STATE OF MICHIGAN

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of the Application of Consumers Power Company for Authority to Increase Its Rates for the Sale of Electricity	)	**Case No. 10335**

DIRECT TESTIMONY OF

PAUL CHERNICK

ON BEHALF OF

MICHIGAN UNITED CONSERVATION CLUBS

Resource Insight, Inc.

October 15, 1993

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I. IDENTIFICATION AND QUALIFICATIONS

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

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

Q: 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. Since 1981, I have been a consultant in utility regulation and planning, first as a Research Associate at Analysis and Inference, after 1986 as President of PLC, Inc., and since August 1990 in my current position at Resource Insight. In those capacities, I have advised a variety of clients on utility matters, including, 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 as Exhibit PLC-1.

Q: Have you testified previously in utility proceedings?

A: Yes. I have testified over one hundred 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 Maine Public Utilities Commission, the Minnesota Public Utilities Commission, the South Carolina Public Service 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.

Q: Have you testified previously before this Commission?

A: Yes. I testified before the Michigan PSC in Cases Nos. U-7775 and U-7785, on power plant performance standards. I also testified before the Commission in Case No. U-10102 on Detroit Edison's demand-management program.

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 in reviewing the Least Cost Plan of Commonwealth Edison; to the South Carolina Consumer Advocate on least-cost planning; to environmental groups in North

Carolina, Florida, Ohio and Michigan on DM planning; and to several parties on incorporating externalities in utility planning and resource acquisition. I also assisted the DC PSC in drafting order 8974 in Formal Case 834 Phase II, which established least-cost planning requirements for the electric and gas utilities serving the District.

Q: Have you testified previously on demand-side management (DM) cost-recovery issues?

A: Yes. I testified specifically on this issue in Vermont PSB Docket 5270 on behalf of Central Vermont Public Service Company, Conservation Law Foundation, Vermont Natural Resources Council, and Vermont PIRG. I have also testified on DM cost recovery in Massachusetts (DPU 472, 86-36, and 88-67), South Carolina (PSC 91-216-E), Pennsylvania (PUC I-900005), and Florida (PSC Docket 920606-EG), and prepared comments in New York PSC Case No. 28223. I recently testified on Detroit Edison's DM cost-recovery in U-10102.

Q: Have you worked on cost recovery issues in collaboratives between electric utilities and other parties?

A: Yes. I have consulted on cost recovery in separate collaborative projects with Central Vermont Public Service, New York State Electric & Gas, New England Electric System, Baltimore Gas & Electric, Vermont Gas Systems, and Potomac Electric Power Company.

Q: Have you advised other clients on issues relating to utility cost recovery for DM?

A: Yes. I assisted Boston Gas Company in development of its cost-recovery proposal to the Massachusetts DPU and assisted the Washington State Public Counsel in reviewing incentive proposals for Puget Power.

II. INTRODUCTION

Q: What is the purpose of this testimony?

A: In this testimony, I review and make recommendations on Consumer Power Company's (CPCo's) demand management (DM) planning, non-residential program design, screening, avoided cost calculations, and cost recovery proposals.

Q: Please summarize the Company's DM filing in this proceeding.

A: According to Company witness Gilzow, CPCo is requesting Commission approval of:

- recovery of $18.7 million spent on DM programs beyond the $65 million that was required by the settlement and order in Docket U-9346;
- recovery of future DM program investments beginning in the year 1994 and continuing through 1995;
- a proposed incentive mechanism, in which the Company would retain a large portion (perhaps more than 100%) of the savings from DM; and
- recovery of lost revenues though a lost revenue adjustment to rates.

The DM programs on which these cost recovery proposals are based are described in CPCo's 1992 IRP, especially in the External References, and modified in the 1993 IRP, the *Weekly DSM Reports* attached to MUCC-CP-7, and other CPCo discovery responses.

Q: What basic perspective do you take in this testimony?

A: Demand management can dramatically reduce the cost of providing energy services, such as warm space in the winter, cool space in the summer, hot water, lighting, and moving materials through industrial processes. CPCo should be

expected and encouraged to use DM to minimize energy service costs to ratepayers.

Q: Please summarize your findings regarding CPCo's DM planning.

A: CPCo's DM programs demonstrate a significant level of financial commitment to minimize revenue requirements through the acquisition of demand-side resources. Unfortunately, the success of CPCo's DM strategy is impaired by several problems:

- As discussed in detail below and in the testimony of MUCC witness Hamilton, the Company is not comprehensively identifying or implementing energy-efficiency resources. CPCo's DM portfolio overlooks important opportunities, especially the inexpensive transitory opportunities that rise when buildings and facilities are constructed, renovated and remodeled. CPCo also does not systematically address the transitory opportunities presented by the replacement of existing equipment at the end of its physical or economic life.
- CPCo's program design process does not adequately address the market barriers to energy efficiency, and the resulting program designs are not likely to overcome those barriers and achieve implementation of the vast majority of cost-effective DM potential.
- CPCo appears to have made many of its program design decisions arbitrarily, without relying on cost-effectiveness analyses.
- To the extent that CPCo actually screens measures and programs for cost-effectiveness, that screening process is not consistent with least-cost planning principles. CPCo's concern with minimizing revenue requirements leads the Company to overlook participant costs and benefits, and pay too much attention to the benefit:cost ratio and the cost of conserved energy, rather than the total net benefits of its decisions. As a result, CPCo's programs are less effective than they could be in reducing costs to ratepayers.

- CPCo systematically and grossly understates its avoided costs, neglecting the costs of generation reserves, non-peaking capacity, transmission and distribution capacity, environmental externalities, and planning risks, and understates other costs.

Q: What is the overall effect of these planning flaws on the Company's DM acquisition efforts?

A: CPCo has neglected significant portions of the attainable efficiency potential in its service territory. The Company may be able to acquire some of this neglected potential in the future at a higher cost than if it were acquired today. The remainder will not be cost-effective to acquire later, and the Company will be forced to substitute more expensive supply for these lost savings. In either case, CPCo will have failed to minimize ratepayer costs.

Q: What do you conclude regarding the Company's proposed cost recovery, lost revenue, and incentive mechanisms?

A: CPCo's proposal to recover direct DM costs in rate cases through projections and deferrals is quite reasonable. The same is true for the 10-year amortization period, at least as an initial estimate. The determination of the prudence and recoverability of the cost overrun from the 1992-93 programs should be deferred to the reconciliation proceeding, especially in light of the problems in program design and implementation discussed in Sections III and IV and in the testimony of MUCC witness Hamilton.

CPCo's proposal to compute lost revenues from pre-installation *ex ante* energy savings estimates per installation introduces unnecessary error, risk, and perverse incentives. The same is true for CPCo's proposal to use a single value for lost non-PSCR revenues per customer class, rather than values based on the actual mix of customers served. CPCo should use the best available estimate of lost revenues.

CPCo's incentive proposal would inappropriately use (mis-estimated) lost revenues as proxies for avoided costs, use *ex ante* energy savings values, ignore participant costs and benefits, unnecessarily reward load management efforts, and give CPCo incentives for even the most modest DM effort. As a result of these errors, CPCo could easily receive incentives comprising more than 100% of net benefits, so that cost-effective programs could raise (rather than lower) costs to customers.

Q: Based on these findings and conclusions, as well as the findings and conclusions of MUCC witness Hamilton, what are your recommendations with regard to Commission action on CPCo's DM program planning?

A: The Commission should clarify that CPCo is expected to:

- acquire all cost-effective DM resources throughout its service area with comprehensive energy-efficiency programs;
- prioritize design and implementation of programs to capture transitory resources, including new construction, renovation, and equipment replacement;
- identify market barriers and design programs to overcome those barriers;
- use realistic avoided costs, including all of the costs identified in Section V of this testimony; and
- use the TRC test to screen all DM options, and select the options that maximize total net benefits.

Q: What are your recommendations with regard to Commission action on the Company's proposed mechanism for recovering program costs, lost revenues, and shareholder incentives?

A: CPCo's proposal should be changed so that the regulatory signals will be consistent with least-cost planning. Most importantly:

- These special mechanisms should only be applied to energy efficiency programs.
- No additional cost recovery should be allowed in this proceeding for the amounts CPCo spent on DM in 1992 and 1993.
- CPCo should negotiate with other parties to this case, to develop a general decoupling proposal for Commission review.
- Lost revenues and incentives should be reconciled, based on the best data available within a reasonable time frame after the revenues are lost.
- Lost revenues should be estimated as realistically as possible considering the blocks of energy and demand charges in which conservation occurs.
- Lost revenues should be computed net of quantifiable cost reductions captured by the utility, the effects of promotional programs, and the promotional effects of conservation or load management programs.
- CPCo's incentive proposal should be rejected. Once CPCo files for approval of a comprehensive DM plan based on reasonable avoided costs and screening, the incentive should be restructured to provide CPCo with a share of net *TRC* benefits above a threshold of about 50% of target levels, reaching about 1% of equity at the target savings.
- The energy efficiency recovery mechanism should not appear as a separate item on the customer bills.
- The Commission should support CPCo's proposal for careful and independent monitoring and evaluation, to support recovery of lost revenues and incentives, to allow continuing improvement of program design, and to increase the dependability of DM as a resource.

III. SHORTCOMINGS IN CPCO's USE OF DEMAND MANAGEMENT IN LEAST-COST PLANNING

A. OBJECTIVE OF LEAST-COST PLANNING

Q: What is least-cost integrated resource planning?

A: Integrated resource planning attempts to identify the combination of resources that constitutes the best resource plan, rather than evaluating options in isolation. As a result, integrated planning is concerned with a diverse set of resource options, including utility-owned generation, non-utility generation, utility purchases, transmission and distribution investments, and DM.

Demand management expands the range of options available to balance demand and supply. Rather than building or buying supply, the utility can reduce the level of electricity necessary to meet the demand for energy service. DM is thus an extension of the continuum from utility-owned generation, to purchases from other utilities, to purchases from non-utility generators, to the reduced use of electricity. In each case, the same level of service is provided, but with different types and amounts of investment by different parties.

Least-cost resource planning attempts to minimize the total cost of providing energy services, where an energy service is the heating, cooling, lighting, motive power, etc., that is produced by energy-using equipment. As described by the Indiana Utility Regulatory Commission:

> Least-cost planning is a planning approach which will find the set of options most likely to provide utility services at the lowest cost once appropriate service and reliability levels are determined.... The goal should be to minimize long-run costs of providing adequate and reliable service to customers. Minimizing total cost requires that utilities choose resources with the lowest cost first, then draw on progressively more expensive options until demand is satisfied. (Decision, Cause No. 38738, October 25, 1989)

Least-cost integrated planning attempts to minimize all costs associated with resource options, including:

- monetary costs to the utility;
- the cost of demand-management options that customers pay themselves (e.g., the price premium for a high-efficiency refrigerator);
- the environmental and other external costs created by the generation and distribution of electricity;
- cost risks; and
- system reliability.

Q: Is least-cost integrated resource planning solely concerned with minimizing the costs of meeting load growth?

A: No. Least-cost planning is not solely concerned with finding the lowest-cost option to meet new load. From a least-cost perspective, any available action that will lower the total costs of providing energy services is needed to minimize cost, whether or not it is needed to keep the lights on. A new resource is needed in the least-cost plan if it can substitute for a more expensive resource, whether or not the displaced resource already exists or is considered to be a committed project or transaction.

Q: How do the principles of least-cost planning relate to the Company's DM planning strategy?

A: CPCo's resource plan will not be least-cost if it does not incorporate all DM resources that are less expensive than supply alternatives. CPCo's customers may capture some portion of this cost-effective DM potential on their own initiative. However, a significant share of the potential will remain untapped because of market failure: customers are unwilling to spend more than a small fraction of the

price they pay for using electricity on reducing its use. This market failure leaves a large — though unquantified — potential for economical efficiency which can be captured by CPCo for less than the cost of supply alternatives.

Thus, the Company's principal DM planning strategy should be to identify and pursue DM actions — by itself, customers, third parties, or a combination thereof — that maximize net benefits (i.e., avoided supply costs minus DM costs) to its customers. Net benefits will not be maximized (and thus resource plan costs minimized) if the Company

- acquires uneconomical DM options;
- acquires cost-effective options at more than the lowest feasible cost (e.g., with suboptimal program designs); or
- limits its pursuit to the cheapest DM options or those that yield large savings.

CPCo's goal should be to efficiently acquire all DM available at a lower cost than the supply it avoids, but no more.

Q: Must CPCo acquire all DM resources immediately?

A: Not necessarily. As discussed below, delaying acquisition of discretionary DM resources may sometimes be appropriate either to increase net benefits or to respond to constraints such as limits on rate increases or rate levels. However, transitory or "lost-opportunity" resources — savings opportunities that are cost-effective only if acquired when they arise — cannot be deferred. Lost opportunities are discussed further in Section III.C.

B. CPCo's DM Programs

Q: Please summarize CPCo's DM programs.

A: CPCo offers three programs for the non-residential (Commercial, Industrial, and Agricultural, or C/I/A) classes. They are the NON-RESIDENTIAL CUSTOM REBATE, NON-RESIDENTIAL DIRECT REBATE, and NON-RESIDENTIAL FREE INSTALLATIONS.

The NON-RESIDENTIAL CUSTOM REBATE is available to all 165,000 C/I/A customers, but is targeted at those 30,200 with demand over 300 kW. It covers retrofit, renovation and new construction applications of all technologies in the following end-uses that are not covered in the direct rebate program: lighting, HVAC, motors, refrigeration, water heating, food service, process, and thermal energy storage.

The NON-RESIDENTIAL DIRECT REBATE program is available to all C/I/A customers (and the common areas of multi-unit residences), but is targeted to the 15,250 customers with demand over 50 kW. Rebates are prescribed for lighting, HVAC, refrigeration, motors and food service retrofits on the basis of measure characteristics other than savings (e.g., $/HP or $/lamp).

The NON-RESIDENTIAL FREE INSTALLATION program is primarily available to C/I/A customers with demand less than 50 kW and annual energy use less than 100,000 kWh. Following an audit, contractors will install up to $5,000 of equipment per customer, including lighting measures, water heaters tank wrap, and set-back thermostat for central air conditioning.

CPCo offers four programs for the residential sector. The programs are RESIDENTIAL REBATE COUPONS, RESIDENTIAL FREE INSTALLATIONS, RESIDENTIAL APPLIANCE RECYCLING, and RESIDENTIAL WATER HEATER CONVERSION.

The RESIDENTIAL REBATE COUPONS program offers residential customers prescribed rebates on lighting, refrigerators, freezers, setback thermostats, water heater wraps and low-flow showerheads. Customers can either mail in coupons

and proof of purchase to receive the rebates or order the discounted products (except refrigerators and freezers) from a catalog.

The RESIDENTIAL FREE INSTALLATION program is a direct installation program for low-income customers. Caulking, weatherstripping, lighting, thermostats, low-flow showerhead and faucet aerators can all be installed in a single site visit. At the same visit, ceiling insulation and electric to gas furnace conversion will be evaluated, and a follow-up visit with a contractor scheduled, if appropriate.

The RESIDENTIAL APPLIANCE RECYCLING Program provides customers with a $50 US Savings bond for each spare working refrigerator or freezer turned in. The appliances are disassembled for recycling and disposal.

The RESIDENTIAL WATER HEATER CONVERSION program arranges for the replacement of electric water heaters with gas water heaters in single-family owner-occupied residences who receive both electric and gas service from CPCo. In 1993 this service was provided at no charge to participants; for 1994 each participant is to be charged $100.

CPCo also offers three pilot load management programs. A RESIDENTIAL AIR CONDITIONER DIRECT LOAD CONTROL program pays customers to allow the cycling of their central air conditioners.[1] A NON-RESIDENTIAL THERMAL ENERGY STORAGE pilot, administered under the Non-Residential Custom-Designed Rebate program, offers participants $300 per kW shifted to off-peak hours, up to the cost of the project. The NON-RESIDENTIAL CURTAILABLE LOAD CONTROL program offers incentives to large customers on firm rates to shed load for a specified number instances and hours in each month.

[1]Neither the incentive level nor the cycling schedule is specified in External Reference C-1 to the IRP.

C. IMPROVEMENTS REQUIRED IN CPCO'S DM PORTFOLIO

Q: What are the key planning strategies that CPCo should adopt to ensure that it integrates and acquires all cost-effective DM at the lowest feasible cost?

A: To maximize the net benefits from DM resources, the Company must

- assess the cost-effectiveness of DM measures and programs using a screening protocol that accounts for all DM costs and benefits to its customers;
- comprehensively invest in customer efficiency opportunities;
- distinctly target lost-opportunity resources;
- build the capability to effectively deploy full-scale DM programs; and
- if faced with constraints to maximum acquisition of cost-effective DM resources, select the constraint-mitigating mechanism that does the least harm to the overall cost-minimization strategy.

I discuss issues relating to DM screening and avoided-cost determination in Sections IV and V, respectively.

1. Comprehensiveness

Q: Please define "comprehensive" as that term applies to DM portfolios.

A: The Vermont Public Service Board described the several dimensions in which DM should be comprehensive:

> Utility demand-side investments should be comprehensive in terms of the customer audiences they target, the end-uses and technologies they treat, and the technical and financial assistance they provide. Comprehensive strategies for reducing or eliminating market obstacles to least-cost efficiency savings typically include the following elements: (1) aggressive, individualized marketing to secure customer interest and participation; (2) flexible financial incentives to shoulder part or all of the direct customer costs of the measures; (3) technical assistance and quality control to guide equipment selection, installation, and operation; and (4) careful integration with the market infra-

structure, including trade allies, equipment suppliers, building codes and lenders. Together, these steps lower the customer's efficiency markup by squarely addressing the factors that contribute to it.[2]

Comprehensive program planning and design maximizes DM net benefits by acquiring cost-effective savings from each DM market segment, and from each customer end-use within the market segments. Moreover, comprehensive investment strategies maximize the savings potential of each end-use by applying the DM measure or bundle of measures that yields the greatest net benefit.

Q: Please define the concept of DM market segments.

A: Opportunities to improve energy efficiency in each customer sector — residential, commercial, and industrial — arise in different circumstances. The barriers to efficiency investments also vary with market setting. Program development should therefore start by addressing distinct DM market segments, differentiated by the context in which customers make energy-efficiency decisions, which defines potential points of market intervention.

The broadest market distinction is between lost-opportunity and discretionary resources. Discretionary resource programs are targeted to capture resources that can be acquired whenever they would be most beneficial. Lost-opportunity programs capture DM resources that cannot be postponed, because the opportunity to cost-effectively acquire them arises and then disappears quickly.

Q: Why is a comprehensive approach to DM resource acquisition essential for minimizing the cost of CPCo's resource plan?

A: A utility that does not pursue DM comprehensively will neglect cost-effective DM resources. This will lead the Company to increase its supply expenditures while a more cost-effective resource remains unutilized.

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[2]Vermont Public Service Board, Decision in Docket 5270, *Investigation into Least-Cost Investments, Energy Efficiency, Conservation and Management of Demand for Energy*, p. III-44.

Q: How does the strategy you recommend differ from other approaches a utility might take to DM investments?

A: Comprehensively acquiring efficiency savings is a markedly different proposition from selling or marketing individual DM measures. The latter tends to concentrate on individual technologies. It often leads utilities to fragmented and feeble efforts to convince customers to adopt individual measures that marketing research indicates will be easiest to promote. Single-measure programs designed around the treatment of a single end-use (e.g., water heating) with one technology (e.g., water heater wraps) are typical of this approach.

Q: What are some of the advantages of comprehensively covering all of a customer's end-uses, and offering all cost-effective measures for an end-use?

A: As discussed by MUCC witness Hamilton, a DM delivery strategy that addresses not just one end-use or measure, but the entire range of a market segment's efficiency potential, can thoroughly mine each customer's DM resources, and can do so with a minimum of overhead costs to the utility. Utility programs that treat only isolated parts of a customer's efficiency potential must revisit customers many times over to tap all available cost-effective efficiency savings. This is especially problematic for small customers. In addition, installing a moderately efficient measure (or a small bundle of measures) may preclude the installation of the highest-efficiency measure (or more expansive bundle of measures). In the end, less of the efficiency resource would be recovered, and at higher costs, than if the utility extracted all the efficiency potential one customer at a time.[3]

Q: Can utilities really pursue the full range of customer efficiency investment opportunities?

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[3]A analogy can be drawn between DM acquisition and the development of oil and gas resources. The resource is limited, and careless extraction of one part of the resource can interfere with development of the rest of the potential.

A: Yes. Treating efficiency potential thoroughly does not necessarily mean installing all measures in one visit. In fact, many successful programs start with a thorough site analysis; for smaller customers, the site visit would also install a few straightforward and common measures. The utility then follows up with a detailed investment plan for achieving the full potential. For example, when an existing chiller needs replacing, the utility may offer a rebate for a downsized, higher-efficiency chiller in conjunction with a comprehensive relamping project.

Nor is it essential that one program cover all end-uses for a particular customer group. Comprehensiveness should be judged by how completely a utility's full portfolio of programs covers relevant measures, end-uses, and DM market segments. For example, utilities may use several programs to cover residential efficiency potential. They target weatherization retrofits, new construction, and appliance replacement separately because of the different structure and timing of the decisions involved.[4] Such an approach is comprehensive if the two programs are linked where appropriate.

Q: Do CPCo's DM programs comprehensively cover all DM market segments?

A: No. CPCo's portfolio of programs omits services to the following market segments:

- general residential retrofit: except for low-income customers, residential retrofit is limited to some lighting rebates;
- residential new construction;
- C/I/A new construction, renovation, and rehabiliation;

[4]Unfortunately, Mr. Gilzow indicated that CPCo does not yet understnad the differences in the residential retrofit and new-construction market segments, by expressing his belief that a new-construction might best be driven by rebates. (Tr. 724)

- C/I/A equipment replacement;[5]
- non-profit, governmental and institutional retrofit

Q: Do CPCo's DM programs comprehensively address all customer end-uses?

A: Almost every end use appears to be included in some program for some market segment. The custom rebate program, in principle, includes all end uses for eligible customers, but not all customers are eligible for that program, and participation in that program is complicated and burdensome. A couple of end uses are often left out of particular programs, for no obvious reason.

- Compressors and chillers do not appear to be explicitly addressed.
- Residential heat pumps are excluded from all programs.
- Refrigeration (through such measures as doors, curtains, controls, system upgrades) is not included in the Non-Residential Free Installation program.

Q: DO CPCo's DM programs cover all cost-effective measures applicable to an end-use?

A: Other than in the custom rebates, CPCo neglects a number of measures.

- Commercial/industrial thermal envelope improvements (e.g., windows) are not included in direct rebates.
- While low-flow showerheads and water heater wraps are included in the Residential Rebate Coupon and Free Installation programs, faucet aerators are included only in the latter, and pipe insulation is entirely omitted. Showerheads are not included in the Non-residential Free Installation program.

5The commercial/industrial custom rebate program is only open to customers retrofitting their equipment. (External Reference C-1, section 4.2.1, numbered page 33506929). Neither the custom rebate nor the direct rebate program is structured to affect time-sensitive replacement decisions.

- Efficient water heaters are not promoted in any program.[6]
- Residential lighting fixtures (which would be particularly relevant for new construction and renovation) are not covered.
- Waterbed insulation is omitted from all programs, and waterbed heater timers are included only in the Free Installation program, not the Rebate Coupon program.
- Room air conditioners are overlooked, although central air conditioning is covered in the Rebate Coupon program.
- Variable-speed drives are left out of the Non-Residential Direct Rebate program, which covers other motor measures.
- Several categories of space cooling measures that are almost broad enough to be considered end-uses themselves are not treated in the Direct Rebate program. These are compressors, room air-conditioners, package terminal air conditioners, window films, and chillers.
- Occupancy sensors are covered under the Direct Rebate program, but not the Non-Residential Free Installation. Other lighting controls are not explicitly included in any program.
- Maintenance and operation measures, such as replacing HVAC filters, are entirely omitted.
- HVAC measures (such as infiltration reduction measures and duct sealing) are not covered in the Non-Residential Free Installation program.

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[6]CPCo claims to reject efficient water heaters and heat pumps because they could be considered to be "load building" (MUCC-CP-59) I do not believe that this is a major problem, since CPCo also provides gas service, and can (and should) offer corresponding incentives for high-efficiency gas equipment. Load builidig can also be limited by restricting incentives to locations in which the electric equipment already exists, or for new construction, where gas is not available.

Other than in the limited water heater conversion program and some space-heating in the low-income direct installation program, CPCo has not undertaken any fuel-switching of end uses from electricity to natural gas. CPCo has not even analyzed the cost-effectiveness of fuel-switching, "because the Company has decided that fuel switching will not be a DSM program offered. Fuel-switching type programs involve unresolved policy issues such as determining which customers pay for such programs" (MUCC-CP-24).[7] This approach is backwards. CPCo should screen options for cost-effectiveness first, and then for cost-effective options resolve the equity issues of the share of costs to be borne by various customer groups.

2. Lost-opportunity resources

Q: What are lost-opportunity resources?

A: The Northwest Power Planning Council defines lost-opportunity resources as savings that, "because of physical or institutional characteristics, may lose their cost-effectiveness unless actions are taken to develop these resources or to hold them for future use." (Northwest Power Planning Council, 1986, Volume 1, Glossary-6). Lost-opportunity DM programs pursue transitory efficiency savings opportunities that otherwise might be lost because of economic or physical barriers to their later acquisition.

Q: Where are lost-opportunity resources usually found?

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[7]CPCo also relates its general rejection of fuel-swtiching to a range of vague philosophical concerns, many of which (*e.g.*, the role of gas provider) seem to present little practical problem in CPCo's combined gas and electric territory (MUCC-CP-62). Oddly, CPCo describes its gas division as a competitor (MUCC-CP-62b). CPCo asserts that gas furnaces are not cost-effective, but also asserts that it has not considered the cost-effectiveness of gas furnace conversion (MUCC-CP-59). CPCo may only have screened furnace conversions for the low-income program, which overstates adminstrative costs and understates savings.

A: Lost-opportunity resources are usually found in one-time opportunities to save energy through improved energy efficiency, and, typically arise in four general market segments: (1) during the design and construction of new building space, (2) during the design and construction of remodeled or renovated existing space, (3) when existing equipment either fails or approaches the end of its anticipated useful life, and (4) when retrofit actions are being taken. If foregone, these resources would have to be replaced in the future either with alternative supply or more costly DM as retrofits to the newly-built facilities. In the case of new equipment such as appliances, all efficiency potential may be lost until the end of its useful life.

Q: What distinguishes a lost-opportunity measure from a discretionary DM opportunity?

A: The two dominant factors that determine whether a DM option is a lost opportunity measure are (1) the feasibility or cost premium of installing it later, and (2) the service life of the building or equipment involved. In new construction and renovation, when walls are being built or replaced, the cost of designing for daylighting is much less than it would be in existing space. In replacement, the difference in cost between buying an efficient motor or refrigerator and buying an inefficient unit is small compared to the cost of discarding a working inefficient unit and installing an efficient one. In the process of efficiency retrofit, if a lighting fixture is open to install an efficient ballast, the incremental labor cost of adding a reflector and delamping is much lower than it would be in a second operation.

Q: How important is the acquisition of lost-opportunity resources?

A: For at least five reasons, acquisition of all cost-effective lost-opportunity resources should be a utility's top planning priority:

1. Lost-opportunity resources often represent extremely cost-effective savings, since it is much less expensive to put in the right equipment in the first place (which only requires spending the incremental cost of the efficient equipment over standard practice) than to tear out inefficient equipment and install efficient replacements later. Mr. Gilzow acknowledges the economic advantages of capturing economic resources (Tr. 722).

2. The market barriers to customer investment in lost-opportunity resources are among the most pervasive and powerful barriers found in any segment. These barriers include limited time and information, risk aversion, time-sensitive equipment availability, and a plethora of split incentives.

3. By their very nature, acquisition of transitory opportunities cannot be post-poned. To acquire these savings, the utility must act at the time of construction or equipment replacement.

4. The failure to capture transitory opportunities can have energy efficiency very long-lasting consequences, especially in new construction, since the basic design of a building and its envelope can easily last for 50 years or more.

5. Lost-opportunity resources most readily adapt to a utility's changing needs. Construction booms, facility expansion, and the addition of new equipment are major contributors to electric load growth, and also determine the scale of lost-opportunity DM programs. Those programs thus tend to increase savings just when those savings are most needed, automatically following and dampening swings in load growth. Unlike any other option available to utilities, the acquisition of lost-opportunity resources will parallel the utility's resource needs.[8]

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[8]The Vermont Public Service Board recognized that "a utility committed to pursuing all efficiency opportunities that would otherwise be lost will automatically synchronize its new resource acquisitions with swings in resource need." *Decision*, Docket No. 5270, III-110.

Q: Has CPCo pursued all lost-opportunity resources?

A: No. CPCo has not pursued energy savings in either residential or commercial new construction. Most of the programs specifically prohibited their application in new construction. External Reference C-1suggests that the Custom Rebates Program would be open to all new-construction measures, but this does not seem to be the case. While new *customers* were eligible for all Reduce the Use programs (except perhaps the water heater conversion program), "there were no specific new construction programs offered. New facilities were handled in the residential class through rebates for high efficiency appliances and fixtures. New facilities in the commercial and industrial classes were covered though the Custom-designed Rebates Program for thermal energy storage projects only" (ST-CP-89).[9]

Mr. Gilzow confirmed that CPCo's restrictive policy denies all energy efficiency assistance to all non-residential new construction

> With respect to all three of those [C/I/A] programs, one of the program requirements was that it must be a retrofit situation. In other words, the customer must take out something and replace it with something more efficient. (Tr. 727)

Mr. Gilzow also explains that the thermal storage component was open to new construction only because it was a pilot program. (Tr. 727) Oddly, CPCo seems interested in reducing energy costs for new construction only if the effects are minimal.

While the residential rebates are available for new construction, the scope of the program is very limited for new construction, since the rebates do not cover

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[9]On p. 37 of External Reference C-1, CPCo mentions a new construction pilot program, but gives no additional information is given on this program. The 1992 IRP mentions that residential and non-residential new construction programs are "either included or planned for inlcusion in [CPCo's] biennial conservation programs," but again provides no further information. (p. 5-11) In a teleconference with Resource Insight on September 20, CPCo staff said that the new-construction programs was still being designed and was not in operation.

building shell design, insulation, infiltration control, ducting, water heaters (other than wraps), heat pumps, air conditioners, or compact-fluorescent lighting fixtures.

Q: Are CPCo's existing programs likely to result in significant levels of savings in new buildings?

A: No. None of the programs offer measures, such as thermal envelope improvements, building design changes, or equipment resizing, that can lead to high levels of savings during new construction. The programs also do not address the market barriers that occur during new construction, including split incentives between the developer and the party that will eventually pay the energy bill, architects' lack of information on energy efficiency, and lack of time to make building design changes. To overcome these barriers, CPCo needs to pay the full incremental cost of energy efficiency improvements, and to offer architects an incentive to make their designs more energy-efficient.

As noted above, CPCo claims that the residential rebate program covers new construction. This is technically true for a few measures, but rebates are a very poor way to deliver residential new construction programs. Under CPCo's program design, the builder would have to decide to invest in efficiency measures, prepare a separate bill of sale for those measures (CPCo may require a bill from an authorized dealer, rather than the builder), charge the ultimate buyer the full cost of the measures, and explain to the buyer how to submit a rebate application, if the program is still running and the purchase is timely. This design is unlikely to overcome the split incentives and encourage builders to participate in the program, especially given CPCo's history of closing programs and refusing to pay customers who have already made efficiency investments in compliance with the program's requirements.

Q: Has CPCo assessed the cost-effectiveness of new construction programs?

A: No. CPCo "as part of its screening process has not evaluated the cost-effectiveness of residential new construction programs." (MUCC-CP-25). MUCC-CP-26 gives the same response with regard to commercial new construction.

Q: Has CPCo assessed the efficiency of standard building practices in its service territory?

A: No. CPCo writes that "[s]ince the Company is not proposing DM programs targeted at residential and commercial building construction, energy-related requirements in building codes have not been documented in the DM area." (MUCC-CP-3) CPCO has not explained why it chose to ignore even the most fundamental data-gathering effort (let alone actually run a program) in these important DM market sectors.

Q: Does CPCo's own research contain any results regarding new construction programs?

A: Yes. The Company's Demand-Side Management Market Research Summary Report, January 1992 (Attachment to MUCC-CP-11) concludes that CPCo should offer a new construction program, and also presents evidence of the market barriers facing new construction.

One of the Key Findings of the study's interviews with major industrial customers is that "a program that covers new construction would be desirable" (p. 5). The report also states that "[f]irst cost is unquestionably the major barrier to the implementation of energy efficient technologies. Because many projects are built by developers who are only concerned with first-cost and who will not be paying the energy bills over the years, there is no incentive for these owners to spend more money to have an energy-efficient technology incorporated in the design, even if the payback is very short." Other market barriers listed in the report include lack of investment capital in a slow economy; low priority of energy-efficiency improvement relative to production improvements; short investment

payback criteria; lack of initiative; limited awareness regarding energy-efficient design; and specification practices of architects, engineers, and developers (p. 15).

Mr. Gilzow agrees that it would "be beneficial to design programs that would be targeted at new construction" (Tr. 725), but he also does not seems to understand the need for program designs appropriate to this market segment, other than the inclusion of different measures (Tr. 724, lines 18-25).

Q: What will be the effect on ratepayers if CPCo continues to ignore lost-opportunity resources?

A: By failing to move vigorously to obtain all cost-effective lost-opportunity resources, CPCo increases the total costs of providing electric service. CPCo might eventually acquire some of these savings as more expensive retrofits. The rest of the potential savings that CPCo misses will be irretrievably lost; CPCo and its ratepayers will have to make up for these lost opportunities with more costly supply.

3. Overcoming market barriers

Q. What are some of the market barriers to customer investment in energy efficiency?

A. Limited access to capital, institutional impediments, split incentives (e.g., between landlord and tenant), information costs, risk perception, and inconvenience are all factors that keep customers from investing their own time and money in efficiency improvements. Market barriers lead customers to act as if they have a very high discount rate, or as if they priced conservation well above its cost to the utility; this phenomenon can be thought of as either a "payback gap" between the customers and the utility, or as a customer "markup" on the societal cost of the measures.[10] The pervasive market barriers underlying the payback gap lead

[10]See Plunkett and Chernick (1988), for a detailed exploration of the payback gap.

customers to reject substitutes for supply which, if analyzed according to utility investment criteria, would appear highly cost-effective.

Utilities can accelerate investment in cost-effective demand-side measures by designing programs to reduce or eliminate these barriers.

Q. Why does the existence of the market barriers create an opportunity for utilities to invest in customer efficiency improvements?

A. Market barriers force customers to apply more exacting investment criteria to efficiency choices than utilities apply to supply options. Without utility intervention, the payback gap will lead customers to under-invest in efficiency and utilities to over-invest in supply. Recognizing the payback gap leads to two conclusions about the potential role for utility intervention to acquire demand-side resources:

- Utility price signals are much weaker as a tool for stimulating investment changes than most analyses assume.
- A vast amount of economical efficiency potential remains for utilities to tap as demand-side resources.

Q: How can DM programs overcome market barriers?

A: Utilities with the most successful DM programs are finding that certain simple strategies allow them to overcome market barriers. These strategies include offering high incentive levels and using direct installation where appropriate.

Q: How should customer incentive levels be set?

A: In general, incentives should be set as high as necessary to maximize the number of participants and to maximize the number and efficiency level of measures installed per participant. Utility experience in most DM market segments strongly indicates that maximum cost-effective savings will only be captured if utilities pay for essentially the full incremental costs of efficiency measures; in some segments

(mostly retrofits of well-known measures), the utility can limit its payments to reducing the participant's payback period to an acceptance threshold, which may vary from 6 months to 2 years. This finding is one of the major lessons learned from utility DM experience.

Q: Might such an aggressive approach offer customers higher incentives than the minimum necessary to induce them to participate?

A: It is certainly possible that high penetration could be achieved in some customer segments, or efficiency measures, with lower utility funding. However, CPCo will not be able to determine the "optimal" incentive until it learns what can be achieved at higher levels. Past utility experience supports the conclusion that setting incentives too low entails more risk than paying too much.

It is important to remember that increasing the fraction of measure costs paid for by the utility will not raise the total costs of the measure, as long as higher incentives lead to additional savings. Provided that uneconomical measures are eliminated at the screening stage of program planning and the diagnostic stage of implementation, increasing utility funding of measure costs is almost certain to increase customer participation, measure penetration, and hence net benefits.

If incentives are set higher than necessary, the worst that will happen is that the utility will pay a larger share of measure costs than with lower incentives: the total measure cost will remain the same. On the other hand, it is likely that higher utility incentives, even full funding, will reduce the total cost of DM programs. The fixed costs of marketing and administering programs will be spread over more savings with full utility funding of measure costs. This will tend to increase the net benefits of the program under the total resource cost test, and may even reduce the utility's cost per kWh saved.

Q: Has CPCo provided adequate incentives well to maximize participation and measure penetration?

A: No. As discussed in the next section, CPCo caps the Custom Rebate incentive at too low a level. More generally, CPCo has not performed any analysis of the effects of rebate levels on participation rates (MUCC-CP-9, 10), even when CPCo decided to increase rebate levels, as in the addition of a $100 participant payment for water heater conversion.

Q: What other program design elements overcome market barriers and yield high levels of savings?

A: In addition to high incentives, a utility can adopt several other program design elements to eliminate market barriers and increase the benefits it obtains from its programs. These program design elements include:

- Offer direct installation of measures for residential and small C/I/A customers. Residential and small C/I/A customers face many barriers to investment in energy efficiency. They have limited time and personnel resources. They are often unwilling to spend money on an investment that is not central to the revenue-generating side of their business. They are not knowledgeable about efficiency measures and their implementation. They may have limited bargaining power with contractors. They are unwilling to take risks with unfamiliar technologies.

  Direct installation programs are a highly effective means of eliminating these market barriers. If a utility installs the measures directly for customers, the hassle and risk are minimized. In general, the easier a utility makes it for customers to participate and choose cost-effective measures, the more cost-effective savings it will acquire.[11]

[11] Furthermore, direct installation programs yield higher savings than their customer-implementation counterparts: without direct installation programs, customers will tend to cream skim, i.e., install only the cheapest or simplest measures. This reduces the level of savings a utility can achieve.

- Target program delivery strategies and marketing approaches according to the decision-makers and types of investments involved. Depending on the program, utilities should direct program incentives to utility customers, equipment dealers, architects, engineers, or building developers. Different marketing and delivery mechanisms are needed to influence investment decisions in new construction, remodeling/renovation, replacement, and retrofit. Trade allies are especially important in improving the efficiency of in-stock equipment and appliances.

- Personal marketing is critical. The prime marketing mechanism for all programs should be personal contacts between utility field representatives and target audiences. These audiences might be residential customers, large customers, equipment and appliance dealers, HVAC contractors, architects, engineers or developers. Through personal contacts, the utility should strive to develop a regular working relationship with the target audience (e.g., for C/I customers, periodic contacts, with the same staff person contacting a particular individual each time). Experience of many utilities, including several side-by-side experiments, shows that personal contact consistently results in higher participation rates than reliance on direct mail, bill stuffers, and other traditional mass-marketing approaches.[12]

- Avoid paying for "naturally-occurring" savings by maintaining high minimum efficiency thresholds. The higher the minimum efficiency criteria utilities set

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[12]For example, NYSEG offered energy audits to two carefully-matched groups of commercial and industrial customers. One group was personally contacted, the other group received a phone call to identify the key decision-maker followed by a direct-mail solicitation to this person. Participation rates averaged 37% for the personal contact group and 9% for the phone/mail group. Xenergy, Inc., Final Report, Commercial Audit Pilot, Burlington, Mass. Likewise, Niagara Mohawk Power Corp. conducted a similar experiment with lighting rebates. Response to the personal solicitation was substantially higher (21%) than it was to the mail solicitation (3%). (Clinton and Goett 1989)

for program eligibility, the more net savings each program dollar buys. This is the best solution for avoiding free riders.

- Encourage measures that improve the efficiency of the overall system, not just equipment efficiency improvements. In many cases, the savings available from improving the overall design of a lighting or HVAC system (e.g., improved sizing, controls, and system layout) exceed the savings from small efficiency improvements in specific components (e.g., lamps, air-conditioners).

- Keep the mechanics of program participation as simple as possible for the customer. The more complex programs appear to customers, the lower participation will be. Make it easy for customers to participate, particularly by minimizing complex calculations and paperwork. For example, a customer requesting payment should not have to list details on individual measures. Programs should minimize application and verification paperwork.

- Provide the right amount of technical assistance to customers free of charge. Energy audits should serve as the point of entry to utility efficiency programs and should therefore be marketed aggressively. The sophistication of technical support should vary according to the size and complexity of customers. To maximize participation and savings in new construction programs, utilities must also provide computerized analysis and pay for outside design assistance.

Q: Will CPCo's program designs overcome market barriers to customer investment in energy efficiency?

A: CPCo's program designs are quite uneven in this regard. Many features of CPCo's program design will help overcome market barriers, but other features often undermine the effectiveness of the programs. For example, CPCo's description of the C/I/A rebate program emphasizes the reduction in participant effort:

> Participation is simple for the CPCo customer. After purchase and installation of the products included in the program, the customer submits an application and sales invoice to CPCo. After review and acceptance by CPCo, the

customer is sent a rebate check. Rebate typically will range from 30 to 75 percent of the customer's cost." (External Reference C-1, Section 3.0, page 33506928)

Unfortunately, this program design still leaves the customer with the responsibility of raising the funds for the entire DM investment, at least temporarily leaving major barriers in place. CPCo could reduce the financial (and hence institutional) burdens on participants by establishing mechanisms for the vendor to bill CPCo directly for the Company's share of the project costs.

More importantly, CPCo requires that customers spend money on DM before they find out whether they will receive funding, even if their projects have been pre-approved. This may be the most serious problem in CPCo's program design, since it transfers back to the participant all of the risks and difficulties that created market barriers in the first place. Even if a plant manager finds sufficient operating funds to provide short-term financing for the entire DM project, he or she faces the risk that the project will not be funded and that the operating budget will be depleted. This program design will not the first-cost market barriers, nor will it encourage trade allies to stock more efficient equipment. The lack of commitment will engender customer disappointment and resentment.

Similar, but less serious, problems arise in the Residential Rebate Program, which requires participants to submit proof of purchase. Since retaining the receipt and packaging is generally required in the event that the product must be returned to the vendor, this feature requires saving the rebate form, the receipt, and the packaging until return is no longer an option. Even at that point, sending CPCo the proof of purchase may preclude later warranty claims; not having the receipt (or having it filed with "rebate to submit" rather than "charge receipts") may complicate review of credit card statements. Many consumers have undoubtedly experienced problems with saving and submitting rebate forms and proofs of purchases, because the materials were lost, or the receipt was needed for other purposes, or the wrong materials were retained (e.g., the box top rather than the

UPC code, or the charge receipt rather than the register receipt). This program design creates unnecessary difficulties for customers, reducing participation. CPCo might more productively reduce the price to the participant by providing a point-of-sale rebate delivered directly through the merchant?

CPCo has not generally made arrangements with trade allies (distributors, vendors) to stock and sell a more efficient mix of equipment (MUCC-CP-21). Unless equipment is available in warehouses, contractors, plumbers, architects, and engineers cannot select it. Unless equipment is on display (with rebate information) at dealers, consumers will have difficulty finding and selecting it. CPCo tends to rely too much on the actions of customers, without providing proper support.

D. REVIEW OF CPCO'S NON-RESIDENTIAL DM PROGRAM DESIGN

Q: Please describe CPCo overall program design for Non-Residential customers.

A: CPCo's basic program design is described in External Reference C-1 to the 1992 IRP. The overall design of the portfolio of programs for the non-residential (commercial, industrial, and agricultural, or C/I/A) customers is exemplary in some respects. In particular:

- The retrofit programs include both relatively simple but inflexible prescriptive rebates, and complex but flexible custom incentives.
- The prescriptive rebates are not limited to low-cost cream-skimming measures, but include a range of measures including those with high efficiencies.
- Smaller C/I/A customers are provided with free installation services, requiring little effort by the participant.

The C/I/A programs also have several important problems, relating to incentives, lost opportunities, comprehensiveness, and time scale.

Q: What are the problems with the incentives in the C/I/A programs?

A: The most important problem is that incentives do not match the cost structure of efficiency investments. CPCo does not recognize that the incremental costs of installing equipment will depend on whether the installation is a retrofit, in which efficiency requires the full cost of the new equipment and installation, or remodelling or replacement, where efficiency requires only the incremental cost of more efficient equipment (and possibly the cost of more complex installation). CPCo does not provide separate incentives for covering full and incremental costs.

The rebates offered for motors in particular are poorly matched to the costs faced by customers. The incentives should vary for different types of motors, because their costs vary. The level of rebate offered may be about right for more expensive fan-cooled motors but may be too high for open drip-proof motors. Other characteristics (such as motor speed) affect motor cost and should affect the rebate also. Especially in market segments where there are split incentives, rebates must be carefully matched to the costs of the particular measure.

The incentive structure of the Custom-Designed Rebate Program promotes cream skimming, by setting a maximum payment of 8¢–20¢ for each kWh of annual savings. This limit is probably near CPCo's avoided costs for heavily off-peak savings, but for on-peak savings it does not even cover the present value of demand-related benefits estimated by CPCo. Many cost-effective projects are likely to cost much more than this amount. As a result, CPCo limits the incentives for some cost-effective projects to a small portion of project costs; this limit will maintain, rather than eliminate, market barriers. For retrofits, CPCo should determine the payback necessary to allow each market segment (commercial, industrial, non-profit, etc.) to participate, and then buy down the investment to that payback period. This buy-down mechanism could be paired with a short-term loan program if potential participants have difficulty raising even their share of the cash. For new construction and expansion, CPCo should probably be paying the

full incremental cost, especially for measures and designs that considerably exceed standard practice.

Q: What are the problems with the treatment of lost opportunities in the C/I/A programs?

A: As noted above, CPCo's program designs do not recognize lost opportunities. In addition to prohibiting the use of rebates (except for thermal storage) for new construction, and not adjusting rebates by market segments, CPCo's C/I/A programs do not include any mechanisms for capturing transitory opportunities on a timely basis. None of the programs offer any special features to make the program easy and helpful for customers in the midst of construction projects or dealing with failing equipment. Nor do any of the programs provide design assistance to improve the quality of the alternatives considered by customers engaged in major projects.

Q: What are the problems with comprehensiveness in the C/I/A programs?

A: Each of the three C/I/A programs has shortcomings in comprehensiveness. The Custom-Designed Program is clearly designed to cover a full range of measures, but even this program is not comprehensive. Although the large customers at whom it is targeted have the greatest technical ability, even they do not always have the skills in house to identify all cost-effective measures. Since CPCo provides no direct assistance in auditing or developing a proposal nor assistance in defraying the costs of feasibility studies, many cost-effective measures are likely to be missed.

The list of measures covered in the prescriptive Direct Rebate program is unnecessarily limited. Although measures that are omitted from this program may be captured by the Custom Program, any measures that can be covered prescriptively should be, in order to maximize participation. Such measures as variable speed drives, window films, and high-efficiency compressors, room air

conditioning, packaged terminal air conditioning, and chillers should be added to the Direct Rebate program. The rebate measure list is also overly general: some of the measures should be disaggregated to reflect application (split system versus single package DX, normal versus high-output fluorescents) and size (e.g., tonnage).

The measures provided under the Free Installation Program are also limited. Notable omissions include lighting controls (e.g., photocells, timers, occupancy sensors), infiltration reduction measures, refrigeration measures (doors, curtains, controls, and system upgrades), and maintenance and operations measures (such as changing HVAC filters). Set-back thermostats should be provided for electric heating customers, even if they do not have central air conditioning. In addition, the cost-effectiveness of set-back thermostats for cooling should depend on the size the load, not on whether the air conditioning is "central;" in particular, large rooftop units should be covered.

The programs generally omit commissioning, the set-up procedures required to ensure that complex high-efficiency equipment operates properly.[13] Although the Customer Rebate Program verifies installation, there should be a thorough review to check that the equipment was properly installed and initialized and that it is functioning as it was designed. This step is particularly important for the less sophisticated customers participating in the Direct Rebate program, who may not know that commissioning is necessary.

Q: What are the problems with time scale in the C/I/A programs?

A: The most important timing problem was discussed above, in Section III.C.3: uncertainty of receiving funding, even after preapproval, creates a barrier to

[13]Commissioning is generally important for complex systems with complex controls, whether or not they are intrinsically high-efficiency systems. While some DM measures are not particularly sensitive to commissioning, this process is very important for other measures.

participation by increasing customer risk. The actual denial of funding to some customers who had already expended funds in expectation of receiving rebates must have created ill will and further discouraged future participation, except by free riders. Participants should be able to apply for rebates and receive assurance that funds would be set aside for a period of time.

A more limited problem is that the Custom Rebate program does not appear to leave sufficient lead time for many covered measures, such as industrial process redesign or installation of cooling equipment in commercial buildings, that require long-term planning. All of CPCo's programs have been oriented to favor relatively short-term options; this pattern is only slightly modified by the 12-month grace period for completion of Custom Rebate projects.

Q: How reasonable are the screening assumptions for the Non-residential programs?

A: In general, the estimates of demand savings between technology levels in External References C-5 and C-6 appear to be reasonable, at least for average conditions. One of the exceptions is CPCo's estimate of 5% cooling demand savings from setback thermostats (External Reference C-5, p. 8); this value is reasonable for energy savings, but temperature setbacks are unlikely to affect peak load. Similarly, the 40% savings from upgrading DX air conditioning equipment seems surprisingly high (External Reference C-6, p. 10). Again, each general type of equipment should be disaggregated, since savings will vary by application and size.

Measures should also be screened for a range of sizes and other conditions, as described in Section IV.A. CPCo does not appear to perform this level of screening, even though CPCo recognizes that savings from a given measure may vary considerably. For example, External Reference C-5, p. 3, shows different number of hours of lighting operation (and hence different savings) for various

types of commercial buildings. Unfortunately, CPCo did not screen lighting for each building type, let alone the different uses within a building. In hotels, for example, interior hallway lighting is usually on 24 hours a day, while lighting in guest rooms is on for only a fraction of the time when the room is occupied, and not at all when the room is vacant. Measures that are highly cost-effective for hallways may not be cost-effective for guest rooms.[14]

The estimates of measure life are not nearly so reasonable.[15] CPCo frequently seems to fail to account for attrition due to remodelling. Commercial space, especially office space and restaurants, goes through regular remodeling cycles that shorten many measures' useful lives. For example, CPCo assumes a life of 22.5 years for T-8 lamps and ballasts, which is a reasonable technical estimate for the life of the ballasts (and hence the T-8 lamps, since the fixtures require that the same type of lamps be used for replacement), but this life should probably be adjusted down to 15 years to more realistically reflect the average effect of renovation.

CPCo likewise assumes that 34W fluorescent lamps will last 12.5 years, the life of their ballasts (External Reference C-5, p. 5). However, the least efficient available lamps may well be used as replacements once the original 34W lamps fail, so the measure life should be considerably lower that the ballast life. In addition, this measure essentially disappears in 1995-96 due to the Energy Policy Act; standard 40W lamps will become unavailable and 34W lamps will be the standard

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[14]Similarly, CPCo did not screen water heater wraps for a range of tank sizes, as suggested by External Reference C-5, p. 9.

[15]Overestimates of measure life would tend to understate the cost of conserved energy (CCE) and hence inflate CPCo's incentive for the Docket 9348 programs. In addition, overstating measure life will result in higher incentives under CPCo's proposed incentives. Excessive estimates of measure lives will partially and erratically counterbalance the understatement of avoided costs for screening purposes.

replacement. In any case, the measure will not continue for more than a couple of years.

Other errors in measure life are more measure specific. CPCo assumes that the life of a compact-fluorescent exit sign conversion is equal to the 10,000 hour rating of the compact fluorescent. If the fluorescent conversion is hard-wired, compact fluorescents are likely to be used in the fixture for the rest of its life, which would be much longer. The 20 year life for reflectors is high, even before attrition; 15-16 years is a more common estimate.

E. IRP PRINCIPLES AND RESOURCE ALLOCATION

1. The potential for DM in least-cost plans

Q: How much DM is included in the plans of utilities with comprehensive and aggressive program designs?

A: These utilities are identifying and pursuing electricity savings that are significant fractions of their projected demand growth. These sizable savings are associated with major financial commitments: aggregate DM expenditures represent a few percent of total utility revenues. The efficiency resources these utilities are buying compare favorably to new utility supply — all the more so when the costs of environmental externalities are included in the costs of new supply. Finally, the long-range DM plans of these leading utilities aim at achieving all cost-effective DM savings from utility customers, over time.

Q: Which are the "leading" utilities you refer to here?

A: I am referring to the plans of several utilities in California, the Northeast, and Mid-Atlantic U.S., most of whom have designed DM programs in collaboration with non-utility parties. The utilities examined here include Boston Edison (BECO),

Eastern Utilities (EUA), New England Electric Service (NEES), Western Massachusetts Electric (WMECO), New York State Electric and Gas (NYSEG), Potomac Electric Power (PEPCO), United Illuminating (UI), Pacific Gas & Electric (PG&E), and Sacramento Municipal Utilities District (SMUD).

Q: Why have you restricted your examination to these utilities in particular?

A: More so than their peers, these utilities have designed DM plans that meet the integrated resource planning objectives described above.[16] Accordingly, the energy and capacity savings of these utilities indicate the level of savings that can be expected by a utility that implements aggressive and comprehensive DM programs in all major DM market segments. Moreover, these efforts should be considered representative of what a utility dedicated to maximizing the amount of cost-effective DM savings can achieve.

Q: What planning characteristics do the DM plans of these utilities share?

A: The program plans of these leading utilities are generally aimed at achieving all cost-effective DM savings from utility customers over time, although some of these utilities have been slow to ramp up programs for certain market segments.

Q: How much electricity are these comprehensive DM plans expected to save?

A: Exhibit PLC-2 provides several measures of aggregate electricity savings for these leading utilities' efficiency plans.[17] Planning periods vary, ranging from 5 years to 20 years. Column 3 shows energy savings in the last year of the planning period as a percent of pre-DM sales in that year. Longer projections include larger DM achievements. SMUD's 19-year program plan generates the largest portion of

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[16]Utilities in the Pacific Northwest are also implementing aggressive and comprehensive DM programs.

[17]I refer to the DM programs of these utilities as *third generation* programs to distinguish them from the first-generation information-only programs and from second-generation simple rebate programs.

future sales, with total energy savings amounting to 23.1% of its projected energy sales.

Column 6 of Exhibit PLC-2 shows projected annual load reductions for the reference utility DM plans. This computation normalizes for differences in DM planning periods between utilities, producing a result analogous to a sales-growth projection. Average sales reductions range from 0.5% to 1.2% annually. For the group, annual energy savings represent 0.7% of annual sales.

Finally, Column 9 of Exhibit PLC-2 shows the fraction of new energy sales that each of these utilities expects to meet by new DM. New energy savings range from 28% to 59% of sales growth, averaging 41%.

Q: How much are these leading utilities planning to spend on DM efforts?

A: Exhibit PLC-3 compares total DM spending planned by the utilities appearing in Exhibit PLC-2.[18] Utilities with ambitious DM acquisition plans plan to spend between 3% and 9% of their annual electric revenue on DM, with an average of 4.6%.

Q: What are the costs of the kWh savings expected from these programs?

A: Exhibit PLC-3 also provides a rough indication of how much DM costs per unit of energy savings acquired. Annualized DM costs are estimated by amortizing DM budgets over an estimated average measure life of 15 years. Dividing the annual cost by cumulative annual energy savings produces the cost of conserved

[18]The Western Massachusetts Electric Company (cited in PLC-3) is a retail subsidiary of Northeast Utiities (PLC-2).

electricity, which ranges from 1.4¢/kWh to 5.8¢/kWh. On average, electricity savings cost 3.6¢/kWh saved.[19]

2. Arbitrary limits to CPCo's DM programs

Q: Does CPCo's DM planning impose arbitrary limits on the amount of DM savings the Company will achieve?

A: Yes. CPCo Company has arbitrarily capped its DM budgets.

Q: How much is CPCo planning to spend on its DM programs over the next five years?

A: As shown in Exhibit CAG-4 to Mr. Gilzow's testimony, the Company originally planned DM expenditures of $96 million in 1996, $98 million in 1997, and $108 million in 1998. In the current docket, however, CPCo proposes to limit DM expenditures in each of those three years to $69.2 million, which leads to an overall cut of $94.8 million in projected DM spending, and a steady decrease in real expenditures on DM.

Q: Did CPCo base its decision to cap its DM spending on an economic analysis of DM spending levels?

A: No. Mr. Gilzow writes that "[t]he decision to modify DSM investment levels during the planning process was a judgment based on total DSM investment." (ST-CP-97) CPCo performed no detailed analysis of the effect of spending levels on participation (MUCC-CP-10).

Q: What are the consequence of CPCo's placing a cap on it DM spending?

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[19]Although spending is expressed in terms of kWh saved, DM spending will also cut peak demand, leading to reduced investments in generating, transmission, and distribution capacity. The higher-cost DM programs may particularly targeted to reducing peak loads.

A: In the short term, CPCo's spending cap has disrupted programs and created customer mistrust. Whatever transitory opportunities that might have been captured in the rebate programs will be lost. In the long term, these limits will cause CPCo and its customers to lose out on cost-effective savings. If CPCo plans to forego some of the least-cost level of DM savings, it should be able to show that

- the constraint is actually binding;
- the effects of the least-cost plan would be unacceptable;
- the magnitude of the unacceptable effects is sufficient to justify adjustment to the least-cost plans;
- the integrated resource plan is least-cost, and does not include any components that unnecessarily contribute to the constraint;
- the constraint cannot be accommodated by actions that do not materially sacrifice the benefits of the least-cost plan, such as modifying cost-recovery mechanisms or some aspects of program design;
- reduction of DM efforts will accommodate the constraint at a lower cost than would adjustments to supply additions or other activities;
- the proposed reduction of DM acquisition imposes lower costs than alternative reductions;
- no significant lost opportunities are created, and the reductions do not themselves result in cream-skimming and the creation of lost opportunities.

CPCo should revise its planning with new participation rates, based on its experience and that of other utilities, to avoid budget crises and avoid cutting back on successful and economic programs in the future.

IV. SCREENING OF DM MEASURES AND PROGRAMS

A. THE DM RESOURCE SCREENING PROCESS

Q: How should CPCo screen DM resources?

A: CPCo should screen DM resources in several steps, determining the incremental cost-effectiveness of options, under the Total Resource Cost (TRC) test.

Q: What do you mean by "incremental cost-effectiveness"?

A: DM planning involves many important decisions about enhancing the levels of program intensity, efficiency or comprehensiveness, such as whether to include smaller customers and low-hours-usage applications, whether to raise insulation or SEER standards,[20] and whether to include additional measures in the program. In each case, the enhancement should be pursued if the incremental benefits exceed the incremental costs.

The incremental net benefit test should be noncontroversial; a change in program design should be pursued if and only if it reduces net costs. CPCo does not appear to have examined alternatives in this manner.

Q: How does CPCo screen DM resources?

A: CPCo screens DM measures in DSManager, properly excluding program overhead costs. The surviving measures are bundled into programs, and overhead costs are added. The resulting programs are apparently indirectly screened through DSManager, by adding together the costs and benefits for the individual measures

[20]SEER (seasonal energy efficiency rating) is the standard measure of central air conditioner and heat pump efficiency.

and for the overheads.[21] The programs that survive DSManager screening are then compared to supply options in the integration phase, using the PROSCREEN model.

Perhaps the strangest feature of CPCo's DM screening is that CPCo does not appear to have used that screening in any systematic manner in the design of its programs. Features that CPCo believed were not cost-effective were included; cost-effective options were excluded. CPCo changed programs between 1993 and 1994, but the changes were not guided by the screening process.[22]

Q: How should CPCo have screened DM resources?

A: The DM program design and screening process can be thought of as consisting of six phases, some of which overlap chronologically. These phases are:

1. measure screening,[23]
2. measure enhancement and design,
3. program screening,
4. program specification,

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[21]CPCo has not clearly explained how the mix of measrues assumed to be delivered by each program is determined. Indeed, Mr. Gilzow (Tr 689, lines 10-11) indicated that programs were not usually screened. This statement appears to reflect some confusion on CPCo's part regarding the nature and purpose of screening.

[22]CPCo reports that its 1994 programs are projected to be more cost-effective than its 1993 programs (Exh. CAG-2 and CAG-3). However, the differences do not generally result from improved program designs. Most of the difference appears to result from the higher costs avoided by measures installed 1– 14 years later (Tr. 735), and from arbitrary changes in assumptions (e.g., a radical reduction in the gas usage of water heater conversions). Some of the improvement in the utility cost test results from increased customer co-payments, which are not reflected in the administrative or marketing costs of the programs.

[23]Some generic programs, especially in the commercial and industrial sectors, will not specify measures. For such programs, the review of cost-effectiveness will essentially start with step 3, program screening, and will rely heavily on step 6, project screening.

5. resource allocation or integration, and

6. project screening for site-specific applications.

Step 1 — measure screening — examines the cost-effectiveness of individual measures in isolation from the program delivery mechanisms for installing the measure. CPCo properly screens measures without program overheads. The utility's avoided costs for measure screening are usually taken from a fairly simple screening tool that lists the present value of savings in $/kWh and $/kW for various measure lives.

CPCo screens measures, properly excluding program overheads. Unfortunately, CPCo uses the DSManager program and the utility cost test, which result in problems described below. In addition, it is not clear how CPCo uses the results of measure screening, if at all (MUCC-CP-58). Mr. Gilzow was not sure that CPCo actually rejected measures whose costs exceeded their benefits (Tr. 698, line 16 to 699, line 24).

The assumptions used in the screening process should be as realistic as possible; determining the cost-effectiveness of DM options using unrealistic values is a waste of time. As discussed below, CPCo's avoided costs are highly unrealistic. CPCo seems to have been aware that some of its assumptions about measure costs and savings are also unrealistic, but used the wrong numbers anyway. For example, CPCo assumes in analyzing the 1993 program that replacing an electric water heater using 3304 kWh annually with a gas water heater results in the use of 23 MCF of gas. In analyzing the 1994 program, CPCo assumes that a slightly less expensive gas water heater uses only 17 MCF. Since both analyses were performed contemporaneously in 1992, CPCo must have known that one of these values (probably the 1993 assumption) was incorrect.

Step 2 — measure design and enhancement — similarly involves comparing the incremental cost of measure improvements with the incremental savings from the

improvement. CPCo did not screen enhancements (MUCC-CP-13), perhaps due to reliance on the relatively clumsy DSManager model, which provides no information to program designers on the value of various types of savings and which requires too much input data (and produces too much output) to allow for numerous sensitivity analyses.[24] Measures must be optimized before initial program screening; at sub-optimal levels, measures may not generate enough net benefits to cover program delivery costs.[25]

In addition to higher levels of intensity (e.g., thicker insulation), CPCo will need to screen other improvements and enhancements, such as combining measuring (e.g., installing daylighting and automatic dimmers in addition to high-efficiency lighting) and lowering thresholds (lower hours use, smaller motors).

Step 3 — program screening — includes the effects of the mix of measures likely to be installed, which will often be fewer than all eligible measures.[26] Program screening takes into account the costs of fielding the programs and reflects specific marketing approaches, customer incentive structures, and delivery mechanisms, as well as free riders and free drivers.

Some programs may change significantly over time, as the program changes the market, produces a better-educated professional community, encourages code

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[24]If measure screening had been simplified, the massive Extenal References to the 1992 IRP could have been much smaller, covered more variants of measure scope and conditions, and provided more information about program assumptions.

[25]Some measures may only be cost-effective in a small but significant number of applications (*e.g.*, houses with large heating loads, lights in use over 5,000 hrs/yr). The screening process should retain these measures for possible inclusion in suitable programs, following more detailed market segmentation or field-screening of the measure with other options. A measure need not be universally applicable to be included in a program. It need only be cost-effective often enough to be worth on-site screening.

[26]For a residential water heating direct-installation program, for example, some customers will already have water heater wraps or low-flow showerheads, or will not allow installation, or will not have suitable applications (*e.g.*, no shower).

changes, and so on. Program costs may fall over time, as effectiveness rises. Hence, program screening should reflect conditions over the life of the program, not just in the first year; use of a more complex accounting model, such as DSManager, is appropriate here.

CPCo's basic structure for screening programs is reasonable, including the use of DSManager. Unfortunately, CPCo uses the wrong screening test, selecting programs on the basis of the utility cost test rather than the correct TRC. CPCo also does not screen a full range of programs, covering all market segments and DM opportunities. Even from among the alternative program designs that CPCo has modelled, it has not used the cost-effectiveness analyses to guide selection of designs, or changes to the design (MUCC-CP-58a).

Full program specification — step 4 — is necessary only for those programs that pass the screening. Specification includes determining such factors as delivery mechanisms, marketing mechanisms, cost shares between the utility and participants, and the structure of participant co-payments. Some of these specifications may also be necessary earlier, for estimating response rates (lower utility cost shares will result in lower penetrations) and costs (low utility cost shares may require greater marketing efforts and hence higher social costs). As was true for all other design decisions, the objective is to maximize net benefits. CPCo does not seem to have adequately considered market barriers or net benefits in selecting program designs.

Step 5 — integration — combines the programs produced by earlier steps into a DM portfolio. The portfolio should contain all of the programs specified in Step 4, unless full-scale implementation of all programs constrained by falling avoided costs, financial feasibility, rate and bill effects, equity, and administrative feasibility. If constraints are identified, program designs may be revised, such as

by stretching out the ramp-up for retrofit programs.[27] Re-screening of marginally cost-effective options may become necessary if the magnitude of the portfolio significantly reduces avoided costs.

CPCo's resource allocation process is completely arbitrary, to the extent that CPCo has limited annual DM spending to $69.2 million in current dollars (so the investment will be falling in constant dollars and real buying power) through 1998. CPCo's excuse for this limitation is its own lack of familiarity with DM technology and delivery systems, and some short-term limits on equipment availability (Tr. 703-705). Since CPCo expects to become more competent in delivery of DM (a goal that I heartily support), continuing this limitation past 1994 unnecessarily limits the DM benefits available to electric customers.

In many programs, Step 6 — project screening — is necessary to determine the optimal combination of measures to install in a particular facility, in retrofits for large customers, and in custom designs (industrial process design, new construction).[28] Project screening is part of implementation, rather than the planning of the IRP.

CPCo does not conduct realistic project screening. For example, CPCo limits custom rebates to levels much lower than even CPCo's estimate of avoided costs, as discussed in Section III.D.

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[27]Cost-effective lost opportunities usually should be run as fast as feasible, since the resources cannot be captured later.

[28]For example, installing electronic ballasts throughout a small commercial building may cost less than specifying the optimal number of ballasts by determining the break-even duty cycle of the lights. Alternatively, creative approximations may be sought, such as installing electronic ballasts in all corridors and workspaces and occupancy sensors in all low-use areas.

B. SCREENING TESTS AND CRITERIA

1. Total Resource Cost and the Utility Cost Test

Q: What cost-effectiveness tests does CPCo use to screen DM measures?

A: CPCo uses the Utility Cost Test (UCT), rather than the Total Resource Cost (TRC) test. As CPCo states in discovery, "During the Company's Integrated Resource Planning Process, the selection of DSM resources is based primarily on minimum revenue requirements" (ST-CP-95) and "Because [CPCo's variation on] least-cost planning is based on the Company's minimum revenue requirements, the utility cost test provides an indication of how a program would impact [that version of] least-cost planning" (MUCC-CP-60) Mr. Gilzow explains the use of the UCT by saying that "we optimize on minimum revenue requirement. ... [The] utility test pretty much reflects a minimum revenue requirement approach." (Tr. 694, lines 21-23.)

While Mr. Gilzow claims that "The TRC test is also utilized to factor in the impacts on the participant" (Tr. 604, lines 24-25), CPCo does not seems to have used the TRC in any concrete manner.[29] CPCO clearly believes that the TRC is not the correct test to use: "[T]he utility cost test provides the best indication of cost-effectiveness for the Company ... From a Company perspective, the total resource cost (TRC) test does not provide the best indication of cost-effectiveness because TRC includes participant costs and ignores utility-paid rebates." (MUCC-CP-58) CPCo rejects programs for failure to pass the UCT (MUCC-CP-59).

This position was also emphasized by Mr. Osborn of CPCo in a telephone conference with Resource Insight staff on September 20, 1993. Consumers confirmed that the UCT was the primary test used in the DSManager screening, and that the TRC was only a secondary test. In any case, Mr. Osborn said that the

[29]Indeed, CPCo does not seem to have used even its preferred UCT in any systematic way.