June 9, 1986

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of:	)	
	)	
Carolina Power & Light Company and NC Eastern Municipal Power Agency	)	Docket No. 50-400 OL
	)	
(Shearon Harris Nuclear Power Plant)	)	

COMMENTS ON IMMEDIATE EFFECTIVENESS REVIEW OF FINAL LICENSING BOARD DECISION

Now come the Conservation Council of North Carolina (CCNC), Mr. Wells Eddleman (pro se), and the Joint Intervenors with comments on the Commission's 2.764(f) "immediate effectiveness" review of the Final Licensing Board Decision in the above-captioned docket. CCNC and Mr. Eddleman are Intervenors in this docket while the Joint Intervenors consist of several of the Intervenor groups and individuals as proponents of certain consolidated contentions. A thirty-day extension of time was requested on May 7, 1986, for the filing of these comments which was granted by the Commission.

It is our understanding that comments for the Commission's "immediate effectiveness" review are less formal than required in filings such as appeal briefs as they are presented primarily to guide the Commission in looking at specific problems which not only effect the safe operation of this plant but also have more generic applications to the licensing process as a whole. We of course do not wish to abandon any issues we have raised below and further urge the Commission to also review the appeals we have made on the various Partial Initial Decisions made by the Licensing Board as well as the appeal of the Final Decision, dated June 9, 1986, to the Appeal Board. LBP-85-5, 21 NRC 410 (1985); LBP-85-28, 22 NRC 232 (1985); LBP-85-49, 22 NRC 899 (1985); Final Licensing Board Decision, ___NRC___ (April 28, 1986).

We are convinced that the Harris Plant cannot be operated without endangering the health or safety of the public or in compliance with applicable NRC regulations as required by 10 C.F.R. 50.57(a). A review of the issues that the Intervenors have raised along with the supporting material in the record shows clearly that after a full and fair hearing on the merits of the Harris plant, it should not be licensed. The following comments support this position:

I. Alternatives to Harris.

10 C.F.R. 2.764(f)(1)(ii) seeks the identification of "close questions" which are "serious" from an environmental or safety standpoint and subpart (2)(ii) allows the parties to file brief comments on such issues.

Obviously the most important environmental issues concerning a nuclear plant operating license is whether there is an environmentally and economically superior alternative to its operation. If the reactor operates even at a small fraction of full power, the adverse environmental impacts accumulate, such as the contamination of the plant and surrounding area and the production of nuclear waste. Therefore, when such an economically and environmentally superior alternative exists, the plant must not be allowed to operate at all.

A viable alternative to the Harris nuclear plant exists, one that saves more money and displaces more energy from coal-fired generation than Harris could if operated. This alternative not only reduces peak demand by nearly three times the Harris plant's design target output (2600 MW demand reduction vs. 900 MW design target output of Harris), it displaces more energy than the Harris plant is likely to produce. (The NRC staff estimates that the Harris plant output will be 868 MW at 55% capacity factor for 4182 GWH per unit per year. Harris FES, NUREG-0972, p. 6-2. The alternative saves 4338 GWH per year). With the considerable energy savings from the alternative, the Harris plant is simply not needed to serve growth in peak demand.

The alternative, when compared to displacing coal-fired generation by the use of Harris, also would save considerably more money. (Indeed, Applicants' estimates of saving may include some of the oil-fired power being displaced also. See Harris Environmental Report, Section 8, Amendment 5, filed by Applicants' in 1982). The alternative saves over $6 billion (in '82 dollars) compared with a saving of only $2 billion (in '82 dollars) from displacing coal with the Harris plant. This does not consider the external environmental impacts and costs that an operating nuclear power plant would have.

This was shown prima facie in a section 2.758 petition and supporting affidavits filed by Mr. Eddleman, on June 30, 1983. The Licensing Board's errors in ruling against the petition are discussed on pages 24 - 33 in Intervenors' Appeal from Partial Initial Decision on Environmental Contentions, dated April 4, 1986, and do not need repeating here (although we would urge the Commission to review those arguments closely).

What does bear repeating, in light of the Appeal Board's questions at oral argument, is that one need only compare the alternative to Shearon Harris for the purpose of displacing coal-fired generation. One need not show that the alternative can eliminate all of the utility's coal-fired generation. Obviously, if the alternative to Harris can displace coal-fired generation more economically and with less environmental impact than the Harris plant can, it therefore displaces that amount of generation in an economically and environmentally superior manner. The alternative thus meets the special circumstances referred to by the Commission in adopting the "need for power" rule. At 47 F.R. 12940, the Commission stated:

> ...at the time of the operating license proceeding the plant would be needed to either meet increased energy needs or replace older less economical generating capacity...(and) this conclusion is unlikely to change even if an alternative is shown to be marginally environmentally superior in comparison to operation of a nuclear facility because of the economic advantage which operation of nuclear power plants has over available fossil generating plants. An exception to the rule would be made if, in a particular case, special circumstances are shown in accordance with 10 C.F.R. 2.758 of the Commission's regulation.

Again, not only is a prima facie case made in the original petition and supporting affidavits, that case is explained fully enough for favorable review in the Appeal of April 9, 1985.

Strengthening this position is that the fact that, at hearing on such alternatives, evidence has now been developed which shows that the costs of alternatives are considerably less than shown in the 2.758 petition, giving the alternative an even greater economic advantage over operation of the Harris plant. (The attached article, "Negawatts: A Practical Remedy for MegaGoofs," presented by Amory Lovins to the National Association of Regulatory Utility Commissioners in November 1985, explains the costs of alternatives in more detail.) Since consideration of the alternative would allow the environmental impacts of operating the Harris nuclear plant to be avoided, and save more money than its operation possibly could save (as its savings only the displacement of fossil-fueled generation), this issue is particularly apt for Commission review before any operating license, even a low-power one, is issued for Harris.

II. Management capability.

At the first prehearing conference of the operating license proceedings, all parties stipulated to the admission of Joint Contention 1 (Management Incapability). The contention read as follows:

> The Applicants have not demonstrated the adequacy of their managing, engineering, operating and maintenance personnel to safely operate, maintain and manage the Shearon Harris Nuclear Power Plant as evidenced by their record of safety and performance at their other nuclear power facilities. A pattern of management inadequacies and unqualified and/or inadequate staff is likely to be reproduced at Shearon Harris Nuclear Power Plant and result in health and safety problems.

In brief, the contention questions the Applicants' ability to safely manage another nuclear plant in light of the poor practices at its other plants, most notably the Brunswick nuclear units.

Management capability was not a new issue as it had been raised repeatedly over the course of the Construction Permit proceedings and before State regulatory agencies. It was the subject of the so-called 1979 remand hearings on management focussing on issue raised by an NRC inspector who had alleged that his concerns over the Applicants' mismanagement had not been properly addressed at the earlier hearing. Carolina Power & Light Co. (Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4), LBP-79-19, 10 NRC 37 (1979). Upon appeal, the Staff were directed to make a full analysis of the managerial changes undertaken by the Applicants in response to NRC criticisms. ALAB-577, 11 NRC 18, 36 (1980); CLI-80-12, 11 NRC 514 (1980). A sketchy assessment was made in mid-1981 which concluded that changes by the Applicants "have improved management controls at the sites." Exhibit JI-38; Joint Intervenors' Proposed Findings 5, 94 and 95, January 9, 1985.

A two-week hearing was held September, 1984, with the Joint Intervenors placing considerable documentary evidence through cross-examination into the record about the Applicants' record of mismanagement. A telling example centered around the numerous violations leading to a $600,000 fine which the Applicants received on February 18, 1983, for "a breakdown in corporate and facility management controls in the areas of corporate oversight, facility management and operations, and problem identification and correction." Transmittal letter to EA-82-106; Exhibit JI-18. This complete lack of management controls which lead to the fine came after the earlier Staff assessment and despite repeated promises to the Staff that the Applicants would do better in the future. The conclusion was made by the Licensing Board that the Applicants had not made any real progress up to that point. Carolina Power & Light (Shearon Harris, Unit 1), LBP-85-28, 22 NRC 232, 245 (1985).

The Licensing Board relied heavily on the testimony of one member of the NRC Staff in reaching its conclusion that although the Applicants had had management problems in the past, it had made "dramatic" progress. This Staff member, Mr. Bemis, had been given the unusual assignment by the Region II Administrator in the fall of 1983 of overseeing the necessary changes the Applicants needed to make in order to break out if their "fossil mentality" to one needed by a well-managed nuclear utility. (This characterization was part of Mr. Bemis's conclusion that there were real problems with the management of Applicants' nuclear plants when he began his position). LBP-85-28, 22 NRC 232, 241 ff. (1985).

The most important overall review of the Applicants' management is in the Systematic Assessment of Licensee Performance--the SALP reports. The four reports available at the time were entered into the record, with the first three underscoring the repeated failures of Applicants' management to respond to and solve safety problems. The fourth, issued only days before the hearing, gave Applicants higher marks in most areas and concluded that there had been considerable and positive change. Mr. Bemis was the editor and principal author of the fourth SALP and thus had the duty of both working with the Applicants to make management changes to become more effective as well as writing the report card for the Applicants which purported to document those "beneficial" changes. The Licensing Board relied almost totally on Mr. Bemis's conclusions in making its own decision.

The Joint Intervenors raised the issue of Mr. Bemis's conflict of interest at the hearing, in proposed findings of fact, and on appeal to the Appeal Board (which has not ruled on the issue yet) of the apparent conflict of interest of Mr. Bemis having as his primary responsibilities both insuring that the Applicants were doing better and assessing their progress. This has the taint of impropriety, the purported progress made by the Applicants as evidenced in the fourth SALP report also put Mr. Bemis in a good light ("he did what he was supposed to do.")

III. Lack of finality of Final Decision.

The Final Licensing Board Decision was not addressed all of the issues raised by Intervenors. The Decision at page 185, footnote 50, states that there is one unresolved matter dealing with incidents of harassment; a Memorandum and Order, dated May 22, 1986, was issued on these matters. Another matter, a late-filed contention alleging the falsification of dose records, was filed on April 22, 1986, before the issuance of the Final Decision, and has also not been acted upon to date. (These will be addressed more fully in our Appeal From Final Licensing Board Decision.)

It has also just come to our attention through newspaper accounts and a letter from Applicants' Counsel to the Appeal Board that one of the counties within the EPZ, Chatham County, withdrew from the Emergency Response Plan on March 27, 1986. (It is also possible that other counties will do so in the future as they realistically assess the resources they will need to comply with the Plan.) We intend to raise this as a new contention in the next week as it has a significant effect on the entire Emergency Plan as changes must be made and any new plan must be field tested. (See section VI. infra).

Thirdly, many issues concerning Applicants' ability to safely manage the plant (see part II. above), plant safety, (such as specific construction defects and drug abuse during construction), and the entire emergency planning area have been appealed to the Appeal Board. It is likely that one, if not more, of these contentions will be remanded for further hearings or that the Licensing Board will be reversed on appeal.

There are several regulatory and policy reasons why a Licensing Board should not issue its Final Decision before hearing all matters which are raised: the first is the obvious one that the Board was established to hear all matters relevant to the safe operation of the nuclear plant and thus should not remove itself before all is considered. The second is that the Board cannot make its final determinations of 10 C.F.R. 50.57 that the plant will be safely operated in compliance with NRC regulations until all matters are resolved. Thirdly, this Licensing Board, as opposed to a newly constituted one, is most familiar with the record of the case.

IV. Major Meltdown.

The NRC Chairman has recently informed a Congressional committee that there is a 12% chance of a major core-damage accident in an American reactor within the operating life of the Harris. Commissioner Asselstine, among others, has testified that there is a much higher likelihood of an accident beyond the design basis of the plant, at one of the United States reactors in the foreseeable future. This threat needs to be considered at the Harris plant because of the potentially substantial health, environmental, and economic impact such a release would have on the surrounding population and property (the issue was not addressed as it was seen as a challenge to the regulations).

Neither the Licensing Board not the Commission can fulfill the mandate of the Atomic Energy Act to put health and safety first unless such accidents are then considered before operating licenses are granted. So far, the only consideration has come after the accident at Three Mile Island. It will be far too late, after the next accident, especially one of the magnitude of Chernobyl, to consider it then.

Mr. Sherwood Smith, Chairman/President/CEO of Carolina Power & Light, is reported on June 8, 1986, by the NEWS & OBSERVER of Raleigh, NC, to not believe the chance is present for any accident beyond design basis. If that is the company's attitude (e.g. "it can't happen here") then it will not take any steps to guard against it. This is the exact attitude that Soviet engineers and administrators said about Chernobyl before its accident in SOVIET LIFE magazine, February 1986, as follows:

> Nikolai Fomin, the plant's chief engineer, believes that man and nature are completely safe. The huge reactor is housed in a concrete silo, and it has environmental protection systems. Even if the incredible should happen, the automatic control and safety systems would shut down the reactor in a matter of seconds. The plant has emergency core cooling systems and many other technological safety designs and systems.

The NRC was criticized by the Rogovin Report on Three-Mile Island for taking the same attitude. The NRC cannot expect greater diligence among its licensees than it requires by rule or example.

Intervenors are likely to prevail on this issue as the Harris plant and its safety systems are not designed to cope with any major accident even though the chances are <u>real</u>.

V. Ten-Mile Emergency Planning Zone

A recent Appeal Board decision, after discussing both the generic problem with the ten-mile EPZ and the site-specific problems associated with any one reactor, allowed Intervenors to supplement the record with further evidence as to the necessity of adjusting the plume EPZ radius. LILCO (Shoreham, Unit 1), ALAB-832, ___NRC___ (March 26, 1986). We would urge the Commission to not only allow such additional evidence in that docket but to increase the possibility for all plants of adjusting the planning area for evacuation to reflect population and transportation considerations.

A ten-mile Emergency Planning Zone for evacuation is unrealistic in light of the Chernobyl accident in the Soviet Union. It makes no difference of the exact mechanism of the accident and the resulting release, what is important that a major release, any significant percentage of the radioactive waste or fuel at the plant, can and will effect persons and property far beyond any artificial ten-mile radius around the plant. Both Chernobyl and NUREG CR-2230 show that serious "health effects," including death and cancers, can result from the release of a significant amount of a nuclear core's radioactive inventory.

Of special concern are localities, such as the densely populated areas primarily to the north and west of the Harris EPZ, just beyond the ten-mile limit. Intervenors had raised contentions below both challenging the ten-mile radius and requesting that cities, such as Cary and Raleigh, become part of the evacuation area because of their proximity to the plant and evacuation corridors. The Licensing Board rejected Eddleman Contentions 57-C (revised) and 57-C-2 as challenges to the rule in the Harris proceeding, although these contentions could, and should, have been narrowed to the parts of them (e.g. including the adjacent densely populated areas in evacuation planning) that are admissible under ALAB-832.

Intervenors are likely to prevail on this issue. Recently several of the localities just outside the ten-mile radius which have demanded that they become part of the Emergency Plan because of the potential impact of a major release on their citizens. Everyone that can be adversely affected by a release of radiation should be protected; careful planning for evacuation now can save lives in the future.

V. Nighttime Notification in EPZ.

The matter of notification of residents of the plume EPZ is ripe for Commission review based on the considerations raised at the hearing on Eddleman Contention 57-C-3. Although the errors in the Licensing Board's Final Decision will be addressed in our Appeal we must emphasize here the extreme difficulty the Applicants will face in notifying people living in the EPZ.

In its study of the siren system around the Harris plant, FEMA concluded that the sirens supplemented by informal alerting (a questionable practice at best) would only be expected to arouse and alert only 90% of the EPZ residents. The Licensing Board, after discussion among the parties, required tone alert radios within the first five miles, concluding that this would increase the total notified to 98%. Besides the obvious flaw that the residents within the five to ten-mile radius are somehow different than those within five miles, the record illustrates the need for several complimentary methods of notification, especially at night and during the winter.

The Licensing Board in its letters to the Commission of November 19, 1985, and May 16, 1986, also presented the serious generic difficulties in using sirens to notify residents in the EPZ.

VI. Emergency Plan Full Participation Test.

The Applicants have not conducted a full-participation test of the Harris Emergency Response Plan within a year of their anticipated receiving of a full-power operating license as required by 10 C.F.R. 50 Appendix E, Section IV.F.A. This is true because the last full-participation exercise was held last May at the Applicants' initiative (and then the completion date was again postponed) and additionally, because Chatham County (one of the counties in the EPZ) withdrew from the Plan on May 27, 1986. Any plan now presented would necessarily be different from the tested plan. To date, no state or other agency has taken over Chatham County's responsibilities, and no new plan has been prepared.

Applicants have requested an exemption from the 10 C.F.R. 50 Appendix E, Section IV.F.1 requirement although the timing for their exercise was their own choice. There is however no way they can cure the effect of Chatham County's withdrawal. Whatever plan would be in effect in the event of an emergency at the Harris plant has not had a full participation test.

Intervenors are likely to win on this issue because the facts are solidly for us as it's been over a year since the May 1985 exercise and the plan that was tested then no longer covers the entire EPZ now. The other counties are considering the possibility of withdrawing and it appears that public acceptance of inadequate emergency plans is at an all-time low, especially post-Chernobyl.

Conclusion.

We have made the above comments to assist the Commission in its immediate effectiveness review of the Harris plant. There are many other serious safety and design flaws we would urge the Commission to begin investigating; some of these we have raised as contentions below, others were beyond our technical expertise. Many of the 400-plus contentions we raised were not admitted and others were summarily dismissed without hearing. We would urge you to review those issues we raised on appeal of the Partial Initial Decisions on environmental, management, and safety matters and the Final Decision on drug abuse and emergency planning.

Respectfully submitted,

John Runkle

John Runkle
Counsel for CCNC
307 Granville Road
Chapel Hill, NC 27514
919/942-7935

WELLS EDDLEMAN

Wells Eddleman
812 Yancey Street
Durham, NC 27701
919/688-0076

This is the 9th day of June, 1986.

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NEGAWATTS: A PRACTICAL REMEDY FOR MEGAGOOFS

ADDRESS TO ENERGY CONSERVATION PANEL, 97TH ANNUAL CONVENTION
NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS
NEW YORK, 20 NOVEMBER 1985

by

Amory B. Lovins[1], Director of Research
Rocky Mountain Institute[2]
Drawer 248, Old Snowmass CO 81654
(303) 927-3851/-4178

The electric utility industry--the most capital-intensive sector of the U.S. economy, with about half a trillion dollars in net assets and an eighth of a trillion dollars in annual revenues--has begun its greatest transition in at least a half-century. Yet the same economic analyses which have correctly predicted the main elements of that transition for the past decade now suggest that changes far more profound have yet to occur, because:

- it is now cheaper to save electricity than to make it, even in *existing* plants;
- "negawatts" (kW-h saved and hence available for resale) can be procured more quickly and surely than megawatts;
- proven hardware and implementation methods, on the most transparently orthodox cost analysis, now permit such outcomes as writing off abandoned plants while *lowering* the rates, turning rate-spiralling utilities into competitive declining-cost enterprises, virtually eliminating utility forecasting and planning risks, abating acid rain at negative net cost, rejuvenating distressed local economies, and paying off the National Debt by 2000.

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[1] The author, a consultant experimental physicist educated at Harvard and Oxford, received an Oxford MA by Special Resolution and five honorary doctorates, has held a variety of visiting academic chairs, and shared with his wife and colleague Hunter a 1982 Mitchell Prize and a 1983 Right Livelihood Award (often called the "alternative Nobel Prize"). He has published a dozen books and over a hundred papers, chiefly on energy policy. Newsweek called him "one of the Western world's most influential energy thinkers" after his 1976 Foreign Affairs article "Energy Strategy: The Road Not Taken?" first enunciated end-use/least-cost analysis and predicted the economic collapse of big-power-plant building and its replacement by efficiency and dispersed sources. Mr. Lovins has been active in energy policy in 15 countries, briefed five heads of state, testified before Commissions in a dozen states and worked with Commissioners and utilities in nearly two dozen more, and consulted extensively for electric utilities, international organizations, national and state governments (including regulatory bodies), public-interest groups, utility customers and suppliers, and other private-sector clients.

[2] Rocky Mountain Institute is a nonprofit educational and research foundation which fosters the efficient and sustainable use of resources. Its 18 staff explore the connections between energy, water, agriculture, security, and economic development. RMI's Energy Program helps to steer both utilities and their customers towards best buys. To this end, RMI provides to utilities and their regulators--and derives two-thirds of its income from--the consulting services of a consortium of a dozen leading analysts of utility reform.

These conclusions are neither fanciful nor quixotic. They are rather the economic realities, the fundamentally new factual premises, that are already starting to reshape utility management and regulation.

Saving Electricity: How Cheap?

Since I had the honor of addressing NARUC's 1984 Convention[3] and 1985 Winter Technical Meeting, the already rapid revolution in using electricity more efficiently has accelerated. Rocky Mountain Institute, however, has recently published several up-to-date and fairly comprehensive "electricity-savers' handbooks" which extensively document the supporting details. My remarks today only summarize highlights; but those highlights rest firmly on *empirical facts* which, though new and perhaps unfamiliar, should really be beyond rational dispute.

It is now extremely cheap to save electricity through new end-use technologies which give the customer exactly the same service as before, often with even better convenience and reliability. Most of these technologies are very new: most of the best ones were not available a year ago, and the same was true a year ago. The best electricity-saving hardware now available collectively costs only about a third as much, yet saves twice as much, as it did five years ago. So rapid is this technical change that last spring I had to update a commercial-lighting analysis four times in six weeks. I recently found an airport extension where the lighting contractor, coming back to do finishwork on luminaires he had installed two months earlier, instead tore them out and replaced them with a newer model, because its capital plus operating costs undercut the old units' operating costs alone.

To illustrate what I mean by "extremely cheap," the best electricity-saving hardware now in U.S. mass production typically permits, for example,

- saving >80% of commercial lighting energy on retrofit, via high-frequency tunable ballasts, tristimulus-phosphor lamps, and specular reflectors, at a societal cost[4] of ~0.5 ¢/kW-h[5];
- saving >90% of commercial lighting energy in new construction, by those measures plus daylighting and tasklighting, at negative net marginal cost[6];
- saving 70%+ of typical commercial-building ventilation energy at <1¢/kW-h[7];

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[3] "Saving Gigabucks With Negawatts", an abridged but unedited version was reprinted in Public Utilities Fortnightly, 21 March 1985, pp. 19-26, and a corrected version is obtainable from Rocky Mountain Institute (Publication #84-16, 14 pp., $5).

[4] That is, the total levelized cost of installing and maintaining the device. This equals the utility's cost (excluding a small administrative cost) of giving the device away. In many cases, the utility's actual cost of inducing customers to buy the device themselves would be much less.

[5] A.B. Lovins, Least-Cost Electricity Strategies for Wisconsin: Practical Opportunities to Save Over a Billion Dollars a Year, Ex. Vol. 53, WPSC #05-EP-4, 9 September 1985 (RMI Publication #85-23, 309 pp., $50). Unless otherwise specified, all costs in this paper are expressed in 1984 cents, levelized at 5.3%/y real, per delivered kW-h.

[6] Id.

[7] Id.

- saving 15-30% of typical process-industry drivepower (nearer 50% for all industrial drive) by 11 measures costing <1¢/kW-h[8];
- saving 80-84% of the normal San Diego residential demand for a fully equipped, all-electric house via passive thermal design and advanced lights and appliances[9];
- saving 85% of summer peak and 90% of annual loads by simple redesign of a supposedly utility-optimized Las Vegas house[10] at roughly zero marginal cost;
- enabling a building (like my home/indoor farm/research center at 7100' elevation in the Rockies) to use no heat and 5-10%[11] of normal electric demand (our domestic bill for lights and appliances is about $5 a month), repaying its net marginal cost in 10 months.

Similar examples could be cited in every sector[12]. More are emerging constantly. And some are even cheaper than those just mentioned: the net marginal capital cost of certain common devices, such as quadrupled-efficiency compact-fluorescent/reflector lamp assemblies or high-torque drivebelts, is often *negative*. As Irwin Stelzer remarks, saving electricity at a negative net cost is not a free lunch; it is a lunch one is paid to eat.

Many of the costs just cited, and many more like them, are less than the costs of just *operating* existing thermal power plants (even nuclear ones), not counting those plants' sunk capital costs at all. In the territory of Commonwealth Edison Company, for example, widespread retrofit could save 60%+ of 1984 sales (and a larger fraction of peak) at an average societal cost <2.9¢/kW-h. (At a similar cost, the saving would rise to ~75%+ on a timescale long enough to retire existing buildings and equipment.) The lower part of the "supply curve" of these savings is so flat that ComEd could save a remarkable 44%+ of 1984 sales by retrofits at an average cost around *0.4¢/kW-h*[13]. In contrast, it costs nearly 2¢/kW-h--in the case of some new plants, 3.5¢/kW-h[14]--to run a

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[8] A.B. Lovins, Least-Cost Electrical Services as an Alternative to the Big "A" Dam, Ex. 1248, Maine Land Use Regulation Commission #HP 00005, 7 May 1985 (RMI Publication #85-4, Scoping Calculation of Electrical Savings in a Pulp-and-Paper Mill, 84 pp. single-spaced, $395).

[9] ——, proprietary 1985 client study; summary available as RMI Publication #85-12, 4 pp., $2.

[10] ——, direct testimony filed 9 August 1985, Nevada PSC #84-724, at pp. 21-26 (RMI Publication #85-14, 147 pp., $40).

[11] Total demand is ~0.13 W/ft^2 or 0.52 kW$_{av}$, 2/3 of it for office equipment. See Visitors' Guide, RMI Publication #H-1, 2nd edn. (August 1985), 18 pp., $5.

[12] See e.g. ref. 5.

[13] The former figure (expressed as a "direct" cost of 2¢/kW-h without discounting future savings) is presented in A.B. Lovins, Least-Cost Electrical Savings as an Alternative to the Braidwood Project, BPI Ex. 12, Illinois Commerce Commission #82-0855, filed 3 July 1985, plus an extensive hearing record (RMI Publication #85-9, 172 pp. single-spaced, $50). The latter figure, based on an explicit "menu" of options, is presented in ICC #82-0855, Petitioners/Forbes Cross Exs. 2-21, and is largely summarized in Petitioners' Brief at 25-28 and discussed at 137-152. Actual program costs to ComEd would generally be much lower than these societal costs.

[14] This is the Middle South Energy Co.'s 10 July 1985 estimate for the first-year operating costs of Grand Gulf (1985-86 $), corrected for grid loss but excluding all capital charges; it includes only fuel (a busbar cost of 1.14¢), O&M (2.06¢), and decommissioning (0.02¢). Property taxes would add another 0.46¢.

nuclear plant, and about that much or more to operate a fossil-fueled power plant. In 1984, for example, ComEd's nuclear plants reportedly had an average delivered operating cost (fuel plus O&M) of 1.46¢/kW-h, and all its plants, of 3.4¢/kW-h.

Such low costs for efficiency imply that existing thermal power plants are in general economically obsolete: once built, they cost more to run than not to run. Cheap efficiency (and equally cheap load-management options) *will inevitably be bought*, with or without utilities' help: the utilities' choice is between participation and obsolescence. If they participate, they can capture some of the cost savings for their investors, and more accurately anticipate future loads. If they don't participate, they will only see dwindling sales. Indeed, in all likelihood, efficiency and load management now available to customers are such keen competitors that increased electric prices will *reduce* long-run utility revenues. Thus a utility which finishes and ratebases a costly plant, in the expectation that its worries are over, may instead find they are just starting: the tough part will be selling enough electricity, at the resulting price, to pay for the plant. If demand turns out to be more sensitive to price than expected, rates will have to increase more than expected, and it is entirely possible that no amount of rate relief will truly bring relief. Rate *cuts*, not rate hikes, may turn out to be the only way to increase long-run revenues; and rate cuts require major short-term cost reductions, which end-use efficiency can readily provide but new plants in general cannot.

Implementation

Even a few years ago, most utilities promoted electrical savings, if at all, only by information programs, such as "audits" which served mainly to make customers think of privation, discomfort, lifestyle changes, and the IRS. Lately, however, many alert utilities, big and small, investor-owned and public, have developed diverse, strikingly effective ways to save electricity--to elicit "*n*egawatts" and thereby provide desired energy services to their customers (comfort, light, shaftpower, etc.) at least cost.

Such implementation typically requires a variety of efforts tailored to specific constituencies--efforts comprising information, financing, rate reform, psychological leadership, and purging institutional barriers. All these elements are important to match incentive with opportunity[15]. The most creative and successful measures, however, have generally been financial arrangements whereby utilities buy negawatts on their customers' premises more cheaply than they could make equivalent megawatts themselves. Such mechanisms cut utilities' operating costs, and may also create a new profit center in the financing department.

Over half of U.S. utility customers can now get utility loans on favorable terms to weatherize their houses, or utility rebates for buying efficient appliances[16]. Some utilities simply give away electricity-saving devices, especially to low-income customers: Southern California Edison Company (SCE), for example, is giving away

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[15] These measures are discussed briefly in Refs. 5 (esp. pp. 229-253) and 13a, and in a fuller and more popular form in L.H. Lovins et al., Energy Unbound: Self-Reliance and America's Future, Sierra Club Books, San Francisco, February 1986 (in press). This novel traces the adventures of Eunice Bunnyhut, a Dubuque housewife who becomes Secretary of Energy, discovers through fictional dialogue (with cartoons) what the energy problem is and what we can all do about it, and ends up running DOE very sensibly, rather as she would run a PTA bake sale.

[16] There is increasing evidence that the inefficient models often get shipped to areas lacking such incentives.

three quadrupled-efficiency light-bulbs to each of 100,000 low-income households, because that is cheaper than operating existing power plants. Most of these loan, rebate, and "full-financing" programs are residential--the sector with the smallest, costliest savings. (With today's programs, program costs typically average about <1-4¢/kW-h, though some important elements are essentially free. Using modern technologies would yield considerably lower costs.) Program performance and predictive accuracy depend sensitively on design factors which are now fairly well understood. Participation rates in well-designed programs over the first year or two are typically 70-90%, with 95-99% for full financing. Experience of cost and performance is often very encouraging[17]: the lesson is to emulate and refine programs that work well, rather than to bemoan and slavishly imitate those that do not. It is also important to avoid the fallacious arguments often used to try to bias investment away from efficiency and towards new power plants[18].

An even more important lesson is that the bulk of the relatively cheap electrical savings are in the commercial and industrial (C&I) sectors, which have had the least analytic and programmatic effort. For example, 83% of SCE's 1983 efficiency-program savings were in these sectors, at an average program cost of only 0.12¢/kW-h (levelized 1984 $). The corresponding 1984 figures were 86% and 0.19¢/kW-h. It is thus gratifying that, for example, Central Maine Power Company's new incentives specifically target commercial lighting and industrial motors--often the two biggest, cheapest "mines" of negawatts. C&I savings bring a triple whammy: they are cheap; C&I customers are likelier than residential customers to pay most of the cost in response to modest incentives, so the *utility*'s cost is cheaper still; and the savings come in larger chunks

[17] A.B. Lovins, Public Utilities Fortnightly, letter, 8 August 1985, p. 10. Experience, too, is often misinterpreted. For example, recent program evaluations by my friend Eric Hirst are often wrongly construed to say that initial weatherization savings "decay" over a few years. Closer reading reveals that over time, the weatherized homes become even more efficient, not less; their savings decline only relative to the houses of nonparticipants, who emulate the participants' savings and thus narrow the initial efficiency gap.

[18] Three major kinds are currently in vogue. One is to apply a "utility perspective" (where the objective is to minimize present-valued utility revenue requirements) to supply investments but a "societal perspective" (seeking to minimize societal cost, often including externalities) to savings investments. Another is to penalize savings programs for "free riders"--people who would have saved even without the program. Even if this effect could be measured, it would be of dubious validity: since markets eventually come to equilibrium, all savings will eventually be achieved with no programs at all, so on the "net-savings" theory all program costs should be infinite. The reason utilities pay to induce savings is of course to do so more quickly and surely than would occur spontaneously. Those savings which do occur spontaneously do nonetheless occur--with less effort and risk than if they had had to be induced. A third fallacy, which takes many forms ranging from "no-losers tests" to "revenue-loss effects," is the notion that a utility should pay for efficiency no more than its avoided cost minus its average price. (Under the Illinois Commerce Commission Staff's proposed methodology, a utility whose marginal cost was less than its average price would buy no efficiency even if efficiency cost less than that utility's operating costs.) The rationale of such bizarre criteria is to avoid raising nonparticipants' rates. But this (a) confuses rates with bills; (b) uniformly but unnecessarily inflates everyone's rates and bills by not buying the cheapest available resource for the system; (c) forgets that higher rates (or bills) for nonparticipants give them an incentive to become participants, rather than penalizing participants for others' choice to remain improvident; (d) asymmetrically requires nonparticipants to pay their share of the marginal system costs which their choices incur only if those choices make demand grow, not if they make it shrink; and (e) assumes that savings are achieved faster than the sum of the depreciation rate plus the rate of growth in service demand--otherwise fixed costs per kW-h sold do not increase and the whole argument becomes moot--yet virtually no utilities which make such arguments project that savings will reduce their sales by the 4-5%+ per year required to incur revenue loss.

through the actions of fewer people, so the savings are generally faster and easier to get than residential ones.

The programs traditionally used to enable and encourage customers to save electricity in all sectors were designed by engineers to deliver specific types of hardware to specific types of customers: weatherstripping, water-heater wraps, improved fluorescent lamps. Such programs are often effective, and are a desirable element of the electricity-saver's armory because they can deal with specific types of market failures. However, absent such failures (such as split incentives between landlords and tenants), these "first-generation" programs are far more cumbersome and less powerful than "second-generation" programs which simply *make a market in negawatts*: so-called *generic market incentives* which reward customers for saving electricity, no matter how, and the more the better.

For example, SCE and PG&E each offer rebates of several hundred dollars per kW_p saved. At least for C&I customers, programs like PG&E's excellent "Great Energy Rebate" do not confine this rebate to preidentified hardware, but offer it for any option the customer devises, thus encouraging innovation. Some programs similarly pay for saved kW-h; the highest offered price appears to be BPA's experimental Hood River County [Oregon] offer of $1.15 per kW-h to be saved in the first year from any durable weatherization improvement which displaces electric resistance heating. (This inflexible restriction is unfortunate, but the size of the offer is impressive. Yet it is still less than about a 10-year present value of avoided cost.) The best such programs reward customers for saving electricity, not for spending money; use an open-ended sliding scale, so that the more customers save, the more they're rewarded; and even *pre*purchase the savings, so that customers can use the payment to buy the device which produces the savings.

"Third-generation" programs are now starting to receive serious consideration:

- utility grants for modernizing inefficient factories: BPA's 20% grant for upgrading alumina smelters simultaneously frees up inefficiently used kW-h at low cost and helps secure the region's economic competitiveness and electric markets.
- transferable-saving arrangements whereby, say, an industrialist wanting cheap power can save it on a third party's premises and buy back the saved power from the utility at an intermediate price.
- marketable contracts to use less power or not to exceed a given demand[19].
- third-party shared-savings arrangements.
- spot and futures markets in saved electricity.

Two especially powerful techniques now nearing field trials merit special mention: a sliding-scale hookup fee which is positive or negative depending on the efficiency of the building, and auctions to elicit a least-cost mix of all ways to make or save electricity:

- The sliding-scale hookup fee looks attractive in rapidly growing areas. Currently, the builder of an inefficient house can often force the utility to spend more on new capacity to serve that house than it costs to build the house. Such home-

[19] Covenants to this effect would be akin to the successfully used "curtail-to-threshold" system, whereby major customers receive a monthly payment for each kW_p by which, in a rare power emergency, they may be curtailed to a threshold which they themselves choose in advance.

building should have to pay a partial-capital-recovery hookup fee--say, tens of thousands of dollars. Such fees, via a balancing account, could then provide rebates--*negative* hookup fees--to builders of highly efficient homes. For illustration, a $5,000 rebate will generally more than repay the extra cost of efficient design; the contractor can then market the house with a guarantee to pay or cap its utility bills for the first five years; the buyer can get a bigger (and often a cheaper) mortgage and, in an educated market, will generally recover many years' worth of energy savings as extra equity on resale; and the utility will save 10-20 times the value of the rebate. Everyone wins.

- Auctions have already been used to select among competing weatherization and cogeneration offers, and can be extended to promote competition between *all* options. The utility would simply offer to buy electricity which anyone would make, save, or displace, by any method, at a series of increasing prices, until it had all it needed. The market-clearing price representing the least-cost mix of all supply- and demand-side options would thus be reached from below, rather than (as with PURPA avoided cost) from above. On most systems, the market would probably clear at around 3-4¢/kW-h.

The Proof of the Pudding: Some Empirical Examples

Even without using such experimental implementation methods, well-proven information and rebate programs have already yielded astonishing results. In SCE's 50,000-square-mile, 9-million-customer territory, for example, about 1.09 GW of long-term peak load was saved just in 1983--the equivalent of 8.6% of SCE's 1983 peak load. Of that saving, about 45% came from utility programs whose average cost was 0.32¢/kW-h for efficiency and $\$31/kW_p$ for load management. The rest of the saving came from State action (chiefly building and appliance standards); yet SCE could have done the same thing itself, through a sliding-scale hookup fee (costing ratepayers nothing) in lieu of building codes, and through a seller rebate (costing, in PG&E's experience, about 0.6¢/kW-h) in lieu of appliance standards. In 1984, SCE saved about as much as it had in 1983, and at similar real cost. In fact, SCE, PG&E, and Texas Utilities (another leader in rebates) all report that broadly speaking, their real unit program costs for efficiency and load management have *fallen* in the past few years: better technologies and smarter program design have outpaced the exhaustion of the relatively cheap savings.

Are comparable trends observable over larger areas? Indeed they are. In California as a whole, for example, electricity sold per real dollar of Gross State Product fell by 17% during 1975-83 and is projected by the state Energy Commission to fall by another 30% in 1985-2004--a 42% total reduction--with additional cost-effective savings officially stated to be available if desired. The Energy Commission projects that electrical sales through 1996 will grow only 53% as fast as Gross State Product, compared with the U.S. 1982-84 average of 87% and with some national projections (*e.g.*, by Messrs. Siegel and Sillin) of 100% or more. (New England has already beaten the California forecast: during 1976-82, electric sales grew only 48% as fast as Gross Regional Product.) And the California IOUs' costs of *all* their electricity-saving programs to date has averaged <1.0¢/kW-h, with all 1983 load-management programs coming in at $\$120/kW_p$. Yet actions taken in 1983 alone saved 1994 peak load equivalent to 5% of the state's entire 1983 peak.

Efficiency and load management, too, are not the only formidable competitors with power plants. California, for example, had a 1984 peak load of about 37 GW, of which 27 GW required thermal plants (since the utilities already own and operate instate 10

GW of hydroelectric and geothermal capacity). Yet 12 GW of savings by 1994 *have already been procured*--16 GW by 2004--and another 7 GW by 1994 is currently being acquired, with still more officially stated to be cost-effectively available if desired. Moreover, by the end of March 1985, an astonishing *20.3 GW* of independent generation, mostly renewable, was on firm offer, 57% of it already online or under contract and being built. During 1984-85, too, those offers *were increasing by 9 GW--a quarter of California's total peak demand--per year.* By 17 April 1985, when the growing glut forced the California PUC to suspend most new small-power contracting, 13.1 GW was already under contract and a further 8+ GW in negotiation. If the boom had been allowed to continue for the rest of 1985, these dispersed sources, averaging only 12 MW each and with lead times ranging from months[20] to a few years, could have displaced every thermal plant now serving California[21]. Together, demand-side measures and diverse, decentralized generating sources have transformed California's electrical prospects from scarcity to seemingly endless glut in only about two years. Yet at least 24 other states and Provinces, undeterred, all still plan to sell California their surplus power, all at the same time.

Nor is California the only example of such behavior. Even New Hampshire, despite the specter of possible PSNH bankruptcy, has small power commitments equal to a seventh of its peak load. From East Texas to Maine, cogeneration (which just in 1984 went from about 5% to about 7% of total U.S. electric output) and other independent power production are suddenly saturating the market at prices competitive with about everything except savings[22]. More new generating capacity has been ordered in the U.S. since 1979 from small hydro plants and windpower than from coal or nuclear plants or both, not even counting their cancellations. During 1981-84, new orders and firm letters of intent, minus cancellations, totalled *minus* 65 GW for central stations, but *plus* 25 GW for cogeneration and *plus* at least 20 GW for small hydro, wind, etc. (Perhaps a fifth of the cogeneration was also renewable.) Thus new small-power projects made up for more than two-thirds of the losses in central-station net orders--and electrical savings far more than made up for the rest.

Many trends in the efficiency of using electricity in the United States underscore the durability and presage the expansion of these remarkable results. In 1984, in the midst of the fastest economic growth since the 1950s, the electric content of GNP hit a ten-year *low*. Since 1980, electric sales per unit of U.S. industrial production have fallen by nearly 2%/y; sales per residential customer have also fallen; and sales per commercial customer have been about flat. The electricity/GNP ratio is continuing its steady decline, and there is now strong evidence that this decline *accelerates* with faster economic growth and with freer competition in the energy-service marketplace. Yet virtu-

[20] For example, Zond acquired a windfarm site in August 1985 and is on schedule to have two hundred 100-kW machines, or 20 MW_p, online in December 1985. Efficiency can be even faster (Ref 5, pp 252-3): the City of Austin, for example, wants to retrofit nearly every commercial light in town in about a year.

[21] Some of the offers were made by poor managers in over their heads, but most offers represented technically and economically sound resources. A secondary market is rapidly emerging to buy out such mismanaged but basically sound projects, complete them, and deliver their power as contracted. Absent regulatory interference, most of the potential 20+ GW will come online. Similarly, managers of successful windfarms, with availabilities of 95-99%, are buying out or contractually retrofitting many of the poorly performing early machines, thus using good wind resources to advantage.

[22] The best 1985 wind machines can even compete without tax subsidies--which is more than can be said for any thermal plant.

ally all the electrical savings so far have been achieved by such crude measures as caulk guns and duct tape--not by the very powerful and sophisticated technologies that have just entered the market. Further, for reasons described elsewhere[23], most national energy savings so far have been in heat and vehicular liquid fuels, not in electricity. Since 1979, the U.S. has gotten more than a hundred times as much new energy from savings as from all net expansions of energy supply combined, and of those expansions, more new energy from sun, wind, water, and wood--collectively now 10% of total U.S. primary energy supply--than from oil, gas, coal, and uranium. But the electrical component of those savings and alternative supplies lags the nonelectrical component, leaving more displacement still to come.

Basic structural changes in the U.S. economy can only accentuate these trends. A typical service worker, for example, uses only a quarter as much electricity as an average manufacturing worker. General manufacturing in turn is five times less electricity-intensive than the production of basic materials. Yet not only are those production processes becoming more efficient and shifting offshore; demand for them, too, is saturating. Per-capita U.S. consumption of both traditional basic materials (steel, cement, paper) and modern ones (aluminum, ethylene, ammonia, chlorine) stabilized in the 1970s and in most cases actually started falling: steel production per dollar of real GNP peaked in the 1920s and is now below its 1880 level. To be sure, there are and will be some new, electrically based industrial processes; but their extra use will be a small fraction of savings achieved both in industry and elsewhere. The unspecified new-uses-yet-to-be-discovered so prominent in many high-demand forecasts (according to the so-called "Orgasmatron Theory of Demand") have not materialized.

In short, no empirical basis whatever has emerged for the essentially theological arguments which such analysts as Messrs. Siegel and Sillin present for rapid growth in electric demand[24]. To the contrary, there are many persuasive reasons to believe[25] that electricity and economic activity will continue to *de*couple, just as they have gradually been doing for the past three decades. This would occur even faster under truthful prices--for example, in the absence of electric utilities' $30 billion in FY1984 Federal subsidies. Per unit of energy, electricity in 1984 got 11 times as much subsidy as direct fuels did, and at least 48 times as much as efficient end-use[26]. If nuclear power did

[23] Ref. 5, pp. 27-42, or Ref. 13a, pp. 14-27.

[24] Another kind of argument often adduced is that real prices will rise more slowly--or, in a more modern version, will fall faster--for electricity than for gas. In the long run, however, cross-elasticities are unimportant if, as the costs cited above indicate, efficiency outcompetes both electricity and gas.

[25] See Ref. 23 for a detailed discussion. In brief, even a perfect correlation would not be evidence of a necessary causality. Moreover, electricity/GNP decoupling has already unmistakably begun, but its onset has lagged that of energy/GNP decoupling because electricity-saving technologies are newer and less familiar than fuel-saving technologies; electricity-using devices are more likely to be bought by first-cost-minimizing third parties, whereas fuel-using devices are more likely to be bought by end-users sensitive to life-cycle cost; electrical prices are more severely distorted than fuel prices (through bigger subsidies, promotional tariffs, and rolled-in pricing aggravated by long plant lead times); and higher fuel prices are felt fully by direct-fuel users but only in part, owing to dilution by fixed costs, by electricity users.

[26] H.R. Heede & A.B. Lovins, "Hiding the True Costs of Energy Sources," Wall Street Journal, p. 28, 17 September 1985, summarizing H.R. Heede, "A Preliminary Assessment of Federal Energy Subsidies in FY1984," RMI Publication #85-7, 29 pp., $20.

not get at least 80 times as much 1984 subsidy per BTU as efficiency and renewables got, those strong competitors would be sweeping the market even more completely.

Strategic Implications

The efficiency revolution--in hardware, implementation and financing methods, and empirical experience of what works--has profound implications still unperceived by many utility managers. For example:

- It is all right for a utility's sales to fall, *as long as its costs fall by even more than its revenues.* Savings which cost less than marginal operating cost will *always* achieve this. Demand shrinkage is nothing to be afraid of; a utility can make more money at less risk selling less electricity, simply by saving it cheaper than making it.
- Official forecasts of demand shrinkage--so far confined, to my knowledge, to one variant of BPA's 1984-2004 sales forecast--should soon become commonplace in the electric business just as they did in the oil business. In both cases, pricing the product out of the market causes sales and revenues to fall. And in both cases, the way to regain lost markets is to cut costs and prices. Any widget manufacturer understands this competitive balance; electricity manufacturers will sooner or later come to understand it too.
- If it is cheaper to save electricity than to make it, a utility should buy savings *regardless of how much overcapacity it has.* The overcapacity represents a sunk cost; only the marginal costs of operation are under the utility's control. No matter what its reserve margin, negawatts should be bought and negative loads dispatched whenever savings beat existing plants in the merit order, for exactly the same reason that a utility should accept a proferred contract to supply coal at $5 a ton or purchased power at four mills.
- The power-marketing reflex is thus often exactly the wrong thing to do. Not only does it generally cost more to make the extra power than it would cost to save it, but the hoped-for net system benefits may not even be realized. A recent example[27] shows that marketing offpeak power (via electric heating) can maximize not only system load factor, but also revenue requirements and rates[28].
- Forecasting load and building to meet it is an obsolete and dangerous doctrine, because it is financially too risky. Building decade-lead-time, multi-billion-dollar plants means playing You Bet Your Company that the ten-year forecast will be about right. In fact, demand is highly uncertain, and two factors, especially in combination, make it even more uncertain: the efficiency revolution, and costly new power plants, which raise rates and hence drive customers even faster towards efficiency.
- Efficiency also means, however, that utility managers can confidently *choose* future demand with enormous flexibility. Demand, after all, is *not fate but choice*; not an inevitability to be helplessly adapted to, not a doom to be prophesied by reading the entrails of forecasters (although that might be a good idea), but a

[27] Nevada Power Company's USAM simulation, Exs. 85-1 and 39, NPSC #84-724, 1985.

[28] More precisely, of the six options which Nevada Power's consultants studied, shaving summer peak 10% while building winter (offpeak) load 10% yielded the highest 20-year present-valued revenue requirement and the third-highest price per kW-h sold, because the extra cost of additional winter operation more than outweighed the spreading of fixed costs over increased sales. In contrast, "strategic conservation" (saving 10% in both summer and winter) yielded the lowest PVRR and rates of all six cases.

policy variable to be influenced according to corporate and regulatory objectives. (If demand suddenly spurts ahead of projections, the proper response--as New England Electric System recently showed--is not to revert to construction but rather to intensify efforts to buy efficiency faster: it's still the best, and fastest, buy.) Forecasting, then, should be done to determine, not how many plants to build, but how fast and in what order to buy which savings.

- Reducing risk to an affordable level entails reducing the level and uncertainty of demand, and reducing the unit cost of hedging against residual uncertainty by buying only options which are small, fast[29], and cheap--precisely the qualities of efficiency improvements. By following these commonsense criteria, utility managers who (in Howard Allen's phrase) "manage by brokenfield running" can *manage uncertainty so as to minimize regret.* That is exactly what the best utility managers are now doing. They are buying small power production (and efficiency) not only because it is cheaper than giant plants, but also because it is less risky. Both cost and risk criteria dictate that the era of the big power plant is over. Efficiency plays three roles in that shift: more efficient end-use of electricity heightens the planning risks of central stations, renders them unnecessary and uneconomic, *and* offers a least-cost, low-risk replacement for them.
- Both risk-management *and* cost-minimizing criteria, then, dictate buying efficiency *instead of plants--not in addition to them*--so that utilities can get the benefits of savings without the costs and risks of the plants. The only thing worse than getting both costs *and* benefits (since the former, as in TVA's case, can swallow up the latter) is to get costs *without* benefits, as ComEd and Middle South seem determined to do.

The trend towards efficiency, in short, is market-driven. Markets, however manifestly imperfect, have a way of working sooner or later, whether we perceive them or not. Electricity is costly; well-designed efficiency is cheap. Therefore, customers will increasingly want less electricity and more efficiency. Utilities which cater to this demand will prosper. Those which ignore or fight it will fail.

The efficiency revolution represents more, however, than a force that will inevitably reorient utilities' business towards helping their customers get the energy services they want in the cheapest possible way. It also represents a vast pot of money which can be used to pay for past mistakes and make everyone whole. It creates "win-win," "no-losers" solutions to regulators' most vexing problems. For example:

- Abandoning a troubled power plant and buying efficiency instead--because it costs less than finishing and running (or *just* running) the plant--can save enough operating cost, in most cases, *to pay off the plant's sunk costs while lowering the rates.* For example, if ComEd abandoned the 2,240-MW Braidwood project and bought proven, commercially available, specifically enumerated efficiency improvements which would deliver the same services to its customers, ComEd would

[29] Lead time is a key variable. Los Alamos researchers have recently shown (LALP-10285-MS, summarised by LALP-84-54) that it is worth paying up to four times as much per kW for options with a 5-year as with a 15-year lead time, in order to achieve the same financial objectives with similar levels of confidence. Options with a ~1-year lead time are far more valuable still.

realize a net saving of probably $6-8+ billion[30]. That saving can repay to the utility's investors every penny of the $3 billion they have spent on the plant, while slashing the rates by probably $3-5+ *billion* in 1984 present value. Indeed, rather than dragging out a costly and exhausting prudency hearing, the Commission could swiftly stipulate a generous level of recovery of sunk costs, and then offer ComEd "incentive recovery": up to a level comprising those costs plus perhaps a return on them, plus (I hope) a reward for being entrepreneurial, ComEd could keep (say) half of every dollar it saved, and flow through the other half as current rate *reductions*. This would be simple, understandable, popular, and an incentive to both the utility and its customers to achieve the savings.

- To the extent that power plants cause acid rain, the savings from marketing negawatts can also be used to abate acid rain. Rather than raising rates to pay for putting diapers on dirty coal plants, a utility could install or finance superefficient lights, motors, and appliances. Its customers would then need less electricity to do the same tasks, so the utility would burn less coal and emit less sulfur. Mainly, though, everyone would save a lot of money, because efficiency costs less than coal. Some of that saved money could then be used to clean up the dirty plants--saving about three times as much SO_2 as the Waxman-Sikorsky bill proposed--while the rest of the saving lowered the rates[31]. Incidentally, the same technologies which can do this in (say) the Midwest are exactly the ones needed for no-losers rescues of the utilities mired in Zimmer, Marble Hill, Midland, Clinton, etc.
- Sometimes both these kinds of problems can be addressed simultaneously. For example, I have recently estimated[32] that substituting efficiency for completion of Ontario Hydro's 3.5-GW Darlington nuclear plant could, in strict merit order, displace that plant, *plus* all of the Province's coal-fired plants (an important source of intra-Provincial sulfur emissions), *plus* probably some existing CANDU capacity--and at the same time save on the order of C$1.4 billion per year, equivalent to about 60% of Hydro's gross interest payments.

Today, the average U.S. utility is still spending about a dollar per household per day to build power plants which it won't need, can't afford, and may not be able to pay for. Some utilities, pregnant with the construction equivalent of a 300-pound baby, are visibly violating Miss Piggy's Fourth Law ("Never try to eat more than you can lift"); some borrow short-term to pay dividends and even interest on prior borrowings. (Why should banks go to Argentina or Mexico to make involuntary loans when they can have the same thrills in New Hampshire?) Whether in Texas, Kansas, or Illinois, C&I customers are stampeding from uncompetitive utility rates into wheeling and cogeneration. And as we are treated to the spectacle of PSNH's petitioning FERC (unsuccessfully) to force municipal utilities to renew ruinous wholesale contracts, jurisdictions from Arkansas to New Orleans to Chicago are brandishing their ultimate sanctions--

[30] I originally showed this was $3.2-7.0+ billion (ref. 13a, later corrected to $3.0-6.9b) in 1984 net present value. ComEd, however, has since increased its cost estimates, and I have shown (ref. 13b) that one Braidwood's worth of efficiency actually costs only half as much as my original calculation had conservatively claimed.

[31] Alternatively, the utility could define an "environmental avoided cost" representing (say) the decremental value of not installing a scrubber, then practice "environmental dispatch"--backing out the dirtiest plants first even though they may burn the cheapest fuel.

[32] Testimony to Ontario Select Committee on Energy, 26 September 1985, based on efficiency-cost data from ComEd.

municipalization and franchise revocations--to avoid having to pay for plants they don't want or need.

I do not believe, however, that these suicidal episodes defy happy endings, because the savings available from efficiency investments are so large and so front-loaded that they can promptly pay off everyone. Utilities would buy the cheapest savings first and use them to back out the plants of highest operating cost first, so the spread between what they saved and what it cost them to save it would begin at a maximum, then gradually taper to zero as cost-effective savings were exhausted over decades. The utility's share of this cashflow would be used first to cover accruing AFUDC on abandoned sunk costs, then to pay down those costs on a schedule probably even faster than traditional amortization. Such a procedure may be legal even in states (such as New Hampshire and Ohio) which normally prohibit recovery of abandoned plants' costs from ratepayers: the recovery in this case would be from savings, not from rate hikes. Indeed, the utility would effectively become a declining-cost industry, putting its Commission back in the pleasant pre-1970 position of allocating savings rather than costs. Nationally, those savings could in the 1990s exceed $50 billion *per year*.

In sum, there *is* an attractive way out of the seemingly intractable pickles into which some utilities have gotten themselves, their investors, and their customers--a way out that leaves no losers. As an astute official of one utility, mired in building a plant he wishes he'd never heard of, recently remarked, "If we finish the plant, we'll have to pay for it; if we don't finish it, we'll still have to pay for it; but either way, we'd be dumb to pay for it by raising the rates, because then we'd price ourselves out of the market. All our customers would get more efficient, the big ones would leave, and we could well wind up making less money. What we need to do is figure out how to pay for the plant out of savings, so we can cut our costs, lower our rates, become more competitive, and get our markets back." The knowledge of how to do that, and empirical proof that it can work, *now exist*. Megagoofs, even gigagoofs, are no longer inescapable.

Economic Implications

U.S. energy bills--roughly $420 billion in 1984--are about $150 billion per year lower than they would have been at 1973 levels of end-use efficiency. But if we were as efficient today as our competitors in western Europe are, we would save about an additional $200 billion per year--enough to balance the Federal budget. And if we bought the cheapest options first for the next 15 years, the cumulative net savings by the year 2000 would be several *trillion* 1984 dollars--enough to pay off the National Debt.

Using electricity in a way that saves money is the most important single step we could take to achieve these savings, both because electricity is the costliest form of energy--8c/kW-h is equivalent in heat value to oil at nearly $140/bbl--and because the utility sector will otherwise continue to misallocate $25-40 billion of capital per year, starving all other sectors for dollars which they could invest more productively, and thus *losing* the economy thousands of net jobs per GW. (For example, just in 1982, the United States spent twice as much money building nuclear power plants, many of which will never be finished, as it invested in the motor-vehicle, iron, and steel industries combined. No wonder we have a Rustbelt!) That is why the least-cost utility resource planning for which Commissioner Wiel has eloquently testified before Congress on NARUC's behalf is an act not only of economic rationality and political prudence but of simple patriotism.

The contribution which electrical efficiency can make to this nation's prosperity and security[33] can perhaps best be illustrated, not by incomprehensibly big numbers, but in microcosm. Osage, Iowa has a population of about 3,800, and an innovative municipal utility which helps people to weatherize their houses and to implement some basic load-management measures. These programs have given that little utility three financial advantages:

- It has retired all its debt. (I hear there was a bond-burning party last January.)
- It has cut its rates four times in the past two and a half years. (Not counting fuel-cost passthroughs, real rates have fallen by half since 1976.)
- Most important, more than $1.6 million per year which formerly left Osage to buy electricity and gas from out-of-town, generally from out-of-state, now stays in the local economy. That's *more than $1,000 per household per year*. Most of it is spent and respent locally, supporting local jobs and creating local multipliers.

If a durable recovery on Wall Street has to start on Main Street[34], Osage is one small example--one of a great many--of how even the simplest "best-buys-first" policy helps get that job done.

Thoughtful utility regulators who rigorously scrutinized capital budgets are now starting to be seen, belatedly, as the saviors of utilities that were often slow to realize new competitive realities. Now the second half of the task remains. Utility regulators, by rewards, penalties, logic, and psychological support, can help utility managers through the most difficult transition in their history--one which compels them to redefine for their people not only corporate missions but also career goals and personal identities.

It is time to decide whether the efficiency revolution will be opposed or ignored--and hence will quietly destroy utilities' sales and price them ever further out of the market--or whether utilities will grasp its unprecedented opportunities to reduce uncertainty, manage risk, improve cashflow and coverage, multiply earnings by severalfold, secure long-term market share, and enhance their (and your) popularity. The events of the past year have started to bear out the hope I expressed to NARUC a year ago: that "to help ratepayers get reliable service at least cost while utilities make more money at less risk, regulators' challenge is to help remove utilities' barriers to market exit from what is no longer a commercially viable enterprise--generating and selling electricity from large thermal power stations--and help instead to speed their entry as effective, efficient competitors in the emerging energy-service marketplace."[35]

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[33] Both economically and by reducing energy vulnerability: A.B. & L.H. Lovins, Brittle Power: Energy Strategy for National Security, Brick House (Andover MA), 1982, summarised in The Atlantic Monthly, November 1983, pp. 118-126.

[34] This is a theme of Rocky Mountain Institute's Economic Renewal Project--a comprehensive approach to creating sustainable local economies by stopping unnecessary leaks of dollars for imports that can be cost-effectively displaced, investing in oneself, supporting new business startups that use local resources more effectively, and recruiting the right businesses to yield net benefit. Further information on the "ER" Project is available on request.

[35] Ref. 3.

CERTIFICATE OF SERVICE

I hereby certify that this Request to Continue Stay Indefinitely, Comments on Immediate Effectiveness Review of Final Licensing Board Decision, Appeal From Final Licensing Board Decision, and Letter to ASLB re. Harassment were served on the following persons by deposit in the U. S. Mail, postage prepaid, or by hand-delivery.

Nunzio J. Palladino*
Thomas M. Roberts*
James K. Asselstine*
Frederick M. Bernthal*
Lando W. Zech, Jr.*
US Nuclear Regulatory Commission
Washington, D. C. 20555

Thomas S. Moore, Chairman**
Dr. Reginald Gotchy **
Howard A. Wilber**
Atomic Safety & Licensing Appeal Board
US Nuclear Regulatory Commission
Washington, D. C. 20555

Wells Eddleman
812 Yancey St.
Durham, NC 27701

Samuel Chilk**
Secretary to the Commission
US Nuclear Regulatory Commission
Washington, D.C. 20555

Paul Bollwerk**
Office of the General Counsel
US Nuclear Regulatory Commission
Washington, D.C. 20555

James L. Kelley
Dr. James H. Carpenter
Glenn O. Bright
Atomic Safety & Licensing Board
US Nuclear Regulatory Commission
Washington, D.C. 20555

Bradley W. Jones
NRC Region II
101 Marrietta Street
Atlanta, GA 30303

Docketing and Service (3 copies)
Office of the Secretary
US Nuclear Regulatory Commission
Washington, D.C. 20555

Charles A. Barth
Office of Exec. Legal Director
US Nuclear Regulatory Commission
Washington, D. C. 20555

Dan Read
PO Box 2151
Raleigh, NC 27602

M. Travis Payne
PO Box 12643
Raleigh, NC 27605

Dr. Richard D. Wilson
729 Hunter Street
Apex, NC 27502

Richard E. Jones
Dale Hollar
Legal Department
Carolina Power & Light
PO Box 1551
Raleigh, NC 27602

Thomas A. Baxter
Shaw, Pittman, Potts & Trowbridge
1800 M Street, NW
Washington, D. C. 20036

Robert Gruber
Public Staff--Utilities Commission
Box 991
Raleigh, NC 27602

H. Al Cole, Jr.
Attorney General's Office
PO Box 629
Raleigh, NC 27602

Spence W. Perry**
Associate General Counsel FEMA
500 C Street, SW, Ste. 480
Washington, D. C. 20740

This is the 9th of June, 1986.

John Runkle

John Runkle
Attorney at Law

*Comments on Immediate Effectiveness Review of Final Licensing Board Decision and Request to Continue Stay Indefinitely only
**Above plus Appeal From Final Licensing Board Decision