LEAST-COST PLANNING IMPERATIVES FOR ELECTRIC UTILITIES AND THEIR REGULATORS

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INTRODUCTION

The first public utility commission appeared in 1907, and eight decades later no serious student of American federalism needs

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reminding that regulating the electricity business is traditionally a state concern.[1] Fifty commissions regularly scrutinize the ledgers of their indigenous investor-owned utilities, and apply generally similar legal and accounting principles in deciding how to price a product prized above all others on the energy markets. Fifty individual systems of reward and punishment seek to shield consumers from abuses of monopoly power, and to supervise the managers of the nation's most capital-intensive and environmentally significant industry.

This eighty-year-old regulatory regime is breaking down. The entire system is succumbing to a gross misalignment of boundaries and functions, even as the theoretical basis for its very existence falls increasingly into disrepute. Many observers see no reason to attempt repairs, and look to a deregulated market in electricity generation for everything from lower rates to improved environmental quality. What follows is an argument for reconstituting the states' regulatory mission, rather than either abandoning it or letting it continue to erode. There remains a vital role for the states in charting our collective energy future, and forestalling economic and environmental mistakes that we cannot afford to go on repeating.

This article sets out a planning framework that proceeds from what should be state regulators' (and utilities') primary goal: to sustain reliable electricity service for a growing economy at the lowest possible cost. Regulators need better tools for removing barriers to cost- and risk-minimizing energy planning. Uncertainties abound regarding the composition and magnitude of future energy consumption, and traditional methods for adding new supplies share the combined disadvantages of long construction lead-times, unwieldy scale, and high cost. The planning process has been analogized to walking along a narrow ridge in a fog: "[w]e can ill afford missteps, but we cannot see as far as we stride."[2] To

1. *See* ENERGY INFORMATION ADMIN., U.S. DEP'T OF ENERGY, ANNUAL OUTLOOK FOR U.S. ELECTRIC POWER 1985, at 3 (1985) (DOE/EIA-0474(85)) [hereinafter cited as U.S. ELECTRIC POWER]; Pacific Gas & Elec. Co. v. State Energy Resources Conservation & Dev. Comm'n, 461 U.S. 190, 206 (1983) ("economic aspects of electrical generation have been regulated for many years and in great detail by the states"); FERC v. Mississippi, 456 U.S. 742, 781 (1982) (O'Connor, J., concurring in part and dissenting in part) ("Utility regulation is a traditional function of state government, and the regulatory commission is the most integral part of that function."). Public utility commissions can be found today in the District of Columbia and every state but Nebraska.

2. *See* Lee, *The Path Along the Ridge: Regional Planning in the Face of Uncertainty*, 58 WASH. L. REV. 317, 319 (1983).

this difficult balancing exercise have recently been added at least two new dimensions: the prospect of seemingly lucrative export markets for long-term power surpluses and the possibility that technological progress will supplant the large-scale power plants that dominate the modern utility sector.

These factors call for strategies that reduce uncertainty about future system requirements and allow for flexible responses to changing conditions. Assurances are also needed that all potential candidates for utilities' scarce investment capital have been identified, and that those candidates have been rigorously compared under methodologies that can accommodate widely differing life-cycle costs and benefits. Energy supply can be expanded either by producing more or wasting less, and the goal of planners should be to direct utility investment toward whatever methods for producing more *or* wasting less best reduce costs, uncertainty, and risk.

Part I reviews why the future course of the utility industry matters so much to the United States economy and environment.[3] Parts II and III assess the increasing difficulties state regulators are having in influencing that course and the increasing willingness in some quarters to let deregulation remove those difficulties in the most drastic possible way.[4] Parts IV and V outline in detail the new state regulatory role suggested above.[5]

I. The Stakes

At least one conclusion commands agreement from both the utility industry and its critics: the stakes involved in charting the industry's future course are exceptional. Electricity is now responsible for more than one-third of total U.S. energy consumption, a fraction that has almost doubled since 1960.[6] Over the first eleven years following sharp oil price increases in 1973, the United States held its overall energy consumption steady and cut petroleum use by almost 11%, even as electricity production increased

3. *See infra* text accompanying notes 6–20.
4. *See infra* text accompanying notes 21–51.
5. *See infra* text accompanying notes 52–135.
6. *See* Energy Information Admin., U.S. Dep't of Energy, Annual Energy Review 1984, at 11 (1985) (DOE/EIA-0384(84)) (the percentages for 1960 and 1984 are 18.7% and 35.3%, respectively) [hereinafter cited as Annual Energy Review].

by almost 30%.[7] In the three most recent years for which U.S. Department of Energy data are available, 1982–1984, electricity accounted for almost half the energy dedicated to all requirements of our residential, commercial, and industrial sectors.[8]

Equally impressive indices of economic and environmental significance include the following:

> —Electric utilities are easily the most capital-intensive U.S. industry, and have accounted in recent years for as much as one-tenth of gross private domestic investment;[9]
>
> —Between 1974 and 1984, utilities spent more than $500 billion (1985 dollars) to build new power plants and transmission systems;[10]
>
> —In few if any other industries is it possible for managers to make costlier planning errors; between 1972 and 1984, for example, more than $20 billion in construction payments flowed into 115 nuclear power plants that subsequently were abandoned by their sponsors;[11]

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7. The figures in the text are computed from data reported in Energy Information Admin., U.S. Dep't of Energy, MONTHLY ENERGY REV., Nov. 1985, at 3, 7, 76 (DOE/EIA-0035(85/10)).

8. *See id.* at 23–25.

9. *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, NEW ELECTRIC POWER TECHNOLOGIES: PROBLEMS AND PROSPECTS FOR THE 1990S, at 46, 49 (1985) (OTA-E-246) (hereinafter cited as NEW ELECTRIC TECHNOLOGIES); OFFICE OF POLICY PLANNING & ANALYSIS, U.S. DEP'T OF ENERGY, THE FUTURE OF ELECTRIC POWER IN AMERICA: ECONOMIC SUPPLY FOR ECONOMIC GROWTH 6-24 to 6-25 (1983) (DOE/PE-0045) [hereinafter cited as POWER IN AMERICA].

10. *See 36th Annual Electric Utility Industry Forecast*, ELECTRICAL WORLD, Sept. 1985, at 58.

11. Between 1972 and 1982, 100 U.S. nuclear power plant cancellations produced a total bill of about $10 billion. U.S. DEP'T OF ENERGY, ENERGY INFORMATION ADMIN., NUCLEAR PLANT CANCELLATIONS: CAUSES, COSTS AND CONSEQUENCES, at x (1983) (DOE/EIA-0392). Fifteen more cancellations in 1983 and 1984 added more than $11 billion to that figure; the worst casualties were Michigan's Midland units ($3.6 billion), Ohio's Zimmer plant ($1.7 billion), Indiana's Marble Hill Units 1 and 2 ($2.5 billion), and four Tennessee Valley Authority plants upon which some $2.7 billion was spent prior to official abandonment in August 1984. *See* TENN. VALLEY AUTH., 1984 ANNUAL REVIEW OF THE STATUS OF HARTSVILLE A AND YELLOW CREEK NUCLEAR PLANTS ii (1984); *CG&E Officials Say Larger Share of Zimmer is Salvageable than Reported*, NUCLEONICS WEEK, June 28, 1984, at 7; *Indiana Utility Scraps $7.7 Billion Marble Hill Because It Costs Too Much*, NUCLEONICS WEEK, Jan. 19, 1984, at 1; *Utility Orders Shutdown of Midland Plant*, Los Angeles Times, July 17, 1984, § 4, at 2, col. 3. The Midland units have not yet been formally cancelled, but the sponsors' suspension of all construction activities in 1984 was viewed by most observers as tantamount to abandonment. The other plants cancelled between 1983 and 1985 are listed in *Atomic Alerts*, GROUNDSWELL, Jan. 1984, at 9; and *State of the Industry 1984*, GROUNDSWELL, May 1985, at 10. The final tally of moribund projects probably will exceed the figure of 115 cited in the text; likely additions include Washington

—Between 1982 and 1984, more than five-sixths of all U.S. coal consumption occurred in the boilers of power plants;[12]

—National and international "acid rain" control strategies inevitably target utilities first; "two-thirds of the sulfur dioxide in the skies over the United States comes from coal and oil-fired power plants."[13]

Whether the issue is air quality, disposal of radioactive waste, preservation of free-flowing rivers, nuclear proliferation, or the danger of catastrophic climate change, utilities are a crucial point of leverage.[14] Such considerations, coupled with the straightforward financial consequences of choices within this sector, help illumine the challenges its regulators have been facing. And the future looks if anything more daunting, as various constituencies battle over the need for more than a trillion dollars in power system investment through the end of the century, and some students of the utility industry warn that its product will soon be in critically short supply.[15] A review of recent national media headlines yields

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Public Power Supply System Units 1 and 3, which had absorbed almost four billion dollars by the end of 1985. 1 NORTHWEST POWER PLANNING COUNCIL, NORTHWEST CONSERVATION AND ELECTRIC POWER PLAN 7-25, 7-37, 7-38 (1986).

12. ANNUAL ENERGY REVIEW, *supra* note 6, at 153.

13. Boyle & Boyle, *Acid Rain*, AMICUS J., Winter 1983, at 22, 26.

14. For a useful overview, see W. RAMSEY, UNPAID COSTS OF ELECTRICAL ENERGY: HEALTH AND ENVIRONMENTAL IMPACTS FROM COAL AND NUCLEAR POWER (1979). For more narrowly focused analyses, see B. ACKERMAN & W. HASSLER, CLEAN COAL/DIRTY AIR (1981) (chronicling a decade of struggles to regulate the emissions of coal-fired power plants); A LOVINS, H. LOVINS, F. KRAUSE & W. BACH, LEAST-COST ENERGY: SOLVING THE CO_2 PROBLEM (1981) (energy policy and global climate changes); Remarks of V. Gilinsky, Commissioner, U.S. Nuclear Regulatory Commission, Before the League of Women Voters Education Fund (Nov. 17, 1980), *reprinted in Nuclear Reactors and Nuclear Bombs*, U.S. NUCLEAR REGULATORY COMM'N NEWS RELEASES, Dec. 1980, at 4–6 (characterizing "the connection between civilian nuclear activities and the spread of nuclear weapons" as "a close one, an inconvenient reality that frequently intrudes on those who would deny it"); NAT'L WILDLIFE FED'N, SMALL-SCALE HYDROPOWER AND THE ENVIRONMENT: HOW MUCH HARM? 20 (1983) (arguing that "[t]he ecological damage per unit of energy produced is probably greater for hydroelectricity than for any other energy source").

15. *See* POWER IN AMERICA, *supra* note 9, at 6-16 (U.S. Department of Energy study concludes that the "cumulative investment required of the electric utility industry through 2000" is likely to total at least $1 trillion in 1982 dollars). A Vice President of the Edison Electric Institute, the leading utility trade association, recently opined that the nation would be the equivalent of at least 36 nuclear plants short of capacity by 1993, an estimate he characterized as "on the low side." *See* NUCLEONICS WEEK, June 13, 1985, at 11 (remarks of Thomas Kuhn). The Chairman of the Nuclear Regulatory Commission suggested in January 1986 that "at least one new large power plant, either coal or nuclear, will be needed in our country each month for the next fifteen years." Remarks of L. Zech, Commissioner, U.S. Nuclear Regulatory Commission, at the Edison Electric Institute Governmental Affairs Conference (Jan. 16, 1986), *reprinted in* U.S. NUCLEAR REGULATORY COMM'N NEWS RELEASES 2, 2 (Jan. 28, 1986).

the likes of "WARDING OFF AN ELECTRICITY SHORTAGE",[16] "NUCLEAR ELECTRICITY: THE GROWTH OF AMERICAN INDUSTRY HANGS IN THE BALANCE",[17] and "UTILITIES SAY THIS SUMMER'S BROWNOUTS WILL ESCALATE TO SEVERE SHORTAGES IN 1990s."[18]

Over the same 1985–1986 period, spokesmen for electricity-intensive industries were arguing vigorously against additional power plant construction, and large surpluses of costly generating capacity were reported across North America.[19] Concurrently, a major debate loomed over the possibility that the dominant generating technologies of the mid-1980's might soon be obsolete.[20]

II. The Ascendancy of Deregulation: PURPA and Power Transfers

State regulators can be forgiven for uneasiness when pondering their institutional future. The dilemmas reviewed above are

16. N.Y. Times, July 7, 1985, at F3, col. 1.

17. This headline appeared in magazine advertisements throughout the United States in May 1985, under the auspices of the utility-financed U.S. Committee on Energy Awareness.

18. Wall St. J., June 17, 1985, at 21, col. 4; *see also Utility Executives Reveal Shortages, Senate Listens*, ELECTRICAL WORLD, Sept. 1985, at 17 (summarizing testimony at Senate Energy Committee hearings held on July 23 and 25, 1985).

19. *See, e.g.*, Anderson, *ELCON: Utils. Exaggerating Need for New Generating Plants*, Energy User News, Sept. 9, 1985, at 18, col. 1 (executive director of Electricity Consumers Resource Council, whose members are industries that consume about 5% of all U.S. electricity, argues that under a regime of "stepped-up construction of power plants . . . many companies in basic industry won't be able to afford their power"); *36th Annual Electric Utility Industry Forecast*, *supra* note 10, at 56 (projecting national reserve margin of generating capacity equal to more than 37% of peak demand in 1986).

20. Some analysts contend that this obsolescence belongs in the category of historical, rather than possible, events. *See* R. SANT, D. BAKKE & R. NAILL, CREATING ABUNDANCE 134 (1984) ("centrally generated electricity *at current prices* is already uncompetitive in several energy service markets . . . [and] is in many cases losing to conservation technologies[,] . . . cogeneration and other decentralized sources of electric generation"); Lovins & Lovins, *Electric Utilities: Key to Capitalizing the Energy Transition*, 22 TECH. FORECASTING & SOC. CHANGE Oct. 1982, at 153, 158 ("debating which new power stations to build is like shopping for the best buy in brandy to burn in your car or for Chippendales to burn in your stove").

Several emerging technologies for generating electricity could further cloud the prospects for large-scale coal and nuclear plants. *See* NEW ELECTRIC TECHNOLOGIES, *supra* note 9, at 19–25 (concluding that "[a] number of developing technologies for electric power generation are beginning to show considerable promise as future electricity supply options," including small-scale atmospheric fluidized-bed combustion plants, wind turbines, fuel cells, and photovoltaics). *But see* Address by J. Herrington, Secretary of Energy, Before the *Oil Daily/International Herald Tribune* 6th Oil and Money Conference, London (October 25, 1985) (U.S. Secretary of Energy calling for increased reliance on conventional nuclear and coal-fired generating technologies).

compounded by a jurisdictional complication: the electrical grid does not respect state lines. More than half of U.S. generating capacity feeds into about a dozen tightly coordinated multi-state pools; elsewhere, power pooling and system interconnections are widespread although less dominant.[21] More than half of U.S. electricity is sold by companies that did not generate it.[22] A network of high voltage transmission lines spans the continental United States and Canada, and sustains transactions between utilities as much as 2,000 miles apart.[23]

As a result, decisions about developing and transferring power supplies have consequences that reverberate far beyond the confines of the state of origin. Given the way U.S. power pools are actually organized, state boundaries make about as much sense as the African national borders drawn by European colonial powers. We have entered an era in which transmission and resource planning are dominated by regional, not state, concerns. But we retain the regulatory apparatus of a less integrated and interdependent system.

This is a prescription for an atrophying state role in utility affairs, a prospect that many analysts applaud. Here, as in many other sectors, deregulation has become an ubiquitous theme in the academic and popular literature.[24] The argument typically unfolds more or less as follows: the classic rationales for sustaining regulated monopolies may apply to the transmission and distribution of electricity, but the generation side of the business is perfectly amenable to competitive arrangements; thus, we should allow en-

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21. *See* Nat'l Governors' Ass'n Comm. on Energy & Env't, An Analysis of Options for Structural Reform in Electric Utility Regulation 3–5 (Jan. 1983) (Report on the NGA Task Force on Electric Utility Regulation).

22. *See* D. CHAPMAN, ENERGY RESOURCES AND ENERGY CORPORATIONS 228 (1983).

23. For a general overview of these transactions, see ENERGY INFORMATION ADMIN., U.S. DEP'T OF ENERGY, INTERUTILITY BULK POWER TRANSACTIONS: DESCRIPTION, ECONOMICS, AND DATA (1983) (DOE/EIA-0418); *see also* Bonneville Power Admin., U.S. Dep't of Energy, Environmental Assessment: Proposed Memorandum of Understanding Between BPA and Western Area Power Administration (Oct. 1983) (describing a 2000-mile transfer, linking a North Dakota coal-fired plant with loads in central California).

24. *See, e.g.*, DECENTRALIZING ELECTRICITY PRODUCTION 183–97 (H. Brown ed. 1983); W. JONES, CASES AND MATERIALS ON REGULATED INDUSTRIES 52 (2d ed. 1976); P. JOSKOW & R. SCHMALENSEE, MARKETS FOR POWER 93–221 (1983); R. MUNSON, THE POWER MAKERS (1985); Sawhill & Silverman, *Your Local Utility Will Never Be The Same*, Wall St. J., Jan. 2, 1986, at 12, col. 3; Habicht, *Competition Can Power Utilities Into the Black*, Wall St. J., Oct. 14, 1985, at 5, col. 1. For a skeptical assessment of such proposals, see Bryson & Brownell, *Deregulation and the Efficiency of the Electric Power Industry*, in ELECTRIC POWER STRATEGIC ISSUES 207–35 (1983).

trepreneurs to bid for the opportunity to provide power to individual distribution systems over common-carrier transmission lines, in an environment free of both guaranteed returns and regulated prices.[25]

On this view, state authorities could relinquish most decisions of importance to our collective electrical energy future.[26] A competitive market would determine what kinds of power plants get built, and how many. The arteries of commerce—the nation's high voltage transmission systems—would become conduits open to all. Local distribution monopolies would deliver power to the ultimate consumer, after shopping around for the best generation deal and arranging for delivery at a convenient point on the high voltage grid.

This idealized description bears little resemblance to business as now conducted, with vertically-integrated utilities still building most generating capacity and zealously guarding ownership rights in transmission systems. But several major trends appear, at least superficially, to favor the deregulators. A crucial step was the enactment in 1978 of the Public Utility Regulatory Policies Act ("PURPA").[27] In PURPA, Congress undertook to assure private investors in certain generating technologies a right to sell electricity to their local utilities, at whatever price those utilities would have had to pay to generate an equivalent amount of electricity themselves.[28]

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25. For additional details of the paradigm, see Bryson & Brownell, *supra* note 24, at 223:

> Under most deregulation proposals, retail regulation would be terminated in the case of larger users that can participate directly in wholesale markets. Such users can be expected to seek to minimize their purchased power costs. Most proposals envision that smaller end-use customers, on the other hand, will be represented in the wholesale market by a distribution company with (regulated) monopoly control over retailing. A key task for retail regulators will be to ensure that the small retail customers' "agent," the distribution company, acts in their interest by striving for the best possible purchased power contracts in the wholesale market.

26. However, as explained in section V, *see infra* text accompanying notes 134–35, even the extreme deregulation models are not inconsistent in principle with a major state role in power planning.

27. Public Utility Regulatory Policies Act of 1978, Pub. L. No. 95-617, 92 Stat. 3117 (1978) (codified as amended in scattered sections of 15, 16, 30, 42, and 43 U.S.C.).

28. *See* 16 U.S.C. § 824a-3 (1982). The statute permits, but does not require, the Federal Energy Regulatory Commission ("FERC") to enforce a rate guarantee at this "avoided cost" level. FERC accepted that invitation, *see* 18 C.F.R. § 292.304(b)(2)–(b)(4)

In some parts of the United States, the results have been remarkable. As of April 1985, California utilities had received or were anticipating power sales offers from sponsors of some 1500 independently-financed generating units with a cumulative capacity equivalent to 22,000 Megawatts ("MW")—this in a state whose *total* peak demand in 1982 was about 35,000 Megawatts, and whose anticipated needs for additional Megawatts from all sources *through the year 1996* total less than what these entrepreneurs are already claiming the ability to develop.[29] Texas and Maine are among the other jurisdictions where the utility monopoly on generation is under extensive challenge.[30]

On the transmission side, meanwhile, the Federal Energy Regulatory Commission ("FERC") has signalled strong interest in promoting freer and more varied inter-utility transactions.[31] While it is doubtful that FERC currently has authority to force anything approaching common-carrier status on transmission systems, some observers see that status as an inevitable outgrowth of current trends.[32] "[T]he total volume of bulk power transfers increased by

(1980), and.the U.S. Supreme Court rejected subsequent protests from the utility industry. American Paper Inst. v. American Elec. Power Serv. Corp., 461 U.S. 402 (1983).

Of course, PURPA's scope extends well beyond decentralized development of generating resources. *See* FERC v. Mississippi, 456 U.S. 742, 746–51 (1982) (discussing Titles I and III of PURPA, which address, among other things, the structure of retail rates for electricity consumers, the delivery of electricity services, and reporting requirements for utilities and their regulators).

29. *See* CAL. ENERGY COMM'N, THE 1985 CALIFORNIA ELECTRICITY REPORT 12, 34 (projecting total statewide needs for new capacity through 1996 at 21,425 Megawatts, taking into account load growth, reserve margin, retirements, and contract expirations); Cal. Pub. Util. Comm'n, Summary of Cogeneration and Small Power Production Projects in Service Areas of PG&E, SCE and SDG&E (As of Apr. 17, 1985) (undated: received Aug. 15, 1985; available upon request from author) (projects are subcategorized as follows: "projects on line"—1829 megawatts (MW); "project commitments"—12,056 MW; "projects under discussion"—8498 MW). Note, however, that only a small fraction of the PURPA projects—the "on line" category—had actually been completed as of the survey date.

30. *See Cogeneration: Can Utilities Make It Pay?*, ELECTRICAL WORLD, Dec. 1985, at 23 (of nearly 12,000 MW of cogeneration installed nationwide through August 1984, 3600 MW were in Texas); Lovins, *The Electricity Industry*, 229 SCIENCE 914 (1985) ("small power commitments now cover . . . more than 22 percent of Maine's and 14 percent of New Hampshire's peak loads").

31. *See* 50 Fed. Reg. 23,445 (1985); *id.* at 27,604 (notices of inquiry announcing FERC's determination "to evaluate its policies toward wholesale electricity transactions and transmission service," in order "to investigate how its policies promote or impede efficiency in electricity markets").

32. *Compare* Federal Energy Regulatory Comm'n, *Regulation of Electricity Sales For Resale and Transmission Service,* 50 Fed. Reg. 23,445, 23,449 (1985) *with, e.g.,* Barber, *Elec. Contract Carriage Urged by Ill. Regulator,* Energy User News, Aug. 19, 1985, at 1, col. 3; Hume, *Users Prod FERC to Encourage Elec. Wheeling,* Energy User News, Aug. 19, 1985, at 9, col. 1. For a perceptive analysis of FERC's transmission prerogatives, see

a factor of 30 between 1945 and 1980 while total electricity production increased only by a factor of 10."[33] These transactions "promote the development of competitive electric generation markets that have more generators or 'sellers' than would a PURPA 'new capacity' market, more buyers than the monopsonistic PURPA market, and prices that are market determined rather than administratively determined proxies."[34]

III. Cautionary Notes For Deregulators

It is premature to rely on embryonic competitive forces to chart a satisfactory course for the utility industry. To begin with, the goals of increased power transfers and more independent power production are—at least in the near term—at odds with each other. The immediate winners in a struggle to provide the cheapest kilowatt-hours on interstate markets are almost certain to be regulated utilities, not independent power producers. For the time being, the North American continent is figuratively sinking beneath the weight of surplus large-scale generating units, completed in advance of the new competitive era, which were costly to build but are inexpensive to operate.[35] As long as the purchase price exceeds the relatively low running costs, utilities can justify dedicating these plants to export markets, even if the sale returns little to pay the construction bill.[36]

That is not a foundation upon which an independent producer can build a business; yet virtually every North American utility with immediate power needs can find a U.S. or Canadian supplier of such "fire-sale" kilowatts. Indeed, often there are enough to

Pollack, *A Proposal to Increase Access to Electric Transmission Services*, 20 Harv. J. on Legis. 227 (1983).

33. New Electric Technologies, *supra* note 9, at 65.

34. Bryson & Brownell, *supra* note 24, at 229.

35. *See supra* note 19 (citing projected reserve margins).

36. Such transactions produce "revenue from capacity that otherwise would have been unproductive." Direct Testimony and Exhibits of Walter E. Pollock on Behalf of the Bonneville Power Administration Before the Federal Energy Regulatory Commission, FERC Docket Nos. Ef81-2011-003, Ef82-2011-003, at 57–58 (Dec. 2, 1983) [hereinafter cited as Pollock Testimony]; *cf.* Bonneville Power Admin., U.S. Dep't of Energy, Using the Only Northwest to Southwest Powerlines: The Intertie 4 (Feb. 1984) (in 1983, average rates for Northwest utilities' sales of power to Southwest utilities were only one to two cents/kwh). Of course, sales at or near the operating costs of baseload plants provide little or no compensation for environmental damage and reduced plant operating lifetimes.

start a bidding war.[37] The criss-crossing flows of deceptively cheap surplus power are driving down the PURPA rates that independent producers can demand.[38] The immediate result should be to strengthen utilities' ability to resist further encroachments on their monopoly.[39]

Even if we could disregard these tensions between the two major contemporary thrusts toward a competitive electricity marketplace—PURPA and increased power transfers—we would still have ample cause to question their long-term implications. In the first place, neither has done much to elicit development of what most concede to be the cheapest and least environmentally destructive source of new electricity supply. For reasons developed more fully below,[40] the source of that untapped resource is improvements in the efficiency of energy use, or "conservation." PURPA speaks exclusively to the generation of electricity; its provisions can be searched in vain for any incentive to conserve the product. Similarly, power transfers have been analyzed almost exclusively in terms of generators; to most utilities, the notion of *conservation* transfers over the grid remains outlandish. Such attitudes reflect widespread but irrational preferences for generation

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37. Cavanagh, *Recycling Our Electric Utilities*, 19 STAN. LAW., Fall 1984, at 22, 55:

> Today, for example, utilities from the following states and territories are courting California with power plants up to 2000 miles away, which all supposedly were built to serve pressing local needs in the host jurisdiction: Utah, Nevada, New Mexico, Arizona, Washington, Colorado, Wyoming, Montana, Oregon, Idaho, North Dakota, British Columbia, and Alberta.

For an account of subsequent efforts by the Northwest sellers to oust their Canadian competitors from the transmission system, see Dep't of Water & Power of the City of Los Angeles v. Bonneville Power Admin., 759 F.2d 684 (9th Cir. 1985).

38. *See* Alpert, *Running Out of Steam: Cogeneration, Once Red-Hot, Has Cooled Considerably*, BARRON'S, Dec. 9, 1985, at 40.

39. PURPA producers can respond by improving the quality of their product through, *e.g.*, long-term supply guarantees to purchasers. But regulated utilities are demonstrating a willingness to offer bulk power purchasers the same kind of long-term guarantees, at prices well below the cost of new large-scale generators. The Bonneville Power Administration, for example, has offered to make power available for export sales of up to 20 years' duration, starting at a base rate of 3.4 cents per kilowatt-hour. Bonneville Power Admin., U.S. Dep't of Energy, Firm Displacement Update (Feb. 12, 1986); *see also WAPA Negotiating Purchase of 1200 MW of Firm Hydropower from Canadian Province of Manitoba Over 35 Year Term*, WESTERN STATES ENERGY PIPELINE, June 22, 1984, at 1 (Issue No. 84-19) (available from the Western Interstate Energy Board, Denver, CO) (describing Manitoba letter of intent to deliver "roughly 1200 megawatts of capacity over a 35 year period, commencing in 1993" at a price reflecting "a percentage of [the buyer's] alternate cost of services for generation").

40. *See* (Section IV(A)) *infra* text accompanying notes 52–55.

over conservation when additional power supply is required. Deregulation advocates who ignore these problems invite unnecessary environmental insults, particularly of the hydropower variety.[41] Federal authorities reinforced that prospect recently by declining to reevaluate the extension of PURPA incentives to a host of environmentally destructive new hydroelectric facilities.[42]

One additional unhappy prospect is worth emphasizing, and it extends across the spectrum of deregulatory initiatives discussed above. Much of the utility industry's leadership has grave misgivings about transferring its traditional responsibility for resource development to unproven entrepreneurs or power brokers. Often accompanying that lack of confidence are concerns about long-term prospects for reliable electricity service.

What unites the new (and old) prophets of shortage in the utility sector is an implicit vision of electricity demand as an inexorably expanding quantity visited upon the body politic by economic growth. Conservation, load management, recessions, and structural changes in the economy can slow but not halt or reverse the majestic trend of annual demand increases. As recently as 1981, the industry was publishing national forecasts that showed demand doubling by the year 2000, even in the aftermath of substantial conservation efforts.[43] An August 1985 Department of Energy ("DOE") survey concluded that we should plan for a decade of continuous demand growth at rates exceeding 3% per year,[44] and both DOE and utility representatives find evidence in an assumed GNP-electricity linkage that consumption may grow still more rapidly if economic expansion accelerates.[45] Accompanying

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41. *See, e.g.*, Thomas, Leacox & Farman, *Federal Incentives for Hydroelectric Projects at New Dams: FERC's Failure to Recognize Congressional Intent and Environmental Concerns*, 18 U.C.D. L. REV. 287 (1984); Whittaker, *The Federal Power Act and Hydropower Development: Rediscovering State Regulatory Power and Responsibilities*, 10 HARV. ENVTL. L. REV. 135 (1986).

42. *See* Order Denying Petition for Rulemaking, 34 F.E.R.C. ¶ 61,008 (rejecting proposal to amend federal regulations implementing PURPA, to make eligible for rate incentives only those hydropower facilities that are installed at pre-existing dams), *rehearing denied*, 34 F.E.R.C. ¶ 61,322 (1986).

43. *See* 2 ELECTRIC POWER RESEARCH INST., DEMAND 80/81: FORECASTS OF ENERGY CONSUMPTION TO THE YEAR 2000, A-13 (1981) (EPRI EA-2078) ("Conditional Forecasts of Energy Consumption-Baseline Prices, Extra Non-Price Conservation").

44. *See* U.S. ELECTRIC POWER, *supra* note 1, at 28 ("base case" forecast of growth in electricity consumption averages 3.4% and 3.1% for the 1985–1990 and 1991–1995 periods, respectively).

45. *See* POWER IN AMERICA, *supra* note 9, at 4-5 (average annual GNP growth of 4% per year would boost national capacity needs by 172 gigawatts (GW) over base case

such concerns are doubts that PURPA resources can meet more than a modest fraction of long-term needs for new capacity.[46]

Such conclusions appear to their authors as a clarion call for renewed construction of utility-financed coal and nuclear units; after all, with ten-year minimum lead-times, the surpluses of today may have faded from memory by the time new large-scale generating units can be completed. Yet there is widespread uneasiness throughout the utility sector about the whole forecasting enterprise; a recent industry-sponsored analysis includes, in the same paragraph, the somewhat inconsistent but widely endorsed sentiments that (1) "any new long-term trends [in electricity growth] must be identified as quickly as possible"; and (2) "[f]uture electric peak demand and energy requirements are just as difficult to predict today as they have been in the last ten years."[47] An extensive empirical assessment of forecasting accuracy, published in 1985, reached a comparable conclusion: "direct observation shows little or no evidence that utility forecasting is improving over time."[48]

These disarming concessions reflect the continuing popularity in forecasting circles of econometric methods, which focus on historical relationships between energy use and such variables as gross national product, personal income, numbers of households, energy prices, and employment in various sectors of the economy.[49] These variables are related only indirectly to the actual

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projections by the year 2000); NUCLEONICS WEEK, June 13, 1985, at 8 (quoting Edison Electric Institute Vice President Thomas Kuhn as "troubled" by the possibility that "electricity sales [could] meet or exceed GNP growth estimates of 3% to 5%"). DOE and Edison Electric to the contrary notwithstanding, U.S. electricity consumption lagged GNP growth in seven of eight years between 1977 and 1984. C. Komanoff, *U.S. Electricity Production vs. Gross National Product, 1973–1984* (Feb. 26, 1985) (Exhibit Ck-26, based on data from DOE's *Monthly Energy Review*).

46. For example, a recent survey of U.S. and Canadian utilities found that only New England, California, Texas, and portions of the Mid-Atlantic region "expect to have significant amounts of cogeneration capacity in service by 1994"; even in these areas, utilities plan on cogenerators to provide only about 5% of system power in 1994. NORTH AM. ELEC. RELIABILITY COUNCIL, 1985 RELIABILITY REVIEW: A REVIEW OF BULK POWER SYSTEM RELIABILTY IN NORTH AMERICA 11 (1985). The utility industry's Electric Reliability Council has recently concluded that reliance on conservation and "small, short lead time generating units" will "lead to unreliable electric service in the 1990's, which the public will then find unacceptable." *Id.* at 5.

47. North Am. Electric Reliability Council, 14th Annual Review of Overall Reliability and Adequacy of Bulk Power Supply in the Electric Utility Systems of North America 4 (1984).

48. Huss, *Can Electric Utilities Improve Their Forecast Accuracy? The Historical Perspective*, PUB. UTIL. FORT., Dec. 26, 1985, at 37, 42.

49. For a recent, classic example, see POWER IN AMERICA, *supra* note 9, at 3-3 to 3-15; *see also* U.S. Gen. Accounting Office, Analysis of Electric Utility Load Forecasting

instrumentalities of energy consumption (*e.g.*, buildings, appliances, and industrial processes). Moreover, econometric forecasts assume that statistical relationships between, for example, wealth, employment, and energy consumption will persist indefinitely without significant change. And the variables that drive the forecast represent demographic and economic trends over which energy planners have little or no control. If analysts could accurately anticipate fifteen or twenty years of economic and energy price changes—a task arguably more difficult than predicting energy consumption itself—and if historical relationships between those variables and energy consumption could be equated with destiny, then we could have some confidence in what the econometric models are telling us. But the preconditions are daunting.

Even these considerations understate the actual uncertainties lurking within utilities' demand forecasts, because few—regardless of methodology—take adequate account of the unexploited potential for improving the efficiency of electricity use. Table I below makes the point in the context of several major consumption categories; these illustrative figures could be replicated for most significant electricity applications. The four generic end uses addressed in the table account for more than one-third of U.S. electricity consumption; of that fraction, lighting of all types accounts for about half and the rest is distributed about equally among residential space heat, water heat, and refrigeration.[50]

The national reserve of untapped conservation creates a major source of additional forecasting uncertainty, exacerbated by the rapid pace of innovation on all efficiency fronts.[51] Any utility's future, to the extent it can be seen at all through current planners'

6–8 (June 22, 1983) (GAO/RCED-83-170) (Report to the Subcomm. on Energy Conservation and Power, House Comm. on Energy and Commerce).

50. In June 1984, the Electric Power Research Institute pegged U.S. lighting energy use at 420 billion kWh/year, about 20% of total U.S. electricity consumption for calendar year 1983. *Compare Evolution in Lighting*, ELECTRIC POWER RESEARCH INST. J., June 1984, at 6, 7 *with* Energy Information Admin., U.S. Dep't of Energy, MONTHLY ENERGY REV., Aug. 1985, at 77 (DOE/EIA-0035(85/08)). For estimates of consumption for space heating, water heating, and refrigeration—all in the residential sector, see U.S. Dep't of Energy, Supplement to: March 1982 Consumer Products Efficiency Standards Engineering Analysis and Economics Analysis Documents 57 (July 1983) (DOE/CE-0045). The total of 4.1 quadrillion BTUs of primary energy distributed among these three end uses for 1980 is almost 17% of total primary energy consumed for electrical purposes in that year. Energy Information Admin., *supra*, at 20.

51. *See, e.g.*, Lovins, *supra* note 30, at 914: "[M]ost of the best such technologies [in 1985] have been on the market for less than a year. Collectively, they now cost a third as much as they did 5 years ago, yet can save twice as much electricity."

TABLE I: THE UNREALIZED POTENTIAL FOR EFFICIENCY IMPROVEMENTS: ILLUSTRATIVE EXAMPLES

End Use	*Typical Efficiencies*	*"State of the Art" Efficiencies*
Lighting, Office Building[a]	6–9 kWh/ft^2/yr	1.5 kWh/ft^2/yr
Electric Water Heat, Residential[b]	4500–6000 kWh/yr	800–1200 kWh/yr
Electric Space Heat, Detached Single-Family Home, 5000 (*F.*) Degree Day Climate[c]	8500–15,000 kWh/yr	1350 kWh/yr or less
Refrigerator (frost-free, 16–18 ft^3)[d]	1200 kWh/yr	180 kWh/yr

[a] *See* D. Goldstein, *Preventing Wasted Light,* THE CONSTRUCTION SPECIFIER 38 (Oct. 1984) (optimal office lighting power budget is 0.5 W/Ft^2).

[b] Water heating needs reflect personal and miscellaneous use (*e.g.,* washing hands, showers), dishwashing, laundry, and the energy required to maintain water at a constant temperature in the holding tank. The upper limit of consumption under "Typical Efficiencies" is taken from Manitoba Hydro, System Load Forecast 1984/85 to 2004/05, at 26 (June 1984). The "state of the art" estimates—which reflect water heater, showerhead, and appliance improvements—are developed in R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, A MODEL ELECTRIC POWER AND CONSERVATION PLAN FOR THE PACIFIC NORTHWEST 153–65, 226–33, and App. 9, at 22–45 (1982).

[c] The "typical" figure reflects submetered data from 1500 square foot homes in Portland (OR), Eugene (OR), and Bellevue (WA). Northwest Power Planning Council, Issue Background: What are Conservation Savings? (June 29, 1982). Compliance with model conservation standards proposed in NORTHWEST POWER PLANNING COUNCIL, NORTHWEST ELECTRIC POWER AND CONSERVATION PLAN (1983), would cut that total to 3000 kWh/yr. *Id.* at 10-9. The "state of the art" figure of 1350 kWh/yr is based on cost-effectiveness calculations in R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note b, App. 7, at 25–31 (1982). This estimate must be regarded as an upper limit; super-insulated passive solar houses with *zero* space heating consumption have been built in climates far exceeding 5000 degree days. *See, e.g.,* ROCKY MOUNTAIN INSTITUTE, VISITOR'S GUIDE (Aug. 1984) (4000 sq. ft. building combining residential and office functions; 8700 (F.) degree days per year).

[d] The "typical" figure is taken from Manitoba Hydro, *supra* note b, at 26; "state of the art" data are developed in Natural Resources Defense Council, A Life Cycle Cost Curve for Refrigerator Efficiency: An Engineering Analysis of Advanced and Not-So-Advanced Technologies (July 5, 1984). The most efficient mass-produced North American upright frost-free refigerator consumes 750 kWh/yr; this 17.2 cubic foot model was introduced in March of 1985 by the Whirlpool Corporation. Japanese efficiencies have been the equivalent of a more stringent 450 kWh/yr target since at least 1983. *See, e.g.,* Petition of the Natural Resources Defense Council to the California Energy Commission to Institute Proceedings to Revise its Refrigerator, Freezer and Air Conditioner Standards 4–5 (Nov. 1984) and sources cited therein.

lenses, is embodied in forecasts that look like widening jaws; by the time the "high" and "low" trend lines for electricity needs reach the end of this century, they are separated by thousands or tens of thousands of megawatts. That result threatens to consign conventional coal and nuclear baseload generation to instant obsolescence, from the standpoint of resource planning. The last thing one would wish to insert between the forecast's gaping jaws is an indivisible large-scale, long-lead-time unit with most of its costs loaded into the construction phase. At the very least, prudent managers would insist on deferring risks of this magnitude until they had determined *both* whether more digestible resources could be added to the inventory of potential supplies *and* whether there were ways to reduce the disabling uncertainties about future demand. Increasing numbers of utility and state officials are now attempting precisely that; the remainder of this article seeks to help them get the best possible answers.

IV. Toward Cost-Minimizing Management of Energy Consumption

A. The Role of Conservation

Utilities and regulators make prudent resource planning possible when they stop conceiving of electricity demand as something they are limited to "predicting." That, in turn, means piercing the econometric veils and accepting demand for what it is: the sum of millions of "end uses"—building shells and heating systems, appliances, lighting systems, industrial processes—of differing, but generally low, efficiency compared with the best technologies now or foreseeably available.

The first step toward a "management" approach to energy planning is to recognize that improvements in these existing efficiencies, if achieved in large quantity on a predictable schedule, constitute *an energy resource*. For purposes of meeting new system needs for power, a kilowatt-hour preserved from waste is indistinguishable from a kilowatt-hour delivered to consumers by a new power plant.[52] A corollary, of course, is that consumer satisfaction is not measured by the quantities of energy used to provide a service, but by the quality of the service itself. Our demand for electricity is a function not of any yearning for kilowatt-hours themselves, but our desire for the heat, light, and mechanical drive that the kilowatt-hours produce.

These self-evident propositions should spur utilities to take an intense interest in the efficiency of their consumers' end uses, both to protect their competitive position in a market that values their product only as an intermediate good, and as part of a search for the cheapest and most secure ways of supplying that product. End-use efficiency improvements must be evaluated as potential sources of supply, with a claim on utility investment dollars superior to that of more costly resources. In addition, conservation offers an alternative to new power plants as a means of extending some regions' current electricity surpluses, allowing long-term exports to capacity-strained and/or oil-dependent areas. This is precisely the conclusion that the U.S. Pacific Northwest has reached in evaluating its own export options.[53] There is no necessary link between long-term power sales contracts and additional large-scale generating capacity. Export income can be used to build indigenous power plants, *but it can also be used to invest in indigenous efficiency improvements*—and it should be so used, if the power freed up by the efficiency improvements is more attractive from a cost, flexibility, and reliability perspective.

Conservation investments should fare well on all these counts: declining real energy prices in the postwar decades left a predict-

52. Arguably, the conservation-based kilowatt-hour is distinguishable, because by definition the power plant that produces it is older and will need replacement sooner than a new generator. Conservation's ample offsetting advantage, however, reflects the risk that the new generator will be obsolete long before the close of its useful life. *See supra* note 20.

53. The Bonneville Power Administration, owner of most of the bulk transmission linking the Northwest with California, has established interim guidelines that effectively prohibit construction of new generating capacity for export markets. Bonneville Power Admin., U.S. Dep't of Energy, Near Term Intertie Access Policy, § II(A)(4), (C)(2) (Sept. 7, 1984) (Administrator will allocate interregional transmission only to existing Northwest power plants). On the other hand, "all BPA customers will be encouraged to develop conservation resources that improve the marketability of electric power offered to California." Bonneville Power Admin., U.S. Dep't of Energy, Surplus Power Marketing Update 3 (Nov. 16, 1984). That goal is ably and extensively analyzed in Meek, *Pacific Northwest Conservation for California: The Mutual Benefits of Long-Term Cooperation,* 13 ENVTL. L. 841 (1983).

able legacy of inefficient end uses, which can be upgraded through programs that combine short lead times, modest scale, and wide dispersal. The new conservation resources are added in small increments, not indivisible 250–1300 Megawatt packages. Costs are incurred primarily during an installation phase of days or weeks, and are not subject to the unanticipated mid-construction escalation that has frequently shattered cost estimates for decade-or-more coal and nuclear projects. And conservation

> reduces risk [to the utility] of investment recovery, since energy saving from installed conservation programs continues regardless if the program is terminated at some future date. This is unlike a central station option where no return on investment is realized until the entire program is completed.[54]

Moreover, no single conservation "unit" is responsible for meeting an appreciable fraction of the system's needs for new energy supplies, and there is no chance that an appreciable fraction of the installed "units" could fail simultaneously. Finally, conservation potential tracks the business cycle in a uniquely favorable way; rapid growth in demand is a function of rapid growth in the instrumentalities of consumption, and correspondingly rapid growth in opportunities to improve efficiency. There is no such inherent congruence between power plant construction schedules and the evolving needs at which such plants are targeted.

While these advantages of scale and flexibility are now generally recognized, conservation yields an additional and less widely appreciated dividend in the form of reductions in costly uncertainty about future demand. As noted earlier, the typical utility forecast is beset with indeterminacy because of its emphasis upon trends in personal income, economic growth, employment, appliance saturation, fuel prices, and consumer sensitivity to rate increases. For purposes of determining energy consumption, however, these variables are much less important than the average efficiencies of

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54. DIV. OF CONSERVATION & ENERGY MANAGEMENT, SOLAR & ENERGY DEMONSTRATIONS BRANCH, OFFICE OF POWER, TENN. VALLEY AUTH., ENERGY CONSERVATION PROGRAM 4 (May 17, 1984). These considerations weigh particularly heavily in jurisdictions where interest on construction expenditures is normally capitalized until the plant is producing output. To "capitalize interest" is to borrow money during the construction period to pay interest on money borrowed earlier; recent and threatened U.S. utility defaults have created understandable nervousness about this device in financial markets.

the devices that actually use electricity. The variables provide only an indirect and imprecise way of guessing at trends that utilities and other public institutions can influence directly.

On a theoretical level, this argument is straightforward: by reducing the electricity needs of houses, appliances, commercial buildings, and industrial processes, societies can diminish the significance—from the standpoint of ultimate energy needs—of fluctuations in economic and behavioral trends. For example, if regulatory and investment policies can fix the average needs of new houses, appliances, and commercial floorspace at levels far below those typical of the current stock, then errors in predicting the absolute number of new houses, appliances, and so on become much less important. Instead of trying to predict future needs, using manifestly inadequate tools, utilities and their regulators can act to shape those needs. Indeed, most of the major nonindustrial end uses of electricity fall squarely within some traditional sphere of state regulation; states have extensive experience, for example, in enforcing efficiency standards for appliances and buildings in the residential and commercial sectors.[55]

As reviewed below in greater detail, there are numerous additional mechanisms for exploiting both the energy and uncertainty-reducing potential of conservation. The latter is particularly important where an export policy for electricity requires assurances of firm surpluses over an extended period in order to maximize receipts. Of course, no plausible combination of measures can eliminate all uncertainty about future trends in energy consumption; with that in mind, I will also address contingency plans that anticipate unexpected future increases in energy needs, which might threaten to overtax then-existing resources.

Before setting out this framework, however, it is important to respond to an obvious preliminary objection. Why is intervention by utilities and regulatory bodies needed to secure conservation benefits? Also, assuming that such intervention will displace or defer new generating units, what if any compensation will emerge for the job-creating benefits that are widely credited to power plant construction programs?

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55. *See infra* text accompanying notes 118–26 (part IV(C)(3)(c)); *infra* text accompanying notes 134–35 (part V).

B. The Case for Intervention

1. Market Barriers to Cost-Effective Conservation

Rational buyers in a free marketplace would seize any opportunity to purchase energy savings whose cost, on a life-cycle basis, was less than that of additional energy supplies. Utilities and regulators could then simply assume, for planning purposes, that market forces would ferret out all or most efficiency improvements that saved power more cheaply than it could be produced at a new generator. Assuming (heroically) that electricity rates accurately signalled the cost of that new generator, there would be no reason for these institutions to invest in or regulate efficiency.

There are a number of compelling reasons to reject such a proposition, even putting aside the ubiquitous distortions associated with average cost pricing in the utility sector.[56] To begin with, the best available evidence indicates that efficiency does not sell unless it produces real annual returns, in reduced energy costs, on the order of 30–200 percent; this is equivalent to a payback requirement of six months to three years.[57] By contrast, utilities typically earn less than 15% on invested capital, and a new large-scale coal or nuclear power plant cannot even *begin* emitting a

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56. *See, e.g.*, THE FORD FOUND., ENERGY: THE NEXT TWENTY YEARS 146 (1979):

> [The rate-setting process] makes no provision for the fact that the prices charged the user of the service fail to reflect the costs incurred by the supplier to meet specific or new demands. Rather, these prices are governed by the cost of meeting the total demand, averaged more or less across all the existing units.

57. *See, e.g.*, ENERGY BRANCH, CAL. PUB. UTIL. COMM'N, 1984 ENERGY CONSERVATION PROGRAM SUMMARY 6 (May 1985) (utilities' "energy auditors have found that their [commercial and industrial sector] customers are reluctant to invest in hardware conservation measures unless the energy savings produce a 100% return within less than two years, and in many cases within six months"); R. STOBAUGH & D. YERGIN, ENERGY FUTURE 195–96 (1981) (citing average of two-year payback requirements for industrial firms); E. Hirst, R. Marlay, D. Greene & R. Barnes, Energy Div., Oak Ridge Nat'l Laboratory, Recent Changes in U.S. Energy Consumption: What Happened and Why 25–27 (Feb. 1983) (citing survey findings for commercial sector conservation measures); Comments of R. Swisher, on Behalf of the Am. Pub. Power Ass'n, Regarding Energy Efficiency Program For Consumer Products 3–4 (Nov. 15, 1984) (failure of residential appliance efficiencies to respond to market forces); *cf.* Manitoba Conservation & Renewable Energy Office, Status Report on Energy Supply Developments and Energy Programs in Manitoba 17–18 (Oct. 4, 1984) (commercial sector participants in matching grant program chose conservation measures that averaged a payback of 2 to 2 1/2 years).

marketable product until the conclusion of a ten-to-sixteen year siting and construction period.[58]

Individuals and businesses are behaving, then, like much more demanding investors than utilities. Such choices are not necessarily irrational; for example, members of a highly mobile society are understandably reluctant to pay for building or appliance efficiencies that will redound primarily to the benefit of subsequent occupants. But the imbalance between the perspectives of consumers and utilities invites enormous, low-return investments in power plants that could be displaced with more lucrative conservation. Put differently, this "payback gap" strangles opportunities to achieve returns greater than those that regulators allow utilities to earn on power plant investment, but lower than consumers' implicit 30–200% per year requirement.

Accompanying the payback gap are other barriers to a free market in efficiency improvements. Decisions about end use efficiencies often are made by developers and landlords who will not be paying the ensuing utility bills.[59] And third-party buyers typically focus on purchase price rather than operating costs; many ignore efficiency considerations altogether.[60]

Of course, one casualty of efforts to eliminate such market barriers is the economic stimulus associated with the new gener-

58. *See* U.S. Gen. Accounting Office, Analysis of the Financial Health of the Electric Utility Industry 10–13 (June 11, 1984) (GAO/RCED-84-22) (Report to the Chairman, Subcomm. on Energy Conservation and Power, House Comm. on Energy and Commerce) (utilities' rates of return); 1 NORTHWEST POWER PLANNING COUNCIL, NORTHWEST CONSERVATION AND ELECTRIC POWER PLAN 3-5 (1983) (ten-year average lead-time for new coal-fired power plants); Battelle Pac. Northwest Laboratories, 14 Assessment of Electric Power Conservation and Supply Resources in the Pacific Northwest: Nuclear (Draft) 3.19 (Apr. 1983) (Prepared for the Pacific Northwest Electric Power and Planning Council) (16-year average lead-time from preliminary planning to start-up for contemporary U.S. light water reactors).

59. *See* H. Geller, Energy Efficient Appliances 23 (June 1983) (available upon request from the American Council for an Energy Efficient Economy). In a similar vein, the popularity of electric heat in new Canadian apartment construction has been credited to "individual controls and meters [that] fre[e] the landlord from involvement with the utility bills." Manitoba Dep't of Energy & Mines, An Evaluation of Residential Space Heating Options in Manitoba (Draft) 8 (June 1983).

60. *See* H. GELLER, *supra* note 59, at 23 (61% of builders surveyed by National Association of Home Builders Research Foundation "said they do not consider energy efficiency when selecting appliances and HVAC equipment"; data for the 1970's indicate that "average efficiency of space heating systems and water heaters (appliances purchased largely by builders and contractors) showed virtually no increase"); *see also* R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, A MODEL ELECTRIC POWER AND CONSERVATION PLAN FOR THE PACIFIC NORTHWEST 76–77 (Nov. 1982) (citing surveys of housing insulation levels and appliance efficiencies).

ating units that efficiency improvements displace. The next section argues that this apparent cost to a utility's service territory is more than offset by the local economic gains that accompany successful conservation programs.

2. *The Jobs Issue*

The job-creating benefits of major energy supply projects are frequently emphasized in projections that do not consider the implications of redirecting capital to equally or less costly conservation programs.[61] That tradeoff was recently addressed explicitly in a study commissioned by the Bonneville Power Administration:

> The literature generally concludes that expenditures on conservation generate more regional employment opportunities than expenditures of the same size on power plant construction and operation. There are several contributing reasons for this. First, conservation programs tend to be more labor-intensive than construction programs. Second, conservation programs are less dependent on imports from other regions than is the construction of power plants.[62]

Per dollar of capital expended, conservation creates up to four times as many on-site jobs as large central station plants.[63] Further, central station power plant construction can produce substantial net *reductions* in regional employment, because ratepayers must reduce expenditures on other goods and services to finance construction, and the employment associated with the plant "is less

61. *See, e.g.*, Manitoba Dep't of Energy & Mines, Potential Opportunities From Northern Hydro Development 4–5 (1984). This report indicates that a $3 billion nominal investment in a 1200 MW hydropower plant will yield 6000 person-years of construction employment and 11,000 person-years of indirect employment—for an unstated but formidable cost per job-year created of more than $175,000. Economic development claims also underpin British Columbia's ambitious hydropower expansion plans. *See, e.g.*, Lewis, *B.C.'s Power Poker*, The Sun (Vancouver), Sept. 25, 1985, at 21, col. 2.

62. Bonneville Power Admin., U.S. Dep't of Energy, Employment Effects of Electric Energy Conservation 2 (Apr. 1984) (report prepared by Charles River Associates under Contract No. DE-AC79-83BP39210).

63. *Compare, e.g.*, *id.* at A-3 ("A reasonable estimate seems to be that $1 million of expenditure on a residential or commercial conservation program will lead to 15 to 20 direct job-years") *with id.* at A-11 (citing U.S. Dep'ts of Labor & Energy, Projections of Cost and On-Site Manual Labor Requirements for Constructing Electric Generating Plants, 1980–1990 (Feb. 1982)) ($1 million ($1980) investment in nuclear, coal, or hydropower typically produces 5–6 job-years of on-site employment).

than the employment reductions associated with lower expenditures on other goods and services."[64] Conversely, to the extent conservation reduces total energy-related expenditures, it frees up capital for investment outside the energy sector; the result is likely to be highly positive from the standpoint of in-region employment, because the energy sector generally is much less labor-intensive than the rest of the economy.[65] "Money saved on energy is almost certain to create more jobs when it is invested in other parts of the economy."[66]

To these comparative advantages, the Bonneville study adds several additional considerations. The flexibility of conservation scheduling allows for readier matching of job creation with periods of cyclical unemployment. The lesser reliance on esoteric skills requiring extended training, compared with the power plant case, means that indigenous labor can capture a larger fraction of these new jobs. And the jobs themselves "are generally dispersed geographically roughly in proportion to the general population," which avoids socially disruptive "boom town" effects.[67]

At the same time, efficiency improvements can be used to enhance the competitive position of local industries. To the extent that conservation is used to firm up electricity surpluses for export, as advocated earlier, the exporter will be trading kilowatt-hours for an invigorated local commercial and industrial infrastructure. All the considerations reviewed above suggest that accelerating conservation in this fashion makes far better sense, from the standpoint of net local economic benefits, than building power plants dedicated to outside markets. The remainder of this article suggests how to identify and exploit such opportunities.

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64. *See* Bonneville Power Admin., *supra* note 62, at 5.

65. *See id.* at A-9 to A-10 (citing L. Lerner & F. Posey, The Comparative Effects of Energy Technologies on Employment (Nov. 1979) (staff report prepared for the California Energy Commission)).

66. R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 356 (1982) (quoting Smolewicz, *Energy and Jobs*, SOLAR WASH., May/June 1981, at 11).

67. Bonneville Power Admin., *supra* note 62, at 6–7. On the boom town issue, for example, a proposed 1200 MW Canadian hydropower plant will induce a more or less immediate four-to-five-fold increase in the population of the host community. Manitoba Dep't of Energy & Mines, *supra* note 61, at 4. The sponsors also recognize the limitations on indigenous companies' ability to participate in power plant construction: while asserting that "substantial contracts could go to Manitobans if government and business work together," Manitoba's Department of Energy and Mines acknowledges that "competitors from all over the world will bid on Limestone contracts" and that "the turbine and generator contracts will likely go to an out-of-province company." *Id.* at 9.

C. A Planning Framework

1. Overview

The typical utility system is dominated by large (250–1300 MW) "baseload" plants with high fixed costs and relatively modest operating costs.[68] If the system had cause for confidence that its existing facilities could sustain internal needs and export commitments indefinitely, there would be no reason to worry about investment in conservation or any alternative source of new supply. Of course, current forecasts provide little basis for such confidence. But the crucial inquiry—too often ignored or mishandled—is whether conservation and other forms of demand management could reliably substitute for new generation at lower cost.

Answers to such questions require, as a first step, a forecast tied more directly to the actual sources of demand: existing and anticipated end uses of electricity. The utility system must, in effect, take inventory of its residences, appliances, heating systems, commercial floor-space, and industrial processes, securing estimates of both absolute numbers and average efficiencies. Many utilities have made substantial progress along these lines already, although additional surveys may be needed.[69]

The next step is to develop low and high case projections of additions to these inventories over the forecast period. The range should bound the universe of plausible growth rates for the major end use categories; for reasons to be explored below, there should be no effort to create a fictitious "most likely" line between the two extremes. Electricity needs for the high and low scenarios should then be calculated by summing existing and new uses, less anticipated retirements, over the forecast period. For purposes of

68. The major "baseload" technologies—coal, nuclear, and hydro—provided 56%, 14%, and 13%, respectively, of U.S. electricity generation in 1984. Energy Information Admin., U.S. Dep't of Energy, MONTHLY ENERGY REV., Aug. 1985, at 76 (DOE/EIA-0035(85/08)). The residual 17% was divided between natural gas (12%), petroleum (5%), and "electricity produced from geothermal, wood, waste, wind, photovoltaic, and solar thermal energy sources connected to electric utility distribution systems" (0.4%). *Id.*

The coal/nuclear/hydro share of the total generation mix was 82% in 1984, up from 69% in 1978. *Id.* Also, in the nuclear category at least, there is a marked trend toward increased power plant sizes. The average operating nuclear reactor had a capacity of 829 MW in July 1985, compared with 617 MW ten years earlier. *Id.* at 85.

69. Sophisticated examples include Bonneville Power Admin., U.S. Dep't of Energy, The Pacific Northwest Residential Energy Survey (July 1980) (Report prepared by Elrick & Lavidge, Inc.) and Puget Power, 1983 Residential End Use Survey (Feb. 1984).

the initial estimates, the planners should assume conservatively that efficiencies of existing uses will not improve significantly over time, and that the efficiency of new uses will track those of the most recent additions to the stock of existing uses. Forecasts should be prepared for both peak and average energy needs.

This calculation will yield a diverging "jaws" forecast comparable to that produced by the econometric methods reviewed earlier, with one crucial difference: the new forecast is rooted firmly in the instrumentalities of demand, allowing planners to track the effects of investments and policies designed to upgrade efficiencies of some or all of those instrumentalities. In parallel with this forecast, planners should develop a comprehensive assessment of opportunities for improving end use efficiencies. What is the "state of the art"—existing and anticipated—for delivering the services performed by the system's end uses at the lowest possible electricity consumption? Table I above is an illustrative but obviously incomplete list.

The question then shifts to how much of this unexploited conservation resource is worth attempting to secure. The answer requires a rigorous methodology for comparing the life-cycle costs of incremental amounts of conservation for each end use with the costs of the most expensive displaceable generating unit in the utility's acquisition plans. In performing that assessment, planners should explicitly credit conservation for its advantages on indices of scale, lead-time, and uncertainty-reduction; the cost column for both the conservation options and the generation alternative should also include quantifiable environmental costs associated with each. The calculation should take specific account of the *avoidance* of line losses, additional transmission construction, and additional reserve capacity that conservation makes possible when it displaces or defers a new power plant. Subsection 3 below offers specific recommendations for handling these and related elements of the cost-comparison process.

From this process will emerge a decision on which efficiency improvements are worth pursuing; it remains, however, to determine how much of the cost-effective conservation resource the system can count on securing. That inquiry focuses on mechanisms for getting the conservation installed; here planners can draw on numerous precedents. Options include state-imposed efficiency standards for some end uses, supplemented by direct utility investment through incentive programs. Planners must anticipate the success of such programs in convincing end users to take advantage of efficiency opportunities. Again, substantial empirical data are already available.[70]

Using those predictions, planners can narrow the "jaws" of the forecast by inserting assumptions about increases in the efficiency of the end use inventories for the "high" and "low" forecasts. Both forecasts will drop, but the high forecast will drop by more because there are more end uses to upgrade. The high forecast then represents the maximum plausible "post-conservation" system needs; the low forecast represents the minimum requirements that will have to be met.

The gap between the two forecasts—which conservation has narrowed but not eliminated—represents a range of outcomes with which the utility must be prepared to deal. The enterprise is analogous to purchasing an insurance policy; the goal is to minimize the cost of coping with contingencies of varying probability. New generating units may be one element of the response, but other options will bear close scrutiny. Load management programs that shift consumption away from peak periods, without necessarily affecting total consumption, are an obvious example. Also worth investigating is the willingness of large industrial and commercial customers to sell interruption rights to the utility system, which would provide additional reserves in the event of unexpected shortfalls. These and related contingency measures, which have ample precedent elsewhere, are addressed more fully below.[71]

In addition, some options, clearly inferior on cost grounds to baseload generators if markets were assured, may look more attractive as a hedge against possible but unlikely growth in demand. Combustion turbines come readily to mind as a generating alternative with relatively high fuel costs, but shorter lead-times and lower capital costs than baseload plants. Obviously, the more certain the system is that it will need significant "post-conservation" additions of energy supply, the better the high-capital-cost, low-operating-cost baseload systems will look. *But the converse is also true*—and most existing forecasts do not permit an informed evaluation of utilities' investment alternatives.

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70. *See infra* text accompanying notes 118–26 (Section IV(C)(3)(c)).
71. *See infra* text accompanying notes 127–33 (Section IV(C)(3)(d)).

2. *The Record to Date*

With some extremely encouraging exceptions, recent conservation and load management initiatives by U.S. and Canadian utilities have often diverged sharply from the framework outlined above. Attempts at a comprehensive program-by-program review would extend this article intolerably, but the record includes recurring themes that bear at least brief mention: artificial constraints on utility investment (the "no-losers test"); failures to integrate utilities' conservation programs into their overall resource plans; program designs that neglect to press savings to cost-effective limits; and major gaps in program coverage. The discussion below touches on each of these points in turn.

a. *"No Losers" but Few Winners*

Arguments against direct utility investment in conservation often draw upon a criterion called the "no-losers test."[72] This test limits payments for energy savings to ensure that conservation raises utility rates no more than would equivalent amounts of new generation. Under such a regime, no individual ratepayer can be harmed by a utility's decision to replace new power plants with end-use efficiency improvements.

Though it appears neutral on its face, the no-losers test is inherently discriminatory. Conservation typically raises rates more than new generating capacity of equal or even much higher cost, because the utility sells less electricity under the conservation scenario and there are fewer kilowatt-hours over which to spread the system's fixed costs. Compared to more expensive alternatives, conservation reduces *bills* but may raise *rates*; utilities applying the no-losers test are in effect contending that bills matter less than rates.

The conservation expenditures blocked by the test force compensating investments in more costly supplies, and produce a

72. The discussion that follows is adapted from a lengthier treatment of the no-losers test, *see* Cavanagh, *Electrical Energy Futures*, 14 ENVTL. L. 133, 162–66 (1983).

higher than necessary societal energy bill.[73] The only plausible justification rests on considerations of equity. Absent the spending limit, those who do not participate in conservation programs will suffer; they would be better off if the utility increased its energy sales instead of buying conservation. Why should nonparticipants' rates (and bills) go up to subsidize other peoples' efficiency improvements—particularly when nonparticipants' rates (and bills) would rise less to pay for equivalent quantities of new generation?

But that is really an argument for promoting participation in utility-funded conservation programs. Few if any electricity consumers cannot take advantage of sharply increased rewards for wasting less.[74] If incentives to install cost-effective efficiency improvements are substantial, and if marketing efforts focus on traditional nonparticipants, utilities can buy energy savings without discriminating against any class of consumers. At that point, "[i]ncentives should not be diluted simply to protect against rate impacts on those who do not respond."[75]

The California Public Utilities Commission took this view in 1983, when it authorized the state's investor-owned utilities to "spend approximately $31 million to weatherize 48,090 low-income homes free-of-charge to the low-income occupants."[76] Under this authorization, in 1984, the Pacific Gas and Electric Company alone installed 150,667 conservation measures in 38,127 low-income homes (out of 145,644 total units weatherized).[77] Further, by offering 100% payments for extensive residential conservation, Northwest utilities enrolled more than ninety percent of all eligible households in an Oregon county between 1983 and 1985.[78] It is misleading to refer to such utility payments as "subsidies"; *they*

73. Indeed, one economist has argued persuasively that the "no-losers" test is really a "hardly-any-winners" test. *See* J. Lazar, *The "No Losers Test" for Conservation and Solar Investment by Utilities*, in R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at app. 8. Authorities in the Pacific Northwest have officially repudiated the no-losers test. *See* 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 2-2 (1983).

74. *See supra* text accompanying notes 56–60 (Section IV(B)(1)).

75. 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 2-2.

76. Letter from George Amaroli, Chief, Energy Conservation Branch, California Public Utilities Commission, to Editor, POWER LINE, July 1983, at 10.

77. Pacific Gas & Elec. Co., Report on 1984 Energy Management and Conservation Activities 2–3 (Mar. 31, 1985).

78. Of 3,282 households in Hood River County with electric heat, 2984 (91%) ultimately participated in a program that included exceptionally high insulation levels, triple-glazing, low-flow shower heads, infiltration controls, and air-to-air heat exchangers. S. French, Hood River Conservation Project: Project Totals to Date (Jan. 24, 1986) (available upon request from author).

are purchases of energy at what, relatively speaking, are bargain prices.

b. Integrating Conservation in Resource Planning

Conservation has been characterized throughout this article as a tool for displacing less attractive utility investments. Only if savings are expressly integrated in resource planning, however, can these benefits be realized. A "worst of all worlds" scenario occurs where one group of managers is funding measures calculated to defer the need for new power plants, while another group presses ahead independently with power plant construction.

That scenario is perilously close to the status quo in some Canadian and U.S. utility systems. The Western Area Power Administration, one of the largest U.S. wholesale power suppliers, has recently issued congressionally-mandated conservation guidelines for more than 500 utility customers: the rules require a "good-faith" effort to reach unspecified but "definite" goals for any three "program activities" from a list of some sixty alternatives.[79] Conspicuous by its absence is any mention of the relationship between these activities and resource planning. In Canada, neither Manitoba Hydro nor British Columbia Hydro make allowances in their long-range demand forecasts for the potential impact of provincial conservation programs.[80]

By contrast, many U.S. states and regions have been moving decisively to rectify such omissions, with some dramatic results. For example:

—In 1983, the Pacific Northwest's utilities deferred all new large central station plants indefinitely, in the aftermath of a system-wide inventory that identified at least 5150 average MW (45,000 Gwh/yr) of conservation achievable through efficiency standards and utility investment over twenty years, at an average cost of 1.8 cents per kilowatt-hour.[81]

79. *See* Announcement of Final Amended Guidelines and Acceptance Criteria for Customer Conservation and Renewable Energy Programs; Final Amended Guidelines and Acceptance Criteria, 50 Fed. Reg. 33,892, 33,895–99 (1985).

80. *See Background: BC Hydro's Conservation Non-Programs,* NORTHWEST CONSERVATION ACT REP., Feb. 3, 1986, at 1; Manitoba Hydro, System Load Forecast 1985/86 to 2005/06 (May 1985).

81. 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 5-12. The estimate represents conservation available according to the Council's high growth forecast.

—Cost-effectiveness analyses have convinced the Tennessee Valley Authority to cancel eight partially-completed central station plants, and to rely on conservation and load management to reduce projected peak needs in the year 2000 by 5000MW, "with contingency plans for developing two 700 MW blocks of additional conservation over and above what is included in the load forecast."[82]

—California regulators have adopted efficiency standards for residential and commercial buildings and appliances that, cumulatively, have cut more than 11,000 MW from projected peak power needs for the year 2004; the nation's largest and most vigorous state economy "now faces a potential abundance of electricity supply—and with appropriate policy decisions—a 'buyer's market' for meeting the state's future electricity needs."[83]

—Nevada "requires electric utilities to submit to the Nevada Public Service Commission every two years a fully integrated, long-range resource plan which must demonstrate that all aspects of a utility's future needs have been considered . . . . [The plan] must include a forecast of future demand and a comprehensive analysis of demand and supply options available to meet or alter demand, which are then unified to derive the 'least-cost' resource plan."[84]

—Iowa has enacted legislation directing its public utilities "to develop 'comprehensive energy management programs' that are to include, among other things, '[e]stablishment of cost-effective energy conservation and renewable energy services and programs.' Companies are also required to show, prior to new power plant construction, that they have 'considered all feasible alternatives . . . including non-generation alternatives' *and* have 'implemented the least-cost alternatives first.'"[85]

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82. Office of Power, Tenn. Valley Auth., *supra* note 54, at C-5 to C-6.

83. *See* CAL. ENERGY COMM'N, THE 1985 CALIFORNIA ELECTRICITY REPORT 1, 17 (1985). The ten separate regulatory measures that produced the totals cited in the text were adopted under both Democratic and Republican governors.

84. Wellinghoff & Mitchell, *A Model for Statewide Integrated Resource Planning,* PUB. UTIL. FORT., Aug. 8, 1985, at 19, 19–20.

85. Colton, *Conservation, Cost-Containment and Full Energy Service Corporations: Iowa's New Definition of "Reasonably Adequate Utility Service,"* 34 DRAKE L. REV. 1, 3 (1984–1985) (citing IOWA CODE § 476A.6 (Supp. 1983)).

c. Pressing Conservation to Cost-Effective Limits

A conservation program should promote installation of all cost-effective measures, not just the cheapest.[86] Utilities are almost universally violating this rule, relying instead on arbitrarily-capped grants and loans aimed at measures with paybacks of three-to-five years or less.[87] Such "cream-skimming" excludes many cost-effective measures outright and holds those that are employed below optimum levels; savings are foregone that cost less, on a life-cycle basis, than the generating capacity that will have to take their place. From the standpoint of both resource development and uncertainty-reduction, these are patently false economies. And ironically, cream-skimming focuses utility and government expenditures on the inexpensive efficiency improvements that are *least* impeded by a grossly imperfect market.[88]

d. Gaps in Program Coverage

Many of the most important end uses of electricity are not addressed in typical utility conservation and load management plans, which emphasize existing residential building shells and—to a lesser but growing extent—residential appliances.[89] That agenda excludes well over half of most systems' end use con-

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86. Thus, the Northwest Power Planning Council's goal is to "[m]ake existing and new residential and non-residential buildings as cost-efficient as current technology and life-cycle economics allow." 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 10-6.

87. For paradigmatic examples from the U.S. and Canada, see Jersey Central Power & Light Co. & Gen. Pub. Util. Corp., 50/50 Demonstration Program (Apr. 15, 1983) (report prepared for the U.S. Department of Energy describing utility-sponsored test of residential conservation program limited to measures that pay for themselves in two years or less); Manitoba Conservation & Renewable Energy Office, *supra* note 57, at 14, 16 (Province caps all residential and commercial sector conservation loans at $1,000 and $15,000, respectively).

88. *Cf., e.g.*, R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 116 (noting that "one of the most persistent objections to utility-financed retrofit programs [is] that they needlessly pay for measures that would have been installed regardless" and urging utilities to focus their efforts on inducing residential and nonresidential consumers to install *all* structurally feasible and cost-effective efficiency improvements).

89. Utility-financed "weatherization" of existing houses is "now available to over half of America's residential utility customers." A. Lovins, Least-Cost Electrical Services as an Alternative to the Braidwood Project, Prefiled Testimony on Behalf of Business and Professional People for the Public Interest, Before the Illinois Commerce Commission, Docket Nos. 82-0855, 83-0035, July 3, 1985, at 110. For a survey of appliance efficiency incentives, see H. GELLER, *supra* note 59, at 29–32.

sumption, including but not limited to residential and street lighting, commercial sector buildings and appliances, and industrial processes—not to mention the *new* buildings and other end uses in all categories, which become increasingly important as forecasts move further into the future.[90] Without taking greater advantage of available regulatory and incentive tools, utilities cannot expect either to minimize their consumers' electric bills or to reduce costly uncertainty about future system needs. Detailed recommendations for pursuing these goals follow.

3. *Methodological Notes on the Planning Process*

This section will flesh out in greater detail the planning framework described earlier. The framework contemplates coordination between utility and regulatory staffs and the potential use of independent consultants who are familiar with the methodologies discussed below.[91] Of course, public involvement in the planning process is extremely important from the standpoint of both the quality and perceived legitimacy of the final product.[92]

a. *The Conservation Inventory*

Before planners are in a position to determine how much conservation is worth buying, the limits of achievable savings for the major end uses must be determined. A host of problems immediately arises. For example, how can we reliably predict the amount of energy that various levels of building shell insulation will save, particularly when such measures interact with others in complex relationships that involve numerous variables? What can be done for an industrial sector rife with idiosyncratic processes,

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90. In the Pacific Northwest, for example, authoritative estimates of space heating conservation potentials over the next twenty years show savings in new houses outstripping those in existing houses by nearly 2 to 1 (770 average MW vs. 425 average MW). 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 11, at 6-6, 6-8.

91. Leading practitioners include Applied Energy Services (Arlington, Va.); Komanoff Energy Associates (New York, N.Y.); the Lawrence-Berkeley Laboratory's Energy-Efficient Buildings Program (Berkeley, Calif.); Morse, Richard, Weisenmiller & Associates (Oakland, Calif.); and the Rocky Mountain Institute (Old Snowmass, Colo.).

92. *See, e.g.*, 16 U.S.C. § 839b(g) (1982) (public involvement requirements for regional power planning in the Pacific Northwest); Bonneville Power Admin., U.S. Dep't of Energy, Procedure for Public Participation in Major Regional Power Policy Formulation, 46 Fed. Reg. 26,368 (1981); Policy for Public Involvement, 51 Fed. Reg. 8624 (1986).

whose owners may be reluctant to provide the information necessary to develop conservation estimates? Will savings in some areas lead to offsetting increases in consumption (*e.g.*, will owners of super-efficient homes be inclined to turn up their thermostats and will commercial buildings that cut lighting needs have to boost heating consumption in the winter, to make up for the waste heat formerly available from the inefficient lighting system)?

Fortunately, a broad base of solutions is emerging for these and related problems. For example, field-tested computer models have been developed by the Northwest Power Planning Council, the U.S. Department of Energy, and others that permit accurate prediction of the effects of packages of building shell conservation measures on energy consumption.[93] The models allow the planner to determine the synergistic effects of combinations of measures on total building needs, and permit assessments of the impact of post-conservation behavioral changes by occupants.[94]

There is also a growing body of work on commercial lighting efficiency strategies; such measures should be integrated with heating conservation measures, in order to avoid partially offsetting increases in heating needs during the winter.[95] Lighting is among the largest single electrical end uses outside the residential sector;[96] traditionally, much of its consumption has maintained background illumination levels during the daytime that far exceed what people choose for their own homes at night.[97] Here utilities can exploit a technological and design revolution, which is creating aesthetically pleasing ways both to waste less light and to achieve any chosen level of illumination at substantially reduced power budgets:

93. The Northwest Power Planning Council's primary building shell computer model is called SUNCODE; the Lawrence Berkeley Laboratory has developed another widely-used program called DOE-2. The models allow analyses of conservation potential for building shells that account for the interaction between some measures: "In tabulations of savings, the more cost-effective measures are included first; thus, the savings calculation for later measures are performed under the assumption that the earlier measures have already been applied." R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 85.

94. Of course, the potential impact of "behavioral overrides" diminishes as efficiencies improve. *See also infra* text accompanying notes 127–33 (Section IV(C)(3)(d) (discussing the role of conservation in contingency planning)).

95. For an extensive treatment of lighting efficiency options, see D. Goldstein, *Preventing Wasted Light*, THE CONSTRUCTION SPECIFIER, Oct. 1984, at 38.

96. *See id.* (commercial lighting accounts for up to 25% of U.S. peak power requirements).

97. *See, e.g.*, R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 189–90 ("interiors of most commercial buildings are lit at least ten times more brightly than homes").

> [S]olid state ballasts are now widely available and clearly cost-effective; these devices can be added to flourescent lighting systems in existing buildings, reducing the electricity consumption needed to maintain a given level of illumination . . . . Lamps of increasing efficiency and improved color rendition are also being introduced . . . . [A] wider range of occupancy controllers (which shut off lights when a space is unoccupied) and other lighting controls are also available.[98]

Lighting efficiency improvements have obvious implications also for space cooling needs, to which profligate lighting contributes significantly, and street lighting consumption.[99]

For the important end use categories of appliances and furnaces, there are numerous aids to identifying potential efficiency improvements. The "state of the art" for mass-produced units is updated regularly in national surveys by the American Council for an Energy-Efficient Economy,[100] and opportunities for improving current products have been investigated extensively in, for example, proceedings that led to the recent tightening of California's minimum appliance efficiency standards.[101]

The industrial sector will prove the most difficult to include in the "conservation inventory"; most planners understandably will resist assuming the role of all-purpose industrial engineer in order to estimate achievable savings. Nor does the practice of mailing surveys to plant managers commend itself; queries about conservation potential from utilities or regulators may seem threatening and are unlikely to elicit productive investigations.

But planners can induce the industrial sector to prepare such estimates, and more important, to stand behind them. Once the

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98. R. Cavanagh, D. Goldstein, & M. Sullivan, Perfecting the Plan 16 (Nov. 1984) (available upon request from the Northwest Conservation Act Coalition, Seattle, Wash.) (citing sources).

99. The Bonneville Power Administration has extensive experience with street-lighting retrofits, which substitute high pressure sodium vapor, low pressure sodium vapor, or metal halide lamps for existing mercury vapor units. The substitutions produce no reduction in illumination levels. Bonneville Power Admin., U.S. Dep't of Energy, Saving Power: 1984 Conservation Sourcebook 12 (June 1984). Savings from such retrofits average almost 60% if solid state ballasts are installed along with the new lamps. Verderber & Morse, *Energy Savings with Solid-State Ballasted High-Pressure Sodium Lamps*, LIGHTING DESIGN & APPLICATION, Jan. 1982, at 34, 38.

100. Issues of *The Most Energy-Efficient Appliances* can be obtained from the American Council for an Energy-Efficient Economy, 1001 Connecticut Avenue N.W., Suite 535, Washington, DC, 20036.

101. *See* sources cited *supra* in footnote d to Table I.

value of energy savings to the utility has been determined,[102] the utility should hold an auction, in which payments are offered in exchange for commitments to long-term demand reductions. The utility's payments should reflect the present value of saved energy, giving industrial conservation parity with the generators addressed in PURPA.[103]

These outlays would override the fast-payback investment constraint that industries typically apply to conservation. Alternatively, the utility's investment can be seen as a way of converting more cost-effective conservation into a fast-payback proposition for industry, and then relying on that incentive to inspire those best equipped to find innovative conservation opportunities. This is the most reliable way to gauge the industrial sector's efficiency opportunities, and it has the added advantage of translating savings into a contractually-committed resource upon which the utility can rely. Of course, such a program presupposes a rigorous calculation of the value of savings, a problem to which we now turn.

b. Cost-Effectiveness Comparisons

Determining how much conservation is available is not the same as deciding how much a utility should pay for it. Conservation must be cost-effective; it must produce energy at a total cost no greater than that of the most expensive displaceable alternatives. In what follows, I assume that large-scale baseload plants comprise this "priority-displacement" category. The cost-effectiveness criterion requires a methodology for ranking utilities' resource options by reference to expenditure per unit of energy delivered. But we are comparing some very different animals, and the calculation must be alert to the differences.

Consider first the projection of capital costs. The scale, leadtime, and risk-related advantages of conservation argue for two

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102. *See infra* text accompanying notes 104–16.

103. *See supra* note 28 and accompanying text. For a different description of "ways for utilities to make a market in saved electricity," see A. Lovins, *supra* note 89, at 114. Lovins would open the market to all comers, start with a low utility-sponsored bid, and work up gradually to "a market-clearing price, representing an optimal mix of all ways to save or to make electricity." In other words, PURPA's guarantee of "avoided cost" prices would be withdrawn from the generation sector, and conservation entrepreneurs would compete directly with small power producers. An unstated but obvious additional assumption is that utilities would withdraw from the business of building their own power plants, or would build only through unregulated subsidiaries.

significant adjustments here: (1) a higher anticipated escalation rate in construction costs over time for the power plant; and (2) the use of a lower real rate of interest in computing the cost of money for the conservation programs, compared with the power plant. Both of these adjustments can be made by reference to market data. The construction escalation "penalty" for power plants simply reflects recent experience with central station units and conservation materials; costs for the former have been more difficult to control. The Northwest Power Planning Council has determined, for example, that appropriate assumptions for real rates of cost escalation are 1%/year for generating resources and 0.4%/year for conservation.[104]

The use of a higher cost of money for the power plant, compared to conservation, is a proxy for the conservation-related risk advantages that were reviewed earlier. Market data on investments bearing different levels of risk provide a benchmark for making this adjustment. I have argued at length elsewhere that the assumed cost of money for conservation should reflect historical real rates of return on low-risk investments, like highly-rated corporate bonds, while large-scale generating units should be assigned a cost of money drawn from averages for common stocks.[105]

Applying these assumptions to estimates of materials and labor costs will yield the bill for bringing the conservation and generation alternatives on line. Those estimates must, of course, incorporate costs of additional bulk transmission capacity (for the power plant) and administrative and quality control efforts (applicable to both, but sometimes neglected for the conservation programs). Adjustments should also be made for quantifiable environmental costs that are not reflected in project balance sheets. Statutory requirements for such adjustments in the Pacific Northwest have elicited some progress in what all concede to be an extremely difficult undertaking.[106] Clearly,

104. *See* Northwest Power Planning Council, 1985 Power Plan Issue Paper: Assumptions for Financial Variables 3 (Jan. 1985) (relying on Wharton-projected escalation rates for "Fixed Investment—Nonresidential" and "Fixed Investment—Residential" structures). California regulators assume 1.5% annual real escalation for coal capital costs, and 2–14% per year for nuclear. California Energy Comm'n, Relative Cost of Electricity Production 14 (July 1984) (P300-84-014).

105. *See* D. Goldstein & R. Cavanagh, Discount Rates for Cost-Effectiveness Comparisons, in R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at app. 1. Typical "low-risk" returns historically have averaged 1–2% real, compared with 3.5%–6% for investments with risks comparable to those of common stocks.

106. Under the Pacific Northwest Electric Power Planning and Conservation Act,

> [t]he task compels the development of answers to some agonizing questions . . . . There is also a continuing temptation to throw up one's hands at costs subject to great uncertainty—until one realizes that . . . not to decide is to decide. Of all the economic values that might be assigned to a range bounded by zero and several billion dollars, zero is the least appropriate result.[107]

One further series of adjustments on the conservation side bears special emphasis: it has proved perilously easy either to abuse or indulge conservation through a popular set of inaccurate assumptions. These include understating the average performance and operating lifetimes of conservation measures.

> For purposes of calculating the cost-effectiveness of residential insulation and glazing, [the Puget Sound Power and Light Company] assigns these measures a lifetime of 25 years . . . . That is equivalent to suggesting, implausibly, that the thermal performance of a house built in 1961 is unaffected today by whether the builder installed insulation and multiple-pane windows.[108]

By contrast, "the Northwest Power Planning Council has recently selected 50 years and 30 years as the average lifetimes to be used for retrofit insulation and glazing, respectively, in cost-effectiveness analyses."[109]

But conservation can also be indulged improperly in such analyses, if measure costs are not adjusted upward to reflect administrative and quality control expenditures. A cost associated with any sound residential conservation program, for example, reflects spot checks of installations by contractors who receive utility payments; by the same token, the bill for regulatory initia-

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cost-effectiveness analysis of conservation measures and generating resources for the Northwest region must encompass "quantifiable environmental costs and benefits . . . [that are] directly attributable to such measure or resource." 16 U.S.C. § 839a(4)(B) (1980). For an intriguing example of estimates produced under the Act, see Biosystems Analysis, Inc., Methods for Valuation of Environmental Costs and Benefits of Hydroelectric Facilities: A Case Study of the Sultan River Project (June 1984) (DOE/BP-266) (report prepared for the Bonneville Power Administration).

107. R. Cavanagh, D. Goldstein & M. Gardner, *supra* note 60, at 50–51.

108. Testimony of Ralph Cavanagh on Behalf of Public Counsel, Before the Washington Utilities & Transportation Commission, Washington Util. & Transp. Comm'n v. Puget Sound Power & Light Co., Cause No. U-85-53, at 11 (Jan. 31, 1986) [hereinafter cited as Testimony of R. Cavanagh]; *cf.* Krause, *The Conservation Pipeline*, Soft Energy Notes, Nov./Dec. 1982, at 123, 124 (citing German study concluding that inert insulation material lasts about 50 years if properly installed).

109. Testimony of Ralph Cavanagh, *supra* note 108, at 11.

tives like building codes must include the hiring and training of inspectors.[110] However, in evaluating measures that admit of different degrees of intensity (like insulation or glazing), the administration/quality control surcharge should be applied *only* in evaluating the initial increment of conservation; subsequent increments (*e.g.*, inches of insulation or panes of glass) will not require corresponding increases in these costs.[111]

This process yields construction cost estimates for conservation and generation alternatives. A final adjustment is needed to reflect the avoidance of line losses and additional reserve requirements associated with the conservation measures. Large fractions of the power plant production—unlike the conservation savings—will be lost in transmission or tied up in providing expanded reserves for a larger electric generation network responsible for meeting larger total system needs. Finally, to the extent that any of the conservation or generation alternatives requires operation or maintenance expenditures, these should be calculated, reduced to present value, and added to the estimate of total resource costs.

Where the analysis moves from here depends on whether the alternatives are being evaluated as peaking or energy resources (or both).[112] Most North American systems currently are peak-constrained; that is, projected shortages in peaking capacity occur prior to their counterparts for energy.[113] However, if the sole concern is dealing with anticipated consumption spikes, load management options or low-capital-cost peaking units may be superior to *either* baseload generation or conservation investments. Accord-

110. *See* R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 125–26 (proposing cost and quality controls for regional conservation programs). Oregon's Hood River Conservation Project has developed invaluable experience with quality controls for "mass-produced" super-insulation retrofits. E. Hirst & R. Goeltz, Participation in the Hood River Conservation Project (Draft) 15 (Aug. 30, 1985) (available upon request from the Oak Ridge National Laboratory) ("After each contractor's work is completed [Project] staff inspect the home to ensure that the correct measures were properly installed. If the work passes inspection, the contractors are paid. If not, the contractors return to the house to rectify the installation problems and the inspection is repeated.").

111. The Northwest Power Planning Council has recently reached the same conclusion. *See NPPC Reassesses Resource Costs,* NORTHWEST CONSERVATION ACT REP., Dec. 23, 1985, at 1, 2.

112. Peaking capacity is used only intermittently, to meet a system's highest demands over the course of a year; energy (or "baseload") resources are run as close to continuously as possible, to supply demand at or below average levels.

113. The only exceptions are hydro-dominated systems like that of the Pacific Northwest; "if energy loads exceed the firm energy capability of the [hydro] system during a period of adverse flows, there is no way in which demands can be met, regardless of how much installed hydropower capacity is available." 2 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at B-4.

ingly, it is sensible to evaluate baseload units and the conservation alternatives from an energy standpoint, by developing estimates of life-cycle costs per kilowatt-hour. Further adjustments can be made subsequently, if desired, to credit or penalize conservation measures with output patterns that are better or worse than new baseload plants from a peak power production standpoint.

The energy cost comparison itself is straightforward; estimated total costs for each alternative, calculated as described above, should be amortized over the lifetime of debt instruments available to finance the resource or the lifetime of the resource (whichever is less), using a constant real-dollar ("levelized") payment schedule. The rate of interest assumed for purposes of setting the payment schedule should vary with the level of risk associated with the resource, as indicated earlier.[114] The annual payment determined through use of these methods is then divided by the annual production of kilowatt-hours anticipated from the resource to yield a levelized cost per kilowatt-hour.[115]

The cost assigned to new baseload generation sets the "cost-effectiveness threshold" that conservation measures must meet in order to secure a higher priority on the utility's investment agenda.[116] Armed with this information, the utility can then complete the conservation resource inventory described above.[117]

c. Implementation Goals and Strategies for Conservation

The amount of conservation that is worth buying is not synonymous with the amount of conservation that a utility can realistically expect to secure. No incentive program is likely to achieve 100% participation; no regulatory measure is likely to elicit 100% compliance. In determining how much of the cost-effective conservation resource can be developed, planners must be alert to such constraints.

But planners can draw on a wide range of precedents for improving on the relatively disappointing record compiled to date

114. *See supra* note 105 and accompanying text.

115. Here a clean break is needed with a history of excessively optimistic assumptions about reliability and operating lifetimes. *See* Cavanagh, *supra* note 72, at 156 n.92, 167 n.117.

116. Lower thresholds may be appropriate for systems whose resource plans anticipate no new large-scale plants under any foreseeable circumstances; what matters, again, is the cost of displaceable resources. Under some deregulation scenarios, the market could set that figure. *See infra* text accompanying notes 134–35 (Part V).

117. *See supra* text accompanying notes 93–103 (subsection IV(C)(3)(a)).

by many utility conservation programs. To begin with, the efficacy of incentives—altogether unsurprisingly—depends in large measure on the extent to which they require the consumer to produce out-of-pocket the capital payments needed to secure a stream of savings.[118] Yet any conservation that is cost-effective, under the test developed earlier, is worth buying—from the standpoint of the utility system—without *any* contribution from the end user. This sets the stage for overwhelmingly attractive incentive programs, where the utility pays the full price of cost-effective efficiency improvements, subject, of course, to quality control inspections and—where necessary—safeguards to ensure that anticipated savings actually materialize.[119] The incentives can be extended to audiences as diverse as commercial building owners, industrial plant managers, homeowners and landlords, appliance purchasers, and municipal street lighting departments. Of course, such conservation is not "free"; the ratepayers as a whole foot the bill, and as a result are spared a larger bill for alternative energy supplies.

Moreover, many end uses are amenable to relatively unintrusive state regulation that offers further assurances concerning dispersal and realization of conservation benefits. Obvious examples include conservation-oriented appliance standards, building codes, and conversion standards for structures that switch to electric heating.[120] Other possibilities include requirements that structures

118. *See infra* note 124. An instructive illustration recently emerged in the Pacific Northwest, where an Oregon weatherization program offering 100% reimbursement to all participants decisively outperformed a Washington initiative that paid 70% of conservation costs. In Oregon, almost 90% of households audited by utilities subsequently added extensive utility-financed conservation measures; the Washington figure was less than 60%. *See* Testimony of R. Cavanagh, *supra* note 108, at 13–15.

119. I have already referred to the practice of negotiating downward adjustments in utilities' contractual obligations to large users that receive conservation payments, a proposal that—at least in the Pacific Northwest—had its origins in the industrial sector itself. *See* Kaiser Aluminum & Chem. Corp., Industrial Conservation and Power Proposal (Dec. 1984). The Tennessee Valley Authority has created almost 140 MW of assured savings through this device. TENN. VALLEY AUTH., ENERGY MANAGEMENT ANNUAL REPORT 30 (fiscal year 1983). For smaller but still substantial users in, *e.g.*, the commercial sector, an alternative is to allocate conservation payments through a formula that bases part of the total utility payout on metered consumption reductions. *See* R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 205.

120. The best models for building codes designed to minimize life-cycle energy costs for consumers are the Northwest Power Planning Council's Model Conservation Standards and California's residential and commercial building standards. *See* 2 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at app. J; CALIFORNIA ADMIN. CODE, tit. 24, §§ 2-5301 to 2-5307, 2-5351 to 2-5352, 2-5361 to 2-5365 (1979).

Conversion standards were an integral part of the initial Northwest Conservation and Electric Power Plan (1983). "[I]t does little good to require that all new . . . buildings using meet minimum "weatherization" standards at the time of sale, and limits on background lighting levels in existing commercial buildings.[121] Utilities can increase the efficacy and political attractiveness of many such regulations by paying at least part of the costs of enforcement and compliance; again, such payments buy relatively inexpensive energy supplies.[122] If state authorities are prepared to invoke proven incentive and regulatory options, planners can reasonably rely on seventy-five to ninety percent of the cost-effective conservation potential that they are able to identify.[123] Program design should not neglect distributional considerations;

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electricity for space conditioning satisfy . . . conservation standards, if buildings that are not built with electric space conditioning can be converted to electricity freely." 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 10-14; *see also* 2 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at app. L ("Efficiency Standards for Conversion to Electric Space Conditioning").

121. *See* R. CAVANAGH, D. GOLDSTEIN & M. GARDNER, *supra* note 60, at 360–61 (discussing mandatory time-of-sale weatherization standards in Wisconsin, Minnesota, and numerous California jurisdictions); *id.* at 208 (proposing standards for background lighting in existing commercial buildings).

122. For example, the Northwest Power Planning Council has directed utilities to defray a number of the costs associated with building code reform, including (1) developing consistent procedures for certifying compliance; (2) educating builders, designers, architects, and code officials; and (3) paying "the incremental cost above that required to meet current code for a sample demonstration of houses built to the [new] standards." 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 10-10 (residential building code), 10-13 (commercial building code).

Payment of the third type of costs is not appropriate for conversion standards,

> because of the danger that the payments themselves will induce conversions that otherwise would not occur. Analogous fuel-choice concerns are raised by incentives for building high-efficiency *new* structures that heat with electricity, but there is a crucial difference: a choice among heating fuels, with electricity prominent among them, *must* be made for every new building; no such absolute compulsion to entertain the electricity option looms for existing buildings that heat with other fuels.

R. Cavanagh, D. Goldstein & P. Miller, Comments of the Natural Resources Defense Council on the Model Conservation Standard Amendments Proposed by the Northwest Power Planning Council 31 (Sept. 13, 1985) (available upon request from the author).

123. The Northwest Power Planning Council has concluded that its four-state region can realize 75% of the cost-effective conservation potential for all sectors, 90% of the potential for improvements in the efficiency of existing buildings, and 85% of the potential for residential space heat savings. 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 7-1, 7-2, 7-7. California inspections peg building code compliance at 75–85% and 85–95% for residential and nonresidential buildings, respectively. Letter from Gene Mallette, California Energy Commission, to Margie Gardner, Natural Resources Defense Council (Mar. 18, 1983) ("The percentages of compliance represent the energy saved out of the total amount of energy which could be saved"). Oregon's Hood River Conservation Project is an example of a large-scale incentive program that reached more than 75% of its target population; the sponsors convinced more than 90% of an Oregon county's 3282 eligible households to participate. *See supra* note 78.

special outreach and monitoring efforts will be needed to ensure that low income families receive an equitable share of conservation benefits.[124]

Actual scheduling of conservation acquisitions is in large part contingent on the demand forecast described earlier. There is no reason to undertake conservation purchases or regulation in advance of system needs (including export commitments), except in cases—like building code reform—where a failure to act promptly will result in the irretrievable loss of long-lived savings.[125] Systems enjoying such a grace period can profitably employ what the Northwest Power Planning Council has termed "capability-building" projects, which ensure that programs for all end use sectors are fully designed and tested in advance of large-scale application.[126]

d. Contingency Plans

The nightmare of every energy planner is the moment when the needs of the system overwhelm available supplies, forcing interruptions of service. Historically, such crises have reflected a breakdown in transmission or distribution systems, not a failure to develop adequate generation.[127] But the importance of being ready to cope with either eventuality prompts a few additional observations here.

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124. For example, utility investment programs for the residential sector that are limited to loans or partial grants effectively exclude participation by indigent households. *See* R. Cavanagh, D. Goldstein & M. Gardner, Comments of the Natural Resources Defense Council on the Northwest Power Planning Council's Draft Regional Conservation and Electric Power Plan, app. E, at 12–18 (Mar. 18, 1983) (reviewing studies of such programs, which uniformly find "[p]articipation rates [that] have been rather disappointing in general . . . and are particularly low for indigent households, seniors, and renters"). In response to these concerns, the Northwest Power Planning Council has called for utility-financed residential conservation programs that "pa[y] 100% of the actual cost of all structurally feasible and regionally cost-effective conservation measures for low income households [defined through a formula keyed to median city or county household income]." 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 10-7.

125. Examples of "irretrievable losses" include failures to incorporate high efficiencies in new major appliances (12–20 year lifetimes) and the design of new buildings (50–100 year lifetimes). Unless projected surpluses extend beyond such periods, which is unlikely, to defer acquisition of conservation savings is either to lose them or render them much more expensive. *See, e.g.*, 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 5-11.

126. *See* 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 10-1 to 10-18 (describing numerous "capability-building" programs for all major end use sectors).

127. *See, e.g.*, A. LOVINS & H. LOVINS, BRITTLE POWER 127–40 (1982) (reviewing history of major system failures).

First, much conservation is itself a species of contingency planning. Thermally efficient residences and commercial buildings are far better equipped to ride out an interruption than structural sieves. The concern that inhabitants of efficient structures will turn up the thermostat as their bills drop should be balanced by appreciation of their increased ability to sustain consumption reductions.

Moreover, not all methods for coping with residual uncertainty require purchases of back-up conservation or generation. The Pacific Northwest has pioneered the development of dual-fuel industrial loads that can switch from electricity to gas (or, of course, vice versa) if system needs dictate.[128] A number of utilities are investigating or exploiting other load management strategies, including the cycling of refrigerators, air conditioners and water heaters;[129] commercial sector heat storage;[130] and purchased interruption rights.[131] Cumulatively and individually, such options il-

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128. *See* Bonneville Power Admin., U.S. Dep't of Energy, *Revised Proposed Nonfirm Energy Policy for Consumer Alternate Fuel Loads*, 49 Fed. Reg. 35,853 (1984); *see also* 1 NORTHWEST POWER PLANNING COUNCIL, *supra* note 58, at 5-12 (estimating Northwest potential for dual-fuel loads at industrial boilers at 900 to 1400 average megawatts).

129. "In 1983, U.S. utilities controlled more than 600,000 water heaters and 500,000 air conditioners through signals carried over the transmission lines, by a radio signal, or through a cable-television link." R. MUNSON, *supra* note 24, at 185. As of November 1984, the Tennessee Valley Authority alone had induced almost 40,000 electric water heat customers to install utility-controlled load management devices. Maize, *TVA Preaches Gospel of Thrift*, The Energy Daily, Nov. 16, 1984, at 4, col 1. For a description of new devices that will cycle refrigerators and freezers off the system for periods of up to 30 minutes, see A. Rosenfeld, Shifting Peak Power: At the Meter, Beyond the Meter, and at the Checkbook (May 22, 1985) (Lawrence Berkeley Laboratory, Rep. No. 19,135, presented at the Pacific Gas & Electric Energy Expo).

130. Heat storage involves heating a storage medium during offpeak hours and using this medium to provide some or all of the space heating required on peak. This technology "has been used successfully in Europe for more than 20 years, in some cases increasing the daily utility load factor to as much as 98%." V. Rabl, Technology for Load Management 6 (1985) (available upon request from the Electric Power Research Institute). U.S. utilities are now funding tests of inexpensive heat storage media available at $10/ton or less. *Id.*

131. I use the term "purchased interruption rights" to refer to utilities' acquisition of options to shed loads temporarily in amounts and for durations that are selected by utility customers. For example, the Southern California Edison Company uses "monthly rebates to major industrial customers for each KWp by which they will allow themselves, in rare power emergencies, to be curtailed to a threshhold which they themselves choose in advance." A. Lovins, Saving Gigabucks With Negawatts 10 (Nov. 1984) (address to National Association of Regulatory Utility Commissioners). A similar Houston Lighting and Power Co. program is described in Gorzelnick, *Utilities Point to Innovative Approaches*, ELECTRICAL WORLD, June 1984, at 87, 88. The same results can be achieved through discounted sales of power that are characterized explicitly as interruptible, which have accounted for up to 900 MW of industrial sales (and system reserves) in the Pacific Northwest. Pollock Testimony, *supra* note 36, at 43.

lustrate cheaper ways to ensure against unlikely-but-possible system interruptions than stockpiling surplus generating capacity.

The same considerations apply, of course, to coping with unlikely-but-possible escalations in demand. Traditionally, electric utilities have launched large-scale generating projects a decade or more in advance of need, to ensure that adequate supplies will be on hand to meet a sustained series of annual consumption increases.[132] The erosion of forecasting certainty over the last decade, which conservation can reduce but not eliminate, counsels utilities to investigate more flexible and inexpensive ways to meet surges in system demand. That suggestion is reinforced by indications that the generating technologies now favored by utilities may be obsolete before new power plants can serve out their useful lives.[133]

In sum, an inventory of potential contingency measures for all consumption sectors merits high priority for utilities. Specifically, planners should adjust their "jaws" forecast of post-conservation needs to reflect the extent to which "high case" peak and energy consumption can be shifted to other fuels, reshaped, or interrupted at lower cost to the regional economy than new generating capacity. The end-use data base used to develop the forecast will pay extra dividends here, because the contingency alternatives tend to be specific to particular uses (*e.g.*, water heating, commercial sector heating and cooling, and industrial boilers). As in the conservation analysis, two questions are relevant: How much potential is there? And how much of that potential can we reasonably expect to exploit? Again, the cost of avoidable generation sets the limit on appropriate incentives, which should permit a large number of offers that are too compelling to refuse.

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132. *See supra* note 58 and accompanying text. In the words of Charles Luce, who has headed two of the nation's largest utilities:

> The future fascinates the utility industry. This is because of the way we do things. Nearly every day we plan projects or discuss operations to meet needs that will occur five or ten years hence. We plan to deliver power from generating plants that are still under construction over lines still on drawing boards to suburbs and industrial plants as yet unbuilt.

Address by Charles Luce, Administrator, Bonneville Power Administration, Before the Northwest Public Power Association's Annual Convention 2 (Apr. 3, 1964).

133. *See supra* note 20.

V. Overcoming Institutional Constraints on Effective Least-Cost Planning

One of the strengths of the methodology advanced above is its adaptability to diverse institutional contexts. North America has yet to produce a regulatory body whose jurisdictional boundaries encompass the whole of a multi-state power pool, and whose authority encompasses all the key elements of least-cost resource planning, including efficiency standards and investment priorities. But we need not await that ideal in order to put these principles to work; every state and utility is large enough to benefit from the least-cost planning techniques described in this article. Indeed, such planning could find a place under even the most extreme model of utility deregulation, where the only monopolies still under state control are distribution companies shopping for power on the open market. Those regulating the distributors would be wise to inquire, for example, whether state-enforced building codes could provide cheaper and more secure power supplies than forseeable contractual arrangements—or whether the kilowatt-hours covered by the distributors' next expiring power purchase contract could be conserved more cheaply than they could be replaced.

As long as utilities retain something like their present form, however, the evolution of regional institutions is the best hope for an effective state regulatory presence.[134] The logic of the grid is inimical to insular prejudices. The choice is not whether we will have regional planning; utilities quietly resolved that issue years ago. Rather, the issue is whether regional planning will remain the exclusive province of utilities—and whether, as a result, opportunities will go on being squandered for applying many of the most effective least-cost planning tools to the management of electricity demands and supplies.

Some might see in this plea for regionalism the prospect of unacceptably concentrated authority, smacking of centrally-planned economies and similar anathemas. But it is not the pre-

134. The first tentative step in that direction is the four-state interstate compact to which Congress consented in the Pacific Northwest Electric Power Planning and Conservation Act, Pub. L. No. 96-501, 94 Stat. 2697 (1980) (codified at 16 U.S.C. §§ 839–839h (1982)). Legislation anticipating a proliferation of such compacts is debated at length in *Regional Electric Power: Hearing on H. 5766 Before the Subcomm. on Energy Conservation and Power of the Comm. on Energy and Commerce*, 98th Cong., 2d Sess. (1984).

rogatives that are new, just their orchestrated application. And the divided authorities whose combination is envisaged here are in no sense now operating after the fashion of checks and balances. A more appropriate analogy is the right hand that is ignorant of what the left is doing. The building code official, appliance manufacturer, utility power manager, commercial lighting designer, and insulation contractor can do far more for their constituents and society by collaborating than by working at cross-purposes.

Indeed, by working at cross-purposes they have already contributed to some of the most expensive planning and investment mistakes in American history.[135] Jurisdictions that move decisively to embrace risk-management and cost-minimization principles will secure an enduring competitive advantage. The universal appeal of the ensuing financial gains may provide the best ground for optimism about our collective electrical energy future.

135. *See supra* note 11 and accompanying text.