STATE OF OHIO

BEFORE THE PUBLIC UTILITY COMMISSION

In the Matter of the 1995 Long-Term	)	
Forecast Report of the Cincinnati	)	Case No. 95-203-EL-For
Gas and Electric Company	)	

DIRECT TESTIMONY OF

PAUL CHERNICK

ON BEHALF OF

CAMPAIGN FOR AN ENERGY EFFICIENT OHIO

Resource Insight, Inc.

February 1, 1996

TABLE OF CONTENTS

EXHIBITS

I. Introduction and Summary

A. Witness Identification and Qualifications

Q: Please state your name, position, and business address.

A: I am Paul L. Chernick. I am president of Resource Insight, Inc., 18 Tremont Street, Suite 1000, Boston, Massachusetts.

Q: Please summarize your qualifications.

A: I hold a Masters degree in Technology and Policy from the Massachusetts Institute of Technology. I have been a utility analyst since 1977, first for the Massachusetts Attorney General and then as a consultant. My experience, publications, presentations, and previous testimony are listed in Exhibit ____ (PLC-1).

Q: Please summarize your experience with electric utility planning.

A: In numerous reports and in testimony before state and federal regulatory agencies, I have addressed virtually every aspect of utility resource planning: demand forecasting; the integrated resource planning process, including the treatment of risk and the selection of the final plan; demand-side management; selection of supply resources, including generation, transmission, and purchases; calculation of avoided costs (both generation and transmission-and-distribution); valuation of environmental costs and risks, and their incorporation into the resource-planning process; recovery of resource acquisition costs; and incentives for utility performance. This experience is detailed in Exhibit____(PLC-1).

Q: Have you previously testified before the Public Utilities Commission of Ohio?

A: Yes. In xx

B. Summary of Testimony

Q: On whose behalf are you testifying?

A: I am testifying on behalf of the Campaign for an Energy Efficient Ohio.

Q: What is the purpose of your testimony?

A: I have been asked to review the Long Term Forecast Report of the Cincinnati Gas and Electric Company (CG&E), a unit of Cinergy, with particular emphasis on CG&E's proposed DSM portfolio.

In particular, I was asked to respond to the request in the 12/7/95 Entry in Case No. 95-659-EL-AAM, *et al.* to

> present testimony addressing innovative approaches to fund energy-efficiency investments that may not meet the stringent cost-effectiveness criteria applicable to DSM programs. Parties should also propose innovative solutions to addressing the particular needs of low-income customers and alternative funding mechanisms for same in light of pending cutbacks in government-sponsored programs. Furthermore, the Company's activities called for in the Ohio Energy Strategy in a more competitive industry should be addressed. (page 6, item 19)

This entry raises a number of questions, which I address in Section II (Alternative Cost-Effectiveness Tests), Section III (DSM in a Competitive Environment) and Section IV (Alternatives to Utility DSM).

In Section V, I discuss the potential for additional cost-effective DSM savings beyond the level in CG&E's LTFR. Section VI discusses the environmental risks facing Cinergy and other utilities (particularly

Midwestern coal-burning utilities), and the benefits of DSM in reducing Cinergy vulnerability to future environmental requirements.

Q: Please summarize your testimony.

A: My major conclusions include:

- The Total Resource Cost Test is the proper test of the cost-effectiveness of DSM.
- The Revised Utility Cost Test, discussed only in Ohio, ignores important benefits of DSM, and its application would result in higher total electric bills, a less prosperous Ohio, and elimination of all low-income DSM programs and most other residential programs. The Revised Utility Cost Test may be a useful guideline in setting rebate levels, but should not be used to reject DSM programs.
- DSM can continue, and be expanded beyond current levels in Ohio, under currently proposed utility structures. The economics of DSM will remain attractive, and the restructured industry will retain the institutions necessary for raising funds, planning DSM, and implementing programs.
- DSM can reduce the costs of living and doing business in Ohio, assist vulnerable business and low-income households, and attract new business.
- The distribution utility is an attractive vehicle for delivering DSM services, but other structures can be developed if the distribution company is not capable or willing to effectively pursue DSM.
- CG&E's proposed DSM portfolio is rather modest, and can be expanded in a number of ways. One important option for increasing DSM savings, reducing costs to business, capturing otherwise lost

opportunities, and eliminating dependence on ozone-damaging chemicals is to expand CG&E's pilot programs for comprehensive treatment of commercial cooling systems, bundling efficiency improvements with reductions in cooling load and in the size of the cooling equipment.

- Coal-burning utilities, including Cinergy, face potentially large costs to mitigate a range of environmental problems. Energy efficiency, by reducing emissions, can reduce these costs.

II. Alternative Cost-Effectiveness Tests

Q: What is the cost-effectiveness test currently endorsed by the Ohio Commission?

A: The Ohio Commission adopted the Total Resource Cost (TRC) test as the basis for DSM resource selection because it treats demand-side and supply-side resources on a consistent basis.

Q: Has any alternative approach been discussed?

A: Yes. The Revised Utility Cost (RUC) test has been discussed in Ohio. The RUC test was described by Steve Puican in a paper entitled "DSM and the Transition to a Competitive Industry" and in testimony before the Commission in a proceeding concerning the 1994 Long Term Forecast Report of Centerior Energy Corporation (Case No. 94-207-EL-FOR), and my understanding of this approach is based on these materials.

In contrast to the Total Resource Cost, the RUC test attempts to eliminate program participant costs and benefits from consideration in DSM resource decisions. To that end, the RUC test excludes:

- The participants' share of avoided fuel costs;
- The market value of energy and capacity sold off-system; and
- The portion of DSM costs paid by the participants, such as their share of the DSM measure costs and the incremental costs (or savings) of operating and maintaining the installed equipment.

Q: Has the RUC test been accepted as the basis for DSM program selection by any other state commissions?

A: No.

Q: What is your understanding of the rationale for the RUC test?

A: Support for the RUC test appears to be motivated by the belief that the primary benefit of DSM is capacity deferral and that the TRC test places too high an emphasis on energy savings. The proponents believe that relying on the TRC test over-values energy savings and will have two undesirable effects:

- Inequitable distribution of costs and benefits between participants and non-participants, and
- Large DSM expenditures and adverse rate impacts, which will put the utility at a competitive disadvantage. [1] The role of DSM in a competitive environment is discussed in detail in Section III below.

Q: Should the RUC test be the basis for selection of DSM programs in Ohio?

---

[1] This DSM spending would not be large compared to total utility expenditures. However, because Ohio has not implemented a current cost recovery mechanism, there is a concern that DSM deferrals could grow to an excessive level. If the creation of large deferral accounts is a problem, the appropriate solution is to develop a current cost recovery mechanism, not to reduce or eliminate DSM funding.

A: No. Use of the RUC test in screening would distort the comparison of demand-side and supply-side resources and thus undermine rational resource planning. Equity issues should be addressed without interfering with rational utility planning.

Q: Do you agree that the TRC test over-values energy savings?

A: No. First, fuel cost savings are an important benefit of DSM. A comparison of utility supply-side and demand-side resources that does not consider avoided fuel costs biases resource choice against DSM. Second, avoided fuel costs is just one of a number of ways in which energy savings can provide system-wide benefits to ratepayers.[2]

Q: How does the exclusion of avoided fuel costs distort resource choice?

A: The RUC test would distort DSM selection in a way that would never be contemplated for *supply* resource decisions. As an illustration of the perverse results of applying the RUC test to supply choice, consider the rationale for utility investment in baseload plants. The utility could always meet increased load on the peak by adding peaker capacity. Utilities justify the much larger expenditures on coal and other baseload plants by their long hours of use and lower fuel costs. The benefits of large costly coal-fired plants are primarily reductions in energy costs. Under the RUC test, no additional value would be assigned to more-efficient power plants.

Furthermore, the results of the RUC test vary arbitrarily depending on how costs are classified between capacity and energy. For example, suppose

---

[2] As defined, the RUC test does not exclude *all* energy-related benefits. However, the only avoided energy costs explicitly included in the RUC test are incremental fuel savings (over and above average fuel costs) and environmental compliance costs.

the next avoidable resource is a combined cycle plant burning gasified coal. The utility can either (1) own the gasification plant or (2) purchase the coal gas from the developer of the gasification plant. In the first instance, the fuel costs are low and the capital costs (including the gasification plant) are high. In the second case, the fuel costs would reflect the carrying costs of the developer's capital expenditure and as a result would be very high, while the utility's capital costs would be low. The TRC test would be very similar in either case. If fuel costs were ignored, on the other hand, the RUC test would differ substantially between the two cases even though the avoided resource is the same in each instance.

Q: What is your understanding of the rationale for excluding avoided fuel costs in the RUC test?

A: Two reasons have been offered. First, it has been argued that, unlike avoided capacity costs, most of the fuel cost savings accrue to the participant, not to the non-participant, and therefore, should be eliminated from consideration. Second, reduced kWh use by ratepayers will not result in true energy savings; the utility will merely turn around and resell these same kWh off-system. These resales, the argument goes, will actually result in a net *cost* to the system whenever the cost of the DSM exceeds the margin of price over variable production costs.

Q: Should the distribution of benefits between participants and non-participants be a factor in determining the cost-effectiveness of a demand-side option?

A: No. The utility should design a resource plan that minimizes total resource costs, including energy costs and customer costs, and *then* decide how to design programs and allocate costs to address rate impacts and equity

concerns.

The exclusion of participant benefits from DSM screening tests is not consistent with utility supply planning. Utilities do not usually consider distributional effects in selecting supply resources; where these factors are considered at all, they are secondary concerns, and do not dominate resource selection. If utilities worried about distributional effects in supply planning, they would:

- Avoid baseload plants because of short-term effects. When a utility brings a major new supply (especially a baseload plant) into service, it typically increases bills and rates in the short term, to reduce them in the long term. This reduction in total costs comes at a considerable price for the elderly, economically marginal businesses, and other customers who may not remain on the system long enough to experience the long-term benefits.
- Favor NUGs. The capital costs of utility-owned plants are recovered in a front-loaded pattern, increasing the short-term rate effects compared to levelized cost recovery by non-utility generators (NUGs). Utilities do not usually reflect the benefits of reduced rate effects in evaluating NUGs versus utility plants in resource planning.
- Avoid baseload plants for equity reasons. Baseload plants, whose benefits are largely reductions in energy rates but whose costs are allocated largely on the basis of peak demand, tend to increase rates and bills to low-load-factor rate classes and, within the demand-metered classes, low-load-factor customers, while decreasing costs for high-load-factor classes and customers.

Q: Do you agree that when kWh saved due to DSM are resold off system, the costs can more than cancel out the benefits?

A: No. The suggestion that the benefit of a resale is only the margin of price over variable production costs results from a double-counting of fuel costs. When energy conservation frees up a kWh from jurisdictional power plant for resale off-system, the benefit is the total market price of energy, not just the margin over variable production cost. No additional fuel is needed for that sale; the same fuel that would otherwise be burned to produce power for retail ratepayers is burned to produce the kWh sold off-system—as the following table illustrates:

	Fuel Cost	Offset for OSS	Cost to Ratepayers
KWh Used by Ratepayers	2¢	—	2¢
KWh Conserved & Resold	2¢	- 4¢	- 2¢
Credit for OSS	—	4¢	4¢

An increase in off-system sales reduces rates for Ohio ratepayers and brings revenues into the state of Ohio, and therefore, is an important benefit of DSM that should be considered in any benefit-cost analysis.

Q: Other than reductions in average fuel cost, what ways can energy savings provide system-wide benefits to ratepayers?

A: There are a number of *capacity-related* benefits of energy conservation, including:

1. Since system reliability depends upon loads in many hours, not just on the peak, a DSM measure that reduces load in every hour would provide a greater contribution to system reliability than a DSM measure that reduces load only on the peak.

2. Utilities make capital expenditures (in baseload generating plant, for example) to lower their fuel costs. Efficiency programs can delay or replace this fuel-saving plant investment.
3. KWh reductions can defer or eliminate investment required to extend the lives of aging generation plant.
4. Energy conservation can free up baseload capacity for sales to other electric companies. If the utility can make additional off-system sales at a profit, it will decrease retail revenue requirements. Energy conservation, in particular, allows the utility to sell off more baseload capacity, which has more market value than peaking capacity.
5. KWh reductions can avoid or reduce costly retrofits of existing fossil-fired plants required to comply with environmental regulations.

Q: Is it appropriate to exclude participant costs from DSM program cost-effectiveness analysis?

A: No. For example, consider a DSM option with $600 in avoided-cost benefits, of which the RUC test would ignore $200 in average fuel costs, that can be implemented through two different program designs. One design requires $100 of utility costs (rebates and overheads) and $100 of participant costs, for a total cost of $200 and a benefit of $400. The other approach requires $70 of utility costs, but $300 of utility costs. The TRC and RUC tests would evaluate these options as follows:

Design	Utility Cost	Participant Cost	Total Cost	TRC Net Benefits	RUC Net Benefits
1	$100	$100	$200	$400	$300
2	$70	$300	$370	$230	$330

Both designs pass either test. However, the TRC test correctly identifies the design with the lower cost as being preferable, while the RUC test erroneously selects the design that costs $170 more. The RUC test can lead to a waste of Ohio's financial resources.

Q: How different are cost-effectiveness results when the RUC test is substituted for the TRC test?

A: According to CG&E's calculations (provided in Revised Figure 4-16), the test ratios for the large commercial/industrial (C/I) programs rise for some and fall for others, but in all cases the programs remain highly cost-effective. The ratio for the small commercial program declines slightly, but if bundled differently the program can probably be designed to be cost-effective. The test results for the residential and low-income programs, on the other hand, plummet.[3]

Q: What does the RUC test mean for residential and low-income programs?

A: Reliance on the RUC test would likely eliminate programs for residential and especially low-income customers, who could end up paying for services provided only to the larger customers.

Clearly the RUC test does not adequately address distributional equity. By eliminating many DSM options, adoption of the RUC test could actually have an adverse distributional effect. Excluding cost-effective programs prevents many customers from participating in DSM, and makes the portfolio *less*, not more, equitable.

---

[3] It is not clear how CG&E handled the difference between marginal and average fuel costs. Including this differential, and avoided T&D costs, would improve the RUC scores of these programs.

Q: How should equity concerns be addressed if not through the screening test?

A: One of the best ways to ensure equitable demand-side investment is to expand the portfolio of DSM programs so that all customers have an opportunity to reduce their electricity usage. Removing market barriers, minimizing cash requirements, and targeting marketing efforts will increase the ability of vulnerable customers (low-income residentials, marginally viable commercial and industrial firms) to participate and reduce their bills.

Several other mechanisms can minimize rate or bill impacts:

- Near-term rate effects can be reduced by amortizing DSM costs over the measures' lives (as is done for supply), instead of fully expensing the costs each year.
- Problems with excessive rate or bill effects on particular classes can be ameliorated by changing the allocation of DSM costs across classes.
- For some market segments, careful program design can overcome market barriers while still allowing participants to pay a substantial portion of measure costs, either at the time of installation or through energy-service charges.
- If rate effects are excessive in early years, with low avoided costs, the timing of discretionary retrofit programs can be stretched to coincide with higher avoided costs due to more expensive fuel and/or the planned construction of baseload plants.

Q: What role can the RUC test play in the DSM planning process?

A: The RUC test may be useful as a guide in selecting rebates and other incentives, but not as the basis for determining whether measures and programs are good for Ohio. For most programs, it is reasonable to limit

rebates to no more than total avoided costs net of baseload (i.e., coal) fuel costs and utility program costs.

However, to permit broad participation in DSM programs, the RUC test should *not* be relied upon in setting incentive levels for hard-to-reach customers, such as low-income customers. For these groups of customers, full funding is essential to effective program implementation. It is important to recognize that full funding of DSM for low-income ratepayers will be offset, at least in part, by reductions in bill subsidies, which would otherwise be provided through rate discounts, fuel assistance programs, and bad debt.

III. DSM in a Competitive Environment

Q: What is the role of DSM in a restructured, competitive environment?

A: The role of DSM depends on the nature of the restructured industry. Under both the AEP and the Cinergy restructuring proposals, customers would purchase bulk power from competitive generators, or from a bundle of power purchased from the competitive market by the distribution utility. The existing integrated utilities would be separated into three functions:

- Generation facilities would be functionally separated or spun off into companies that would sell to retail customers and distribution utilities throughout the state and beyond.
- Transmission facilities and dispatch would become the responsibility of an Independent System Operator (ISO), who might operate the systems of several utilities, the entire state, or a larger region.[4]

[4] Transmission facilities might be owned by the distribution or generation companies, or someone else.

- Distribution companies would continue to be regulated monopolies.

In this type of industry structure, the distribution utility would continue to be a logical and appropriate delivery agent for DSM, and for other resources that are tied to the distribution system. The generation companies may also find bundling of DSM with power sales increases their competitiveness.

Q: What resources are tied to the distribution system, and why should the distribution monopolies pursue them?

A: Energy efficiency in the T&D system (larger conductors, low-loss transformers, improved system configurations), DSM, and distributed generation (such as photovoltaics at the end of summer-peaking feeders, or fuel cells in customers' basements) are all closely associated with the distribution system. All of these activities must be coordinated with the planning of the distribution system, and provide benefits to the customers in the service territory, regardless of where they purchase power. Distributed resources are likely to remain the responsibility of the local monopoly retail utility, whatever may happen to generation, and are unlikely to be stranded in any future industry.[5]

All of these distributed resources, and especially DSM, can reduce the cost of living and doing business, and hence increase the attractiveness of the service territory. The distribution utility will not be in direct competition with the generation companies, but it may compete with other distributors for the location of large customers, based on distribution rates, regional power costs,

---

[5] With unbundling of service, the distribution companies will be freed of the dominance of central supply resources in integrated utility planning, allowing them greater freedom in pursuing DSM and distributed resources.

other regional costs (transportation, labor, land, taxes), and assistance in cost reduction. If the generation function is separated from the retail utility, the local utility will not be able to attract load with a low price for bulk power, since the same power supply will be available over a wide regional area.

If a customer can get increased efficiency and lower bills from CG&E distribution, that may tip the balance in favor of CG&E's service territory compared to some other location with the same power supply options.[6] DSM should be seen as a low-cost way to attract load, rather than a burden that discourages customers. Energy efficiency would become an increasingly important factor in attracting load to particular service territories.

Q: How could a distribution utility finance DSM that reduces T&D expenses and attracts new business?

A: There are at least three sources of funds for this DSM:

1. The funds that otherwise would have been used on upgrading the T&D system.
2. The funds that would otherwise have been used to finance the rate discounts that otherwise would have been necessary to attract and retain customers.
3. Funds raised from ratepayers through normal DSM cost-recovery mechanisms.

---

[6] In conjunction with DSM programs, in addition to reducing the amount of electricity needed to provide a particular service, the distribution utility can further increase its attractiveness, by increasing power quality (protecting valuable customer equipment), increasing the reliability of energy delivery, and improving the quality of energy service (improved quality of lighting, better temperature and humidity control, etc.), which can produce productivity benefits even greater than the energy savings.

Q: How can utilities increase customer competitiveness and loyalty, and reduce the probability that customers will seek alternative energy solutions?

A: By lowering participants' energy bills, and often improving the quality of service, DSM adds value to the electric service a distributor provides, enhancing the Company's competitive position with respect to alternative suppliers. Customers will still value reductions in their *total* energy service costs, not just lower prices for one component of those costs, regardless of whom they buy electricity from. In a freely competitive market where all service providers have equal access to cheap supply, the ability to provide energy efficiency and other value-added services may be decisive in winning and retaining customers.

Q: Should competition change the way generation companies view lost revenue from DSM?

A: Yes. In a more competitive market, generators will offer customers packages of both cheap electricity and usage-reducing efficiency improvements. When competing for individual customers, CG&E's generation company can either meet the competition by losing *some* revenues with efficiency and a lower electricity price, or lose *all* the revenues by unsuccessfully competing only on electricity price.

While generation companies can use energy efficiency to compete for large customers, the distribution utilities will remain uniquely suited to pursuing DSM for smaller customers (for whom transaction costs would be excessive for generators with no tie to the service territory) and for long-term benefits, beyond the term of typical power-supply contracts.

Q: Does the provision of DSM services threaten utilities' ability to attract and retain large, cost-sensitive industrial customers, prior to the transition?

A: No, for several reasons. First, the costs of DSM can be collected from the rate classes participating in each program, so that the industrial class is assured of receiving lower total bills, regardless of whether DSM activity is greater in other sectors. Second, the utility can concentrate its DSM efforts on vulnerable customers, using DSM to reduce the bills of customers who would otherwise be likely to relocate or seek other power supplies. Third, the utility can tie funding of DSM to a multi-year commitment by the customer to remain on system.[7] Fourth, rates for the most price-sensitive large customers are usually set through special contracts, which do not usually follow strict cost of service and need not reflect class-average DSM costs.[8]

Q: Does the provision of DSM services threaten distribution utilities' ability to attract and retain those large industrial customers, after the transition to generation competition?

A: No. The distribution utilities will be in much the same position after the transition that the integrated utilities are today.

Q: Is this a theoretical observation, or has DSM actually been used to attract or retain industrial load?

A: DSM has been used by utilities as an effective marketing. For example, Boston Edison Company's Energy Efficiency Partnership program saved a

---

[7] Generation companies are likely to use this approach after the transition.

[8] Indeed, the rate discounts to these customers can be reduced, to the extent that efficiency improvements reduce their bills.

Sealtest ice-cream plant and 180 jobs from likely elimination. A company spokesperson credited energy savings paid for by Edison with giving the plant "a major competitive edge."[9]

Northeast Utilities has had numerous successes retaining load by improving the competitiveness of its large customers. One of NU's success stories involves Fortune Plastics, a plastics manufacturing plant. Located in Connecticut and Tennessee, Fortune had been shifting production to Tennessee to lower its operating costs. By taking advantage of the DSM services offered by NU's retail subsidiary, Connecticut Light and Power, Fortune was able to decrease energy costs by 17% and to maintain, and possibly expand, operations in Connecticut. According to Fortune Plastics President John Duhlig,

> This package allows our Tennessee and Old Saybrook [Connecticut] plants to operate on a much more equal footing. While electric rates will continue to be lower in Tennessee, our Old Saybrook operations will be made so much more efficient that the energy costs of the two facilities will be roughly similar.
>
> Now, instead of transferring the manufacturing capacity of our Old Saybrook plant to Tennessee, we're considering expanding our operations here because this plant is so much more efficient.[10]

Northeast Utilities' successes in improving efficiency at its customers' facilities provide tangible benefits beyond retaining load, jobs, and the local tax base. The lighting, motor, and process upgrades installed as a result of

---

[9] Boston Globe. "At Sealtest, Sweet Smell Of Success With Energy," *Boston Globe* (October 9, 1991):39.

[10] Quoted in Connecticut Light and Power. Undated. "Incentives Spell Good Fortune: Fortune Plastics, Inc., Old Saybrook, Connecticut." Hartford, Conn.: Northeast Utilities.

participation in NU's industrial program reduce water consumption, improve working conditions, and mitigate environmental hazards.

IV. Alternatives to Utility DSM

Q: What benefits that have been delivered to other service territories (and to some extent in Ohio) through integrated utility DSM?

A: Regulation of the integrated utility has provided a framework for

- financing DSM, with cost recovery for prudent efforts assured by the utility's retail monopoly and regulatory approval;
- planning acquisition of efficiency, with regulatory supervision of procedures (e.g., objectives, cost-effectiveness tests, risk and environmental allowances) and/or programs;
- delivering design, installation, financing and other incentives to energy decision-makers (consumers, builders, and designers);
- evaluating the delivery and impacts of programs;
- coordinating planning of DSM with acquisition of conventional generation, maintenance of existing generation (life extension, environmental retrofitting), and planning of transmission and distribution facilities.

Q: Are these functions duplicative of services provided by government agencies.

A: Not really. Existing governmental mechanisms include:

- building codes,
- equipment standards, mandatory or voluntary (such as Energy Star),
- R&D investments,

- tax incentives (property-tax exemptions, production credits),
- educational activities.

On the other hand, a number of mechanisms have been developed in the context of integrated resource planning (IRP) in the vertically-integrated utility to complement and enhance these government efforts:

- golden-carrot energy-efficiency innovation incentives,
- direct-installation efficiency and renewable programs,
- programs that pay incentives (rebates, low-cost financing) for installation of energy-efficient equipment,
- programs that provide or pay for design services for improved efficiency in industrial processes and new buildings,
- targets for acquisition of efficiency savings,
- guarantees of cost recovery for prudent acquisition of DSM, and
- recognition of environmental costs.

These utility programs have complemented governmental programs in several ways:

1. Pushing efficiency markets by providing incentives for higher efficiency levels than can be uniformly required by codes and standards.
2. Demonstrating the feasibility of efficiency levels and practices, and increasing the comfort of designers and builders with those options, facilitating later inclusion of the options in codes and standards.
3. Providing more detailed technical support and more precisely defined incentives than is usually possible in government programs.
4. Providing mass markets for innovative efficiency technologies, speeding commercialization.

5. Identifying optimal efficiency levels, rather than offering the same incentives or requiring the same actions in all situations.

Each of these mechanisms was developed to overcome market imperfections that will persist in the restructured industry. Moreover, the basic economics of these mechanisms for promoting DSM will not change with restructuring. If these potential benefits are not to be lost in the restructuring shuffle, they must be transformed to survive in the new environment.

Q: What options are available for pursuing efficiency programs?

A: As discussed in the previous section, for the industry structures currently under discussion in Ohio, the distribution utility is one reasonable agent for delivering DSM benefits, especially if the current integrated utilities divest or otherwise isolate their generation operations from the distribution function.[11] Other options are available, however.

Continued provision of these services requires a funding source and mechanism, and an entity responsible for implementing the programs. There are many options for structuring efficiency programs, as suggested in the following table.

Funding Source	Funding Mechanism	Implementation Entity
distribution utility	as needed and cost-effective	distribution utility
generators	fixed ¢/kWh	state energy office
marketers	fixed $/year	special state agency
all utilities in state	annual acquisition goal (e.g., % of kWh sold)	independent contractor
all-fuels energy fee		
pollution fees		
tax revenues		

[11] If utilities are to recover any stranded costs, the best way to determine the level of those costs is to auction off all generation assets. If stranded-cost recovery is not an issue, generation and distribution functions could continue within the same corporate structure, so long as the distribution utility cannot preferentially purchase from its generation affiliates.

The most successful existing energy efficiency programs have used the options from the first line of the table: distribution utilities fund and implement programs driven by the size of the market and the economics of efficiency options. This is an appealing approach for the restructured industry, as well. Utilities have planning, coordination, information, and financing resources; an existing regulatory structure; regular contact with every electric consumer in their service territories; and a continuing requirement to plan a distribution system, considering load growth, energy efficiency, and distributed generation.

Q: Please describe the choice of funder, mechanism, and implementor from this table.

A: Depending on the nature of the restructured electricity market, almost any combination of funder, mechanism, and implementor may be feasible.[12] Additional options and variations are possible in each of the categories. For example, one implementation entity may serve the entire state, one contractor may be used to deliver service for each retail distributor's service territory, or service territories can be split into regions. One contractor may serve all classes, or separate implementors (with different types of expertise) can serve residential, multi-family, small commercial, large commercial, and industrial process customers. The implementor can provide services directly; or plan,

---

[12] Some of details of the efficiency delivery structure are dependent on the new industry structure. For example, some pool-based restructuring proposals would continue to have the distribution utility sell all the power consumed in its service territory, at a market-clearing price, while other schemes would require each consumer to contract with a generator or require all power to be delivered through licensed marketers. Each industry structure has a different set of actors who can be required to collect a fee, meet acquisition goals, acquire allowances or credits, etc.

coordinate, inspect, and evaluate the work of a range of contractors who perform those services. Each efficiency delivery structure also requires some form of oversight.

Q: How do the funding mechanisms differ?

A: For many utilities, the funding mechanism has been "as needed"; the utility determines the amount of DSM that is cost-effective and otherwise feasible, and requests regulatory approval for those spending levels. Other utilities have operated under a requirement to meet a goal, such as acquiring a target amount of energy savings, or annual spending budget. Many preliminary discussions of DSM in a new industry structure have suggested that DSM be funded through a non-bypassable fixed $/MWh "universal systems benefit charge."

Q: What are your conclusions regarding DSM in a restructured electric industry?

A: Energy-efficiency efforts will remain economically attractive after restructuring. Many structures can be developed to deliver efficiency and other distributed services to electricity consumers; the distribution utility is one attractive vehicle, if it is isolated from the central-generation function, but other approaches are feasible.

V. Potential for Expansion of DSM: Comprehensive Cooling Programs

Q: Could DSM represent a larger portion of CG&E's resource plan?

A: Yes. CG&E's DSM portfolio has been limited in a number of ways, and could be readily expanded to reduce the need for transmission and

distribution investments, to reduce energy consumption, to defer the need for capacity, and to increase energy and capacity available for off-system sales.

Q: How could CG&E's DSM be expanded?

A: CG&E has imposed many artificial limits on its DSM, including failing to pursue such widely-accepted cost-effective measures as fluorescent reflectors and occupancy sensors. However, perhaps the fastest way to increase the scale of CG&E's DSM benefits would be to implement the proposed Customized Financial Incentive Programs for HVAC Systems with Chillers and Rooftop Units (Custom HVAC). These programs include

- an audit
- improvement in cooling equipment efficiency, and possibly conversion to gas cooling
- reduction in cooling loads due to waste heat from lighting and external heat through windows and the building shell, allowing reduction in the size of the new cooling equipment
- improvement in the efficiency of cooling and ventilation auxiliaries (motors, drives, controls, ducts, piping, etc.)

CG&E's description of its proposed programs is not very specific, but the general approach is very promising. The major problem with the proposed programs is that they would be run at a very low level, at a time when opportunities for comprehensive efficiency improvements are slipping away.

Q: Why are these programs particularly attractive?

A: These programs

- capture lost opportunities,
- can be very comprehensive,

- capture interactions that are not considered in most customers' investment decisions,
- are very inexpensive, easily passing TRC and even the restrictive RUC test,[13]
- can produce large total savings,
- eliminate customer exposure to the risks of using CFCs, without sacrificing efficiency,
- have low free ridership, and
- reduce peak weather-driven summer loads on the generation, transmission, and distribution systems.

Q: What is the basic rationale for programs like Custom HVAC?

A: Custom HVAC starts from the recognition that customers keep chillers and packaged rooftop units in service for extremely long periods, typically 30 to 40 years. This is because HVAC equipment is a large capital investment. Obtaining such long service life requires that customers rebuild or overhaul chillers every 10 to 12 years; for packaged units, compressors require replacing every 8 to 10 years. This periodic overhaul is analogous to an engine overhaul to extend the life of an automobile, or a life-extension investment in a generating facility. Thus, a typical chiller or packaged unit will undergo such maintenance overhauls two or three times over its life.

These investments typically involve capital expenditures between 10 and 25% of the cost of a new standard-efficiency unit, depending on the type and size of the equipment involved. It also involves some reduction in the

[13] CG&E reports that these programs perform even better on the RUC test than on the TRC test. This is not surprising, since participants are likely to be willing to pay a large portion of the costs of the program, especially if some simple financing mechanism is available.

efficiency of the existing equipment. Another critical consideration is the imminent phase out of the manufacture of refrigerants containing chlorofluorocarbons (CFCs). The CFC factor increases the size of the investment customers make at the time of the rebuild, as well as the performance penalty it produces. Replacing the CFC refrigerant with a non-CFC refrigerant sacrifices the cooling capacity and/or the efficiency of the unit. Needless to say, the prospect of increased capital expenditures, electricity consumption, and potential loss of occupant comfort has caused commercial customers considerable concern.

Q: What behavior are Custom HVAC programs designed to alter?

A: The Custom HVAC concept is designed to accomplish four changes to the normal approach to cooling equipment overhaul:

1. comprehensive reductions in cooling load, primarily through lighting efficiency improvements;
2. early retirement of the existing, inefficient equipment that would be rebuilt, with new, more efficient equipment;
3. downsizing of the new unit to match the new, lower cooling load; and
4. selection of the highest level of cost-effective energy-efficiency in the new unit.

A similar program proposed by the Vermont Department of Public Service is described in Exhibit ____ (PLC-2).

Q: WHAT TYPES OF SAVINGS DO THESE CHANGES PRODUCE?

A: First, the lighting efficiency improvements produce savings in their own right. Second, early retirement of the old equipment with a new chiller produces further savings, even if the new chiller is of modest efficiency by current standards.

Third, proper sizing of the new unit to match the reduced cooling load produces long-lasting kW savings. Not only is the peak kW load reduced due to the lower tonnage of cooling capacity and the lower kW/ton, savings are also achieved by sizing the new unit to run at proper loading to reach peak efficiency. Under normal practice, cooling equipment is oversized when installed, and become more oversized if cooling loads are later reduced, as through lighting efficiency improvements. Chillers and packaged units operate less efficiently when they operate at a low percentage of rated load, so proper sizing results in further improvement in the performance of the unit.

Finally, further savings are achieved by motivating the customer to select the highest efficiency level that is economically justifiable.

Q: Are these programs major sources of DSM savings?

A: Yes. The combination of these savings results in large energy and load reductions. Based on analyses by Potomac Electric Power Company (PEPCo), which has been running a very successful Custom HVAC program for a couple years, a typical building employing all these changes would realize kW demand savings on the order of 25% and energy savings around 20%, compared to a rebuilt system. These are very high savings for commercial DSM programs. In addition, the customer benefits by avoiding the capital costs of the larger cooling equipment that would have eventually been installed without the load and capacity reductions in the future.

Q: How do the savings from Custom HVAC programs represent lost-opportunity resources?

A: Without a Custom HVAC program, most customers would simply rebuild their existing systems, imposing a higher load on the CG&E system and

paying higher energy bills due to the reduction of efficiency associated rebuilding or overhauling the equipment. They would not pursue the complete, comprehensive lighting retrofits, and the associated downsizing of cooling equipment capacity, partly due to differences in responsibilities for operating and capital costs, for HVAC and lighting advice. The opportunity for this major low-cost saving is lost until the next rebuild.

If they are not undertaken in conjunction with the chiller replacement, the lighting retrofits are also lost opportunities, since their benefits are much lower if they are not timed to reduce chiller size and cost. Indeed, later lighting retrofits could decrease cooling efficiency.

Q: Why would free riders be lower for Custom HVAC programs than for programs that encouraged installation of high-efficiency chillers and package units when existing units burn out and must be replaced?

A: If we wait until the chiller must be replaced, CG&E would be providing assistance and incentives only to participants who were going to buy a new chiller anyway. Clearly some percentage of these would have purchased a unit with an efficiency exceeding the baseline, as this offers the best life-cycle cost. Therefore, some percentage of participants in normal-replacement programs will be free riders.

In contrast, Custom HVAC intentionally targets those customers who have functioning (although aging and in need of expensive work) chillers and would not normally to replace them, and requires them to participate in a comprehensive program of load reduction, distribution system efficiency improvements, chiller efficiency upgrade, and optimal sizing. Customers are unlikely to undertake this comprehensive package of efficiency measures on

their own. Hence, free-ridership in the Custom HVAC program would normally be very low.

Q: What benefits result from combining gas and electric options in Custom HVAC programs?

A: Encouraging customers to retire chillers early and replace them with downsized gas chillers can both reduce customer costs and result in positive impacts on both the gas and electric system load shapes (increased summer gas sales and decreased summer electric peaks). Improvements in the distribution and ventilation systems can save gas in the winter and electricity in the summer.

Q: How would the effects of energy efficiency on weather sensitivity benefit CG&E?

A: The programs described above will particularly reduce summer weather-driven peak cooling loads, improving load factors and making CG&E (either as the current integrated utility or as a future distribution utility) less vulnerable to heat waves. Extremely hot weather generally coincides with reduced generation capacity, due to warming of air for combustion turbines and of cooling water for steam units. In addition, long periods of hot weather may coincide with drought conditions, as in 1988, reducing hydro-electric generation, thermal generation capacity (as cooling water levels fall), and fuel supply (as river levels fall to low for barges). Extreme weather conditions are likely to become more common with the continuation of global warming, which is now accepted as a current and future reality by the international scientific community.

VI. Environmental Costs and Risks

Q: How would energy efficiency reduce CG&E's vulnerability to environmental regulations?

A: Lower levels of energy consumption will benefit CG&E by reducing its vulnerability to potentially expensive environmental regulations, including

- limits on CO_2 emissions to slow global warming, which is now generally accepted to be occurring and to be driven by the burning of fossil fuels;
- limits on NOx emissions to reduce ozone levels in Ohio and downwind in the high-ozone areas of the Northeast;
- limits on NOx emissions to protect sensitive forest regions, especially in mountains;
- limits on short-term (e.g., 5-minute) local SO_2 concentrations, to protect asthmatics;
- limits on mercury emissions;
- limits on fine-particulate emissions.

These potential costs are discussed in more detail in Exhibit ____ (PLC-3)

Q: How do these environmental constraints affect the benefits of DSM?

A: Most of these potential environmental constraints are most likely to occur as some form of cap or trading system, in which less energy consumption (and particularly less coal burning) will allow utilities to avoid installing some controls or buying some allowances, or to sell additional allowances to other emitters. In other cases, new environmental rules may increase fuel and variable operating costs, so reducing energy usage would again reduce costs.

Prior to a fully competitive generation market, DSM will reduce CG&E's compliance costs, which will reduce revenue requirements and bills to ratepayers. If Ohio eventually moves to a competitive generation market, the higher costs of producing energy with environmental controls will increase the market value of energy. Both prior to and after restructuring, CG&E retail ratepayers will be able to avoid much of these potential costs through DSM.

Q: How can CG&E minimize the environmental risks associated with generation from existing coal plants?

A: Energy-efficiency efforts in the next few years will reduce the usage of those plants and the costs of responding to environmental initiatives. Near-term DSM efforts will also build CG&E's capability for achieving larger savings in the future if they are needed or desired.

Q: Are the environmentally-related benefits of DSM eliminated if conserved energy is resold off system?

A: No. The sale of energy off-system will displace some other utility's generation, and its emissions.[14] The value of off-system sales is increased by the environmental compliance costs avoided by the buyer. Furthermore, the margins earned on additional off-system sales can help pay for installation of pollution control equipment, allowing Ohio to make money mining coal and selling electrical energy to higher-cost areas, while cleaning up Ohio generation and reducing total emissions. Ohio would end up with increased income, reduced utility bills, cleaner air, reduced vulnerability to future

[14] Following restructuring to a competitive generation market, the same would be true of out-of-state sales.

environmental regulations, with funds provided by energy consumers in other states (who would also save money).

VII. Recommendations

Q: Please summarize your recommendations.

A: I recommend that the Commission:

1. Reaffirm that the Total Resource Cost Test is to be used to screen DSM programs.
2. Permit utilities to use the Revised Utility Cost Test as a guideline for setting DSM rebates, but only where
   a) the resulting rebates are sufficient to acquire the efficiency resources;
   b) no social subsidy or support is desired (as is the case for low-income and economic-development programs);
   c) the utility cost savings include transmission and distribution costs; and
   d) the omitted energy savings are limited to average fuel costs.
3. CG&E should be strongly encouraged to increase future DSM savings beyond those in the 1995 LTFR, especially by full-scale implementation of the Customer HVAC programs.
4. CG&E should be required to propose a structure for continuing and expanding its DSM efforts beyond current levels, if the electric generation market becomes fully competitive.
5. CG&E should be required to file a plan for using energy efficiency to reduce its exposure large costs to mitigate environmental problems.

Q: Does this conclude your testimony?

A: Yes.

Early HVAC Retirement Component of the Commercial-and-Industrial Market Opportunities Core Program

Draft

Introduction

An early-HVAC-retirement program component (EHR) will serve as a complement to the C&I Market Opportunities Core Program by Vermont utilities. The EHR will encourage customers with older—but functioning—HVAC equipment to install cost-effective efficiency measures that reduce cooling loads, and to replace their HVAC equipment with new, high efficiency equipment sized in accordance with the resulting lower cooling load.

The EHR will offer financial incentives and/or assistance for both energy-efficiency measures and energy-efficient design. The primary delivery mechanism will be to offer financial incentives directly to participating customers. It is expected that trade allies (HVAC and lighting vendors) will play a major role in encouraging customer participation. In addition, the implementing agency will offer technical assistance and contractor management services. The rest of this plan provides a brief overview of the program objectives, target market, marketing approach, eligible measures and other program requirements, financial strategies, and the delivery approach.

Program Objectives

Short-term

Short-term objectives for EHR are to

- capture large, cost-effective, and durable savings comprehensively from existing customers,
- leverage planned customer investment to capture what would otherwise be lost opportunities by incorporating cooling-load-reducing measures and downsizing at the time of HVAC equipment replacement,

- achieve substantial program participation,
- prevent the uneconomic extension of highly inefficient HVAC equipment from refrigerant conversions and major overhauls,

Long-term

In the long-term, Vermont utilities will

- achieve market transformation, including greater coordination between HVAC and lighting trade allies, improved HVAC sizing practices in the equipment replacement market, greater comprehensiveness in building and system design, and higher levels of equipment efficiency stocked and promoted by vendors.
- reduce the long run total resource costs of energy services to Vermont citizens and businesses.

Eligible Population and Target Market

All existing commercial, industrial, agricultural and governmental customers are eligible to participate. However, the program will target those customers that are likely to overhaul their existing cooling equipment in the near future. Overhauls typically involve rebuilding chillers or replacing compressors on roof-top or split-system unitary air conditioners or heat pumps (hereinafter referred to as a "rebuild"). Customers typically rebuild cooling equipment about every 10 to 12 years. Therefore, at any given time, approximately 8% to 10% of C&I customers will be targeted for EHR participation. While all customers will be eligible, small C&I customers with unitary equipment will be separately targeted, with marketing and program delivery approaches designed to overcome the even stronger barriers to efficiency these customers face.

Marketing Plan

The EHR will be marketed both directly to customers and through trade allies. Consistent, statewide marketing will be used. This will minimize confusion among customers and provide a clear message to all Vermont businesses. Separate customer marketing materials and approaches will be used to target small and large customers. These will include general mass media (print and broadcast advertising), direct mailings, and personal contact for Vermont's largest customers. The mass media messages will focus on all C&I customers. Separate direct-mail materials will be developed for the chiller and unitary markets, describing the different program services and procedures. Direct mail will be

relied on more heavily in the small C&I market, where trade ally marketing and delivery is likely to be less effective than in the large C&I market.

Trade allies exert a great deal of influence on their customers' decision-making process concerning their energy using systems. In addition, trade allies (lighting and HVAC installation and service contractors) know which customers are considering, or in need of, cooling equipment rebuilding, and they are typically in contact with these customers. This is particularly true for the large customer market. Because trade allies are the key to intervention in the customer's purchase and rebuild cycles, the primary marketing focus for large customers will be on trade allies. Utilities will rely on cooling equipment contractors to identify customers in need of rebuilds and to explain the benefits of participating in EHR instead. In addition, utilities will market EHR to lighting contractors. In this way, both large and small customers planning a lighting replacement may be drawn into the program, as well as those customers planning a cooling equipment rebuild.

Trade ally marketing will include direct mailings, state-wide seminars, and coordination with trade associations. Utilities will mail promotional literature to all Vermont trade allies. This literature will describe the program, its benefits to participants and to contractors (increased sales, higher mark-ups on new cooling equipment, etc.), and the procedures for referring customers to EHR. In addition, trade allies will be invited to seminars where program staff will provide an overview of the EHR. These seminars will also serve to bring lighting and HVAC contractors together, and encourage them to establish cooperative program delivery arrangements. Utilities will also work closely with local chapters of trade associations representing the trade allies. This will include presentations at member meetings and inclusion of program literature in member mailing packages.

Finally, it is expected that some customers will be brought into the EHR through participation in the prescriptive rebate portion of the Market Opportunities Core Program. When a customer submits an application for, or inquires about, either lighting, motors or HVAC measures, the coordinating utility will contact them and encourage comprehensive, multiple end-use treatment, either under the comprehensive portion of the Market Opportunities Program or under the EHR.

Eligible Measures and Participation Requirements

The EHR will promote early retirement of all cooling equipment, including centrifugal, screw, and reciprocating chillers, and roof-top, and split system unitary air conditioners and heat pumps.

In addition to retiring cooling equipment, the EHR will have three requirements. First, all participants must complete a comprehensive lighting retrofit. This must

include installing all, or almost all, recommended cost-effective lighting measures, as identified by either an outside engineering firm or a utility provided audit. In addition to lighting improvements, the utility or consulting engineer will identify and recommend installation of other high efficiency, cooling load reducing and HVAC system optimization measures. Second, customers must size the new HVAC system to meet the new reduced cooling load. Third, the new HVAC equipment must meet minimum efficiency requirements.

Only customers with HVAC equipment older than a certain age will be eligible for EHR. This age is likely to be approximately 8 and 10 years for packaged DX units and chillers, respectively. Actual age criteria will be developed based on state-wide avoided cost screening. The ages at which HVAC equipment typically become cost effective to early retire will be used, based on assumptions about existing stock and baseline efficiencies.

Financial Strategies

The measure incentives for this program can be decomposed into three components: 1) the incentive for lighting and other cooling load reduction measures; 2) the incentive to encourage the early replacement of the HVAC equipment with a properly sized, minimum qualifying efficiency unit; and 3) an incentive to increase the efficiency of the new unit above the minimum qualifying efficiency. For the first and third components, incentives will be the same prescriptive rebates offered under the Market Opportunities core program for non-EHR participants. For the second component, utilities will offer the customer a choice of:

- discounted, extended, positive-cash-flow financing of the net customer capital costs after the standard prescriptive rebates for each qualifying measure (defined below). Financing would be structured to provide a cash flow of approximately one third of the bill savings to the average customer. The financing term would be either 10 years, or the estimated HVAC measure life minus the current equipment age, whichever is less; or
- monthly bill credits equal, in present-worth terms (at the average utility cost of capital), to the value of the interest discount, payable over the same term as if the financing option were selected.[1]

[1] For some customers, particularly those that already have a source of capital, or those using ESCos to install measures, the monthly bill credit may be more attractive than the financing option.

These additional financial incentive options are structured to cover the additional first cost customers face when participating in EHR. This "net capital cost" consists of the full installed cost of the HVAC-load reducing measures and the new, properly sized, high efficiency HVAC equipment, but less:

- the standard prescriptive rebates,
- the expected cost of HVAC equipment rebuilding (including refrigerant conversion),[2] and
- the present value of the full installed cost of a standard efficiency HVAC unit of the same size as the one replaced, assuming it would have been purchased at the end of the existing HVAC equipment life.

The latter two parameters will depend on the age of the existing HVAC equipment. As equipment nears the end of its useful life, additional incentives to early retire this equipment reduce to zero. As a result, incentives will vary based on the age of the current system, the level of downsizing achieved, and the efficiency of the new HVAC equipment. This incentive structure encourages customers to strive for maximum, comprehensive savings.

The expected cost of HVAC equipment rebuilding is defined as follows:

- if existing chiller age is less than or equal to 25 years, expected rebuild cost = cost of rebuild × (25 years - existing chiller age) ÷ 15
- if existing chiller age is greater than 25 years, expected rebuild cost = 0
- if existing unitary equipment age is less than or equal to 18 years, expected rebuild cost = cost of rebuild × (18 years - existing equipment age)÷ 10
- if existing unitary equipment age is greater than 18 years, expected rebuild cost = 0

The implementing agency will screen the package of EHR measures against state-wide avoided costs to ensure cost effectiveness.[3] No incentives will be provided for non–cost-effective measures. In the event that a package of measures does not

---

[2] Production of chlorofluorocarbons (CFCs) in the U.S. are banned beginning January 1, 1996. As a result, many customers are likely to overhaul their equipment to convert to non-CFC refrigerants over the next few years (some CFCs will still be available due to stockpiling and recycling). For purposes of calculating rebates, HVAC overhauls will be assumed to include a refrigerant conversion to a non-CFC refrigerant. The typical cost for these rebuilds is approximately 20 to 30% of the cost of a new, standard-efficiency unit.

[3] Cost-effectiveness criteria will be based on the societal cost test, which will include externality and risk adders.

pass the cost effectiveness screening, the implementing agency will work with the customer to modify the package of measures to achieve a cost effective installation.

In addition to measure incentives, the implementing agency will provide design assistance and/or incentives to large customers to properly size the new cooling equipment and identify and design all cost-effective cooling load reduction measures. These services may be provided by program staff (at no cost), consulting engineering firms, or by other trade allies such as equipment vendors. If the customer uses an outside consultant, an initial incentive of 50% of the cost of design services will be provided. Upon ultimate participation in EHR, the customer will be reimbursed the remaining 50%. Total design incentives would be capped at $3,000.

Program Delivery

Technical assistance and contractor arranging services will be available to all customers. State-wide design-assistance professionals (DAPs) will be available to all participants. For large customers, the DAP will provide an audit to identify cost-effective cooling load reduction measures, if desired. If the customer uses outside contractors, the DAP will play a coordinating role, make sure the HVAC and lighting contractors work together, and review the HVAC sizing calculations.

For small customers, the DAP will provide a turnkey service that includes an audit to identify cost-effective cooling load reduction measures, design of the proposed lighting system, sizing of the new HVAC equipment, and contractor arranging services that include assisting the customer in selecting contractors and ensuring that all measures are properly installed. This service will overcome many of the barriers faced by small customers, including lack of knowledge about what to install, who to hire to install it, and the high transaction costs of managing contractor activities.

Environmental Issues that May Affect Utility Operations and Costs

Paul Chernick
Resource Insight, Inc.

January 1996

Introduction

New health and scientific information about the environmental and health effects of pollutants may lead to new regulations that impose new operating costs on energy utilities. Some regulations are likely, others less so, depending in part on scientific uncertainty over health and environmental damages and benefits.

The recent scientific and health developments described below create material risks that New England utilities face in the current planning period. New resource planning and selection, and decisions about the operation, repowering, and retirement of existing resources, should reflect these risks.

NOx

Power plants are major sources of oxides of nitrogen (NOx) emissions, which are subject to near-term reduction requirements under two titles of the Clean Air Act Amendments of 1990, Title I (ambient air quality) and Title IV (acid rain). The environmental effects of NOx follow at least four pathways:

- NOx itself has acute effects on human health, and may facilitate metastases of cancer. NOx is thus a criteria pollutant under Title I of the CAAA, with its own NAAQS to protect public health.
- Through reaction with volatile organic compounds in the presence of sunlight, NOx contributes to the formation of ozone and the brown smog visible over much of New England in the summer. Because NOx is long-lived in the atmosphere, it can contribute to increased ozone levels miles from its source. Ozone is also a criteria pollutant.

- In the atmosphere, NOx transform into nitrates, forming small particulates (yet a third criteria pollutant) with associated health impacts (as described in the next section).
- Nitrate deposition contributes to the acid-deposition problems addressed by Title IV of the CAAA and to the accumulation of nitrogen in forest soils, which has recently been implicated as causing declining health of forests. [1]

Utilities are subject to additional regulations and costs due to concerns about each of these NOx pathways. Reduced emissions and more restrictive ambient air standards may result from any of the following processes:

- The NOx NAAQS is currently under review.
- The EPA is currently reviewing a proposal to reduce the existing 120-ppb ozone NAAQS to 80 ppb. The New England Electric System (in its 1994 IRP, as reproduced by Chernick [1994, Exh. AG-PLC-9]) predicts that there is a 35% chance that EPA will adopt a tighter ozone standard or reduced ozone compliance period after 1997.[2]
- Utility boilers in most of the Northeast must achieve much larger reductions in NOx emissions. The Northeast Ozone Transport Commission (from New England through Pennsylvania to Northern Virginia) has adopted a requirement of 65% reductions (or 2 lb. per MMBTU) by 1999 (Phase 2), with a stand-by provision requiring 85% reductions (or 1.5 lb. per MMBTU) by 2003 (Phase 3). Many plants will require expensive modifications, changes in fuel, and post-combustion treatment to achieve these levels. Emissions trading is widely expected to reduce the total cost of compliance, while creating a market for NOx reductions.
- Concern about transport of NOx into the Northeast and other high-ozone areas has resulted in formation of the Ozone Transport Assessment Group, covering all the states east of the Mississippi, including Ohio, Indiana, and Kentucky. Modeling and analysis of emissions, ozone formation, and transport are to lead to recommendations regarding national and regional controls by January of 1997.

---

[1] Deteriorating condition of forests has a number of economic and environmental effects, including exacerbating the difficulty of achieving net greenhouse gas stabilization.

[2] NEES hardly seems alarmist: it assigned only a 75% chance that the EPA would adopt stricter requirements for complying with the ozone standard, requiring reductions beyond RACT. Since the OTR has recommended requirements far beyond RACT, however, this contingency is a virtual certainty.

- State are meeting great resistance to ozone controls for transportation (especially automobiles), raising the possibility that stationary sources (especially utilities) will have to bear a larger share of total reductions.
- The Ozone Transport Region, EPA, and the states are pursuing some form of regional NOx trading, which may greatly increase the costs of operating units that continue to have high emissions following compliance with the required reductions.
- While the Title IV requirements for low-NOx-burner installations roughly parallel the RACT requirements of Title I in the Northeast, new studies of nitrate deposition indicate that Northeastern forests may be reaching critical thresholds, at which forest productivity, and even the viability of some species, would decline dramatically. The currently mandated decreases in NOx emissions may only slow forest decline.

Particulates

As part of the ongoing review process for criteria pollutants under Title I of the CAAA, the EPA is required to complete its review of the NAAQS for PM10 (particulate matter smaller than 10 microns) by January 31, 1997. Since the last review of the PM10 standard (in 1987), substantial evidence has been gathered linking elevated death rates to fine particulates, including in areas in compliance with the current standard.[3] A change in the particulate standard could affect the compliance status of urban areas and impose further particulate controls on utility oil and coal plants, including more efficient electrostatic precipitators and fabric filters. Some research indicates that the very smallest particulates, under 5 microns, may have particularly important respiratory-health effects; these particulates are the most difficult and expensive to control.

Title III of the CAAA also allows for controls on precursors to particulates (U.S. EPA, *Clean Air Act Amendments of 1990 Detailed Summary of Titles,* November 30, 1990.) Precursors include NOx (for nitrates) and SO_2 (for sulfates).

Sulfur Dioxide

The EPA is weighing the need to adopt additional regulatory measures to address short-term peak SO_2 exposures, to protect asthmatics. The alternatives under consideration include: revising the existing national ambient air quality standards (NAAQS) by adding a new five-minute standard of 0.60 ppm, allowing one

[3] For example see Dockery, Pope III, Xu, et al. (1993).

expected exceedance per year; establishing a new regulatory program under §303 of the Clean Air Act to supplement the protection provided by the existing NAAQS; and augmenting implementation of the existing standards by focusing on those sources or source types likely to produce high 5-minute peak SO_2 concentrations.[4]

Carbon Dioxide

The science of global climate change remains uncertain and is likely to be uncertain for some time. However, the costs of adapting to or mitigating climate change are being reflected in international commitments for greenhouse gas emissions reductions and voluntary domestic initiatives to reduce greenhouse gases. Potential actions include carbon (or energy) taxes, emissions caps and trading, and reductions in fuel use (through efficiency improvements or greater use of non-fossil energy supply).

The International Framework Convention on Climate Change went into effect in March 1994, two years after it was signed by 150 nations. The long-term goal of the treaty is to stabilize greenhouse gas concentrations in the atmosphere that would prevent dangerous interference with the global climate system. Toward that end, the convention required developed countries to submit plans to reduce their emissions of CO_2 and other greenhouse gases to 1990 levels by the year 2000. The convention does not require nations to meet this goal. The convention has been criticized for not addressing greenhouse-gas stabilization and emissions reductions after the year 2000.

The increased frequency and severity of storm damages experienced in recent years has been of considerable concern to the international reinsurance market. These storm damages have been cited as early evidence for climate change, and represent the first major warming-related costs to the developed world. The magnitude of the damages, the political influence of the insurance industry, and the threat of reduced availability of coverage for storm-related catastrophes could all provoke public and political pressure for reducing emissions of greenhouse gases.

The U.S. Climate Change Action Plan and Climate Challenge currently specifies voluntary targets to return greenhouse emissions to 1990 levels by the year 2000. Several European countries are pressing for reductions from the 1990 base by 2005 or 2010.

---

[4] These measures are proposed in the EPA's pending reproposal for national ambient air quality standards for sulfur oxides (sulfur dioxide).

Working Group I of the Intergovernmental Panel on Climate Change released a report in early December of 1995, finding, "the balance of evidence suggests that there is a discernible human influence on global climate" (Kerr 1995, 1565–1567.).

Toxic Air Pollutants

CAAA Title III governs emissions of toxic air pollutants. Toxic air pollutants are those pollutants known to be hazardous to human health but are not specifically covered under the NAAQS (or other parts of the CAA).

The CAAA list 189 toxic air pollutants, of which utilities emit 36. Chow, Miller, Fortune, et al. (1990) indicate that most coal-fired utility boilers would exceed a 10 ton per year limit imposed by the CAAA. Large oil-fired boilers may also exceed this limit

Mercury from coal-fired utility boilers is of specific concern under Title III. Utilities are responsible for an estimated one-third of anthropogenic mercury emissions in the U.S. (U.S. EPA 1995, 1:4-3). The EPA is currently studying the effects of mercury deposition on sensitive areas, including the Great Lakes.

A number of subtle effects have been detected below the level of damages for which patients would normally seek treatment, and overlapping with mercury levels (such as blood mercury, or BHg) observed in the general population. These subclinical effects include the following:

- An increase in abnormal tremor from 5% to 30% of the subjects (Roels, Lauwerys, Buchet, et al. 1982).
- A 20% increase in trail-making time (a measure of hand-eye coordination and fine motor control) (Ibid.).
- Increased aggression (Ibid.).
- Numerous other effects, including reduced short-term memory, with average score differences of 13.9% from controls (Ibid.).[5]

The collective productivity and quality-of-life effects of low-level mercury poisoning may be very large.

---

[5] Additional effects at comparable blood levels were found for verbal intelligence and short-term memory by Piikivi, Hanninen., Martelin, et al. (1984), for a battery of neuro-behavioral tests by Soleo, Urbano, Petrera, et al. (1990), and for finger tremor by Verberk, Salle, and Kemper (1986). All of these results are cited in U.S. PHS (1994).

Utility mercury emissions, especially coal plants, are about a quarter of the national total (U.S. EPA 1995, 1:4-3). For existing coal plants, control measures are likely to include carbon injection. The EPA has estimated that the cost of this technology would be on the order of $5,240–28,000 per pound of mercury, and $0.4/MWh–2.1/MWh for coal plants of various sizes and characteristics (U.S. EPA 1995, 6:3-5).

The other toxics emitted by utilities are also of concern. Control options for the other metals and toxics include more effective fine particulate matter control equipment such as fabric filters and scrubbers.

Works Cited

Chernick, Paul. 1994. "Testimony of Paul Chernick" in MDPU 94-49. Boston: Massachusetts Office of Attorney General.

Chow, Winston, M. J. Miller, J. Fortune, G. Behrens, and E. Rubin. 1990. "Managing Air Toxics." Presented at the 83rd Annual Air and Waste Management Association Meeting, Pittsburgh, Pennsylvania, June, 1990.

Dockery, Douglas, C. Ardel Pope III, Xiping Xu, John Spengler, Hames Ware, Martha Fay, Benjamin Ferris, and Frank Speitzer. 1993. "An Association between Air Pollution and Mortality in Six U.S. Cities" New England Journal of Medicine 329(24):1753–1759.

Kerr, Richard. 1995. "It's Official: First Glimmer of Greenhouse Warming Seen" *Science* 280:1565, 1567.

Ngim, C., S. Foo, K. Boey, et al. 1992. "Chronic Neurobehavioral Effects of Elemental Mercury in Dentists" *British Journal of Independent Medicine* 49(11):782–790.

Piikivi, L., H. Hanninen., T. Martelin, et al. 1984. "Psychological Performance and Long-Term Exposure to Mercury Vapors" *Scandinavian Journal of Work and Environmental Health* 10:35–41.

Roels, H., R. Lauwerys, J. Buchet, et al. 1982. "Comparison of Renal Function and Psychomoter Performance in Workers Exposed" *Archive of Occupational and Environmental Health* 50:77–93.

Soleo, L., M. Urbano, V. Petrera, et al. 1990. "Effects of Low Exposure to inorganic Mercury on Psychological Performance" *British Journal of Independent Medicine* 37(2):105–109.

U.S. Department of Health and Human Services. 1994. *Toxicological Profile for Mercury* (Update) TP-93/10. Atlanta, Ga.: Agency for Toxic Substances and Disease Registry.

U.S. Environmental Protection Administration. 1995. "Mercury Study Report to Congress" EPA/600/P-94-002Aa. Review Draft; 6 vols. Washington:U.S. EPA.

Verbeck, M., H. Salle, and C. Kemper. "Tremor in Workers with Low Exposure to Metalic Mercury *American Industrial Hygene Association Journal* 47:559–562.