#88

Docket No. 90-286
Exhibit PLC-1

STATE OF MAINE
PUBLIC UTILITIES COMMISSION

DIRECT TESTIMONY OF

PAUL CHERNICK
Resource Insight, Inc.

ON BEHALF OF THE

PENOBSCOT RIVER COALITION

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1. INTRODUCTION AND QUALIFICATIONS

1.1 Qualifications

Q: Mr. Chernick, please state your name, occupation, and business address.

A: My name is Paul L. Chernick. I am President of Resource Insight, Inc., 18 Tremont Street, Suite 1000, Boston, Massachusetts, 02108.

Q: Mr. Chernick, would you please briefly summarize your professional education and experience?

A: I received a S.B. degree from the Massachusetts Institute of Technology in June, 1974 from the Civil Engineering Department, and a S.M. degree from the Massachusetts Institute of Technology in February, 1978 in Technology and Policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, and the engineering honor society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi.

I was a Utility Analyst for the Massachusetts Attorney General for over three years, and was involved in numerous aspects of utility rate design, costing, load forecasting, and the evaluation of power supply options.

As a Research Associate at Analysis and Inference and in my current position, I have advised a variety of clients on utility matters. My work has considered, among other things, the need for, cost of, and cost-effectiveness of prospective new generation plants and transmission lines; retrospective review of generation planning decisions; ratemaking for plant under construction; ratemaking for excess and/or uneconomical plant entering service; conservation program design; cost recovery for utility efficiency programs; and the valuation of environmental externalities from energy production and use. My resume is attached to this testimony as Attachment PLC-1 to this testimony.

Q: Mr. Chernick, have you testified previously in utility proceedings?

A: Yes. I have testified approximately seventy times on utility issues before various regulatory, legislative, and judicial bodies, including the Massachusetts Department of Public Utilities, the Massachusetts Energy Facilities Siting Council, the Vermont Public Service Board, the Texas Public Utilities Commission, the New Mexico Public Service Commission, the District of Columbia Public Service Commission, the New Hampshire Public Utilities Commission, the Connecticut Department of Public Utility Control, the Michigan Public Service Commission, the Illinois Commerce Commission, the Minnesota Public Utilities Commission, the Federal Energy Regulatory Commission, and the Atomic Safety and Licensing Board of the U.S. Nuclear Regulatory Commission. A detailed list of my previous testimony is contained in my resume. Subjects on which I have testified include nuclear power plant construction costs and schedules, nuclear power plant operating costs, power plant phase-in procedures, the funding of nuclear decommissioning, cost allocation, rate design, long range energy and demand forecasts, utility supply planning decisions, conservation costs and potential effectiveness, generation system reliability, fuel efficiency standards, and ratemaking for utility production investments and conservation programs.

Q: Have you testified previously before this Commission?

A: Yes. I testified in Docket 84-113, Phase 1, on the desirability of further investment in Seabrook 1 on the part of the Maine utilities (Central Maine Power, Bangor Hydro, and Maine Public Service), on behalf of the Public Advocate. I also testified in Docket 84-113, the review of the prudence of those utilities in investing in Seabrook 2, on behalf of the PUC Staff. Again on behalf of the Staff, I testified in CMP's 1984 rate case, Docket 84-120, on the prudence of CMP in managing its investments in the Pilgrim 2 nuclear project, the Sears Island nuclear project, and the Sears Island coal project.

Q: Have you been involved in least-cost utility resource planning?

A: Yes. I have been involved in utility planning issues since 1978, including load forecasting, the economic evaluation of proposed and existing power plants, and the establishment of rate for qualifying facilities. Most recently, I have been a consultant to various energy conservation design collaboratives in New England, New York, and Maryland; to the

Conservation Law Foundation's (CLF's) conservation design project in Jamaica; to CLF interventions in a number of New England rulemaking and adjudicatory proceedings; to the Boston Gas Company on avoided costs and conservation program design; to the City of Chicago on Commonwealth Edison's least-cost plan; and to several parties on incorporating externalities in utility planning and resource acquisition.

Q: Have you authored any publications on utility planning and ratemaking issues?

A: Yes. I have authored a number of publications on rate design, cost allocations, power plant cost recovery, conservation program design and cost-benefit analysis, and other ratemaking issues. These publications are listed in my resume.

1.2 Introduction

Q: What is the purpose of this testimony?

A: The purpose of this testimony is to review the adequacy of the conservation program of Bangor Hydro-Electric (BHE). My review concentrates on the propriety of BHE's approach to DSM planning, the adequacy of BHE's DSM program, and the likely effect of an aggressive DSM program. I do not evaluate the success of BHE in reaching its past DSM goals. Instead, I consider whether BHE's overall management philosophy and approach are appropriate and in the best interest of BHE ratepayers.

Q: What is BHE's basic approach towards DSM?

A: For the most part, BHE does not believe that it should be engaged in what I would consider significant efforts to increase its customers' energy efficiency. BHE supports its negative attitude with three basic assertions:

- Without BHE intervention, BHE customers are already making most cost-effective energy-efficiency investments, which are reflected in the BHE load forecast.
- BHE can cause customers to invest in energy efficiency, while recovering essentially all costs from the participating customers.
- If customers are not willing to undertake and pay for apparently cost-effective conservation measures with minimal utility involvement, the measures must

have some unnoticeable costs to the customers, making the measures non-cost-effective. In other words, if customers will not accept (and pay for) measures, the measure must be inherently undesirable.

Q: Please discuss the effect of these positions on BHE's DSM program offerings.

A: Three aspects of BHE's programs may be linked to its philosophy on DSM. The major effect is the tiny size of BHE's existing and proposed DSM programs, compared to those of utilities which have accepted some significant responsibility for assuring that cost-effective DSM is implemented by their customers. Second, some of BHE's proposed programs are vague, perhaps in part because the company is not willing to commit to a major role in overcoming market barriers, and cannot define a program without such a commitment. Finally, a large portion of BHE's DSM portfolio, including programs listed as energy-saving, are in fact promotional, designed to increase electricity usage.

Q: How do you address these issues in the remainder of your testimony?

A: I start by discussing the basic purpose of least-cost planning. I then provide some background on the need for utility participation in DSM, discussing the nature of market barriers to DSM and the methods utilities have been using to overcome those barriers.

Next I provide evidence on the potential for cost-effective DSM, the scale of other utility DSM programs, and the types of programs various utilities are pursuing.

Finally, I return to BHE's basic arguments for inaction, and explain why those arguments are inconsistent with the information I provide in earlier sections.

2. THE ROLE OF UTILITY-SPONSORED DSM IN LEAST-COST PLANNING

2.1 The Purpose of Least-Cost Planning

Q: What is the objective of least-cost utility planning?

A: The objective of true least-cost planning is to satisfy customer demands for energy services at the lowest total cost. At the most restrictive, the costs included in this calculation should be the costs of the energy services normally served by the utility for all of its ratepayers.[1] This is can be thought of as the "all-ratepayers" perspective on least cost.

A more expansive view of the cost-minimization standard would include other cash costs to ratepayers, such as incidental reductions in water, fuel oil, and O&M costs. The regulated utility services (e.g., water, gas) can be priced at marginal costs to reflect the total benefit of the reduction to all utility customers. Direct costs to the utility may also reflect interactions with other utilities in the state, power pool, or other region of interest, to reflect the cost to a group of utility customers wider than those of the particular utility in question. These refinements tend to move the cost test toward the "total resource cost" test.

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[1] I will assume throughout that the utility's shareholders incur no net cost, and perhaps benefit, from least-cost planning. The effect on shareholders is a function of regulatory provisions for recovery of direct costs, lost revenues, and potentially explicit incentives.

The broadest view of the least-cost planning objective includes costs that are not borne by utility customers, or are not paid in direct cash values. Examples of these externalities include air pollution, other environmental and health effects, and effects on the regional or national economy (e.g., from import balances and employment creation). The inclusion of externalities broadens the perspective to that of a "social" or "societal" cost test.[2]

Q: Does the inclusion of DSM in least-cost planning complicate the application of these tests?

A: In one regard only. So long as utilities only supply energy, and customers make all decisions regarding the use of the supplied energy, the utility need not consider the quality of the ultimate energy services. Once the utility starts to promote the use of demand-side resources that are cheaper than supply-side resources, it must be able to compare the amount of energy that would be provided by a supply option to the quality of service provided by a DSM measure. This comparison

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[2]The definition of "society" can vary widely. Some states include only effects within the state, or a defined region, or the country, while other include (at least in principle) the entire world.

As an aside, Mr. Kolbe's Appendix B asserts that externalities can be "assumed to be zero because applicable laws and regulations have already internalized them." This indicates a total lack of understanding of the concept of externalities. So long as BHE's operations create any effects (e.g., air pollution, water pollution, a tighter oil market) for which BHE is not fully charged, those effects are externalities. Those externalities are clearly not zero; by the accounting of the Massachusetts DPU (DPU 89-239), they are at least 5 cents/kWh for reductions in NEPOOL dispatch in the near term.

is not always self-evident. In commercial lighting, for example, a decrease in ambient lighting levels may be a benefit or a cost, depending on the initial light level and the nature of the activities in the particular space.

Q: Is this a significant complication?

A: Not generally. These issues can be resolved by the application of common sense, market research, and technical expertise (such as information regarding efficient ambient lighting levels for various tasks). So long as the comparisons are approached thoughtfully, serious errors are unlikely.

2.2 The Nature of Market Barriers to DSM

Q: Why must utilities intervene in energy efficiency?

A: Customers routinely fail to invest in energy-efficiency measures that would be cost-effective under the utility's investment rules. This is true even where rates are set so that the customers' costs for electricity are set equal to (or higher than) the utility's avoidable costs. A range of <u>market barriers</u> prevents customers from minimizing the total social costs of energy services.

Q: What are those market barriers?

A: As discussed in Plunkett and Chernick (1988), attached as Attachment PLC-2, there are many factors that create market barriers. With choices between energy consumption and investments in energy efficiency, price signals are weaker than economic theory expects. As discussed in Attachment PLC-2, there is substantial evidence of a wide "payback gap" between customer and utility investment horizons. For example, commercial customers routinely require more efficient equipment to pay for itself in two years or less, while BHE trades off costs and benefits on the supply side with a 10-year payback requirement.[3] Customers act as if they place a high markup on the costs of energy efficiency, as discussed in the NARUC Least-Cost Planning Manual:

> According to extensive surveys of customer choices, consumers are generally not motivated to undertake investments in end-use efficiency unless the payback time is very short, six months to three years. Moreover, this behavior is not limited to residential customers. Commercial and industrial customers implicitly require as short or even shorter payback requirements, sometimes as little as a month. This phenomenon is not only independent of the customer sector, but also is found irrespective of the particular end uses and technologies involved. (NARUC, 1988, page II-9)

This behavior is largely attributable to substantial market barriers impeding customer choice.

BHE has discussed ways to overcome some barriers, such as simple lack of information and lack of capital. However, even customers who know that a technology exists and possess sufficient capital may not invest in the technology. Uncertainty, inconvenience, aversion to risk (real or perceived), split incentives, lack of time for exploring

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[3]This computation assumes an 8.7% discount rate, and a 25-year project life. For a 40-year life (as for a hydro plant), the payback period might be as long as 12 years.

options, limited retail availability, and aversion to dealing with contractors will not be overcome by simple information or financing. BHE fails to appreciate the multitude and magnitude of these barriers, how they interact to inhibit economical efficiency investments, and, as other utilities are discovering, tactics to overcome them. Consequently, BHE rejects the strategies other utilities are using successfully to reduce the distortions that these barriers impose on customers' conservation choices.

This approach will result in BHE's rejecting conservation resources that could cost less than utility supply. BHE's information and financing initiatives will not overcome all barriers. A customer who has not found the time to seek out compact fluorescent bulbs is not likely to find the time to seek out the bulbs based on a flier or a utility loan offer.

Q: Can the difference in payback requirements be overcome through market-rate financing programs?

A: No. As discussed in Plunkett and Chernick (1988), even corporations with ample access to capital generally do not invest in all conservation measures that would appear to be cost-effective. Consumers seem to avoid the risk and difficulties involved in adopting new technologies, or even changing from one established technology to another. For large customers, this behavior may result in part from asymmetric incentives and the division of responsibility between professions and job categories. Any plant manager, architect, or engineer who specifies unusual technology or an "unnecessary" change in equipment will face criticism if the investment does not appear to perform well or (worse yet) is blamed for adverse effects on sales or production.[4] Decisions to continue business as usual generally do not impose such risks.

Residential consumers who are investing their own money (whether taken from savings, borrowed from a bank, or borrowed from the utility) face significant time requirements to select technologies and contractors, to monitor the quality of work, to determine whether the project was successful, and to pursue suppliers and contractors if problems arise. They also face uncertainty regarding their tenure in the home, and the recoverability of their investment in the resale price of the home.[5]

None of the concerns I list above is irrational. However, they may cause consumers to avoid efficiency investments that, evaluated from the utility's perspective, are clearly less expensive than the utility's cost of supply.

Q: Is the risk of a DSM program to the utility equivalent to the risk of the underlying measures to individual customers, if they pursued them on their own?

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[4]Outside professionals, such as architects and engineers, are more vulnerable to malpractice suits if unusual technology fails than if standard approaches fail.

[5]Multi-family and rental properties also pose situations in which the person with the ability to invest in energy efficiency is not the person who pays the energy bills.

A: No. Suppose that a measure saves 2000 kWh/year for 95% of installations, and has no effect for the other 5%. The average savings are thus 1900 kWh/year. If the measure costs $60/year, the savings cost only 3.2 cents/kWh on average. Individual customers face a 5% risk that they will commit to the $60 annual cost but achieve no savings, for an infinite cost of conserved energy. This may deter some individuals from making the investment. The utility, on the other hand, may make thousands of these installations in an aggressive program, and many thousands of installations of other measures. The utility's overall outcome thus will be very close to the average savings. Hence, a real risk for individual customers becomes a negligible risk for the utility.

Q: Are there differences between consuming electricity and investing in conservation that affect the nature of rational consumer behavior?

A: Yes. In choosing to use BHE electricity, rather than making efficiency investments, consumers avoid many of the problems I listed above. They commit little or none of their own capital (or capital they are responsible for repaying), and need not be concerned about recovering an investment. Their risks are diversified, since BHE sells them a package of supply sources.[6] They face no choices, no regret, and no

[6] It is interesting to speculate how the electric utility industry might differ from its current practices if customers had to invest in particular power plants, distribution lines, and

recriminations, and need not be familiar with the technical basis for BHE's investment decisions. They do not select BHE's contractors, monitor their work, or pursue those contractors for inadequate performance.

So long as BHE provides an integrated and diversified package of electrical services, and requires its customers to assume most of the risk and hassles of efficiency investments, supply-side and demand-side investments are not provided on a level playing field.

2.3 Utility Approaches for Overcoming Market Barriers

Q: How can utilities address and overcome these market barriers?

A: The critical steps are the recognition that market barriers exist, and the commitment to overcome them. Each market barrier must be identified and addressed with a program design appropriate to the customer class or subclass, the end use, the technologies, and the market sector(s) affected by the barrier. At least three general considerations are likely to be important in most applications:

- market-oriented design,
- service delivery, and
- cost sharing.

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transformers, and were responsible for the cost, reliability, and durability of those assets. Based on the experience with energy efficiency investments, it appears that customers would tend to prefer plants with low fixed costs, low technical risks, and high operating costs.

2.3.1 Market-Oriented Design

Q: What do you mean by "market-oriented" program design?

A: A market-oriented DSM design process starts with a segment of the market, and designs a program to achieve all cost-effective conservation within that market. The cost-effectiveness of the resulting program is also determined at the level of the entire package. This can be thought of as a "Top-Down" design process, as opposed to the common "Bottom-Up" process of enumerating and evaluating each technology (or end-use, or measure) individually.

Q: What types of segments might be useful for BHE's analysis?

A: The segments should be defined in terms of the type of delivery mechanisms that would be appropriate. These may include separation of small customers from large customers, lost opportunities from discretionary programs, and customer-driven choices from those usually made by contractors. For the residential class, useful segments might include:

- heating retrofits,
- water-heating retrofits (possibly including heat pumps),
- new-appliance efficiency, including choice and water-heater installation measures (wraps, pipe insulation, end-use reductions),
- new-building efficiency, and
- lighting, probably broken into direct retrofit, demonstration programs, and retail market shifting.

Many of these markets would have separate requirements for owner-occupied and rental housing, and for low-income and other customers, since the barriers differ among these groups.

For the commercial, institutional, and governmental customers, there may be similar differences in requirements for delivery mechanisms and incentive levels for large and small customers, and for business and non-profit customers. Appropriate segments might include:

- comprehensive retrofit, including lighting, HVAC, building shell, window treatments, refrigeration, and motors (e.g., elevators);
- new construction, renovation, and rehabilitation; and
- routine equipment replacement (e.g., chillers).

Industrial customers' categories would be similar to those for commercial customers. However, the "new construction" category should probably also include major equipment and process changes (analogous to the commercial rehab, but not necessarily affecting the spacial layout). In addition, the retrofit program must allow for customer-originated improvements in equipment and processes.

Depending on how the segments are defined (e.g., whether the low-income residential retrofit market is counted as a subset of the residential retrofit, or as a separate market), this approach would focus on roughly a dozen packages.

Within each market, delivery of measure should be coordinated to be as comprehensive as possible, to achieve the total opportunities for improving the efficiency of each customer. The comprehensive approach delivers all the efficiency services that are economical as a package; the single cost of getting an installer to the house is spread across a large number of measures, and no potential cost-effective savings are left "on the table."

Q: Does BHE properly approach DSM markets?

A: BHE's presentation is spotty. In some cases, BHE has grouped measures into appropriate markets. An example would be the water-heating retrofit program, which includes tank wraps, pipe wrapping, thermostat resetting, low-flow showerheads, and faucet aerators. Unfortunately, BHE has not included any lighting measures in the water-heating program, which has already included visits to about 27,000 customers, or one third of BHE's residential customers.

BHE has also included generic market-defined programs for the residential and commercial classes.[7] At this point, it is not clear whether BHE intends that these programs be comprehensive, since they are not yet designed. It is difficult to believe that BHE will be able to achieve comprehensive market-wide penetration in all end-uses, while

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[7]It is not clear why BHE did not include a comparable industrial program.

requiring that the participants pay for essentially all of the costs of the program.

2.3.2 Delivery of Services

Q: How could BHE deliver its measures most effectively?

A: For many measures, BHE should offer direct design and/or installation services, and assume most of the hassle and risks. For example, a residential heating retrofit program should provide for an audit, selection of cost-effective measures, and installation, with as little demand on customer time as possible. To the extent that BHE (or more generally a BHE contractor) designs, arranges, finances, oversees, and warranties the work, the customer avoids most of the hassle factors that complicate any major home improvement, and avoids the risk that his/her investment will not produce (or appear to produce) tangible savings. This is particularly important for residential and small commercial customers, and may also be significant for larger customers in some segments.

In other cases, BHE may need to change the way that products and services are delivered in its service territory. Offering incentives to appliance dealers, heating contractors, plumbers (for water-heater replacement), and lighting dealers may be more effective than offering incentives to customers. For lighting, BHE may need to get compact fluorescents into homes through direct delivery or discount mail order (so that customers gain some experience with them) and also get them onto store shelves (so that customers can buy them). Information and financing may be appropriate as part of some programs, but they are often only part of the best solution, and are sometimes totally inappropriate.

2.3.3 Participant cost-sharing

Q: How should BHE determine how much of the cost of a conservation measure it will bear?

A: BHE should start by identifying an efficient mechanism for delivering services in each market. Given that mechanism, and the nature of the market barriers in each market, BHE should select a funding level that will achieve essentially all of the achievable potential by the time that it is cost-effective, and that will not significantly increase the costs of program delivery. BHE should not arbitrarily refuse to pay for the full incremental cost of efficiency improvements, if that is the most effective and efficient means of securing those improvements.

To the extent that some program costs are recovered from participants, the participants should be given the option of having the recovery flow through their bills.[8] This may be very important for some customers (such as government agencies) which would have to secure numerous and complicated approvals to put up cash or to sign a loan agreement. It may

[8] BHE appears to recognize this point, at least for the programs it envisions, in which participants will pay for all program costs.

also be important for customers with cash constraints, and may overcome a psychological barrier for those customers who are not cash-constrained.

2.4 Cost-Effectiveness Tests for Utility DSM

Q: What screening test does BHE use in its evaluation of DSM programs?

A: BHE's testimony on this subject is inconsistent. However, Mr. Lee's cross-examination in Docket 89-193, et al., makes it quite clear that BHE essentially uses the non-participant's test (non-participants test): BHE will not implement a measure or program that increases rates to non-participating customers.

Q: What test should BHE have used in screening programs?

A: For screening measures against their direct costs and for screening programs against their total costs (direct, administrative, and monitoring), BHE should use one of the least-cost perspectives I discussed in Section 2.1, above. In the long run, I would recommend the use of the societal test, including all customer benefits, the marginal value of other regulated utilities affected by the program (e.g., water, gas), and externalities. Only this test reflects the value of the program to BHE, its customers, and the general public interest.

Since the PUC has not yet defined an approach to externalities, or adopted specific externality values, it may be premature to expect BHE to use the societal test. Given the lack of natural gas service in BHE's service territory, the total resource cost test (TRCT) and the all-ratepayers test (ART) are not likely to differ greatly.[9]

Any measure that passes the TRCT/ART screening is "good," and BHE should attempt to realize the potential of all such measures.

Q: What role should the utility revenue requirements test play?

A: Once BHE has committed to implementing a measure because it passes the societal cost test (or TRCT/ART), the company may have several options for how to deliver the measure and how to recover the cost of the measure. Some of these options will charge more of the cost to the participants, or otherwise reduce the utility's costs, increasing the revenue-requirements benefits of the measure, while others will increase utility costs. To the extent that program design can improve the present value of the revenue requirements test (e.g., reduce revenue requirements) while not significantly reducing the present value of the societal benefits, the utility revenue requirements test can be a useful guide to improving program design.

Q: Why should the utility revenue requirements test be given only a secondary role, compared to the societal test?

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[9]One obvious difference is the valuation of water at retail prices or (generally higher) marginal costs. Since most hot-water conservation measures are usually cost-effective without recognition of the value of the water, this is not likely to be an important distinction.

A: The societal test reflects the total benefits and costs, while the utility test reflects only the portion of the costs and benefits that flow through the utility. On the supply side, for such issues as reliability, utilities are routinely expected to include the costs to their customers (e.g., in reduced service quality) in evaluating the cost-effectiveness of investments. It is difficult to imagine, for example, a utility arguing that reduced tree-trimming is cost-effective because it cuts revenue requirements, unless it believes that the cost to customers of the increased frequency of outages is less than the benefit from the cost reduction.

Q: What role should the non-participants' test play?

A: The non-participants' test is not very meaningful on a measure-by-measure or program-by-program basis. The non-participants' test is a measure of equity, of the effect on other customers of the operation of a particular utility DSM program or measure. However, individual measures and programs cannot really be thought of as equitable or inequitable in isolation. Rather, the costs and benefits of the entire portfolio of conservation programs either produces an equitable outcome, or it does not. The effect on equity of each program will depend on the cost recovery from that program,[10] whether the participants in this program are already participating in other programs, and how the bills of

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[10]For example, the equity effects will depend on how the costs are recovered from various rate classes.

members of various classes and sub-classes are affected by the program.

Once an entire portfolio is designed, it is relevant to ask whether the effects are equitable overall. If there are equity problems, they can be addressed by changing cost recovery patterns, by increasing the penetration of programs to groups which would otherwise face higher bills, and possibly by changing the timing of program implementation.

Q: Has the non-participants test been widely adopted by regulatory commissions?

A: No. This commission has clearly rejected the non-participants test in favor of the TRCT/ART. So far as I am aware, virtually every commission which has squarely addressed this issue has rejected the non-participants test.[11] Examples include:

- Wisconsin PSC, Findings of Fact, Conclusions of Law and Order in Docket 05-EP-4, 5 August 1986, at pp. 8-9. Wisconsin re-affirmed its rejection of the no-losers test in its fifth Advance Plan decision in April 1989 in Docket 05-EP-5.
- Vermont utilities are prohibited from using the no-losers test to reject efficiency investments in

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[11]Several commissions allow or require utilities to present several economic tests, often including the NPT. I know of no regulatory agency which has adopted the NPT as the principal DSM screening test, as BHE advocates.

the PSB's Decision in Docket 5270, April 16, 1990, pp. III 85-88.

- The D.C. Public Service Commission rejected the no-losers test as a primary screen on demand-side investments in its March 1988 order in D.C. PSC F.C. 834 (Phase II). I was a technical advisor to the DCPSC in that proceeding.
- The Maryland PSC rejected the non-participants test in Decision 68660 in Docket 8063 Phase II, December 1989.
- The Idaho Commission rejected the non-participants test in Order No. 22299, Case No. U-1500- 165 (Jan. 27, 1989).
- The Connecticut DPUC rejected the non-participants test in its June 11, 1986 decision in Docket 85-10-22 at pp. 35-86.
- The Nevada Commission rejected the non-participants test in its October 1986 decisions in Docket 86-701 regarding the resource planning of Sierra Pacific Power.
- The New York PSC rejected the non-participants test in its 26 July 1988 decision in Opinion No. 88-20 in Case 29409, pp. 23-49.
- The Massachusetts Department of Public Utilities firmly rejected the no-losers test in its Decision and Order in DPU 85-266-A/85-271-A, 26 June 1986,

pp. 147-48. It reaffirmed this policy in subsequent orders, including DPU-86-36-E, November, 1988.

3. POTENTIAL FOR COST-EFFECTIVE CONSERVATION

3.1 Studies of Potential

Q: How large might the potential for cost-effective electricity conservation in BHE's service territory be?

A: No precise answer to that question is currently available. The amount of cost-effective conservation depends on the social avoided cost (including externalities and risk reduction), on the composition of current and future stocks of buildings and equipment, on the evolution of efficient technologies, and other factors. No comprehensive study of conservation potential has been performed for BHE. Since the best way to determine the potential for most markets is to implement an aggressive program and measure the response, it is not clear that a comprehensive study would be useful.[12]

We can get a rough sense of the potential by examining the results of studies performed in other states. It should be noted that these studies generally reflect technology options from several years ago. Since these studies were performed, the cost of efficiency improvements has fallen, and

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[12] Improvements in technology and in delivery strategies will also continually increase the achievable potential, so any study of potential can be "comprehensive" for only a short period of time. On the supply side, utilities generally commit to investing in technologies even though they do not know exactly what heat rate each unit will achieve or exactly how many sites may be available in the service territory. So long as an initial unit appears to be cost-effective, and a site has been identified, the utility can start using a new type of resource (e.g., combined cycle) long before it knows exactly how much it will build or exactly how the units will perform.

potential for efficiency has increased. As such, the conclusions may be conservative. The values of avoided costs used in these analyses vary, but they generally represent some proxy for new baseload plant construction, without any adjustment for line losses, T&D costs, load factor, or the benefits of reduced risk or avoided externalities.[13] Also, these studies generally do not examine fuel-switching from electricity to direct fuel use, which my work for the Boston Gas Company and (with others) for the Central Vermont Public Service Corporation collaborative has indicated is highly cost-effective, both in terms of direct costs and in terms of total social costs, including externalities.

Chernick, et al. (1989), a study prepared for the Minnesota Department of Public Service, determined that the total cost-effective conservation potential for Minnesota's electric utilities was 52%. We estimated that potential cost-effective efficiency savings were 60% in the residential class, 50% for farms, 60% for commercial customers, and 35% in industry.

Lovins (1986), a report to the Austin (TX) Electric Utility Department found that cost-effective efficiency investment by 2005 could reduce annual peak demand by 73%, and energy usage by 72%.

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[13]Except for Chernick, et al., (1988) and Lovins's work, these analyses generally ignore avoided line losses and avoided transmission and distribution costs.

Usibelli, _et al._, (1983), a study commissioned by DOE, found that technically feasible energy conservation measures costing less than 40 mills (roughly equal to the Northwest Power Planning Council's estimate of avoided supply costs) could reduce residential electricity demand in 2000 by 36.5% in the Pacific Northwest.

Geller, _et al._, (1986), prepared for Pacific Gas and Electric, examined seven end-uses representing 70% of PG&E's residential electricity consumption. They found that cost-effective efficiency investment could reduce electric energy needs in 2005 by 25%-44%, depending on the penetration of current and prototype technologies.

Miller, _et al._, (1989), a study for the New York State Energy Research and Development Authority, estimated that efficiency investments in the 1986 building stock which were cost-effective under their "societal" test would yield 34% savings in the residential class, 47% reduction in commercial electric usage, and 16% savings in the industrial class, for total savings of 34%.

Gertner, _et al._, (1984) limited their scope to retrofit technology and capability for office and retail buildings built before 1983. That study concluded that full implementation of cost-effective measures, with pay-back periods of one to three years, would reduce the electrical usage in those buildings by 36%.

Krause et al., (1988) studied the residential loads of Michigan's two largest utilities, and estimated technical conservation potential from existing and prototype technologies at 42% of usage in 1995 and 56% in 2005. The same study estimated that cost-effective conservation programs (with realistic limits on participation) could achieve energy reductions of 21% in 1995 and 29% in 2005. Technical potential of 19% of 1985 sales was identified for fuel-switching of appliances, excluding space heat.

Overall, it seems reasonable to expect cost-effective energy efficiency potential in the 30-70% range, depending on the level of avoided costs, the time frame used, and other variables. Even excluding the studies by Lovins, who is widely seen as an advocate for DSM, the range of potential is 30-50%.

While all of these utilities have significant DSM programs, only a few of them can be considered to be national leaders. Most of these utilities are not doing all they could or should do to promote energy efficiency. The sample presented here represents a range of DSM efforts from moderate to aggressive. The New England and New York utilities with DSM design collaboratives tend to lie at the more aggressive end of the scale.

3.2 Scale of Utility DSM Efforts

3.2.1 Review of utility DSM commitments and plans

Q: Which utilities' conservation commitments and plans have you reviewed?

A: I have reviewed the conservation plans of a number of New England utilities, which I have summarized in Table 3.1. Table 3.1 also summarizes the DSM plans of Wisconsin Electric Power (WEPCo), which probably has the most ambitious DSM program of any Midwestern utility. The DSM programs of the seven New York investor-owned utilities are summarized in Table 3.2, and those of the three major California utilities are summarized in Table 3.3.

Q: Please describe your sources for the figures in Table 3.1.

A: All the figures were obtained from utility testimony or reports, or from DOE publications.

Q: Please describe the results of Table 3.1.

A: Table 3.1 summarizes the conservation expenditures and savings for selected New England utilities and for WEPCo. The period analyzed depends on the form in which the utility projects its program: the time period varies from two to twenty years. The most interesting columns in Table 3.1 are columns [4], [6], and [8]. Column [4] expresses each utility's conservation expenditures as a percentage of its 1987 revenues. This percentage is evenly distributed between 2.5% to 4.6%.

Column [6] expresses the annual MWh saved by the end of the program as a percentage of ultimate consumer sales. The percentage ranges from 1.3% to 6.8%. Note that because the savings in the last year of the program include the effects of all the conservation measures installed in the course of the program, longer programs will tend to show more impressive results.

Column [8] expresses the peak-load reduction from each DSM program as a percentage of the utility's peak load. The savings are distributed over a wide range, from a low of 1.6% for WEPCo to a high of 18.3% for NEES. Again, program length is a key determinant of effect.

Q: How does this compare with the conservation efforts in New York State?

A: The New York utilities spend on average the same proportion of their revenues on DSM as their New England and Wisconsin counterparts, and reap comparable savings. Table 3.2 outlines the conservation spending and savings of the seven major New York utilities. As ordered by the New York PUC, each company has assembled its own 18-year DSM plan. For the last year of the plan, the utilities have budgeted on average 3.4% of their revenues to DSM. The programs result in average cumulative savings of 8.6% of projected sales, and 13.2% of projected peak load. Note that the New York savings tend to be higher than those for New England and Wisconsin because the New York programs run for more time. NYSEG is the only New York utility which has participated in a collaborative DSM program design; NYSEG DSM expenditure and savings levels exceed those of the other New York utilities.

Q: Please describe Table 3.3.

A: Table 3.3 is a summary of projected 1989-90 conservation expenditures and savings for the three major California utilities: Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E). These programs are the result of the "collaborative" agreements reached between the utilities and intervenors, as described in the <u>Report of the Statewide Collaborative Program, An Energy Blueprint for California</u>. In those two years, the utilities spent an average of 1.3% of their revenues on DSM to reduce their energy demand by an average of 1.1%.[14]

Q: What magnitude of effort would constitute a reasonable DSM effort for a utility the size of BHE?

A: To be comparable to the utilities listed in Tables 3.1-3.3, and to capture a large fraction of its cost-effective DSM opportunities, BHE should have to spend a few percent of its annual revenues on conservation, or roughly $3-5 million a year.[15] BHE's program savings should increase by an

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[14] Note that these savings figures appear lower than those for New York and New England utilities because they include only two years of programs.

[15] This calculation is based on the 1988 revenues of $111 million.

additional 0.5-1% of sales each year, or roughly 7-15 GWH. By the tenth year of the program, BHE should be looking for annual savings on the order of at least 100 GWH, or 5% of sales. Subsequent plans may well identify larger amounts of cost-effective DSM, so these targets should be considered starting points.

3.2.2 BHE DSM program scale

Q: What is the scale of BHE's proposed programs?

A: In the context of the more aggressive utilities in New England and nationally, BHE's efforts are extremely modest. These efforts may be summarized at several levels.

The most favorable interpretation of BHE's DSM program would include all of BHE's claimed savings, without recognizing the promotional basis of certain programs, and excluding the clearly promotional storage heating program. Under these rules, BHE's program would be computed as saving 2% of energy and 7.8% of demand in the year 2000, and 2% of energy and 7.9% of demand in the year 2018.

One of the few conditions under which Mr. Lee expresses BHE's willingness to pay for increases in customer end-use efficiency is if the measures are necessary to retain load. BHE's major near-term conservation program, water-heater wraps, appears to be intended to prevent customers from switching to other fuels, through increasing electricity use compared to conditions without the wraps. Eliminating this program reduces the claimed DSM savings, to 1.7% of energy and 7.6% of demand in the year 2000. It has no effect in 2018, since BHE expects to stop wrapping water heaters and has no alternative water-heater efficiency program.[16]

One of the major components of BHE's DSM portfolio is the storage heating program, which is primarily oriented toward building load. Adding in the projected effects of this program produces a slight net increase of in energy and a 7.7% reduction of demand in the year 2000, and a net decrease of 0.6% of energy and 7.9% of demand in the year 2018.

Q: How do these values compare to the scope of DSM programs by utilities that have major DSM programs?

A: The BHE DSM plan is minuscule in comparison to serious utility DSM plans.

Q: Do you know of any reason why BHE should not be able to develop a DSM program which would provide as much cost-effective savings as the programs designed and implemented by the utilities discussed in Section 3.3?

A: No. The magnitude of savings will depend to some extent on the mix of customers and end-uses on the utility's system. For example, commercial lighting presents large, low-cost conservation options; utilities with large commercial loads

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[16]This correction may be under-stated, and the resulting DSM effects overstated, if other programs (such as storage water heating) are also designed for promotional purposes. BHE was less than candid with the PUC regarding the purpose and effects of the water heater wrap program, reporting the program as a conservation program while planning the program to promote sales.

are likely to have somewhat greater DSM potential than those with primarily residential and industrial loads. However, significant DSM opportunities exist in all customer classes and in most major end uses. Hence, BHE should be able to assemble a DSM program on the scale of the programs listed in Tables 3.1-3.3.

3.3 Components of Utility DSM Programs

Q: Have you surveyed the measures and programs included in relatively ambitious utility DSM plans?

A: Yes. Tables 3.4 and 3.5 provide checklists of the measures and programs incorporated in selected utilities' residential and commercial/industrial DSM plans. Many utilities' DSM programs are under continuing revision, hence some recent refinements may not be reflected in these Tables. Fourteen utilities are represented in the Tables. Half of these utilities have participated in a collaborative DSM plan design process. These include six New England utilities (Boston Edison, Commonwealth Electric, Eastern Utilities, New England Electric Systems, United Illuminating, and Western Massachusetts Electric) and a New York utility (New York State Electric and Gas). The non-collaborative utilities include one Wisconsin utility, (Wisconsin Electric Power), and the six remaining New York utilities (Central Hudson Gas & Electric, Consolidated Edison, Long Island Lighting Company, Niagara Mohawk, Orange and Rockland, and Rochester Gas and Electric).

The non-collaborative New York utilities have been ordered to address deficiencies in their programs, so it is likely that they will increase the number of measures they offer.

The Tables distinguish between a measure that is included as part of a larger program (marked by "I"), and a measure that is a program unto itself (marked by "P"). For example, as UI includes residential weatherization as part of its "one-stop" Smart Energy program, weatherization is marked with an "I". WEPCo has a program dedicated to refrigerator turn-ins, therefore under "extra frig. disposal" WEPCo has a "P".

Q: What conclusions do you draw from Table 3.4, the checklist of residential DSM measures?

A: Table 3.4 expresses six important points about utility residential DSM programs.

First, the opportunities for residential DSM are manifold. Home appliances, air conditioners, electric heating, home and security lighting, pool pumps, and water heaters all offer potential for cost-effective measures.

Second, savings for each end use can be obtained through a number of different approaches. For example, door-to-door programs, mail-order discount catalogs, and point-of-purchase rebates and displays are among the options for promoting more efficient residential lighting. Appliances can be targeted through second-appliance turn-in programs, point-of-purchase labeling, fuel switching, cleaning and maintenance programs, and coupon books. A utility can obtain savings from electric water heaters through efficiency rebates on routine replacement, through fuel switching, and through direct installation of conservation measures such as tank wraps and aerators.

Third, utilities have found that special attention needs to be paid to low-income and/or public housing customers. While the end uses and technologies are generally similar to other applications, these customers generally face different market barriers and may require different delivery techniques from those of other residential customers.

Fourth, utilities have generally recognized the necessity of a separate program for new construction.

Fifth, while programs that rely on price signals or load shifting (e.g., submetering, TOU rates, and load control) are frequently included in utility programs, they are generally a small portion of the residential conservation plan.

Sixth, fuel switching from electric to fossil fuels can be cost-effective. Three utilities -- ConEd, LILCo, and Niagara Mohawk -- have implemented fuel switching for appliances, residential HVAC, or water heating.

Q: Please describe how groups of measures and end-uses have been combined into larger programs (as marked by an "I" in the Table).

A: Many utilities have chosen to bundle DSM for several end uses in a larger program. The most common kind of bundling is the "one-stop-shopping" program, in which a utility representative going door to door conducts an audit and offers (or installs) lost-cost measures such as compact fluorescent bulbs, water heater wraps, or low-flow showerheads. The representative may also perform simple maintenance on an appliance (clean coil, change filter), arrange installation of other measures, and offer energy management information or referrals to other programs. These "bundled" programs are targeted to certain neighborhoods, or to certain types of customers (e.g., low income, multifamily, electric heat high use).

Q: What distinguishes the collaboratively-designed programs from the others?

A: The collaboratively-designed residential DSM programs generally share the following six characteristics:

- they include a program dedicated to New Construction,
- they offer a stand-alone program for low-income customers and/or public housing customers,
- they place a strong emphasis on lighting: the lighting programs generally take a three-part approach to obtaining savings, including free or low-cost door-to-door distribution (often delivered with other measures and/or through local non-profit organizations), reduced-price catalogue sales, and point-of-purchase displays;
- they offer free hot water conservation measures,

- they provide free or low-cost weatherization of electrically heated homes, and
- they address appliance energy savings through efficiency rebates or through point-of-purchase labeling.

Comprehensive residential DSM portfolios will need to address these market sectors explicitly.

Q: What conclusions do you draw from Table 3.5, the checklist of commercial/industrial DSM measures?

A: Table 3.5 points out several important aspects of DSM opportunities in the C/I sector. The C/I sector, like the residential sector, contains a variety of energy conservation opportunities. HVAC systems, refrigeration, industrial processes, lighting, motors, new construction, retrofits/remodeling, and water heating are all important conservation resources a utility can tap.

The programs of all utilities surveyed share certain characteristics:

- they offer lighting incentives,
- they offer motor efficiency incentives, and
- they offer HVAC measures.

Further, an number of utilities emphasize other DSM resources:

- they dedicate a program to the C/I new construction market,
- they provide special assistance to non-profits, and
- they offer fuel switching.

Q: Are there any features that distinguish the collaboratively designed programs from the others?

A: Yes. The collaboratively designed programs have four salient features. They are:

- inclusion of a program that addresses industrial process,
- inclusion of a new construction program,
- less emphasis on load shifting/clipping than the non-collaborative programs, and
- less emphasis on an audit than the non-collaborative programs.

Q: How have utilities organized different measures into programs?

A: Though they address similar end-uses, the DSM plans that I reviewed packaged their C/I measures in different ways. Some bundle many measures together in a single retrofit/remodel program. Others maintain separate umbrella programs for small and large C/I; these are umbrella programs than include many (or all) end-uses. Still others design distinct programs for each end-use.

Q: Are there important characteristics of utility DSM programs that are not addressed in Tables 3.4 and 3.5?

A: Yes. It is important to keep in mind that the Tables do not attempt to assess whether a program has been designed truly to maximize savings. There are many questions we might ask about the programs listed. For example:

- have rebates been set high enough to encourage customers to purchase the most efficient equipment?

- does a new construction program minimize lost opportunities by including all end-uses?
- does a lighting program cream-skim by offering reflectors but not efficient electronic ballasts?

A program that seeks to maximize savings must address such questions.

Q: How do BHE's program offerings for DSM compare to the utilities you describe in Tables 3.4 and 3.5?

A: BHE's programs are very limited. Other than the promotional storage heating program, BHE plans to offer only seven programs. Three of those programs involve water heating, but none encourage the use of more efficient tanks, or the insulation of new tanks as they are installed. Two of the programs (the "Residential" and "Commercial" programs) are very vague program concepts, without specific designs. The only industrial program is an interruptible service rate. No specific programs exist for new construction or for low income customers. BHE has clearly not identified and targeted the range of market sectors present within its service territory.

4. BHE POSITIONS ON DSM

Q: What screening test does BHE use?

A: In effect, BHE uses the non-participants test. While BHE has periodically argued that it uses the non-participants test primarily for program <u>design</u> rather than for <u>screening</u>, this argument appears to be largely semantic. In fact, BHE is not planning to achieve much increase in energy efficiency through its DSM program, BHE is not addressing a wide variety of market sectors, and BHE is not proposing to overcome significant market barriers in most sectors.

Q: Please review BHE's three basic arguments for the small scale of its DSM program.

A: BHE argues that:

a. BHE customers are already making most cost-effective energy-efficiency investments, without BHE intervention; these investments are reflected in the BHE load forecast.

b. BHE can cause customers to invest in energy efficiency while recovering essentially all costs from the participating customers.

c. If customers are not willing to undertake and pay for apparently cost-effective conservation measures with minimal utility involvement, the measures must have some non-obvious costs to the customers, making the measures non-cost-effective.

These three explanations are offered as alternatives, even though they are obviously partly contradictory. I will consider them in order.

4.1 BHE DSM Potential

Q: BHE has suggested that its DSM opportunities may be limited by the fact that its retail rates are greater than its marginal supply costs. Is this an unusual situation?

A: No, not for most of the utilities which are particularly active in DSM.[17] Most of the utilities in Tables 3.1-3.3 would maintain that their marginal production costs, especially in the short run but generally in the long term as well, are lower than their rates. Full avoided costs, including transmission and distribution costs, losses, externalities, and risk, are considerably higher than short-run marginal busbar costs; even these values are usually lower than projected rate levels.

The differences between BHE's current program targets and the DSM programs of other utilities cannot be explained by the relationship between rates and marginal costs.

Q: BHE has suggested that its customers' efficiency levels may be relatively high, due to BHE's relatively high rates. Does

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[17]This issue does arise for the utilities in the Northwest, whose rates are depressed by large amounts of inexpensive Federal hydro power. The Northwest utilities are not represented in my tables.

this argument explain any part of the difference between BHE's DSM program and that of other utilities?

A: No. The argument could be correct as a theoretical matter, but it is simply incorrect for BHE on an empirical basis. BHE's rates are low compared to those of most other New England utilities, and particularly compared to the utilities engaged in collaborative DSM design processes. Table 4.1 compares Bangor Hydro's average residential, commercial, and industrial rates to those of 10 northeastern utilities participating in a collaborative. The table reveals that in all three sectors, Bangor Hydro has rates that are relatively low. In the residential sector, only NEES has lower rates than Bangor Hydro (7.5 cents/kWh as compared to 8.9 cents/kWh). Bangor's commercial rates are lower than those of six of the companies considered. All nine of the other companies have higher industrial rates than Bangor.

Recent Energy User News surveys of commercial and industrial rates further discredit the company's claim to having high rates. The EUN reviews show that while Bangor does indeed have high rates relative to much of the rest of the country, its rates are low compared to other utilities in the Northeast, including most of the utilities with relatively ambitious DSM programs.[18]

[18] "Ranking of Electricity Prices," Energy User News, Vol. 15, Nos. 11, 12; Vol. 16, Nos. 1,2.

Since BHE's rates are lower than those of most utilities with collaborative DSM programs, it is not reasonable to believe that price elasticity will cause BHE's customers to use electricity (before DSM) as efficiently as those of the collaborative utilities, let alone more efficiently. In addition, even if BHE were higher, only a small portion of cost-effective DSM would be achieved through customer-initiated actions.

Q: BHE has argued that its load forecast is lower than other New England utility load forecasts due to the incorporation of large amounts of customer-initiated energy efficiency, and that BHE DSM programs are thus unnecessary. Is this position correct?

A: For two reasons, no. First, BHE has not shown that its forecast really incorporates any more autonomous energy efficiency improvements than do those of other New England utilities. Load forecasts can differ due to differences in assumed service consumption levels, construction rates, demographics, and levels of economic activity, as well as energy efficiency. The differences between utility projections can reflect different expectations for national and regional trends,[19] or differences between service territories.[20]

Second, even if BHE assumed higher growth rates in energy efficiency, it would still need to implement DSM programs to cause those changes. Simply projecting that customers will make different energy-use decisions does not assure that the customers will actually take the expected actions. BHE has ignored the existence of significant market barriers.

4.2 The Feasibility of Achieving Efficiency Under the Non-Participants Test

Q: Is BHE correct that any DSM that passes the all-ratepayers test should be achievable without violating the non-participants test?

A: No. The market barriers I discussed earlier discourage customer investment in energy efficiency, even with rates above marginal costs. In order to pass the non-participants test with rates above marginal cost, the DSM program would generally have to charge participants more for the DSM program than they would spend if they were to undertake it on their

[19]Testimony in Docket 89-193 indicated that some of BHE's load forecast comparisons were to older forecasts that assumed higher economic growth.

[20]Bangor is not Portland or Boston, and there is no reason to believe that Bangor's family sizes, out-migration rates, pre-capita income, commercial floor space, or other forecast parameters will change in synchrony with those of other parts of New England.

own. Most of the market barriers addressed above would not be eliminated by this approach.

Q: What is the basis for BHE's belief that any DSM that passes the all-ratepayers test should be achievable without violating the non-participants test?

A: As articulated by Mr. Lee, BHE's position seems to be based on an explicit theoretical assumption that consumers are "rational," in a specific utility-maximizing sense, and on an implicit assumption that rationality means the same thing for consumers and for utilities.

In essence, Mr. Lee argues that consumers will select the best mix of energy services and will always select the least-cost option from equivalent energy services. He recognizes that access to information and capital may restrict the ability of consumers to select options. However, if consumers are provided with information and offered financing, Mr. Lee believes they will always select the least-cost option.

Q: Is Mr. Lee's optimism justified?

A: No. BHE has provided no basis for its optimism, other than the belief of Dr. Kolbe and Mr. Lee in "rational" consumers. BHE does not appear to have any market research supporting its positions.

Q: Do BHE's witnesses acknowledge the existence of market barriers?

A: Yes. Dr. Kolbe acknowledges that, for example, customers are impeded from investing in energy efficiency by the "time needed to research the issues and make a decision," (testimony, p. 26), and that "home buyers may not price-distinguish between two otherwise identical homes, one with a major DSM investment, the other without" (Kolbe and Chapel, 1989). Mr. Lee agreed on cross in Docket 89-193 that landlord/tenant market barriers exist. While these are a small sampling of the range of market barriers, BHE is certainly aware of the impediments to efficiency operation of the energy-efficiency market place.

Q: Are these observations consistent with the simple rational model of consumers?

A: No. Customers are affected by more complex considerations than the simple rational cost-benefit analysis BHE assumes.

Q: What is BHE's rationale for designing programs to pass the non-participants test, if that were possible?

A: In the pre-filed testimony of Mr. Lee, and as a secondary argument in his live testimony in Docket 89-193, et al., BHE argues that paying for DSM that fails the non-participants test produces inequitable results. As discussed in Section 2.1, the non-participants test is a totally inappropriate test of equity. A program that fails the non-participants test may increase the overall equity of the DSM portfolio, depending on the end uses, technologies, and sub-classes covered, and on the ratemaking used to recover DSM costs.

4.3 The Non-Participants Test as an Efficiency Test

Q: What is BHE's other rationale for using the non-participants test?

A: In the testimony of Mr. Lee and Dr. Kolbe, BHE basically argues that the non-participants test is an efficiency test. This argument in turn has three parts. First, BHE argues that paying for programs that fail the non-participants test would cause overconsumption on the part of the participants. Second, BHE argues that programs that fail the non-participants test are inherently inefficient. Third, BHE argues that paying for DSM that fails the non-participants test will result in inefficient behavior on the part of non-participants.

4.3.1 The Non-Participants Test and Participant Consumption of Services

Q: Is BHE correct that paying for programs that fail the non-participants test would cause inefficient behavior on the part of the participants?

A: No. Mr. Lee asserts that underpricing of conservation services would induce participants to over-consume the conservation service. It is difficult to see how this could be a widespread problem for well-designed programs. If the utility selects eligible measures and evaluation techniques, and properly determines the cost-effective installations for each site, participants will have little opportunity to "over-consume" the conservation service.

Over-consumption of conservation services is a theoretical problem for naive conservation programs, which simply pay customers for delivered conservation, without evaluating the cost-effectiveness of the measures undertaken.[21] Most of the critiques BHE cited in support of this position address the issue of over-consumption of conservation services in hypothetical bidding arrangements and other naive utility programs which simply "buy negawatts," without reviewing cost-effectiveness. None of the critiques BHE provided addresses a situation in which the utility operates the program and identifies cost-effective conservation.

If BHE's position were that some minor inefficiencies can occur in utility provision of DSM services, I would certainly agree. For example, a customer might not mention that a couple of rooms are used only occasionally, and the utility may install lighting measures that are not cost-effective at the low utilization rate. Such situations probably occur for BHE's current programs for water heating conservation and water heater control: a customer may allow BHE to spend money on DSM measures when the customer does not expect to use much

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[21] I discuss such a program in Chernick (1984). Naive programs can correct some of the price signals resulting from rates that are less than marginal costs, but they are totally inappropriate when rates exceed marginal costs.

hot water (e.g., in a second home) or when the customer expects to replace the electric system with oil in the near future. These inefficiencies should be factored into the estimates of annual savings and of average life of DSM measures, but would rarely render otherwise cost-effective programs uneconomic.

4.3.2 The Non-Participants Test and Participant Choices

Q: What is BHE's argument regarding the effect of programs that fail the non-participants test on the efficiency of choice made by participants?

A: Dr. Kolbe argues that any perceived costs to the customer are real costs, which must be added to the monetary costs of the DSM. He reasons that if customers are not undertaking apparently cost-effective DSM measures, they must perceive subjective costs that exceed the cash savings. Dr. Kolbe concludes that, if rates exceed marginal costs,[22] any utility effort to encourage conservation (other than providing market-rate financing and information) will result in the implementation of conservation measures with total costs (direct plus subjective) that exceed the marginal costs.

Q: Is Dr. Kolbe correct?

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[22] He apparently equates marginal costs with avoided costs. This is an oversimplification.

A: No. He describes an interesting theoretical world, in which all actors are "rational" in a very limited sense, in which capital markets operate efficiently, in which corporations allocate capital as financial theorists would have them do, and in which all decision-makers are faced with and are responsible for the financial consequences of their actions. He also assumes that utilities will only provide subsidies for actions consumers take, rather than facilitating the actions and sharing in their risks.

Q: Can you discuss a few areas in which the real world appears to be different from that which Dr. Kolbe describes?

A: Yes. In terms of the behavior of individuals and organizations:

- Regardless of the theoretical basis (or lack thereof) for capital rationing, corporations do impose very rapid payback requirements, especially for investments (such as DSM) that are outside their primary business area. Ensuring that DSM decisions are made on the same basis as utility supply decisions results in leveling of the playing field; it is not the result of any special pleading for DSM.
- Access to conventional capital for many individuals and organizations involves large administrative costs for the borrower and for the lender. So long as BHE secures financing for supply without

evaluating its customers' creditworthiness, but DSM investments must be funded through cumbersome retail channels, resources will tend to be biased towards supply.

- Many energy efficiency decisions are dominated by split incentives. Developers and landlords select building and equipment designs, while buyers and tenants must pay the bills. The developer's concerns are apt to be dominated by construction budgets, short-term risk reduction, and the marketability of the building, rather than theoretical incremental effects of energy efficiency on sales prices or long-term rents. Architects and engineers are generally responsible for construction budgets and for adequacy of equipment operation; specifying non-standard high-efficiency equipment increases the architect's risk with little or no offsetting benefits. Building managers may be responsible for maintenance expenses, but not for energy expenses; they may incur major administrative difficulties in receiving authorization for capital investments.
- Many decision-makers must consider not just the expected net present value (the basic decisionmaking tool for utilities), but also the potential for regret. Using standard technologies and procedures

is unlikely to result in serious recriminations, even if technical or energy-market problems subsequently arise; using energy-efficient equipment may expose the decision-maker to a range of problems.

In terms of utility responses:

- The utility can eliminate many of the inefficiencies produced by split incentives, capital budgeting processes, and the costs of obtaining capital through market mechanisms, by supplying the incremental funds required for efficiency investments.
- While customer can purchase only one chiller (for example), a utility program can influence the installation of thousands of chillers. The utility can substantially diversify the risk of poor performance of individual units.
- The utility can virtually eliminate the extensive information costs Dr. Kolbe discusses. The utility and its contractors need learn about the technology only once. So long as the utility is undertaking the bulk of the costs and the risks, individual customers need not repeat this effort.
- The utility can also greatly reduce or eliminate the costs customers (especially small customers) incur in dealing with suppliers and installers. Locating,

its customers on the supply side.[23] If it provides the same services on the demand side, many market barriers will disappear.

4.3.3 The Non-Participants Test and Non-Participant Efficiency

Q: Is BHE correct that paying for DSM that fails the non-participants test will result in inefficient behavior on the part of non-participants?

A: No. BHE argues that raising rates that are already above marginal cost will result in "uneconomic" conservation. Certainly, consumption is price-elastic, and higher rates will cause some customers to install more efficient equipment (e.g., insulate), to use energy more carefully (e.g., turn off lights in rooms not in use, or be more conscientious about not leaving hot water running), and even to reduce the level of energy services they utilize. However, it is unlikely that even large rate increases would result in over-investment in energy efficiency.

Suppose a customer imposes a two-year payback, while the utility's financial criterion is equivalent to a 12-year payback. If marginal rates equal marginal costs, the customer

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[23]As noted previously, the mix of BHE's supply investments might be very different if each customer were required to contract for and finance the specific mix of supplies the customer wishes to use. The mix would probably be biased toward low-risk, short-lead-time, low-capital-intensity, established technologies. This is the correct situation for most energy efficiency decisions in BHE's service territory.

will invest in energy efficiency only if it costs less than 1/6 of the amount the utility could pay for the efficiency. If conservation programs, or any other consideration (e.g., uneconomic supply investments) raise rates to twice marginal cost, the customer will invest in conservation up to 1/3 the value to the utility. Obviously, even very large utility investments in energy efficiency are unlikely to raise rates enough to result in widespread uneconomic efficiency investments by non-participants.

4.4 Inconsistencies in BHE Criteria

Q: Does BHE make any exceptions to its rule that only programs that pass the non-participants test will be funded?

A: Yes. BHE is willing to invest in DSM programs that fail the non-participants test in three circumstances: if they promote the use of BHE electricity, if they are essentially universal, or if they are required by law or regulation. The last point is obviously not much of a concession, since BHE is agreeing to do that which it must do anyway.

Q: Please comment on BHE's willingness to fund DSM that fails the non-participants test but promotes the use of electricity.

A: Promotion of electricity is the wrong standard for evaluating DSM. DSM programs should be undertaken only when they reduce the total social costs of energy services. Increasing BHE's "competitive position" is not a valid purpose for DSM, and is inconsistent with any least-cost planning perspective.

Q: Please comment on BHE's willingness to fund DSM that fails the non-participants test but is universally applicable and acceptable to a class of customers.

A: The requirement that a single measure must be universal is clearly too stringent. It is not clear to me why five programs, each serving a fifth of the customer class, should not be treated as favorably as a single program serving the entire class. In either case, all customers can benefit, and total costs are reduced.

A: Yes. Those costs include lost energy savings, short-term supply costs, and potentially poor decisions on preparations for long-term supply acquisition. One area in which the failure to develop DSM is likely to result in poor decisions is the continued investment in licensing of hydro facilities, which might be entirely unnecessary if BHE had a fully developed DSM program. In determining the cost to ratepayers of BHE's inaction on DSM, the PUC should consider these categories of costs.

Q: Is it necessary to quantify these costs?

A: No, although such quantification would be interesting information for this proceeding. The PUC can consider the quality of BHE's management in terms of the costs and risks to which ratepayers have been exposed, in addition to the specific outcomes of BHE mismanagement. For the determination of rate of return, the quality of management decision-making may be more important; for disallowance of specific supply costs, quantifying the effects of poor decisions become more important.

Q: Does this conclude your testimony?

A: Yes.

Table 3.3: Summary of 1990-91 Conservation Expenditures and Savings for Major California Utilities

Utility	Program Expenditures [1]	% of projected revenues [2]	Energy savings, MWh/yr [3]	% of projected sales [4]	Capacity savings, MW/yr [5]
PG&E					
1989	$80,338,000	1.4%	201,511	0.3%	97
1990	$137,766,000	2.2%	365,166	0.5%	660
cumulative savings			566,677	0.8%	757
SCE					
1989	$53,911,000	0.9%	371,067	0.6%	200
1990	$84,062,000	1.2%	901,900	1.3%	332
cumulative savings			1,272,967	1.9%	532
SDG&E					
1989	$6,938,180	0.5%	44,040	0.3%	28
1990	$7,850,788	0.5%	48,604	0.4%	30
cumulative savings			92,644	0.7%	58

Notes:

[2]: Utilities' annual ultimate consumer revenues from the Energy Information Administration's "Financial Statistics of Selected Electric Utilities, 1988" (published in 1990), adjusted for year considered (2% growth and 4% inflation assumed).

[4]: Utilities' annual ultimate consumer sales from the EIA (cited in note [2]), adjusted for year considered.

Spending and savings totals do not include load retention programs.

Source for Utility figures:

Pacific Gas and Electric "Annual Summany Report on Demand Side Management Programs in 1989 and 1990" (3/90).

Southern California Edison Company's (U 338-E) Filing of 1989/90 Demand-Side Management (DSM) Annual Report in Compliance with Decision No. 87-12-066, ordering paragraph 29 (3/90).

San Diego Gas and Electric "Annual Summary of Demand-Side Management Activities, March 1990."

All 1989 figures are historical, and 1990 figures are utility projections.

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Table 3.5: Checklist of Commercial/Industrial Conservation Programs Implemented by Selected Electric Utilities

	Conservation programs designed in a collaborative							Total	Non-collaborative programs							Total	Total,
	BECo	COM/Elec	EUA	NEES	NYSEG	UI	WMECo	collab. utilities	CHG&E	Con Ed	Lilco	NiMo	ORU	RG&E	WEPCo	non-collab. utilities	all utilities
Agricultural					P		P	2				P			I	2	4
Audit					P	I	P	3	P	P	P	P	P	P		6	9
HVAC																	
elec. A/C, chillers	I	I	I	I	I	I	I	7	P	P	P	P	P	I	P	7	14
fuel switching					(2)			1	I	P	I		P	I		5	6
other (3)						I		1			I		P	I		3	4
Refrigeration	I	I	I		P		I	5	I		I			P	P	4	9
Custom C&I				I		I		2	P		I	P				3	5
Industrial process	I	I	I	I	P		I	6							P	1	7
Information					P	P	I	3		P		P				2	5
Lighting	I	I	I	I	P	I	P	7	P	P	I	P	P	P	P	7	14
Load shifting/clipping																	
TOU rates					P			1		P						1	2
curtl/intrptl rates				P	P			2	I	P		P	P		P	5	7
other (4)				P		I		2	P	P	P	P	P	P		6	8
Motors	I	P	I	I	I	I	(1)	7	P	P	I	P	P	I	P	7	14
New construction	P	P	P	P	P	P	P	7			P			P		2	9
Non-profit		P						1		P	P	P		P		4	5
Retrofit/remodel	P		I	I	P	I	I	6			I			I		2	8
Water heating	I	I	I			I		4	I					P	I	3	7
DSM bidding				P	P			2	P		P		P			3	5

(1): efficient motors research program.

(2): only in NYSEG's combination Electric and Gas service territory.

(3): includes thermal storage and load control.

(4): includes stand-by generation.

Notes for Tables 3.4 and 3.5:

An "I" indicates that a measure is Included in a larger program.
A "P" indicates that a Program is dedicated to that measure.

Sources:

Boston Edison, "The Power of Service Excellence: Energy Conservation for the '90's" (3/90).
Central Hudson Gas & Electric, "Long Range DSM Plan and 1991-92 Annual Plan" (7/90).
COM/Electric, "Mass. State Collaborative Phase II Detail Plans" (10/89).
Consolidated Edison, "Demand-Side Management 1991-92 Annual Plan and Long Range Plan."
Eastern Utilities, "Plan for the 90's: Results from Phase II of the Collaborative Planning Process" (2/90).
Long Island Lighting Co., "1991 Long Range Conservation and Load Management Program" (7/90).
New England Electric System, Testimony of Peter G. Flynn in Docket #xx before the Mass. DPU, (10/90).
New York State Electric and Gas, "Demand Side Management Summary and Long Range Plan," (10/90).
Niagara Mohawk, "1991 Integrated Demand-Side Management Plan", (7/90).
Northeast Utilities, "Status of Private Power Producers and Conservation & Load Management" (4/90).
Orange and Rockland, "Demand Side Management Plan - Long Term Plan 1991-2008" (7/90).
Rochester Gas & Electric, "1990 Long Range DSM Plan and 1991-92 Annual DSM Plan" (7/90).
Western Mass Electric's " Conservation and Load Management Program Plan for the 1990's" (9/89) and
Wisconsin Electric Power Co. "Integrated Resource Plan in Support of the Concord Generating Station" (5/89).

Table 4.1: Comparison of Bangor Hydro Rates to those of New England Utilities with Collaborative Conservation Programs.

Utility	***** Residential ***** Sales (GWh)	Revenues (million$)	c/KWh	***** Commercial ***** Sales (GWh)	Revenues (million$)	c/KWh	***** Industrial ***** Sales (GWh)	Revenues (million$)	c/KWh
1. Bangor Hydro	503	45	8.9	217	17	7.8	797	44	5.5
2. BECO	3,430	340	9.9	7,004	573	8.2	1,839	133	7.2
3. COM/Electric	1,784	158	8.9	1,887	137	7.3	472	31	6.6
4. CL&P	8,008	713	8.9	7,446	589	7.9	4,373	290	6.6
5. WMECo	1,403	125	8.9	1,251	94	7.5	1,044	68	6.5
6. CVPS	660	66	10.0	744	68	9.1	365	25	6.8
7. EUA	1,378	128	9.3	1,421	119	8.4	869	70	8.1
8. NEES	7,735	581	7.5	7,128	486	6.8	5,064	302	6.0
9. UI	1,870	200	10.7	2,174	209	9.6	1,186	97	8.2
10. NYSEG	5148	507	9.8	3069	258	8.4	3159	198	6.3

Notes:

Source for all sales and revenue figures is the EIA "Financial Statistics of Selected Electric Utilities 1988," except for NEES.

2: Boston Edison

3: COM/Electric figures represent the sum of Cambridge Electric and Commonwealth Electric data.

4: Connecticut Light & Power

5: Western Mass. Electric

6: Central Vermont Public Service

7: Eastern Utilities figures represent the sum of Eastern Edison and Blackstone Valley data.

8: New England Electric System (personal communication).

9: United Illuminating

10: New York State Electric and Gas

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