The Choice Between Markets and Central Planning in Regulating the U.S. Electricity Industry

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SCHOOL OF LAW

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July 8, 1993

Professor William Hogan
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Dear Professor Hogan:

I thought the members of the Harvard Electric Utility Policy Group might find the enclosed paper of interest. It will be published in the October issue of Columbia Law Review (with some revisions we have not yet made). The paper addresses some of the issues mentioned at the organizational meeting.

I am confident that some members will disagree with many of the views expressed. The paper does not address transmission access and pricing. I believe the resolution of the transmission pricing and access issue will shape all other issues and will preordain the resolution of many issues.

Very truly yours,

Dick

Richard J. Pierce, Jr.

Encl.

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Bernard S. Black & Richard J. Pierce, Jr.*

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* Respectively, Professor of Law and Paul J. Kellner Professor of Law, Columbia University. We thank David Leebron, George Mundstock, Peter Strauss, and seminar participants at the University of Miami Law School for useful comments. Notwithstanding the criticism herein, Bernie Black could not have written this article without the invaluable education in conservation as an alternative to power production he received from Ralph Cavanagh and David Goldstein of the Natural Resources Defense Council as a law student intern in the summer of 1981.

I. Introduction

> "It was the best of times. It was the worst of times." Charles Dickens, A TALE OF TWO CITIES.

Dickens' famous description of France at the beginning of the revolution describes equally well the present state of the U.S. electricity industry. All participants and observers recognize that the structure, methods of operation, and forms of government intervention that have dominated the industry since its birth are no longer viable. The industry has begun a period of revolutionary change. When that process is complete, the electricity industry and its regulation will bear little resemblance to the patterns that have become familiar over the past century.

No one can predict with confidence the path the revolution will take, or the new form in which the industry will emerge. The revolution is unplanned. The defenders of the old regime, recognizing that the status quo ante is dead, have changed their allegiances to one of two competing revolutionary armies. Those armies, led by policy wonks with radically different visions of the post-revolutionary state of the electricity industry, are assaulting the ramparts at state utility commissions, state legislatures, a variety of federal agencies, and the U.S. Congress.

The results of the revolution to date are surprising. Both armies have won almost every battle! Over the past five years, government institutions have begun to implement a combination of four revolutionary changes in the structure, operation, and governance of the electricity industry. The four changes are competitive contracting, negawatt acquisition programs (NAPs) (essentially, subsidies for conservation), market-based pollution control (either emission fees or marketable pollution permits), and environmental adders (essentially, shadow prices for pollution harm).

These revolutionary changes cannot continue indefinitely on their present paths. One combination of changes -- competitive contracting and market-based pollution control -- will yield an industry in which consumers and competing power producers play the dominant role in determining industry structure, electric rates, and the level of electricity consumption. Moreover, market-based pollution control will yield significant air quality improvements at costs much lower than those attainable through traditional "command and control" environmental regulation.

By contrast, NAPs and environmental adders will produce a world in which bureaucrats make many of the critical decisions relating to electricity generation, purchase, and consumption. Large-scale negawatt programs cannot coexist with competitive contracting. Environmental adders are unnecessary if we adopt market-based methods of controlling pollution, and require continued reliance on command and control environmental regulation. In some cases, NAPs and adders can *increase* pollution harm. Taken together, NAPs and environmental adders undermine our ability to achieve the economic gains from competitive contracting and market-based pollution control.

We must choose between two revolutionary visions of the future of the electricity sector of the U.S. economy. The first vision relies where possible on markets, private incentives, and decentralized decisionmaking to produce optimal pricing and consumption of electric power. For pollution, regulators establish a market price for clean air, or a cap on emissions, and then step aside and let competing power producers achieve the desired level of pollution control at least cost. This vision resembles the deregulatory trend that has produced huge benefits in the telephone, transportation, and natural gas sectors of our economy. The second vision distrusts markets and relies on central planners, housed in state utility commissions and federal regulatory agencies, to correct perceived large-scale market imperfections. It bears a remarkable resemblance to the systems previously used to govern the economies of eastern Europe and the former Soviet Union.

As this analogy suggests, we have strongly held views concerning the best path for revolutionary change. In this article, we set forth the bases for those views by describing the four revolutionary changes in electric utility regulation, predicting the effects of each, and developing the many complicated ways in which they will interact to produce beneficial or detrimental changes in economic and environmental conditions.

Part II reviews the events that have destroyed the viability of electricity regulation in its current form. It then surveys the emergence of competitive contracting for wholesale power production, the prospects for retail competition, and the efficiency gains from replacing regulated monopolies with competing power producers. Part III discusses the emergence of negawatt programs. We develop the limited circumstances under which subsidies are an appropriate response to consumer failure to invest in energy conservation; describe utility programs that can respond directly to the market imperfections that purportedly justify negawatt programs, at far lower cost; and explain why NAPs may produce little or no environmental benefit. Part IV develops our preferred approach to inducing optimal electricity use -- setting price equal to marginal cost. We explain why competition among power producers will drive price toward marginal cost, and why marginal cost pricing is incompatible with NAP subsidies.

Parts V and VI address the principal source of mispricing that competition cannot eliminate -- social harm due to power plant pollution. Part V explains how emission fees or marketable pollution permits can force power producers and consumers to internalize this cost, and reviews the growing use of these market-based methods to control power plant emissions. Part VI discusses the emerging use of environmental adders in choosing new power sources.

We explain why environmental adders are far more complex in design, and produce smaller environmental gains, than utility regulators have realized; the limited extent to which adders can co-exist with market-based environmental controls; and why emission fees or marketable pollution permits are *always* preferable to environmental adders.

A recurring theme in this article is the huge gap between theoretically optimal regulation and actual regulatory decisions. Rate regulation, conservation subsidies, and shadow prices for pollution harm are all plausible regulatory tools. But each has been massively misused. The reasons for misuse are deeply embedded in a combination of strong political forces, the powerful symbolism of energy conservation and environmental protection, the incentives of utility regulators and rate regulated utilities, and the limited competence of utility regulators in addressing highly complex issues involving rate design, energy conservation technology, and environmental science. Past regulatory mistakes, and the seeming inevitability of future mistakes, are an important part of our preference for imperfect markets over imperfect central planning.

II. Competitive Contracting

A. The Status Quo Ante in Electricity Regulation

The electricity industry combines three conceptually distinct steps: *production* of wholesale power; *transmission* of bulk power over high-voltage lines from power plants to local geographic areas; and *distribution* of power to retail customers. Until the late 1980s, the U.S. relied primarily on several hundred government protected and regulated private monopolies to accomplish all three tasks, each in its own region of the country.[1] As recently as 1989, Paul Joskow could describe the electric power industry accurately as "largely unaffected" by the

[1] See Paul Joskow & Richard Schmalensee, *Markets for Power* 1-92 (1983).

deregulatory movement that had produced major changes in the markets for transportation, telecommunications, financial services, and natural gas.[2]

The status quo ante was conceptually simple. In recognition of significant economies of scale in the production, transmission, and distribution of electricity, each utility was granted a monopoly on electric service in a specified area. In return for the grant of a legal monopoly, each utility was required to accept price regulation designed to approximate the results of a competitive market. In a competitive market, in long-run equilibrium, price will equal long-run marginal *economic* cost, which includes a normal return on invested capital. Since monopolists have an incentive to charge prices that exceed marginal cost, the regulator's principal task is to set prices approximately equal to the utility's marginal cost.[3]

Traditional rate regulation was implemented with little controversy or analysis until the late 1960s. The real price of electric power declined steadily because of a constant stream of technological advances, making consumers happy, and both utility executives and regulators enjoyed a quiet life free from significant oversight by politicians or policy analysts.[4] The public was content, so politicians had no incentive to question the status quo. However, there is little reason to believe that this long period of quiet complacency was attributable to the efficiency of the traditional approach. Retrospective studies have produced considerable evidence that cost-of-service regulation was ineffective in its basic task of limiting price to marginal cost.[5]

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[2] See Paul Joskow, Regulatory Failure, Regulatory Reforms, and Structural Change in the Electrical Power Industry, Brookings Papers: Microeconomics 1989, at 125.

[3] See Ernest Gellhorn & Richard Pierce, *Regulated Industries* 19-49 (2d ed. 1987); 1 Alfred Kahn, *The Economics of Regulation* 1-19 (1970).

[4] See Paul Joskow, Inflation and Environmental Concern: Structural Change in the Process of Public Utility Regulation, 17 J.L. & Econ. 291 (1974).

[5] See Stephen Breyer & Paul MacAvoy, *Energy Regulation by the Federal Power Commission* 89-121 (1974); Joskow (1974), supra note 4; Richard Pierce, A Proposal to Deregulate the Market for Bulk Power, 72 Va. L. Rev. 1183, 1183-1208 (1986).

Moreover, electric utilities were plagued by the same inefficiencies and bloated costs that characterized firms in all other sectors of the economy where we formerly relied on cost-of-service regulation of legal monopolies, or rate regulation combined with regulatory limits on entry.[6] The technology-driven fall in prices masked these basic flaws in the regulatory system.

Two developments threatened the status quo ante in the late 1960s and 1970s. First, electric rates increased, due to rising fuel and environmental costs. Political institutions and analysts turned their attention to the electricity industry for the first time in decades. This produced modest changes in rate design intended to reduce the gap between price and marginal cost.[7] The traditional system creaked, groaned, and made minor adjustments, but it continued in place.

The second development was less visible but ultimately far more important. Utilities began increasingly to exhaust economies of scale in power production. At the same time, regional power transmission networks made it possible to build powerplants hundreds of miles from power users. The relevant geographic market for power production was now regional, not local. Power production was no longer a natural monopoly, though it continued to be regulated as such.

The status quo ante could not survive the nuclear powerplant controversy of the 1980s. With enthusiastic encouragement from state and federal regulators, utilities began construction of over one hundred nuclear powerplants in the 1970s. Utilities and regulators predicted

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[6] Examples at the national level include telephone service, natural gas transmission and distribution, airlines, trucking, and railroads. All have undergone at least partial deregulation in recent years, with large benefits to consumers. See Jordan Hillman & Ronald Braeutigam, *Price Level Regulation for Diversified Public Utilities* (1989); John Meyer & William Tye, Toward Achieving Workable Competition in Industries Undergoing a Transition to Deregulation: A Contractual Equilibrium Approach, 5 Yale J. Reg. 273, 277-79 (1988).

[7] See infra Part IV.D.

continuation of the historic pattern of a doubling in electricity demand every decade. Moreover, nuclear plants were expected to drive the cost of electricity to new lows. The massive nuclear construction program predicated on forecasts of low costs and high demand became instead an economic nightmare for all concerned. Actual costs of nuclear power plants vastly exceeded estimates, sometimes by as much as 1000%. Moreover, increasing electric rates during the 1970s induced consumers to reduce significantly their demand for electricity. As the powerplants approached completion, it became apparent that they were both unneeded and extravagantly expensive.[8] The industry and its regulators made two crucial errors that should have enduring value as lessons for the future: They placed undue reliance on engineering projections of the cost and efficacy of a new technology, and they underestimated the power of market prices to influence consumption levels.

The nuclear powerplant debacle destroyed the viability of the status quo ante in the electricity industry. Consumers were outraged at the huge increases in electric rates that would result from letting utilities recover their massive investments in nuclear powerplants. Regulators and their political superiors responded to the outpouring of populist sentiment by disallowing tens of billions of dollars in utility investments, approximately 20% of total utility investments in nuclear powerplants. Most utilities (and their shareholders) suffered significant financial harm from these disallowances, and several utilities went bankrupt.[9]

The massive disallowances of utility investments in nuclear powerplants produced a

[8] For more detailed descriptions of this sad chapter in the industry's history, see Joskow (1989), supra note 2, at 149-63; Richard Pierce, The Regulatory Treatment of Mistakes in Retrospect: Canceled Plants and Excess Capacity, 132 U. Pa. L. Rev. 497 (1984).

[9] Writeoffs between 1985 and 1992 totalled $22.4 billion, about 17% of the book value of total 1992 utility investment. See Charles Studness, The Big Squeeze: 1992 Electric Utility Financial Results, Pub. Util. Fort., June 1, 1993, at 79. For background, see Joskow (1989), supra note 2; Richard Pierce, Public Utility Regulatory Takings: Should the Judiciary Attempt to Police the Political Institutions?, 77 Geo. L.J. 2031.

dramatic change in the incentives of utilities and utility investors. Prior to the mid-1980s, many students of utility regulation believed that traditional rate regulation led utilities to make excessive investments. Utilities attempted to convince regulators to allow a return on invested capital that exceeded a normal return on capital. Utilities that succeeded in that effort had a financial incentive to overinvest in capital assets -- the well-known Averch-Johnson (A-J) effect.[10] These incentives were reinforced by the incentives of corporate managers to see their one-and-only firm grow in size even if that meant accepting a somewhat below-market rate of return.[11] After the disallowances of the mid-1980s, utilities confront instead a powerful *negative* A-J effect. Utilities are extremely reluctant to invest in new generating plants because they perceive a high risk of regulatory disallowance. Utility shareholders are not compensated for this risk through the allowed rate of return;[12] disallowances also place utility managers' jobs in jeopardy. Utilities now systematically underestimate future demand to justify *not* building new generating capacity. In many areas of the country, those underestimates are leading to capacity shortfalls as demand finally catches up to supply.[13]

In sum, utility investment of over $100 billion in a new technology predicated on unduly optimistic engineering estimates, followed by regulatory disallowance of tens of billions of dollars of those investments, destroyed the viability of the status quo ante in the industry. That

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[10] See Harvey Averch & Leland Johnson, Behavior of the Firm Under Regulatory Constraint, 52 Am. Econ. Rev. 1052 (1962).

[11] See, e.g., Ronald J. Gilson & Bernard S. Black, *The Law and Finance of Corporate Acquisitions* ch. 9 (Supp. 1993); Robin Marris, *The Economic Theory of Managerial Capitalism* (1964); Steve Kihm, Why Utility Stockholders Don't Need Financial Incentives to Support Demand-Side Management, Elec. J., June 1991, at 28.

[12] See, e.g., U.S. Dep't of Energy, *Report of the Electricity Policy Project, The Future of Electric Power in the United States, Economic Supply for Economic Growth* 4-1 (1983); Larry Kolbe & William Tye, The Fair Allowed Rate of Return with Regulatory Risk, 15 Res. in L. & Econ. 129 (1992).

[13] See Charles Studness, NERC's Ten-Year Projections of Electric Demand and Capacity, 1992-2001, Pub. Util. Fort., Oct. 15, 1992, at 29.

created a void that must be filled with a new industry structure, new methods of operation, and new forms of government intervention.

B. Competitive Contracting in Wholesale Power Markets

The first leading candidate to replace the status quo ante in the electricity industry is competitive contracting for wholesale power. The basic mechanism is simple. Utility *A* determines that it needs to add 1000 MW of generating capacity over a particular period of time. Instead of building its own rate-regulated powerplants, the utility issues a request for proposals (RFP) from third parties. Prospective suppliers then submit proposed long-term contracts under which they are willing to sell electricity to the utility. The utility evaluates the bids with reference to the criteria set forth in its RFP, especially price and reliability, and chooses a winning supplier or suppliers. The utility then attempts to negotiate the most favorable contract it can with each supplier it has tentatively chosen. The entire process is overseen by the state public utility commission (PUC), which either specifies in advance the criteria and procedures the utility must use or reviews and approves in advance the criteria and procedures proposed by the utility.[14]

Utilities would continue to engage in electric power transmission and distribution, subject to rate regulation. However, as we discuss below, competitive markets for wholesale power will create strong pressure for competitive provision of retail power, especially for larger customers.

Competitive contracting for wholesale power has long been advocated by academics who studied the industry, especially after the natural monopoly justification for rate regulation

[14] For a more detailed description of competitive contracting, see Paul Joskow, The Evolution of an Independent Power Sector and Competitive Procurement of New Generating Capacity, 13 Res. in L. & Econ. 63, 73-100 (1991).

withered in the 1970s.[15] For many years, it foundered on the rock of industry opposition.[16] Acquiring power from third party generators was anathema to most utilities, who preferred to build their own plants, thereby earning a return on their investment.

Recently, however, several factors have turned competitive contracting from a theoretical possibility into a strategy that is supported by most interested parties, including, critically, both utilities and regulators. First, nuclear powerplant cost disallowances created an environment in which utilities are reluctant to risk constructing their own generating plants. Utilities now prefer to acquire power from third party generators to meet expected demand.

Second, a 1978 legislative experiment with utility purchases of power from third parties demonstrated the viability of competitive contracting. The experiment also indicated that such a system would have significant advantages over the status quo ante as the principal means of adding new generating capacity. This experiment, like the nuclear powerplant construction program, also produced broader lessons that should continue to guide policymakers as they restructure government intervention in the electricity industry.

Section 210 of the Public Utility Regulatory Policies Act of 1978 (PURPA), as implemented by the Federal Energy Regulatory Commission (FERC) required utilities to purchase power from cogenerators and small power producers at a price based on the utility's

[15] See Breyer & MacAvoy (1974), supra note 5, at 89-121; 2 Kahn (1970), supra note 3, at 70-77; Twentieth Century Fund, *Electric Power and Government Policy* (1948); James Meeks, Concentration in the Electric Power Industry: The Impact of Antitrust Policy, 72 Colum. L. Rev. 64 (1972); John Miller, A Needed Reform in the Organization and Regulation of the Interstate Electric Power Industry, 38 Fordham L. Rev. 635 (1970); ______ Olds, The Economic Planning Function Under Public Regulation, 48 Am. Econ. Rev. 553 (1958); Pierce (1986), supra note 5; ______ Weiss, Antitrust in the Electric Power Industry, in *Promoting Competition in Regulated Markets* 135 (A_____ Phillips ed. 1975).

[16] Its only proponent within the industry was the then-CEO of Virginia Electric Power. See ______ Berry, The Case for Competition in the Electric Utility Industry, Pub. Util. Fort., Sept. 16, 1982, at 13.

avoided cost.[17] Congress wanted to support development of these generating technologies. Congress also believed that rate regulation gave utilities strong disincentives to buy power from third party generators.[18]

In one important respect, the PURPA section 210 mechanism performed poorly. FERC delegated to the states the determination of each utility's avoided cost.[19] Many state PUCs and legislatures grossly overestimated utilities' avoided costs, thereby compelling utilities to purchase power at prices far greater than the cost at which utilities could otherwise acquire power.[20] Utilities in California and New York were particularly burdened by contractual obligations to purchase power at excessive prices attributable to regulatory overestimates of avoided cost. Niagara Mohawk Power Corporation contends, for instance, that it is now obligated to make $7.3 billion in excess payments to third party generators.[21]

Some of these regulatory mistakes seem reasonable in retrospect, but others were obviously flawed at the time. In particular, regulators assumed continued rapid increases in the real price of fossil fuels despite ample coal supplies, and maintained these assumptions long after oil and natural gas prices collapsed in the mid-1980s.[22] The unsupportable assumptions drive

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[17] 16 U.S.C. § 824a-3 (198_); 18 C.F.R. § 292 (199_).

[18] See H.R. Conf. Rep. No. 175, 90th Cong., 2d Sess., reprinted in 1978 U.S. Code Cong. & Ad. News 7797; Philip Nowak & ______ Watts-Fitzgerald, Regulatory Incentives for Development of Cogeneration Facilities, 13 Nat. Resources L. 613 (1981).

[19] See American Paper Inst. v. American Elec. Power Serv. Corp., 461 U.S. 402 (1983).

[20] See U.S. Dep't of Energy, *Emerging Policy Issues in PURPA Implementation* 5.21-5.40 (1986); Michael Einhorn, Avoided Cost Pricing: Who Wins?, Pub. Util. Fort., May 30, 1985, at 33; ______ Yokell & ______ Marcus, Rate Making for Sales of Power to Electric Utilities, Pub. Util. Fort., Aug. 2, 1984, at 21.

[21] See NiMO Wants NUGs to Secure Overpayments, Elec. J., Nov. 1992, at 2. One of us (Pierce) has analyzed all of NiMo's power contracts. While he did not attempt to verify the dollar amount of excess payments, he was able to verify the existence of numerous contracts that obligate NiMo to purchase electricity at prices as high as six times its avoided cost.

[22] New York, for example, tied the New York PSC's hands by adopting a statute that prescribed a minimum avoided-cost figure of 6¢/kwh in 1980, to be adjusted for inflation thereafter. N.Y. Pub. Serv. Law § 66-c (19__) (repealed 1992).

one to assume either a high degree of regulatory incompetence, or else a political motive to favor cogenerators and small power producers. Probably, both explanations are partly right. Neither bodes well for the politically charged efforts by PUCs, described in Parts III and VI, to estimate the cost of negawatt programs and determine appropriate environmental adders.

Over time, utilities convinced regulators that their original methods of implementing PURPA section 210 were harming consumers by requiring utilities to incur billions of dollars in excess costs. PUCs around the country became convinced that allowing prospective third party suppliers to bid to meet a utility's needs for new generating capacity would produce more capacity at lower cost. Instead of relying on an administrative estimate of each utility's avoided cost, most PUCs now rely on competitive bidding to yield an appropriate purchase price.

Beginning in the late 1980s, in the new regulatory environment spawned by nuclear investment disallowances, most utilities have expanded competitive contracting beyond PURPA-eligible suppliers. They are working with prospective third party suppliers and regulators to maximize their use of purchased power and to reduce its cost. Within a remarkably few years, competitive contracting has become the principal means of acquiring new generating capacity for most utilities.[23]

FERC has also enthusiastically embraced competitive contracting. It has approved numerous proposals to sell electricity at market-based prices, and taken steps to encourage and sometimes require utilities to provide transmission services to potential third party sellers.[24]

[23] In 1992, for the first time, generating capacity added by independent producers exceeded capacity added by utilities. By 1996, independent power producers will account for an estimated 2/3 of all new generating capacity. See Leah Beth Ward, Utilities Brace for a Buyer's Market in Electricity, N.Y. Times, May 9, 1993, § 3, at 10.

[24] See Richard Pierce, Using the Gas Industry as a Guide to Reconstituting the Electricity Industry, 13 Res. in L. & Econ. 7 (1991); Charles Stalon, The Significance of FERC's Transmission Task Force Report in the Evolution of the Electricity Industry, 13 Res. in L. & Econ. 105 (1991); Bernard Tennenbaum & Stephen Henderson, Market-Based Pricing of Wholesale Electric Services, Elec. J., Dec. 1991, at 30.

Transmission line access makes the market for purchased power even more competitive by allowing competition from noncontiguous suppliers.

As utilities watched unregulated cogenerators and small power producers bid to supply wholesale power, the better managed utilities itched for a piece of the action. After a bitter political battle within the industry, the pro-competition forces won a resounding victory in 1992, as Congress eliminated three significant barriers to competitive contracting.[25] Congress eliminated the size and technology limits on independent generating units that can make unregulated sales under PURPA; amended the Public Utility Holding Company Act to permit utilities to form their own unregulated subsidiaries to construct and operate independent powerplants that can sell wholesale power at market prices; and amended the Federal Power Act to permit FERC to compel utilities that own transmission lines to provide access to independent generators (called power wheeling).

The newly-formed independent power sector of the industry is structurally competitive, with over fifty major firms and many more small firms bidding to meet demand for power.[26] Utility RFPs always elicit bids far in excess of the utility's needs; the average RFP elicits bids that total approximately ten times the needed capacity.[27] The wholesale power industry can only become even more competitive now that unregulated utility subsidiaries can compete with independent producers.

The competitive bidding process yields contract prices far lower than the administratively determined "avoided cost" that utilities were required to pay under the original method of

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[25] See Energy Policy Act of 1992, Pub. L. No. 102-486, §§ 711-726 (1992); see Charles Studness, Energy Policy and the Electrics, Pub. Util. Fort., Nov. 15, 1992, at 39.

[26] See Joskow (1991), supra note 14, at 69-70.

[27] See id. at 74-76.

implementing PURPA.[28] Independent power "is now being bid at a levelized price of about 3 cents a kilowatt-hour -- about half the price of 6 to 10 years ago."[29] Competitive pressure to improve efficiency deserves at least some of the credit. Moreover, power contracts allocate many risks, such as construction cost overruns, to power producers. By contrast, rate regulation allocated these risks to consumers.[30]

The savings from competitive bidding go beyond cheaper sources of *new* power. Competitive bidding often produces power costs well below the utility's cost to run its existing powerplants. This puts enormous pressure on the utility to reduce its costs or sell its powerplants to more efficient operators. Some utilities are even considering the drastic step of selling their powerplants and engaging only in transmission and distribution.[31]

We do not mean to suggest that competitive wholesale power markets have no problems. Supply reliability is a concern, but can be addressed through a combination of reliance on multiple power providers, heavy contractual penalties for nondelivery of power, and interruptible service contracts with large customers. Long-term supply contracts are complex, and must cover both delivered power and reserve capacity to meet peak demand. With the benefit of hindsight, some of these contracts will surely prove suboptimal in their pricing formulas or their allocation of risks. One likely problem: Utilities want to avoid unexpected price hikes, which might lead regulators to disallow utility costs. This could lead to contracts that impose risks on power

[28] See id. at 70-76.

[29] Olof Nelson & Roger Sant, Two IPP Points of View, Pub. Util. Fort., June 1, 1993, at 63.

[30] See Edward Kahn, Risks in Independent Power Contracts: An Empirical Survey, Elec. J., Nov. 1991, at 30; Mason Willrich & Walter Campbell, Risk Allocation in Independent Supply Contracts, Elec. J., Mar. 1992, at 54.

[31] See Ward (1993), supra note 23.

producers that are better borne by ratepayers.[32]

A more serious long-term concern is transmission bottlenecks. Transmission capacity is finite, and new transmission lines are hard to build because of public fear about the possible health effects of high-voltage lines.[33] Moreover, transmission pricing is enormously complex. Utilities and regulators will surely make errors, either charging too little today under long-term contracts, thus unduly limiting future access, or charging too much, thus limiting the geographic scope of competition. Still, there are solutions. Regulators can assist utilities and independent power producers in overcoming local political opposition to building new transmission capacity. Transmission rights, even if initially mispriced, can be resold to higher-valuing users, albeit with transaction costs.[34]

In sum, in just a few years, the wholesale sector of the U.S. electricity industry has been transformed almost completely from an industry dominated by ineffectively regulated, inefficient monopolists to an industry that is increasingly dominated by robust competition. Consumers are already deriving significant savings from this change.

C. Competition in Retail Power Markets

Once market forces are allowed to function in one sector of an industry, it is just a matter of time until they produce changes in all other sectors that render traditional methods of regulation obsolete, reduce firms' monopoly power, and produce strong political pressure for

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[32] For further discussion of the potential problems with competitive markets, and the available responses, see, e.g., Joskow (1989), supra note 2.

[33] See, e.g., Consumers Power Cancels PSI Link, Pub. Util. Fort., Apr. 15, 1993.

[34] For further discussion of transmission access and pricing issues, see William Hogan, Electric Transmission: A New Model for Old Principles, Elec. J., Mar. 18993, at 18; Joskow (1989), supra note 2; Joshua Rokach, Transmission Pricing Under the Federal Power Act: Applying a Market Screen, 14 Energy L.J. 95 (1993); Stalon (1991), supra note 24; Michael Toman, *Improving Performance of Wholesale Electric Generation Markets* (Resources for the Future Discussion Paper ENR 88-03, 1988).

additional transitions to market-based regulation. If the transformation in wholesale power markets is allowed to continue down its natural path, market forces increasingly will displace monopoly power and bureaucratic controls in the retail sector of the industry as well, with further benefits to consumers.

The natural gas industry illustrates this market transformation process.[35] FERC changed gas industry regulation in 1985 in ways that permitted competition to become dominant in the wholesale market.[36] Within a few years, the wholesale gas market was transformed to such an extent that traditional methods of regulating the retail market became obsolete. Regulators have responded by allowing retail competition as well.[37]

Unless government institutions stop the natural process of evolution, the robust competition that now dominates wholesale trade in electricity will spread rapidly to the retail level.[38] In many parts of the country, adjacent electric utilities charge prices that vary widely; the retail price of electricity can vary by as much as 100% for consumers that live a block apart.[39] These differences in price are too large to attribute to real differences in uncontrollable costs. They can only be explained by inefficiencies in utility operations or PUC-mandated cross-

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[35] The natural gas industry is analogous to the electricity industry in many important respects. See Pierce (1991), supra note 24.

[36] See Richard Pierce, Reconstituting the Natural Gas Industry from Wellhead to Burnertip, 9 Energy L.J. 1 (1988).

[37] See Suedeen Kelly, Intrastate Natural Gas Regulation: Finding Order in the Chaos, 9 Yale J. Reg. 355 (1992); Richard Pierce, Intrastate Natural Gas Regulation: An Alternative Perspective, 9 Yale J. Reg. 407 (1992); Richard Pierce, *Regulation and Competition in Natural Gas Distribution* (1990). The same phenomenon has been observed in the telecommunications industry. See ______ Egan & ______ Weisman, The U.S. Telecommunications Industry in Transition, Tel. Policy 164 (1986).

[38] For similar assessments, see Charles Studness, The Calm Before the Storm, Pub. Util. Fort., May 15, 1993, at 37 (argument by veteran industry analyst that retail competition is inevitable throughout the country); California PUC, Division of Strategic Planning, *California's Electric Services Industry: Perspectives on the Past, Strategies for the Future* 4 (Feb. 3, 1993) (available on WESTLAW, PUR file) (("increased pressure to allow consumers to benefit from competition through greater choice will shape the future structure of the industry").

[39] See Charles Studness, Regulation and Local Rate Differences, Pub. Util. Fort., Aug. 15, 1992, at 28.

subsidies. Once competition is allowed to govern the wholesale market, the pressure will increase to allow competition at the retail level. Industrial firms will threaten to relocate or switch to self-generation rather than pay a price double that of their competitor a mile away, and residential consumers in Jonesboro will demand the benefits of the lower-priced electricity available to residents of neighboring Smithville.

This combination of political and market pressure has already produced the inevitable result in New Mexico.[40] Because of bloated costs attributable to numerous management errors, Public Service of New Mexico charges prices significantly higher than neighboring utilities. The New Mexico legislature responded to public protest over this situation by threatening to enact legislation that would authorize cities to solicit bids for electric power, accept the lowest bid, and then pay the local utility a fee to transmit electricity purchased from a remote supplier through its lines.[41] Public Service has now accepted the inevitability of retail competition. It is restructuring its debt and reducing its bloated costs in an effort to compete with its more efficient neighbors. California, Michigan, and Texas are also experimenting with or evaluating retail competition.[42]

Producers of wholesale power provide a second potent political force for extending competition to the retail level, for this lets them reach new customers. They are already proving to be remarkably creative in devising ways to sell power to large customers within the current

[40] See Public Service of New Mexico Faces Tough Challenge, Wall St. J., Feb. 12, 1993, at B4.

[41] See Power and Politics, N.Y. Times, May 9, 1993, § 3, at 10. Harold Demsetz, Why Regulate Utilities?, 11 Bell J. Econ. 55 (1968), originally proposed this method of relying on market forces to displace cost-of-service regulation.

[42] See Ward (1993), supra note 23; Michigan to Consider Retail Wheeling, Pub. Util. Fort., Nov. 1, 1992, at 81; California PUC, Division of Strategic Planning (1993), supra note 38, ch. 6.

regulatory structure.[43] And industrial consumers have established their own lobbying group, ELCON (the Electricity Consumers Resource Council), to promote retail wheeling.[44]

Most utilities fiercely oppose retail wheeling. They are worried that competition will force massive writeoffs of their investments in existing plants -- as it will if those plants' economic value is less than their depreciated cost.[45] Utility opposition will slow, but is unlikely to derail, the movement to retail competition. Some utility CEOs have already publicly acknowledged the inevitability of retail wheeling.[46]

There remains, however, a serious risk that regulators will halt, or even reverse, the trend toward reliance on market forces to govern the electricity industry. They are about to discover that competitive contracting is irreconcilable with a second revolutionary change -- negawatt acquisition programs -- that is premised not on the efficiencies of competitive markets but on massive government intervention to correct massive market failure.

III. Negawatt Acquisition Programs

The second revolutionary development in electricity regulation is the dramatic growth of negawatt programs. In this Part, we describe the NAP concept (section A), and the history and

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[43] One common tactic is to build a new generating facility at a large customer's plant site, provide the customer with electric power plus some steam heat (thus qualifying for treatment as a cogeneration facility under PURPA), and sell any excess power back to the local utility. See [cite to come]. Another approach, if one or two large customers are the dominant power users in a small town, is to buy the local distribution network in order to serve the large customers. Conversation with a senior executive of a major New York utility (Mar. 24, 1993). For an extreme case, where a distributor sought unsuccessfully to invoke FERC jurisdiction over power sales *for resale*, by spinning off a subdistributor that would serve a single large industrial customer (and 24 residential customers added to camouflage the transaction), see People's Electric Cooperative, 60 FERC ¶ 63,004 (1992). The goal was to sell power to the industrial customer at a discount otherwise forbidden by the Oklahoma PUC.

[44] See Studness (1993), supra note 38.

[45] See, e.g., Daniel Scotto, Deregulation 1993: Be Careful What You Wish for, You Might Get It, Pub. Util. Fort., May 1, 1993, at 13.

[46] See 1993 Electric Executives' Forum, Pub. Util. Fort., June 1, 1993, at 19, 32 (CEO of Public Service Co. of Colorado states that "retail wheeling will be a near term reality"); id. at 33 (CEO of Iowa-Illinois Gas & Electric Co. notes the "strong and increasing demand for retaila wheeling").

future prospects of NAPs (section B). We then evaluate critically the principal justifications for NAPs (sections C and D), develop the undesirable indirect effects of NAPs (section E), and explain why NAPs promise only limited environmental gains. (section F). Section G draws on this analysis to evaluate four illustrative NAPs. Finally, section H argues that many NAPs deliver less than they promise and that we should carefully evaluate how current NAPs are working before making huge additional NAP investments.

A. General Description

The improbable term "negawatt acquisition program" NAP is descriptively accurate. In an NAP, a utility acquires negative watts by subsidizing investments by customers that reduce the customers' level of electricity consumption. These subsidies are of two main types. First, the utility can pay some or all of the cost of electricity consuming equipment, e.g., light bulbs, refrigerators, heat pumps, or industrial motors, that uses less electricity than the customer's current equipment. Second, the utility can pay some or all of the cost of conservation equipment, e.g., attic insulation, water heater blankets, double-pane windows, or heat-reflective window coatings. We focus below on utility investment in power-consuming equipment, but the analysis applies fully to investment in conservation equipment.

Negawatt acquisition programs are usually referred to as DSM, the acronym for demand side management. We prefer the acronym NAP because DSM includes a wide variety of tools utilities have long used to influence the temporal patterns of demand for electricity, including seasonal pricing, time-of-day pricing, and lower prices for interruptible service.[47] These traditional forms of DSM are designed to create electricity prices that approximate marginal cost and are entirely compatible with competitive contracting.

[47] See, e.g., Howard Spinner, The Peak Shifts: 18 Years of Load Management, Elec. J., Nov. 1992, at 64.

NAP subsidies take three forms: (1) the utility pays a customer directly to purchase qualifying equipment; (2) the utility buys the equipment itself and either gives it to customers or resells it to customers at a price below the utility's cost; or, (3) the utility pays an independent energy service company (ESCO) to purchase and install equipment on a customer's premises for free or at a reduced cost. Many utilities use a combination of all three. We will assume that NAPs are implemented through the first or second method. For our purposes, adding an intermediary does not affect the NAP process.[48]

NAPs can be illustrated with a simple example. Utility *A* estimates that a new type of industrial motor will use 2,000,000 kwh less electricity over its expected life than the older motors used by many of its customers. The utility estimates that its avoided cost if its customers buy the new motor is 5¢/kwh, for estimated dollar savings of $100,000 per motor.[49] If the utility's estimates are correct, it can pay its customers up to $100,000 to buy new motors, and still reduce its own costs. If each motor costs $200,000, the utility can buy motors for $200,000 each and resell them to customers who choose to participate in the NAP at, say, $120,000 each. Customers will participate if they value all of the features of the new motor, including lower energy consumption, at $120,000 or more.

If the utility's estimates are right, and *if* the customer wouldn't have bought the new motor on its own, the utility has saved $20,000 by subsidizing the purchase of the new motor.

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48 For discussion of the different forms of NAPs and the technical differences among them, see Paul Chernik & Sabrina Birner, Additional Thoughts on the Future History of DSM, Elec. J., Mar. 1992, at 64; Chuck Goldman & John Busch, DSM Bidding -- The Next Generation, Elec. J., May 1992, at 34; Peter Fox-Penner, Earle Taylor, Roger Sant, Harrison Wellford & Eric Hirst, The Future History of Demand-Side Management, Elec. J., Dec. 1991, at 46; Jeffrey Howard, Secret Weapon: The Energy Act's Assault Against In-House Utility DSM, Pub. Util. Fort., Jan. 15, 1993, at 29.

49 The calculation is: (2,000,000 kwh) × (5¢/kwh) × ($1/100¢) = $100,000. In the real world, computing savings is far more complex. Both avoided cost and energy savings will vary over the life of the program, and future savings must be discounted to present value. These complexities, of course, increase the opportunity for error in computing the estimated savings.

The utility places the $80,000 loss on each motor in its rate base, thus passing the cost on to its customers and earning a rate of return on its investment in negawatts. The allowed rate of return on NAP investments invariably exceeds the allowed rate of return on other investments by a PUC-specified premium intended to encourage utilities to make socially beneficial conservation investments.[50] The utility increases the electric rates it charges to all consumers to reflect amortization of its negawatt investment and the premium rate of return on that investment.

Sometimes, but not always, negawatt programs must "compete" with conventional power sources in a competitive bidding environment. The utility then computes the cost of the negawatt program per kwh saved. In our example, the cost per motor is $80,000 and the estimated power savings is 2,000,000 kwh. Thus, the program has a bid "price" of 4¢/kwh.[51] It will be chosen because this is lower than the 5¢/kwh cost of conventional power.

We have put "compete" in quotation marks because this competition has a preordained end. An NAP can *always* be designed to have a lower cost per kwh than conventional power. The utility or ESCO simply chooses a subsidy level that is a fraction (80%, in our example) of the estimated energy savings. The NAP's estimated cost per kwh will then equal the same fraction of the cost of conventional power.[52]

B. Genesis, Present Scope, and Future Prospects of NAPs

NAPs were spawned by the fortuitous convergence of two forces. First, some environmentalists and engineers have long contended that utilities should be required to invest

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[50] The precise form of the financial incentive offered the utility varies, but all NAP programs include large financial inducements to utilities. See note 58 infra.

[51] The calculation is ($80,000 cost/2,000,000 kwh saved) x (100¢/$1) = 4¢/kwh.

[52] The calculation of NAP cost per kwh, and the subsidy level at which success in competitive bidding can be assured, becomes more complex when one takes free riding into account. See section E.1 infra.

in conservation because it costs less to conserve energy than to produce energy.[53] Many claims concerning the cost of conserving electricity are dramatic. For example, Amory Lovins claims that U.S. electricity consumption could be reduced by 23% through investments in energy-saving equipment and building design that have a *negative* cost per kwh saved -- the lifetime cost of the less-consuming equipment is claimed to be lower than the high-consuming equipment it replaces.[54]

Most utilities strenuously resisted investing in conservation until the late 1980s, except for limited programs to enhance consumer awareness of conservation opportunities. But utility incentives have changed in the wake of the massive disallowances of utility investments in nuclear powerplants. Utilities are now unwilling to make investments that present significant risks of future regulatory disallowances. These incentives *not* to build powerplants fueled the move toward purchasing power from third parties described in Part II.

As utilities began to substitute power purchased from third parties for investments in utility-owned plants, they found themselves in a predicament. Power contracts with third parties do not add to a utility's rate base, and utilities earn no profit margin on the resale of such power. With their rate bases shrinking, utilities became concerned about the source of their future profits. Shareholders might not care much if a utility shrinks, as long as the utility earns a normal return on capital while doing so. The shareholders can simply redeploy their capital elsewhere. But utility managers care intensely about future growth and profits. They began a

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[53] See, e.g., Ralph Cavanagh, David Goldstein & M. Gardner, *A Model Electric Power and Conservation Plan for the Pacific Northwest* (1982) Ralph Cavanagh, Least Cost Planning Imperatives for Electric Utilities and Their Regulators, 10 Harv. Envtl. L. Rev. 299 (1986); Amory Lovins, The Electricity Industry, 229 Sci. 914 (1985); Amory Lovins, Energy Strategy: The Road Not Taken?, 55 Foreign Aff. 65 (1976).

[54] See Amory Lovins & Hunter Lovins, Least-Cost Climatic Stabilization, 16 Ann. Rev. Econ. & Env't. 433 (1991). Fluorescent bulbs provide an example. The cost of the bulb per hour of projected life is less than the cost of the multiple incandescent bulbs it replaces; the energy savings are a bonus.

desperate search for new ways to add to their rate base by making investments that, they believed, presented little or no political risk of regulatory disallowance.[55] For utility executives, NAPs were a heaven-sent opportunity.

In the late 1980s, some utilities began to meet with environmental groups to discuss NAPs. This time, however, the discussions were not at all contentious. Instead, the utilities expressed their enthusiastic support for conservation investments, provided of course that they were adequately compensated for making such investments. In this dramatically changed environment, the parties were able to reach agreement on a plan with relative ease. Utility executives wanted an above-market return on their investment in negawatts, the better to induce them to make investments they badly wanted to make anyway. Environmentalists were happy to agree that utilities should have incentives to invest in conservation. They didn't mind if electric rates went up, indeed, they may have preferred that outcome, for higher rates would induce still more conservation.

The only remaining step was to convince state PUCs to approve NAPs. This also proved to be an easy task in most cases. PUCs saw an opportunity to please two powerful constituencies who rarely agreed about any issue. At the same time, PUC officials could take credit for encouraging politically correct investments in conservation and environmental protection. Consumer groups were placated by the promise of lower utility *bills* (even though *rates* would necessarily rise). Besides, their liberal constituency overlapped strongly with the environmentalist constituency, so they were loath to oppose the environmental groups. Thus was born the new process of collaborative regulation.

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[55] See Richard Pierce, Placing the *Duquesne* Opinion in a Political Framework, 15 Res. in L. & Econ. 171 (1992).

The first NAP collaborative was formed in Connecticut in 1988 between Connecticut Light & Power and the Conservation Law Foundation (CLF).[56] The utility agreed to fund CLF so CLF could hire consultants to assist it in developing NAPs. This joint effort quickly produced results acceptable to the parties and to the PUC. The utility agreed to make large investments in conservation in return for large financial incentives. In the words of one NAP proponent, the Connecticut precedent "was soon followed by a wave of [NAP] collaboratives around the country."[57]

Since 1988, environmentalists and utilities have convinced a majority of state PUCs to adopt ambitious NAPs that incorporate a wide variety of financial incentives for utilities.[58] In 1989, the National Association of Regulatory Utility Commissions passed a resolution urging all PUCs to "ensure that the successful implementation of a utility's least-cost plan [a euphemism

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[56] See Armond Cohen & Michael Townsley, Perspectives on Collaboration as Replacement for Confrontation, Pub. Util. Fort., Mar. 1, 1990, at 9.

[57] Martin Schweitzer & Jonathan Raab, DSM Collaboratives: What Characteristics Lead to Success, Elec. J., Nov. 1992, at 47. See also Natural Resources Defense Council & Pacific Gas and Electric Co., Energy Efficiency in the National Energy Strategy: NRDC and PG&E Find Common Ground, Elec. J., Oct. 1990, at 38; Bernice McIntyre & Bernard Reznicek, Collaborative Approaches to Conservation, Pub. Util. Fort., Mar. 1, 1992, at 16; John Rowe, Making Conservation Pay: The NEES Experience, Elec. J., Dec. 1990, at 18.

[58] See, e.g., Re Northern States Power Co., 121 PUR 4th 246 (Minn. PUC 1991) (authorizing rate base treatment of investment with 5% bonus rate of return on equity for the unamortized balance); Re Orange & Rockland Utils., 107 PUR 4th 233 (N.Y. PSC 1989) (authorizing utility to collect rates for "non-sales" of electricity); Re Impact of Demand-Side Management Programs and Purchases on the Profitability of Electric Utilities, 123 PUR 4th 28 (Ohio PUC 1991) (authorizing retention of 10% of estimated savings for the benefit of shareholders, over and above allowed rate of return); Re Washington Water Power Co., 135 PUR 4th 382 (Idaho PUC 1992) (2% bonus rate of return); Glenn Blackmon, Conservation Incentives: Evaluating the Washington State Experience, Pub. Util. Fort., Jan. 15, 1991, at 24 (describing Washington statute that authorizes 2% bonus return on conservation investments). See also Re Resource Planning, 128 PUR 4th 448 (Ariz. CC 1991); Re Rules and Procedures Governing Demand-Side Management, 131 PUR 4th 139 (Cal. PUC 1992); Re Public Serv. Co. of Colo., Dkt. No. 91A-480EG (Colo. PUC Jan. 13, 1993); Re Potomac Elec. Power Co., Case No. 834, (DC PSC Jan. 16, 1990); Re Georgia Power Co., Dkt. No. 4132-U (Ga. PSC Jan. 5, 1993); Re Proceeding to Require Energy Utilities to Implement Integrated Resource Planning, 131 PUR 4th (Haw. PUC 1992); Re Delmarva Power & Light Co., 128 PUR 4th 18 (Md. PSC 1991); Re Consumers Power Co., 122 PUR 4th 486 (Mich. PSC 1991); Re Electric Utility Incentives for Acquisition of Conservation Resources, Order No. 92-1673 (Or. PUC, Nov. 23, 1992); Re Atlantic City Elec. Co., 125 PUR 4th 314 (N.J. BPU 1991); Re Central Vt. Pub. Serv. Corp., 126 PUR 4th 235 (Vt. PSB 1991); Re Monongahela Power Co., 125 PUR 4th 126 (W.Va. PSC 1991); Re Advance Plans for Construction of Facilities, 136 PUR 4th (Wis. PSC 1992).

for an NAP with a projected cost per kwh less than the projected cost of new power] is its *most profitable course of action.*"[59] It is not difficult to see why NAPs have become popular with virtually all utilities. State regulators have agreed that if the utilities invest billions of dollars in NAPs, those billions of dollars, plus normal rate of return, plus incentives, will then be extracted involuntarily from consumers.[60]

In 1993, utilities are expected to invest over $2 billion in NAPs, approximately double the 1990 level.[61] This is just the beginning of a massive investment program. The Edison Electric Institute, the industry's trade association, has announced that its members plan to purchase negawatts equivalent to 45,000 megawatts of generating capacity by the year 2000.[62] That is the equivalent of forty-five large coal plants. The industry places NAPs "at the very top of our list" because "[t]hat's good public policy, but it's also good business."[63] Southern California Edison, one of the nation's largest utilities, recently proposed to meet 100% of its new supply needs through the year 2003 with NAP investments, making even the California PUC, which has aggressively supported NAPs, nervous that SoCal Edison was putting all its eggs in one uncertain basket.[64] Other utilities plan to rely on NAPs to meet 25-75% of their

[59] National Ass'n of Reg. Util. Commissioners, Resolution in Support of Incentives for Electric Utility Least-Cost Planning (Feb. 1989) (emphasis added).

[60] The CEO of New England Electric described the effects of NAP incentives on his firm's 1992 profits: "For us, the conservation incentives made the difference between a good year and a great year for our shareholders." 1993 Electric Executives' Forum, Pub. Util. Fort., Jule 1, 1993, at 19, 46.

[61] See John Emshwiller, Firm's Profit is Generated by Energy Efficiency Chaos, Wall St. J., May 11, 1993, at B2.

[62] See John Ellis, The Electricity Industry: Shaping Our Future in the 90s, Pub. Util. Fort., May 24, 1990, at 18, 20.

[63] Id. at 19.

[64] See re Biennial Resource Plan Update, 132 PUR4th 206, 243-46 (Cal PUC 1992).

capacity needs.[65] One projection is that utilities will invest $165 billion in NAPs by the year 2010.[66]

Massive spending on negawatts seems entirely realistic, given the financial incentives and political encouragement that many PUCs give to utilities to adopt large NAPs,[67] and the prospect that even more incentives will be forthcoming from other government institutions. According to the general counsel of the ESCO trade association: "At last count, eight [congressional] subcommittees were trying to think up some new incentive or advantage to give the industry."[68]

C. The Level Playing Field Justification for NAPs

Proponents support the need for hundreds of billions of dollars in NAP investments with two justifications. First, they assert that utilities and PUCs should create a "level playing field" on which negawatts produced by NAPs can compete equally with megawatts produced by powerplants.[69] Second, they claim that massive imperfections in the electricity market induce

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[65] See Marion Fraser, Demand Management in Ontario, Pub. Util. Fort., Nov. 1, 1992, at 67; Martin Schweitzer, Eric Hirst & Lawrence Hill, A Look at the Resource Portfolios of 24 Electric Utilities, Elec. J., Aug./Sept. 1991, at 38; Robert Wirtshafter, The Dramatic Growth in Demand-Side Management: Too Much, Too Soon?, Elec. J., Nov. 1992, at 36, 37.

[66] See Eric Hirst, *Fulfilling the Demand-Side Promise*, Pub. Util. Fort., July 1, 1991, at 31, 32; ; see also Earle Taylor, *Nurturing DSM in Its Formative Years*, Elec. J., Dec. 1991, at 49, 51 (hyperbolic estimate of $100 billion in *annual* NAP investments).

[67] The Wisconsin PSC, for example, recently rejected a utility planning forecast that called for 1400 MW of annual demand reduction by 2010, and instead estimated annual demand reduction of 2100 MW, to be achieved by "more aggressive demand-side programs than the utilities presently contemplate." Re Advance Plans for Construction of Facilities, 136 PUR 4th 153 (Wis. PSC 1992).

[68] Harrison Wellford, Fair Competition for DSM Services, Elec. J., Dec. 1991, at 52, 53.

[69] See, e.g., Ralph Cavanagh, FERC: Electricity Demand-Side Bidding, Hearing Before the Subcomm. on Energy and Power of the House Comm. on Energy and Commerce, 100th Cong., 2d Sess., Ser. No. 100-197, Mar. 31, 1988, at 3, 9, 12-13; Jayand Sinha & Raymond Saleeby, Balancing Supply and Demand Resources, Pub. Util. Fort., Sept. 27, 1990, at 24; Mason Willrich, A Vision of the Future, Pub. Util. Fort., Oct. 1, 1991, at 12, 14; Natural Resources Defense Council & Pacific Gas & Electric Co. (1990), supra note 57, at 39-41.

consumers to underinvest in conservation.[70] It follows that utilities and PUCs should help consumers correct this irrational behavior by taking money from them through higher electric rates and spending it to purchase higher efficiency equipment on their behalf. In theory, consumption will decline by enough so that electricity *bills* fall, on average, despite the higher electric *rates*.

Though NAP proponents almost always blend the two justifications,[71] they are unrelated and inconsistent. We consider the level playing field justification in this section and the market failure justification in section D.

NAP proponents who rely on the "level playing field" justification invariably urge that utilities that use competitive contracting treat negawatts as one source in "all source" bidding. The utility buys negawatts if the estimated cost is less than its avoided cost -- the lowest bid for new power. Many utilities have adopted all source bidding. Moreover, most PUCs have instructed utilities to use the avoided cost test to evaluate NAPs outside the competitive bidding context.[72] Of course, it was administratively calculated estimates of avoided cost in implementing PURPA that produced billions of dollars in excessive consumer costs. In either situation, the utility or ESCO can ensure that an NAP will be selected by choosing a subsidy level at which estimated savings will be less than 100% of avoided cost.

The level playing field argument is premised on a fundamental misunderstanding of

[70] See, e.g., Cavanagh (1988), supra note 69, at 3, 16-19; Stephen Wiel, The Electric Utility as Investment Bank for Energy Efficiency, Elec. J., May 1991, at 30; Larry Hamlin, Energy Efficiency: The Future Business Opportunity for Electric Utilities, Elec. J., Aug./Sep. 1990, at 30; Natural Resources Defense Council & Pacific Gas & Electric Co., supra note 57; Thomas Chema, In Support of Demand-Side Management, Pub. Util. Fort., Jan. 18, 1990, at 11; National Ass'n of Reg. Util. Commissioners, *Least-Cost Utility Planning Handbook* II-1 to -15 (1988).

[71] See sources cited in note 69 supra. Ed Kahn is one of the rare exceptions to this generalization. See Edward Kahn, Integrating Market Processes Into Utility Resource Planning, Elec. J., Nov. 1992, at 12.

[72] See sources cited in note 57 supra.

markets. Market prices create incentives to conserve scarce resources. That is one of their primary functions. Returning to our earlier hypothetical NAP example, an industrial consumer has a market-based incentive to replace its existing motor with a new, more efficient motor if the present value of the expected future savings in operating costs exceeds the capital cost of the new motor. If a new motor costs $200,000, the consumer will buy the motor if the present value of expected future savings equals $250,000, but not if the present value equals $150,000. In a properly functioning market, the prices of electricity and electricity consuming equipment will equal the marginal costs of the two products. Those price signals will induce the consumer to make the optimal trade off between the social cost of making motors and the social cost of generating and distributing electricity.

Now consider how all source competitive bidding on a "level playing field" changes the situation. Assume that the utility sells electricity to industrial consumers at 5¢/kwh. The utility needs to add capacity to meet expected load growth in its market area. Assume that it receives two bids -- one at 5¢/kwh from a supplier of megawatts, and the other at 4¢/kwh from a supplier of negawatts. The negawatt supplier proposes that the utility subsidize the cost of new $200,000 motors by $80,000 each. The utility will, of course, take the "least-cost" bid.

By taking this action, however, the utility will waste society's resources. The utility is now offering to pay the consumer $80,000 to save 2,000,000 kwh, a payment of 4¢/kwh conserved. But the consumer will also save $100,000 (5¢/kwh) from using less electricity. Thus, the consumer will evaluate the purchase of the motor based on electric power savings of $180,000, or 9¢/kwh -- the 5¢/kwh price of electricity *plus* the 4¢/kwh negawatt payment from the utility. Yet the only resources conserved by the purchase of the motor are represented by the 5¢/kwh price of electricity. This double-counting effect is thoroughly understood by industry analysts.[73] It has simply been ignored by PUCs and NAP proponents.

If the consumer won't buy the motor without the negawatt payment, it must believe that the motor's value, including but not limited to the value of the electricity conserved, is less than $200,000. The $80,000 negawatt payment will induce the consumer to buy the motor if its value is between $120,000 and $200,000. The marginal consumer, who was just willing to buy the motor for $120,000, but not for a higher price, has bought a motor whose true price ($200,000) is nearly double its present value, *including the present value of the electricity conserved.*[74]

A central function of prices is to inform consumers of the social costs of their purchases. The $200,000 price of the motor reflects the value of the scarce resources required to manufacture a motor, including the cost of extracting iron ore, converting it to steel, and machining it to meet the specifications for the motor. If the markets for electricity and electricity consuming equipment are performing reasonably well, all source bidding on a "level playing field" will induce too much investment in high efficiency electricity consuming equipment and too much investment in conservation equipment.

We have thus far assumed that the wholesale and retail cost of power is identical. Allowing for a retail markup to allow the utility to recover power distribution costs will

[73] For other explanations of this double-counting effect, See Paul Joskow, FERC: Electricity Demand-Side Bidding, Hearing Before the Subcomm. on Energy and Power of the House Comm. on Energy and Commerce, 100th Cong., 2d Sess. Ser. No. 100-197, at 30-96 (Mar. 31, 1988); Larry Ruff, Equity vs. Efficiency: Getting DSM Pricing Right, Elec. J., Nov. 1992, at 24, Alfred Kahn, An Economically Rational Approach to Least Cost Planning, Elec. J., June 1991, at 11; Paul Cicchetti & William Hogan, Including Unbundled Demand-Side Options in Electric Utility Bidding Programs, Pub. Util. Fort., June 8, 1989, at 9; Michael Hoover, James Garces & Richard Ridge, Demand-Side Bidding: A Practical View, Pub. Util. Fort., June 12, 1990, at 17.

[74] For the inframarginal consumer, who would have bought the motor for a smaller subsidy, say $50,000, the direct social waste is smaller ($50,000 in this case) but there is also a $30,000 wealth transfer from other electricity consumers to the motor buyer. For consumers who would have bought new motors anyway, there is no direct social waste, but there is a large wealth transfer ($80,000 per motor in our example). We discuss wealth transfers and the related problem of free riders in section E.1 infra.

generally exacerbate the double counting. The average retail markup needed for the utility to recover its costs must, of necessity, equal the utility's average cost. Retail distribution costs, while lumpy, generally involve increasing returns to scale -- marginal cost *less than* average cost. Thus, if wholesale power is priced at marginal cost, retail consumers, on average, are already paying more than marginal cost.

Staying with the same example, assume that retail cost is 7¢/kwh, wholesale cost is 5¢/kwh, and the marginal cost of retail distribution is 1¢/kwh. The industrial customer will then save 11¢/kwh by buying the motor (4¢/kwh in negawatt compensation plus 7¢/kwh in power cost savings), while the resources conserved are 6¢/kwh (5¢/kwh for power generation plus 1¢/kwh for retail distribution). The gap between private incentive and true resource cost has increased from 4¢/kwh to 5¢/kwh. The increase reflects the difference between the 2¢/kwh that the consumer pays for retail distribution and the 1¢/kwh marginal cost of distribution.

An analogy may illustrate the absurdity of the "level playing field" argument. Suppose that you fill your car's gas tank once a week at a local gas station. You customarily buy 20 gallons per week at $1.25 per gallon, for a weekly cost of $25. This week, however, you have a proposal for the gas station owner. You will buy a smaller, more fuel-efficient car, and buy only 10 gallons per week, if he pays you $1.00 for each gallon *not* consumed. You will then pay $12.50 for the 10 gallons you purchase, less the negagallon payment of $10.00, for a net payment of $2.50 per week.

At this point in your attempt to close your negagallon transaction, we predict that you will confront a bewildered gas station owner. He will quickly go broke selling gas at a net price of $0.25 per gallon. Suppose, however, that a government agency assures gas station owners that they will be reimbursed for their losses on all negagallon transactions, plus they will receive a $.10 per negagallon incentive payment for each transaction they complete. We predict that negagallon payments will grow to billions of dollars in a very short period of time. If the government raises the revenue for these negagallon payments through a gasoline tax, gasoline prices will soar to new heights. If you believe that negagallons equal gallons, you should believe that negawatts equal megawatts. You also should abandon any plans for a business career.

D. The Market Failure Justification for NAPs

The second justification for NAPs is based on the claim that a variety of market imperfections yield massive underinvestment in high efficiency equipment. This is an empirical claim, provable or refutable only by examining each alleged market imperfection. If true, and if the market imperfection cannot be alleviated in other ways, it could justify NAP subsidies designed to bring consumer decisions closer to those that a rational, fully informed consumer would make.

As we will see, the available evidence suggests that market imperfections justify some government intervention, including NAPs targeted to particular classes of consumers, especially poor residential consumers, utility efforts to publicize energy-saving technology, and (perhaps) limited investments targeted at jump-starting promising new technologies. There is no justification, however, for investing $100 billion or more in NAPs that apply broadly to all classes of consumers.

1. *General Considerations*

Before discussing each of the imperfections alleged to exist in the electricity market, it is important to put the specific evidence in a broader context. First, the electricity market, performs in the same manner as all other markets. When the price of electricity increases, consumers reduce their demand for electricity and increase their demand for high efficiency electricity-consuming equipment and conservation equipment. For example, the price of electricity increased significantly during the period 1974-1982.[75] As a result, the quantity of electricity demanded fell well below forecast levels throughout the period.[76] This response parallels consumer reaction when the price of gasoline jumped in 1973 and again in 1979. Consumers demanded, and automakers supplied, more fuel-efficient cars. Overall fuel economy far exceeded the federal CAFE (corporate average fuel economy) minimums until gasoline prices fell sharply in the mid-1980s, fueling renewed customer thirst for high-powered, less fuel efficient vehicles.[77]

Second, virtually all markets, at all times, exhibit substantial inefficiencies. Consumers make imperfect and sometimes demonstrably irrational decisions, based on incomplete information. Firms can grow bureaucratic and inefficient, can squander their comparative advantage in one stage of production through waste at another stage. This does not mean that government can improve matters by subsidizing the purchase of all products that it believes are currently underconsumed. Indeed, the central lesson from the economic history of the 20th century is that decentralized market decisions, despite their many imperfections, have a huge *comparative* advantage over centralized decisions.

There are multiple reasons for this. Private actors have incentives to make good decisions, while planners have no direct economic stake in the outcome of their decisions. Often, private actors have better information than central planners, not least because market

[75] See Joskow (1989), supra note 2, at 153-55.

[76] See Studness (1992), supra note 13; Pierce (1984), supra note 8, at 502-03.

[77] [cite to Crandall's book to come]

prices condense huge amounts of information into a readily understood form; private actors also respond more quickly to new information, especially information about prior mistakes. Subsidies create their own distortions, as do the taxes needed to pay for the subsidies. One can scarcely propose government bureaucracy as a cure for large firm bureaucracy. Lastly, central planning decisions often reflect political rather economic imperatives. The advantages of markets loom especially large when technology is changing rapidly. Political forces inevitably resist the "creative destruction" of capitalism.[78] Subsidies, in particular, often maintain a life of their own long after any economic justification has passed. These general considerations do not mean that subsidies are never appropriate. But we must always ask, once subsidy advocates identify a supposed market imperfection, not only whether the imperfection is real, but whether the cure will be worse than the disease.

Third, the electricity market would have to be massively flawed to justify the NAPs now being implemented by most utilities. Under all source bidding on a "level playing field," NAPs will be chosen over power sources at any subsidy level up to a 100% subsidy for each kwh conserved. Few markets function so poorly that their performance is likely to be improved by a 100% subsidy.

The subsidy can exceed 100% if, as we discuss in Part VI, the state adopts an environmental adder program that inflates the imputed cost of power beyond the level that can be justified based on the marginal social cost of powerplant emissions. It should not be surprising that the environmental groups who support NAPs also support large environmental adders; some utilities also support large adders. The environmentalists may really believe the

[78] The term is Joseph Schumpeter's. See Joseph Schumpeter, *Capitalism, Socialism and Democracy* ch. 7 (1942).

adders are justified, or they may see conservation as a goal in itself, and view adders as a means to that end. Utilities are unlikely to care about externalities or conservation, but may welcome large adders because they expand the opportunities for profitable NAP investments.

To put these subsidies in perspective, suppose that 50% of current U.S. power use were replaced by negawatts (a proportion that negawatt proponents believe is entirely reachable[79]), at an average cost of 4¢/kwh. The annual negawatt subsidy would be over $55 billion per year. Retail electricity rates would have to rise from the current national average of about 7¢/kwh to more than 11¢/kwh to pay for the negawatt campaign.[80]

2. *Specific Market Failure Claims*

NAP proponents allege market imperfections in four broad areas: (1) consumers have inadequate information about the availability and efficiency of new equipment; (2) consumers face high costs of financing new equipment; (3) consumers use irrationally high discount rates for conservation investments; and (4) electricity prices vary from marginal social cost. We will address each in turn.

a. *Residential Consumers*

In a perfectly functioning market, all participants are assumed to have instant access to all relevant information. Of course, no market actually conforms to such a paradigm. Consumers will never have perfect information, because information is costly. At best, they will have an efficient amount of *mis*information -- they will invest in information up to the point where the expected marginal benefit from better decisionmaking equals the marginal cost of

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[79] See sources cited in note 53 supra.

[80] Electricity use in 1990 was approximately 2,808 billion kwh, and average retail cost was 6.6¢/kwh. See U.S. Dep't of Energy, Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets* 54 (Nov. 1992) [cited below as *Federal Energy Subsidies*]. The subsidy calculation is: (2,808,000,000,000 kwh/year) x 50% x ($.04/kwh) = $56.2 billion.

additional information.[81] Moreover, in any market, there is a lag between the time when a new product with desirable characteristics becomes available and the time when consumers become aware of the product's availability and develop confidence that the product will perform as its manufacturer claims.

Manufacturers of high efficiency products can reduce information costs and time lags by advertising the product's availability and desirable characteristics. They confront two major obstacles, however: providing consumers with relevant information is costly; and consumers will be skeptical about the benefits claimed by a product's manufacturer. These obstacles vary considerably by product and by the nature of the market for the product. It is much more difficult and expensive to communicate effectively with residential consumers than with industrial or large commercial consumers. Residential consumers are numerous, they have limited ability to verify the claims made by product manufacturers, and because dollar savings per consumer are modest, consumers will not put much effort into researching the characteristics of new products.

Turning from theory to evidence, there is some evidence that residential consumers lack sufficient information concerning the relevant characteristics of appliances. There is somewhat more evidence that residential consumers have trouble understanding the significance of the information they do have.[82] But there are also government programs, such as energy efficiency labelling and, for some products, minimum efficiency standards, that mitigate the effects of information deficiencies.

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[81] See Sanford Grossman & Joseph Stiglitz, On the Impossibility of Informationally Efficient Markets, Am. Econ. Rev., June 1980, at 393; Gilson & Black (1993), supra note 11, ch. 5 (discussing limits on stock market efficiency due to cost of gathering information).

[82] See Scott Newlon & David Weitzel, Do Market Imperfections Justify Utility Conservation Programs? A Review of the Evidence, Elec. J., May 1991, at 40, 45-47.

There is strong evidence that residential consumers experience high capital costs that deter them from investing in new, high efficiency equipment.[83] It is not at all clear, however, that this is attributable to market imperfections. Consumer capital markets are structurally competitive; thousands of financial institutions compete to make consumer loans. The high financing costs many residential consumers confront are attributable to two basic characteristics of the consumer finance market -- high default risk and high transaction costs.[84] These characteristics are not market imperfections.

There is no reason to expect that utilities can provide consumer loans at lower cost than traditional financial institutions. Nor have they shown any inclination to try. Here the proof is in the pudding. If utilities can profitably lend to consumers who want to buy consumption-reducing equipment at lower rates than commercial lenders, they need only ask PUCs for permission to do so. We would have no objection, as long as investors', not ratepayers', money was at risk. If the problem is truly a capital market imperfection, no ratepayer subsidy is needed.

Several studies have found that consumers use very high implicit discount rates to evaluate prospective purchases of high efficiency equipment.[85] NAP proponents rely heavily on these studies to support the proposition that all consumers consistently undervalue conservation and underinvest in high efficiency equipment. However, when Scott Newlon and David Weitzel disaggregated the data in these studies, they concluded that the data support instead more particularized findings. In the residential sector, the findings vary significantly

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[83] See Wiel (1991), supra note 70.

[84] See Charles Stalon, Comments on Wiel, Elec. J., May 1991, at 38.

[85] See ______ Train, Discount Rates in Consumers' Energy-Related Decisions: A Review of the Literature, 10 Energy 1243 (1985).

with income level; low income consumers have implicit discount rates of 50-90%, while middle income consumers have rates of 4-20%.[86] This wide variation by income seems intuitively correct. People with larger incomes routinely defer current consumption in favor of long-lived investments -- whether in education, housing, or energy-efficient appliances. In contrast, consumers who are concerned about having enough to pay next month's rent are unlikely to make many investments to enhance their future wealth.

High discount rates, like capital constraints, justify utility loans, not NAPs. If utilities believe that consumers have unduly high discount rates, then can lend money for energy-efficiency investments at market rates. If high discount rates are the real obstacle to conservation investments, consumers should jump at this opportunity. The interest rate will, by hypothesis, be lower than their own irrationally high discount rate, and the utility can predict that their new monthly utility bill, plus loan repayment, will be lower than their current utility bill.[87]

In sum, residential consumers, especially low-income consumers, suffer to some degree from lack of information, limited information processing ability, capital constraints, and high discount rates. A paternalistic society might try to correct these errors by subsidizing, the purchase of high-efficiency electricity consuming equipment or conservation equipment. But it is not clear that society ought to do so. There are many other areas of life where people make demonstrably foolish choices -- smoking cigarettes, overconsuming alcohol, riding motorcycles,

[86] See Newlon & Weitzel (1991), supra note 82, at 45.

[87] For proposals that utilities offer loans instead of subsidies, see Douglas Houston, Demand Side Management: A Losing Proposition for Consumers, Pub. Util. Fort., May 1, 1993, at 17, 19; A.L. Kolbe, M.A. Maniatis, J.P. Pfeifenberger & D.M. Weinstein, It's Time for a Market-Based Approach to DSM, Elec. J., May 1993, at 42. Cf. Johannes Pfeifenberger & David Weinstein, Charge It: Financing Demand-Side Management Programs May Reduce Rate Impacts, Help Allocate Costs, and Maintain Participation Rates, Pub. Util. Fort., May 1, 1993, at 24 (advocating NAPs where the subsidy is delivered through loans at below-market interest rates).

leaving school, having a child in one's teens -- with far more drastic consequences than spending a few extra dollars on electricity. We cannot control all of these choices without drastically reducing the scope of individual liberty. Should government then seek to channel the purchase of electricity-consuming equipment in particular ways? Autonomy values are important to us; they will seem unimportant to some readers. But they form an element of the overall policy choice between markets and central planning that electricity regulators must make.

Moreover, there are less interventionist responses that respond directly to the various market imperfections. If consumers lack information, utilities or government agencies can provide it. Thus, for instance, energy efficiency labeling rules for major appliances and utility energy audit programs may enhance social welfare by improving the flow of information relevant to conservation investments. If consumers disbelieve manufacturer claims, utility endorsement can put the utility's reputational capital behind high-efficiency products that deliver what they promise. If consumers lack capital or suffer from high discount rates, utilities can lend them money at a market rate of interest. If PUCs want utilities to subsidize conservation by low-income consumers, they can require utilities to loan money to those consumers at below-market interest rates.[88] These responses are far less costly and far less paternalistic than conventional NAPs. They are also far less profitable for utilities, a critical fact that does much to explain why utilities favor NAP subsidies over these direct responses to market imperfection.

b. *Industrial and Commercial Customers*

For industrial and commercial customers, the basic situation is very different. The

[88] We do not mean to imply that this would be good policy. One might ask: (i) why society should subsidize loans used to buy energy-efficiency-related items and not other items; (ii) whether utilities are the optimal agency to deliver cheap loans to poor people; and (iii) what subsidized loans have to do with the PUC's central mission to limit monopoly profits. But most centrally for present purposes, such a subsidy would be targeted at the particular problem that is claimed to justify NAPs.

theoretical case for large information gaps is weaker. Dollar savings for each consumer are larger, which justifies more product research. Many firms have energy managers or engineering staffs who can evaluate a product's characteristics and estimate the firm's electricity savings from purchasing the product. Specialized consulting groups also exist that advise firms on energy efficiency investments.[89] Moreover, firms that fail to exploit cost-saving opportunities will be at a competitive disadvantage compared to other firms; they will tend to shrink while cost-conscious firms grow.[90]

For large purchases, there is no evidence that industrial and commercial consumers lack sufficient information about the energy requirements of the equipment they buy, or cannot evaluate that information. Moreover, industrial and commercial consumers generally have access to capital at competitive rates. And any capital market imperfections provide an opportunity for utilities to earn profits by making loans, not a justification for subsidies.

Industrial and commercial consumers use implicit discount rates that approximate their cost of capital when they evaluate large investments. They appear to use much higher implicit discount rates to evaluate small investments.[91] This variation also conforms with intuition. Large firms do not devote significant resources to evaluating small investments because the cost of evaluation is likely to exceed the gains from making the investment. Large firms often decline to make small investments of all types that would provide a positive return if evaluation were costless.

In sum, the only significant market imperfection that has been demonstrated for industrial

[89] See, e.g., John Emshwiller, Firm's Profit is Generated by Energy Efficiency Chaos, Wall St. J., May 11, 1993, at B2 (describing success of E-Source, a for-profit spinoff from Amory Lovins' Rocky Mountain Institute).

[90] Small firms will form something of an intermediate category -- they are likely to be better informed than residential consumers, but less well-informed than larger firms.

[91] See Newlon & Weitzel (1991), supra note 82, at 49.

and commercial consumers is that they are neither well informed about, nor interested in, investments that involve small savings. This shows up in studies as a high implicit discount rate. But again, a cheap alternative to NAPs is available to utilities -- provide the information in easily usable form.[92]

Moreover, evaluating small investments involves real costs. Beyond providing information, utilities can do little to reduce those costs. If an investment of $10,000, plus evaluation costs of $5,000, will produce electricity savings of $12,000, the investment should not be made. Yet it will be made if the utility offers a $6,000 NAP subsidy, purportedly justified by the consumer's mistake in not spending $10,000 to save $12,000.[93]

c. *Divergence Between Price and Marginal Cost*

The final form of market imperfection -- electricity price less than marginal social cost -- applies to both residential and commercial consumers. It can yield underinvestment in conservation even if all consumers act in their long-term best interests. The sources of the divergence between the price and the marginal social cost of electricity are easy to eliminate. We address them in detail in Part IV. For now, we need only make a few general observations.

First, apart from uninternalized environmental costs, about as much electricity is sold at a price in excess of marginal cost as is sold for less than marginal cost. Second, competitive contracting for new generating capacity will create powerful incentives for utilities to price all electricity at marginal cost. Third, as we discuss in Part V, there are straightforward ways to

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[92] As EPA is beginning to do, at least in a small way. See Matthew Wald, E.P.A. is Urging Electricity Efficiency, N.Y. Times, Jan. 16, 1991, at D6 (describing EPA efforts to encourage use of high-efficiency fluorescent light bulbs in office buildings); The Green Machine, PC Magazine, May 25, 1993, at 110 (describing Energy Star program to reduce power consumption by personal computers).

[93] In the customary level-playing-field calculation, this 50% subsidy will appear to cost only 2.5¢/kwh if new purchased power costs 5¢/kwh.

incorporate environmental costs into the electricity market. Moreover, uninternalized environmental costs would have to be huge to justify the conservation subsidy that is provided by most NAPs. As we discuss in Part VI, this is simply not the case. To the contrary, existing environmental regulation of power plants, including fuel taxes, already internalizes most and perhaps all of the pollution costs of power generation.

E. The Indirect Effects of NAPs

In addition to the direct effect of inducing excessive production of electricity-consuming and conservation equipment, NAPs will produce a number of undesirable indirect effects, including: windfalls to participants in NAPs; wealth transfers from non-participants to participants; pricing of electric power above marginal cost; substitution of other energy sources for utility-supplied power, with an accompanying rate spiral; distortions of the subsidy program as utilities, ESCOs, subsidy recipients, and equipment manufacturers fight over the subsidy pie; and cessation of the trend toward increased reliance on competition and market forces to govern the electricity industry. This section explains each of these indirect effects.

1. *Windfalls and Free Riders*

The windfall effect is easy to illustrate by considering variations of our recurrent hypothetical.[94] An industrial consumer who expects $150,000 in present value of future savings by buying a new motor for $200,000 will not buy the motor absent an NAP. With an $80,000 NAP subsidy the customer will buy the motor, but $30,000 of the payment is a windfall to the customer. If the expected savings are $200,000 or more, the entire payment is a windfall. NAPs will thus confer large windfalls on many participating customers.

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[94] For other discussions of the windfall effect of NAPs, see Taylor (1991), supra note 83; Joskow (1988), supra note 72, at 73-74; Kahn (1991), supra note 72, at 16. Even some utility executives acknowledge the problem. See Rowe (1990), supra note 57, at 24.

Moreover, customers will begin to incorporate the expectation of NAP payments in their purchasing decisions. In the new environment, rich in NAPs and potential new NAPs, even customers who would have bought new equipment at the market price will learn never to invest in energy-efficient equipment without an NAP payment. No sophisticated customer will settle for an expected gain of $10,000 if the customer believes that the friendly local utility can be convinced to turn the same transaction into a gain of $90,000. Utilities won't be able to tell who needs the subsidy and who doesn't.

The prospect of future NAPs, and their accompanying windfall, will also distort the timing of equipment purchases. Suppose that an industrial consumer believes that buying a new $200,000 motor today, instead of a year from now, will produce a net present value of $20,000. The consumer will forgo that $20,000 of real social gain and defer the purchase if it expects that next year, the local utility will pay it $80,000 to buy the motor. And, of course, the transaction costs of learning about NAPs, factoring NAP payments into purchasing decisions, applying for and receiving NAP payments, convincing utilities to adopt NAPs, etc., are a deadweight loss to society.

The presence of free riders -- consumers who would have made the efficiency investment without a subsidy -- increases the NAP's cost per kwh saved. In our industrial motor example, with expected energy savings of $100,000 per motor, assume *arguendo* that a real market imperfection exists. If half of the participants are free riders, and administrative costs are $10,000 per motor, the net savings from each subsidized purchase will be only $40,000. Any subsidy greater than $40,000 will increase not only electric rates, but electric *bills* as well.[95]

[95] At this subsidy level, the purchase of two motors will cost the utility $80,000 in subsidies, and will cost utilities and their customers $20,000 in administrative costs, for total cost of $100,000, which just equals the energy savings from the induced purchase of one additional motor.

To model how free riders affect NAP cost, let:

N_s	=	the number of subsidy participants
i_s	=	the fraction of induced participants -- those who will buy only with the subsidy. The remaining participants are free riders.
$\$D$	=	the dollar savings in energy costs per induced participant.
a	=	administrative and other transaction costs incurred by utilities and customers, as a fraction of dollar savings
s	=	the subsidy level, as a fraction of the dollar savings per induced participant.

We have put a subscript s on the number of participants N and the fraction of induced participants i to indicate that they depend on the subsidy level s.

The NAP subsidy will cost ($N_s \cdot \$D \cdot (s + a)$). The energy savings are ($N_s \cdot \$D \cdot i_s$). The net gain is:

$$\text{Net Gain} = N_s \cdot \$D \cdot (i_s - s - a)$$

Several points about this formula deserve emphasis. First, at low subsidy levels, most participants are likely to be free-riders, who will participate as long as the subsidy level exceeds the transaction costs of applying for the subsidy. Thus, the net gain will probably be negative. At high subsidy levels ($s \approx 1$), the savings will be outweighed by the cost of the subsidy. Assuming a real market imperfection exists, *some* NAPs will generate net gains at an intermediate subsidy level. But for an NAP with extensive free riding or high administrative costs, there may be *no* subsidy level that produces a net gain.

Second, estimating the fraction of free-riders is a tricky business. In theory, one must know the demand curve for the subsidized product. Demand curves can never be estimated precisely, and approximations are often very rough. Not surprisingly, utilities often underestimate free-riding effects, and thus overestimate NAP savings; some utilities don't adjust for free riders at all.[96]

Third, the subsidy level should be chosen to maximize the net gain from the negawatt program, *not* the program's penetration. (Equivalently, the subsidy level should be set at the point where the *marginal* gain from increasing the subsidy is zero.) The highest subsidy level at which net savings are zero ($i_s = s + a$) is *too high*. Some PUCs have simply failed to understand this.[97]

2. *The Wealth Transfer Effect*

The wealth transfer effect is also easy to illustrate.[98] Assume that a utility serves only two types of customers -- *A* and *B*. There are the same number of *A* and *B* customers. Each customer purchases 100,000 kwh per year at 7 ¢/kwh, for total electricity cost of $7,000 per year. Assume the utility agrees to buy 50,000 kwh per year of negawatts from each *A* customer for 6¢/kwh. The utility saves $3,500 per customer in costs, but it loses $3,500 in foregone revenues plus the $3,000 NAP payment. The PUC must let the utility increase the price it charges to all customers from 7¢/kwh to 9¢/kwh to recover its NAP investment.[99] Electricity rates will in fact increase by more than 2 ¢/kwh for two reasons. First, PUCs routinely provide utilities with financial incentives to make NAP investments. More importantly, higher rates will

[96] See Paul Joskow & Donald Marron, What Does a Negawatt Really Cost?: Evidence from Utility Conservation Programs, 13 Energy J. 41 (1992).

[97] See, e.g., Re Advance Plans for Construction of Facilities, 136 PUR 4th 153, slip op. at 12-13 (Wis. PUC 1992) (Wisconsin PUC fails to understand the difference between marginal and total benefit, leading it to criticize utility NAP plan because "a more expensive [NAP] option is compared, not with the status quo, but with the next-most inexpensive [NAP] options"). This is exactly what the utility ought to do.

[98] For other discussions of the wealth transfer effect, see Kahn (1991), supra note 72, at 13; Tom Sparrow, Reed Clearly, Lance McKinzie & Forrest Holland, Equity, Efficiency, and Effectiveness in DSM Rate Design, Elec. J., May 1992, at 24; Ruff (1992), supra note 72, at 28-29.

[99] Each *A* customer now consumes 50,000 kwh per year, and each *B* customer consumes 100,000 kwh per year. To recover $3,000 in annual cost per *A* customer, the utility must raise rates by ($3,000/150,000 kwh)·(100¢/$1) = 2¢/kwh.

induce reduced electricity consumption, which forces the utility to spread the cost of the NAP over fewer delivered kilowatt hours.

Through this mechanism, NAPs transfer wealth from non-participants to participants. The resulting redistribution of wealth will often be from residential consumers to large commercial and industrial consumers. Many proposed NAPs are targeted at large commercial and industrial consumers, and large consumers have stronger incentives to participate in the NAP design process. Residential consumers are also likely to bear the bulk of the NAP-driven rate increases because industrial consumers can more easily switch to other suppliers or to self-generation if NAP costs increase the price of electricity above marginal cost.[100]

Within the class of industrial and commercial consumers, the largest beneficiaries will be those firms who have been *least* efficient in using energy in the past. This is exactly the opposite of how capital markets allocate capital. Subsidizing the least efficient producers seems unlikely to improve the overall competitiveness of American businesses. It may also have the perverse effect of weakening existing incentives to invest in conservation, the better to qualify for future NAPs.

Within the residential class, NAPs will most likely redistribute wealth from poor consumers to affluent consumers.[101] Most residential NAPs are offered to all residential consumers. Poor people, however, have higher personal discount rates, are less likely to learn about NAP programs, and are more likely to be capital constrained. Thus, they are much less likely to participate in NAPs.

NAPs can be designed so that participating consumers receive up-front payments for

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[100] See Kahn (1992), supra note 71, at 14-15.

[101] See Texas PUC To Look at Whether Poor Get Short End of DSM Stick, Quad Rep., Jan. 1993, at 1.

energy-efficiency investments, but the utility recoups the payments to each participant through that participant's future bills. Under this approach, only participants for the cost of NAPs (sometimes called the "no-losers test").[102] This would eliminate wealth transfers. If participation is voluntary, this is akin to a utility loan, and isn't a subsidy program at all. Utilities and NAP proponents, however, have successfully opposed direct chargeback and other variants of the no-losers test, on the grounds that they will produce little consumer interest in participating in NAPs.[103]

3. *Pricing of Electricity Above Marginal Cost*

The price increases needed for utilities to recover large NAP investments will systematically increase electricity prices. In some areas of the country, this will bring prices closer to marginal cost, and thereby reduce current excess consumption of electricity. But more often, large NAPs will drive rates above marginal cost, and thereby cause a further loss of social wealth, as consumers forego socially beneficial uses of electricity.

To return to the example in the last section, if the final price of electricity is 10¢/kwh, each *A* customer consumes 40,000 kwh/year and each *B* customer consumes 80,000 kwh/year, there are two sources of loss: (i) the subsidy that gave *A* consumers an incentive to spend up to 16¢/kwh to reduce consumption, when the marginal social cost was only 7¢/kwh[104]; and (ii) the NAP-driven price hike, which induced all consumers to forgo consuming power whose social

[102] See, e.g., Cicchetti & Hogan (1989), supra note 72, 73; Paul Joskow, Understanding the "Unbundled" Utility Conservation Bidding Proposal, Pub. Util. Fort., Jan. 4, 1990, at 18; Larry Ruff, Least-Cost Planning and Demand-Side Management: Six Common Fallacies and One Simple Truth, Pub. Util. Fort., Apr. 28, 1988, at 19.

[103] See sources cited in notes 57 and 69 supra.

[104] If there are many *A* customers, the decision by each whether to participate in the NAP will not affect the final price of electricity. Thus, each will save 16¢/kwh by participating -- the *new* 10¢/kwh expected price of electric power plus the 6¢/kwh subsidy.

cost was 7¢/kwh and whose value to them was between 7 and 10¢/kwh.[105]

4. *Substitution of Other Power Sources*

NAPs increase the price of utility-supplied power, but not the price of other energy sources. Customers who can do so will have an incentive to switch to lower-cost electricity suppliers, generate their own electric power, substitute other energy sources, or move to a region with lower electricity costs. The more money that a utility invests in NAPs, the higher the rates the utility must charge, and the greater the incentive to switch. These switches entail efficiency losses, since the customer's revealed preference, under the prior rate structure, was not to take these actions.

In an extreme case, rate hikes can result in what utility executives call the "death spiral": Higher rates cause loss of customers and lower demand by the remaining customers, which forces the utility to charge even higher rates to cover its fixed costs (including the costs of NAPs), which causes even more customers to desert the utility and still lower demand by the remaining customers, which forces still higher rates, and so on, until only totally captive customers are left, paying astronomical rates for the limited amount of electricity they cannot avoid using. Or, more realistically, until the PUC stops the spiral by disallowing some costs, as PUCs did with high-priced nuclear power. Even in a less extreme case, this rate spiral will exacerbate the welfare loss from customers paying rates that exceed marginal cost, and thus overinvesting in conservation and avoiding uses of electric power whose value exceeds the marginal social cost of power generation.

5. *Rent-Seeking Activity*

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[105] For an effort to model the social gain (loss) due to the effect of NAPs in moving price toward (away from) marginal cost, see Benjamin Hobbs, The "Most Value" Test: Economic Evaluation of Electricity Demand-Side Management Considering Customer Value, 12 Energy J. 67 (1991).

NAPs, like all subsidy programs, will induce rent-seeking behavior. Utilities have an incentive to exaggerate the availability of NAP savings and to choose more, rather than less capital-intensive ways of saving energy. This is simply the A-J effect in a new guise. The many environmentalists who are ideologically committed not to *optimal* energy consumption but to *minimal* consumption also have incentives to exaggerate savings. Manufacturers of high-efficiency equipment and conservation equipment will try to convince utilities of the merits of their products, and may succeed when they shouldn't.[106] Large customers will try to convince utilities of the energy savings from projects they plan to undertake anyway. ESCOs, whose financial existence depends on NAPs, will fight to preserve and expand their market under the politically appealing banner of conservation. Utilities will build in-house staffs whose jobs depend on finding a continuing stream of NAPs. And so on.

There are political and economic limits on the extent of rent-seeking. Consumers will complain if rates rise too high. Utilities want to avoid a severe rate spiral. And some large consumers will find it cheaper to exit the utility system (if they can) than to fight for their piece of the subsidy pie. But these countervailing forces still leave room for large efficiency losses from rent-seeking. These include both the losses from inappropriate NAPs and the deadweight cost of lobbying and counterlobbying.

The ultimate arbiter of claims of energy savings will be the PUC. But PUCs were also the arbiters of the competing claims of cogenerators and utilities about avoided costs under PURPA, and made massive errors. There is even less reason to expect that they will succeed in the far more complex and politically charged task of evaluating a myriad of negawatt

[106] For example, manufacturers of fiberglass insulation used the oil price crisis of 1979-1980, and projections of oil at $100 per barrel by 1990, to convince many local jurisdictions to amend their building codes to require very high insulation levels. These requirements are unjustified given current and projected energy prices, but largely remain in place.

programs.

6. *Inconsistency with Competitive Markets for Electric Power*

Finally, NAPs will force utility regulators to stop the rapid movement toward reliance on competition and market forces we described in Part II. At the wholesale level, NAPs will compete with power sources on an extremely unlevel playing field. Aggressive conservation NAPs can potentially eliminate the need for new powerplants for decades in all but the fastest growing areas of the country. That means that utilities will rely for power on a mix of old, regulated plants and NAPs. We will defer for decades the cost savings derived from competitive wholesale power markets.

At the retail level, NAP-driven rate increases will induce customers to switch suppliers or to self-generate, thus setting off a rate spiral, unless they are prohibited from doing so. Thus, regulators cannot continue simultaneously to encourage increased reliance on competition in the electricity industry and to encourage utilities to make massive investments in NAPs. Regulators must soon decide either to encourage the trend toward competition and sharply limit investments in NAPs, or to encourage NAPs and forbid retail competition. So far, no PUC has recognized the fundamental incompatibility of these recent innovations. PUCs and other government institutions continue to encourage both.[107]

A recent New York proceeding involving Niagara Mohawk Power NiMo is a harbinger of the tension between markets and central planning that is at the heart of this Article. NiMo has recently adopted an aggressive industrial and commercial NAP plan. A number of industrial and commercial consumers petitioned the New York Public Service Commission (PSC) for

[107] Commentators have largely neglected the tension between competitive markets and NAPs. An exception is Houston (1993), supra note 87.

permission to neither participate in nor pay for NiMo's NAPs. One petitioner estimated that it would receive $14,000 in subsidy payments and pay $700,000 per year in higher electricity bills. Environmentalists, NiMo, and other NAP proponents opposed the opt out effort.[108]

In a messy compromise, the New York PSC required industrial and commercial consumers who don't participate in NiMo's NAPs to still bear 60% of the rate impact of NAPs directed at other industrial and commercial consumers. The PSC also required consumers who opted out to conduct energy audits and then either make the indicated energy-saving investments or explain to the PUC why they didn't do so. The New York PSC has thus assigned itself the heroic task of second-guessing decisions by large, sophisticated industrial consumers, *after a full energy audit*, whether to make particular consumption-reducing investments.[109]

F. The Uncertain Environmental Benefits from NAPs

A final indirect effect of NAPs deserves special treatment because it is so counterintuitive: NAPs can potentially *increase* pollution levels. At best, NAPs will reduce pollution by less than one would expect by looking only at total electricity consumption. There are three principal reasons for this: (i) NAPs will result in continued use of old, dirty power plants instead of new, cleaner plants; (ii) NAPs will result in substitution of dirtier energy sources for utility-supplied power; and (iii) for pollutants subject to marketable permits plans or offset requirements, NAPs cannot reduce total emissions.

New powerplants must meet far stricter emission standards than existing plants. Consider, then, two alternative scenarios: (i) meeting new demand by building new

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[108] See Robert Marritz, Industrials Can "Opt Out": Who Won, Who Lost in New York's New Shared Savings Experiment, Elec. J., Jan./Feb. 1993, at 14.

[109] See Re Niagara Mohawk Power Co., No. 92-E-0108, 140 PUR 4th ___ (NY PSC Feb. 2, 1993); Clarifying the New York PSC's Ruling on Niagara Mohawk's Industrial Conservation Programs: A Conversation with Chairman Bradford, Elec. J., Mar. 1993, at 76.

powerplants; and (ii) avoiding new demand through NAPs. New powerplants will often have lower operating costs than older plants due to higher technical efficiency or use of a lower-cost fuel.[110] If so, the utility will use new powerplants for baseload capacity and old plants for peaking capacity. This may *reduce* total emissions. Lower emissions from the old dirty plants can more than offset the additional emissions from new plants. In contrast, meeting new demand with NAPs doesn't permit this environmentally beneficial substitution of new power for old.

Clinton Andrews has modeled how the old plant effect affects SO_2 emissions in New England. He estimates that SO_2 emissions will be lowest if New England utilities build new coal-fired powerplants, which are cleaner than existing oil-fired plants; next lowest if demand is met by new gas-fired plants, which are cleaner than coal plants but have higher operating costs and thus displace less existing capacity; and highest if a significant fraction of new demand is avoided through NAPs.[111] These results depend on the pollutant, the nature of the existing capacity, and the percentage of new capacity replaced by NAPs. For example, NAPs reduce CO_2 emissions, because the principal determinant of total CO_2 emissions is aggregate power produced.[112] But they suggest that the environmental benefits of NAPs must be carefully modelled, not just presumed.[113]

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[110] As discussed in Part II, many of the potential improvements in the technical efficiency of powerplants had been achieved by around 1970. But there have been continued modest improvements since (especially for gas-fired plants), and many currently operating powerplants were built well before 1970.

[111] Clinton Andrews, The Marginality of Regulating Marginal Investments: Why We Need a Systemic Perspective on Environmental Externality Adders, 1992 Energy Pol'y 450, 452.

[112] Id. at 455.

[113] The old plant effect is likely to persist for decades. For various reasons, including rate regulation based on historical cost, utility reluctance to build new powerplants, and high environmental compliance costs for new plants, utilities almost never retire old fossil-fuel plants. Instead, the plants are refurbished and kept in the pool of available power sources. Even in a competitive wholesale power market, many old plants will retain a cost advantage over new plants due to less stringent environmental regulation.

A second factor that can reduce and perhaps eliminate the environmental gains from NAPs is energy source substitution. We have already noted that large customers have an incentive to switch to self-generation or use alternate energy sources to avoid NAP-driven rate increases. More broadly, whenever electric motors compete with gasoline-powered motors (notably in motor vehicles), higher electric rates will lead to greater reliance on gasoline-powered motors. These shifts will increase pollution levels. Large utility powerplants (even old powerplants), are cleaner sources of energy than the available alternatives. Even a small substitution effect from electric to gasoline motors could increase overall pollution, because gasoline motors are so much dirtier than powerplants.[114]

Third, as we discuss in Parts V and VI, some pollutants are subject to marketable pollution permit schemes, or offset rules that have similar effects. For SO_2, the marketable permits scheme covers only utilities. This means that NAPs will not affect SO_2 emissions *by powerplants*. NAPs will, however, increase SO_2 emissions *by all sources*, because energy source substitution will increase emissions by nonutility sources. For NO_x and VOCs, the pollutants most often subject to offset rules, NAPs will not significantly affect total emissions. They will increase total emissions slightly in areas where offset requirements exceed 1:1, since fewer offset transactions will take place.[115]

G. Evaluating NAPs in Four Illustrative Contexts

[114] We discuss the adverse environmental consequences of energy source substitution in more detail in Part VI.E.1.

[115] A complete calculus of the environmental benefits or costs of NAPs must also include the environmental costs of producing conservation equipment. For example, an industrial motor NAP will increase the social resources devoted to motor production, with an accompanying increase in pollution in the mining and manufacturing sectors of the economy. See Peter Menell, Eco-Information Policy: A Comparative Institutional Perspective (working paper 1993) (stressing the importance of life-cycle environmental analysis in product choice). However, this extra pollution may be of less concern to state PUCs because it will largely occur outside the state adopting NAPs. See infra Part VI.F (discussing appropriate state response to out-of-state pollution).

Many different NAPs are being used to subsidize acquisition of a wide variety of electricity-consuming equipment by all classes of electricity consumers. The available evidence provides stronger support for some types of NAPs than for others. In this section, we describe four NAPs with differing scope, target products, and target populations in an attempt to identify situations where NAPs are likely to enhance or detract from social welfare.

One of the many NAPs approved by the California PUC authorizes utilities to pay 100% of the cost of installing energy-efficient equipment in residences occupied by low-income customers.[116] Despite the large subsidy, this NAP could yield an improvement in social welfare. It targets a class of consumers -- low income residential consumers -- who usually receive electricity at heavily cross-subsidized prices that fall well below marginal cost; have particular difficulty obtaining information about and understanding the implications of investments in high efficiency appliances and lighting; use very high implicit discount rates to evaluate investments in electricity-conserving equipment; and lack the political clout to keep the subsidy in place when it has outlived its economic justification.

The NAPs adopted by the Power Authority of the State of New York (PASNY) include a program in which it purchases and installs free of charge new, high efficiency lighting systems in public schools.[117] Despite the generous subsidy, this program may yield net social benefits. Public schools usually buy electricity at subsidized prices. Moreover, public schools are notoriously poorly managed. New York's citizens may well benefit by, in effect, assigning PASNY the task of managing the energy needs of public schools.

Third, many utilities heavily subsidize consumer purchases of screw-in fluorescent bulbs,

[116] See Don Schultz & Joseph Eto, Carrots and Sticks: Shared-Savings Incentive Programs for Energy Efficiency, Elec. J., Dec. 1990, at 32, 38.

[117] See Diane Boiler, Bright Ideas in Conservation Lighting, Pub. Util. Fort., July 15, 1992, at 39.

designed to replace incandescent bulbs in the same sockets. New York's Con Edison, for example, recently offered residential consumers the chance to buy up to 6 fluorescent bulbs for about $10 each, half the usual price. More broadly, fluorescents are a major element of the claims by NAP proponents of large unrealized energy savings. Proponents claim that fluorescents can largely replace the __% of total electric power now devoted to incandescent light, at roughly the same cost for bulbs (the higher per bulb cost of fluorescents is offset by longer bulb life), and with roughly a 75% savings in electricity consumption.[118]

The reality is far more complex and ambiguous. Many consumers aren't aware of the claimed advantages of fluorescents. If given the opportunity to buy a few bulbs at a discount, they may like them, and thereafter buy more on their own. But bulb cost and energy use are not the only relevant differences between incandescent and fluorescent bulbs. Fluorescents take several minutes to fully warm up; are bulkier than incandescents and won't fit some fixtures; can only replace lower-wattage incandescent bulbs (40, 60, and 75-watt bulbs, in Con Edison's recent offer); don't have the aesthetically pleasing range of shapes that incandescents do; can't be used on a circuit equipped with a dimmer switch; draw more power than a comparable incandescent when warming up; suffer shorter life if turned on and off frequently; and will overheat and burn out too quickly if used in recessed fixtures. Moreover, many consumers consider the light to be of inferior quality. Thus, if consumers don't buy screw-in fluorescent bulbs, that may partly indicate market failure, but it may also reflect a rational judgment about the relative merits of the two light sources.[119]

[118] See Lovins & Lovins (1991), supra note 54.

[119] For example, one of us (Black), who is fully aware of the claimed advantages of fluorescents, recently installed high-efficiency straight fluorescents in his basement recreation room, despite their higher capital cost, and subscribed fully to the Con Edison 6-bulb offer. But he also finds that these a half-dozen screw-in bulbs largely exhaust the plausible locations for screw-in fluorescents in his home. Moreover, he selected locations that receive

An analogy may be helpful. Suppose that each automobile comes with two engine options -- weak and powerful. Many consumers choose powerful engines, even though powerful engines cost more to buy, guzzle more gasoline, and don't get people where they're going measurably faster. Surely, environmentalists claim, this is powerful evidence of consumer irrationality, to which government should respond by subsidizing the purchase of weak motors (and raising the price of gasoline to pay for the subsidy).

A subsidy will increase the market share of weak motors, save gasoline, and reduce pollution. But we should not imagine that there are no offsetting social costs. Consumers presumably pay extra for powerful engines, and the extra gasoline they consume, because they perceive greater safety from stronger acceleration, want towing ability, or simply derive pleasure from powerful cars. These lost benefits *may* (and absent a true market imperfection, *will*) outweigh the gasoline savings from the subsidy.[120]

For the fourth illustrative NAP, we return to our earlier example of a program targeted at high-efficiency industrial motors. We assume again that the utility agrees to pay $80,000 of the price of a $200,000 high-efficiency motor. Even though the fractional subsidy is much smaller than the subsidies in the low income consumer and public school contexts, we think it highly likely that this program will yield net social waste. Industrial consumers rarely pay less than marginal cost for electricity. Indeed, the ubiquitous practice of using utility rate designs for political purposes routinely produces cross subsidies from industrial consumers to more

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limited use because of warm-up time and because his wife dislikes the light quality. Because of that limited use, he is confident that the energy savings will be smaller than the utility expects. Moreover, the energy savings must be offset, in a full calculus, by the perceived lower quality of light.

[120] Larry Ruff analyzes this aspect of NAPs in Ruff (1992), supra note 72.

politically favored classes of customers.[121] It is relatively easy for product manufacturers to make industrial consumers aware of the availability and alleged advantages of large ticket items like industrial motors. Moreover, industrial consumers have powerful incentives to evaluate the characteristics of these products. A consumer that has twenty industrial motors with similar specifications, for instance, is paying a large electric bill to operate those motors. It can devote significant resources to assessing the performance of a replacement motor. Indeed, large firms often employ energy managers, supported by engineers and analysts, whose principal responsibility is to evaluate the desirability of investing in energy-saving equipment. Industrial consumers who failed to accurately estimate the savings attributable to such investments will lose money.

It seems highly unlikely that the performance estimates of electric utilities will be more accurate, on average, than the performance estimates of industrial consumers. Even if the utility has a comparative advantage in assessing energy efficiency (which is by no means clear), it is surely at a disadvantage in assessing the many other factors that enter into a motor-replacement decision, including reliability in use, maintenance requirements, the likely duration of the motor's intended use, the cost of downtime for motor replacement, and the option value of deferring a purchase if it isn't clear what motor will best meet future needs. If an industrial consumer estimates that its investment in a $200,000 motor will produce a total present value of only $150,000, including but not limited to electricity savings, and the electric utility that serves the customer estimates the savings at $250,000, we will lay odds that the industrial consumer is closer to the mark than the utility. Our confidence in the utility's judgment is not

[121] See Electricity Consumers Resource Council, *Profiles in Electricity Issues: Cost-of-Service Survey* (1986) (documenting $2.5 billion per year in excess payments made by industrial consumers to cross-subsidize residential consumers); Alfred Aman & Glen Howard, Natural Gas and Electric Utility Ratemaking Reform: Taxation Through Ratemaking, 28 Hast. L.J. 1085, 1085-1116 (1977).

enhanced by the powerful financial incentives built into NAPs, which encourage utilities to overestimate energy savings in order to justify NAPs and earn a premium rate of return on negawatt investments. Moreover, if the utility judges that its customers have erred, there is a cheap alternative to an NAP subsidy: Tell the customers. They have every incentive to correct their errors, if any. Of course, this approach isn't nearly as profitable for the utility.

In approving NAPs targeted at industrial consumers, state PUCs are making the opposite bet -- that the utility knows best. With the $80,000 subsidy in hand, the industrial consumer will buy the motor for $200,000, even if it projects savings equal only to $150,000, since it will add to those projected savings the $80,000 NAP payment from the utility.

Unfortunately, a large percentage of the hundreds of billions of dollars of projected NAP investments are likely to be made in contexts that resemble our last illustrative program, where social waste is the most likely outcome. Much of the rest is likely to go to programs like the fluorescent light program, where the net social gains are unclear and are surely smaller than the utility predicts by looking only at energy savings. Only a small fraction of NAP investments are likely to be made in contexts that resemble our first two illustrative programs.

For example, many NAPs that focus on high efficiency lighting target only commercial and industrial consumers.[122] Boston Edison's NAP targets the 500 largest commercial and industrial segments of its market.[123] When developing NAPs, many utilities and ESCO's "start with the largest commercial and industrial customers."[124] ESCO's generally invest in projects in the $250,000 to $5,000,000 range, but they are searching for larger projects.[125] Utilities

[122] See Boiler (1992), supra note 117, at 40.

[123] See McIntyre & Reznicek (1990), supra note 57, at 19.

[124] Taylor (1991), supra note 66, at 50-51.

[125] See Roger Sant, The IPP Parallel: An Outsider Looks In, Elec. J., Dec. 1991, at 51, 52.

and ESCOs prefer large commercial and industrial projects because they incur smaller transaction costs.[126] Ironically, of course, it is the high informational and other transaction costs of the residential market that provides the principal justification for NAPs. Thus, these NAPs are likely to yield social waste in the form of overproduction of electricity-consuming equipment and the other distortions discussed above.

H. The Need to Evaluate the Effects of NAPs

We are certain that the "level playing field" justification for NAPs is nonsense. Anyone who understands price theory can identify the conceptual flaw in that justification. We cannot be as confident that we are correct in our skepticism about the market imperfection justification for NAPs. But the degree of actual market failure is susceptible to empirical study. It would seem prudent to study carefully the effects of the billions of dollars already invested in NAPs before utilities spend hundreds of billions of dollars of their customers' money in the additional NAP subsidies they plan to make in the next few years.

Most utilities and PUCs do not seriously attempt to evaluate the efficacy of NAP subsidies. In most NAPs, the utility's financial incentive is based entirely on how much it spends rather than the actual savings produced by those expenditures.[127] In some NAPs, the utility's financial incentive is nominally "performance-based," but the term refers to engineering estimates of expected savings rather than to actual savings.[128] Engineering estimates are notoriously inaccurate.[129]

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[126] See Newlon & Weitzel (1991), supra note 82, at 50.

[127] See Michael Laros & Brian Bailey, Demand-Side Management: Surviving in the '90s, Pub. Util. Fort., Aug. 1, 1992, at 16.

[128] See Schultz & Eto (1990), supra note 116, at 42.

[129] See Kahn (1991), supra note 72, at 15; Eric Hirst, Letter to Kahn, Elec. J., July 1991, at 54. The engineering estimates used by PUCs are often quite crude. See Ken Monts, One Office Building is Not Like Another: The Need for Greater Analytical Rigor, Elec. J., May 1993, at 66 (wide variation in office building

Assessments of NAP costs are equally crude. Most assessments neglect or understate various costs, including the administrative costs of utilities and program participants, free rider effects, and the economic loss from replacing existing equipment before the end of its useful life. Given the skimpy data, the only statement that can be made with confidence is that NAPs cost much more per kwh saved than utilities predict.

One of the few careful comparisons of predicted savings to reported savings is by Phoebe Caner of Seattle City Light. In 27 of the 32 programs she evaluated, reported energy savings were less than expected savings. In 15, reported savings were less than half of the initial estimates.[130] But the gap between predicted and reported savings is only half the story. Paul Joskow and Donald Marron, after analyzing reported negawatt savings at 14 utilities, lament:

> What does a negawatt really cost when it is "purchased" by a utility? The honest answer is that neither we nor anyone else really knows with any precision! . . . Our best guess is that the numbers reported [by utilities] are, *on average*, too low by a factor of *at least two*.[131]

Even many NAP proponents have begun to criticize the failure of utilities and PUCs to evaluate the actual savings from NAP investments.[132] However, utility executives and ESCO

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design is not captured in simple models used by utility consultants to estimate NAP savings).

[130] Phoebe Caner, The Drive to Verify Energy Savings, Elec. J., May 1992, at 43; see also David Stipp, Some Utilities' Plans to Cut Energy Use Cost More and Save Less than Projected, Wall. St. J., May 27, 1993, at B1.

[131] Joskow & Marron (1992), supra note 96, at 70 (first emphasis in original, second emphasis added); see also Douglas Houston, *Demand-Side Management: Consumers Beware* 37-39 (Inst. for Energy Res. 1992). Joskow & Marron report that reported utility costs per kwh are lower for commercial and industrial NAPs than for residential NAPs. These differences could reflect the invariable utility practice of neglecting customer administrative costs, combined with utility administrative costs that inevitably form a larger fraction of total cost for residential NAPs. If the disparity between the cost-effectiveness of residential and commercial NAPs persists in more comprehensive cost assessments, it would suggest that our assessment of the potential savings from NAPs is perhaps too optimistic for residential NAPs, and too pessimistic for commercial and industrial NAPs.

[132] See Wirtshafter (1992), supra note 65, at 39-44; Goldman & Busch (1992), supra note 48, at 37-39; Peter Fox-Penner, The Private DSM Industry: A Gleam in Whose Eye?, Elec. J., Dec. 1991, at 46, 49; Taylor (1991), supra note 66, at 50-51; Wellford (1991), supra note 68, at 53-54; Eric Hirst, Documenting Success, Elec. J., Dec. 1991, at 55; Eric Hirst, Balancing the Scales: Toward Parity in Electric Supply and Demand Data, Elec. J., May 1990, at 28.

executives complain that even the present efforts to evaluate NAP investments are too expensive.[133] Three former members of the Maine PUC describe the present situation well:

> For the utility, then, the way to play the . . . [NAP] game is to maximize measured savings, but not actually to save anything at all. In theory, such abuse can be policed. In practice, [NAP] program design and administration make regulatory oversight difficult, at best.[134]

A full assessment of NAP effectiveness, moreover, cannot be limited to their impact on energy consumption. As our fluorescent light and industrial motor examples show, an investment can yield *all* of the projected energy savings and still be socially wasteful. Non-energy costs can outweigh the energy savings, or reduce the net savings to the point where the investment is not cost-effective.

An evaluation of non-energy costs isn't easy. Yet it is critical, lest a fluorescent bulb or industrial motor program be validated on the spurious grounds that fluorescent light bulbs and high-efficiency motors consume less electricity. We know that already. We need to know the full measure of costs that consumers will incur to realize those energy savings. No evaluation of NAPs to date attempts such an assessment.[135]

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[133] See, e.g., Sant (1991), supra note 125, at 52; Cohen & Townsley (1990), supra note 56, at 12 (recognizing need to evaluate, but criticizing movement to "microanalyze").

[134] David Moskovitz, Cheryl Harrington & Tom Austin, Weighing Decoupling vs. Lost Revenues: Regulatory Considerations, Elec. J., Nov. 1992, at 58, 63.

[135] Several additional claims are sometimes made in support of NAPs. They are claimed to be less risky than conventional power sources. See, e.g., Eric Hirst, Do Utility DSM Programs Increase Risk, Elec. J., May 1993, at 24; [additional cites to come]. This claim seems simply wrong, especially in a competitive contracting environment where power producers bear the risk of construction cost overruns and uncheduled downtime. As noted in text, predicted and actual NAP savings often vary by a factor of two or more. The capital costs of new fossil-fuel plants are much more predictable than this. If desired, future fuel costs can be locked in through long-term contracts. Moreover, consumers can take the risks retained by the utility (and thus by consumers), into account in their equipment purchasing decisions. Thus, even if NAPs were less risky, this would justify NAP subsidies only if consumers systematically underestimate electric rate risk in making energy-efficiency investments. We are aware of no evidence to support this claim. And if it were true, there is an easy solution: power supply contracts could impose more risk on power producers. The utility, and thus consumers, will pay a market price for this insurance. There is no need for NAPs and their accompanying distortions.

Hirst (1993), supra, at 31 n.7, claims that the ability to shift risk to power producers is irrelevant because

IV. The Superior Alternative -- Getting the Price Right

NAP proponents often point to the divergence between the price of electricity and its marginal social cost to justify NAP subsidies.[136] We respond to this justification in four ways. First, the divergence between price and marginal cost justifies NAPs only when marginal cost exceeds price. Even in that context, the divergence justifies only NAP payments limited to the difference between marginal cost and price.[137] However, NAP proponents oppose limiting NAP subsidies in this manner, because doing so will yield little investment in NAPs.[138] They have persuaded PUCs to adopt NAPs that authorize utilities to invest in negawatts even when the price of electricity equals or exceeds marginal cost and in which the NAP subsidy vastly exceeds any conceivable difference between price and marginal cost.[139]

Second, NAP proponents have not analyzed the sources of the divergence between price and marginal cost. Thus, they have failed to recognize that those sources yield electric rates that exceed marginal cost about as often as they yield rates below marginal cost.

Third, the best response to mispricing is to eliminate the mispricing, rather than to

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societal risk doesn't change. This is wrong at two levels. First, many risks are unique to particular powerplants. The U.S. as a whole is diversified against these risks. See Gilson & Black (1993), supra note 11, ch. 3 (discussing the value of diversification in reducing unsystematic risk). Second, any undiversifiable risk imposed on power producers will be reflected in electricity rates, and thus will give consumers incentives to reduce consumption. Justifying NAPs on this basis doublecounts risk -- once when consumers pay a market price for insurance, and again when they pay for NAP subsidies. This is the level playing field fallacy in a different guise.

Proponents also claim is that NAPs can be "purchased" in smaller increments and new "capacity" can be brought on line more quickly than new powerplants. See id. at 30; [other cites to come] In a competitive contracting environment, these arguments are nonsense. Power is available at competitive prices, in any increment a utility chooses. If utilities demand capacity availability on short notice, producers can respond to that demand by building capacity for "spot" sales.

136 See sources cited in note 72 supra.

137 See, e.g., Kahn (1992), supra note 71; Ruff (1990), supra note 72; Joskow (1990), supra note 102; Cichetti & Hogan (1989), supra note 72, 73; Eric Hirst, Quantifying Tradeoffs Between Costs and Prices in Utility DSM Programs, Elec. J., May 1992, at 16.

138 See, e.g., Cavanagh (1986), supra note 53, at 325-27.

139 See sources cited in note 58 supra.

introduce an additional distortion in an attempt to offset the effects of the initial distortion. The price-below-marginal cost justification for NAPs assumes that we will retain subsidies for electricity consumption and that we must offset those subsidies with subsidies for conservation equipment. That method of reasoning has produced our present agricultural policies -- billions of dollars in annual production subsidies offset by billions of dollars in payments not to produce.

Lastly, the reforms we favor -- reliance on competition to govern the electricity industry and reliance on market-based means of addressing environmental costs -- will quickly eliminate any significant gap between price and marginal social cost. Conversely, large NAPs will produce electricity rates that exceed marginal social cost -- a result no more to be desired than rates below marginal cost.

The price of electricity varies from marginal cost for one or more of five reasons: (1) direct government subsidies; (2) cross subsidies embedded in the prices that PUCs require utilities to charge to different classes of customers; (3) temporal bias in the regulatory formula through which utilities recover their capital costs; (4) rate designs based on average rather than marginal cost; and (5) uninternalized environmental costs, principally lower air quality, caused by electricity generation.

A. Direct Subsidies

Direct government subsidies for electricity production are small. The Energy Information Administration determined that the industry received $1.8 billion in government subsidies in 1990.[140] That level of subsidy can account for only a 2% divergence between the marginal cost and price of electricity nationwide. The largest market distortion created by government subsidies is in the Pacific Northwest, where the Bonneville Power Authority BPA sells electricity

[140] See *Federal Energy Subsidies* (1992), supra note 80, at 7.

to aluminum smelters for 1.5¢/kwh, far below BPA's marginal cost.[141] Eliminating this subsidy and privatizing BPA would improve allocative efficiency, give the smelters incentives to invest in conservation, and reduce the federal budget deficit. So far, however, Northwest legislators have successfully blocked all attempts to take this socially beneficial action, because they want to preserve for their region the jobs that the smelters now provide.[142] In all other geographic areas, government subsidies for electricity consumption are trivial or, as in the case of TVA, offset by bureaucratic inefficiency within public power agencies.[143]

B. Cross Subsidies

State PUCs have long used their power over utility rates to further social and political goals. They require utilities to charge artificially low prices for some classes of customers, typically residential customers.[144] This practice yields various market distortions, including an incentive for subsidy recipients to underinvest in conservation. However, PUCs can cross subsidize some customers only by increasing artificially the prices paid by other customers, typically industrial customers. That, in turn, gives most industrial consumers an incentive to overinvest in conservation. Cross-subsidies, then, at most justify shallow NAP subsidies to (typically residential) consumers who benefit from cross-subsidies, while further weakening the case for industrial and commercial NAPs. Moreover, it would be decidedly peculiar to advance NAPs, which themselves involve massive cross-subsidies, as a solution to existing cross-

[141] See Costello, Freeing the Bonneville Power Administration, Pub. Util. Fort., Sept. 1, 1992, at 14; *Federal Energy Subsidies* (1992), supra note 80, at 53-69.

[142] See OMB Plan to Alter Public Power Agencies in NES Draws Fire from Hill, Inside Energy, Nov. 26, 1990, at 5.

[143] See, e.g., Symposium, The TVA Controversy, Pub. Util. Fort., Feb. 15, 1991, at 15.

[144] See Richard Posner, Taxation By Regulation, 2 Bell J. Econ. & Mgmt. Sci. 22 (1971); see also sources cited in note 121 supra.

subsidies.

The preferred solution to the cross-subsidy problem is, of course, to eliminate cross-subsidies. The movement to competitive contracting described in Part II will force this result. Cross subsidies can exist only in monopoly conditions. With industrial consumers increasingly free to choose among competing suppliers, engage in cogeneration, or engage in self-generation, utilities and PUCs will soon discover that they lack the power to implement significant cross-subsidies.[145] Moreover, during the transition period to fully market-based pricing, cross-subsidies can be designed to minimize distortions of consumption decisions -- for example by charging low (or high) rates for the first units consumed and marginal cost for additional consumption.

C. Temporal Bias in the Traditional Rate Formula

The method that regulators use to reflect the value of a utility's capital assets in its rates yields results only loosely related to the economic cost of using the assets. The regulatory formula values an asset at cost, and then lets the utility recover its investment through straight line depreciation and recover its cost of capital by multiplying its authorized rate of return times the depreciated original cost of the asset. Markets do not value assets in this manner.[146]

In the absence of inflation, the straight line depreciation for a capital asset with a 40-year life is roughly double its economic depreciation in the early years of the asset's use; by the twentieth year of the asset's use, straight line depreciation is about one-half of economic

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[145] See Harry Broadman & Joseph Kalt, How Natural Is Monopoly? The Case of Bypass in Natural Gas Distribution Markets, 6 Yale J. Reg. 181 (1989); Pierce (1990), supra note 37, at 12-18.

[146] See Stuart Myers, Larry Kolbe & William Tye, Inflation and Rate of Return Regulation, 2 Res. in Transp. Econ. 83 (1985); John Navarro, ___ Peterson & Tom Stauffer, A Critical Comparison of Utility-Type Ratemaking Methodologies in Oil Pipeline Regulation, 12 Bell J. Econ. 392 (1981); Pierce (1986), supra note 5, at 1202-03.

depreciation.[147] Expected inflation, factored into the authorized rate of return, increases this effect. Unexpected changes in the inflation rate can increase or decrease this temporal bias depending on when they occur and when they are reflected in the authorized rate of return. In general, customers served by a utility with relatively old generating plants pay less than marginal cost. Conversely, customers served by a utility with relatively new generating plants pay more than marginal cost.

There is no reason to believe that the divergence between price and marginal cost produced by the traditional ratemaking formula creates a significant, net incentive to underinvest in conservation. At any given point in time, about half of the consumers have an incentive to underinvest in conservation and the other half have an incentive to overinvest. In any event, the temporal bias in electricity prices created by the traditional ratemaking formula is rapidly becoming an issue of only historical interest. The traditional method of valuing generating plants in utility prices cannot survive in a competitive wholesale power market.[148] The prices that utilities pay for wholesale power through competitive contracts are a reasonably accurate surrogate for the third party generator's marginal cost of production.[149]

D. Rate Designs Based on Average Cost

Traditionally, utilities and PUCs set retail electricity prices based on a utility's average

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[147] For discussion of the difference between straight line and economic depreciation, see Charles Hutten & Frank Wyckoff, The Measurement of Economic Depreciation, in *Depreciation, Inflation, and the Taxation of Income from Capital* 81 (Charles Hutten ed. 1981); George Mundstock, Taxation of Business Rent, 11 Va. Tax. Rev. 683, 687-92 (1992).

[148] See Larry Kolbe, How Can Regulated Rates -- and Companies -- Survive Competition?, Pub. Util. Fort., Apr. 4, 1985, at 25; Pierce (1986), supra note 5, at 1218-26.

[149] Competitive markets will still permit long-term contracts that depart, in any given year, from the price that would be predicted for that year based on economic depreciation, as long as the contract's present value reflects the producer's economic cost. But these temporal distortions will tend to average out across multiple contracts. Moreover, retail competition will lead utilities to prefer pricing patterns that approximate annual cost.

cost per unit of production. However, the marginal cost of a unit of electric power varies significantly by season and time of day, because demand varies over time and electricity is extremely expensive to store. The failure of utility rates to reflect the high marginal cost of peak demand gives consumers incentives to underinvest in limiting peak demand (through, for example, window treatments and high-efficiency air conditioners). But utility rates also fail to reflect the low marginal cost of off-peak demand, which induces consumers to overinvest in reducing off-peak demand (through, for example, insulation against winter heat loss).

In the 1970s, PUCs began serious efforts to eliminate this source of the disparity between price and marginal cost. They achieved significant improvements, but fell well short of total success.[150] Utilities and PUCs encountered two significant obstacles to adoption of retail rate designs based on marginal cost. First, it was hard to measure marginal cost. The best measure of marginal cost is the price produced by a competitive market. This easy measure of marginal cost was not available. Second, a retail rate structure in which all prices equal marginal cost would yield either more or less total revenue than the utility was authorized to earn under the traditional formula for calculating allowed revenues.[151]

The movement to competitive contracting for wholesale power is rapidly eliminating these impediments to basing retail electricity prices on marginal cost.[152] The prices that utilities pay in a competitive wholesale power market are good proxies for the marginal cost of generating electricity, including time-of-day and seasonal variations in power prices. Moreover, as competitive contracting replaces utility rates based on depreciated cost, utilities and PUCs will

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[150] See John Miller, Conscripting State Regulatory Authorities in a Federal Electric Rate Regulatory Scheme: A Goal of PURPA Partially Realized, 4 Energy L.J. 77 (1983); Pierce (1986), supra note 5, at 1201-05; Spinner (1992), supra note 35.

[151] See Gellhorn & Pierce (1987), supra note 3, at 202-08.

[152] See Pierce (1986), supra note 5, at 1218-26.

discover that, for the portion of retail power rates attributable to wholesale power costs, there is no conflict between prices based on marginal cost and the return the PUC wants the utility to earn. The utility will incur out-of-pocket costs based on marginal cost in the newly competitive wholesale market.

Utilities will continue to need to recover the *average* cost of retail distribution through retail rates. This cost will usually exceed marginal cost for residential consumers because of the economies of scale in residential power distribution. This will give residential consumers an ongoing incentive to overinvest in conservation, though this incentive can be minimized by charging prices above marginal cost for inframarginal units of power, and marginal cost for marginal units.

As competition inexorably extends to the retail market, utilities will discover that they have no choice but to base the prices they charge to non-captive customers on marginal cost.[153] If they charge less than marginal cost, they will lose money on every unit they sell. If they charge more than marginal cost, they will lose customers to their competitors.

Ironically, this is the point at which the inherent incompatibility of NAPs and the movement to competitive markets becomes clear. As a competitive retail market evolves, market forces will preclude utilities from recovering their NAP investments and the generous financial incentives PUCs have promised them for making NAP investments. It follows that utilities and PUCs will begin to create obstacles to competitive retail markets to protect their NAP investments.

E. External Environmental Costs

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[153] Major advances in metering technology now offer the realistic prospect that the price of electricity will vary instantaneously with *temporal* changes in marginal cost. See ______ Burkhart, Real-time Pricing -- Allowing Customers to Respond, Pub. Util. Fort., Oct. 15, 1992, at 31; ______ Brown, So Long Calvin Coolidge, Pub. Util. Fort., Mar. 1, 1992, at 86.

Electricity generation imposes environmental costs on society that are not borne directly by the firms that generate the electricity. For example, acid rain caused by emission of SO_2 by coal-fired generating plants causes corrosion of materials, lowered visibility, and acidification of lakes and streams. The magnitude of these pollution costs depends on several variables, including the fuel used to generate electricity, the pollution control technology used by the generator, and the location of the generator.

The gap between the utility's marginal cost and marginal social cost is functionally equivalent to a subsidy for electricity consumption. Such a gap can justify an NAP subsidy less than or equal to the utility's residual environmental costs, subject to the concerns expressed in Part III about the efficiency of real-world NAPs.

However, there are at least two ways to internalize or account for environmental harm, that can obviate or reduce the need for conservation subsidies: (1) a market-based approach in which utilities either pay emission fees that approximate the marginal social cost of their emissions, or participate in a marketable permits system for their emissions; or (2) an environmental adder approach that requires utilities to incorporate environmental costs in choosing fuels and generating technologies. The United States is implementing both of these methods of addressing residual environmental costs simultaneously. Yet, the two have very different effects, and they interact with each other and with competitive contracting in ways that render them functionally incompatible. Regulators must choose between these methods of addressing environmental externalities.

We argue in the next two Parts that market-based environmental regulation is compatible with competitive contracting and can eliminate the gap between utility cost and marginal social cost. Indeed, under reasonable estimates of the marginal harm from pollution, the partial implementation of market-based approaches to date largely internalizes pollution harm and eliminates the need for environmental adders or NAPs as a response to pollution costs. Environmental adders, in contrast, promise continued inefficiency in environmental regulation. Properly designed adders can reduce but cannot correctly internalize environmental costs. Moreover, the badly misdesigned adders adopted to date, when layered on top of other environmental regulation, will cause consumers to pay huge amounts for modest pollution control benefits.

V. Federal Environmental Regulation of Power Plants

A. The Status Quo Ante: Command and Control Regulation

Most environmental regulation in the U.S. is "command and control" (C&C) in nature. Regulators specify, for each pollution source, how much of each pollutant that source can emit. Often, they prescribe specific technology designed to meet those emission limits. A large factory or powerplant can have dozens, perhaps hundreds of point sources within it; *each* point source needs a permit for *each* regulated pollutant.

Command and control regulation has succeeded in reducing air and water pollution in the U.S. in the last 25 years, despite growth in population and industrial output.[154] But these reductions have cost much more than they needed to. Some sources are strictly regulated; others are regulated loosely or not at all. For example, under EPA's "new source performance standards" (NSPS), new coal-fired power plants must install expensive SO_2 control technology, technically called flue gas desulfurization and colloquially called "scrubbers."[155] Most old

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[154] *See, e.g.*, EPA, *National Air Quality and Emissions Trends Report, 1988*, at 14 (1990) [cited below as EPA, *Emissions Trends Report*] (sharp declines since 1970 in particulate, CO, and lead emissions; moderate decline in SO_2 and VOC emissions; slight increase in NO_x emissions).

[155] See Clean Air Act § 111, 42 U.S.C. § 7411 (1988) (amended 1990); 40 C.F.R. § 60.40 (199_); Bruce Ackerman & William Hassler, *Clean Coal/Dirty Air* (1981).

plants, in contrast, emit SO_2 with no limits except tall smokestacks that limit local concentrations of SO_2 and, perversely, increase acid rain (SO_4) downwind.[156] A power plant cannot, in general, increase emissions of pollutant *A* at one smokestack by 10 units if it decreases emissions of the same pollutant by 10 units elsewhere. Still less can it trade with another plant at a different location, promising to emit less so the other plant can emit more. Moreover, NSPS rules require *all* new sources to install the best available control technology even if they are located in clean air regions where pollution harm is minimal. In addition, C&C regulation tends to fall more strictly on large than on small sources. Powerplants are large, visible polluters; thus, they are often required to install control technology that costs far more per unit of pollution prevented than smaller businesses.

Enforcement of this complex system is an overwhelming task that has often proven to exceed the capacity of environmental regulators. In many cases, regulators don't even measure actual emission levels! Instead, they rely on engineering estimates of the pollution levels that will result from particular control technology. Case studies commonly show large differences between estimated and actual emission reductions.[157]

From this perspective, NAPs, to the extent they produce net environmental gains,[158] are simply a particular form of C&C regulation. There is no reason to believe that NAPs are a least-cost means of achieving those environmental gains. To the contrary, a more most cost-

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[156] See Ackerman & Hassler (1981), supra note 155, at 64; Bernard Nebel *Environmental Science* 325-26 (3d Ed. 1990).

[157] See, e.g., Caleb Salomon, What Really Pollutes?: Study of a Refinery Proves an Eye-Opener, Wall St. J., Mar. 29, 1993, at A1 (EPA never measured actual emissions at Amoco refinery); Ackerman & Hassler (1981), supra note 155, at 70-72 (weak enforcement of SO_2 emission limits); Charles McCoy, Alyeska Record Shows How Big Oil Neglected Alaskan Environment, Wall St. J, July 6, 1989, at A1 (weak enforcement of Alyeska's pollution control promises); cf. Keith Hawkins, *Environmental and Enforcement: Regulation and the Social Definition of Pollution* (1981) (describing enforcement problems in Great Britain).

[158] On which, see Part III.F supra.

effective strategy for reducing powerplant emissions will often be to impose stricter controls on old plants, which today are often loosely regulated.[159]

A further problem with C&C regulation is its tendency to freeze compliance at current technology levels. Polluters have no incentive to clean up any more than required by their C&C permit, even if they can do so cheaply. They have only limited incentives to develop new, more effective methods of pollution control, since those methods, once EPA learns about them, can lead to stricter emission limits. Moreover, they have no incentive to develop cheaper methods of pollution control unless those methods permit full compliance with the current standards. There is no opportunity, in short, for the cost/quality tradeoffs that are routine in other areas of their business.

B. The Theory of Market-Based Pollution Control

The well-understood problems with C&C regulation have led many economists and environmental law scholars to advocate a market-based approach to environmental regulation that promises the same level of pollution control at cost savings of 50-90% over traditional methods, or (if we prefer) much greater pollution control for the same level of spending.[160] The market-based approach is rooted in a simple insight: Pollution is overproduced because each polluter treats the air as a free resource. Other scarce resources must be bought at a market price that reflects their value in alternative uses. Market forces ensure that these resources go to their highest-valuing users, and are consumed in optimal amounts.

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[159] See Andrews (1992), supra note 111, at 455.

[160] See, e.g., Robert Crandall, *Controlling Industrial Pollution* (1983); Thomas Schelling, *Incentives for Environmental Protection* (1983); Thomas Tietenberg, *Emissions Trading: An Exercise in Reforming Pollution Policy* (1985); Bruce Ackerman & Richard Stewart, Reforming Environmental Law, 37 Stan. L. Rev. 1333 (1985); Richard B. Stewart, Controlling Environmental Risks Through Economic Incentives, 13 Colum. J. Envtl. L. 217 (1988). For earlier discussions, see, e.g., William J. Baumol & Wallace E. Oates, *Economics, Environmental Policy, and the Quality of Life* (1979); John H. Dales, *Pollution, Property and Prices* (1968); Allen V. Kneese & Charles L. Schultze, *Pollution, Prices, and Public Policy* (1975).

In the market-based approach, the government creates a market for clean air in one of two ways. First, the government can set a price for each unit of pollution, which it collects as an emissions fee or tax. Alternatively, the government can establish the total amount of pollution that can be emitted by all sources, and then sell or give away only that number of pollution permits, with the critical feature that the permits are *marketable* -- they can be resold to the highest bidder. The emissions fee approach establishes a market price for pollution. The marketable permits approach establishes a market quantity of pollution. Since, in equilibrium, specifying the market price also fixes quantity, and vice versa, the two approaches are close substitutes. If one knows the marginal benefit and marginal cost curves for pollution control, either approach can be used to achieve the same outcome.

There are important differences between the two approaches in a world where marginal benefit and marginal cost are uncertain,[161] and where regulators respond to changing conditions with substantial lags. There are also important political differences -- emissions fees raise revenue, while permits do not if given away to polluters. But emission fees and marketable pollution permits share a core similarity: Both rely on market prices, and private incentives to limit pollution generated by those prices, to produce least-cost pollution control.

In both schemes, polluters pay, at the margin, a market price for clean air. Under the fee approach, every extra unit of pollution means an extra fee. Under the permits approach, every extra unit of pollution means an extra permit must be bought, or (what amounts to the same thing) one less permit can be sold to others. Clean air will be consumed (pollution emitted) only by producers who value the ability to pollute at more than its market price. Conversely, producers will reduce emissions if doing so costs less than the market price of

[161] See Crandall, supra note 160, at 61-68.

pollution. We will achieve pollution reduction, to the government-prescribed level, at minimum cost. A further feature of emissions fees (and marketable permits if sold rather than given away) is that they raise revenue. This lets government reduce income taxes (which are taxes on desirable economic activity), with accompanying efficiency gains.[162]

Since polluters pay, at the margin, for every unit of pollution, the marginal cost of production will reflect the social cost of pollution -- whether that cost is made explicit through a fee, or is implicit in the market price of permits. The existence of a market price for pollution ensures that polluters (consumers of clean air) make optimal use of this scarce resource. As these costs are passed on, downstream consumers of goods (such as electricity) produced by polluting firms (such as powerplants) will also take pollution cost into account in deciding how much to consume. Moreover, market-based approaches give polluters strong incentives to innovate -- to develop cheaper, or more effective methods of pollution control.

To be sure, market-based approaches can't be used everywhere. Regulators must monitor actual emissions, because you can't price and sell what you can't measure. If there are many small polluters, monitoring costs may be higher than under C&C regulation, and may outweigh other cost savings. For powerplants, though, monitoring costs should be small relative to the savings in pollution control costs, and the transaction costs of permit trading should be small relative to the value of the permits.

The efficiency gains from market-based environmental regulation have long been understood by academics. In the last few years, they have emerged from the netherworld of

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[162] This spillover benefit from emissions fees can substantially affect the optimal emission fee level. For example, under particular assumptions about the costs of global warming, William Nordhaus estimates that an optimal carbon tax will be $0 if half of the additional tax revenue is wasted; $5/ton if the revenue is rebated through lump-sum payments (with no change in other taxes); and $59/ton if the tax is used to reduce distortionary income taxes. William Nordhaus, Optimal Greenhouse-Gas Reductions and Tax Policy in the "DICE" Model, Am. Econ. Rev., May 1993, at 313, 316.

academic debate into the political mainstream. They have gathered support from both ends of the political spectrum and from some leading environmental groups, notably the Environmental Defense Fund.[163] In 1990, a marketable permits plan for SO_2 emissions by power plants was incorporated into the Clean Air Act. An international compact to phase out CFCs relies on a combination of emission fees and marketable permits. Southern California, having largely exhausted the pollution control available from C&C regulation of large polluters, plans marketable permits for NO_x and VOCs.[164] Emission fees and marketable permits are being widely discussed as the only feasible means of attacking the international problem of greenhouse gas emissions.[165]

These and other examples of the burgeoning interest in market-based environmental regulation carry the promise of combining cost-effective regulation with full internalization of pollution costs by both producers and consumers. The next two sections discuss the successes and limitations of the principal market-based approaches adopted to date that apply to electric power generation.

C. Bubbles, Netting, and Offsets

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[163] See, e.g., Daniel Dudek & John Palmisano, Emissions Trading: Why is this Thoroughbred Hobbled, 13 Colum. J. Envt'l L. 217 (1988) (Daniel Dudek is employed by the Environmental Defense Fund); National Economic Research Assocs., *Market-Based Approaches to Reduce the Cost of Clean Air in California's South Coast Basin* (Report to the Calif. Council for Envtl. & Econ. Balance, 1990); *Project 88 -- Round II, Incentives for Action: Designing Market-Based Environmental Strategies* (1991); *Project 88, Harnessing Market Forces to Protect Our Environment* (1988); Robert Repetto, Roger Dower, Robin Jenkins & Jacqueline Geoghegan, *Green Fees: How a Tax Shift Can Work for the Environment and the Economy* (World Resources Inst. 1992); Robert N. Stavins & Bradley W. Whitehead, *The Greening of America's Taxes: Pollution Charges and Environmental Protection* (Progressive Pol'y Inst., Pol'y Rep. No. 13, Feb. 1992); United Nations Conference on Trade and Development, *Combating Global Warming: Study on a Global System of Tradeable Carbon Emission Entitlements* (1992) [cited below as UNCTAD, *Combating Global Warming*].

[164] See South Coast Air Quality Management District, *Regional Clean Air Incentives Market: Summary Recommendations* (1992); Richard Stevenson, California Proposal Would Let Industry Sell Pollution Rights, N.Y. Times, Jan. 30, 1992, at A1.

[165] See, e.g., UNCTAD, *Combating Global Warming* (1992), supra note 163; Peter Passel, Cheapest Protection of Nature May Lie in Taxes, Not Laws, N.Y. Times, Nov. 24, 1992, at C1.

EPA has long made a half-hearted effort to implement market-based approaches to environmental regulation through its bubble, offset, and netting policies. All three involve limited trading of "emission reduction credits (ERCs)," layered on top of an existing C&C regulatory regime. Under the bubble policy, sources can swap emissions as long as total emissions from all sources within the imaginary bubble don't exceed 80% of the sum of the source-specific emission limits. Under the netting policy, old sources can make modifications, without complying with the strict technology-based rules that govern new sources, as long as total emissions don't increase. Under the offset policy, new and modified sources in non-attainment regions (regions that don't meet EPA's air quality standards) must offset their emissions by buying ERCs from existing sources (by 1.2 to 1 in "serious" or "severe" non-attainment regions).[166] The offset program applies principally to NO_x and VOCs, which are precursors to ozone, for which over 40% of the U.S. (by population) is in nonattainment.[167]

These programs are not truly market-based. Calculation of ERCs is often based on engineering estimates rather than measurement of actual emissions; complex EPA rules inhibit firms from setting up bubble or netting plans; EPA retains the right to use the information in a ERC-generating plan to tighten emission limits; and new sources that buy offsets must also comply with technology-based standards. As a result, the use of bubble and netting programs has been limited. The offset rules do, however, force new sources in dirty air regions to fully internalize their pollution costs for covered pollutants. In particular, the offset rules require coal-fired powerplants, which are major NO_x and VOC emitters, to pay a market price for these

[166] See EPA, Emissions Trading Policy Statement: General Principles for Creation, Banking and Use of Emission Reduction Credit, 51 Fed. Reg. 43,814 (1986); Richard Liroff, Reforming Air Pollution Regulation: The Toil and Trouble of EPA's Bubble (1986); Tietenberg (1985), supra note 160; Tom Tietenberg, Relevant Experience with Tradeable Entitlements, in UNCTAD, *Combating Global Warming* (1992), supra note 163, at 37.

[167] See EPA, *Emissions Trends Report* (1990), supra note 154, at 15.

emissions in ozone nonattainment areas.

D. SO_2 Permit Trading Under the Clean Air Act

The 1990 Clean Air Act Amendments adopt a marketable permits plan for SO_2 that, when fully phased in after the year 2000, will limit SO_2 emissions by powerplants to 8.9 million tons per year -- about half of the 1990 level.[168] Permits will be given away to existing power-plants and can then be sold to any other powerplant anywhere in the country. The marketable permits plan is layered on top of C&C regulation, but that regulation is so lenient for SO_2 that the need to buy permits will be the dominant source of SO_2 regulation for all old and most new power plants. Congress expected the 50% reduction in SO_2 emissions required by the 1990 Amendments to cost utilities roughly $4 billion per year (in 1990 dollars), a savings of as much as 50% over the cost of achieving the same reduction through C&C regulation.[169] This cost savings was critical in breaking the political logjam that had long stalled acid rain legislation.

Early returns on the savings from the marketable permits plan are promising. Savings over traditional regulation will surely run to several billion dollars a year. However, some potential gains are being left on the table. For many utilities, the cheapest SO_2 control strategy involves switching to low-sulfur coal; for others, scrubbers are the least-cost compliance option. The principal obstacle to least-cost pollution control has been intervention by state legislatures and PUCs, at the behest of local coal interests, to prevent utilities from switching to low-sulfur coal. For example: the Ohio PUC refused to let American Electric Power switch from high-

[168] Clean Air Act Amendments of 1990, title IV, 42 U.S.C. §§ 7701-7716 (Supp. 199_); see Comment, Smoke for Sale: Paradoxes and Problems of the Emissions Trading Program of the Clean Air Act Amendments of 1990, 40 UCLA L. Rev. 1101 (1993); Note, Emissions Trading to Reduce Acid Deposition, 100 Yale L.J. 2707 (1991).

[169] See Edwin Dolan, Controlling Acid Rain, in *Economics and the Environment: A Reconciliation* 215 (Walter Block ed. 1990); Clean Air Act Amendments of 1989, S. Rep. No. 101-288, at 316-19, *reprinted in* 1990 U.S. Code Cong. & Ad. News ____, ___.

sulfur local coal to low-sulfur Western coal at its Gavin plant;[170] a new Illinois law forbids fuel-switching without PUC approval and ensures that utilities can recover the cost of scrubbers through electric rates;[171] and the Pennsylvania PUC has granted pre-construction rate review and construction work in progress rate hikes for scrubber installation.[172] These decisions have zero environmental benefit. They simply raise the cost of electric power. These state actions are on top of a one-time subsidy for scrubbing built into the Clean Air Act -- utilities that scrub get an extra 3.5 million permits, worth about $1 billion at current market prices.[173]

A second important regulatory obstacle to least cost SO_2 control is utility fear of future cost disallowances. No utility strategy is entirely safe. Build a scrubber, and the PUC may disallow some of your cost because the scrubber proved to be more costly than buying SO_2 permits. Preapproval helps if available, but is no guarantee since today's PUC can't bind future regulators or legislators. Buy permits, and the PUC may disallow some of your cost if buying permits proves more costly than some other option, or if you could have bought the permits more cheaply if you had only bought them sooner (or later). Overcontrol emissions, planning to sell excess permits, and the PUC may disallow some of the cost of control if it proves to

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170 Re Ohio Power Co., 127 PUR 4th 329 (Ohio PUC 1991); see James Norris, Extension Reserve Allowances and Clean Air Act Compliance, Pub. Util. Fort., Jan. 15, 1992, at 32.

171 Ill. Pub. Util. Act § 8-402 (199_); see James Norris, Clean Air Act Compliance: State Regulators Respond, Pub. Util. Fort., Apr. 1, 1992, at 31.

172 Re West Penn Power, 123 PUR 4th 1 (Pa. PUC 1991); see Norris (1992), supra note 171, at 31; John Egan, To Fuel Switch or Not to Switch, There's the Scrub, Elec. J., Dec. 1991, at 9.

173 Clean Air Act § 404(d), 42 U.S.C. § 7704(d) (199_). The House Report is remarkable candid about the political origins of the scrubber subsidy:

> These provisions benefit mine workers and companies selling high-sulfur [coal] who fear that the title could cause many utilities to switch from high-sulfur coal to low-sulfur coal to lower emissions, thus jeopardizing the future of high-sulfur coal mines.

Clean Air Act Amendments of 1990, H.R. Rep. 101-490, pt. I, at 368, reprinted in 1990 U.S. Code Cong. & Ad. News ____, ____.

exceed the revenue from selling permits. For a regulated utility, the gain from a correct decision flows largely to ratepayers, while the cost of a decision that proves suboptimal *in hindsight* may be borne by shareholders. The utility's incentive in choosing an SO_2 compliance strategy is thus to take the least regulatory risk; that incentive only loosely correlates with minimizing compliance cost.[174]

It is ironic that utility rate regulation, designed to limit the cost of electricity, is now emerging as the principal obstacle to cost-effective SO_2 control. Fortunately, competitive contracting for power can solve the problem of misplaced utility incentives. Power supply contracts typically require power producers to bear the cost of environmental compliance. Producers that spend too much on compliance will be outbid by other sources. Producers that choose the cheapest compliance strategy will make money, while producers that err in estimating their costs will lose money, just as in any other industry.

Competitive contracting cannot as easily solve the problem of state preference for local coal, since incentives to use local coal can be built into the competitive bidding structure. But competitive contracting makes the cost of the local coal subsidy more visible. Moreover, independent power producers, who profit by using a cheaper fuel, may be more powerful opponents of local coal subsidies than regulated utilities. The utilities will earn roughly the same rate of return regardless of the fuel source they choose, and are vulnerable to political retaliation in future rate cases if they oppose powerful local coal interests.[175]

While state utility regulation will reduce the cost savings from the SO_2 permits plan, the

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[174] For more extended discussion of these regulatory risks, see Douglas Bohi & Dallas Burtraw, Regulatory Aspects of Emissions Trading: Conflicts Between Economic and Environmental Goals, Elec. J., Dec. 1990, at 47.

[175] See, e.g., Egan (1991), supra note 172 (describing counterattack by natural gas producers against West Virginia PSC's efforts to favor scrubbing over fuel switching).

savings are likely to be higher than expected in other ways. Market-based regulation, unlike C&C regulation, provides strong incentives for private actors to develop cheap ways to control pollution. This process is in full swing for SO_2, as multiple new technologies and fuel sources emerge that were useless under the prior C&C regime. These include "self-scrubbing" coal, adipic acid scrubbers that promise 95% sulfur removal (compared to 90% with conventional scrubbers), sulfur-eating bacteria, microwave-induced catalytic conversion of SO_2 into 0_2 and elemental sulfur, use of ultra-low-sulfur coal from Indonesia, blending coal with fuel pellets derived from solid-waste, and more.[176] These new technologies are a large part of the reason why SO_2 permits, expected to cost about $500 per ton when the marketable permits plan was adopted, now have an estimated price of $300 per ton or less.

The early experience with SO_2 permit trading thus confirms the *ex ante* estimates of massive cost savings, and highlights the innovative pollution control strategies that market-based regulation can unleash. The success of the SO_2 experiment may well lead Congress to extend market-based approaches to other pollutants. The distorted incentives introduced by utility regulation will cause some inefficiencies, but competitive power markets will solve that problem, at least for new power sources. Those inefficiencies, moreover, only strengthen the case for relying on markets rather than utility regulators to determine how power producers price their product and control their emissions.

VI. State Environmental Adders

A. An Overview

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[176] See Elizabeth Corcoran, Cleaning Up Coal, Sci. Amer., May 1991, at 104; James Kindig & Robin Godfrey, Controlling the Cost of Clean Air -- A New Clean Coal Technology, Pub. Util. Fort., June 15, 1991, at 23; Solid Waste: A Least Cost Compliance Option, Pub. Util. Fort., June 1, 1992, at 11; Matthew Wald, Help for Cleaner Air from a Mystery Coal, N.Y. Times, Aug. 10, 1992, at D1; Matthew Wald, Maybe a Cheaper Way to Scrub Smoke, N.Y. Times, Jan. 6, 1993, at D2; Microwaving Pollutants May Lessen Acid Rain, Wall St. J., Sept. 4, 1992, at B1.

The traditional goals of state utility regulation have been to ensure reliable supply and to limit the price charged by the local monopoly provider to a rate that approximates marginal cost. As long as PUCs defined their goals this way, the environmental impact of power plant emissions was someone else's problem. Utilities complied with external (generally federal) environmental rules, but grudgingly. Utilities, supported by PUCs, did their best in the political arena to weaken environmental rules. Once emission limits were imposed, utilities did the bare minimum needed to comply. To do any more would risk regulatory disallowance of the extra cost. Negawatt programs shift the focus from electricity *rates* to electricity *bills*, but they do not challenge the PUC's central mission to reduce the cost of electric power.

This definition of utility regulators' central mission is changing with astonishing speed. At last count, seven states have adopted environmental adder programs, under which utilities must impute an environmental externality cost to alternative power sources when choosing new sources; and two other states take environmental costs into account qualitatively.[177] Many other states are considering similar steps.[178] The federal government is travelling down this road as well -- the Bonneville Power Administration has used environmental adders since 198_,[179] and the 1992 Energy Policy Act requires the administrator of the Western Area Power

[177] California, Massachusetts, Nevada, New York, and Wisconsin have adopted numerical adders. See Re Biennial Resource Plan Update Following the California Energy Commission's Seventh Electricity Report, 124 PUR 4th 181 (Cal PUC 1991); Re Environmental Externality Values, 139 PUR 4th 164 (Mass. DPU 1992); Re Resource Planning Changes Pursuant to SB 497, 119 PUR 4th (Nev. PSC 1991); Re Orange & Rockland Utils., 101 PUR 4th 280 (NY PSC 1989); Re Advance Plans for Construction of Facilities, 136 PUR 4th 153 (Wis. PSC 1992). Illinois and Utah have approved adders in principle, but have not yet determined numerical values. See Re Comprehensive Energy Plan for the State of Illinois, 132 PUR 4th 49 (Ill. CC 1992); Re Pacificorp, 135 PUR 4th (Utah PSC 1992). Colorado and Idaho have endorsed qualitative consideration of environmental externalities, but rejected numerical adders as too speculative at this time. Re Integrated Resource Planning, 139 PUR 4th 379 (Colo. PUC 1992); Re Washington Water Power Co., 135 PUR 4th (Idaho PUC 1992).

[178] See S.D. Cohen, J.H. Eto, J. Beldock & G. Crandall, A Survey of State Regulatory Commission Activities to Incorporate Environmental Activities into Electric Utility Planning and Regulation (Lawrence Berkeley Laboratory 1990).

[179] [cite to come]

Administration to choose resource options that will "minimize life-cycle system costs, including adverse environmental effects of providing [electric] service."[180] Environmental adders are used both in competitive contracting for new power, and in noncompetitive resource decisions. Adders are generally not used to make dispatching decisions (which plants to use for base load power, and which for peak demand) or decide when to shut down old capacity in favor of new, but they easily could be.

Environmental adders have surface plausibility. In the absence of other regulation, utilities will not take the social costs of powerplant emissions into account in making resource decisions. This will lead to more pollution than is socially optimal. Moreover, the social cost of pollution won't be reflected in utility prices, leading to overconsumption of electricity.

But environmental adders are appropriate only if pollution harm is not internalized in other ways, and adders have major weaknesses compared to marketable permits or emissions fees as methods of internalizing pollution harm. Moreover, if a marketable permits or emissions fee system is already in place, the adder program will double count pollution costs. This is already a major problem. PUCs have adopted adders in blithe disregard of other sources of regulation that already largely internalize the harm from most pollutants.

A further problem with adders is their limited scope. They apply only to power plants and not competing power sources. Moreover, they are adopted on a statewide basis. This is too small a scale for regional or international pollution problems (SO_2, NO_x, fine particulates, CO_2, and other greenhouse gases), too large a scale for local problems (larger particulates, O_3),

[180] Energy Policy Act of 1992, Pub. L. No. 102-486, § 114 (amending 42 U.S.C. § 7275_). The House bill would have required state PUCs to consider "the external cost of power production, such as environmental degradation and the cost of maintaining access to foreign sources of supply" as part of a broader process of integrated resource planning, but this requirement was not adopted. Compare H.R. Rep. No. 474, 102d Cong., 2d Sess., pt. 1, at 174, 1992 U.S. Code Cong. & Ad. News 1953, 1996, with Energy Policy Act of 1992, § 111(d).

and a poor fit with a multistate market for wholesale power.

The theoretical problems with adders pale in comparison with the practical problems with actual adder programs. There are huge discrepancies between optimal and actual adders. Nor are the practical problems easily fixable. They are rooted in the institutional incapacity of PUCs to address complex environmental issues in the complexity of adder design, and in the distorting impact of local politics, including the efforts of environmentalists (and some utilities) to support high adders, the better to justify negawatt programs.

B. How Environmental Adders Work: Two Examples

A typical environmental adder program specifies, for each major pollutant, the PUC's estimate of the harm from each unit of emissions (say, $*E* per ton of NO_x). This harm value is then multiplied by an emission rate (say *w* pounds of NO_x per kwh), to generate a harm value for each powerplant measured in ¢/kwh.[181] The adders for the various pollutants emitted by a powerplant are then added to the cost of power from that source when the utility makes new resource decisions. Adders are used both in comparing powerplants and in comparing NAPs to power sources.

We will use two of the early states to adopt adders, Massachusetts and New York, to illustrate how adders operate in practice. Massachusetts has been using the adders listed in Table 1 since 1990.[182] Of these adders, the most important is the $24 per ton adder for CO_2, which increases the cost of coal power by about 2.4¢/kwh, compared to about 1.1¢/kwh for natural gas power. This adder alone, utilities believe, will "eliminate coal as a resource

[181] The harm in ¢/kwh is $H = (\$E/\text{ton}) \cdot (w\ \text{lbs/kwh}) \cdot (1\ \text{ton}/2000\ \text{lbs}) \cdot (100¢/\$1)$.

[182] See Environmental Externality Values, 139 PUR 4th 164, slip op. at 91 (Mass. DPU 1992); Re Rules to Implement Integrated Resource Management Practices, 116 PUR 4th 67 (Mass. DPU 1990).

option."[183]

Table 1
Massachusetts Environmental Adders
(1992 dollars)

Pollutant	Adder ($ per ton)
CO_2	24
SO_2	1,700
NO_x	7,200
Particulates	4,400
Volatile Organic Compounds	5,900
CO	960
CH_4	240
N_2O	4,400

Translating these externality values into ¢/kwh depends on assumptions about the nature of the source, but a reasonable estimate in 1992 dollars for a clean, combined-cycle gas-powered plant is 1.8¢/kwh, and a reasonable estimate for a coal plant equipped with a scrubber that already reduces SO_2 emissions to 0.2 lbs/MBTU (far below EPA requirements), is a whopping 4.8¢/kwh.[184] The coal adder, in short, roughly doubles the cost of wholesale coal power.

New York has only recently begun a proceeding, expected to take several years, to determine what environmental adders to use.[185] But ignorance of the proper adders hasn't stopped New York from using, since 1989, adders that can total up to 1.4¢/kwh when comparing

[183] Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 64 (Mass. DPU 1992).

[184] See Stephen Bernow, Bruce Biewald & Donald Marron, Full-Cost Dispatch: Incorporating Environmental Externalities into Electric System Operation, Elec. J., Mar. 1991, at 20, 26-28.

[185] Conservation with Liza Moses, Esq., LeBoeuf, Lamb, Leiby & McCrae (Mar. 23, 1993).

NAPs to new power sources.[186]

Table 2
New York Environmental Adders

Externality	Maximum Adder (¢/kwh)	Implied $ Per Ton Adder
CO_2	.100	2
SO_2	.250	820
NO_x	.550	1,780
Particulates	.005	320
Water Impacts	.100	---
Land Use	.400	---

Two key points are worth noting about these environmental adders. First, neither is based on an estimate of the marginal social harm from pollution! Instead, both are based on the cost to the utility from eliminating an extra unit of pollution, over and above current pollution-control rules.[187] As we discuss below, this *marginal compliance cost* method produces adders that greatly exceed marginal harm for most pollutants.[188]

Second, even though supposedly based on the same methodology, the two sets of adders bear little similarity to each other. In Massachusetts, the CO_2 adder dominates all others. In New York, the adder for CO_2 is relatively small, overall adder levels are a fraction of

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[186] See Re Orange & Rockland Utils., 101 PUR 4th 280, 301 (N.Y. PSC 1989) (maximum adder of 1.405¢/kwh); cf. Re New York St. Elec. & Gas Co. (N.Y. PSC Opinion No. 89-26, Aug. 16, 1989), at 52 (maximum adder of 1.364¢/kwh). The per ton estimates are taken from Paul Chernick & Emily Caverhill, Methods of Valuing Environmental Externalities, Elec. J., Mar. 1991, at 46, 49. Coal plants will presumably be assigned the maximum adders for CO_2, SO_2, and particulates, plus a substantial NO_x adder. Natural gas plants will presumably receive a smaller CO_2 adder and negligible SO_2 and particulate adders, but a substantial NO_x adder. See Bernow, Biewald & Marron (1991), supra note 184, at 26.

[187] See Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 17-19 (Mass. DPU 1992); Re Orange & Rockland Utils. 101 PUR 4th 280, 299-301 (NY PSC 1989).

[188] See sections D.1 and G infra.

Massachusetts, and there is a large, puzzling adder for land use,[189] a factor that Massachusetts doesn't count at all. Such wide variation between states is common.[190]

C. The Nonequivalence of Environmental Adders and Emissions Fees

Environmental adders may seem very similar to emission fees. They are not. This section discusses the principal differences, all of which argue in favor of emissions fees as the superior regulatory tool.

1. *Cost Internalization*

The environmental adder is counted when the PUC decides which source to approve, but the adder attributed to the winning source is not charged to consumers. Thus, consumers do not pay the full social cost of electric power, and continue to overconsume. Table 3 illustrates this with a simplified example, involving a choice between coal and natural gas.

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[189] The New York PSC explained that the land use adder "would reflect terrestrial impacts, fuel delivery, noise, transmission, solid waste, and aesthetics." Re Orange & Rockland Utils., 101 PUR 4th 280, 301 (N.Y. PSC 1989). But most of these impacts seem largely captured by the market prices paid by the utility for land for its plant, fuel, equipment, land corridors for transmission, and waste disposal. Noise and aesthetic impacts are likely to be small since new powerplants are usually located in out-of-the-way areas.

[190] The Massachusetts values are based on a study by the Tellus Institute. Stephen Bernow & Donald Marron, *Valuation of Environmental Externalities for Energy Planning and Operations: May 1990 Update* (Tellus Inst. 1990). The New York values are based on an unpublished report by the New York PSC staff. See Re Orange & Rockland Utils., 101 PUR 4th 280, 299-301 (N.Y. PSC 1989). Eugene Trisko, Environmental Externalities: Thinking Globally, Acting Locally, Pub. Util. Fort., Mar. 1, 1993, at 52, 53, collects these and other externality values.

Table 3
Competitive Contracting with Environmental Adders
(all amounts in ¢/kwh)

Fuel Source	**Delivered Cost of Electricity**	**Environmental Adder**	**Imputed Cost**	**Cost to Consumer**
Case 1: Coal Preferred				
Coal	**5**	**2**	**7**	**5**
Natural Gas	7	1	8	*not chosen*
Case 2: Natural Gas Preferred				
Coal	5	4	9	*not chosen*
Natural Gas	**7**	**1**	**8**	**7**

In case 1, coal is the preferred source, despite its higher environmental adder. The PUC approves a new coal plant, and authorizes the utility to charge 5¢/kwh to consumers. Since consumers do not pay for the pollution externality, they will consume too much power. In contrast, a 2¢/kwh emissions fee will make consumers reflect the full social cost of coal-generated power.[191]

Case 2 is more complex. Natural gas is the preferred source, despite its higher raw cost, because it has a lower environmental adder. Consumers now pay 7¢/kwh for electric power. They don't pay the 1¢/kwh pollution externality of natural gas, but they do pay an extra 2¢/kwh for the more expensive power source. The effect is the same as if the state had levied a 2¢/kwh emissions fee on coal, and no emissions fee on natural gas.

In both cases, power is underpriced relative to its marginal social cost. The degree of underpricing depends on the externality attributable to the winning source. Power will be

[191] Similarly, marketable permits for the pollutants produced by coal plants will produce full internalization in a competitive power market (where price equals marginal cost) if the permit levels are set so that the combined market price of the necessary permits is 2¢/kwh.

correctly priced only if a zero-adder source wins the contract. Unfortunately, no such source exists when full life-cycle costs are considered.

2. *The Old Plant Effect*

A further distortion arises because marketable permits and emission fees cover both new and old sources, while environmental adders are used principally for new sources. If raw costs are as in case 2, the utility will rely on natural gas for new power. But it typically will not ask whether new gas power has a lower imputed cost than old coal power, either in dispatching decisions or in deciding when to retire an old plant. Combined with rate formulas that overstate the cost of new power and understate the cost of old power,[192] this creates a strong bias toward use of old and generally dirtier power plants, and toward keeping old, dirty plants on line.

The old plant effect also means that we spend more than necessary to achieve a given level of pollution control. New plants, spurred by adders, spend heavily to reduce emissions. Meanwhile, old plants merrily spew out the exact same pollutants, even though the old plants could reduce emissions at much lower cost per unit. We have lost the central feature of market-based regulation -- the ability to achieve a given level of emissions at lowest cost.[193]

It is quite possible for the old plant bias introduced by a large adder to result in *both higher cost and dirtier air* for as much as 15-20 years after it is introduced, because the adder retards the replacement of old, dirty plants with new, moderately clean plants. For example, the strict SO_2 emission limits adopted by EPA for new power plants in 1979 cost utilities several

[192] See supra Part IV.C.

[193] A related problem is that PUCs don't regulate federal power authorities, such as BPA and TVA, and many PUCs don't regulate municipal utilities and rural electric cooperatives. Just as emission fees will produce least-cost pollution control only if applied to all pollution sources, environmental adders will be less cost-effective if applied only to some power producers. There will also be some cross-subsidies, as customers of investor-owned utilities pay for environmental benefits realized by all state residents. See Paul Agathen, Dealing with Environmental Externalities, Pub. Util. Fort., Feb. 15, 1992, at 23.

billion dollars a year, yet were predicted to result in no net environmental gains in the eastern U.S. until after 1995, due to the old plant effect.[194]

The impact of adders in exacerbating the old plant effect can be corrected by extending adders to dispatching and plant life decisions.[195] But that would magnify their impact on electric rates, and make it obvious to consumers that large adders will, in the long run, cost large amounts of money. That might destroy the uneasy environmentalist-consumerist coalition that is now united behind NAPs and adders. At a minimum, it would lead to political pressure for smaller adders, a result that environmentalists don't want. Thus, adders seem likely to be primarily limited to new plants, despite the serious inefficiencies created by the old plant effect.[196]

How should regulators respond to the old plant effect, if adopting emission fees or extending adders to resource and dispatching decisions is politically infeasible? The adder for each pollutant should equal the marginal social benefit from each unit of pollution reduction *by sources covered by environmental adders.* Without the old plant effect, if the marginal harm from pollution is *$E*/unit, the marginal benefit from emissions reduction by adder-covered sources is also *$E*/unit. The adder should therefore equal *$E*/unit. This gives utilities an incentive to eliminate pollution when doing so costs less than the marginal benefit from reducing

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[194] See Ackerman & Hassler (1981), supra note 155, at 68.

[195] See Bernow, Biewald & Marron (1991), supra note ?.

[196] The Massachusetts DPU uses the fact that environmental adders apply only to new sources to *defend* its adder policy. Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 15 (Mass. DPU 1992) ("[T]he Department's externality values are considered only in the selection of new resources and, as such, these values can only have a significant [rate] impact over a long period of time . . . ."). See also Andrews (1992), supra note 111, at 456 ("Several regulators have made the point that it is necessary, from a political point of view, to start with an easy target -- new capacity -- because its very irrelevance makes it relatively noncontroversial.") But see Re Nondiscriminatory Access to Electricity Transmission Services for Nonutility Power Producers, 139 PUR 4th 540 (Cal. PUC 1992) (curtailment decisions for new sources of purchased power to be made by imputing an environmental cost to the new source and the alternate power source).

pollution.

Suppose, however, that due to the old plant effect, half of the reductions *by adder-covered sources* are offset by increased emissions at old sources. The marginal social benefit per unit of pollution reduction *by adder-covered sources* then is only *$E/2*, because total pollution declines by only ½ unit.[197] The adder should then equal $*E*/2 per unit. This will ensure that at the margin, new power sources spend the right amount -- $*E* -- to achieve each unit of *total* emissions reduction. We won't achieve the optimal level of pollution by all sources. Nor will we achieve least-cost pollution control, since new sources will spend up to $*E*/2 to reduce pollution by one unit, while old sources won't spend anything. But at least we won't spend too much to achieve marginal reductions in pollution. In contrast, an adder of *$E*/unit wastes society's resources because it induces covered sources to spend $2*E* to reduce total pollution by one unit.

3. *Command and Control Regulation Versus Market Incentives*

A third difference between marketable permits or emission fees and environmental adders is more subtle, but is perhaps the most important. Permits and fees force private actors -- utilities and consumers -- to internalize pollution harm, but then leave those actors free to make their own power generation and electricity consumption decisions. Environmental adders, in contrast, inject regulators far more heavily into new resource decisions and, potentially, dispatching and plant retirement decisions.

[197] The actual calculation is far more complex than this simple example suggests. Estimating the old plant effect is a difficult task requiring close knowledge of the costs of new and old plants. Moreover, the process is iterative: the fraction of emission reductions by adder-covered sources that result in *overall* emission reductions will vary with the adder level. The offset factor will also vary over time: the old source effect will be more powerful in year 1 than in year 20. To reflect this, regulators need to estimate total emissions in each year in the life of a new source, and then discount those emissions to present value to produce a lifetime offset factor. For discussion of EPA's efforts to model the old plant effect in developing new source performance standards for SO_2, see Ackerman & Hassler (1981), supra note 155, ch.6; Sierra Club v. Castle, 657 F.2d 298, 332-36 (D.C. Cir. 1981).

Consider the new resource decision. Under a permit or fee system, producers know that SO_2 emissions cost X/ton, NO_x emissions cost $$Y$/ton, etc. Producers factor those costs into their bids. If a powerplant emits more than a producer projected when the plant was built, the producer pays the difference. Conversely, a producer that keeps emissions lower than projected keeps the savings. Producers bear the risk of error, and have an ongoing incentive to minimize emissions.

For adders, in contrast, *regulators* must estimate the emissions that each source will produce, in an environment where each producer has an incentive to underestimate emissions to win the contract. Once the contract is let, producers have no further incentive to reduce emissions. In the unlikely event of vigorous enforcement of the contract terms, producers will try to keep emissions at the contract limit, but they gain nothing from doing any better. Adders thus force state utility regulators either to replicate the cumbersome, costly, and ineffective apparatus of command and control regulation, or to rely on an existing C&C regulatory scheme.

The superficial similarity of environmental adders and emission fees is only that. Permits and fees privatize all decisions except the overall level of pollution. Adders require government resource, dispatching, and retirement decisions. And where permits or fees provide continuing incentives to find cheaper and more effective cleanup methods, adders do so only insofar as the chosen method affects one's contract bid price, or the cost of reaching the contracted level of emissions.

In sum, there are three decisions to be optimized: the utility's choice among different power sources; the power source's choice of emission level; and the consumer's choice of consumption level. Environmental adders optimize none of these decisions. Emission fees (or marketable permits) can optimize all three.

D. Conflicts Between Multiple Regulatory Regimes

So far, we have treated environmental adders as if they were the *only* environmental regulation that affected power plant emissions or electricity rates. This is far from being the case. All major pollutants except CO_2 and CH_4 are subject to extensive C&C regulation. All fuels are subject to various taxes that have effects similar to emission fees, and SO_2 is subject to control under a marketable permits plan. State taxes on electric power and cost recovery for NAPs raise rates and thus encourage conservation, though without distinguishing between fuel sources. In many regions of the country, NO_x and VOCs are subject to offset rules that have effects similar to marketable permits. Thus, it is essential to understand how and if environmental adders can coexist with C&C regulation, emissions fees, and marketable permits. Where coexistence is possible, we also need to understand how adders must be modified to reflect the existence of other forms of regulation.[198]

As we will see, adders can coexist with C&C regulation, with appropriate modification, but they cannot be layered on top of a properly designed emissions tax or marketable permits plan. Yet no adder plan properly takes other sources of environmental regulation into account.

1. *Combining Adders with Command and Control Regulation*

For pollutants that are already subject to traditional command-and-control regulation, the case for adders becomes more complex. C&C regulation already limits utility emissions and thus reduces pollution harm. Moreover, utilities partly internalize the social harm from pollution

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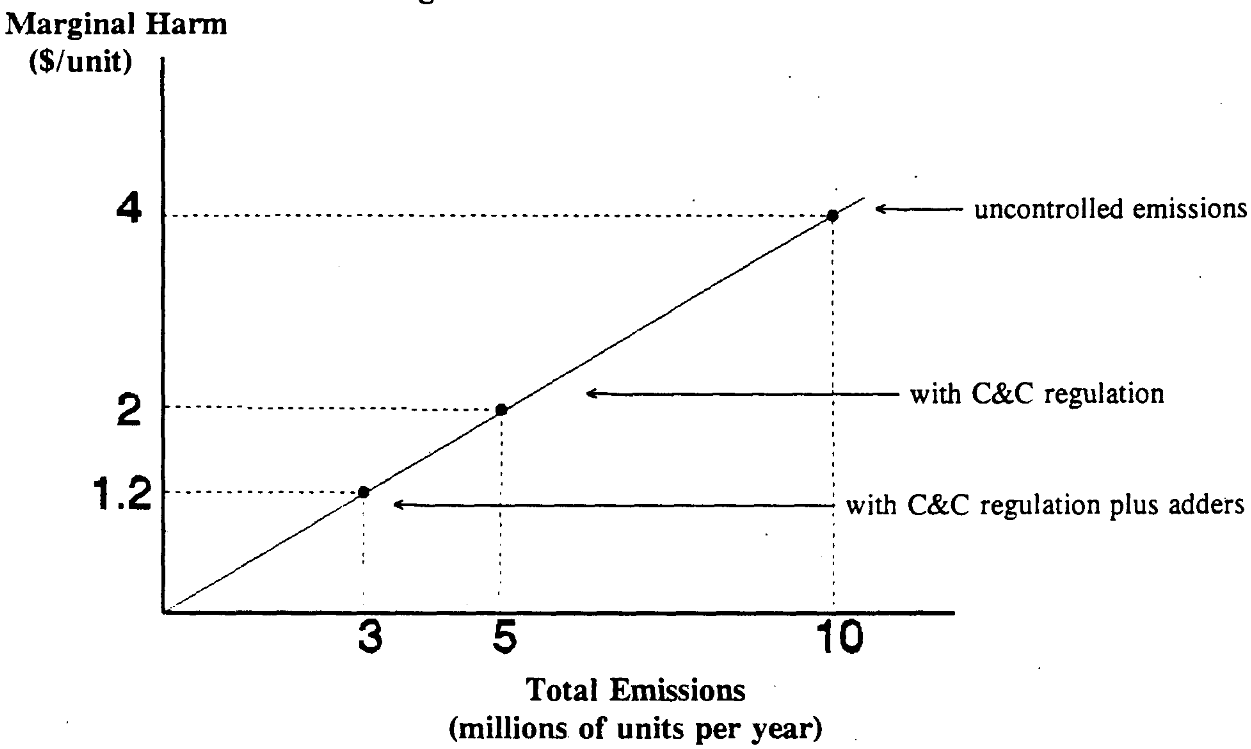
[198] For other discussions of the issues involved in combining environmental adders with other forms of environmental regulation, see Oak Ridge Nat'l Laboratory & Resources for the Future, *U.S.-EC Fuel Cycle Study: Background Document to the Approach and Issues* app. C (Report No. ORNL/M-2500, Nov. 1992) [cited below as *DOE Externality Study Background Document*]; A. Myrick Freeman, Dallas Burtraw, Winston Harrington & Allan J. Krupnick, Weighing Environmental Externalities: How to Do It Right, Elec. J., Aug./Sept. 1991, at 18; Benjamin Hobbs, Environmental Adders and Emissions Trading: Oil and Water?, Elec. J., Aug./Sept. 1992, at 26; Paul Joskow, Weighing Environmental Externalities: Let's Do It Right, Elec. J., May 1992, at 53.

in making resource decisions, because they must pay pollution control costs. Similarly, the pass-through of the utility's cost to consumers causes them to partly internalize pollution control costs in making consumption decisions. But internalization is incomplete. In the absence of adders, neither the utility nor consumers will take the social harm *from the residual pollution* fully into account in making decisions.

If the marginal cost of compliance with C&C regulation is less than or equal to the marginal benefit from pollution reduction, cost internalization can be improved by applying an adder to the residual emissions equal to the marginal benefit from emission reductions by adder-covered sources. Even this simple case, however, requires two important caveats. First, if emission reductions at adder-covered sources lead to offsetting increases in emissions elsewhere, due to the old plant effect or the substitution effects discussed in section E, the marginal benefit from reductions *by adder-covered sources* will be less than the marginal harm from each unit of pollution.

Second, marginal benefit must be measured at the emissions level that will exist taking into account both existing regulation and the adder. If C&C regulation has already sharply reduced emissions and thus the marginal benefit from further reductions, the adder level should reflect this. Figure 1 illustrates this point. For simplicity, we assume that marginal harm varies linearly with the level of pollution and that the marginal benefit from adders equals marginal harm. Uncontrolled emissions would run at an annual rate of 10 million units and cause marginal harm of $4 per unit. C&C regulation reduces emissions to 5 million units per year, and thus reduces marginal harm to $2 per unit. The PUC believes that a $1.20 adder, when fully phased in, will reduce emissions to 3 million units per year, with marginal harm of $1.20. The correct adder is then $1.20 per unit. A higher adder would produce less than 3 million units of annual emissions; the adder would then exceed marginal harm. A lower adder would produce a higher level of emissions; the adder would then be less than marginal harm.

Figure 1
Marginal Harm versus Total Emissions



Suppose instead that the marginal cost of compliance with C&C regulation *exceeds* the marginal harm from pollution. In Figure 1, this will be the case if the marginal cost of C&C regulation exceeds $2 per unit. Utilities and consumers are then already paying too much, at the margin, to control emissions. This extra cost will have the same effect on resource procurement and consumption decisions as an emissions fee. The adder should be reduced by the amount of the effective emissions fee.[199] If PUCs do not take the excess cost of C&C

[199] The total amount of the fee equals the excess cost of emissions control -- the cost over and above the harm from the emissions prevented. To give a numerical example, if: (i) the excess cost of C&C regulation is $3 million; (ii) residual emissions are 5 million units; and (iii) marginal harm is $2/unit, then the adder should be reduced from $2/unit to $1.40/unit to reflect the $0.60 fee equivalent of the excess cost ($3,000,000/5,000,000 units = $0.60/unit). Reducing the adder to reflect excess C&C cost then produces optimal choice of power sources, and full internalization of environmental costs by consumers.

regulation into account -- and thus far, none have -- the combination of C&C regulation and environmental adders will overcount pollution costs and electric power will be overpriced relative to true social cost.[200]

It is highly likely that the marginal cost of C&C controls will exceed the marginal harm from pollution. EPA is required to establish national ambient air quality standards that are sufficient "to protect the public health" with "an adequate margin of safety."[201] In theory, EPA is to do this *regardless of cost*.[202] If EPA achieves this statutory mandate, then marginal harm to human health, which is the dominant harm for most pollutants, will be negligible. In contrast, the marginal cost of complying with EPA rules is often very large, as indicated by the Massachusetts adders, which are based on marginal compliance cost. Thus, the adders for most pollutants should be substantially reduced, to reflect the overcharging implicit in C&C rules.

Overcharging will be especially severe in clean air regions. Under the Clean Air Act, "new" (post-1970) sources must install the best available control technology that has been "adequately demonstrated."[203] EPA takes cost into account in deciding when technology has

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Technically, this assumes that C&C rules already require powerplants to adopt all control measures where cost is less than marginal benefit -- in our example, less than $2 per unit. If so, then an adder of $2 or less will not affect the level of emissions by any source. If C&C rules are not only too strict but also wasteful, in that they require powerplants to install controls that cost more than $2 per unit while bypassing other controls that cost less than $2 per unit, then the optimal regulatory strategy is uncertain. An adder of $2 per unit will give power sources incentives to install measures that cost less than $2 per unit but will overcharge power sources and consumers for overall pollution harm. A lower adder, such as $1.40, can produce the correct charge for consumers and the correct imputed cost for each power source, but will cause power sources to forgo control measures costing between $1.40 and $2 per unit.

[200] Freeman, Burtraw, Harrington & Krupnick (1992), supra note 197, at 21, and *Doe Externality Study Background Document* (1992), app. C, at C-13 to -14, fail to recognize that overly strict C&C regulation is equivalent to an emissions fee, and thus calls for reducing the adder that would otherwise apply to residual emissions.

[201] Clean Air Act § 109(b)(1), 42 U.S.C. § 7409(b)(1) (1988).

[202] See Lead Indus. Ass'n v. EPA, 647 F. 2d 1130, 1148-51 (D.C. Cir.), cert. denied, 449 U.S. 1042 (1980); Union Elec. Co. v. EPA, 427 U.S. 246 (1976).

[203] Clean Air Act § 111, 42 U.S.C. § 7411 (1988).

been adequately demonstrated, but the agency's focus is on cleaning up dirty air regions. Technology that EPA finds appropriate for dirty air regions will then be imposed on the entire country, which virtually guarantees that marginal cost will greatly exceed marginal benefit in clean air regions.

2. *Combining Adders with Permits or Fees: Double Counting*

Environmental adders are intended to force utilities to take pollution costs into account in their resource decisions. As we saw in Part V, marketable pollution permits and emission fees serve the same goal. Unlike adders, permit and fee programs push social costs fully down to consumers, thus providing optimal incentives to conserve energy. Permits and fees also can be extended to a broader range of sources than just power plants, can be adapted to a geographic region larger or smaller than state boundaries, and can be promulgated and enforced by specialized environmental agencies instead of a PUC whose expertise lies in other areas. Given a choice, permits or fees are clearly the superior alternative.

More fundamentally, any effort to combine the two approaches will double count pollution costs -- once when the power producer buys a pollution permit or pays an emission fee, and builds that cost into its bid price, and again when the adder is layered on top of the bid price. We will illustrate this incompatibility by showing how the national permit system for SO_2, under which SO_2 emissions by fossil fuel plants will be limited to 8.9 million tons per year after the year 2000, interacts with the $1,700 per ton SO_2 adder adopted by the Massachusetts Department of Public Utilities.

Under the federal permit system, a new power source that bids to supply power to a Massachusetts utility must buy permits for its SO_2 emissions from older sources. The market price isn't yet clear, but \$300 per ton is a ballpark estimate.[204] Though this is more fortuity than design, \$300 per ton is also roughly consistent with the best available estimates of the marginal social harm from SO_2 emissions, including the estimate implicit in EPA's own 1988 Regulatory Impact Analysis for a proposed new SO_2 rule.[205]

A coal-powered source bidding on a new Massachusetts power supply contract will include the \$300 per ton cost of buying permits in its bid price. The Massachusetts DPU recently decided to waive its SO_2 adder for sources that must buy federal SO_2 permits. But it did so over the objection of environmental groups, and only for "the initial stages of the allowance market operation."[206] Moreover, Massachusetts kept its large CO_2 adder, which will have an even stronger effect than an SO_2 adder in discouraging coal use by new Massachusetts sources. Suppose, then, that Massachusetts or another state doesn't waive its SO_2 adder. The utility will add another \$1700 per ton of SO_2 to the bid price in selecting power suppliers. The total imputed cost per ton of SO_2 will be \$2,000 -- far higher than the best available estimates of actual social harm, and higher (by \$300 per ton) than the regulators intended.

This overpricing will have several effects. First, coal will be disadvantaged compared

[204] See Barnaby J. Feder, Sold: The Rights to Air Pollution, N.Y. Times, Mar. 30, 1993, at D1 (winning bids at initial auction of SO_2 permits ranged from \$122 to \$450 per ton; most were sold toward the lower end of this range). These prices, *paid today*, are consistent with a \$300 value for the permits when they will be used, which will generally be after 2000.

[205] See Table 5 infra (harm estimate of \$60 per ton by Professor Lester Lave); EPA, *Draft Regulatory Impact Analysis on the National Ambient Air Quality Standards for Sulfur Oxides* ch. 6 (1988) [cited below as EPA, *SO_2 Regulatory Impact Analysis*] (median benefit estimate of \$5 billion per year, in 1984 dollars, from 0.25 ppm one-hour SO_2 limit, which is roughly equivalent to the 10-million-ton emission reduction required by the 1990 Clean Air Act Amendments); Paul Portney, Policy Watch: Economics and the Clean Air Act, 4 J. Econ. Persp. 173, 175-76 (1990) (estimating benefits at \$2-9 billion from the SO_2 controls required by the 1990 Clean Air Act Amendments). Because federal rules will already limit total SO_2 emissions to 10 million tons per year (including 8.9 million tons from electric utilities), marginal harm should be assessed at that emission level. *Marginal* harm per ton will be lower than the *average* benefit per ton, estimated by EPA and Portney, from reducing total emissions from 20 million to 10 million tons.

[206] Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 117 (Mass. DPU 1992).

to other fuels. Power purchase decisions will be unduly biased (more than warranted by the social harm from SO_2) towards other, higher cost fuel sources. As a result, coal will be underconsumed, other fuels will be overconsumed, and consumers will pay too much for electric power.

Second, SO_2-emitting sources will have an incentive to spend up to $2,000 per ton to reduce SO_2 emissions, far more than is warranted by marginal social harm, because each ton of emission reductions reduces the source's imputed cost by $2,000, and increases the chance that the source will be the winning bidder. These costs will be passed on to consumers and once again, consumers will pay too much for electric power.

Third, because Massachusetts uses "all-source" bidding, adders provide a further boost to NAPs, relative to power sources. All source bidding already provides a 100% subsidy for NAPs. When combined with overly large environmental adders, the effective subsidy for a marginal NAP program exceeds 100%. Utilities will overinvest in conservation, equipment purchasing decisions will be highly distorted, and (a steady refrain in this Article) consumers will pay too much for electric power.

If the emission fee or permit level has been properly set, then pollution costs have already been fully internalized, and the correct adder is zero. Period. If the fee or permit level is wrongly set, or the geographic scope of a permit trading plan is too large, the best approach is to fix the fee or permit system. If the error is debatable (as it almost surely will be due to the scientific uncertainty that pervades all estimates of pollution harm), the next best approach is probably to do nothing, in light of the costs and complications associated with multiple regulation of the same problem, and the risk that the second regulator will err as well. That leaves little room for adders. Nonetheless, we consider, in the subsections that follow, the limited role that adders might play when layered on top of a demonstrably incorrect fee or permit system, and the complexities that make even this limited role a doubtful proposition.

3. *Combining Modified Adders with Emissions Fees*

Assume that the PUC's estimate of the proper adder is X per unit and the emissions fee is Y per unit. If the emissions fee exceeds the estimated adder, the PUC can do no better than to use a zero adder. Assume, however, that the estimated adder exceeds the emissions fee, and that the PUC is confident that it's judgment about harm is better than the agency that established the emission fee, perhaps because the PUC is estimating local harm while the fee is uniform across a multistate region. The PUC can then improve internalization by adopting a modified adder Z equal to the difference between the two: $Z = X - Y$.[207]

Such opportunities will be rare, however. The effective emissions fee includes the fee implicit in any general fuel tax,[208] any state tax on electricity consumption,[209] the charge imposed by the utility to reflect any NAPs,[210] and the fee equivalent of C&C regulation where marginal cost exceeds marginal harm. Emissions fees and equivalents already equal or exceed

[207] Freeman, Burtraw, Harrington & Krupnick (1992), supra note 197, at 22, and *DOE Externality Study Background Document* (1992), app. C, at C-14 to -15, argue that the PUC should adopt a negative adder if the emissions tax exceeds marginal harm. This is incorrect. There is no environmental gain from a negative adder. Moreover, the fee is a real cost that must be paid. Consumer cost will increase if the PUC pretends, by using a negative adder, that a power source costs less than its true cost.

[208] Because fuel taxes are not pollutant-specific, the reduction in the adder must be applied to the multi-pollutant dollar adder attributed to each source, rather than to the adders attributed to specific pollutants.

[209] These taxes can be substantial. Twenty-five states impose gross receipts taxes of up to 10% on electric utilities; in many cases, these are in addition to customary sales taxes on electricity sales. See Frank Muller, Carbon Taxes: The Case for State Leadership, Elec. J., Jan./Feb. 1993, at 58, 61. If power production competes with NAPs, the adder for each power production source should be reduced to reflect taxes on electricity consumption. These taxes already force consumers to internalize costs not associated with the out-of-pocket costs of power production, and hence substitute for taxes targeted specifically at pollution. If only power production is being considered, this reduction is not necessary, because the reduction per kwh will be the same for all sources, and will not affect which source wins the bidding.

[210] From the consumer's perspective, the rate increase to fund NAPs is indistinguishable from a tax on electricity consumption.

some estimates of the harm from residual power plant emissions. Fuel taxes alone add 6%, on average, to the cost of natural gas, 15% to the cost of fuel oil, and 36% to the cost of coal.[211] The modified tax on the heat content of fossil fuels proposed by the Clinton administration, partly for environmental reasons,[212] will increase these figures to about 20% for natural gas, 36% for fuel oil, and 71% for coal.[213] State taxes on electricity consumption raise the toll even higher. If the heat content tax is adopted, fuel tax levels will exceed the lower-bound estimates of the environmental harm from all three fuels reported in a recent EPA-sponsored study.[214] For natural gas, the proposed tax levels exceed *upper-bound* harm estimates. Once we exclude SO_2, which is covered by a federal marketable permits plan, the proposed tax on fuel oil also exceeds upper-bound harm estimates, and the proposed tax on coal exceeds median harm estimates. If these harm estimates are even roughly correct, the appropriate environmental adder for all three fuels will be zero.

In all cases, moreover, a modified state adder is less desirable on environmental grounds than an equivalent *state* emissions fee or marketable permit system. State-level market-based regulation, like its federal counterpart and unlike adders, fully internalizes environmental costs at both the producer and consumer levels, is not subject to the old plant effect, produces least-

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[211] See W. Kip Viscusi, *Pricing Environmental Risks* 19 (Center for the Study of Amer. Bus., Pol'y Study No. 112, June 1992).

[212] See David Wessel, At Treasury, Bentsen Opposes Tax Breaks Senator Bentsen Pushed, Wall St. J., Apr. 8, 1993, at A1 (discussing origins of Clinton tax proposal).

[213] See Robert Samuelson, Energy Tax: A Good Idea?, Newsweek, Mar. 29, 1993, at 46. In some cases fossil fuel sources compete against other sources that are subsidized in various ways. See, e.g., Energy Policy Act of 1992, Pub. L. No. 102-486, § 1212 (codified at ___ U.S.C. §__) (1.5¢/kwh subsidy for first 10 years of operation for solar, wind, biomass, and geothermal sources owned by local governments or nonprofit electricity cooperatives). Such subsidies have the same effect as an equivalent tax on fossil fuel sources. Thus, fossil fuel adders should be reduced by the amount of the subsidy when fossil fuel plants compete with subsidized sources.

[214] See Viscusi (1992), supra note 210. Viscusi's harm estimates do not include harm from global warming, but as we discuss in section F infra, the appropriate state environmental adders for greenhouse gases are small *even if harm is large*, because of the international nature of the problem.

cost pollution control, and permits coverage of a broader range of energy sources.

4. *The Inconsistency Between Adders and Marketable Permits*

Powerplants are already subject to a marketable permits plan for SO_2. Powerplants in ozone nonattainment areas are subject to offset requirements for NO_2 and VOCs, which have the same effect as a marketable permits plan.[215] Even a modified adder cannot be combined with a marketable permits scheme. This can be seen by returning to the SO_2 example. Suppose that the Massachusetts DPU firmly believes that SO_2 causes harm of $1,700 per ton, and therefore adopts a modified adder of $1,400 per ton (estimated harm of $1700 per ton - permit price of $300 per ton). This will result in lower SO_2 emissions by new Massachusetts power sources. Those sources will have an incentive to spend up to $1,700 per ton to reduce emissions. But total emissions within the geographic region covered by the permits (national in the case of SO_2) will not change. Instead, the permits will simply be used by other sources. The lower demand from new Massachusetts sources will reduce the market price of permits. Other sources will buy more permits and spend less on pollution control. Utilities as a whole, however, will spend more to achieve that emission level. Suppose, for example, that the market price drops to $275. The extra reductions by new Massachusetts sources will cost Massachusetts consumers between $300 and $1,700 per ton. Other power producers will react to the lower permit price by abandoning pollution control efforts costing between $275 and $300 per ton. Thus, each ton of emissions shifted from new Massachusetts sources to other sources (usually, though not always, outside Massachusetts) will impose social cost of between $0 and $1,425 per ton.

[215] To the extent that the offset is more than 1 for 1, construction of a new powerplant will *reduce* total emissions. This should, in theory, be accounted for as a negative adder. California does this; Massachusetts does not; other PUCs that have adopted adders haven't considered the issue. Compare Re Biennial Resource Plan Update Following the California Energy Commission's Seventh Electricity Report, 124 PUR 4th 181, 198-99 (Cal PUC 1991), with Re Environmental Externality Values, 139 PUR 4th 164 (Mass. DPU 1992).

The beauty of the marketable permits system -- its ability to achieve the prescribed level of pollution control at minimum cost -- has disappeared.[216] The stricter the Massachusetts rule, and the more "successful" it is in reducing SO_2 emissions from new Massachusetts sources, the more we spend nationwide to achieve the same overall level of SO_2 emissions. Even within Massachusetts, if the environmental adder applies only to new sources, these sources will spend up to $1,700 per ton to reduce SO_2 emissions, while old sources will spend only $275.

In the particular case of SO_2, the shifting of emissions would be doubly perverse. Not only do costs go up, but total harm will go up as well. Northeastern states with little local coal, such as New York and Massachusetts, will find it politically easy to adopt high SO_2 and CO_2 adders. Midwestern states, with ample coal supplies, are unlikely to adopt large SO_2 or CO_2 adders because of the political power of local coal interests. If Massachusetts adopts heavy adders, as it has, and Illinois does not, and (because of the importance of local coal) it won't,[217] then more SO_2 will be emitted in Illinois and less in Massachusetts. This is environmentally perverse, since SO_2 emitted in Illinois gets converted to sulfuric acid (H_2SO_4) in the atmosphere and then falls as acid rain in the Northeast.[218] In contrast, SO_2 emitted in Massachusetts is less harmful and may be environmentally *beneficial*. SO_4 is a cooling gas that

[216] This is also true for a modified adder layered on top of an emissions fee. If Massachusetts imposes a $1,400 per ton adder, on top of a national $300 per ton emissions fee, then new Massachusetts sources will spend up to $1,700 per ton to reduce pollution, while other sources (including older Massachusetts sources) will spend only up to $300. Whatever the total level of emissions, we could have achieved that level at lower cost by spending less per ton at new Massachusetts sources and more per ton elsewhere. But at least the modified adder reduces total emissions at a cost less than the marginal harm from these emissions. With a permit system, adders simply raise the cost of pollution control, for no net environmental gain.

[217] Cf. Remarkable Remarks, Pub. Util. Fort., Apr. 15, 1993, at 8 (quoting Illinois PUC Commissioner Terence Barnich complaining that "President Clinton's energy tax proposal is fundamentally discriminatory and grants a massive artificial advantage to natural gas.").

[218] Nebel (1990), supra note 156, at 321-28, discusses the geography of SO_2 emissions and acid deposition.

helps to counteract global warming,[219] and the eventual acid rain will land in the ocean, which has ample buffering capacity.[220]

5. *Combining Adders and Permits When Harm Varies By Location*

The SO_2 example shows how combining adders and permits can be perverse if adders are high where harm is low, and vice versa. Can we turn the example around, and make a case for adopting modified adders where harm is especially high, within a permit trading region? A theoretical case can be made, but it applies to few, if any, real-world situations. First, the harm must vary between states in a permit trading region by enough to justify an additional layer of regulation. This is a sign of a badly designed permit trading system, for which the best solution is smaller trading regions or harm-weighted permits. Second, the state PUC must be able to assess differential harm between states. This is a massive task that no PUC has yet attempted. On the contrary, all adder programs are based on a limited number of studies that do not draw such fine distinctions. For most pollutants, even producing a single national estimate of harm per unit of emissions involves massive guesswork. Refining that estimate to state-by-state estimates is all but impossible given current data (SO_2 is a partial exception), and will remain so absent an intensive, multi-year research effort that state PUCs lack the resources to fund.[221]

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[219] See, e.g., Sharon Begley, The Benefits of Dirty Air: Pollution May Negate the Greenhouse Effect, Newsweek, Feb 3, 1992, at 54; William Stevens, Volcano's Eruption in Philippines May Counteract Global Warming, N.Y. Times, June 31, 1991, at 1.

[220] The perversity runs deeper. Under the federal SO_2 emissions permit system, if Illinois wants to subsidize its high-sulfur coal producers, Illinois consumers must pay the cost of that subsidy, because Illinois utilities must either buy more permits or spend more on SO_2 controls. This constrains the depth of the subsidy. Moreover, the existence of a market price for permits lets subsidy opponents compute and publicize the cost. If Massachusetts adopts a heavy SO_2 adder, it is paying a heavy price to ship back to Illinois, in the form of cheaper SO_2 permits, some of the dollars that Illinois spent to subsidize high sulfur coal. This makes it cheaper to subsidize high-sulfur coal, and increases the likely scope, and thus the efficiency loss from these subsidies.

[221] By way of comparison, the recently completed federal NAPAP (National Acid Precipitation Assessment Program) study took 10 years, cost $500 million, and did not produce dollar estimates of harm, though it may lay the groundwork for others to do so. See generally U.S. National Acid Precipitation Assessment Program. *Acidic Deposition: State of Science and Technology* (1991).

Third, the PUC must be able to predict where the extra permits will end up, also a very difficult task requiring knowledge of the marginal compliance cost for powerplants in different areas.[222]

In theory, a state where harm from a particular pollutant is relatively *low* should adopt a negative adder. Massachusetts, for example, should have a *negative* SO_2 adder. Unfortunately, using negative adders in this way is politically infeasible. No state will voluntarily import pollution from somewhere else by adopting negative adders. Even in the extreme case of SO_2, where Massachusetts might be *better off* if Massachusetts sources) emit more SO_2 and Midwestern sources emit less, PUC officials cannot hope to convince the public of this. And an environmental group would surely have trouble explaining to its members that it supports a negative 2¢/kwh "adder" for coal-fired powerplants, on the grounds that SO_2 emissions are less harmful here than elsewhere.[223]

6. *Bidding with Geographically Varying Harm*

As competitive bidding spreads, and FERC implements the power wheeling provisions of the 1992 Energy Act, power production bids will often come from sources that are geographically distant from the power consumers, often from outside the state. A state with environmental adders then faces several choices, none ideal. First, it can ignore the geographic location of the bidder. This is the most common approach to date.[224] But this undercuts the justification for having the adder, much of which (when adders are combined with emission fees), or all of which (when adders are combined with permits), depends on geographic variation

[222] See Hobbs (1992), supra note 197, at 27.

[223] Ironically, New York environmental groups are making precisely this argument in trying to prevent Long Island Lighting Co. from selling excess SO_2 permits, without realizing that it is inconsistent with their support for SO_2 adders. See James Dao, Some Regions Fear the Price As Pollution Rights Are Sold, N.Y. Times, Feb. 6, 1993, at 1.

[224] See, e.g., Re Resource Planning Changes Pursuant to SB 497, 119 PUR 4th 257, 268 (Nev. PUC 1991); [cites to come].

in harm.

Second, PUCs can establish adders that depend on pollution harm where the powerplant is located. California has recently adopted this approach.[225] Such geographically varying adders are the theoretically correct result. But they may, over time, lead to political pressure for adders that favor in-state sources. Out-of-state sources will then challenge those adders under the dormant Commerce Clause, claiming that the adders unfairly discriminate against out-of-state sources. Other states may retaliate by adopting their own discriminatory adders.[226] Alternatively, the PUC can override the objections of local producers and adopt adders that favor out-of-state producers, in an effort to export pollution. Once again, other states can retaliate. In either case, the efficiency losses in power production from discriminatory adders are clear, while the environmental gains are dubious. With no solution in sight, we can only count the complexity raised by competitive bidding with geographically varying harm as an additional reason not to layer modified adders on top of a multistate emission fee system.

E. Substitution Effects

Adders raise the cost of utility-supplied electric power. This will induce consumers to shift to sources that are not subject to adders. Two kinds of shifts will occur: (i) within the state, consumers will switch to non-utility power sources; and (ii) industrial and commercial consumers will move energy-intensive operations to lower-cost states (or countries).[227]

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[225] See Re Biennial Resource Plan Update, 132 PUR 4th 207, 250-51 (Cal. PUC 1992) (allowing nonuniform valuation of residual emissions); Re Nondiscriminatory Access to Electricity Transmission Services for Nonutility Power Producers, 139 PUR 4th 540 (Cal. PUC 1992) (valuation depends on location of each powerplant).

[226] The outcome of a Commerce Clause challenge is uncertain. Discriminatory adders might be held illegal per se. They also might be upheld if the PUC convinces a reviewing court that the differential adders are reasonably related to actual differences in harm. For analysis of the case law on discriminatory taxes, see Richard Pierce, The Constitutionality of State Environmental Taxes, 58 Tul. L. Rev. 169 (1983).

[227] Substitution effects are also discussed by Joskow (1992), supra note 197, at 59; *DOE Externality Study Background Document* (1992), supra note 197, app. C.

1. *Energy Source Substitution*

Suppose that an industrial consumer is currently indifferent between buying electric power from the local utility and generating its own power (perhaps by operating a cogeneration facility). An increase in electric rates will induce the customer to switch to cogeneration. Unfortunately, a switch to small-scale cogeneration will increase pollution, because large sources are regulated much more strictly than small sources.[228] Switching to other energy sources will also increase pollution, because utilities are already the cleanest of all fossil fuel burning power sources.

Even a small price-induced shift from purchased electric power to direct burning of fuel can wipe out the environmental gains from adders. To take an extreme example, gasoline-powered lawnmowers, leaf-blowers, and hedge-trimmers compete with electric powered models. The gasoline-powered models use notoriously dirty, 2-stroke engines, which can emit as much as 100 times the pollution generated by a power plant to produce the same amount of delivered power.[229] So even a 1% shift from electric to gasoline-powered models will increase total emissions. A second example with enormous practical importance involves the choice between gasoline-powered and electric-powered motor vehicles. Electric vehicles can sharply reduce air pollution, but the more the utility charges for electricity, the fewer of them we are likely to see.[230]

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[228] For example, the new source performance standards for fossil fuel-fired power plants apply only to sources that consume at least 250 million British Thermal Units (MBTUs) of heat energy per year, an amount roughly equivalent to 73 megawatts of heat energy. See 40 C.F.R. § 60.40(a) (199_).

[229] See Matthew Wald, Lawn Mower is New Target in War Against Air Pollution, N.Y. Times, Aug. 6, 1992, at A1 (lawnmowers are 30 times dirtier than cars, which are themselves much dirtier than power plants).

[230] Natural gas plants emit an estimated 2% as much VOCs, 1% as much CO, and 11% as much NO_x as automobiles. See Diane Wittenberg & Julianne Meurice, Electric Vehicles: A New Challenge for Utility Planners, Elec. J., Apr. 1993, at 46, 47.

The energy source substitution effect, like the old plant effect, means that only a fraction of emission reductions *by adder-covered sources* will reduce *total* emissions. The regulator's best response is the same: the adder should equal the benefit from each unit of pollution reduction *by adder-covered sources*. This will equal the marginal harm per unit of pollution multiplied by the ratio of total pollution reductions to reductions by adder-covered sources.[231]

Fuel substitution effects are not unique to environmental adders. Emissions fees and marketable permits have similar effects if applied only to powerplants (as with the SO_2 permits system) and not to competing power sources. But emissions fees and marketable permits have a crucial advantage: They can (and should be) applied to all competing power sources. Environmental adders cannot.

2. *Geographic Substitution*

Adders can also cause geographic substitution: Electricity users will shift to states with low (or no) adders, or to countries with weaker environmental rules. The appropriate response by state regulators when designing adders depends on the nature of the pollutant and on what weight state regulators assign to pollution harm outside the state. We consider here pollutants that cause purely local harm. Section F addresses regional and international pollution problems.

Suppose, first, that the PUC gives zero weight to out-of-state emissions in choosing optimal adders. The PUC should then ignore geographic substitution and count in-state pollution reduction in full. Other states can respond to their own pollution problems as they see fit. If PUCs want to give some weight to non-environmental costs, such as job loss and depletion of the state's tax base, that accompany the movement of industry to other states, the adder should

[231] In general, both the old plant effect and the energy source substitution effect will operate simultaneously. The adder should equal the marginal social harm per unit of pollution multiplied by a fraction *f* that reflects the combined impact of both effects on the ratio of total pollution reductions to reductions by adder-covered sources.

equal the social benefit from adder-driven pollution reductions minus these offsetting costs.

The other extreme, in which state regulators give out-of-state emissions the same weight as in-state emissions in the regulatory calculus, is unrealistic. Politicians who voted that way would soon be ex-politicians. We can, however, imagine out-of-state emissions being given *some* weight. We can model this by multiplying the harm from out-of-state emissions by an altruism factor a, where a is between 0 (complete selfishness) and 1 (complete altruism). Suppose then that: (i) the marginal benefit from each unit of emissions reduction at adder-covered sources is $\$E'$; and (ii) each unit of adder-driven in-state pollution reduction produces g units of extra out-of-state emissions. The effective marginal benefit from each unit of emissions reduction *by adder-covered sources within the state* is then $\$E' \cdot (1 - a \cdot g)$. The adder should equal this amount.[232] The more altruistic the state, the *lower* the adder, because greater weight is given to pollution that is exported to other states.

Geographic substitution effects apply to all forms of environmental regulation, not just adders. Some geographic substitution is desirable: We want pollution sources to move from dirty air regions, where the marginal harm from pollution is high, to clean air regions, where marginal harm is low. But geographic substitution that merely shifts the locus of pollution without decreasing harm is simply an inherent limiting factor on the effectiveness of local environmental regulation. A complete solution requires regional, national, or possibly international regulation.

F. Regional and International Pollution Problems

In the previous section, we assumed that pollution harm is strictly local, so that the state

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[232] The marginal benefit value *$E'* should already reflect the old plant effect, the energy source substitution effect, and any other sources of divergence between the marginal harm per unit of pollution, and the marginal benefit from pollution reduction *by adder-covered sources*. We assume, for simplicity, that the marginal benefit *$E'* from each unit of pollution reduction at adder-covered sources is the same both inside and outside the state.

adopting an environmental adder realizes the full benefit of emission reductions within the state. This is true for some pollutants (CO and heavy metals, for example). But many (air pollution problems are regional (e.g., SO_2, NO_x, VOCs) or international (e.g., greenhouse gases like CO_2 and CH_4, and ozone-depleting chemicals). This section considers the special problems in using environmental adders to address regional or international pollution problems.

The analysis will become complex, but the qualitative conclusions are straightforward. If we assume zero altruism, then the adder should reflect: (i) the social benefits within the state from pollution reduction within the state; minus (ii) the social harm within the state from pollution *outside the state* caused by geographic substitution. Introducing partial altruism increases the effective social benefit from each unit of pollution reduction within the state, but also increases the offset due to the harm from extra pollution outside the state.

1. An Analytical Model

To model optimal adders for regional and international pollution problems, let:

$E	=	the marginal harm from each unit of pollution, which is assumed to be constant across all jurisdictions of interest.
f	=	*in-state substitution factor*: the fraction of emission reductions by adder-covered sources that are offset by increased emissions within the state by other sources due to the old plant and energy source substitution effects; the net fractional emission reduction is $(1 - f)$.
g	=	*geographic substitution factor*: the fraction of emission reductions within the state that are offset by increased emissions outside the state; the net fractional emission reduction is $(1 - g)$.
s	=	*local harm factor*: the fraction of the total harm from emissions within the state that is realized within the state, which is assumed to equal the fraction of the total harm from pollution *outside* the state that is realized within the state.[233]

[233] This assumption is plausible for some pollution problems, like global warming and ozone depletion, where emissions from all sources are thoroughly mixed in the atmosphere. It will not be appropriate for more local problems, were the external harm from in-state pollution will be mostly downwind, while the in-state harm from external pollution will come mostly from upwind sources. Even there, however, it may be a decent approximation for a state that is upwind from some areas and downwind from others.

a = *altruism factor*: the fractional weight assigned to out-of-state pollution harm, relative to in-state harm.

Consider first the zero altruism case ($a = 0$). The benefit within the state, from each unit of pollution reduction by adder-covered sources, is:

$$\text{In-State Benefit} = \$E \cdot (1\text{-}f) \cdot s \quad \textbf{(1)}$$

The harm from extra emissions outside the state that flow back into the state is:

$$\text{In-State Harm} = \$E \cdot (1\text{-f}) \cdot g \cdot s \quad \textbf{(2)}$$

Combining equations (1) and (2), the net benefit within the state, from each unit of pollution reduction by adder-covered sources, is:

$$\text{Net In-State Benefit} = \$E \cdot s \cdot (1\text{-}f) \cdot (1\text{-}g) \quad \textbf{(3)}$$

The optimal adder should equal this amount.[234]

The intuition behind this formula is as follows: The factor $\$E{\cdot}s$ is the marginal harm *within the state* from each unit of emissions. The factors $(1 - f)$ and $(1 - g)$ reflect the fact that emission reductions by adder-covered sources will be offset, in part, by emission increases elsewhere.

The factor s will vary widely depending on the pollutant. For regional problems, like NO_x and VOCs in the Northeast, a plausible value might be 0.25 or 0.50. For international problems like greenhouse gas emissions, s will be minuscule. Since global warming is the only known harm from the principal greenhouse gases, CH_4 and CO_2, the case for state environmental adders for these gases *rests entirely on altruism.*

This conclusion does not turn on the scientific debate about the likely degree of global

[234] Subject, of course, to reduction to reflect other forms of environmental regulation. See supra section D.

warming, or the extent of harm from global warming.[235] Rather it reflects the inescapable fact that international problems require an international response. One state acting alone, even one country acting alone, can accomplish little (except self-impoverishment).

Introducing an altruism factor a into the analysis strengthens the case for greenhouse gas adders at the level of formal analysis. The benefit within the state from pollution reduction within the state is still given by equation (1). But now there will also be an out-of-state benefit from pollution reduction within the state:

$$\text{Out-of State Benefit} = \$E \cdot (1\text{-}f) \cdot (1\text{-}s) \cdot a \tag{4}$$

Similarly, the harm within the state from extra emissions outside the state that flow back into the state is still given by equation (2). But now there is also a cognizable out-of-state harm from these extra emissions:

$$\text{Out-of-State Harm} = \$E \cdot (1\text{-}f) \cdot g \cdot (1\text{-}s) \cdot a \tag{5}$$

Combining equations (1), (2), (4), and (5), the effective net benefit realized by the state from each unit of pollution reduction by adder-covered sources is:

$$\text{Net Benefit} = \$E \cdot (1\text{-}f) \cdot (1\text{-}g) \cdot [s + a\cdot(1\text{-}s)] \tag{6}$$

As before, the optimal adder equals this net benefit.

For regional pollution problems, both terms in equation (6) are potentially important. For international problems, where almost all harm occurs out-of-state ($s \ll 1$) and the state is willing to expend significant amounts for altruistic reasons ($a \gg s$), equation (6) can be

[235] For recent analyses, see William Cline, *The Economics of Global Warming* (1992); *Global Warming: Economic Policy Responses* (Rudiger Dornbusch & James Poterba eds. 1991); William Nordhaus, To Slow or Not to Slow: The Economics of the Greenhouse Effect, 101 Econ. J. 920 (1991). Our reading of the evidence is that some degree of global warming is likely, though the extent remains shrouded in the mists of competing computer simulations. What is far less clean is whether warming on the order of mid-range estimates, say 2°C on a global average, will be on balance helpful or harmful. Some regions of the globe will experience large benefits; others will experience large costs. Neither question -- the extent of warming or whether it will be helpful or harmful -- seems likely to be answered anytime soon.

simplified. The second term in brackets on the right-hand side dominates the first, s can be approximated by 0, and equation (6) becomes:

$$\text{Net Benefit (Altruistic Limit)} = \$E \cdot (1\text{-}f) \cdot (1\text{-}\ g) \cdot a \qquad (7)$$

Equation (7) looks much like equation (3); the only difference is that the local harm factor s in equation (3) has been replaced by the altruism factor a. The optimal adder is still less than the marginal harm from pollution, this time by a combination of the substitution factors $(1 - f)$ and $(1 - g)$ and the altruism factor a.

Our analysis is not limited to adders. Optimal local emission fees must also reflect the regional or international nature of pollution problems. Emissions fees can avoid the old plant and energy source substitution effects that are reflected in the $(1 - f)$ factor in the equations above. But an optimal local emissions fee will still be lower than the marginal harm per unit of pollution. Similarly, an optimal local subsidy for conservation will be smaller than the marginal harm from pollution (and will be zero in the presence of an optimal emissions fee). Adopting a local emissions fee that is lower than the marginal harm from pollution means that pollution costs are not fully internalized. But a higher fee will cause sources within the jurisdiction to spend more to control pollution than the jurisdiction receives in benefits (including benefits outside the jurisdiction reflected in the altruism factor).

2. *The Uneasy Case for PUC Altruism*

The analysis above suggests a limited role for greenhouse gas adders, if regulators believe that out-of-state harms should be given significant weight. We have grave doubts, though, about whether PUCs should be giving away ratepayers' money, even for a noble cause. Such a decision runs directly contrary to the central reason for the PUC's existence -- to ensure that consumers do not pay too much for electric power. Altruism is a quintessentially political decision, which politicians should make -- and then take credit or blame at the polls. It is not the job of appointed regulators.

If regulators do adopt adders partly for altruistic motives, they should at least be honest about what they're doing. Explicit discussion of the proper altruism factor, in a reviewable order, will expose this issue to public debate, let courts decide if altruism is part of the PUC's mission, and increase the chance that the proper decisionmakers -- elected legislators -- will step in and resolve the matter.

3. Interstate Coordination

Our analysis above of the merits of state adders for regional or international pollutants has thus far assumed that each state acts on its own. That has been PUC practice to date, but is not inevitable. If states *A* and *B* reach a bilateral agreement under which both adopt adder programs (or other environmental regulation), that increases the benefit to each state because state *A* will receive some of the benefits from *B*'s pollution reduction and vice-versa. Geographic substitution will also become less of a problem. The larger the group of states that reach such an agreement, the closer they can come to achieving collectively optimal regulation.

Multistate compacts may be difficult to reach in practice, and even more difficult to enforce. As with any cartel, each member is tempted to cheat. Nonetheless, they are a more promising vehicle for addressing regional pollution problems than unilateral state action.[236] Similarly, a multinational compact is the *only* approach that offers much hope of limiting greenhouse gas emissions. Moreover, the effort to reach such agreements may be valuable, even if unsuccessful. State *A* is unlikely to accord more weight to pollution harm in state *B* than state

B's own regulators are willing to, or to accord much weight to pollution in state *B* if *B* won't reciprocate.

G. Environmental Adders in Practice: Bad Data, Silly Results

The fundamental justification for environmental adders is that they give power producers incentives to control emissions when the cost of doing so is less than the social benefit of lower emissions, and bring electric rates more closely in line with the total social cost of power generation. A recurring theme in our analysis of adders is that only in highly artificial circumstances will the optimal adder equal the marginal social harm from each unit of pollution. Multiple factors reduce the optimal adder to an amount lower than this base level. None go in the opposite direction. To review, the following factors all call for optimal adders lower than marginal harm per unit of pollution, and in some cases for eliminating adders entirely: the old plant effect; overly costly C&C regulation; internalization of pollution costs through emissions fees or fee equivalents; marketable permits plans; offset rules in dirty air regions; problems raised by interstate bidding; energy source and geographic substitution effects; and the regional or international scope of some pollution problems. Adjusting adders for these factors ensures that states do not spend too much to reduce pollution at the margin.

State practice to date in adopting environmental adders is light-years away from the approach outlined above, States begin by adopting adders that greatly exceed marginal harm. They compound this error by making few or none of the necessary downward adjustments. The result is that consumers pay far too much for the pollution reductions that adders produce. In some cases, as with adders layered on top of marketable permit plans, consumers pay heavily for programs that don't reduce pollution at all.

1. *Adders Based on Marginal Compliance Cost*

The proper adder calculation begins with an estimate of the marginal harm from an additional unit of pollution. This marginal harm value is then adjusted downward to reflect substitution effects, the effects of other regulation, and the regional or international nature of some pollutants. Recall, though, that our two example states, Massachusetts and New York, do not compute adders this way. Instead of measuring marginal harm, they measure the marginal cost of compliance with existing environmental rules. The adder is set equal to "the most expensive control technology that society has revealed a willingness to require."[237] *All* states that have adopted numerical adders to date use adders based on marginal compliance cost.[238] Several defenses of this practice have been suggested, but none stands up to analysis.

The first defense of environmental adders involves the claim that current environmental regulation requires pollution control up to the point where the marginal cost of compliance equals the marginal harm from additional pollution.[239] This is simply false. As discussed above, EPA's clean air rules are health-based, not cost-based. The marginal cost of compliance with EPA rules and the marginal harm from residual pollution are simply unrelated. All marginal compliance cost tells us is how costly it was to reduce pollution to *and beyond* the point where marginal harm to health is negligible.[240] To be sure, cost enters through the back door, as politicians protest the extreme measures needed to bring urban areas into full compliance with strict air quality standards. But this still gives us no reason to expect that

[237] Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 18 (Mass. DPU 1992).

[238] See sources cited in note 177 supra.

[239] See, e.g., Stephen Wiel, The New Environmental Accounting: A Status Report, Elec. J., Nov. 1991, at 46 (Mr. Wiel is a member of the Nevada PSC); Union of Concerned Scientists, *America's Energy Choices: Investing in a Strong Economy and a Clean Environment* 36-37 (1991) (making the even more extreme claim that cost-based adders are "a *lower bound* to actual damage costs" because "[i]f the regulators were willing to require technology with a given cost for the last pound of pollutant removed, then they must reckon the value of environmental damages associated with that last pound of pollutant to be *at least* that cost") (emphasis added).

[240] See supra section D.1.

marginal compliance cost is a respectable measure of marginal harm.

An alternate defense of the marginal compliance cost method is the claim that if society is willing to pay $1,700 per ton to reduce SO_2 emissions in one context, it should be willing to pay the same amount in other contexts.[241] This argument, too, is flawed. Willingness to pay for pollution control can, in some contexts, be a respectable surrogate for marginal harm. But EPA's decision to require a particular control technology, under a statute that deliberately ignores cost, tells us nothing about median consumer willingness to pay. Consider SO_2, for example. Prior to 1990, the highest marginal cost paid for SO_2 control at new power plants may indeed have been on the order of the Massachusetts estimate of $1,700 per ton. But this figure applied only to new *Western* coal plants, which were already burning low-sulfur coal. The marginal control cost in the East was far lower -- about $500 per ton (in 1992 dollars).[242] Moreover, society was apparently willing to spend nothing at all to control the dominant source of SO_2 emissions -- old coal plants. Which figure, then, reflects society's willingness to pay for additional emissions?[243]

These huge discrepancies arise because environmental regulation is designed neither to

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241 See, e.g., Bernow & Marron (1990), supra note 190; Chernick & Caverhill (1991), supra note 186, at 50; Wiel (1991), supra note 238, at 54 n.4.

242 See Crandall (1983), supra note 160, at 36-37 (EPA estimated NSPS compliance costs for coal-fired Eastern power plants at $265-$298/ton in 1980, compared to Western costs of $1167-$1414 per ton).

243 The political history of the 1977 Clean Air Act Amendments and subsequent EPA rules, which established these expensive control requirements for new Western coal plants, further undercuts the claim that $1,700 represents social willingness to pay for SO_2 control. The requirements were adopted over the objection of representatives of Western states. The key support came from representatives of Midwestern and Eastern states, some of whom were interested in imposing costs on their Western competitors. See Ackerman & Hassler (1981), supra note 155 (describing political history of new source performance standards for SO_2); Crandall (1983), supra note 160, ch. 7 (detailing support and opposition to these new standards). This political history makes it purely fanciful to suggest that there is any political consensus on spending $1,700 per ton to reduce SO_2 emissions. To the extent that a political consensus can be discerned, it is quite the opposite -- $1,700 per ton of SO_2 is too much of one's own money to spend. That political consensus on a much lower value of SO_2 control is consistent with the marketable permit provisions of the 1990 Clean Air Act Amendments, which were expected to result in a permit price, and thus a marginal control cost, on the order of $500 per ton.

measure willingness to pay nor to equate willingness to pay with marginal control cost. To be sure, the overall level of spending on all environmental problems provides a rough measure of societal willingness to pay for a cleaner environment. But to go from that broad generalization to willingness to pay to control particular pollutants at the margin is sheer fantasy.

Moreover, PUCs do not apply the willingness to pay test honestly. Current environmental laws do not address CO_2 emissions at all. The same peculiar logic that supports a $1,700 adder for SO_2, then, supports a zero adder for CO_2. Yet Massachusetts and other states have adopted large CO_2 adders, basing them on the cost of mitigation measures that society has not yet been willing to pay for.[244] And they have retained large SO_2 adders even though we now have available a much better (and lower) estimate of willingness to pay to reduce SO_2 emissions -- the market price of SO_2 permits.[245]

A third defense of cost-based adders admits that PUCs *should* use harm-based adders, but asserts that this is impractical because we lack good measures of harm.[246] This argument, though, is a non-sequitur. If we are unsure of the harm from pollution, we can either venture an informed guess or wait until better data is available. Picking a compliance cost-based value

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[244] See, e.g., Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 45 (Mass. DPU 1992) (CO_2 adder is based on "marginal cost of tree-planting"). The $24 per ton compliance cost value for CO_2 is also implausibly high. There are many ways to reduce carbon emissions at lower cost. See, e.g., Dale Jorgenson, Daniel Slesnick & Peter Wilcoxen, Carbon Taxes and Economic Welfare, Brookings Papers: Microeconomics 1992, at 393, 414-18 (estimating that U.S. carbon emissions can be reduced by 14% over the levels that would otherwise prevail in 2020 through a $17/ton carbon tax); William Nordhaus, The Cost of Slowing Climate Change: A Survey, 12 Energy J. 37, 63 (1991) (estimating that U.S. can reduce greenhouse gas emissions by 10% at a marginal cost of $5.30 per ton of carbon emissions). Some cheap strategies may not be available to electric utilities, but that only underscores the wastefulness of regulating one industry strictly while ignoring emissions of the same pollutant elsewhere.

[245] Similarly, the Massachusetts DPU reaffirmed an NO_x adder of $7,200 per ton only six months after Massachusetts and other Northeastern states reached agreement on NO_x controls at power plants that will cost up to about $1,000 per ton, and *deferred action on more costly controls*. See Wald (1992), supra note 235.

[246] The Massachusetts DPU uses all three arguments, but appears ultimately to rely on this argument. See Re Environmental Externality Values, 139 PUR 4th 164, slip op. at 39-45 (Mass. DPU 1992).

that will systematically overestimate harm is not a sensible response to uncertainty.

Adders based on marginal compliance cost have further perversities. Where pollution control costs already exceed the marginal harm from pollution, as is often the case under C&C regulation, a properly designed adder should be *reduced* to keep the power source's imputed cost in line with the actual social cost of pollution. Adders based on compliance cost do exactly the opposite: The more wasteful the C&C regulation, the larger the adder. Powerplants are already subject to C&C regulation that often costs far more per unit of emission reduction than controls on smaller, less visible sources. Adders based on powerplant compliance costs will thus induce powerplants to reduce emissions at a very high marginal cost, when much cheaper emission reduction is available elsewhere.

Moreover, compliance cost-based adders do not take into account geographic variations in pollution concentration, and thus in marginal harm. Nevada, for example, has adopted virtually the same environmental adders as Massachusetts, even though Nevada has minimal pollution problems.[247] The highest marginal cost paid anywhere in the United States to control pollution bears no meaningful relationship to the marginal harm from pollution in a sparsely populated state like Nevada. Moreover, clean air regions like Nevada are already over-paying for pollution control because C&C regulation is often imposed on a nationally uniform basis. This calls for reducing whatever harm-based adder would otherwise apply -- a step that the Nevada PUC has not taken.

We are not alone in our caustic assessment of cost-based adders. In a recent assessment, the FERC staff explained that compliance cost-based adders have "no underlying economic logic;

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[247] See Union of Concerned Scientists (1991), supra note 238, at 36 (Nevada and Massachusetts adders both based on Tellus Institute estimates of marginal compliance cost).

only by coincidence would control costs reflect the true social costs of increased pollution."[248]

2. *Harm-Based Adders: The Pace Study*

The correct approach to computing environmental adders begins with the best available estimates of the marginal harm from different pollutants. Unfortunately, there is simply no good data available, though this may be remedied by a major Department of Energy study that is due out in late 1993.[249] Lacking good data, environmental adder proponents have latched onto attractively packaged bad data, in the form of a 1990 Pace University study titled *Environmental Costs of Electricity*.[250] The Pace study reaches damage estimates for three pollutants -- SO_2, NO_x, and particulates -- and a compliance cost-based estimate for CO_2. Its values are shown in Table 4, along with, for comparison, the compliance cost values developed by the Tellus Institute and adopted by Massachusetts and Nevada.

Table 4
Pace and Tellus Externality Values
(per ton, adjusted to 1992 dollars)

Study	Basis of Study	CO_2	SO_2	NO_x	CH_4	Particulates	VOCs	N_2O
Tellus	cost	24	1,700	7,200	240	4,400	5,900	4,400
Pace	mixed	15	4,500	1,820	---	2,640	---	---

Unfortunately, the Pace study is an uncritical compendium of a limited sample of prior studies that report damage estimates. The estimates from prior studies are then adjusted to reflect generous values of $4,250,000 per life saved and $425,000 per illness prevented (in 1992

[248] Federal Energy Regulatory Comm'n, *Report on Section 808: Renewable Energy and Energy Conservation Incentives of the Clean Air Act Amendments of 1990*, at iii (Dec. 1992); see also Joskow (1992), supra note 197, at 60 (describing compliance cost-based adders as "completely worthless").

[249] See *DOE Externality Study Background Document* (1992), supra note 197.

[250] Pace Univ. Center for Environmental Legal Studies, *Environmental Costs of Electricity* (1990) [cited below as *Pace Study*].

dollars), and future benefits are discounted at whatever rate (if any) the original study used. The Pace researchers collect the prior estimates in a table, adopt one of the reported estimates for each possible harm associated with each pollutant (usually but not always the highest estimate), and then sum these adopted values to obtain a "starting point" value of overall harm from the pollutant. Such an uncritical compilation is likely to overestimate actual harm. One poor study can skew the overall results severely. We discuss below, as an example, the huge Pace damage estimate for SO_2.

The Pace "starting point" estimate of harm from SO_2 is $4,500 per ton (in 1992 dollars). The vast bulk of this ($3,800) reflects harm to human health.[251] For its human health estimate, the Pace authors rely on an earlier damage estimate by ECO Northwest (commissioned by the Bonneville Power Administration), which, in turn, relies on a single 1979 study by Mendelsohn & Orcutt.[252] In contrast, EPA's 1988 Regulatory Impact Analysis for a proposed new SO_2 ambient air quality standard, which was available to but ignored by the Pace researchers, discusses the Mendelsohn & Orcutt study plus six additional published studies (several of which find no significant correlation between SO_4 concentrations and mortality) and two unpublished expert estimates prepared for the National Science Foundation. EPA rejected the Mendelsohn & Orcutt study because of "criticisms regarding both the underlying air quality data and omission of important independent variables."[253]

EPA, for its part, found enough doubt about the validity of *any* of the studies that it declined to include a value for SO_4-related mortality in its benefit estimates (EPA did estimate

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[251] *Pace Study* (1990), supra note 249, at 209.

[252] Id. at 195.

[253] EPA, *SO_2 Regulatory Impact Analysis* (1988), supra note 204, app. B, at B-4.

SO_4-related *morbidity*). EPA explains:

> Attempts to quantify and evaluate changes in mortality risk associated with SO_2 control must rely on a weak data base for which the interpretation is inherently controversial. The major evidence suggesting an association between [SO_4] and mortality is derived from a series of large scale retrospective cross sectional epidemiological studies. Substantial disagreement exists within the scientific and analytical community regarding the proper interpretation of the pollutant-mortality associations reported in these studies.[254]

One finds none of these caveats in the Pace study.

Problems like these explain why the Department of Energy, which partially funded the Pace study, promptly commissioned a much more careful study of environmental externalities, scheduled to be released in late 1993, and why the researchers conducting the DOE study (we have spoken to several) uniformly criticize the Pace study.

Our point is not that SO_2 does not cause significant harm (though preliminary DOE harm estimates are a small fraction of the Pace value). Rather, the Pace study is simply too deeply flawed to be an appropriate source of harm estimates.

3. Toward Better Estimates of Harm

What would better estimates of pollution harm look like? There is no right answer, because scientific uncertainty is enormous, but more plausible values can be found in the testimony before the Massachusetts DPU of Professor Lester Lave of Carnegie-Mellon. Professor Lave is a central participant in the DOE study and the co-author of a study that found a strong correlation between SO_4 concentration and mortality, which EPA relied on for its *upper bound* estimate of harm.[255] Table 5 reports Professor Lave's "best" and "high" estimates, along with the Pace and Tellus values.

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[254] Id. at B-3.

[255] See Lester Lave, Testimony on Behalf of Western Mass. Elec. Co., Mass. Elec. Co. & Boston Edison Co. (Massachusetts DPU Proceeding No. DPU 91-131) (undated, approx. 1992).

Table 5
Lave Estimates Versus Pace & Tellus Estimates
(per ton, in 1992 dollars)

Study	Basis of Study	CO_2	SO_2	NO_x	CH_4	Particulates	VOCs	CO	N_2O
Tellus	cost	24	1,700	7,200	240	4,400	5,900		4,400
Pace	mixed	15	4,500	1,820	---	2,640	---		---
Lave-best	harm	2	60	70	---	100	600	0	---
Lave-best	harm	10	950	450	---	1500	1,800	0	---

The key reason why Lave's "best" estimates are so much smaller than the Pace values is that he attempts to measure harm *at the margin*, against the backdrop of the air quality levels already achieved by C&C regulation. His lower values reflect not the unimportance of pollution control, but the *success* of existing regulation in reducing residual harm to low levels. The harm values for NO_x and VOCs are dominated by their contribution to ozone, for which many urban areas do not meet EPA air quality standards.[256]

We can press this analysis one step further. Divide the U.S. crudely into clean air regions and dirty air regions. Next, eliminate SO_2 from consideration for an adder because of the federal marketable permits system. In ozone nonattainment regions, also eliminate NO_x and VOCs from consideration for adders because new sources are already subject to offset requirements. Fourth, heavily discount the CO_2 and CH_4 adders because of the international

[256] The Congressional Research Service reached a similar conclusion in 1989:

> [S]ubstantial benefits remain to be captured by further controlling ozone (0_3) and by controlling acidic aerosols, which are not now directly regulated. . . . For carbon monoxide (CO), particulate matter (PM_{10}), and nitrogen dioxide (NO_2), there are *no readily detectable health effects of current U.S. exposures*, except those associated with PM which are most likely due to the acid aerosol component.

Congressional Research Serv., *Health Benefits of Air Pollution Control* 13 (No. 89-161 ENR, Feb. 27, 1989) (emphasis added); see also Congressional Research Serv., *Potential Benefits of Enacting Clean Air Act Amendments* (No. 90-73 ENR, Feb. 5, 1990).

nature of global warming as discussed above.

One is left with a flimsy case for adders. In dirty air regions, the only pollutant of interest *for adder purposes* is particulates.[257] In clean air regions, NO_x and VOCs are also theoretically of interest, but marginal harm will be small. Once we reduce these adders to reflect fuel taxes, the appropriate adder will almost surely be zero.[258]

4. *The Expected Cost of Future Regulation*

We have thus far assumed that the justification for environmental adders is that they partly internalize pollution harm. An alternate defense posits that environmental regulation is likely to be even stricter in the future than today. PUCs, it is claimed, should force utilities to take these *future* compliance costs into account by adopting adders, insisting that power producers bear the risk of future environmental regulation, or both. This argument decouples adders from marginal harm; instead they are tied to the expected cost of future regulation.[259] Some PUCs have used this argument to justify adders or standard form power contracts that require producers to bear the cost of future environmental compliance.[260]

[257] A further complication makes the use of a particulate matter adder questionable for coal-burning power plants. The dominant particulate produced by burning coal is the SO_4 that results from SO_2 emissions. Most other particulates in stack gases are already captured under existing C&C rules. In computing a particulate matter adder for coal plants, one must first back out SO_4 because of the marketable permits plan for SO_2; the remaining emissions may be too small to be significant. A particulate adder is more likely to be significant for wood, which produces far more non-SO_2 particulate emissions than any other source, see Viscusi (1992), supra note 210, at 16, and is not subject to significant fuel taxes.

[258] Technically, harm estimates should be based on the full fuel life-cycle, not just powerplant emissions, and should incorporate all environmental effects, not just air pollution. See *DOE Externality Study Background Document*, supra note 197; Menell (1993), supra note 115; Trisko (1993), supra note 190. This complication is beyond the scope of this article.

[259] See Ralph Cavanagh, Askok Gupta, Dan Sashof & Marika Tatsutami, Utilities and CO_2 Emissions: Who Bears the Risks of Future Regulation, Elec. J., Mar. 1993, at 64; Chernick & Caverhill (1991), supra note 186, at 51-52; Joskow (1992), supra note 197, at 66.

[260] See, e.g., Re Pacificorp, 135 PUR 4th 306 (Utah SC 1992); Re Advance Plans for Construction of Facilities, 136 PUR 4th 153 (Wis. PSC 1992). The California PUC has adopted both a CO_2 adder and a requirement that power supply contracts impose the risk of future CO_2 regulation on power suppliers. See Re Biennial Resource Plan Update, 132 PUR 4th 206, 223-24 (Cal. PUC 1992). Other PUCs are considering similar steps. See Cavanagh,

We think this argument for risk-shifting contracts or environmental adders is weak. Consider, for example, the risk of a future greenhouse gas tax. Without regulation, this risk will be shared by producers and consumers. In a competitive market, fuel suppliers and power producers will take a possible future tax into account because it affects the future demand for their product, *even if* they can pass through the tax to the buyers of their product (many contracts don't provide such rights, or have durations shorter than the expected useful life of a power plant). Consumers will also take the risk of future price increases into account in making long-term investments that affect future consumption.

We see no reason why regulators should impose *all* of this risk on producers. Consumers can pay the greenhouse tax either *ex post* through higher rates if the tax is adopted, or *ex ante* through the higher rates needed to compensate power producers for bearing more risk. The key question is whether consumers should, in effect, buy insurance from power producers against a future greenhouse tax. We think not. The theory of insurance involves an undiversified buyer and a diversified insurer. The insurer's greater diversification permits risk-shifting at a price that produces gain to both sides. Here, consumers are reasonably diversified; power producers are not. Thus, the market price of such insurance will exceed its value to consumers. A CO_2 adder, in this context, is a shadow price for insurance against a CO_2 tax. But if consumers shouldn't buy this insurance directly, neither should they do so indirectly through a shadow price.

We also have no confidence in the ability of utilities or PUCs to price such political insurance properly. The analytical tools of finance are of no help: They cannot predict what governments will do. And it was not so long ago that gas pipelines, with regulatory

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Gupta, Lashof & Tatsutani (1993), supra note 258.

encouragement, bought insurance against natural gas price increases, in the form of take or pay contracts that turned out, in hindsight, to be wonderful deals for the sellers and hugely expensive for the buyers.[261]

H. The Problem of Institutional Competence

The defects in the Tellus and Pace studies are not subtle. Anyone with basic microeconomics training will quickly realize that pollution harm, not cost of compliance, should be the starting point for adder calculation. Anyone with a basic understanding of the Clean Air Act knows that the marginal cost of compliance with EPA's air quality standards is unrelated to the marginal harm from pollution. Anyone trained in environmental science will quickly see the flaws in the Pace study.

That leaves a puzzle. If these defects are so obvious, why have the Tellus and Pace studies been so widely relied on by state PUCs? Why have PUCs compounded the error of using very high base adders by failing to reduce these adders to reflect other sources of regulation and the various substitution effects noted above? Why, in short, have PUCs reached manifestly erroneous results that will cost ratepayers billions of dollars for marginal environmental gains? There are two plausible reasons: limited institutional competence, considered in this section;[262] and the influence of local politics, considered in section I.

Estimating marginal harm attributable to emissions of various pollutants is an extraordinarily difficult task. It requires application of many types of expertise and analysis of

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[261] See Pierce (1988), supra note 36, at 11-15. We do not suggest that power supply contracts should leave the risk of future environmental compliance entirely on utilities. Rather, we are unsure of the sensible allocation of risk, believe that some risks are probably better borne by consumers, and are skeptical about PUC ability to sort out which risks should be borne by whom. We therefore prefer to let these risks be allocated by contract rather than regulatory fiat.

[262] Paul Joskow also relies on the limited competence of PUCs in environmental matters to argue that they should not adopt environmental adders. Joskow (1992), supra note 197.

voluminous data. Often, different researchers reach different conclusions from the same data. Regulators must then decide what to make of conflicting and highly technical scientific studies. That task is daunting even for a well-funded federal agency like EPA or DOE. The 10-year, $500 million NAPAP study of acid rain suggests the magnitude of the task. Similarly, the multi-year, ongoing study of environmental externalities commissioned jointly by DOE and the EC relies on a large international, interdisciplinary team of outside consultants.[263]

These efforts are well beyond the capacity of state PUCs. PUCs in most small states have tiny staffs.[264] Even the PUCs with the largest staffs and budgets have expertise only in the discipline central to their traditional mission -- regulating the rates charged by local electric, gas, and telephone utilities. That by itself is a difficult task, at which even the best-staffed PUCs have achieved only mixed success. A regulatory environment where electric utilities are unwilling to invest in new capacity even when needed, for fear of regulatory disallowance of costs, is scarcely a sign of regulatory success. Moreover, PUCs have performed miserably when they have attempted to estimate costs. It was state PUCs, after all, that grossly underestimated the cost of nuclear power plants and overestimated future demand for electricity in the 1970s. The largest states, with the best staffed PUCs, New York and California, inflicted on their citizens billion of dollars in unnecessary costs by overestimating avoided cost under PURPA.[265]

There is every reason to believe that the PUC record on estimating environmental externalities will be even worse. No PUC has significant expertise in environmental economics.

[263] See *DOE Externality Study Background Document* (1992), supra note 197.

[264] The Louisiana PUC illustrates this phenomenon. It has five part-time commissioners and a full-time professional staff of one. It employs no economists and no one with expertise in environmental science.

[265] See supra Part II.

Even EPA, which has such expertise, has made any number of huge mistakes in this terribly complex area. This is not to say that the right externality value is always zero. An estimate constructed with the best care a specialized agency like EPA or DOE can muster is better than no estimate, at least if conducted without the strong upward bias that is built into EPA's risk estimates in other contexts.[266] But ignorant or biased estimates by state PUCs can easily be, and to date have been, far worse than no estimate at all.

I. The Perverse Influence of Local Politics

A recurring theme in this Article is that PUCs make decisions based as much on political considerations as on economic logic. This is especially true for PUC efforts to consider NAPs or environmental adders. As one utility lawyer told us (off the record), PUCs are under "intense political pressure" to adopt NAPs and environmental adders. The symbolism, after all, is wonderful. Who can be against conservation, or for pollution?

Utilities, who understand the costly reality behind the symbols, might provide a countervailing force. But many have been co-opted by the promise of large NAP profits. Others are run by CEOs who were chosen for their political savvy and won't oppose the political trends of the day. Some utility executives appear to believe the rhetoric of massive market failure (of course, it's always easier to convince yourself something is true when you stand to profit thereby). Still others have been cowed into submission by past cost disallowances, and the everpresent threat of future disallowances.

The results may become a classic in the annals of low-visibility, special interest politics. The real reason why the marginal compliance cost method is used, as near as we can tell, is that

[266] See Albert Nichols & Richard Zeckhauser, The Perils of Prudence: How Conservative Risk Assessments Distort Regulation, Regulation, Nov./Dec/ 1986, at 13.

it produces ridiculously high adders. This pleases the principal groups supporting high adders: environmentalists, who want to reduce pollution regardless of cost and also understand that high adders help to justify large NAPs; utilities who want to justify large NAPs; and (sometimes) natural gas suppliers, who want to give their fuel an advantage over coal.[267]

The use of large SO_2 adders illustrates PUC politics at work. While it would be theoretically possible for states to assess whether SO_2 emissions in their own state are more or less harmful than an expected average of other states, and set a positive or negative adder appropriately, there is every reason to think that this will not happen. Instead, states with lots of coal will set low adders because of the power of the coal industry and coal miners, while states with little coal will tend to use high adders because coal proponents are comparatively weak. Given where coal reserves are found and how SO_2 emissions are gradually transformed into acid rain downwind, this will systematically produce perverse results in the eastern United States. We'll get low adders or coal subsidies where they should be high, and high adders where they should be negative.

As we have seen, state adders may have a limited role to play, but they are in all cases a less-preferred alternative to a state emissions fee, or a state marketable permits system. Why then do we see adders and not fees? One reason is that the cost of an adder isn't so obvious, partly because it's hidden in the resource acquisition process, and partly because the costs are only partially passed on to consumers. But, precisely because costs are hidden and not fully passed on, we lose the political discipline that might limit the extreme adders that some states have adopted.

267 Re Environmental Externality Values, 139 PUR 4th 164 (Mass. DPU 1992) (describing the views of the various regulatory participants). The incentives of natural gas suppliers are mixed: they want both to gain an advantage over coal and to limit their adder-based disadvantage compared to NAPs, which are invariably assumed to be environmentally benign.

VII. Conclusion

These are exciting times in the electricity industry. Electric power generation is no longer a natural monopoly. Thus, we no longer need to choose between overpriced power supplied by an unregulated monopolist, and the distorted incentives introduced by rate regulation. We no longer need to accept the huge *X*-inefficiency of the monopolist, exacerbated by rate-of-return regulation. Competitive markets for wholesale power won't work perfectly (what market does?), but they are vastly superior to regulated monopoly, and are already bringing large cost savings.

Competition for *retail* electric service may never be complete, but it can penetrate much of the industrial and commercial markets, and some of the residential market as well, as towns (or even large apartment complexes) seek out power from the lowest bidder. Retail competition promises to eliminate the price distortions introduced by the current web of cross-subsidies, and to force efficiency improvements in electricity distribution. At the same time, market-based environmental regulation, exemplified by the SO_2 permits system, can force utilities to internalize pollution costs and greatly enhance the cost-effectiveness of pollution control.

But there are storm clouds on the horizon. As competitive wholesale power markets and market-based environmental regulation are introducing new efficiencies, large NAP subsidies and enormous environmental adders are introducing new distortions and cross-subsidies. These two approaches, one premised on competitive markets and the other premised on central planning to correct market failure, cannot long coexist. Competitive markets drive out cross-subsidies. NAPs, on the scale endorsed by many PUCs and all environmental groups, require large cross-subsidies.

The inherent conflict between competition and cross-subsidies will force NAP proponents to oppose the consumer freedom to choose that is at the heart of market competition. PUCs that follow the path of adders and NAPs will be forced to replace choice with central planning. PUCs will decide which power source is "cheapest" (including imputed environmental adders), and what rates utilities can charge to captive customers to recover the costs of NAPs. Utilities, under PUC oversight, will decide what energy-efficiency investments their customers will make. Regulators will have to forbid the losers from NAP programs from exiting the utility system. In the process, they will heavily distort the market for wholesale power and destroy the prospects for retail competition.

Radical reform of the electricity industry is badly needed. The nuclear power fiasco of the 1970s, the avoided cost mistakes of the 1980s, and the poorly conceived NAPs and environmental adders of the 1990s illustrate the problems of the status quo. But the needed reform is less regulation, not more.

NAPs have their place, but it is a small place. For example, carefully conceived programs, targeted at low-income consumers, could modestly improve efficiency in electric power consumption. The level of cross-subsidy is probably sustainable within a partly competitive retail power market, and the distributional consequences are good. We have, though, no hope that NAPs will be so limited. The cost savings are too small to interest utilities and the conservation gains are too small to satisfy environmentalists. Moreover, the subsidy flows away from, not to, the affluent members of the consumer and environmental groups whose political support is essential for any NAP. The more realistic prospect is for NAPs to continue to be what they mostly are today -- a combination of a subsidy *to* middle-class voters and *away from* poorer consumers, and an ill-conceived effort to tell sophisticated industrial and commercial consumers what equipment to buy.

Utilities and PUCs should experiment with negawatts, and learn what they really cost, before they waste $100 billion, as they did on nuclear powerplants. Our bias is to trust markets, and to suspect that negawatts will cost far more than the current projections. The early evidence is on our side. But more importantly, only time and an extensive data gathering effort will tell what the cost really is. Let's begin with small scale pilot programs. Later programs can build on the pilots that deliver what they promise.

As for state environmental adders, let's scrap them. There is a theoretical argument that adders, in some circumstances, are better than nothing. But the combination of existing command and control environmental regulation, SO_2 permits, offset rules in dirty air regions of the country, and federal and state fuel taxes largely, perhaps fully internalize the social harm from local and regional pollution. And states can't do anything useful about international pollution problems. Moreover, the witches' brew of local politics, limited PUC competence, and complex interactions between adders and other forms of environmental regulation gives us little confidence that environmental adders will be used sensibly. Their use to date has been a mockery of sensible regulation. If future studies of pollution harm show that the current level of internalization is incomplete, let's turn instead to the better approach of emissions fees or marketable permits.

We close with a warning to utilities. Having learned the political risks of building new powerplants, many utilities have embraced negawatt programs as a new, less risky way to earn an attractive return on capital. Beware. Nuclear plants, too, once seemed an attractive way to earn a good return on capital. But that was before cost overruns turned the promise of 2¢/kwh power into the reality of 12¢/kwh power. If a multibillion dollar negawatt program that was projected to deliver 2¢/kwh negawatts turns out to deliver them at 8¢/kwh instead and consumers see their utility bills soar to pay for overpriced negawatts; then industrial and commercial users will revolt, the bizarre consumer group/environmentalist coalition will break, and state PUCs will embark on a new wave of cost disallowances, directed this time at negawatt programs. The precedents for disallowance are already in place. That prospect should give pause to the utility executives who are now jumping on the negawatt bandwagon.

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