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BOOK REVIEW


Reviewed by William H. Miernyk.**

Introduction

Future historians of ideas will surely be impressed by the plethora of energy studies published during the 1970's. A careful review of the literature would surely lead them to conclude, however, that never was so much written about a single topic with so little impact on public policy or individual behavior.

Most of the energy reports published within a year or two of the 1973 oil embargo became dated soon after they appeared. The authors of some, particularly those predicting the early demise of OPEC, would probably be just as happy if all vestiges of their wildly optimistic projections for the continued availability of cheap energy could be swept away. Since OPEC did not collapse, and since oil (and other energy) prices rose faster than the general price level, a number of energy study groups were later established to examine the problem in a more systematic way, and to report the results of their studies after due and careful deliberation. The most famous of these reports, by a wide margin, is the volume under review. And although it is a rare event when any book with even modest scholarly pretensions makes the nation's best sellers' list, this was the happy fate of Energy Future.

The popular success of the book is not hard to understand. It appeared at a time when the "energy crisis" was forcibly brought

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* In addition to Stobaugh and Yergin, contributing authors include I.C. Bupp, Mel Horwitch, Sergis Koreisha, Modesto A. Madigue, and Frank Schuller.
** B.A., M.A., University of Colorado; M.A., Ph.D., Harvard University; Benedum Professor of Economics and Director, Regional Research Institute, West Virginia University.
to the attention of millions of Americans by the gasoline shortages of the summer of 1979. Although their counterparts in Great Britain and Western Europe pay much higher prices for gasoline, many Americans appear to believe that they have a "right" to be sold all the gasoline they want at "reasonable" prices. When, for the first time since the rationing days of World War II, American motorists were unable to buy all the gasoline they wished to consume, their reaction in many cities bordered on hysteria. Addressing a topic of immediate interest to the vast majority of Americans, Energy Future could not have appeared at a more opportune time.

The timeliest book in the world will not make the best sellers' list on the strength of its content alone, however. Best sellers have to be well written, and Energy Future is a finely crafted book. Much of the credit for this is probably due to the editorial hand of Daniel Yergin, who has written lucidly for the general public in the New York Times Magazine and other publications which insist on readable prose.

Not all parts of the book will be given equal attention in this review. And the chapters will not be reviewed seratim. In fact, the review will begin at the back of the book by considering first its only appendix. Also, more attention will be paid to the chapter on coal than to those dealing with other forms of basic energy.

Energy Models

One of the more rapidly expanding fields of economics during the past decade or so is called "econometrics." It is a relatively new field which attempts to integrate economic theory with mathematical and statistical analyses. Although courses in econometrics were not taught even in the nation's leading graduate economics departments until the late 1950's, it would be unthinkable today to award anyone an advanced degree in economics without at least one course in this esoteric, and still highly experimental, field.

The word "model" usually refers to a small-scale replica of a larger working object. There are flying model airplanes, for example, which follow the same laws of aerodynamics as their full-scale counterparts. And some model automobiles reproduce in minute detail the characteristics of actual cars. An econometric model, however, is a system of interdependent equations. Econome-
Econometricians attempt to include as many relevant variables as possible in their models, and they try to describe the correct relationships among these variables by the appropriate choice of equations. Because of the complexity of economic systems, however, even the most elaborate econometric model must be recognized as an abstraction.

The energy crisis was a boon for econometric model builders. A number of energy models were hastily assembled in response to former President Nixon's Project Independence. Subsequently, there was an almost explosive proliferation of such models during the formulation of the National Energy Plan, and a further stimulus was provided by the enactment of the omnibus National Energy Conservation Policy Act\textsuperscript{1} in 1978.

The editors of Energy Future assumed, no doubt correctly, that general readers would have little or no interest in econometrics, so they relegated their discussion of energy models to a thirty-two page appendix entitled "Limits to Models." (P. 234). Written by Sergio Koreisha and Robert Stobaugh, it is an excellent treatment. Many economists would no doubt consider it to be the most interesting part of the book.

The authors could not systematically survey all of the published models because "they number in the dozens, perhaps even in the hundreds." (P. 235). Instead, they chose to select the three most prominent ones for detailed examination. These models, they point out, are taken quite seriously not only by policy makers but also by the business press. They then suggest that much of the attention given to the models, and to the econometricians who build and manipulate them, is due to their mystique. Although it is unlikely that a single Senator or Congressman understands the inner workings of an econometric model, who can help but be impressed by its several hundred equations, or the flow diagrams which describe it with various boxes and interconnecting arrows?

It is clear, however, that Koreisha and Stobaugh are not dazzled by such models, and in this appendix they explain the rea-

sons for their reservations. They discuss succinctly, but pointedly, the substantial limits of econometric models. These include:

*Exclusion* — any factor not included in a model is assumed to have no effect on the conclusions. Consequently, the reliability of the conclusion is limited by the extent to which the excluded factors actually do affect it.

*Aggregation* — unlike data are combined in many models to reduce the number of variables to manageable proportions.

*Range* — econometric models are “specified” and solved in terms of past economic data. The past, therefore, prescribes a range of variation for future performance. If the future were exactly like the past, forecasts would remain within this range. But the more the future becomes unlike the past, the greater the gap between what has been projected and what actually happens.

*Reversibility* — models are built upon the assumption that causation is reversible. For example, if lower prices caused increased consumption in the past, higher prices should result in reduced consumption in the future.

The mathematical and statistical complexity of econometric models can easily mislead laymen into believing that the state of the art is highly advanced. But the necessity of relying on such oversimplified assumptions as those listed above, and others not mentioned in this appendix, demonstrates that the current state of econometric model building is somewhere between the Stone Age and the early Bronze Age in mankind’s intellectual history.

Mssrs. Koreisha and Stobaugh conclude their survey with a summary statement:

> [M]odels can be extremely useful in the formulation of energy policy. They provide a framework for decision-makers to make intelligent choices. They facilitate the evaluations of the influences of the various factors that affect the decision. Furthermore, they allow decision-makers to test their ideas “on paper” without manipulating the actual system. But a model is not reality.

(P. 265)(emphasis in the original). This is a typical, cautious *Energy Future* conclusion. After an analysis of the most obvious weakness of econometric models, the authors still say that such models “can be extremely useful.” They avoided stating, however, that the models *have* been useful. Indeed, since the nation’s en-
ergy policy has not been effective, this would have been a questionable conclusion. Still, why offend the econometricians?

In fact, why offend anyone? The best way to avoid giving offense — as any seasoned politician knows full well — is to be vague and equivocal. This evasive tone not only characterizes the section on econometric models, it dominates the entire book, which ultimately proposes a “balanced energy program” that has a little something for everyone and, at the same time, skillfully avoids antagonizing the various single-issue groups that have coalesced in our society to attack a host of political, social, environmental, and economic problems — real or imagined.

Oil

The book’s first two chapters, written by Robert Stobaugh and Daniel Yergin, discuss the end of “easy oil” and the “threat of imported oil.” The story is neatly summarized in a table on page eighteen. Oil consumption in the United States increased from 9.7 million barrels daily in 1960 to 19 million barrels in 1979. Domestic production during this period, however, only increased from 8 million barrels per day to 10 million. The deficit was made up from imports, which rose from nineteen percent of total domestic consumption to forty-seven percent during these two decades.

By 1977, the authors point out, petroleum accounted for half of the country’s energy consumption (p. 15). This share has probably increased slightly since then. Prices quadrupled after the 1973 oil embargo and have continued upward since then. As a consequence, the country has suffered a steadily rising deficit in its balance of payments, which, in turn, has been a major cause of the weakening of the U.S. dollar in world money markets and of inflation at home.

The authors have a short, but probably adequate, discussion of domestic oil policy. They are doubtful that elimination of price controls would add significantly to domestic production, a view rather widely shared among energy specialists.

They are not sanguine about the economic feasibility of pro-

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* The cost of imported oil was sixty billion dollars in 1979 and is expected to rise to seventy-five billion dollars in 1980. Bus. Week, Jan. 28, 1980, at 74.
ducing oil from shale. Three decades ago, they maintain, chemical engineers claimed that if oil prices went up twenty percent, oil from shale would become economically feasible, but some engineers and promoters still say the same today (p. 43). If this twenty percent gap remains constant, they suggest we will never be able to produce oil from shale. Stobaugh does add that the dim outlook for oil from shale is based on his judgment (p. 281), however, and he is not known for his technical competence in this area.

The authors then address a more salient public concern. One of the more durable beliefs of Americans is that there is no “energy shortage.” As poll after poll has shown, a majority of citizens believe that higher energy prices are a deliberate result of the monopolistic behavior of the giant oil companies. This belief is given sustenance by conservative economists who suggest that all would be well if only free markets were to become ubiquitous.

Those who subscribe to these beliefs want to dismember the oil corporations. If this would happen, the free market proponents assert, aggressive competition would stimulate new oil discoveries, increase production, and reduce prices. Stobaugh examines the issue and concludes that “there is no evidence that divestiture would lead to greater domestic supplies of oil” (p. 45) (emphasis in the original). Experts familiar with declining oil reserves would quickly agree that this sort of legal action will neither augment oil supplies nor spur production.

Natural Gas

The third chapter, by I.C. Bupp and Frank Schuller, considers natural gas. Subtitled “How to Slice a Shrinking Pie,” it adds little to what is already known about dwindling natural gas reserves. The authors view the prospect of major new discoveries with pessimism and conclude that the nation should not rely on an increased use of this basic energy source to stop the rise in oil imports. “Indeed,” they say, “it will be a challenge to find enough new gas reserves to maintain production at current levels.” (P. 78).

Their discussion of conventional natural gas and liquified natural gas is a fair summary of the traditional views concerning these fuels. However, this is one of the weaker chapters of the
book. Despite the extensive documentation of the section, the authors fail to analyze adequately a number of important issues. Specifically, their treatment of the extensive deposits of gas-bear-
ing Devonian shale found in parts of central and southern Ap-
palachia, which could have important influences on the choice of location for certain kinds of manufacturing industries, is entirely superficial. In addition, the importance of coal gasification is deemphasized in a discussion that is outdated and too brief to be useful.

**Nuclear Power**

Chapter 5, also by Bupp, discusses the nuclear "stalemate." Each of the major points in the nuclear controversy is discussed briefly, with the questions of safety and disposition of nuclear waste occupying much of the chapter. Although the advocates of nuclear energy believe that it is the only source capable of fulfilling a great proportion of our energy needs during the rest of this century, Bupp concludes that "there is simply no reasonable possibility for 'massive contributions' from nuclear power [in the United States] for at least the rest of the twentieth century." (P. 135). Indeed, he points out, unless the regulators and the industry leaders are able to reach a compromise with the nation's nuclear power critics, a number of plants currently in operation will run out of space for spent-fuel storage within a few years. The chapter ends with the assertion that the nuclear power industry faces a dim future in this country for the next two decades and "offers no solution to the problem of America's growing dependence on imported oil" during that period (p. 135) (emphasis in the original).

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3 Documentation throughout the entire book is impressive. Following the 265 pages of text, there are 72 pages of references.

4 Gas from Devonian shale flows at a very slow rate, compared with conventional wells, but Devonian shale wells have much longer useful lives than conventional gas sources. While conventional wells last, on the average, about four years, it is not uncommon for Devonian shale wells to maintain a fairly steady flow for 40 or even 50 years. See U.S. DEP'T OF ENERGY, PROCEEDINGS OF THE FIRST EASTERN GAS SHALE SYMPOSIUM, (March 1978); U.S. DEP'T OF ENERGY PREPRINT FOR THE SECOND EASTERN GAS SHALE SYMPOSIUM, (Oct. 1978); U.S. DEP'T OF ENERGY PRO\nCEEDINGS OF THE THIRD EASTERN GAS SHALE SYMPOSIUM, (Oct. 1979) (these three symposia, held in Morgantown, W. Va., were sponsored by the Morgantown Energy Technology Center (formerly the Morgantown Energy Research Center)).
Chapter four, entitled "Coal: Constrained Abundance," was written by Mel Horwitch, with the assistance of Frank Schuller. Before the publication of this book Horwitch's name was not widely known in the coal research community, and his work in this chapter is based entirely on secondary sources.\(^5\)

The chapter begins — as have so many recent discussions of coal — with the statement that "coal has been rediscovered," (p. 79) and goes on to point out that coal is America’s most abundant fossil fuel, another well-known fact. Although the production of coal had started to rise quite sharply as early as 1961, and prices had started to rise as early as 1969, Horwitch attributes the rediscovery of coal to the oil embargo of 1973. Regardless of the exact period in which a renewed interest was shown, Horwitch correctly reports that a frenetic reaction to the oil embargo may have exaggerated expectations about the short-term future of the coal industry in the United States.

In President Carter's National Energy Plan (April, 1977), coal was given a major role. The plan called for an eighty percent increase over the amount produced in 1976, and this increase was to occur by 1985. This would be the equivalent, Horwitch points out, of increasing domestic oil production from about 7.9 million barrels per day to about 14.5 million over this period (p. 80). However, he contends that a "ubiquitous and diverse set of obstacles stands in the way of reaching the original Carter short-term goal of 1.2 billion tons by 1985" (pp. 81-82). These comprise the constraints referred to in the title of his chapter, discussed below.

The System. Under this rather strange subheading, Horwitch first discusses public policies designed to stimulate the demand for steam coal. These included the Energy Supply and Environmental Coordination Act of 1974,\(^6\) which authorized the Federal Energy Administration to order power plants to convert from oil or gas to coal. By mid-1977, 74 conversion orders had been issued,

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\(^5\) Although Horwitch apparently conducted no interviews, he lists one reference to a private communication with Harry Perry, who has written extensively about coal and other energy matters.

but only 15 had been approved by the Environmental Protection Agency. Horwitch fails to point out that all 15 of these cases were taken to court as a delaying tactic.7

The Carter Administration shifted its policy early in 1979, however, to encourage the short-term use of natural gas instead of coal. The uncertainty which these policy shifts and maneuvers created has undoubtedly slowed the expansion of coal mining capacity. Another "systemic" barrier, to use Horwitch's term, is the transportation system, particularly the railroads. The railroads are well-developed in the East, but there is inadequate rail capacity in the West to haul the projected output of western surface mines. But the future of western coal production also remains uncertain because of the Clean Air Act of 1970 and its subsequent amendments.8 Uncertainty about the development and installation of pollution abatement equipment compounds the problems of the western railroads, Horwitch believes. These and other systematic barriers have "slowed down the rush to mine western coal" (p. 90). The problems Horwitch describes are real and important. The primary cause of the slowdown in coal production, however, was the continued rise in oil imports despite the massive price increases since 1973. He might have added that the same combination of factors have slowed the expansion of output in eastern fields as well.

Environmental Barriers. Horwitch discussed some of the environmental constraints on coal production in the preceding section. In this section he elaborates on what he considers to be the second major hurdle to increased coal utilization; its "troublesome attribute of generating a seemingly endless string of environmental hazards that are ubiquitous and pervasive" (p. 91). He feels that as soon as one hazard, such as sulfur dioxide emissions, is "identified and solved," another possible environmental dan-

7 The 15 approved orders were delayed by litigation brought by the affected utilities. Although not noted by Horwitch, this point was made in an address by Irving Hoch to the Conference on a National Policy Toward Regional Change: Alternatives to Confrontation, Austin, Tex., Sept. 24-25, 1977.


* Although there has been some progress in the removal of sulphur dioxide from coal-fired combustion, the problem has not been solved. For the estimated
ger associated with coal, such as carbon dioxide emission, becomes a source of controversy (p. 91). He goes on to list other environmental problems such as acid mine drainage, surface subsidence, and black lung disease, and considers governmental efforts to control their effects, such as the Surface Mining Control and Reclamation Act of 1977, as further constraints on the expansion of coal utilization.

*People Barriers.* Unlike the other industries which produce basic forms of energy, coal mining is labor-intensive (Horwitch calls it "people-intensive") (p. 94). He gives a sketchy history of the development of the United Mine Workers, and describes briefly the effects on productivity of the federal coal mine health and safety laws. He concludes this section by discussing the anomaly of the endemic poverty which exists in the coal fields despite the high average wages of coal miners. In spite of the increasing affluence of the miners, he says, "old and deep-seated social problems remain" (p. 97). Among these he includes labor productivity and motivation, managerial thinness, distrust of coal operators, and social insecurity. Although he feels that these problems can be resolved, in his view they continue to constrain the production of eastern coal in the short-term.

Turning to the long-term, Horwitch discusses the entry of some of the nation's large oil companies into the coal business, generally by way of merger. The first one he mentions is the acquisition of the Consolidation Coal Company by Continental Oil in 1966. Similar acquisitions by Standard Oil of Ohio, Occidental Petroleum, and Ashland Oil soon followed. Horwitch claims that this "large-scale entry" by petroleum firms has become a "source of controversy" which could be another obstacle to the further development of the industry (p. 98).

The controversy, if indeed there has been one, has been mild. After extensive study, the Federal Trade Commission, the agency

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costs of controlling sulphur dioxide emissions, see W. MIRENYK & J. SEARS, AIR POLLUTION ABATEMENT AND REGIONAL ECONOMIC DEVELOPMENT 81-99 (1974).


most likely to be disturbed if energy conglomerates restricted coal production, has expressed no great concern about the monopolistic consequences that might result from increasing concentration in the coal industry.\textsuperscript{12} In spite of the allegedly controversial takeovers of some coal sources by the oil companies, they owned only eleven percent of the 214 mining companies producing more than one million tons annually in the mid-1970's.\textsuperscript{13}

Horwitch then briefly discusses new technologies in coal production and utilization, ranging from continuous mining machinery to fluidized-bed combustion facilities and the synthetic fuel effort. He is not particularly sanguine about the economic feasibility of coal liquefaction and gasification,\textsuperscript{14} but his discussion is inconclusive. Although it appears to lend support to the proponents of synthetic fuels, it also appears to support those who advocate the development of "alternative" energy sources, particularly solar energy.

Horwitch bypasses the synfuel-solar controversy as such and concludes the chapter with a section headed "The Disappointment and the Hope." "[C]oal will not," in his opinion, "become our major near-term solution to the energy problem. Its use, however, will grow, and it will play an increasingly important role in certain sectors" (p. 105). While noting the potential for technological innovation and the emerging indications of long-run strength in the industry, he feels that this country's energy planners must "accept the inevitable disappointment" which he believes is already developing as "it becomes clear that coal cannot be the transitional energy source" (p. 105).

This somewhat gloomy conclusion (from a coal industry perspective) might be the result of relying too heavily on a number of secondary sources whose authors take a basically negative view of coal's potential role in future energy developments. He is right to emphasize the exaggerated expectations engendered by the ini-


\textsuperscript{13} Miernyk, Coal, in Collective Bargaining: Contemporary American Experience 10 (G. Somers ed. 1980).

\textsuperscript{14} For a contrary position on coal gasification, see W. Miernyk & J. Sears, supra note 9, at ch. 6.
tial reaction to the oil embargo of 1973, and he is probably right in his prediction that it is not likely—even though it is not impossible—for output to reach the original Carter goal of a 1.2 billion ton level as early as 1985. Even a simple extrapolation of the recent disappointing growth trend, however, shows that coal production will climb past the 1.1 billion ton level before 1990. An "accelerated" projection based on current and predicted increases in world oil prices indicate a strengthening in coal demand that could easily lift production to the 1.2 billion ton per year mark by 1985.18

The Denouement

This is, as mentioned earlier, a carefully crafted book. Its chapters have not been reviewed seriatim, but by reading them in their natural order one can see the unfolding of the theme. Unlike an equally well-crafted mystery novel, where the denouement comes as a surprise, the authors give numerous clues throughout the book about what to expect in the concluding chapters.

The plot unfolds quickly in chapter 6, entitled "Conservation: The Key Energy Source" written by Daniel Yergin. "There is a source of energy," the chapter begins, "that produces no radioactive waste, nothing in the way of petrodollars, and very little pollution. Moreover, the source can provide the energy that conventional sources may not be able to furnish. Unhappily, however, it does not receive the emphasis and attention it deserves." (P. 136).

What is this surprising "source" of energy? It is, in a word, conservation! Conservation is no less of an alternative, Yergin insists, than oil, gas, coal, or nuclear energy. And it could be more productive in the near-term than the expansion of any of the conventional sources.

But will conservation reduce the standard of living? Not according to Yergin. We could, he believes, "consume 30 to 40 percent less energy" than we do now "and still enjoy the same or an even higher standard of living" (p. 136) (emphasis added). If this is not the best of all possible worlds, it will certainly do until

someone can discover a better one. No major technological breakthrough is required; only "modest adjustments" in the way people live are needed. *Mirabile dictu!*

Yergin identifies three kinds of conservation: (1) curtailment, (2) overhaul, and (3) productive conservation. Curtailment is Yergin's term for the reduction of energy consumption which is forced on us by the interruption of supply — the shortage of gasoline during the summer of 1979 is a good example. Overhaul entails a major rearrangement of ways in which Americans live and work, and other extreme measures which few persons would accept willingly. He believes that neither curtailment nor overhaul would be acceptable to Americans.

The third alternative, productive conservation, encourages "changes in capital stock and daily behavior that promote energy savings in a manner that is economically and socially nondisruptive" (p. 138). This sounds almost too good to be true; we can have our cake and eat it too. Yet Yergin maintains that this is the road to be followed in overcoming our energy problems.

Not surprisingly, there are obstacles. The "major roadblock," to use Yergin's term, is the very character of productive conservation; its complete lack of glamour.

The second obstacle to be overcome in incorporating this alternative is the inability of participants in the energy debate to reach a consensus. In Yergin's view, the traditional energy suppliers (mainly oil producers) dominate the debate, and they are the ones who determine what is to be considered important and what is not.

The third obstacle is the maxim: "Let the market do its work." Yergin believes that there has been too much reliance placed upon the role of prices as a method by which to enforce conservation.

The fourth barrier is "a fundamental misconception about the relation of energy use and economic growth" (p. 141). Although many believe there is a close link between the amount of energy consumed and gross national product, Yergin thinks this is not so. He cites the reaction of the city of Los Angeles to the energy embargo as a case in point. Because of the shortage of oil that occurred in November 1973, the Los Angeles Department of Water and Power adopted an Emergency Energy Curtailment
Plan to mitigate the effects of an expected shortfall in electricity production. All classes of users, residential, industrial, and commercial, were to restrict consumption, and anyone failing to do so was to be punished by a fifty percent surcharge in their monthly electric bill.

Although the goal was to reduce total consumption by twelve percent, the plan actually succeeded in reducing energy use by eighteen percent. Furthermore, even after the restrictions were lifted, the impact of the program remained. In 1975, electricity sales were still eight percent lower than they had been in 1973, and in spite of the reduced consumption of energy there was little sacrifice or disruption. Yergin goes on to assert that this "semi-market" approach is viable on a nationwide basis, citing as an example the fuel savings realized by the implementation of the fifty-five mile per hour speed limit, and the expected fuel savings that should occur by 1985 under the fuel economy standards set by the Energy Policy and Conservation Act of 1975.16

As for the manufacturing industry, Yergin believes that it too could sharply curtail its consumption of energy through "improved housekeeping," through recovery of waste heat and reclamation of waste products, and, over a longer period, through the adoption of new technologies that would increase the energy efficiency of many manufacturing operations. He adds that these changes will not occur automatically, but will require "a strong and persistent interest and commitment by senior management" (p. 155). This is not a surprising conclusion in view of the auspices under which the book was written.

Another potential source of energy efficiency is "cogeneration." Yergin calls it "Industry's North Slope." (p. 157). What this term means is "combined heat and power." It calls for, in essence, using productively the waste heat which is now dissipated into the atmosphere during the generation of power by whatever means.

There are two types of cogeneration. In the first, steam or hot water from a power station is delivered to consumers under a system of district heating. Such systems are common in Europe. The second type produces steam and electricity simultaneously. But

unlike present-day utility plants, electricity is the by-product of generating steam. Steam generated by high pressure is used to drive turbines which, in turn, generate electricity. The steam is not dissipated, however, but is used in industrial processes. This type of cogeneration, Yergin asserts, requires "about half as much fuel...to produce electricity and steam as would be needed to produce the two separately" (p. 159).

What this boils down to is that many industrial establishments would produce their own electricity as well as the steam they need for other purposes. This seems such a sensible approach one might ask: Why hasn't it been followed all along? Yergin has two answers. First, industry was scared away by the regulatory system. Second, the real price of electricity declined steadily during the era of "cheap energy" being cut in half, for example, between 1940 and 1950 (p. 159). In brief, under the conditions that prevailed before 1973, there was simply no incentive to practice this kind of energy efficiency.

Why isn't industry rushing to adopt this major means of saving energy now? Yergin believes it hasn't been given the financial incentives that are needed. The National Energy Conservation Policy Act of 1978 provides a 10 percent tax credit for conservation investment. Yergin thinks this isn't enough. He suggests credits up to 40 percent plus accelerated amortization and energy conservation loans. Yergin cites the Dow Chemical Company—one of the three largest energy consumers in the U.S.—which has managed with relatively little capital investment to increase its energy efficiency by 40 percent. He doesn't suggest that other companies could go this far. "Still," he believes, "the lesson is clear."

Yergin also advocates increased incentives to induce improved efficiencies in buildings such as homes, commercial structures, and factories. His suggestions in this regard range from designing better buildings, in the long run, to "retrofitting" existing buildings by adding insulation, plugging leaks, and installing storm windows and doors, which could be brought about in the near term. He understates his case when he labels the fifteen percent, $300 limit on tax credits for residential investments as

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"rather modest" (p. 173).

It is interesting, although not surprising, that Yergin and his Business School associates do not recommend heavy taxes on gasoline. However, taxation has been the approach followed by the industrial nations of Western Europe to discourage gasoline consumption. Increasing the cost of gasoline is an even more certain method than Yergin's "productive conservation" to sharply reduce reliance on imported energy. Serious curtailment of gasoline consumption would, of course, have fairly obvious and quite severe economic repercussions in the short-run. If gasoline consumption dropped by one-fourth or one-third, the automobile industry and all of its suppliers would be seriously affected. With a minimum of effective planning and enough warning to keep the public from being surprised, however, it might be possible to divert some of the resources now used in the production of private automobiles to the construction of efficient public transportation systems. The authors completely avoid this admittedly controversial, but nonetheless essential, component of any plan which seeks to resolve the energy problem.18

**Toward a Solar America and a Balanced Energy Program**

The penultimate chapter 7, by Modesto A. Maidique, begins by contrasting the extreme forecasts for solar energy19 proposed by its supporters with those of the spokesmen for the oil industry, their opponents. His own view is that, "given reasonable incentives," solar could provide between a fifth and a quarter of the nation's energy requirements by the end of the century (p. 183). This level of solar production would not require major technological breakthroughs, in his view, because the relatively low-level technology needed to provide this share either currently exists or is near at hand.

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19 In the book, the term "solar energy" is used in its broadest sense to include not only energy obtained directly from the sun itself, but also from the wind, the ocean, hydroelectric dams, and fuel or heat from biomass.
What are the possibilities that solar energy will actually be an important part of the nation’s total energy package by the year 2000? Citing a number of projections, Maidique equivocally concludes that it could account for as little as seven percent or as much as twenty-three percent of total consumption by that date. He more firmly asserts that, whatever the amount, solar energy will become increasingly important. He feels that an intensified solar energy program “is a vision — but an eminently practical one” and that it “deserves a fair chance” (p. 215).

Stobaugh and Yergin conclude the book with a chapter headed “Toward a Balanced Energy Program.” Their balanced program would allow for substantial increases in energy consumption during the 1980’s, as compared with 1977, but with some difference in the energy “mix.” For ease of comparison they express everything in “millions of barrels daily of oil equivalent (mbd).” They would have us try to maintain 1977 levels of domestic oil and natural gas production, but at the same time increase coal usage from 7 mbd to 11 and allow nuclear to double from 1 mbd to 2. Solar energy, including hydroelectric power, would grow from 1 mbd to 4. They would hold the line on imported oil at 9 mbd, but would increase imports of natural gas (presumably in liquid form) from a negligible quantity in 1977 to 1 mbd in the late 1980’s. The contribution of conservation would grow from nothing at present to 8 mbd.

Their “balanced” program would thus allow an increase from 37 million barrels of oil daily (or its equivalent) to 54 million, an increase of forty-six percent. This could hardly be called a “conservative” projection by anyone’s standards. If further efficiencies in the use of energy were to be achieved in any significant amount during this period, their program would provide for a substantial increase in the average standard of living; much greater, for example, than that experienced in the United States between 1969 and 1979.

**Conclusion**

What can one say, in summary, as a final evaluation of the most famous book to come out of the protracted discussion of energy matters which started in the early 1970’s? The reasons for its popular appeal are obvious. First, it is a highly optimistic book, and Americans love to be told that the future is bright. Second, it
holds out a bit of that optimism for everyone. Major controversies are carefully avoided, and each of the numerous parties involved in the energy debate can find some part of the book to support their widely divergent positions. The coal industry is told that there will be some expansion of coal. Although the problems faced by the nuclear sector are acknowledged, substantial growth is not ruled out here either. But the real promise of the future, as these authors see it, is the expansion of solar energy and the major savings that could be derived from productive conservation.

This book was clearly not intended for a technical audience, so it is not a serious criticism to say that it contains little in that regard that is new. It is an outstanding example of what good writing and good editing can accomplish. Judged by customary standards it is an overwhelming success. Unfortunately, however, it is doubtful that it will really help educate a public which appears to be badly confused by a babel of voices, each promising its own panacea for problems that disturb us all. The projections, which are in a sense its final end product, should not be taken seriously. Even some segments of the business press have now recognized that the American economy is growing very slowly, if at all.\(^\text{20}\) There is a strong possibility that the 1980's will be characterized by little or no growth. Although this in itself does not mean catastrophe, it will require the implementation of a new set of energy policies based upon a more realistic future than that envisioned by the writers of this book.

The rate of economic growth in the United States, defined as real GNP per employed worker, dropped from 1.9% annually in the 1960's to 0.1% in the 1970's.\(^\text{21}\) If this slow rate of growth continues through the 1980's, as this reviewer believes it will, increases in GNP and the demand for energy will drop below the levels projected in Energy Future. Although it will still be necessary to encourage conservation as well as to discourage consumption by taxation, it will also be necessary to see that the economic burdens of slow growth do not fall unduly on the poor, the unemployed, and those on fixed incomes.

As a final note, it should be mentioned that another energy

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study appeared quietly while *Energy Future* received much public attention and acclaim. This book, *Energy in America's Future*, was written by a number of energy experts at Resources for the Future (RFF). Because it is a more technical book, replete with tables, charts, and graphs, the attraction of widespread public interest is unlikely. For serious observers of the energy situation, however, it will invite comparison with the more popular Harvard study.

Not only are the methods of presentation different, but there are important substantive differences as well. The RFF authors recognize that the economic process involves tradeoffs, and that even with substantial improvements in energy efficiency, a reduction in total energy consumption will entail a reduction in economic output. The message of *Energy Future* is that, if we behave sensibly, we can have our cake and eat it too. The lesson of *Energy in America's Future* is far more consistent with the well-known economic axiom that "There's No Such Thing as a Free Lunch!" It isn't pessimistic, but it is a realistic book. Anyone who becomes euphoric after imbibing the exuberant optimism of *Energy Future* should read *Energy in America's Future* as a mildly tranquilizing antidote.

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23 Authors include S. Schurr (project director), J. Darmstadter, H. Perry, W. Ramsay, and M. Russell.