A Welfare Approach to Energy Pricing: A Case Study for India

by Gopal K. Kadekodi (Institute of Economic Growth, Dehli, India)

Introduction

Because oil crises or other supply constraints distort energy production and demand management, energy pricing remains an important policy instrument of economic management. Moreover, for many developing countries, the problem of energy management includes the pricing of energy products within a framework of planning, as well as questions of supply. In many countries energy production and distribution are now publicly managed. Such public operations have to account for both efficiency in production and equity in distribution. The pricing of energy inputs thus emerges as a key planning parameter. Feldstein (1972a, b,c), Ahmed and Stern (1981), Diamond and Mirrlees (1971), Stiglitz and Dasgupta (1971), Munk (1977), and many others have drawn attention to the problem of pricing public goods. Apart from treating issues of efficiency, several authors have attempted to deal with equity and justice questions by deriving optimum pricing structures for public goods, using an appropriate package of indirect taxes and subsidies. This paper derives optimum pricing rules in the Indian context for three major publicly produced energy resources coal, petroleum, and electricity. The model developed here is somewhat aggregative but the analysis can be extended to disaggregated energy products or consumer groups without limitation. A welfare-maximizing framework is established that takes into account income disparity, and hence divergent social marginal utilities of different consumers.

A Decision Analysis Approach to Energy System Expansion Planning

by James P. Peerenboom (Energy and Environmental Systems Division, Argonne National Laboratory) and Wesley K. Foell (Energy Research Center, University of Wisconsin, Madison, WI, USA)

Capacity expansion decisions are critically important to both public and private-sector energy suppliers as well as regional and national energy planning agencies. Simplistically stated, planning for the expansion of an energy supply system involves determining when and where new energy production facilities of various types and sizes should be deployed
to meet projected demands. As with most energy-related decision problems, several factors complicate capacity expansion planning. These factors include the involvement of multiple decisionmakers and interest groups, uncertainties about technology costs and demand projections, varying degrees of risk associated with alternative energy technologies, the need to consider costs and effects over long time horizons, and the difficulty of quantifying key impacts and concerns. Traditionally, most capacity expansion decisions in the United States have been made on the basis of a single objective, such as the minimization of total discounted system cost. However, as a result of landmark legislation like the National Environmental Policy Act and more-stringent regulations at both the state and national levels, decision- and policymakers must now consider multiple objectives, including not only technical and economic considerations, but also environmental factors, including human health and safety. This article describes a decision analysis framework for treating multiple objective capacity expansion problems. The focus is on an illustrative case study in which the framework was used to analyze long-range strategies for the development of supplemental gas supply systems for Wisconsin.

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Short-Term Price Formation in the U.S. Uranium Market

by A. D. Owen (School of Economics, University of New South Wales, Kensington, NSW, Australia)

Since the establishment of a private market for uranium in the United States in the late 1960s, the industry's fluctuating fortunes have been reflected in the short-term price of uranium as represented by NUExco's "exchange value." Exchange values are current prices for current or near term delivery. While NUExco emphasizes that its exchange value is not a "spot" price in the usual sense of the word, it still is generally regarded as an indicator of uranium spot (short-term) market price levels. My aim is to discuss the major determinants of short-term uranium price formation as reflected by the exchange value. Although government policy and regulation changes, speculation, panic, and lack of information (or knowledge) on the short-term market all play a role, this paper pays particular attention to the effect of inventories in short-term price determination. All references to the price of uranium indicate NUExco's exchange value, expressed in U.S. dollars (unless otherwise specified).

Pages 51-65

Biogas Development in India and the PRC

by V. P. Kharbanda and M. A. Qureshi (National Institute of Science, Technology and Development Studies, New Dehli, India)

The years since the 1973 spurt in oil prices have witnessed a growing interest in renewable energy sources. Increased attention has been paid to the development of
technologies using new and renewable sources of energy, such as solar, wind, tidal, biomass, and hydropower. These sources are all the more important in developing countries with scarce conventional sources of energy like coal and oil. The new and renewable energy resource systems offer attractive prospects because they are pollution-free, unlimited, and often cheap. They can also help preserve ecosystems and retard degradation of the environment. Moreover, renewable energy resources can be developed extraordinarily rapidly, as shown by the experience with wood fuel in United States, small hydropower and biogas in the PRC, and energy crops in Brazil. In some countries technical advances have brought wind machines, solar cells, and biogas close to commercialization for heating and electricity generation. Thus far, over 3 million solar water heaters have been sold in Japan and over 5 million wood stoves in the United States. Government commitments for the development and promotion of renewable energy sources have been instrumental in promoting an ambitious alcohol fuel program in Brazil, geothermal and wood energy programs in the Philippines (Deudney and Flavin 1983), and biogas programs in the PRC and India. Today, there are about 6.5 million biogas plants in the PRC ("Research Proves Aid to Production" 1984) and about 250,000 in India. Some 3.8 percent of the population of the PRC uses biogas, compared with 0.1 percent in India. This paper attempts to identify the critical aspects of biogas technology development and its successful diffusion on the basis of the experiences of these two countries.

Pages 67-78

The Relationship Between Refined Product Imports and Refined Product Prices in the United States

by John J. Gonzales (Crown College, University of California, Santa Cruz, Santa Cruz, CA, USA)

Since the Organization of Petroleum Exporting Countries (OPEC) emerged in the early 1970s as a dominating force in the world petroleum market, much effort has been devoted to investigating the relationship between U.S. demand for crude oil imports, the world price of crude oil, and the domestic price of crude oil. Little attention has been paid, however, to the role of refined product imports in the U.S. market. My purpose is to fill this gap through an empirical investigation of the "competitiveness" of refined will be on the motor product imports in the domestic market. The focus gasoline, residual fuel oil, middle distillates, and jet fuel markets, as these four products account for most domestic product consumption. Most analysts of the world crude oil market have concluded that modeling the price behavior of OPEC is difficult if not impossible. But, there appears to be a consensus that in the short run the United States is a price taker of the world crude oil price. That is, at any moment the United States faces a perfectly elastic crude oil import supply at the world price. If the imported price is below what the domestic price would be exclusive of imports, the domestic price is determined by the world price, and in the short run the United States takes this price as given. This paper examines the same issue in the domestic refined product market. The main concern is the degree to which domestic product prices are determined by the price of imported products.
Competition as a Complement to Regulation

by Richard P. Rozek (Bureau of Economics, Federal Trade Commission, Washington, DC, USA)

Competition and regulation are often perceived to be in conflict, because regulation usually evolves in response to a failure of the market system. In the case of public utilities in the United States, the familiar argument is that production scale economies make it cheaper for a single firm to provide essential products or services than for two or more firms to do so. To take advantage of the production efficiencies but avoid the resource allocation problems inherent in monopoly levels of price and output, either assets are publicly owned or a privately owned firm is regulated. In the first case, the incentive to maximize profits is replaced by the need to maximize political support. Thus the price charged for output is less than the monopoly price. In the second case, states have created public utility commissions (PUCS) to control both access to the market and the monopolist's price and output decisions. A PUC may be reluctant to allow any form of competition because of either a perception that competition would not be in the public interest or a concern that reliance on competition casts doubt on the PUC's ability to fulfill its regulatory mandate. Increasingly, however, some are arguing that it will be advantageous to permit some competition in markets previously protected from such pressure. Competition may actually complement regulation, making it possible to achieve lower rates, better service, and lower costs of regulation.

The Economics of Natural Gas Utilization in Developing Countries: Methodology

by Y. Hossein Farzin (Development Research Department, The World Bank, Washington, DC, USA)

The sharp oil price increases of the 1970s, and the consequent balance-of-payments difficulties, encouraged many oil-importing developing countries to develop and exploit their indigenous energy resources. Today, several developing countries with commercially attractive reserves of natural gas (for example, Bangladesh, Egypt, Pakistan, and Thailand) have seriously begun to use their gas resources for internal domestic and industrial purposes as well as for exports. They now confront the basic economic question of how to value gas resources and how to allocate them. The natural gas pricing and utilization decision must (1) recognize that gas reserves are an exhaustible resource; and (2) determine how this exhaustible resource should be depleted (over what time period, and for what uses) to obtain maximum benefit. Intertemporal issues have typically been overlooked in studies of gas use in developing countries. Some studies have maintained that the economic value of gas should be the price of a substitute source of energy (usually
fuel oil) while others have suggested marginal extraction costs. This paper presents a general methodology for efficient pricing and intertemporal allocation of natural gas resources in developing countries. It focuses on the problem of simultaneously determining efficient gas prices and choosing optimal mix of gas-using projects where (1) scarcity rents are significant and (2) there are imported substitutes. The conventional method of using marginal cost pricing to allocate reserves is valid only if reserves are so large that the scarcity rents are negligible.

Pages 101-107

Industrial and Commercial Demand for Electricity by Time of Day

by Derek Bosworth (Head of School, Faculty of Social Sciences, Polytechnic of Central London, London WIP 3P6, England) and Clive Pugh (Lecturer, Department of Mathematics, Loughborough University of Technology, Loughborough, Leicestershire, England)

The initial stimulus for this note came from Chung and Aigner (1981), which examined the impact of a major change in electricity tariff structure on industrial and commercial electricity demands. Using a translog cost function the authors investigate the effects on consumption of a change in the pricing practices of the Pacific Gas and Electricity Corporation (PGEC). Instead of charging a uniform price for electricity throughout the 24-hour period, PGEC switched to a "time of use" (TOU) pricing regime. The model performed well for 10 of the 13 industry groups over the 41-month period, and indicated a considerable variation across industries in the impact of TOU pricing. The authors find a general pattern of moderate response to TOU pricing in the peak period and some substitution among electricity demands over other times of the day. The industries that showed the most elastic demands were logging camps, paper mills, industrial gases, and cement manufacturers (as well as shopping centers and educational institutions in the non-manufacturing sector). The limited available evidence suggests that a similar diversity of responses exists across industries in other countries (Mitchell, Manning, and Acton 1978, pp. 89-120). Very little work appears to have been done to investigate why the effect of TOU electricity pricing on the timing and organization of production activities differs across industries. Chung and Aigner (1981), for example, simply suggest that "an industry's response to electricity price changes will depend on the characteristics of its present production process" (p. 104). While this statement is obviously true, it is too vague to be very helpful. It is with the aim of stimulating debate in this area that we have produced this note, drawing on our own, quite distinct research interests in work patterns and labor markets.

Pages 109-114

Coal Transportation System Modeling - The Case of Taiwan: A Comment
In his recent Energy Journal article G.H. Tzeng (1985) emphasizes on the transportation aspects of increased coal use in Taiwan. He does not, however, offer much detail on the economic basis for the switch in National Energy Policy from imported oil to coal. While such a switch confirms that the exercise of rational fuel mix choices has found its due place in Taiwan, it seems appropriate to examine the efficiency of such a switch and its implications, especially for import balances. The new Taiwan energy policy Tzeng describes would increase coal consumption from 7.8 million tons (MT) in 1982 to 43.4 MT over the period ending in 2001. Ninety percent of this requirement would be imported. Of this, more than half would go to the electric power industry (23.8 MT by 2001). The total growth in coal consumption projected by Tzeng for this period amounts to 456 percent in 19 years. Is such a growth in electricity demand a reasonable forecast? Past rates have been around 12.4 percent a year for the period 1970-1975 and 12.3 percent a year for 1975-1980. Taipower projects growth will slow to an annual rate of less than 5 percent for each five-year period between 1980 and 2000. These projections appear to understate the demand for boiler fuels.

Energy Consumption in Hungary: An Ex Post Analysis

Julia Kiraly and Laszlo Lovei (National Planning Office, Department of Methodology and Department of Industry, Budapest, Hungary)

This paper analyzes the causes of the recent stagnation of Hungary’s gross energy consumption. Applying a dynamic method, we estimate the effect of three factors: reduced growth, structural adjustment, and energy conservation. After an explanation of the methodology and a description of the estimating procedures, we discuss our results and offer some conclusions. Individual equations are contained in the appendix. Hungary’s gross energy consumption increased steadily from 1970 to 1978. Since then, it has been virtually flat. There is broad agreement that this leveling off reflects the recent slowdown in the growth of Hungary’s economy. This slowdown in turn stems from the delayed impact of the sharp increase in world oil prices and Hungary’s inability to offset the resulting higher import costs and greater exports. But decisionmakers and planners require more information than this general notion if they are to understand how changes in the energy sector have affected the economy. To shed light on this relationship, economists have attempted to divide the total reduction in energy consumption into three major constituents: slower economic growth, structural changes in energy-using sectors, and energy intensity or conservation. This study examines changes in Hungary’s energy consumption since 1978 in terms of these components, and quantifies each of them.
Again, Federal Tax Credits Are Found Effective: A Reply

by Edwin H. Carpenter and Cathy Durham (Department of Economics, University of Arizona, Tucson, AZ, USA)

One of the greatest compliments that can be paid to a research effort is an attempt to refute its findings that instead replicates those findings. That is the present case. Commenting on Carpenter and Chester (1984), Peterson (1985) states, "The authors conclude that conservation credits have done little to stimulate conservation expenditures, but that the renewable energy credit has increased the demand for solar space and water heating systems. Unfortunately, problems with the data used by Carpenter and Chester cast doubt on their findings." Peterson then concludes, from his analysis of the "better" data set, "The percentages from the table suggest that solar purchasers are much more affected by the availability of tax credits than are conservation investors." Perhaps this is enough said, but we cannot resist the opportunity to continue. Peterson is correct that some survey respondents were confused. In reply to the question about state tax credits, some people in Nevada and Washington misstated the availability of state credits. But Carpenter and Chester did not analyze the data on awareness of state benefits; rather they were concerned with awareness and use of federal income tax credits only. The reissued survey of 1983, which eliminated two of the western states originally included, also dropped what Peterson reported as the confusion state credit portion of the tax credit question. Elimination of the state credit awareness question, rather than providing clarification, may have been an unfortunate way to reduce confusion.

Solar Versus Conservation Tax Credits

by H. Craig Petersen (Department of Economics, Utah State University, Logan, Utah, USA)

In the late 1970s concern about energy shortages motivated Congress to establish federal income tax credits to individuals for (1) household energy conservation expenditures and (2) purchases of renewable energy systems. Under terms of the Energy Tax Act of 1978, the tax credit for conservation expenditures is 15 percent of the amount invested, with a maximum credit of $300. The credit for renewable energy systems (such as solar space or water heaters) was initially set at 30 percent of the first $2000 and 20 percent of the next $8000. In 1980, the Windfall Profit Tax Act increased the tax credit for renewable energy systems to 40 percent of the first $10,000 in qualifying expenditures-a maximum credit of $40M. The energy tax credits are intended to reduce consumption of nonrenewable fossil fuels in the residential sector. By lowering the effective cost of renewable energy systems and also the cost of such energy-conserving materials as weather stripping and insulation, Congress hoped to induce expenditures that otherwise would not be made. The
conservation tax credit and the credit for renewable energy systems expire December 31, 1985. Assessments of these programs must compare their benefits and costs. Clearly, each time the tax credit is claimed, the federal government loses revenue. If the credits stimulate significant additional renewable energy or conservation expenditures, then the loss in revenues may be justified by the saving in fossil fuels. However, if there is little or no stimulus to such investments, then the tax credits are primarily a windfall received by those who would have made their expenditures anyway. In this case, the main impact of the energy tax credits is to redistribute income from taxpayers in general to those who claim the credits. A recent article in *The Energy Journal* by Carpenter and Chester considers the effectiveness of the federal energy tax credits (Carpenter and Chester, 1984).

Pages 137-154

**Changing Climate and Energy Modeling: A Review**

by John Reilly (Institute for Energy Analysis, Oak Ridge Associated Universities, Oak Ridge, TN) and Jae Edmonds (Pacific Northwest Laboratory, Richland, WA, USA)

In recent years, the greenhouse problem has aroused widespread public concern. *Changing Climate*, a report by the National Academy of Sciences (NAS, 1983), represents a useful and timely synthesis of current scientific investigations of the impact of greenhouse gases on climate and society. The report is notable both for the research it documents and its influence on the public awareness of the issue. The report was a direct result of Congressional concern about the issue of carbon dioxide-induced climate change as expressed in the Energy Security Act of 1980. The National Research Council of the NAS was directed to examine the expected rate of increase of CO$_2$, and the likely effects on global climate, agriculture, and sea level. This examination is reported in a 500-page volume that contains 14 papers organized into nine chapters. This review focuses on the link between energy and CO$_2$ emissions, which is examined in Chapter 2 of the report, "Future Carbon Dioxide Emissions from Fossil Fuels." The full report is briefly reviewed in the next section, and we offer some broader summary comments in the final section. The NAS report *Changing Climate* generally finds that the greenhouse problem is serious, but does not require an urgent response, It concludes that CO$_2$ concentrations are likely to double by late in the twenty-first century, with associated global temperature increases and climate changes.