we intend to deal with the future organization of the economy in general. The NGPA extended ceiling price controls to previously unregulated intrastate markets and prolonged them for the interstate market. Interstate market ceiling price controls that were too inflexible to respond quickly and properly to energy market realities were the cause of the natural gas shortages of the 1970s and have now been extended to the total gas market. There is no longer an unregulated market indicator of sufficient size to provide an alternative standard of comparison to regulated results.

Nevertheless, in terms of simple price adjustments alone, the decade of the 1970s saw substantial movement for natural gas in the direction required for a rational national energy policy. Now a perception is growing that deregulation of wellhead markets for

natural gas is necessary and desirable. There is another dimension as well: finding the political will required to end the self-imposed restrictions that encumber the operation of the process and inhibit us from addressing the fundamental questions. In this regard we now stand on the threshold of new initiatives. With what should we replace the visible hand of activist intervention? May I suggest the translucent hand that restrains our tendencies to intervene.