Regulatory Reform in the Electric Power Industry

Vernon L. Smith[*]
Regents' Professor of Economics
University of Arizona

January 1995

Traditionally, economists argued that the production and distribution of electric power -- along with the telephone, water and natural gas industries -- were natural monopolies: economies of scale implied that the natural economic state was for only one company to emerge and for monopoly prices to prevail. Consequently, efficiency and fairness required that such industries must either be owned and operated by the government or regulated by it. In Arizona, for example, monopoly was such a concern to the framers of the state constitution that they explicitly affirmed that "monopolies and trusts shall never be allowed in this state....[1]" An early position taken by the Arizona Corporation Commission applied this concept to electric power: "... we believe that ordinarily the distribution of electric energy is essentially and rightly monopolistic in its application[2]." This view has served to rationalize a political equilibrium in this country in which most electric utilities are privately owned, but subject to price controls based upon "fair" rate of return regulation. In many foreign countries, including the United Kingdom, New Zealand, Chile

[*] I am indebted to Penelope Brook Cowen and Stephen Jennings of C.S. First Boston, N.Z., and to numerous government and industry officials for discussions on the privatization of electric power in New Zealand during my tenure as a C.S. First Boston Fellow, July-August, 1991. Also to John McQuarrie and others of Prospect Electricity in Parramatta, NSW, Australia, in August 1993, for discussions familiarizing me with the Australian proposals to create a market for electrical energy on their Eastern and Southern grids.

[1] Arizona State Constitution, Article XIV, Section 15.

[2] Third Annual Report of the Arizona Corporation Commission, 1915, p. 231.

and several other South American nations, the electric power industry, until recently, has been owned and operated by central governments. The traditional argument, however, is buckling under the forces of change, and is now on the defensive.

The convergence of a number of intellectual, political and economic developments, beginning in the late 1970's and continuing through the 1980's, has caused a radical revision of the traditional view of natural monopoly. These recent developments include: (1) revisionist views on the origin of state utility regulation; (2) theoretical and empirical challenges to the natural monopoly view of the electric power industry; (3) incentive failures under rate of return regulation (RORR); (4) the worldwide economic failure of government utility ownership, and regulation, which weakened political opposition to reform.

Revisionist Views of the Origin of State Utility Regulation

The folklore that the original purpose of regulation was to protect consumers from monopoly prices has been challenged. From 1879 to 1907 electric utilities were not subjected to any kind of price regulation. They were required to obtain operating franchises from municipalities, but the literature of the day described an era of free competition in which municipalities granted franchises to many who applied.[3] It was the industry, whose profits suffered from open entry, that vigorously lobbied for entry restrictions and for state regulation of prices and

[3] Business history shows that all new product innovations go through a similar life cycle: the first innovators enjoy temporary monopoly status and high prices, followed by a rush of entry, rapid product improvement, falling prices, and finally bankruptcy, mergers and consolidation. This was the case for automobiles, aircraft, ball point pens, hand held calculators, successive waves of computer technology and essentially all new products.

profits. Beginning in 1897, Samuel Insull, then president of the industry's National Electric Light Association and a persistent advocate of regulation, repeatedly called for exclusive licensing of electric utilities and for "fair profit" price control by state governments. The resulting regulations were important in protecting the industry against the competitive pricing that dominated its early history.[4] Theodore Vail's influence on the early regulation of the telephone industry was strikingly parallel to that of Insull in electric power.[5]

A study of the period 1900-1920 shows that the first states to adopt regulation were those in which electric rates and profits were lowest and output highest. Furthermore, the effect of regulation during the early period was to increase prices and profits and to lower output. These data support the hypothesis that regulation was a response to the utilities' desire to protect profits, not a consumerist response to monopoly pricing.[6] Indeed, monopoly pricing had not been a primary problem.

Theoretical and Empirical Challenges to the Natural Monopoly View of the Electric Power Industry

The idea that the electric power industry is inherently a natural monopoly stems from three arguments: (1) that there are economies of scale in the production and delivery of electricity; (2)

---

[4] See S. Insull, Central Station Electric Service: Its Commercial Development and Economic Significance as set forth in the Public Addresses (1897-1914) of Samuel Insull, privately published, Chicago, 1915.

[5] See David S. Evans, Breaking Up Bell. New York: North-Holland Press, 1983.

[6] See G. A. Jarrell, "The Demand for State Regulation of the Electric Utility Industry," Journal of Law and Economics, October 1978, 269-295.

that duplication of facilities is inefficient; and (3) that natural monopoly cannot be disciplined by entry or the threat of entry.

Economies of Scale and Avoidance of Duplication

The theory that economies of scale in production implies that a single firm can serve the market at lower cost than multiple competitors is essentially a classroom exercise in static economic analysis. It assumes that demand is constant and that supply is certain. In reality the industry is subject to highly variable daily, seasonal and geographical fluctuations in demand, to growing annual average demand, and to potential power supply interruptions due to technical problems. A firm would have to build multiple parallel generation and transmission facilities to assure an uninterrupted supply and to meet peak load demands, even if there were unbounded economies of scale in building these units. Furthermore, growing demand, together with the durability and irreversibility of large capital investments, makes it economical to add capacity in discrete, parallel lumps which are smaller than if one had no capacity available at the time of increased demand.[7] Thus, a transmission line large enough to meet all future demand would experience a long period of idle capacity cost to say nothing of obsolescence cost. Consequently, one builds capacity to meet some anticipated growth, then adds parallel capacity later. These economic and technological considerations have led to the extensive use of multiple facilities, in both generation and transmission, by individual firms. Arizona is a representative case: a handful of companies

[7] See V.L. Smith, Investment and Production. Cambridge: Harvard University Press, 1961, Chapters 3, 4, 6, 10 and 11.

own more than thirty producing plants, many with multiple turbines, and several parallel transmission lines.

Local distribution systems are often thought to present the strongest argument for natural monopoly: to avoid inefficient duplication. It is significant that in the 1915 report of the Arizona Corporation Commission, quoted above, it was the distribution of electricity that was singled out as "essentially and rightly monopolistic."

One flaw with this view is that in other industries such "duplication" is the norm and widely applauded as providing diversity of service. For example, innumerable neighborhoods are served by multiple supermarkets and service stations, sometimes located next to each other, and shopping malls normally have competing stores selling the same product. Contrary to the conventional view, New Zealand (see below) has eliminated the monopoly franchising of local distribution.

Many early empirical studies challenged the traditional claim that relatively large firms can capture economies of scale and produce at lower unit cost.[8] For example, Nerlove found only modestly decreasing average unit costs in medium sized firms and increasing average unit costs in larger firms.[9] Nor is there evidence that integrated gas-electric utilities achieve lower unit costs by, for example, capturing scale economies in meter reading or billing. Studies comparing cities with and without combined gas-electric utilities consistently show that combined utilities have higher,

---

[8] Johnston, J., Statistical Cost analysis. New York: McGraw-Hill, 1960. Nerlove, Marc, "Returns to Scale in Electricity Supply ," in Carl Christ, editor, Measurement in Economics. Stanford: Stanford University Press, 1963. Primeaux, Walter J., "A Reexamination of the Monopoly Structure for Electric Utilities," in Almarin Phillips, editor, Promoting Competition in Regulated Markets, Washington: Brooking, 1975.

[9] Marc Nerlove, 1963, op cit.

not lower, electricity rates.[10] Electricity and gas compete as alternative forms of energy, and this competition tends to discipline prices and costs even within the RORR apparatus.

A complication of the view that distribution utilities are natural monopolies is that it is often accompanied by the assumption that providing distribution necessitates investment in generation. Where transmission is adequate, there is no technological or economic reason why a distribution utility cannot acquire all its power by contracting with competing generators. For example, in Arizona, city-owned Mesa Electric has in the past met all its energy needs by contracting. Distribution utilities need not produce their own power, any more than that they need produce their own trucks.

Threat of Entry

In Arizona and other states, ownership of electric facilities is concentrated in a few firms. This is directly the result of exclusive franchising, not of natural monopoly. Indeed, the most serious indictment of natural monopoly as a justification for regulation is the widespread granting of exclusive monopoly franchises. In Arizona this has been the effect of the Court's interpretation in the Trico case of a certificate of convenience and necessity granted by the state. If anything is clear and unambiguous in the theory of natural monopoly it is that such monopolies are "natural". By definition legal restrictions on entry are superfluous. Exclusive franchising appears to be a legacy of the early opposition of the industry to competitive entry, not the result of academic natural monopoly arguments.

Exclusive franchising removes the threat of entry. The latter is an important consideration

[10] Weiss, Leonard W., "Antitrust in the Electric Power Industry," in Almarin Phillips, op cit.

that was not recognized in the theory of natural monopoly. If entry is legally unimpeded, the incumbent firm must recognize that monopoly prices may attract an entrant who can contest the incumbent for the market that either could supply. The competing plant that has not been built, but could be built (and could perhaps produce at lower cost due to technological improvements), can deter monopoly pricing. This theme has been developed at length, and found to have empirical support, under the label of "contestable markets theory."[11]

Incentive Failures Under Rate of Return Regulation

After a period of rising prices following the introduction of state regulation,[12] the electric power industry and its customers benefitted from falling inflation-adjusted electric rates for almost a half century, from the 1920's until about 1970, excluding the rapid deflationary years of 1930 through 1933. The long decline in rates was due largely to the falling real price of petroleum and to improved technology that increased the thermal efficiency of fossil fuel steam generation.

The new technology provided a cost effective means of capturing the engineering economies of scale of large generation and transmission facilities. Such scale economies are always theoretically available based on engineering principles. The problem is to find ways of building the larger units so that the resulting decline in fuel requirements per unit of output are not

---

[11] See William J. Baumol, John C. Panzar and Robert D. Willig, Contestable Markets and The Theory of Industry Structure, New York: Harcourt Brace Jovanovich, 1982 and Don Coursey, R. Mark Isaac and Vernon L. Smith, "Natural Monopoly and Contested Markets: Some Experimental Results, Journal of Law and Economics, 27, April 1984, pp. 91-113.

[12] G. A. Jarrell, 1978, op cit.

more than offset by increased capital costs per unit of installed capacity. The cost efficient capacity of a generator or transmission line is always limited by the current state of technological knowledge, including construction know-how; beyond this limit increases in capital cost per unit of capacity restrict the economical size of the plant. Growth in demand allowed these new technologies to be introduced painlessly; i.e. expansions in capacity were needed to meet demand, so you install the most advanced, lowest cost, technology to meet the increase in demand.

These external developments, however, masked the internal incentive problems of cost-plus pricing under RORR. Such prices are based on historical cost, not the costs of current technology. In unregulated industries subject to rapid technological advance, competition forces the obsolescence of facilities before their historical cost is fully "depreciated." Efficiency requires that obsolete facilities be abandoned earlier in accordance with their shortened economic lives. Under RORR such assets tend to be protected by averaging their historical cost, along with the lower cost of new facilities, into the rate structure. Consequently, price declines in electric power were actually retarded by RORR, especially in the period of rapid general price deflation, 1930-1933. Since rates were generally falling, there was no political motivation to question the efficiency of the regulatory apparatus.

Beginning around 1970, the industry's tranquil half-century of hidden problems ended abruptly. Improvements in fossil fuel technology slowed considerably. The political environment demanded more severe pollution standards. Petroleum prices began their unprecedented increase, rising from $3 per barrel to $12 and ultimately to over $40. Accelerating inflation also drove up non-energy input prices and construction costs. Whereas earlier regulatory lag in approving cost-

based rate increases had benefitted profits, it now squeezed profits severely.

In response to this environment and to anticipated demand growth, much of the industry turned to nuclear construction although the availability of low sulphur coal continued to attract new plant investment in the Southwest. At the time, nuclear power, with its promise of scale economies and much lower fuel costs, seemed the answer to the industry's wrenching problems. Moreover, the regulatory environment had long promised rates that would yield the revenues required to cover costs plus a reasonable profit. Only utility industry managers routinely use the phrase "revenue requirements": investment costs, once incurred, lead to revenue requirements that consumers should be expected to pay. This was not an environment that would condition managers to be wary of untried technologies or of possible cost overruns. With this history it was reasonable for managers to expect that construction costs would be embedded in new higher rates if such were required.

Decisions in the 1970s to pursue relatively untested nuclear technologies in an inflationary economy led to the cost overruns of the 1980s. The prime example in Arizona was the Palo Verde nuclear facility, although its cost overrun was less severe than those in some other parts of the country. Many of these cost overruns were more than the political environment could absorb. Although rates generally were increased -- at times substantially -- the commissions balked at fulfilling management expectations that new rates would cover the full revenue requirements of these costly ventures. That some utilities and some states relied on alternatives to nuclear construction exacerbated the problem. In the Southwest, some utilities expanded with traditional coal-fired technologies. Wisconsin used load-shifting programs and time-of-use rates to encourage conservation as a substitute for expanding capacity. Consequently, with 20/20 hindsight, some

managers and commissions clearly had controlled costs better than others. Politically, this increased the difficulty of rewarding the costly nuclear plants with cost-plus rate schedules.

Widespread fears that the energy crunch was here to stay, and that power shortages existed, were thought to require new political initiatives. One response was the Public Utility Regulatory Policies Act (PURPA), adopted in 1978, which provided tax benefits to encourage tiny "mom and pop" hydroelectric, windmill,[13] solar, or woodchip-burning power sources. PURPA also required utilities to purchase both this power and power from industrial cogeneration units at rates as high as avoidable cost: the most expensive source of marginal power available to the utility. The positive side of PURPA is that it helped utilities to overcome their reluctance to deal with alternative energy sources. Many cogeneration projects are cost-effective at today's power rates even without special inducements. PURPA also demonstrated that decentralized power generation can be compatible with long-distance transmission. On the negative side, some states applied the avoided cost concept in a way that encouraged an oversupply of uneconomical energy.

The Northeast experienced a surplus of power produced under contracts between utilities and independent power companies. Part of New York's surplus was the result of a state law (repealed in 1992) requiring utilities to pay a minimum of six cents per kilowatt hour for power from independent producers. While such incentives are, of course, quite effective, they can hardly be justified as benefiting consumers. With the wholesale spot price recently at two cents per

[13] One result of PURPA stands out like a sore thumb if you drive Interstate 10 to California. In the area of Palm Springs to the right of the highway is a sea of unsightly small wind power units few of which have operated for several years. The earlier wind power units suffered from very high maintenance costs.

kilowatt hour (a price level caused by the proliferation of these contracts), contracts at six cents are not viable. Many have been renegotiated in the venerable market tradition that long-term contracts stand only so long as short-run prices do not fall perpetually below the contract prices.[14]

Avoiding Regulatory Problems

All markets are "regulated" in the sense that participants are constrained by private and public rules governing (property) rights to act. The problem that must be avoided is using failures in the regulatory process itself to justify continued and more invasive regulation. Such failures are inherent in the regulatory process because the announced intentions of regulation -- such as limiting profit to a "fair" return on the "prudent" use of capital -- create incentives that are incompatible with the intentions. Firms, seeing rate of return regulation as guaranteeing a markup over cost, are less motivated to control costs than they would be in competitive regimes where a residual claimant gets to keep whatever is saved. Prices under rate of return regulation are set by adding capital cost and a profit rate to other costs, thereby attempting to reverse the competitive process in which prices determine the amount of capital cost one can profitably afford to incur.

In other countries, government-owned industries suffer from similar incentive problems. Numerous foreign governments have embarked upon restructuring and privatization programs for their electric power industries in an effort to find a property rights approach that avoids these incentive problems.

---

[14] See Kansas, Dave, "Power Glut Jolts Northeastern Electricity Producers," Wall Street Journal, April 20, 1993.

Foreign Developments in Electric Power

The United Kingdom launched a denationalized competitive structure for electric power in early 1991 when the Crown's non-nuclear generation capacity was sold to private companies. But Britain was not first: Chile privatized its industry, with a competitive market for generation, a decade ago. Argentina has been in the process of privatization along British lines. New Zealand is in the process of defining how to restructure the industry to make it competitive, and minimize the need for regulation. As of December 1994 Australia is working on proposals for creating a market on its Eastern and Southern grids.[15] Since all these examples share characteristics with the "British experiment", we will discuss that case in detail, followed by a discussion of New Zealand's approach.

Privatization in the United Kingdom

The two British principles that survived the political process were, first, that efficiency is the primary objective, and, second, that competition is the vehicle for accomplishing this objective. Of course all regulatory systems, including both state-owned and RORR systems in the United States, proclaim efficiency as an objective, but the administrative processes for achieving it have been notoriously unsuccessful. Under the U.K.'s new approach competition is intended to be the primary means for disciplining costs, prices and service, but it is overlaid with central dispatch to maintain coordination and reliability. It also involves some regulation, but it is intended to be

[15] I and my colleagues at the Economic Science Laboratory of the University of Arizona are part of an Australian working group to design experiments that will examine the issues that need to be settled in restructuring the government owned industry into privatized competing entities.

relatively light-handed compared to RORR and is intended to minimize adverse incentives.

Obligation to Serve

There is no obligation to supply on the part of any entity producing power, distribution or transmission services. The absence of an obligation to supply is not as radical a departure from U.S. regulation as might be thought. Despite much rhetoric in the U.S. claiming that the "regulatory compact" obliges utilities to serve everyone in their area in exchange for a limit on profit, one has only to refuse to pay one's utility bill to find out how long the obligation to serve will keep the lights burning. The practical impact of the obligation to serve is price discrimination. Since there are limitations on refusing service to higher cost customers, others must pay higher rates to maintain the utility's allowed rate of return. Price discrimination occurs wherever the price charged, whether too much or too little, is not justified by the assignable costs incurred. Different prices are not discriminatory if they reflect differences in the cost of service.

Generation

The generation of electricity, which is clearly separated from the wires service business, is in principle competitive. Two companies controlled 75 to 80 percent of the United Kingdom's capacity under the original privatization, with small additions available in Scotland, whose interconnect capacity is under expansion, and in France, via a channel interconnect. Nuclear plants, constituting 15 to 20 percent of capacity, continue to be government-owned. (No one wished to buy them).

Energy, with the exception of the administrative charge noted below, is priced in a free market. Each day, generation companies submit offer price schedules to supply power half-hourly

from each generating unit for the following day. The pool price is the highest offer price accepted for dispatch. Those with lower offer prices all receive this common pool price; those that are higher are rejected.

A capacity charge, based on the "value of lost load," is added to the competitive short-run marginal price. The charge is set by the Director General of Electricity Supply and is designed to represent the value of capacity. The charge is also intended to provide an adequate return on capacity and an incentive for new investment. While the intent is for the Director General to review it infrequently, perhaps every five years, he has discretion to do so more often. The Director General's extensive power to determine this charge is perhaps the greatest compromise with competitive principles in the U.K. system. This compromise was a response to the fear that the auction system would force prices down to the out-of-pocket marginal cost of energy, leaving no profit return on investment.[16]

New generation capacity will be supplied only if some agent expects that the future pool

[16] I have encountered frequent expressions of this fear from both executives in U.S. electric utilities (as an argument against market deregulation) and managers of New Zealand's state-owned electric industry. Yet these same executives, when traveling, stay in high rise hotels built with large speculative capital expenditures by investors who have no guarantee of an "adequate" return on investment. Hotel accommodation space is like electric power in that it cannot be stored; demand can only be satisfied with current existing capacity. As is well-known, the competitive response in the hotel/motel industry has been rental rates that vary seasonally, and even daily within the week. Such facilities rely upon the higher on-peak rates to compensate for the inadequate revenues generated by the off-peak competitive discount rates. This is a rational and economical market response, because capital capacity cost is determined by the peak demand not the average or off-peak demand. Hence, prices on-peak will rationally (and fairly) reflect the capital cost that is the direct consequence of the on-peak consumption decisions, and provides an incentive for such customers to shift some of their load to the off-peak times. A similar pricing pattern would emerge in a market regulated power industry.

price (including the capacity charge) will justify the investment. Generators are licensed but this is an agreement to follow the rules, not a restriction on entry. Any licensed, electrically compatible, generator can hook up to the grid provided there is excess transmission capacity.

Power Contracts

Generators can contract with local suppliers of power and such contracts have been written for up to five years. These are contracts for differences between the pool price and the contract price. Since the generator owner receives revenue from the pool at the pool price, the only payment necessary between the buyer and seller is the difference between the pool and contract price. Thus, if the contract price is C, the pool price is P, and C is greater than P, then the buyer pays the difference (C-P); if C is less than P, then the generator pays the buyer (P-C). Such contracts are simply a risk sharing arrangement for smoothing cash flows and anyone, including people not in the electricity business, can enter into such contracts. All prices are public information, published in the newspapers, and the London Futures and Options Exchange operates a market in electricity futures. Since the contracts are independent of the physical flow of power, they will be renewed only if they have risk sharing value. With the deregulation of gas in the United States, buyers have come to rely on the spot market for gas, and less upon long term contracting. So, it is an open question whether, and to what extent, electric power contracting will continue.

Transmission and Distribution

For the transmission and local distribution wires businesses, the most heavily regulated portion of the U.K. system, price cap regulation substitutes for U.S.-style rate of return regulation. Although the National Grid Company (the transmission system) is owned by the twelve regional

electric companies (local distribution systems), the charges for the wires of both are subject to ceiling price caps. These may increase annually by an "RPI-X" factor: the retail price index (RPI) less a target rate of real price decrease (X) to reflect productivity gains. The price level and the "X" factor are subject to review approximately every five years. The intent is to provide, within these ceilings, an incentive to control cost. If you are able to reduce costs you are entitled to keep the money.

The National Grid Company recovers its expansion costs through the ceiling price formula; i.e., if capacity is expanded and transmission revenues are inadequate to cover the cost of expansion plus a "reasonable" return on investment, the ceiling price cap will be increased. Indirectly, then, the grid is subject to American style regulation, for capacity increases, and is subject to the documented hazards of such regulation.

Determination of Retail Price

Retail customers are billed by the local distributor (one of the 12 Regional Electricity Companies). The cost of the energy used (the pool price including the capacity charge) is passed through on a full cost basis and is subject to no cross-subsidy (discrimination) license conditions. Similarly the transmission charge is passed through to the customer. In addition there is a charge for the use of the local wires which is subject to "RPI-X" price ceilings. Within these ceilings if a distributor is able to cut costs the savings can be carried through to that distributor's bottom line.

During the first four years the local distributor has an exclusive franchise to serve customers whose annual consumption is below rates of one megawatt. Larger customers can contract directly for power or buy spot power from the pool. When the franchise period expires (1995), a market for

small customers will be free to develop. National chains of pubs, hotels and retail stores have moved to obtain single supply contracts for their various locations. Credit card companies, British Telecon, and others with established access to customers will be free to offer electric supply to individual households. Such third party suppliers will simply pay the local distributor the wires charge, and bill the customer for electricity supply. Customers will be free to invest in their own local wires and bypass the local distributor. Consequently, the markets for energy and distribution services are contestable, with customers having a choice among alternative providers.

Experience with Privatization in the United Kingdom

According to Professor Stephen Littlechild, Director General of Electricity Supply in Offer (the Office of Electricity Regulation) the initial fear that under privatization no one would risk building new generation capacity has proven to be unfounded.[17] His agency has issued 14 new generator licenses since privatization, bringing planned new capacity to 6700 megawatts (MW), and construction is underway to increase the capacity of the Scotland interconnect to 1800 MW. 3200 MW of new capacity has already been commissioned and the share of capacity by the two primary generating companies has declined from 75 or 80 percent to 61 percent. This share is likely to fall further this year and next.

Customer electricity prices declined about 15 percent during the first year after privatization. This was due largely to excess capacity built earlier by the nationalized industry,

[17] Stephen Littlechild, "Privatization and Regulation of the UK Electricity Industry," Office of Electricity Regulation, United Kingdom, September 1994.

some of which was becoming obsolete at the time of privatization, but also due to the ability of customers to shop around. Some 30% of the large non-franchise sites went to sources of supply other than the local distributor. Prices were expected to rise as excess capacity was absorbed, and indeed this began to occur after the first year. Subsequently, prices started to increase significantly. The expectation of rising prices may have stimulated the new capacity now under construction. This interpretation is confounded, however, by the possibilities that the capacity charge has been fixed at a level more than sufficient to encourage new generators to be built, or that the short-run marginal price of energy was artificially inflated by market power exercised by the two generation companies who accounted for most of the capacity that was variable with demand. Much of the new capacity is competitive at the margin so entry is solving this problem. The good news is that inflation adjusted prices have declined for all customer classes except the largest industrial customers. Price increases for the latter are the result of the withdrawal of special terms they had enjoyed under Nationalization.

New Zealand Modifications

The denationalization of electric power in New Zealand, still in process, is modeled on the British system but differs in several features.[18] Under the New Zealand proposal, the potentially competitive production and marketing of energy would be clearly separated from the more problematic wires business. But regulation of the latter would be even more light-handed than in

[18] Report of the Electricity Task Force, "Structure, Regulation and Ownership of the Electricity Industry," Government Printing Office Building, Wellington, N.Z., September 1989.

the United Kingdom in that there would be no central regulator comparable to the United Kingdom's Office of Electricity Regulation. Since the transition is still in process, the final form is not certain. Hence, the following discussion primarily focuses on the reforms that have been proposed, and are under discussion.

Generation

Competition in the wholesale market would be achieved by two policies: (1) open entry to the transmission/distribution grid by new generators; (2) breakup of generation capacity now held by the Crown-owned Electric Corporation of New Zealand (ECNZ).[19] The first provision is not controversial in principle, and will almost certainly be a cornerstone of the new privatized industry in New Zealand. In fact new investments are already being contemplated by various private interests.

The second provision is more controversial, and the extent of breakup of ECNZ is still in process of being resolved. If generation is spun off into separate companies no more than four or five such companies are likely to be formed and probably fewer.[20] ECNZ, while opposed to breakup, has responded to a government request with a proposal that it retain a core of 22 stations, or 63.2% of total capacity. Under this proposal, ECNZ would continue as the dominate generation

---

[19] Under the State Owned Enterprises Act, prior to privatization an industry is first incorporated separately from the department of government that previously managed it. In April, 1987, ECNZ was formed under this Act. ECNZ is owned by the Crown, has a clear mandate to seek profitable commercial activities, and has a Board of Directors drawn from the private sector. See B. Spicer, R. Bowman, D. Emanuel, and A. Hunt, The Power to Manage. Restructuring the New Zealand Electricity Department as a State Owned Enterprise: The Electricorp Experience, Auckland, N.Z.: Oxford Press, 1991.

[20] Report of the Electricity Task Force, 1989, op cit, pp. 77-78.

company under privatization.[21]

The Wholesale Energy Market

The pricing of wholesale power would be effected through a combination of a spot market for power, integrated with central dispatch, and "long-term" contracts for power between generators and distributors.[22] The spot market would operate essentially as does the current engineering energy cost minimization dispatch system except that decentralized generator owners would submit the offer price schedules at which they were willing to supply location-specific spot power to the grid. The dispatch center will accept the lowest priced generators first, in order, up to the marginal generator required to meet demand. Higher priced generators will be rejected, and the spot price will be the offer price of the marginal generator.

New Zealand, unlike the U.K., is not proposing to add a capacity charge to the spot price, but of course this proposal is not looked upon with favor by the supply side of the industry. New Zealand proposes to use the market for "long-run" contracts between generators, distributors and power merchants to provide a return on generation investment. Some contracts have already been written between ECNZ and the distributors, but according to R. S. Deane, former Chief Executive of ECNZ, the distributors refuse to sign contracts for more than one year. While this has been a concern to ECNZ, the distributors' reluctance is hardly surprising given ECNZ's surplus of

---

[21] Electric Corporation of New Zealand, "Report of the Minister of State Owned Enterprises on Generation Break-up in the New Zealand Electricity Industry," Rutherford House, Wellington, New Zealand, September 18, 1990, p. 24.

[22] Report of the Electricity Task Force, 1989, op cit pp. 69-71. In addition, TransPower will contract with individual generators for (1) the provision of "spinning reserve" for security of supply, and (2) the supply of reactive power to ensure reliable voltage control.

generation capacity and the uncertainties of the privatization process.

Transmission

The high voltage transmission network and the dispatch center would be constituted as TransPower, a private operating company jointly owned by the generation and distribution companies. Separation of the transmission system from ECNZ was postponed several times, but has now been effected. TransPower would not itself be involved in any energy transactions. Dispatch may be operated by TransPower or an independent agency. All generation and distribution entities, whether existing or new, would have nondiscriminatory access to the services of TransPower.

All TransPower prices, capacity charges, and hookup fees are to be cost-based and regulated through "transparency" and "public monitoring". Transparency means that all charges, the supporting cost allocations, cost computations, policies and audited financial statements are published in the New Zealand Gazette and available to all interested parties. Public monitoring means that any interested party can, under the Commerce Act, formally complain to the Commerce Commission or a court, as appropriate. The onus is on complainants to show that prices are excessive or discriminatory.

The Local Distribution Companies

The 1989 Report of the Electricity Task Force called for distribution, which for 70 years has been operated by local municipalities, to be privatized with commercial objectives and with direct ownership in the form of transferable shares. Exclusive franchising for both the local lines service and energy would be eliminated. This means that the entry of competing supply lines is not

prohibited although new lines connecting with an existing distribution network must meet the latter's technical standards. The task force recognized that the owners of existing lines have a "natural line franchise" which, because it is indeed natural, needs no legal protection. The threat of entry, being real and legally open, can therefore help discipline prices.

Along with exclusive franchising, distributors' obligation to supply is eliminated. Historically distributors were required to connect all who so desired. Remote uneconomic customers paid the same average charge as all others under a regulatory formula. Removal of the obligation to supply means that this cross-subsidization would be eliminated: some customers will pay more and some less. Many subsidized customers filed opposing minority opinions.[23] Whether this proposal will survive the political process remains to be seen.

Distributors must itemize bills to distinguish clearly the capital rental charge for the lines part of the business -- both transmission and local -- and the charge for metered energy. The cost of new or altered connections would also be charged to the customer.

Power Merchants

The New Zealand proposal has a novel feature: free entry by retail power merchants. Anyone will be free to buy power under contract or on the spot market, pay the local rental rate on wires and go into the power marketing business in competition with local distributors. Distributors cannot prevent entry by power merchants and must charge them the same cost-based rental rate -- subject to challenge -- on lines that they charge their own retail customers. A power merchant passes through the distributor's rental charge for the wires. This renders the energy marketing

[23] Report of the Electricity Task Force, 1989, op cit, pp. 126-127, 139; passim, Part III).

portion of the business highly contestable.

New Zealand's 1989 reform menu, to separate the local distribution lines business from the energy business, has now been implemented, and as of April 1994 the local monopoly retail franchise was eliminated. This is remarkable given that the conventional wisdom alleges that distribution is the primal example of natural monopoly. Yet progress in restructuring the energy supply industry, and the creation of an independent transmission grid has been repeatedly stalled. The political process has recurrently stretched out the timetable for completing the privatization of ECNZ assets held by the Crown. In order to break the stalemate between the supply and wholesale demand sides of the industry, the government appointed a new Wholesale Electricity Market Development Group to oversee the detailed implementation of the wholesale market. One of its charges was the "adoption of a structure that cannot be dominated by any one organization or interest group." This group has now filed its report to the Minister of Energy, and the government's response is awaited.[24]

A Proposed Structure to Discipline Distribution, Transmission and Energy with Markets

In this section we propose a privatization model, which shares some features with the United Kingdom and New Zealand privatization programs, but makes greater use of markets to

[24] WEMDG, "New Zealands Wholesale Electricity Market - Draft Proposal for Evaluation, March 1994, Wholesale Electricity Market Development Group, Auckland, Fax: +64 9 3096220, cited in the critique by Hugh R. Outhred, "Comments on: New Zealand's Wholesale Electricity Market -- Draft Proposal for Evaluation," Department of Electric Power Engineering Report DEPE 940608, New South Wales University, Australia, March 1994.

regulate electric power. The concept of separating the energy and wires service portions of the industry at both the transmission and distribution level is retained. The discussion below[25] addresses ways in which the operation of the market for energy, and the structure of transmission and distribution can be configured so that market forces can substitute for (or supplement) the light-handed regulation used in the British or New Zealand models. We do not address political feasibility, but only economic, institutional, and technical feasibility.

Generation

All generating companies would be for-profit private entities competing to sell energy on the spot market to retail power merchants and bulk commercial and industrial customers. They would also be free to negotiate contracts for differences, as in the UK. The generating companies would purchase location-specific power injection rights to the grid. New electrically compatible generators could freely enter provided that they pay for capacity rights and for connection charges.

Transmission

The high voltage transmission network, including the dispatch center, would be owned jointly by retail power merchants, commercial and industrial customers, and, perhaps, as proposed in New Zealand, by the generating companies. (Politically, it may be difficult not to give generator companies a stake in transmission although the cost of their stake will obviously be borne ultimately by the final customers.) The network as a joint venture would be an operating company, run as a shared resource cost center, not as a profit center. It would be constituted as a

[25] See V.L. Smith, "Can Electric Power -- A "Natural Monopoly" -- Be Deregulated?," in Making National Energy Policy (edited by H. H. Landsberg), Washington, D.C.: Resources For the Future, 1993.

competitively ruled property right system defined by the government, and not as an ordinary shared ownership corporation. The property right rules would have the objective of providing incentives for prudent investment and maintaining competition as follows. Capital and maintenance cost for the transmission system would be shared by the owners in proportion to their installed capacities to withdraw power from, or inject power into, the network. Large customers, consortia of small customers, and new generators would also have access to the grid subject to the payment of their direct connection costs and their share of grid capital and maintenance costs. Capacity expansion of any part of the grid would be the responsibility of any user or consortium of users willing to make the investment. In turn the user(s) would obtain rights to the increased capacities made possible by the expansion. Users who are not part of the capacity expansion will have no rights to block the expansion or demand compensation if the result is to shift the supply or demand for power in favor of others. But they will be free to join the joint venture, to share in the creation of more favorably located new grid rights. Network capacity rights can be brought, sold, rented or leased subject only to the antitrust laws that apply to any other industry.

The Market for Energy

The dispatch center, the core of transmission operations, would be responsible for economic dispatch and for the technical stability of the high voltage grid. Economic dispatch means the following: (1) retail power merchants would submit bids to the center for various quantities of power delivered to specific points during half-hourly market periods; (2) generators would submit offer schedules to the center specifying the prices they would be willing to accept for various quantities of power injected into the network at specific locations each half-hour; (3) the dispatch

center would then apply standard optimizing algorithms to these bids and offers to determine one market clearing spot price, which is then location-adjusted for incremental transmission losses at each node. Simultaneously the algorithms determine which generators are to be active, and their respective power injection levels. Note that bids to buy above the spot price pay only the spot price, and offers to sell below the spot price all receive the spot price. A high bid simply assures that the bid will be accepted. Similarly, a low asking price offer by a generator assures that the offer will be accepted. There is no price discrimination among buyers and sellers; all price differences reflect incremental transmission loss. The algorithms maximize the gains from exchange based upon the bids, offers, and the energy loss characteristics of the transmission system. Since transmission losses would be reflected in the wholesale spot price at each take-off or injection node in the network, they would be paid by the retail merchants and ultimately their customers. The spot market would be supplemented by technical futures markets to facilitate the planning of generator commitment and its coordination with maintenance outages. Thus a generator, completing maintenance, and requiring several hours for start up, is free to contract ahead for an assured revenue before incurring the start up cost.

Except for the addition of active buyer bidding, the dispatch process does not differ from the long-standing practice of engineering dispatch that minimizes fuel costs plus transmission losses in integrated systems. Generator owners, however, would be free to select the terms on which they are willing to supply power. There is no requirement that their offer prices conform to their marginal cost of fuel, since their price must not only cover fuel costs, but also capital and maintenance costs. Generator owners would be free to enter into financial hedging contracts with

buyers, as in the United Kingdom, but not into bilateral (physical flow) capacity contracts, since the latter would inefficiently constrain the dispatch center's system-wide optimization objective.

The above structure relies on the creation of fungible capacity rights to jointly owned transmission facilities. Although the use of such rights as an explicit instrument of competition may be novel, joint venture arrangements are commonplace in the U.S. utility industry. Generating plants and powerlines are often owned under co-tenancy contracts between two or more companies. They are not, however, competitively ruled by property right specifications like those articulated above.

At present, utilities are commonly exempt from antitrust laws because they are regulated. In the above structure all parties would be subject to the ordinary antitrust laws applicable to any other industry. Cotenancy arrangements would be strictly production joint ventures, and any marketing agreements among the competing cotenants would be forbidden as in any unregulated industry.

Distribution

In view of New Zealand's "experiment" with restructuring distribution so that decentralized economic and judicial processes are given an opportunity to discipline costs and prices, we suggest that proposed new initiatives for the privatization of distribution await the outcome of the New Zealand experience.

New Developments in the United States

The United States has not been immune to the above international trend, although we are

among the last to join it. Increasing pressure from consumer interests resulted in the Energy Policy Act of 1992, passed by Congress at the end of the Bush administration. This act requires utilities, most of whom share in the ownership of the transmission system, to permit customer access to other utilities and to the growing number of independent power producers. It sets the stage for multilateral long distance competition among energy consumers and producers connected to the power grid. Customers served by a local utility at high rates could buy power from other lower cost sources by paying a small transmission user fee. The California Public Utilities Commission has announced its intention of allowing electricity customers in that state the freedom to shop both inside and outside the state. Beginning in January 1996 the largest industrial customers will be able to choose any supplier of energy. In the following years free access will be expanded to smaller industrial customers, then commercial customers, and finally to all residential customers in 2002. This competition is likely to yield lower prices in the current environment in which there is a surplus of power. The short run impact will be to erode overall electric utility profits, with differential impact on individual firms, but the long run effect will be to lower cost and bring capacity into better balance with demand. This development almost certainly means that Arizona will increase its participation in the California market by increased exports of power.

These trends have there opponents in both the industry and the regulatory commissions, but opposition by those threatened by these changes seems unlikely to prevail, although it certainly can delay needed reforms. Technological and organizational innovation has caused the traditional regulatory apparatus to become obsolete. If regulators are to promote the consumer interest, which is their traditional charge, then it is incumbent upon them to ask how they can facilitate these

changes. Yet these changes undermine the need for regulators in their traditional role; their self interest in the perpetuation of the regulatory apparatus is in conflict with the consumer interest, and is more compatible with the interest of those utilities opposing competition. This is why reform may be slow, highly controversial, and require transition-easing mechanisms.

An important consideration, and point of contention, in the United States is the question of how transmission costs are to be allocated among users. The proposal outlined above in which the high voltage grid is jointly owned by the users in proportion to their respective capacities to inject (or withdraw) power at specific nodes is conceptually easier to implement in countries like New Zealand in which the government now owns the grid. The government can simply elect to sell joint venture rights to the grid in proportion to status quo capacities to inject or withdraw power, and thereby constitute the grid as a rule governed joint venture of the users. Although I believe this conception could be applied in principle to the American scene, the devil is in the details. The grid is already balkanized into pieces privately owned by existing utility companies. To create a joint venture such as the one envisioned above, each utility would acquire use right to the rest of the grid in return for giving others use rights to its own grid. This requires agreement in a world in which some utilities have invested more extensively in transmission than others, requiring compensation through transfer payments. Guidelines for compensation are no doubt implicit in existing contracts for grid rights and in historical capital investments, but making such rights permanent on a voluntary basis to create a competitively ruled joint venture is sure to be a Promethean task. Short of this what seems likely to prevail is some form of Federal regulation of transmission charges with its inevitable costs and potential incentive failures.

The current state of our research knowledge of electric power markets based on foreign experience, and limited laboratory experimental studies, suggests that the final form of a deregulated electric power industry in the United States should respect, at minimum, the following considerations.

1. Computer-based regional dispatch of energy

It is important to recognize that central dispatch is not central control. It is simply rule-governed nerve center coordination, based entirely on the bids to buy power, and the offers to sell power or transmission services, by decentralized competing owners. In electric power we are, and should be, talking about the development of a property rights system -- rights to inject or withdraw power, rights of transmission access, rights to invest and to claim the benefits (and incur the losses) that accrue to such investment.

Central coordination is necessary in electric power because electrons flow according to the laws of physics, not economics. Hence, the market institutions must honor these technical considerations. Every industry has its own technical peculiarities which are reflected in its economic institutions, and electric power is particularly sensitive to special technical considerations. The stability and viability of electric networks simply cannot be respected if power injections and withdrawals occur without coordination.

2. Open entry to buy, sell and transmit power

A privatized industry, whose prices and services are regulated predominately by a market, must be open to entrants who wish to consume, produce or transmit power, subject to electrical compatibility standards. This means that new generation capacity is built at the financial risk of the

investor, not the rate payer as in U.S. style regulation (or the tax payer in foreign style government ownership). Similarly, buyers incur the risk of investing in energy-using equipment subject to unforseen changes in future energy prices.

3. Demand-side bidding

The spot market for energy should provide for demand-side bids, as well as supply-side offers to sell. For example, managers of an industrial plant might enter a bid to reduce its demand by 10MW if the spot price rises above $20 per MW. If this is below the price at which the marginal generator would produce the extra 10MW, then dispatch would accept the demand-side bid, and reject the extra generation of energy. Demand-side bids would be more likely to be accepted during peak-use times when prices are high.

4. Contracts should be financial instruments for hedging against risk, not for physical delivery.

People want, and should have available, contracting instruments which enable them, at a price, to protect against unanticipated movements in energy prices, and to enable them to better plan their business activities both in the short run and over more extended periods of time. Thus, long term contracting can take the form of (but need not be restricted to) the financial instruments used in the United Kingdom and elsewhere, in which a fixed price contract leads to bilateral payment transfers when the spot price differs from the contract price. Because bilateral contracts for physical delivery limit coordinated dispatch they can yield infeasible, and potentially unstable, system requirements. Deliveries should reflect the economic and physical realities expressed by agents in their spot market bids and offers, whatever might be the additional financial contracts they might have entered into at an earlier and more uncertain time.

5. Prices at different location nodes in the network must reflect the marginal cost of energy lost in transmission.

This is accomplished under "nodal pricing" using computer-based dispatch. That is, the dispatch center takes into account the higher transmission cost of energy generated at more remote locations. Such "distance price" concepts are important in providing better incentives for locating new generation sources, as well as new energy demand loads, so that energy is not wasted.

Concluding Comments

Over a century of change in the electrical power industry, whose pace has accelerated in the

last decade, has brought us full circle. Throughout the world we see a return to structures more open to regulation by market competition than at any time since the industry's inception. The form of competition today, however, will necessarily differ from that which prevailed at the beginning because of intervening technological and institutional change. Many questions concerning the detailed architecture of the new industry cannot be answered by anyone at this time, although provisional answers are in process of being developed, and the learning from the variety of recent world wide experiences is being assimilated. These developments are converging, but are not likely to yield a single solution because different countries have started with different initial conditions that require accommodation.