Using DSM to Help Meet Clean Air Act Targets: A Case Study of PSI Energy

Steven Nadel and Jennifer Jordan
American Council for an Energy-Efficient Economy

Christopher Holmes and Kevin Neal
PSI Energy

October 1994

American Council for an Energy-Efficient Economy
1001 Connecticut Avenue, NW, Suite 801, Washington, DC 20036
2140 Shattuck Avenue, Suite 202, Berkeley, CA 94704

EXECUTIVE SUMMARY

Under the Clean Air Act Amendments (CAAA) of 1990, utilities must substantially reduce their SO2 emissions. These requirements particularly affect a band of utilities in the midwest and mid-Atlantic regions stretching from West Virginia to Illinois. PSI Energy, the largest electric utility in Indiana, is an example of a heavily impacted utility; by 2000, PSI must reduce SO2 emissions by approximately 50 percent of forecast levels or acquire emission allowances in lieu of these reductions. PSI already has an extensive set of DSM programs.

For this project, PSI worked with ACEEE to develop an enhanced set of DSM programs and to explore how these enhanced programs affect PSI's CAAA compliance plans. Results of the analysis indicate that the suggested program enhancements increase energy savings by between 45 and 104 percent relative to projected savings from PSI's current DSM programs. These ongoing and enhanced DSM programs can contribute about seven to twelve percent of the sulfur dioxide (SO2) emissions reductions that PSI needs in 2000 and nine to nineteen percent of the SO2 emissions reductions PSI needs in 2010. Given the large emission reduction PSI needs to make, DSM has only a modest impact on PSI's compliance plan. DSM does provide added flexibility for meeting CAAA requirements and DSM does help to reduce the customer bill impacts of CAAA compliance. Also, factoring avoided CAAA costs into DSM cost/benefit calculations can have a significant impact on the cost-effectiveness of some DSM programs.

INTRODUCTION

PSI Energy

PSI Energy (formerly Public Service of Indiana) is the largest electric utility in the State of Indiana and serves over 610,000 homes, farms, and businesses including approximately 1.9 million people in north central, central and southern Indiana. Its service area spans 22,000 square miles and includes portions of 69 of the State's 92 counties.

PSI Energy is a summer-peaking electric utility. The 1993 summer peak load was 5,110 MW. The winter of 1994 peak load was 4,937 MW, which occurred during the coldest weather recorded in the state. Installed resources are 6,100 MW with 94 percent being coal fired. Load growth, after a period of stagnation throughout the 1980s, has increased significantly in the 1990s. Load forecasts are presently assuming two and a half to three percent annual growth over the next ten years.

The availability of low-cost, high-sulfur coal has kept rate levels low. The average price per kilowatt-hour was $0.0457/kWh in 1992 (EEI 1993). However, new power plant construction and environmental compliance costs associated with the Clean Air Act Amendments could require PSI to invest $1.5 billion over the next ten years. This upward cost pressure has driven PSI Energy to look seriously at all viable options to minimize this expense.

PSI Energy is currently working with The Cincinnati Gas & Electric company to form a new company, CINergy. CINergy will serve approximately 1.3 million electric customers and 400,000 gas customers in a 25,000 square mile area spanning three states. Based on owned generating capacity of 11,000 megawatts, CINergy will be the thirteenth largest investor-owned electric utility in the United States.

Clean Air Act Amendments

The Clean Air Act Amendments of 1990 (CAAA) included several provisions that promote the continued development and implementation of DSM programs, but by far the most important of these are the Title IV Acid Rain Provisions. These provisions call for major reductions of SO_2 emissions from fossil-powered utility boilers in two phases: Phase I, which covers the 110 plants with the highest SO_2 emissions, and Phase II, which covers most remaining plants. For the first time a market-based approach is being used.

SO_2 emission allowances were established with each allowance representing the right to emit one ton of SO_2 in the year in which it occurs or any year after. Factored on a historical baseline, utilities are allocated emission allowances, and each affected utility is required to develop compliance plans to reduce their SO_2 emissions to match the allowances they receive from the Environmental Protection Agency (EPA), or buy allowances from utilities that over-comply and have an excess of allowances to sell on the open market.

In order to promote energy efficiency, Congress also established a pool of conservation bonus allowances available to utilities with sources that could qualify by reduction of generation during the period from 1992 until the utility has an affected unit -- 1995 for Phase I utilities and 2000 for Phase II.

A recent report by the Center for Clean Air Policy (Helme and Gille 1993) provides further details on the CAAA and how energy conservation can be used to lower the compliance costs of meeting Acid Rain Law requirements.

The Clean Air Act and Coal Belt Utilities

The Clean Air Act Amendments affect nearly all utilities throughout the country, but have a particularly strong impact on "coal belt" utilities in the midwest and mid-Atlantic regions. Of the 110 plants regulated under Phase I, approximately two thirds come from the states of Illinois, Indiana, Kentucky, Ohio, Missouri, Pennsylvania, Tennessee, and West Virginia. Phase II requirements also have a strong impact on these states; out of the SO2 reductions scheduled under Phase II, approximately 80 percent will come from these eight states. As a result, utilities in this region have been scrambling since the bill's passage to develop plans to bring their generating plants into compliance. Nationwide, expenditures of approximately $20 billion or more have been projected for the period 1995 through 2005, of which approximately half will come from this eight state region (Soloman 1994).

PSI's Present Phase I & II CAAA Compliance Plans

Under requirements of the CAAA, PSI Energy will be required to reduce SO2 emissions by approximately 50 percent from forecast levels for each year from 2000 through 2010, or acquire allowances in lieu of those reductions. Based on PSI's current load forecast, to achieve these reductions will require emissions reductions of 138,000 tons of SO2 in 2000 and 156,000 tons in 2010. As compared to the 1990 SO2 emissions level (approximately 500,000 tons), CAAA requires PSI to reduce emissions levels by 38 percent by 1995 and 70 percent by 2000.

For compliance on its four Phase I plants, which contain 15 generating units, PSI Energy has planned to use an array of compliance options. One of its largest units will retrofit a scrubber which will remove 92 percent of the SO2 from that unit. The company will also reduce the sulfur content in the coal burned at all of the other Phase I units to the extent that can be accomplished with existing particulate control equipment. These steps are by far the greatest portion of PSI Energy's compliance plans.

To comply with Phase II SO2 requirements, compliance alternatives within the PSI system could include additional scrubbers, use of western and midwestern coal blends, and installation of precipitators and flue-gas conditioning equipment. The company is evaluating these alternatives in order to provide the most cost-effective strategy for meeting Phase II SO2 requirements while maintaining optimal flexibility to meet potentially significant new environmental demands. In order to delay or eliminate compliance alternatives within the PSI system, which could be significantly more costly, the company intends to utilize offsetting emission allowances to the extent a viable emission allowance market is available.

The ACEEE Acid Rain and Electricity Conservation Study

During the debate leading to the passage of the Clean Air Act Amendments, ACEEE conducted a study on the potential role of energy-efficiency measures in helping to address sulfur dioxide emissions in the midwest. The study concluded that accelerated energy conservation efforts could directly reduce electric-utility sulfur dioxide emissions by five to six percent of forecast emissions levels in 2000. More importantly, the study found that an accelerated conservation program could reduce regional expenditures for sulfur dioxide control by 25 percent or more (because the last ten percent or so of emissions reductions was particularly expensive), and that savings in consumer bills from energy conservation (resulting from reduced energy use and reduced need for new power plants) would more than offset bill increases associated with emissions reductions (Geller, et al. 1987). However, this study was based on mid-1980s data for the entire region, which are not necessarily representative of utility-specific situations in the 1990s. To address these limitations, in 1991, ACEEE proposed to PSI that the two organizations work together to assess the potential role of demand-side management programs in helping PSI to meet its Clean Air Act obligations, an offer which PSI accepted.

The PSI/ACEEE Study

The PSI/ACEEE study was designed to build upon PSI's existing demand-side management (DSM) and Clean Air Act implementation plans. For the study, PSI's existing programs and plans were used as a base. ACEEE, with extensive PSI input, then worked to develop new or enhanced DSM programs that complemented PSI's existing programs and resulted in additional cost-effective energy savings. The emissions impacts of these programs were then analyzed based on year-by-year emissions factors developed from a load dispatch analysis on PSI's system. Finally, the financial implications of these two scenarios were assessed from the utility and consumer perspectives. The methodology and results for each of these steps are discussed in subsequent sections of this report.

DSM AT PSI

Current Programs

As part of a DSM settlement agreement between PSI and groups representing PSI Energy's customers, PSI Energy has been implementing twelve DSM programs. The agreement provides for the recovery of implementation costs, the recovery of lost revenues, and a shareholder incentive to encourage performance. The result is a set of energy-efficiency programs that put PSI Energy at the forefront of Midwest utilities in DSM.

DSM programs are considered important not only for the cost savings to the utility, but also for the value created for customers through reduced bills and the environmental benefits that accrue through reduced electricity use. The environmental benefits of DSM are particularly important considering the impact that the Clean Air Act Amendments are expected to have on PSI's capital investment requirements. As a result, PSI's DSM programs include a significant focus on energy savings because energy savings allow PSI to reduce the amount of coal burned in its power plants.

Table 1 lists PSI's current DSM programs. This set of programs is very diverse, offering a range of energy-efficiency services to residential, commercial and industrial customers.

Table 2 provides a comparison of the expected demand and energy impacts and the cost effectiveness of the programs from different perspectives. The programs are expected to produce 260 megawatts of summer peak demand reduction and 1,232 gigawatt-hours of energy reduction in 2000. Further details on PSI's current DSM programs can be found in PSI's most recent *Demand-Side Implementation Update* (PSI 1993).

Possible Expanded DSM Offerings

In developing recommendations for expanded DSM programs for PSI, four general concepts were followed: (1) influence purchases that are already happening in the market, thereby addressing lost opportunity resources; (2) promote market transformation where possible; (3) address major efficiency opportunities and customer segments not addressed by PSI's current programs; and (4) limit retrofit programs primarily to customer segments that might be underserved by other programs. Each of these concepts, and the programs they lead to, are discussed in the paragraphs below. The programs that emerged from this process are summarized in Table 3.

During periods of new construction, remodeling and equipment replacement, customers are spending substantial amounts of money to purchase energy-consuming equipment. By providing incentives to help cover the incremental cost difference between standard-efficiency equipment and high-efficiency equipment, utilities can encourage customers to save energy at modest cost. If efficient equipment is not purchased at this time, windows of opportunity are lost because it will often be technically or financially difficult to upgrade equipment later on a retrofit basis. In an effort to take advantage of these market-driven opportunities to improve equipment and facilities, new or enhanced programs were developed for residential new construction, commercial new construction, industrial new construction, commercial remodeling, commercial planned HVAC change-outs, residential water heaters and residential clothes washers.

Some utilities are developing long-term strategies to transform the market so that efficient equipment or practices are the norm and utility incentives are no longer needed. These strategies often use utility programs to help leverage government actions, such as adoption of improved building codes or equipment efficiency standards. A market-transformation approach has the potential to increase participation rates (because once a market is

Table 1: Summary of Current PSI Energy DSM Programs

Residential Water Heating	A direct installation program for electric water heating customers that promotes installation of energy efficient water heating measures. Participants are also eligible for reduced price compact fluorescent lights.
Residential Smart $aver Home	An efficiency program targeted toward the new construction and existing home markets. The program promotes high efficiency building construction and the installation of high efficiency air conditioners and heat pumps.
Residential Storage Water Heater	Encourages customers to install oversized water heaters with lock-out devices to shift usage from peak to off-peak periods.
Residential Appliance Cycling	Provides bill credits to customers who allow PSI to cycle air conditioners and water heaters.
Residential Seal-Up	Provides the same measures as the water heating program and also includes blower door tests to detect leakage sites and the installation of caulking, weather-stripping, outlet gaskets and door sweeps to reduce leakage.
Residential Low Income	Designed to enhance delivery of government supported low-income weatherization through the addition of measures found in other PSI Energy residential programs.
Commercial Custom Energy Audits	Provides a comprehensive energy audit that identifies cost effective energy efficiency measures. Incentives are offered to partially offset installation cost. Also provides incentives for more efficient equipment in new construction.
Small Commercial Direct Lighting	A direct installation program for small commercial customers. Measures include: T8 lamps, electric ballasts, exit signs and compact fluorescent lights.
Industrial Customized Audit	PSI Energy provides a comprehensive energy audit. Incentives are offered to partially offset the installation cost.
C&I Time of Use Rates	A rate program that encourages customers to shift use from high-cost on peak periods to lower cost off-peak periods. Current design is a three season, three period rate.
C&I Curtailable Rates	Participants are provided bill credits based upon a mutually agreed upon level of interrupted load. Credit varies with notification period and seasons.
Planergy Water Link Cooperative	A five megawatt load shed cooperative comprised of water and waste water treatment plants.

Table 2: PSI Energy Demand-Side Management
Project Impacts of Existing Programs

Program	Utility Cost Ratio[1]	Total Resource Cost Ratio	Peak Demand MW Reduction (2010)	Annual Energy GWh Reduction (2010)
Residential Water Heating	1.49	1.34	3.5	51.0
Residential Smart $aver	1.30	1.25	50.5	510.7
Residential Storage Water Heater	1.27	0.88	13.9	17.7
Residential Appliance Cycling	1.15	1.86	7.2	2.1
Residential Seal-Up	1.37	1.28	3.9	88.6
Residential Low Income	1.32	1.35	0.7	11.1
Commercial Custom Energy Audits	1.52	1.17	82.7	326.5
Small Commercial Direct Lighting	1.48	2.52	13.1	80.9
Industrial Customized Audit	2.93	1.50	100.7	730.0
C&I Time of Use Rates	1.12	1.67	10.4	4.3
C&I Curtailable Rates	1.13	3.84	21.2	7.5
Total	1.54	1.31	307.8 MW	1830.4 GWh
Forecast Retail Load without DSM			4,939 MW	38,751GWh
DSM as % of Forecast			6.2%	4.7%
Levelized Rate Impact (twenty year)			.75 mills	

[1]Benefit cost ratio using the revenue requirements or utility cost (UC) test evaluated over twenty years.

Table 3: Summary of Proposed New/Enhanced DSM Programs

Residential Sector	
Second refrigerator turn-in	Encourages customers to turn in under-used second refrigerators and includes environmentally-safe disposal.
Compact Fluorescent Lamp Manufacturers' Cost Credits	Promotes availability of affordable CFLs in local retail stores by providing cost credits direct to manufacturers.
Heat Pump water heater	Seeks to establish local market for HPWH through use of incentives and work with trade allies -- targets new construction and equipment replacement markets.
Clothes washers	Provides incentives for purchase of horizontal-axis and high-spin speed clothes washers.
Farm efficiency	Provides technical assistance and incentives to farmers to improve lighting, heating, ventilation, grain drying, watering, food handling, and food storage.
Enhanced Smart $aver	Adds duct sealing to new construction program.
Commercial Sector	
Equipment replacement	Works with trade allies to provide incentives for purchase of high-efficiency ballasts, motors, HVAC and refrigeration systems.
HVAC retirement	Encourages building owners with HVAC systems that are about to fail to install new, efficient systems and at the same time improve lighting systems so that HVAC systems can be downsized.
Remodeling	Encourages efficient lighting designs at time of tenant build-out or tenant changes.
Enhanced new construction	Adds technical assistance, a systems perspective, and expanded marketing to existing PSI program.
Industrial Sector	
New construction	Encourages factory and process-line designers to improve the efficiency of their design through expert technical assistance and incentives.
Small Industrial	Extension of existing small commercial program into the industrial market, with an emphasis on the high-and-low-bay lighting systems common in the industrial sector.
Enhanced efficiency improvement	Expansion of existing retrofit program - includes expert technical assistance and addition of prescriptive components for fans, pumps, air compressors and ASD's.

transformed, participation rates are near 100 percent) while reducing costs per kWh saved (because once transformation is complete, incentives are no longer needed) (Nadel and Geller 1994). Several of the proposed PSI programs seek to advance market transformation including the residential, commercial, and industrial new construction programs, equipment replacement programs for clothes washers, water heaters, ballasts, and commercial HVAC equipment, and the retailer-based compact fluorescent lamp program.

As noted in the previous section, PSI has an extensive array of DSM programs. However, some efficiency measures and customer segments are not fully covered by PSI's existing programs. For example, existing residential programs do not address residential appliances, some new construction efficiency measures (e.g., sealing ducts), and efficiency measures unique to farms. Existing commercial programs do not cover equipment replacement, design of new buildings and remodeling of existing buildings. Existing industrial programs do not fully address process efficiency improvements or small facilities, and do not provide prescriptive incentives for customers who want to avoid the complications of applying for customized incentives. To address each of these limitations, new or enhanced programs were developed.

Finally, because previous studies have found that retrofit installations are often more expensive than efficiency improvements in new construction or building rehabilitation (see, for example, Katz et al. 1989), proposals for new or expanded retrofit programs were primarily limited to customer segments that might be underserved by other programs. Serving all customer segments is important because DSM programs often lead to modest rate increases but significant bill reductions for participating customers due to lower energy use. By offering programs for all customer segments, everyone has an opportunity to reduce their bills. Programs that serve potentially underserved customer segments are programs for residential and farm customers and small commercial and industrial customers. The one exception to this guideline is that enhanced retrofit programs are proposed for the industrial sector, in part because there is a chance this customer segment may be underserved by existing programs and in part because industrial retrofit programs generally have low costs per kWh saved, making them highly cost-effective (Jordan and Nadel 1993).

Detailed descriptions of each of the expanded DSM programs are provided in Appendix A, including narrative descriptions, cost data and a set of tables describing the assumptions used to estimate the costs, savings, and other impacts of each program.

In addition to the programs summarized in Table 3, ACEEE also developed descriptions and input assumptions for seven additional programs that were subsequently dropped from the analysis including three programs that were found to be not cost-effective or of uncertain cost effectiveness (refrigerator rebates, home insulation retrofits, and industrial fans and pumps), and four programs that were subsequently incorporated into PSI's plans for its existing DSM programs (industrial compressed-air-system retrofits, and enhanced residential central air conditioner, residential hot-water retrofit, and small commercial lighting retrofit programs).

In developing input assumptions for the particular programs, there was substantial discussion between PSI and ACEEE about the specific assumptions to use. In most cases the two organizations agreed to a single set of common assumptions. For four programs there was a difference in opinion as to the participation level that could ultimately be achieved. For these four programs, two scenarios were run -- an optimistic and a conservative scenario. As a result of these differences, energy savings from the more optimistic package of programs are approximately 21 percent higher than energy savings for the more conservative package of programs in 2000 and more than 40 percent higher in 2010.

For three of the programs, the differences were relatively minor and stem largely from the fact that PSI caps incentives at 60 percent of measure cost while in some cases ACEEE believes higher incentives are justified. For one of the programs, the HVAC retirement program, differences were more substantial. PSI program staff believe that most of the savings that can be achieved from existing commercial buildings are captured by PSI's current audit and incentive program and hence they project very little additional savings from the HVAC retirement program. ACEEE, on the other hand, believes that savings from PSI's audit and incentive program are relatively modest (participating customers reduce their energy use by about five percent) and that substantial savings are available in the long-term through a program that emphasizes HVAC system optimization at the time of HVAC equipment replacement and also includes comprehensive lighting retrofits that allow the new HVAC system to be downsized substantially. Approximately 75 percent of the difference between the conservative and optimistic scenarios is due to different assumptions regarding this one program. Details of the assumptions used to model the conservative scenario are provided in Appendix B.

The three new/expanded DSM programs that promise the greatest energy and demand savings are the Commercial HVAC Retirement/Upgrade program, the Industrial New Construction program, and the Enhanced Industrial Efficiency program.

The Commercial HVAC Retirement/Upgrade Program will target commercial HVAC systems that are about to be replaced. The program will provide participants with a package of lighting and shell improvements which will reduce the size of an HVAC system simultaneous to installation of a high-efficiency HVAC system with energy-saving controls. The two key features of this program are (1) it increases savings by combining equipment-efficiency improvements with equipment downsizing made possible by overall building-load reductions; and (2) it spreads the participation and costs of a full-scale effort over many years. Under the Optimistic scenario, this program is projected to save approximately 211 MW and 845 GWh/year by 2010.

The Industrial New Construction Program is intended to capture the cost-effective lost conservation opportunities in the new plant and new process line market. Limited data indicate that the typical industrial process line is changed every ten to fifteen years (although many lines are changed on slower or more rapid schedules). This renovation rate implies that approximately eight percent of industrial process lines are renovated every year. By working with this renovation cycle, utilities can capture significant energy savings without the plant downtime required for retrofit projects. Under the Optimistic scenario, this program is projected to save approximately 39 MW and 291 GWh/year by 2010.

The Enhanced Industrial Efficiency Improvement Program is designed to complement the existing I-1 program, which focuses on lighting, motors, and other auxiliary system measures. The pilot program will address improved energy efficiency in the industrial processes within a participant's facility and should target the approximately 240 PSI customers over 1 MW in size. Under both the Optimistic and Conservative scenarios, this program is projected to save approximately 39 MW and 296 GWh/year by 2010.

While Tables 1 and 3 show a total of 25 programs, in actual operation many of these programs are or will be offered as part of a package of DSM services targeted to particular customer segments. Thus, to most individual customers and trade allies, it will appear that PSI offers a single program that contains several program components.

The combined impacts of the new/expanded DSM programs listed in Table 3 are substantial. As shown in Table 4, by 2010, the peak year of the DSM impacts, these additional DSM programs are estimated to save 832 GWh in the conservative case and 1,906 GWh in the optimistic case. This represents a 45 percent increase for the conservative case and a 104 percent increase for the optimistic case over projected savings from PSI's current DSM programs. The new programs also substantially reduce peak demand, savings 132-386 MW in 2010, a 43 - 125 percent increase over projected savings from PSI's current programs. The benefit/cost ratios for the new programs vary from 1.3 to 3.4 using the Utility Cost test. These results are summarized in Table 4. Additional results of the analysis are provided in Appendix C.

EMISSION IMPACTS OF EXPANDED DSM

Methodology

PSI Energy uses detailed production dispatch models to determine the amount of fuel burned, and hence SO2 production, by its power plants. Emission impacts of DSM are determined by running these models with and without the DSM programs. Emission levels and production costs are determined for each DSM case by the difference between base case (no DSM) and each of the three DSM cases. The emission levels are converted to emission allowances and applied to a forecast of allowance prices.

The forecasted emission allowance prices are quite uncertain. Initial forecasts made in 1992 were substantially higher than forecasts used at the present time. The most recent forecasted emission allowance prices (the values used in this analysis) range from a 1995 level of $155 per ton of SO2 avoided rising at a 6.8 percent rate over the next ten years.

Table 4: PSI Energy Demand-Side Management
Projected Impacts of ACEEE Programs

	Optimistic Assumptions				Conservative Assumptions			
Program	Utility Cost Ratio	Total Resource Cost Ratio	Peak Demand MW Reduction (2010)	Annual Energy GWh Reduction (2010)	Utility Cost Ratio	Total Resource Cost Ratio	Peak Demand MW Reduction (2010)	Annual Energy GWh Reduction (2010)
2ND refrig. Turn-in	1.28	1.28	0.00	0.00	1.28	1.28	0.00	0.00
CF Coupon Program	2.13	1.63	0.07	7.2	2.13	1.63	0.07	7.2
Heat Pump/Water Heater	1.67	1.19	6.82	89.1	1.67	1.19	6.80	89.1
Clothes Washer Rebate	1.71	1.53	1.40	9.3	1.71	1.53	1.40	9.3
Farm Efficiency	1.30	0.98	0.01	0.08	1.18	0.89	0.01	0.04
Enhanced S$ - Duct Seal	3.27	2.70	1.94	14.3	3.27	2.70	1.94	14.3
Commercial Equipment Replacement	1.48	1.60	28.58	114.5	2.30	1.52	19.49	78.1
Commercial HVAC Retirement Upgrade	2.93	2.44	210.84	844.8	2.60	2.18	10.54	42.2
Commercial Remodeling - Lighting	2.74	2.31	37.46	150.1	2.91	2.07	7.36	29.5
Commercial New Construction	3.44	3.86	19.51	78.2	3.44	3.86	19.52	78.2
Industrial New Construction	1.71	1.71	38.68	290.5	2.43	1.81	23.44	176.1
Small Industrial Direct Installation	1.93	1.62	1.61	12.1	1.93	1.62	1.61	12.1
Enhanced Industrial Efficiency	2.99	9.10	39.40	296	3.01	8.81	39.40	296
Total ACEEE Programs	3.01	2.33	386.30	1906.00	2.55	2.55	131.59	832.10
Forecast Load without ACEEE			4,939 MW	38,751 GWh			4,939 MW	38,751 GWh
ACEEE as % of Forecast			7.80%	4.92%			2.66%	2.15%
Levelized Rate Impact (twenty year)			2.0 Mills				1.1 Mills	

For each of the three DSM cases reviewed -- PSI Energy's Current, ACEEE Conservative, and ACEEE Optimistic cases -- the production dispatch models were applied to determine the level of SO2 emissions. The base case used to determine the environmental benefit from these DSM programs did not contain any environmental compliance options beyond PSI's Phase I plan. As compliance options are finalized and implemented, however, DSM programs may impact cleaner units on average, thereby reducing the SO2 impacts from the efficiency improvements. Thus, the emissions reductions attributed to DSM programs should be viewed as an upper bound.

These avoided-emission-allowance benefits are included in the cost-effectiveness tests used by PSI Energy to screen and evaluate the cost effectiveness of its DSM programs. The cost-effectiveness tests reflect the standards in the California Standard Practice manual and include the utility cost (UC), total resource cost (TRC) and rate impact measure tests (RIM). All benefit/cost ratios presented in this paper include the estimated value of avoided emissions, based on the projected emission allowance prices.

Results

PSI Energy's base case DSM programs reduce SO2 emissions by approximately 10,000 tons in 2000, peaking at 14,100 tons in 2010 before gradually declining to 12,400 tons in 2013 as DSM measures wear out (see Figure 1). The enhanced programs developed by ACEEE increase SO2 emissions reductions by approximately 3,200 - 6,000 tons in 2000 (the range captures the difference between the conservative and optimistic scenarios); incremental SO2 emissions reductions from ACEEE enhanced programs rise to 5,900 - 12,700 in 2005 and 5,500 - 15,000 tons in 2010.

Combining PSI's existing programs with ACEEE's conservative scenario, total SO2 reductions in 2000 are 13,100 tons, which represents more than nine percent of PSI's total required emissions reductions expected in that year. Emissions reductions due to conservation programs increase to 19,600 tons by 2010 in this case -- approximately 13 percent of the emissions reductions PSI expects to need in that year (see Tables 5 and 6).

Combining PSI's existing programs with ACEEE's optimistic scenario, total SO2 reductions in 2000 are 15,800 tons, which represents more than 11 percent of PSI's total required emissions reductions expected in that year. Total emissions reductions due to conservation programs increase to 29,100 tons by 2010 in this case -- more than 18 percent of the emissions reductions PSI expects to need in that year (see Tables 5 and 6).

In terms of energy savings, under the conservative scenario, the total package of programs is projected to save 2,664 GWh in 2010. This represents nearly nine percent of PSI's load forecast for 2010 before accounting for the effects of PSI's DSM programs (see Table 5). Under the optimistic scenario, the total package of programs is projected to save 3,738 GWh in 2010, which represents more than 12 percent of PSI's load forecast for 2010 before accounting for the effects of PSI's DSM programs.

Figure 1: PSI Energy - Emission Reductions from DSM

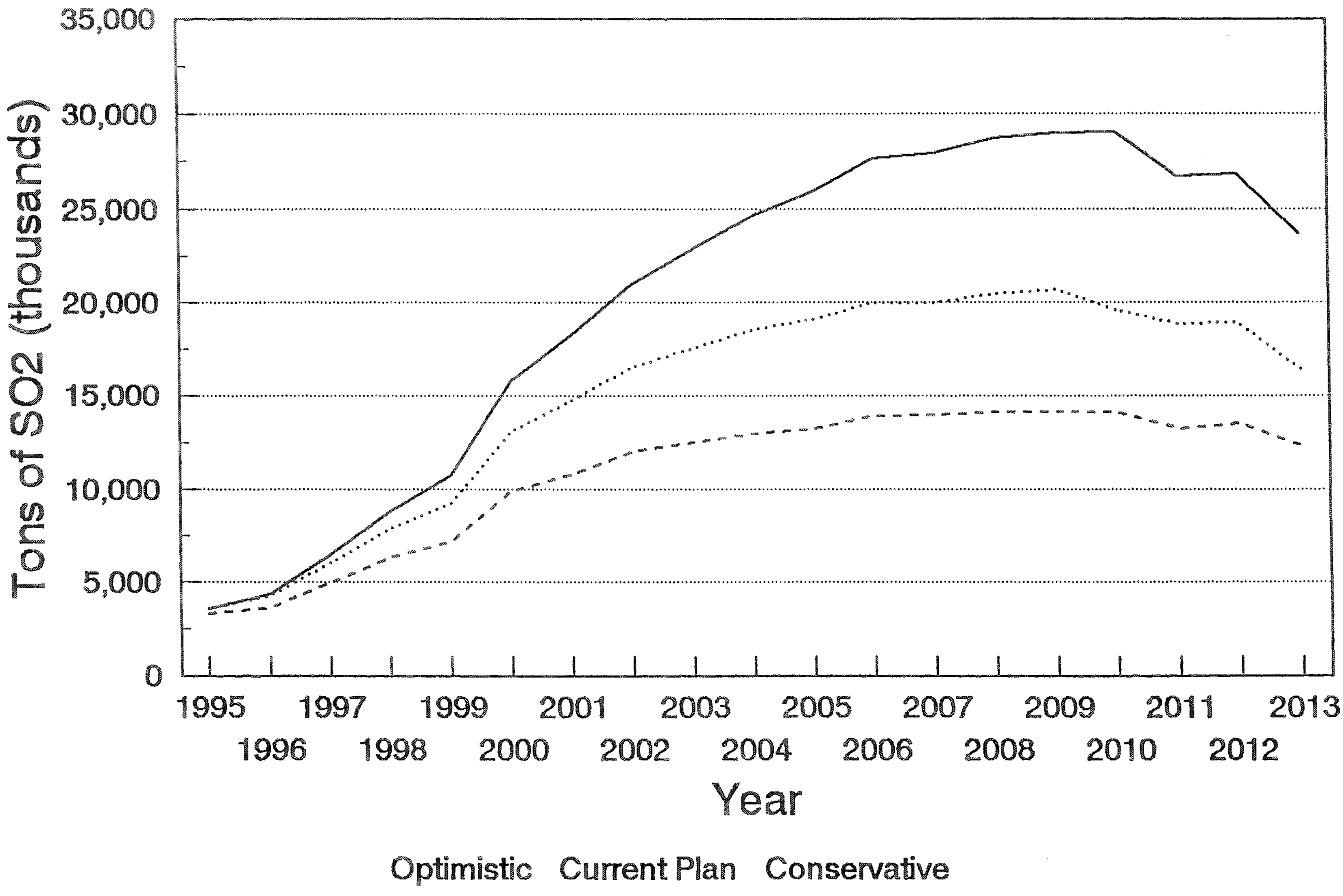

Table 5. Impact Summary for Three Scenarios Analyzed

	SO2 Reductions					
	Current		Conservative Enhanced		Optimistic Enhanced	
Year	Tons (000)	% of Total Required	Tons (000)	% of Total Required	Tons (000)	% of Total Required
1995	3.3	4.8%	3.6	5.3%	3.6	5.3%
2000	9.9	7.2%	13.1	9.5%	15.8	11.5%
2005	13.2	7.9%	19.1	11.4%	25.9	15.5%
2010	14.1	9.0%	19.6	12.6%	29.1	18.6%

	CO2 Reductions					
	Current		Conservative Enhanced		Optimistic Enhanced	
Year	Tons (000)	% of Total	Tons (000)	% of Total	Tons (000)	% of Total
1995	430.3	1.9%	465.3	2.1%	471.5	2.1%
2000	1,259.7	5.2%	1,663.1	6.9%	2,007.8	8.3%
2005	1,704.2	6.1%	2,459.9	8.9%	3,340.2	12.0%
2010	1,896.4	6.1%	2,155.5	8.9%	3,881.4	12.5%

	NOx Reductions					
	Current		Conservative Enhanced		Optimistic Enhanced	
Year	Tons (000)	% of Total	Tons (000)	% of Total	Tons (000)	% of Total
1995	0.9	1.4%	1.0	1.6%	1.0	1.6%
2000	2.7	3.9%	3.6	5.1%	4.4	6.3%
2005	3.7	4.6%	5.3	6.7%	7.3	9.1%
2010	4.1	4.6%	6.0	6.7%	6.4	7.2%

	Annual GWh Reductions					
Year	Current		Conservative Enhanced		Optimistic Enhanced	
	GWh	% of Total	GWh	% of Total	GWh	% of Total
1995	414.1	1.9%	447.8	2.1%	453.6	2.1%
2000	1,232.0	5.2%	1,626.8	6.9%	1,964.0	8.3%
2005	1,642.2	6.1%	2,370.0	8.9%	3,219.0	12.0%
2010	1,830.5	6.1%	2,663.7	8.8%	3,738.0	12.4%

	Average Bill Reductions (Average of Participants and Nonparticipants)					
	Current		Conservative Enhanced		Optimistic Enhanced	
Year	$	%	$	%	$	%
1995	$29	1.4%	$31	1.6%	$31	1.6%
2000	$101	4.0%	$133	5.3%	$162	6.4%
2005	$142	4.8%	$210	6.9%	$297	9.4%
2010	$168	4.8%	$260	6.9%	$385	9.8%

Table 6: PSI Energy SO2 Emissions Forecast

Year	EPA Allotment (tons)	Pre-CAAA Forecast Emissions* (tons)	Surplus/ (Deficit) (tons)
1995	311,679	243,152	68,527
1996	311,679	216,713	94,966
1997	311,679	228,352	83,327
1998	311,679	228,477	83,202
1999	311,679	236,268	75,411
2000	145,918	283,571	(137,653)
2001	145,918	283,082	(137,164)
2002	145,918	297,414	(151,496)
2003	145,918	302,256	(156,338)
2004	145,918	293,942	(148,024)
2005	145,918	313,128	(167,210)
2006	145,918	319,575	(173,657)
2007	145,918	318,847	(172,929)
2008	145,918	320,715	(174,797)
2009	145,918	311,865	(165,947)
2010	145,918	302,018	(156,100)

* assumes no DSM or Environmental Compliance Options

In all three scenarios, emissions reductions, on a percentage basis, are less than energy reductions, as shown in Table 7. These results are due to end-use efficiency improvements impacting power plants that are slightly below average in terms of their SO2 emissions rates. In other words, DSM primarily displaces peaking and intermediate power plants with below-average emissions. The coal-fired baseload plants are only moderately affected by DSM. However, as one moves from the current PSI programs to the ACEEE conservative case and then to the ACEEE optimistic case, emissions reductions per kWh saved increase as these additional programs have a greater impact on the baseload coal plants.

Table 7. Emissions and Energy Reductions as a Percent of Forecast in 2010.

	GWh Reduction as % GWh Sales	SO2 Reduction as % SO2 Emissions
PSI Base Case	6.1%	4.6%
Conservative Enhanced Case	8.8%	6.5%
Optimistic Enhanced Case	12.4%	9.6%

PSI is presently developing a new optimized CAAA compliance plan -- results of this analysis are not yet available. However, a range of possible financial impacts can be estimated by assuming that DSM either defers emissions allowance purchases (which provides a low-end estimate of cost savings) or scrubbers (which provides a high-end estimate of cost savings). In all likelihood, the correct answer lies between these two extremes.

If only emissions allowance purchases are deferred, based on forecasted emissions allowance prices developed for PSI by a contractor, PSI's current DSM programs over a 20-year period will save approximately $69 million (1994$) in emissions allowances. The ACEEE programs will save an additional $27 - 62 million. These emissions allowance savings represent 27 percent of the total projected benefits of DSM. These results suggest that emissions allowance benefits can substantially alter the cost effectiveness and hence the level of DSM programs a utility affected by the CAAA may cost effectively undertake. For example, the Farm Efficiency Program, with a Utility Cost ratio of 1.18 under the conservative case, would not pass this cost test without counting avoided emission reduction costs. These emissions allowance benefits, however, represent only a small portion of PSI's CAAA compliance costs, which are projected to be $0.6 - 1.2 billion. Thus, PSI's CAAA compliance costs could decline by approximately 8 to 16 percent based on the conservative DSM scenario and approximately 11 to 22 percent based on the optimistic DSM scenario.

If only scrubbers are deferred, based on an average scrubber cost of $400 per ton of SO2 removed annually, PSI's current DSM programs will reduce CAAA compliance costs by approximately $108 million over 20 years, and the ACEEE programs will save an additional $42 - 94 million. Such a scenario accounts for a much more significant share (25-34 percent) of PSI's estimated CAAA compliance costs.

Another advantage of DSM is that it helps ameliorate the bill impacts of CAAA compliance. PSI estimates that in 2000, CAAA will cost a typical customer $180 annually. DSM programs, by reducing energy use and hence energy bills for the average customer, reduce these impacts by $133 under the conservative DSM scenario and $162 under the optimistic DSM scenario (i.e., DSM reduces CAAA bill impacts to $47/year under the conservative scenario and $18/year under the optimistic scenario).

CONCLUSIONS

There are many reasons for utilities to undertake energy efficiency programs. This analysis suggests that complying with the CAAA is one of them. Incorporating these benefits into the DSM screening process can increase the number and extent of cost effective DSM programs. It also suggests that as a stand-alone strategy, DSM programs are insufficient to meet compliance. However, DSM does provide some non-trivial emissions reductions -- approximately 12 - 18 percent of total SO2 reductions that PSI Energy is required to make in Phase II of the Clean Air Act Amendment. In addition, DSM programs help reduce the customer bill impacts of overall CAAA compliance.

PSI is a leader in the Midwest with respect to DSM, spending approximately two and a half percent of revenues on DSM. Our study, however, shows that much more can be done that would be cost effective and help meet future environmental regulations. Because of the economic and environmental benefits that expanded-DSM programs can provide to PSI Energy and its customers, we recommend that other Midwestern states and utilities closely examine DSM as a least-cost environmental compliance option.

ACKNOWLEDGEMENTS

Support for ACEEE's work on this project was provided by grants from The Joyce Foundation and PSI Energy. Project conception and overall direction were provided by Duejean Garrett and Greg Collins at PSI Energy and Howard Geller at ACEEE. Assistance developing the designs for the new programs was provided by PSI program staff, particularly Jerry Brandom, Dave Mulder, Dennis Gibbs, and Brad Blackman. Information on state-of-the-art DSM program designs was provided by staff at many utilities and other organizations too numerous to list here. To them we are especially grateful. Final edits and report production were coordinated by Miriam Pye at ACEEE.

REFERENCES

EEI. 1993. *Typical Residential, Commercial and Industrial Bills -- Investor-Owned Utilities.* Edison Electric Institute, Washington, DC.

Geller, H., E. Miller, M. Ledbetter, and P. Miller. 1987. *Acid Rain and Electricity Conservation.* American Council for an Energy-Efficient Economy, Washington, DC.

Helme, N. and J.A. Gille. 1993. *Energy Conservation = Lower Compliance Costs: Using Energy Conservation to Meet the Acid Rain Law Requirements.* Center for Clean Air Policy, Washington, DC.

Jordan, J. and S. Nadel. 1993. *Industrial Demand-Side Management Programs: What's Happened, What Works, What's Needed,* DOE/EE/01830-H1. U.S. Department of Energy, Washington, DC.

Katz, G., D. Baylon, and F. Gordon. 1989. *Lost Conservation Opportunities Created by Remodeling and Renovation in the Commercial Sector.* Office of Conservation, Bonneville Power Administration, Portland, OR.

Nadel, S. and H. Geller. 1994. "Market Transformation Programs: Past Results, Future Directions." Proceedings of the 1994 ACEEE Summer Study on Energy Efficiency in Buildings. American Council for an Energy-Efficient Economy, Washington, DC.

PSI Energy. 1993. *Demand-Side Implementation Update.* DSM Planning. November.

Soloman, B. 1994. personal communication. Environmental Protection Agency, Washington, D.C.

APPENDIX A

DESCRIPTIONS OF PROPOSED NEW PSI DSM PROGRAMS INCLUDING DETAILED ANALYTIC ASSUMPTIONS

SECOND REFRIGERATOR TURN-IN PROGRAM (Revised 6/27/94)

More than 18% of PSI's residential customers, or roughly 97,000 customers, own more than one refrigerator. The second refrigerator turn-in program would offer residential customers who operate more than one refrigerator in their residence free refrigerator pick-up and appliance recycling.

Experience from other utilities appears to indicate that a financial incentive is not necessarily required during the first few years of the program, since some participants during this time are simply "cleaning out their basements" (Barbian 1993). However, after the first two years, we recommend that PSI offer a $25 rebate to participating customers to encourage participation from the rest of the eligible market.

A number of utilities offer refrigerator/freezer turn-in programs, including Consolidated Edison, WEPCo, Northeast Utilities, Pacific Gas & Electric, NEES, SMUD, Northern States Power, and Otter Tail Power.

Cartage contractors should be hired to pick up and haul refrigerators and freezers either to a dismantling facility or to a combination dismantling/recycling site. The recycling sites would recover metal parts, dispose of PCBs found in the capacitors of some refrigerators, and recycle CFCs found in the refrigerants. The costs of refrigerator pick-up and recycling for two programs averaged $88 per unit (Barbian 1993, Viccarro 1993). More recently, PSI has received indications from one vendor that pick-up and recycling might cost approximately $105. PSI could contract with appliance stores or furniture movers to pick-up and deliver second refrigerator/freezers to the recycling sites. At least one utility noted that hiring appliance stores to do pick-up led to problems when the dealers tried to sell participants a new second refrigerator (Nelson 1993).

PSI could possibly contract with the Minnesota-based Appliance Recycling Centers of America (ARCA) for pick-up and recycling of the refrigerators. Services offered by ARCA include program design, marketing assistance, data collection and analysis, appliance collection, and environmentally-sound appliance processing and recycling. There are presently seven ARCA centers in the U.S. and Canada. There are other pick-up and recycling outfits which PSI could consider hiring, such as Planergy based in Austin, Texas.

Not only does a second refrigerator turn-in and recycling program help get generally old and inefficient refrigerators off the system, but the program also has environmental benefits. Ozone-damaging CFCs are captured in the recycling process and prevented from being released to the atmosphere. Due to these benefits, programs of this type typically provide positive public relations benefits for the sponsoring utility.

Based on data from two utilities, savings per refrigerator is estimated at 1,030 kWh per year. This includes estimates of the percent of refrigerators that are used year-round and the percent of refrigerators which are frost-free versus manual defrost (Johnson 1993, Otter Tail Power 1993). Based on experience with NU, WEPCo, and BC Hydro, 25% of the participants are assumed to be free riders (The Results Center 1992: BC Hydro, The Results Center 1992:

WEPCo; Viccarro, 1993). During the four years of the program, we assume participation rates are similar to those achieved by appliance recycling programs, offered by Northeast Utilities and WEPCo (Johnson 1993, The Results Center 1992: WEPCo).

In the past, CFC-11 found in foam insulation of refrigerators has not been recovered during appliance recycling, with the exception of the recently-adopted process at Northeast Utilities. At the moment, available technologies for recovering CFC-11 are available but generally expensive. However, according to one experienced appliance recycling program administrator, the technology is rapidly becoming more cost-effective and viable (Barbian 1993). Therefore, we recommend that PSI follow closely the developments of technologies for recovering CFC-11 and consider adding this component to the program.

SECOND REFRIGERATOR TURN-IN PROGRAM: revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	1999	
Program type	Rebate and refrigerator pick-up/recycling program.	
TECHNOLOGY:		
Technology description	Approximately 20% of single-family and 8% of multi-family dwellings have at least 2 refrigerators.	
Incremental equip. cost	n/a	There are no incremental equipment costs.
Incremental install. cost	$105 per unit	PSI estimate based on discussions with recycling vendors.
Incremental annual O&M	n/a	There are no additional O&M costs.
Annual kWh savings	1,029 per unit	ACEEE estimate. Based on surveys done by NU and Otter Tail Power. An Otter Tail survey indicated that second refrigerators consume approx. 950 kWh. NU metering showed approx 1,565 kWh usage for frost-free refrigerators and 649 kWh usage for manual defrost refrigerators. NU survey showed 43% of the 2nd refrigerators are frost-free, and 57% are manual defrost. Our estimate for PSI assumes that the ratio of frost-free to manual is 1:1 (Johnson 1993, Otter Tail 1993). We calculate savings as follows: (950+((1565+649)/2))/2) = 1,029.
Coincident kW deferred	0.13 per unit	Based on multiplying kWh savings times the ratio of summer peak kW to annual electricity use as determined by a Massachusetts end-use metering study (Applied Energy Group 1989).
Measure life	8 years	BC Hydro staff noted that they use an estimated 10-year measure life for their program based on a preliminary customer survey performed in their pilot program (Scotland 1993). Northeast Utilities estimates an 8-year measure life based on past participant surveys (Viccarro 1993). To be conservative, ACEEE assumes an 8-year measure life.
Replacement rate	n/a	Not applicable here.
Load shape	Residential refrigeration	
PARTICIPATION:		
# eligible in 1991	96,997	(527,160 resid. customers in 1991) * (18.5% of resid. customers have 2 or more refrig.). From PSI 1991 Appliance Saturation Survey and PSI 1992 Forecast Data Book.
Annual participation rate	10,15, 20, 25%	ACEEE estimate. First year is based on NU data, next three years are based on WEPCo experience (The Results Center 1992: WEPCo, Johnson 1993). These estimates are as a percent of customers with second refrigerators.
Annual growth rate	6.3%	ACEEE estimate: 1/19 + (0.99% residential new construction growth rate), where 1/19 is proportion of refrigerators replaced each year assuming an average refrigerator lifetime of 19 years. Growth rate derived from PSI 1992 Forecast Data Book.
Free rider proportion	25%	ACEEE estimate. Based on taking midpoint of estimates made for WEPCo's and BC Hydro's programs, and 2/3 the estimate from a NU survey (The Results Center 1992: BC Hydro, The Results Center 1992: WEPCo; Vicaro 1993).
Rebate/unit	$0 per unit for 1st 2 yrs. $25 per unit thereafter	During the 1st two years, we recommend that PSI not offer a financial incentive. However, after 2 years, we recommend that an incentive of $25 be offered.
Administrative costs	$44 per unit	ACEEE estimate. Based on results from BC Hydro's program (The Results Center 1992: BC Hydro). This includes all costs except costs for hauler/recycler & rebate costs. This is probably conservatively high, since it based on the pilot stage of BC Hydro's program. WEPCo's administrative costs weren't available, but are reportedly very small, and significantly less than their other incentive program administrative costs (The Results Center 1992: WEPCo).
Staff — number	1 FT (plus 1 hauler/region, recycling outfit)	ACEEE estimate. Based on information on WEPCo's program. Costs for the 1 FT employee are included in the administrative costs above.

COMPACT FLUORESCENT COUPON PROGRAM (Revised 6/27/94)

Compact fluorescent lamps (CFLs) are an energy-saving substitute for incandescent lamps. Relative to a standard incandescent lamp, compact fluorescent lamps use 60-75% less energy for equivalent lumen output. For example, 60, 75, and 90 Watt incandescent lamps are commonly replaced with 15, 18, and 23 Watt compact fluorescent lamps respectively. Compact fluorescent lamps come in many sizes, shapes, and colors (e.g. ranging from the "warm" color of standard incandescent lamps to the much "cooler" colors of typical office fluorescent lamps). New products which have recently entered the market will fit in most, but not all incandescent fixtures. Compact fluorescent lamps also last about ten times longer than the typical incandescent lamp. Compact fluorescent lamps are becoming increasingly common in commercial buildings, but due to their high initial cost ($10-25/bulb) they have made limited inroads into the residential marketplace. In fact, most retail stores that sell light bulbs do not stock compact fluorescent lamps and thus even consumers who want to purchase compact fluorescent lamps may not be able to find them.

This program will seek to address these problems by providing cost credits to manufacturers who sell CFLs through local retailers at a discount. This program approach has been used by Southern California Edison (SCE) and other California utilities. In the SCE program, the utility periodically issues a request for proposals to CFL manufacturers asking them to compete against each other for utility incentives paid direct to the manufacturer. Manufacturer bids are ranked using a multi-faceted scoring system and each manufacturer is allocated a portion of SCE's incentive dollars -- the higher each manufacturer's score, the more bulb rebates it is allocated. SCE then pays manufacturers for each CFL shipped to retail stores in the SCE service area. Incentives have averaged $5 per bulb. As a result of the manufacturer-direct incentive, distributor and retailer mark-up amounts are reduced because the price distributors and retailers pay for CFLs is reduced by the incentive paid to the manufacturer. Also, competition between manufacturers prompted many manufacturers to match a portion of the SCE incentive with an additional discount to their normal wholesale price. As a result, CFL costs were reduced substantially, with typical retail CFL prices of only $3-12 per bulb. In the first 12 months of the program, 950,000 lamps were sold. Assuming five bulbs per participant (based on Nadel et al. 1994), this amounts to 5% of SCE's 3.6 million residential customers (SCE 1993; Grimm 1993).

Based on the success of the SCE program, the Consortium for Energy Efficiency is organizing a group of utilities who will offer CFL programs along this line. Details on this program can be found in the program description (CEE 1994a). PSI has been an active participant in these discussions; we recommend that PSI offer this program once it is finalized.

Keys to the success of this type of program are structuring a good request for proposals that elicits good and credible manufacturer responses. Also, the bid program should include a "dynamic incentive share reallocation scheme" in which a series of interim targets for CFL sales are set for each winning manufacturer; if any manufacturer falls short of their target, the unused portion of the manufacturer incentive money is reallocated to winning manufacturers who met their targets. In this manner, manufacturers have the most incentive to make bids they can successfully implement, and to pay careful attention to the successful implementation of their bids. In addition, PSI should not rely fully on manufacturers to enlist local dealers to participate in the program and to encourage residential customers to purchase CFLs. Instead, PSI should supplement manufacturer efforts by working on its own to enlist dealer support for and participation in the program and to encourage customers to purchase CFLs. Among the steps PSI should consider are personal contacts with store managers, meetings with corporate management of chains, providing in-store education and marketing materials, and bill inserts and other direct-mail informational materials.

Given the fact that IPALCo and many municipal utility territories are totally surrounded by PSI's territory, the costs of rebates to non-PSI customers could be quite high. To address this problem, we recommend that PSI encourage other utilities to participate in the program and/or encourage the State of Indiana to sponsor the program statewide, with support from PSI and other utilities.

The ultimate participation rate in this type of program can be estimated from the results of other utility CFL programs. The Burlington Electric Department has achieved a 42% participation rate with its Smartlight CFL program in which customers lease CFLs from the utility. Wisconsin Public Service has achieved a 28% participation rate in only two and a quarter years with a mail order based program (Nadel et al. 1994). Based on these successes, we estimate an ultimate participation rate of nearly 50% after seven years of program operations.

A coupon program promotes sales of bulbs but does not ensure that bulbs will be installed and used. Impact evaluations on CFL programs have been conducted by CMP (Michelson and Lonergan 1992), NEES (Granda 1992), and PG&E (1992). Based on these studies we estimate the average compact fluorescent bulb will save about 52 kWh/year. This figure incorporates such factors as bulbs that are not used, bulbs that are used for only limited hours each day, free riders, and watts saved/bulb.

Based on our review of compact fluorescent programs, several other program features are recommended as follows:

* Structure the RFP to encourage manufacturers to make a wide range of CFLs available. No single product will meet the needs of all consumers and all applications -- the wider the array of products, the more consumers and applications that can be satisfied.

* Consider requiring product quality testing for products to be tested. While many compact fluorescent bulbs are high quality products, some lower quality equipment is also on the market. Also, even some of the better quality products do not put out as many lumens of light as manufacturers claim. A product quality testing program, can help avoid these problems. For example, NEES has conducted product tests for their 1993 program (Granda 1992). One option is for PSI to work with other utilities on a joint product testing program.

* Since most consumers are not familiar with compact fluorescent products, educational materials should be provided to consumers. Among the points to cover are the different sizes and colors of bulbs available (some companies have

even provided full-size paper cutouts of different bulbs so consumers can assess their fixtures for proper fit), how to ensure that adequate light levels are provided, and how to fit bulbs into fixtures (e.g. selection of properly shaped bulbs as well as use of socket and harp extenders).

COMPACT FLUORESCENT COUPON PROGRAM: revised 5/31/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2000	
Program type	Coupons distributed thru the mail and thru retail stores allow consumers to purchase compact fluorescent bulbs at a discount.	
TECHNOLOGY:		
Technology description	Compact fluorescent lamps use 60-75% less energy than incandescent bulbs with similar light output.	
Incremental equip. cost	$50 per participant	4 bulbs/paricipant @ $12.50 each. Based on SCE program which provides manufacturer cost credits (Grimm 1993).
Incremental install. cost	$0	Homeowners install lamps.
Incremental annual O&M	($4) per participant	4 lamps/participant * 1-2 incandescent lamps are displaced each year/socket @ an avg. cost of ~$0.75/lamp.
Annual kWh savings	218 per participant	4 lamps/participant * 59 W saved/lamp (from PG&E 1992) * 85% installed and not removed (based on PG&E 1992, NEES 1993) * 1087 hours/yr (based on NEES end-use metering)
Peak kW savings	0.033 per participant	Average savings during the day in the summer -- based on survey reported in Goett et al. 1992.
Measure life	8 years	9000 hours avg lamp life / 1087 operating hrs/yr. 9000 is an ACEEE estimate and is based on the low end of manufacturer estimates of 9-10,000 hour lives. 1087 is from NEES 1993.
Replacement rate	50%	ACEEE estimate.
Load shape	Residential lighting	
PARTICIPATION:		
# eligible in 1992	527,160	Number of residential customers from PSI Energy Forecast Databook 1992.
Annual growth rate	0.99%	PSI Forecast Databook 1992.
Annual participation rate	6,12,17,22,27,32, 37,42,47%	6% is based on PEPCo's 1st yr results (Simpson 1993), 12% is based on MG&E's results for 1st yr of coupon within their small territory (Nadel et al. 1993). Latter year figures are ACEEE estimates.
Free rider proportion	5%	From NEES 1993.
UTILITY COSTS:		
Rebate costs	$20 per participant	4 bulbs/participant * $5/bulb. Based on SCE program which provides manufacturer cost credits.
Admininstrative costs	$2.10 per participant	PSI and ACEEE estimate based roughly on vendor price quotes given to PSI.
Staff --- number	2 FT	PEPCo has 2 FT (Simpson 1992). Staff costs included under administrative costs. Does not include coupon processing which is typically handled by a contractor and is included in administrative costs.

RESIDENTIAL HEAT PUMP WATER HEATER PROGRAM (Revised 6/27/94)

The heat pump water heater (HPWH) uses a heat pump to supply heat, rather than an electric resistance coil. Through the use of a vapor compression cycle, the heat pump removes low-grade energy from a heat source (usually ambient air) and uses it to heat potable water. Residential HPWHs typically provide 50% energy savings over conventional electric heaters. Until recently, HPWH cost roughly three to four times as much as conventional heaters. However, in late 1993 EPRI and E-Tech announced development of a new HPWH that costs hundreds of dollars less than previously available models (EPRI 1993).

The Consortium for Energy Efficiency is now developing two model programs for promoting heat pump water heaters -- one to add HPWH to utility new construction programs, and another to promote HPWH in the water heater replacement market (CEE 1994b). We recommend that PSI offer both programs beginning with the new construction program in 1995 and following with the equipment replacement program one to two years later.

For the new construction program, PSI should make the HPWH an optional feature of Smart Saver homes. In the initial years builders should be offered incentives that cover the full incremental cost of a HPWH installation, including time to learn about proper HPWH installation. Over time, as builders become more familiar and comfortable with the technology, incentives can be reduced. In the first few years, PSI should actively reach out to builders who are willing to innovate, and get them to try HPWH. PSI should provide technical assistance to assist builders with these installations. PSI should also monitor these installations and provide publicity on homes built with this new enhanced feature.

For the equipment replacement program, PSI should encourage customers whose existing electric water heaters fail, to purchase a new HPWH. We recommend that PSI advertise to these households, perhaps through bill inserts and directed mailings, indicating that when the customer is ready to replace their water heater with a new heater, they should contact the utility, who will in turn install a heat pump water heater. As part of the installation package, PSI should offer to finance the HPWH, with monthly loan payments included on the customer's electric bill. Payments should be structured so that monthly payments are less than the monthly savings attributable to the HPWH. Units should be installed by local contractors selected by PSI through a RFP process. We recommend that PSI buy HPWHs in quantity, perhaps in coordination with other utilities involved in the CEE program. As quantities increase over time, prices should come down; in fact, the largest HPWH manufacturer is on public record that as soon as production reaches 10,000 units annually, the price will be reduced by one-third (EPRI 1993). For the analysis of the equipment replacement program, we assume PSI provides financing for the full HPWH cost (including the cost of a conventional electric resistance water heater) with a ten year loan at a zero percent interest rate.

The target market for the program is single- and multi-family dwellings with electric hot water heating and three or more household members (smaller households do not use enough hot water to easily justify the extra expense of a heat pump water heater). Based on this market, estimated annual savings per installed HPWH are approximately 2,400 kWh. Participation rates for the first two years -- 1% and 4% -- are taken from one existing pilot HPWH program, and we make estimates for participation rates in following years since no data is available (Anker 1993). Due to lack of consumer familiarity with HPWHs, it will take several years for participation rates to gather momentum. Hence, we estimate that by the fifth year of the program, a 13% participation rate will be achieved.

HEAT PUMP WATER HEATER PROGRAM: revised 5/31/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End years	1997	For new construction
	2010	For replacement water heaters
TECHNOLOGY:		
Program type	Direct installation program for replacement water heaters; rebates for new contruction.	
Technology description	The heat pump water heater is a water heater which uses a heat pump to supply heat and not an electric resistance coil. Through the use of a vapor compression cycle, the heat pump removes low-grade energy from a heat source (usually ambient air) and uses it to heat potable water.	
Incremental equip. cost	$650 per unit for 1st 2 yrs. $450 per unit thereafter	$600 is current price of E-Tech unit; they have stated price will drop to $400 once production reaches 10,000 units/year. To these costs we add $50 for accessories.
Incremental install. cost	$200 per unit for 1st 2 yrs. $100 per unit thereafter	$100 cost from DOE 1993 which assumes experienced installers. We assume twice as much in early years.
Incremental annual O&M	$18 per unit	Units require annual oiling and occasional vacuuming (Mittelstaedt 1993). These are no-cost measures which can be done by the homeowner. Most likely problems w/HPWHs are freezing-up of the compressor, circulator pumps, and/or air circulating fans (Johnson 1993). Since HPWHs are more complex than standard water heaters, an extra service estimated at $100 per unit halfway through the water heater life is likely (U.S. DOE 1990). This is modeled as an annual $8/yr maintenance cost. In addition, when the water storage tank fails after approximately 10 years, a $250 charge for a replacement tank is incurred (U.S. DOE 1993), half of which is chargeable to this program (because) the replacement tank will last 10 years but only half of this period falls within the measure life for the program). The $125 replacement tank is modeled as a $10 annual maintenance charge.
Annual kWh savings/unit	2,400 per unit	Assume 50% savings (BC Hydro 1988; Mittelstaedt 1993; Johnson 1993). Based on PSI analysis of average electricity consumption for 3+ person households with electric water heaters.
Coincident kW deferred	0.21 per unit	Based on multiplying kWh savings times the ratio of summer peak kW to annual electricity use as determined by a Massachusetts end-use metering study (Applied Energy Group 1989).
Measure life	15 years	This life is for the heat pump unit. The tank typically has a 10 year life and thus the maintenance costs include a replacement tank in year 10.
Replacement rate	50% after program ends	ACEEE estimate.
Load shape	Residential water heating	
PARTICIPATION:		
# eligible in 1991	969 for new construction 9,793 for equipment replacement	(((527,160 resid. customers in 1991 * 48% resid. customers w/electric water heat) / 10 year avg. water heater life) + (527,160 customers * 0.99% new construction rate*48% customers have electric water heat))*38.7% residential customers have 3 or more residents). PSI 1990 Appliance Saturation Survey, PSI 1992 Energy Forecast Data Book). ACEEE's preliminary cost-effectiveness screening indicates that the program is cost-effective for households with three or more people. Includes both single and mutifamily dwellings.
Annual growth rate	-1%	PSI estimate.
Annual participation rate	1,4,7,10,13, 17,22,27,32,37, 40% ->end	ACEEE and PSI estimate. Participation in first two years is similar to participation in 1st 2 years of pilot BPA program which combined high promotion and high rebates (Major and Cody 1987). Participation beyond the 1st few years has not been demonstrated.
Free rider proportion	0%	Due to the high cost of the technology without an incentive, free riders are assumed to be zero.
UTILITY COSTS:		
Rebate/unit - new construction	$850 per unit in 1st 2 yrs. $550 per unit thereafter	100% of incremental equipment and installation costs. After third year of the program, PSI should be able to incrementally reduce the incentive by about by about $25 per year.
Incentive/unit - replacement	$510 per unit in 1st 2 yrs. $370 per unit thereafter	Assumes replacement water heaters financed with a 10 year zero-interest loan. $510 and $370 are the present value of the interest rate subsidy assuming PSI's cost of capital is 10%.
Administrative costs	$160 per unit for new construction $220 per unit for equipme replacement	ACEEE estimate, based on staff costs plus an additional 50% (new construction) or 100% (equipment replacement) for marketing and other non-staff administrative costs. These are preliminary estimates and need further research. The equipment replacement figure includes some allowance for loan defaults.
Staff --- number	4 FT	ACEEE estimate. Includes two in central office, and 1/2 person in each of the 4 regions. In early years, staff emphasizes marketing. In later years, more effort is devoted to handling rebate and financing requests.

CLOTHES WASHER REBATE PROGRAM (Revised 6/27/94)

Research by the U.S. Department of Energy (U.S. DOE 1990), National Institute for Standards and Testing (Lovett 1981), American Council for an Energy-Efficient Economy (Nadel et al. 1993), Washington State Energy Office (Pope and Slavin 1992), and others have found that large energy savings can be achieved by improving the energy performance of clothes washers. At least three types of energy savings are possible. First, use of a horizontal-axis clothes washer can reduce hot water use by 50% or more. Hot water accounts for the vast majority of clothes washer energy use. Second, use of higher spin speeds can remove more water from clothes, reducing dryer energy use by 25-45%. Third, automatic controls and "bubble-action" can reduce water and energy use by 20-30%.

More than 95% of clothes washers in the U.S. are top-loading units that spin on a vertical axis. To wash clothes, the wash tub must be filled so that all clothes are covered. In Europe the dominant type of washer is the horizontal-axis machine. Horizontal-axis machines reduce hot water use because the washtub is only partially filled. With each rotation of the tub, clothes are dipped in the water at the bottom of the half-filled tub. Many horizontal-axis units are front-loading machines, but some units sold in Europe are top-loading; consisting of a conventional top loading door and a second door in the rotating metal drum. In addition to saving energy, horizontal-axis machines offer several other potential advantages. First, water use is reduced by approximately 40%, a major plus in areas with limited water supplies. Second, by eliminating the agitator, these units may create less wear and tear on clothes (however, some manufacturers dispute these claims). Third, they are not as prone to load imbalance problems that can plague some vertical axis machines (Lebot et al. 1990). Fourth, they do a better job cleaning clothes than a vertical axis unit. One recent study conducted by Ontario Hydro compared the washing performance of a popular North American vertical axis machine to a popular European horizontal axis machine. The washing performance was consistently and significantly better for the European model (Edwards and Lithgow 1991). Presently, one major U.S. manufacturer produces horizontal-axis washers, and all are front-loading units. This manufacturer has indicated it is developing an entirely redesigned model that may be introduced to the U.S. market as soon as late 1994 (HFD 1993). A small U.S. firm has developed an American-sized top-loading horizontal-axis unit and plans to bring it to market in 1994 (DSTR 1994). In addition, EPRI has indicated that it is working with a major American manufacturer to develop a horizontal-axis washer (Kesselring 1993). Other U.S. manufacturers are reportedly also conducting research on horizontal-axis models.

The spin cycle in standard American clothes washers is at a speed of approximately 550 rpm and this cycle reduces the moisture content of the load by 25-45%, depending on the fabric. A study by the National Institute of Science and Technology -- NIST -- found that increasing spin speed to 850 rpm can reduce dryer energy use by 25-40%, also depending on the fabric (Lovett 1981). High-spin-speed units are common in Europe. Several of the horizontal-axis washers discussed above that are now in development will include higher spin speeds.

The volume of water needed to wash and rinse clothes varies depending on the size of the load, the type of clothes, and how dirty the clothes are. In a typical washer, water quantities, temperature, and fabric type are selected by the user from a limited number of possible settings. Substantial energy and water could be saved if this choice was left to an automatic control system

which uses sensors to assess the amount of clothes in a load. Laboratory tests of automatic fill systems in the U.S. and Europe show 20% reductions in motor electricity and hot water use. Adding wash-water turbidity sensors may increase the savings substantially (Shepard et al. 1990). Automatic control systems are being examined by several American manufacturers. Energy and water savings in vertical-axis washers can possibly be increased even further by replacing the agitator with nozzles that generate horizontal and vertical bubble swirls within the wash water. A machine of this type is now sold in Japan and is claimed to reduce water usage by 30% per wash cycle while getting clothes cleaner than a conventional washer (Levene 1993).
If all residential washing machines in the U.S. were replaced with high-spin-speed horizontal-axis units (or advanced vertical-axis units with similar performance), annual nationwide energy savings would amount to approximately 0.51 Quadrillion Btu of energy, which represents about 2.8% of residential sector energy use (Nadel 1993). Given these large potential savings, a nationwide consortium of utilities -- the Consortium for Energy Efficiency -- has developed a multi-utility coordinated incentive program for high efficiency clothes washers. PSI should join this consortium.

Under this program, utilities have developed recommended eligibility levels for clothes washer incentives, but individual utilities will set incentive amounts and other program parameters such as who receives the rebate (consumers, dealers or manufacturers). A central administrative mechanism is being put in place so that manufacturers can obtain up-to-date lists of participating utilities and utilities can obtain up-to-date lists of eligible models. Under this program, equipment eligibility in terms of three parameters: energy factor, remaining moisture content, and water use factor . For the program, threshold EF and WF values are established that horizontal-axis washers can meet but presently available vertical-axis machines cannot (although new technologies could allow very efficient vertical-axis machines to also qualify for incentives). Threshold RMC values are set that are significantly below those of present washers. The coordinated utility program began nominally in 1994, but full-scale implementation is not planned until 1995 when more horizontal-axis washers are on the market. The program is scheduled to run through 1998. In 1999 new federal efficiency standards will be set. In fact, this program could have a significant impact on the standard level that is set.

The data analysis for this program assumes that PSI runs the program as a consumer rebate program. Incentives should cover the majority of the incremental costs of the more efficient equipment. One level of incentive should be paid to the approximately 48% of PSI customers with both electric water heaters and electric dryers (because most of the energy savings are due to reduced hot water use and to a reduced need for moisture removal in the clothes dryer) and a second, lower incentive level set for the 23% of PSI customers with only electric dryers. Local gas and water utilities should also be approached to see if they are willing to pay incentives for consumers with gas water heaters or dryers. If local gas and water utilities do not participate, an alternative approach would be for PSI to pay rebates to all customers, regardless of the type of water heater or dryer they had, but to reduce incentives so that the program is cost-effective on the basis of electricity savings alone. This approach should be used only if a good mechanism cannot be found to identify electric water heat and dryer customers. Regardless of how incentives are structured, dealers should be extensively involved in the planning and marketing of the program. In addition, a consumer education program should be planned because most consumers are unaware of the many benefits of high efficiency clothes washers.

CLOTHES WASHER REBATES - revised 5/31/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	1998	Program ends when 1999 Federal efficiency standards take effect. However, the program's impact on the 1999 Federal standards will result in additional benefits accruing in 1999 and beyond.
Program type	Consumer rebate program for worn-out equipment that is being replaced.	
TECHNOLOGY:		
Technology description	Improved efficiency clothes washers including horizontal axis washers (which cut hot water use by more than 50%), washers with improved controls, and/or higher spin speeds (which can reduce dryer energy use by up to 50%).	
Incremental equip. cost	$225 for customers w/ elec. dryers & water heat $90 for customers with electric dryers & non-elec. water heat	1st figure assumes horizontal axis washer and high spin speed. 2nd figure assumes only high spin speed. Figures based on Nadel et al. 1993.
Incremental install. cost	$0 per participant	Same as standard washers.
Incremental annual O&M	negative	Reductions in water bills of about $10 (Lebot et al. 1990). For customers with gas water heat, will save approximately 21 therms due to reduction in hot water used for clothes washing (Nadel et al. 1993).
Annual kWh savings	725 for customers w/ elec. dryers & water heat 313 for customers with electric dryers & non-elec. water heat	Savings in hot water use of 412 kWh due to horizontal axis washer. Savings in dryer use of 313 kWh due to high spin speed (Nadel et al. 1993).
Peak kW savings	0.097 for customers w/ elec. dryers & water heat 0.042 for customers with electric dryers & non-elec. water heat	Based on multiplying kWh savings times the ratio of summer peak demand to annual kWh as determined for clothes dryers by a Massachusetts end-use metering study (Applied Energy Group 1989).
Measure life	14 years	From U.S. DOE 1990.
Replacement rate	100%	Due to effect of future efficiency standards, when rebated units are replaced, the efficiency of the new units will at least equal the efficiency of the worn-out units.
Load shape	Residential dryers	To our knowledge, clothes washer load shapes are not available. Clothes dryer load shapes will provide a reasonable approximation.

PARTICIPATION:

# eligible in 1992	17,286 washers w/ elec. water heaters & elec. dryers 8,283 additional washers w/ electric dryers but non-elec. water heaters	[(527,160 residential customers * 84% w/ washers / 14 year average washer life) + (527,160 existing customers * 0.99 annual growth rate * 84% w/ washers) * 48% w/ elec. water heaters]. [(527,160 residential customers * 84% w/ washers / 14 year average washer life) + (527,160 existing customers * 0.99 annual growth rate * 84% w/ washers) * (71% w/ elec. dryers - 48% w/ elec. water heaters)]. Implicit in these calculations is the assumption that customers with electric water heaters will not have gas dryers. Data on existing customers and growth rate from PSI Forecast Databook 1992. Data on appliance saturations from PSI 1990 Customer Appliance Saturation Survey.
Annual growth rate	0.99%	From PSI Forecast Databook 1992.
Annual participation rate	1,4,10,20,30%	ACEEE "guesstimate". No real world experience is available.
Free rider proportion	25% in 1st yr sloping down to 8% in 5th yr.	ACEEE estimate based on approximate current market share of horizontal axis washers (2%). Incorporated into these figures is a 3% allowance for participation by customers from adjoining service areas (ACEEE estimate).

UTILITY COSTS:

Rebate costs	\$150 for customers w/ elec. water heat & dryers \$75 for customers w/ elec. dryers but non-elec. water heat	ACEEE estimate -- covers approximately 2/3's of incremental cost.
Admininstrative costs	\$40 per participant	Based on staff costs plus a nearly equivalent amount for marketing and other administrative costs. This is approximately 50% more than the administrative costs in PG&E's appliance rebate programs (Mah and Casentini 1993).
Staff --- number	2	ACEEE estimate -- includes central office and parttime staff in regional offices.

FARM EFFICIENCY PROGRAM (Revised 10/7/93)

There are approximately 7,500 agricultural operations in PSI's service territory. In the state of Indiana, feed crops such as corn and hay account for 27% of the state's farm income, hog and cattle account for 23%, soybeans account for 20%, and poultry and eggs account for 12% of the farm income. During the 1980s, the number of farms in Indiana decreased by roughly 10%, while the size of the farms increased by approximately the same amount (Office of the Commissioner of Agriculture 1992).

PSI is in the process of distributing a farm customer end-use saturation survey, and results are not available yet. This survey should provide important information on PSI's farm customers and is likely to result in some modifications to the preliminary program design discussed here.

Based on existing information from PSI and other utilities already offering agricultural DSM programs, we recommend that PSI initially offer a package farm-efficiency program targeting "three-phase" farms which includes farm energy analyses, energy-saving rebates, and stray voltage analyses upon request. We estimate that there are approximately 1,000 PSI customers having the 3-phase farm designation, based on data in PSI 1990 Load Characteristics.

Stray voltage is a low-level voltage that may be present from metal objects on the farm, such as water cups or feeder trays. Electrical codes require bonding of these objects to the electrical system for safety reasons. This voltage can cause electrical currents to flow through livestock when they are physically in contact with these objects and can lead to production problems, as has occurred on some Wisconsin dairy farms (Spang 1993, Wiedemeier 1993). Upgrading existing wiring and/or installing electronic grounding systems (EGS) are two ways to help eliminate stray voltage problems (WEPCo 1992). Most likely, PSI farm customers participating in this program will not have significant stray voltage problems, since all participants will be three-phase, and stray voltage is largely a one-phase farm problem (Wiedemeier 1993). If such is the case, PSI may decide to phase-out the stray voltage analyses under this program.

In the mid-1980s, the Office of the Commissioner of Agriculture in Indiana performed a series of studies of energy use on Indiana farms. Otto Doring, the manager of the studies and an agricultural engineer at Purdue University, is awaiting a call from PSI requesting the results of these studies (317-494-4226). The motors which run the fans in grain-drying facilities and livestock confinement building heating and ventilation equipment appear to consume the bulk of electricity used in Indiana's farm operations. New motors will be covered separately in PSI's motors program, but improvements to motor <u>systems</u> will be covered through this program.

Some of the measures for which prescriptive rebates may prove useful are: (1) energy-efficient exhaust and circulator fans, variable speed fans, and ventilation maintenance measures in livestock confinement housing (such as cleaning of air filters and ventilation fan louvers); (2) energy-free and energy-efficient stock waterers; (3) low-wattage brooder lamps in poultry and hog confinement housing; and (4) energy-efficient indoor and outdoor lighting, such as compact fluorescent (CFs) and high-pressure sodium (HPS) lamps. In addition, custom rebates should be available to agricultural customers to encourage farmers to submit their own ideas on energy-efficient projects.

A few utilities offering agricultural conservation programs have found it useful to leave most of the marketing of the program up to the farm equipment suppliers (Spang 1993, Turcotte 1993). These suppliers generally know the farmer's needs and behavior patterns better than utilities do. PSI may find it useful to offer a dealer incentive as well as a customer incentive.

Lacking further information, estimates of the overall potential energy savings per participant from farm efficiency program are based on results from two Wisconsin utilities, adjusting down 50% to account for the fact that there are greater opportunities for improved efficiency on Wisconsin dairy farms than on Indiana's crop and livestock farms (Doring 1993, Spang 1993). The PSI survey of farm customers (discussed above) should provide information that will allow these estimates to be refined. Based on the Wisconsin data, we estimate annual savings of 4,140 kWh per participant, which is roughly 15% of electricity use on the average 3-phase farm in PSI's service territory. This appears reasonable based on experience at two Wisconsin utilities and Otto Doring's experience in Indiana. The two Wisconsin utilities noted that savings on small dairy farms (consuming roughly 30,000 kWh/year) are typically 25-30%, savings on poultry farms are typically 15%, and savings on swine farms are typically 10% (Spang 1993, Wiedemeier 1993). Otto Doring estimated that crop and livestock farmers can cost-effectively save 20% of their electricity use and crop-only farmers approximately 5-10%; he noted that more farmers within PSI's territory will be crop-only farmers rather than crop and livestock farmers (Doring 1993).

We suggest that PSI offer free energy audits to customers, and that incentives for recommended measures cover 50% of the measure and installation costs. Based on results from two Wisconsin utilities, we estimate that such an approach will lead to an average rebate of approximately $450 per participant, additional audit costs of roughly $100 per participant, and administrative costs of $240 per participant (Spang 1993, Wiedemeier 1993).

As understanding of PSI's farm customers' needs increases, additional program options should be considered, particularly for the large number of farms with single-phase service.

FARM EFFICIENCY PROGRAM: revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year End year	1995 2000	ACEEE estimate.
Program type	Package program: energy audits, education, custom and prescriptive rebates.	
TECHNOLOGY: Technology description	Energy audits of farm operations. Prescriptive rebates for grain-drying measures, livestock confinement housing and livestock feeding measures, and lighting measures. Custom rebates. Stray voltage education and assistance.	
Incremental equip. cost	$570 per participant	We assume equip. & installation costs will be 1/2 of the equipment & installation costs of Wisconsin Electric's (WEPCo) and Wisconsin Public Service's programs plus lighting costs (Wisconsin data did not include lighting). The large dairy farms targeted in these programs have higher costs and savings per participant (roughly estimated at twice that at smaller non-dairy farms). The average unadjusted Wisconsin costs are $600/participant. Lighting costs per participant are calculated as follows: 2 HPS bulbs @ $75 ea. & 8 CF bulbs @ $15 ea. (600 * 1/2) + (2 * 75) + (8*15) = $670 (Spang 1993, Wiedemeier 1993).
Incremental install. cost	$325 per participant	ACEEE estimate, based on 1/2 the average WEPCo installation costs (Spang 1993). Niagara Mohawk noted that incremental installation costs are close to $0 for most ventilation and lighting measures under their program (Sweetland 1993).
Incremental annual O&M	$0	Incremental maintenance costs roughly same as that of conventional equipment.
Annual kWh savings	4,140 per participant	Based on adjusted savings/participant data from WEPCo and Wisconsin Power & Light, adding in lamp savings. Wisconsin savings are 3,350 kWh/yr on average. We conservatively estimate PSI can achieve 1/2 these savings due to the large number of heat recovery & milk precooling measures performed in the dairy industry, the sum of which roughly save twice that of other measures (Spang 1993, Wiedemeier 1993, WEPCo 1992). CF savings: switch 75 watt bulb with 15 watt CF bulb (hrs use/year=2,000); savings = ((75-15)*2000) = 120 kWh/lamp. HPS savings based on assumption of replacing 300 watts of incandescent bulbs w/50 W bulb (hrs use/yr=3,000); savings=((250-50)*3000)=750 kWh/lamp. Overall savings are: ((750*2)+(120*8)+(3,350*1/2))=4,142 kWh/participant per yr.
Coincident kW deferred	0.00 per participant	(Annual kWh savings) * (peak kW/annual kWh consumed) for 3-phase farms, using the weekday 4 pm September 1990 peak (1990 PSI Load Characteristics, Section 6).
Measure life	10 years	ACEEE estimate. Typical lifetime for CF (5 years), HPS (roughly 15 years), livestock waterers (15 years), and ventilation fan (10 years). (Nadel and Tress 1990, WEPCo 1992.)
Replacement rate	60%	Based on WEPCo data (Spang 1993).
Load shape	Farm (LR data)	
PARTICIPATION: # eligible in 1991	700	Number of large farms -- estimate by Steve Hoeppner, PSI based on preliminary results from survey of farm customers.
Annual participation rate	10, 25,45,60,75%	ACEEE estimate, partly based on WEPCo's and Wisconsin Public Service's experience that a measure's saturation is typically reached at 85% participation (Spang 1993, Wiedemeier 1993).
Annual growth rate	0.99%	PSI estimate.
Free rider proportion	20%	ACEEE estimate. Based on WEPCo and Wisc. P&L program experience with non-lighting measures (25% FR on average), and 5% FR assumption for lighting measures (Carls 1993, Spang 1993).
UTILITY COSTS: Rebate/unit	$448 per participant	50% of incremental equipment and installation cost. Niagara Mohawk, and most of the Wisconsin utilities, pay for 100% of the incremental equipment and installation costs.
Audit costs	$100 per participant	ACEEE estimate. (4 hours) * (1 person) * ($25/hour).
Administrative costs	$245 per participant	Based on WEPCo's and Wisconsin Public Service Corporation's program (includes stray voltage and farm safety education, publications, mailings, & other administrative costs). Staffing costs, as well as costs for hiring outside service providers, are included here. Audit costs are not included, since this is outlined above.
Staff requirements	1/2 FT + contractor	ACEEE estimate. Based on staffing at WEPCo, and assumption that outside service providers will be hired to conduct energy audits. Equipment suppliers can help in the marketing of the program. Included as part of administrative costs listed above.

ENHANCED SMART SAVER RESIDENTIAL NEW CONSTRUCTION PROGRAM (revised 6/27/94)

The Smart Saver program is an established new construction program that provides technical assistance, incentives, comfort guarantees and discounted electric rates to builders and buyers of efficient homes. Under the program homes must exceed the state building code in several respects including higher attic insulation, reduced infiltration, and increased heat pump efficiency. The current program is serving an estimated 42% of new construction in the service area including over 90% of electrically -heated homes. A small part of the program also promotes ground source heat pumps, although these presently represent only a small proportion of program participants (PSI 1992). In 1995, PSI will improve upon the existing program by adding low-e windows as a mandatory part of the program (all Smart Saver homes must have low-e windows) and by increasing the minimum SEER for the program from 11 to 12. Both off these changes had previously been recommended by ACEEE.

The Enhanced Smart Saver program will build upon PSI's 1995 program by adding one additional measure -- duct sealing. Recent research has found that leaky ducts can account for approximately 30% of energy used for space conditioning and that this energy waste can be reduced by 50% or more by properly sealing ducts (Proctor 1991). Under the present program PSI addresses this problem by encouraging builders to locate ducts within the conditioned space (when ducts are in the conditioned space, any conditioned air that ducts out is helping to satisfy the conditioning needs of the space). However, many ducts are not located in the living space, and even when ducts are located in the living space, duct leaks can result in air distribution problems which can increase energy use. Builders should be required to seal ducts with mastic -- a low cost measure that is a much more effective duct sealant than duct tape. We estimate this measure will reduce space conditioning energy use by 15% based on modeling work done as part of an analysis of building code options for the State of Illinois (Smith and Nadel 1993).

When this change is made to the Smart Saver Program, a builder training program will be needed to familiarize builders with duct sealing practices. This change will increase the energy saved in each Smart Saver home. This measure will sometimes also increase occupant comfort. Given the attractiveness of PSI's Smart Saver rate, this change can probably be introduced without increasing incentive payments. However, PSI may want to provide some additional incentive in order to encourage builders to try the new standards. We recommend an incentive of $185 in the first two years (100% of the incremental costs discussed above), $140 in the next two years (75% of incremental cost), and $100 thereafter (about 50% of incremental costs). Once builders learn how modest the changes are, they are likely to stick with the program in the future, even with lower incentives.

For purposes of modeling this enhanced program, we only include costs and savings relative to the existing program, under the assumption that costs and savings for the existing program are fully reflected in PSI's plans.

In addition to these changes, we also recommend that PSI consider making ground source heat pumps a mandatory part of the Smart Saver program as of the turn-of-the-century. According to a recent study by the U.S. Environmental Protection Agency (EPA 1993), presently marketed ground-source heat pumps can reduce energy use in Chicago and Atlanta (the two nearest cities to Indiana analyzed by EPA) by approximately 30% relative to a standard air-source heat pump. Advanced products now under development can raise these savings to approximately 50%. However, ground source heat pumps presently carry a price premium of approximately $2500 for a typical home, including the heat pump and the ground loop. Efforts are underway at PSI and elsewhere to find ways to reduce these costs. EPA estimates that products now being developed will reduce these costs to approximately $2200 for an advanced system with better performance (e.g. 50% savings) than today's systems. We would expect that by the turn-of-the-century these efforts will be successful and ground source heat pumps could be required for electrically-heated Smart Saver homes (for gas-heated homes, a condensing furnace combined with a high-efficiency air-source air conditioner will roughly achieve similar performance according to the EPA study). This additional program enhancement is not included in our analysis as costs and savings are too speculative at this time.

ENHANCED SMART SAVER (RESIDENTIAL NEW CONSTRUCTION) - revised 5/31/94

VARIABLE	ASSUMPTION		NOTES
Start year	1995		
End year	1999		Assume building code upgraded to smart saver level by 2000.
Program type	Discount electric rate for homes that meet expanded Smart Saver standards. Also training, technical assistance, and financial incentives.		
TECHNOLOGY:			
Technology description	Duct sealing added to planned 1995 version of Smart Saver program.		
Incremental equip. cost	$185	per participant	From Smith & Nadel 1993.
Incremental install. cost	$0	per participant	Labor costs for duct sealing included in row above.
Incremental annual O&M	$0	per participant	Same as standard measures.
Annual kWh savings	1,146	per participant in single-family homes	15% of space conditioning energy use -- from Smith and Nadel 1993. Baseline energy use of 1995 smart saver homes from PSI, Smart $aver Impacts, 10/22/93.
	523	per participant in multi-family homes	
Peak kW savings	0.23	per participant in single-family homes	Based on 15% of difference in coincident peak load between May and August for PSI's RO60 customer class. Peak demand data from PSI Load Characteristics 1990.
	0.10	per participant in multi-family homes	
Measure life	20	years	ACEEE estimate.
Replacement rate	100%		Due to effect of future building codes and equipment efficiency standards, when rebated units are replaced, the efficiency of the new units will at least equal the efficiency of the worn-out units.
Load shape	Residential heat pumps		
PARTICIPATION:			
# eligible in 1992	2,040		Average number of new electric heating customers projected over 1992-2005 period (from PSI 1992 Forecast Data Book).
Annual growth rate	0.99%		From PSI Forecast Databook 1992.
Annual participation rate	50,75,90 = > end		ACEEE estimate. Current Smart Saver program is achieving a 90% participation rate among electric heat customers.
Free rider proportion	5%		ACEEE estimate.
UTILITY COSTS:			
Rebate costs	$185	per participant in 1st two years	100% of incremental cost. Assume cost of rate discount already reflected in analysis of current program.
	$140	per participant in next two years	~75% of incremental cost.
	$100	per participant thereafter	~50% of incremental cost.
Admininstrative costs	$0	per participant	These program changes should not increase administrative costs above present levels for the program.
Staff --- number	0		These program changes should not increase staffing above present levels for the program.

COMMERCIAL EQUIPMENT REPLACEMENT PROGRAM (Revised 6/27/94)

A major opportunity to save energy at moderate cost is to encourage building operators to purchase efficient equipment when existing equipment needs replacement. When equipment needs replacement, the cost of the efficiency improvement is only the cost difference between standard and high efficiency equipment. If efficiency measures are installed on a retrofit basis, the cost of the efficiency improvement is the full cost of the high efficiency equipment. This full cost can be many times higher than the incremental cost relative to standard equipment. Thus, if efficient equipment is not installed when equipment is being replaced, it may be prohibitively expensive to upgrade the equipment later on a retrofit basis. For this reason, equipment replacement measures are often referred to as "lost opportunity" measures -- if high efficiency equipment is not installed during a narrow window of opportunity, the opportunity for efficiency upgrades will be lost.

To address these situations, PSI should offer an equipment replacement program that provides incentives to equipment purchasers based on the price difference between standard and high efficiency equipment. The program should be promoted primarily through equipment dealers and contractors who sell replacement equipment, although additional promotion to customers will also be useful including printed materials as well as personal contacts between customers and PSI field representatives. Few utilities have tried to specifically target equipment replacement situations but a few examples exist. For example, Wisconsin Electric has targeted some of the marketing of its conventional rebate program towards the replacement market. Likewise, Green Mountain Power has recently begun an equipment replacement program which is still in the start-up stage.

As a start, we recommend that a PSI program include fluorescent ballasts, motors, packaged HVAC equipment, chillers, and refrigeration equipment (e.g. multideck systems used in supermarkets). For each type of equipment, detailed planning work will be needed to select eligibility and incentive levels for each size and type of equipment. As a first step in this process the attached data sheet provides information on a single average sized unit for each product category. Data is provided both for equipment that exceeds current federal standards and national building codes, and for equipment that is likely to exceed new standards and codes that will take effect in the 1996-98 period (e.g. federal efficiency standards on ballasts, motors and packaged HVAC equipment and a new ASHRAE building standard on chillers and other equipment). The data on current equipment are fairly well determined. The data on equipment for the late 1990's are very preliminary and likely to change as further data become available.

PSI has already begun work to develop a program of this type. Motor incentives are presently included as part of PSI's industrial retrofit program, although incentives, and hence participation rates are likely to be lower than shown here. In addition, in 1993 PSI included incentives for HVAC equipment and lighting fixtures in its commercial new construction program. These incentives were extended to the retrofit market in 1994. All of these programs should be marketed as a package to commercial and industrial customers. In addition, we recommend that PSI complement these incentives with incentives for ballasts and refrigeration equipment. For refrigeration in particular, extensive research will be needed to identify prescriptive measures and estimate costs and savings. EPRI has done extensive work in this area and should be consulted. In addition, some refrigeration system measures will need to be done on a customized basis, in which customers submit engineering analyses documenting savings estimates.

COMMERCIAL EQUIPMENT REPLACEMENT PROGRAM - revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2003	In approximately 2003 federal and ASHRAE standards will again be revised. At this time opportunities for additional savings beyond the standards should be assessed.
TECHNOLOGY:		
Program type	Replacement. Rebate program to encourage customers to purchase efficient equipment when existing equipment needs replacement. Customers receiving incentives from new construction and remodeling programs cannot receive rebates for the same equipment through this program. Program eligibility levels will be revised in 1998 after 1997 Federal efficiency standards and new ASHRAE 90.1 takes effect.	
Technology description	Will include efficient ballasts, motors, HVAC and refrigeration equipment. Specific measures summarized on attached worksheet.	
Incremental equip. cost	Varies by type of equipment. See attached worksheet.	
Incremental install. cost	$0	Generally the same as conventional equipment.
Incremental annual O&M	$0	Generally the same as conventional equipment.
Annual kWh savings	Varies by type of equipment. See attached worksheet.	
Peak kW savings	Varies by type of equipment. See attached worksheet.	
Measure life	15 years for ballasts, motors, pkgd HVAC, refrigeration 20 years for chillers	From Nadel and Tress 1990.
Replacement rate	50%	
Load shape	Commericial lighting Commercial HVAC Commercial refrigeration Industrial (for motors)	
PARTICIPATION:		
# eligible	Varies by type of equipment. See attached worksheet. From the figures in this worksheet, number eligible is reduced by 10% for packaged HVAC and motors (to eliminate overlap with commercial new construction and existing industrial retrofit programs, respectively) and by 50% for ballasts and chillers (to eliminate overlap with commercial remodeling, HVAC retirement, and new construction).	
Annual growth rate	0.91%	Based on projected growth in commercial customers from PSI 1992 Forecast
Annual participation rate	3,10,20,3 for motors 30,50%->end 3,10,20, for other equip- 30%->en ment types	ACEEE estimate. First year based on SCE motor program offered several years ago. Maximum participation for motors based in large part on BC Hydro motors program which has served 60% of hp sold after approximately five years of program operation (Jordan and Nadel 1993). Participation rate doesn't increase in year five because this is the first year of new standards. Maximum participation rate is lower for non-motor equipment because much of the new equipment market will be served by the new construction and remodeling programs, leaving harder to convince customers to be served by this program.
Free rider proportion	10%	ACEEE estimate. Free rider levels should be fairly low as long as eligibility levels are kept fairly high as proposed here.
UTILITY COSTS:		
Rebate costs	Full incremental costs -- see attached worksheet.	
Admininstrative costs	100% of incentive costs in 1st year, 50% in 2nd year, 25% thereafter	Based on Berry 1989.
Staff --- number	6 FT	ACEEE estimate -- includes 2 in central office and 1 in each of four regions.

COMMERCIAL HVAC RETIREMENT/UPGRADE PROGRAM

This program will target commercial HVAC systems that are about to be replaced. The program will provide participants with a package of lighting and shell improvements which will reduce the size of an HVAC system simultaneous to installation of a high-efficiency HVAC system with energy-saving controls. The two key features of this program are (1) it increases savings by combining equipment efficiency improvements with equipment downsizing made possible by overall building load reductions; and (2) it spreads the participation and costs of a full-scale effort over many years.

A number of utilities -- including Commonwealth Edison, Boston Edison, PEPCo, Northeast Utilities, and NEES -- have either already decided to offer a commercial HVAC retirement pilot later this year or are currently studying the possibility. The program design and marketing approach are described below, as well as the estimated savings, participation, and costs.

For unitary HVAC systems, buildings should be identified whose HVAC units have compressors nearing the retirement point. Cost-effective building cooling load reduction measures should be performed in an eligible customer's building simultaneous to an HVAC equipment efficiency upgrade, focusing on lighting measures but also giving attention to other measures as well. The cooling load measures can allow for significant HVAC size reduction.

For built-up chiller systems, there are generally three customer investment decision points: (a) customer decides to replace old chiller; (b) customer decides to replace or rebuild compressor; or (c) customer decides to rebuild the system to accept an alternative refrigerant. This final decision point will be very common in the 1990's as CFC's 11 and 12 are phased out. As with packaged HVAC systems, cooling load reduction measures should be performed simultaneous to HVAC equipment efficiency upgrades.

The utility incentive will basically cover the "incremental" costs of the projects. The building owner will pay what would have been the compressor replacement costs. One report states that emergency compressor replacement can cost \$1200 to \$1500 for a five ton unit (Jones, et al. 1993). In addition, in large buildings, the participant should contribute an amount equal to the first year's energy savings.

PSI should target equipment with compressors having less than two years of mean life to failure. One source estimates the mean compressor life to be approximately 10 years for unitary equipment compressors and 12 years for centrifugal compressors used in chiller systems (Stouppe and Lau 1988). It is worthwhile to keep in mind that compressors typically fail during the summer and generally must be replaced within 1-2 days (Jones, et al. 1993). Thus, PSI should anticipate which units may fail and complete such work before the summer cooling season begins. PSI should utilize HVAC contractors (who should be trained and certified for this program) to help identify eligible buildings, and equipment wholesalers to help market the program to the HVAC contractors.

Initial estimates indicate that each participating building can experience energy savings of 40-55% relative to pre-program building energy consumption (Jones, et al. 1993). Since this is based on projections and not actual program experience, we conservatively estimate that energy savings of 28% and 43% can be achieved in small and large office buildings, respectively. Taking the average of these two figures, a savings of 35% of baseline building electricity consumption is assumed. On average, we estimate annual savings of 875 MWh per participant. Based on projections made for PEPCO's HVAC retirement program, we estimate that the energy saving improvements will cost, on average, approximately $221,000 per participant more than a compressor replacement alone. We recommend that PSI pay 75% of these costs based on the premise that the average job will have a four-year simple payback (derived from Jones, et al. 1993) and the customer should be willing to pay for a one year simple payback.

COMMERCIAL HVAC RETIREMENT/UPGRADE PROGRAM: revised 6/10/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2008	
Program type	The program targets commercial HVAC systems that have compressors needing replacement. A package of lighting and shell improvements are offered to reduce the HVAC system size simultaneous to installing a high-efficiency HVAC system with energy-saving controls. Financial incentives covering 75% of the incremental equipment and installation costs are offered to participants. The program should target commercial customers not eligible for the Small C&I program, or commercial customers with demand over 100 kW.	
TECHNOLOGY:		
Technology description	Buildings should be targeted whose HVAC units have compressors nearing the retirement point. Building cooling load reduction measures (primarily lighting measures) will be performed simultaneous to HVAC equipment efficiency upgrades, including high-efficiency equipment and improved controls.	
Incremental equip. + installation costs	$199,263 per participant	Based on equipment and installation cost estimates for PEPCO's Commercial HVAC Retirement Program (Stein 1993). The average of the cost per 1st year kWh savings for the 2 building types represented in PEPCO's computer modeling equals $0.25/1st year kWh savings. Therefore, ($0.25) * (875,000 kWh savings [see below]) = $221,400.
Annual kWh savings	787,500 per participant	The average annual kWh for eligible customers is approximately 2500 MWh per year (Neal 1993). Based on computer modeling done for PEPCO's program, a typical small building is estimated to save 40% and a large building 55%. ACEEE adjusted the savings estimated for small buildings down 33% and the estimates for large buildings down 25% to be conservative. An average of the revised savings estimates for the two building types gives a 35% savings relative to baseline building electricity consumption. Therefore, (2,500 MWh) * 35% * 90% = 787,500 kWh savings per participant on average.
Coincident kW deferred	215 per participant	(Annual kWh savings) * (peak kW/annual kWh consumed) for Gen ******** customers using the weekday 4 pm September 1990 peak (1990 PSI Load Characteristics, Section 6).
Measure life	21 years	ACEEE estimate, based on taking the average of ASHRAE estimates of the average lifetime of commercial HVAC equipment, 15 years, and the experience of program designers for other utility commercial HVAC replacement programs, 27 years (Jones, et al. 1993).
Replacement rate	50%	ACEEE estimate.
Load shape	Commercial	
PARTICIPATION:		
# eligible in 1992	2,800	There are approximately 2,800 commercial customers with demand over 100 kW.
Annual participation rate	years 1-10: 0.5, 1.2, 2.5, 3.7, 5% -> end years 11-14: 4.5, 3.8, 2.5, 1.3%	Years 1 through 5 were based on experience in PG&E and NU's commercial new construction programs, dividing participation rates by 10 to compensate for the average 10-year HVAC compressor life (The Results Center: NU Energy Conscious Construction, 1992; The Results Center: PG&E Commercial New Construction, 1992; Wajcs, 1990). In years 11-14, it is assumed that eligible buildings that did not participate in the first "cycle" of the program participate in these years.
Annual growth rate	approx. 0.99%	PSI forecast for increase in commercial customers (PSI 1992 Forecast Databook).
Free rider proportion	5%	ACEEE estimate.
UTILITY COSTS:		
Rebate/participant	$149,397 per participant	The utility rebate equals 75% of the incremental equipment and installation costs of the project, and the customer pays the avoided operation and maintenance costs.
Administrative costs	$37,349 per participant	ACEEE estimate. Administrtive costs for this program type are not well-determined. We assume administrative costs are 25% of incremental equipment and installation costs, based on Berry 1989.
Staff — number	1 FT, 2 FT -> end	ACEEE estimate.

COMMERCIAL REMODELING PROGRAM

A relatively inexpensive way to acquire DSM savings is to take advantage of situations -when building owners are making changes to their buildings using standard efficiency equipment, but with the proper incentive (i.e. payment of a significant portion of the cost difference between standard and high efficiency equipment), building owners can be persuaded to use high efficiency equipment instead. Two classic examples of this situation are during new construction and when existing equipment breaks down and must be replaced. A third example is building remodeling -- situations where interior partitions are moved and decor is changed, but the building exterior and whole-building systems are not changed. Building remodeling generally takes place when tenants in rental property change, or when owner-occupants need to reconfigure their space. Lighting systems are often changed during remodeling, which provides an ideal opportunity to install high efficiency lighting equipment and to utilize good, energy-conserving lighting design. During remodeling, HVAC systems are sometimes modified as well, but these changes occur less often. Similar DSM opportunities occur during tenant build-outs. Tenant build-outs occur as space is rented and is customized for individual tenant needs. At this point walls are often installed/moved and lights are installed.

According to a study on building remodeling practices in the Pacific Northwest, approximately 7% of commercial buildings are renovated each year (Skumatz et al. 1991). This implies that 105% of commercial buildings will be modeled over the 15 year program period. For purposes of estimating the eligible population, we assume that 75% of buildings are remodeled over the 15-year period, an average of 5%/year. The difference between 5% and 7% is attributable to buildings that are remodeled more than once during the program period, a factor which is reflected in the estimated average measure life).

In order to capture the potential energy savings available when space is remodeled, PSI should offer a building remodeling program. Initially the program should target lighting improvements, but over time additional components can be added. Such a program should include an aggressive marketing effort, technical assistance on lighting design and equipment specification issues as well as incentives. An aggressive marketing effort is needed to identify spaces that are about to be remodeled and to convince decision-makers to participate. In marketing the program it will be necessary to make extensive personal contacts with people involved in the remodeling process including rental agents, facility managers, electrical contractors, interior designers, and architects who specialize in remodeling. Technical assistance is needed because during remodeling, lighting layouts are generally done by electrical contractors who have limited expertise in the area of energy-saving lighting design. Incentives are needed to pay a large portion of the incremental cost of the lighting upgrade. The entire marketing/technical assistance/incentive need to be closely coordinated so that services can be delivered quickly and efficiently. The window of opportunity to influence remodeling decisions is very narrow -- often only a month or two elapses between the decision to remodel and the completion of the work.

Utilities are just beginning to offer commercial remodeling programs. Programs have recently been started by Green Mountain Power and Boston Edison. Both programs are still in their start-up phases; neither program has been heavily marketed.

Savings and equipment costs for this program were estimated based on an analysis prepared by an ASHRAE subcommittee which found that lighting energy use can typically be reduced to 1.0-1.1 W/sq.ft. at modest cost (Nadel 1992). Assuming a baseline energy use of 1.65 W/sq.ft. (estimated from PSI's commercial new construction baseline study -- SRC 1992), the average participant should reduce their lighting energy use by 35%. PSI's incentive structure for the commercial new construction program can be used in this program as well.

COMMERCIAL REMODELING PROGRAM - LIGHTING - revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2010	
Program type	Technical assistance and incentives for upgrading lighting systems when buildings are being remodeled.	
TECHNOLOGY:		
Technology description	A wide array of lighting measures such as improved fixtures, lamps, ballasts, controls and lighting system layouts.	
Incremental equip. cost	$0.50 per sq.ft.	Approximate cost of upgrading office and retail lighting systems from about 1.6 W/sq.ft. to 1.1 W/sq.ft. (from Nadel 1992).
Incremental install. cost	$0 per sq.ft.	Included in above.
Incremental annual O&M	$0 per sq.ft.	O&M costs are likely to decline somewhat due to reduced bulb and labor costs from using compact fluorescent lamps instead of incandescent lamps. However, to be conservative we ignore these cost savings.
Annual kWh savings	1.86 per sq.ft.	6.2 kWh/sq.ft. for lighting in PSI comm'l bldgs (derived from Xenergy 1991) * 30% savings (based on change from ~1.6 to ~ 1.1 W/sq.ft.).
Peak savings	0.33 W/sq.ft.	Based on ratio of annual kWh for lighting to peak kW for lighting (August peak) as derived from Xenergy 1991.
Measure life	15 years	ACEEE estimate based on data in Skumatz et al. 1991.
Replacement rate	50%	ACEEE estimate.
Load shape	Commercial lighting	
PARTICIPATION:		
# eligible in 1992	8.10 million sq. ft.	162 million sq.ft. total PSI commercial floor area (derived from Xenergy 1991) * 5% renovated each year (derived from Skumatz et al. 1991).
Annual growth rate	2.30%	Based on PSI forecast data (PSI 1993).
Annual participation rate	5,12,25,37,50% = = > end.	Based on participation rates achieved and targeted by PG&E and NU new construction programs (The Results Center 1992 -- reports on NU and PG&E comm'l new construction programs).
Free rider proportion	10%	ACEEE estimate.
UTILITY COSTS:		
Rebate costs	$0.40 per sq.ft.	80% of incremental costs.
Admininstrative costs	$0.18 per sq.ft.	Based on staff costs plus 50% for marketing and other non-staff administrative costs. Also based on PG&E and NU new construction programs plus an additional 50% allowance for the fact that remodeling jobs are generally smaller than new construction jobs (The Results Center 1992 -- reports on NU and PG&E comm'l new construction programs). These costs include technical consultants and staff.
Staff --- number	4	ACEEE estimate.

COMMERCIAL NEW CONSTRUCTION PROGRAM

The Commercial New Construction Program is a new PSI program. Thus far the program consists of prescriptive rebates for efficient lighting and HVAC systems.

The current program appears to be a short-term interim program that is being used to build a bridge to a long-term, more comprehensive effort. In planning this long-term effort, we recommend that two "big picture" issues be kept in mind.

First, the PSI program does not occur in a vacuum -- there are other complementary processes that influence commercial building efficiency including building codes and architect/engineer education. These other processes can be harnessed to increase the amount of energy that is saved. In particular, since the State of Indiana has just adopted the ASHRAE 90.1 standard as part of the State Building Code, PSI should work closely with the state on offering joint training sessions on code and PSI program issues and using PSI incentives as a bridge to encourage architects and engineers to experiment with new technologies in order to lay the foundation for future code updates. In this way long-term savings can be maximized while reducing costs to PSI. To the extent possible, other Indiana utilities should also be involved in this effort.

Second, each customer and building is different, and no one program approach will work for all buildings. The current program approach features ease of participation and a limited list of measures. This approach is fine for many customers. But for large, owner-occupied structures, substantial amounts of additional energy can be saved by working with the design team to develop an integrated package of efficiency measures. Such a process is time consuming, and involves extensive computer modeling and technical assistance, but as shown by programs offered by the Bonneville Power Administration and Northeast Utilities, this approach can reduce building energy use by 30% or more (Wacjs 1990). A critical element is achieving these savings is the active involvement of the architects and engineers who are designing these buildings. In order to design a more efficient building generally requires more time than an inefficient building. PSI should provide incentives to architects and engineers to compensate them for this additional time.

The present PSI program features limited measures and limited technical assistance. For some buildings, more extensive technical assistance including brainstorming design options, assisting with measure analysis, reviewing plans and specifications, and offering advice on working with contractors. While some of these services could be provided by PSI field representatives, most of these services will require PSI to engage on retainer architects and engineers with extensive practical experience in implementing state-of-the-art energy efficiency measures.

This program should be closely coordinated with related proposed PSI programs including the Commercial Remodeling Program and the Industrial New Construction Program. As tenant build-outs occur in new buildings, referrals will need to be made to the remodeling program. Similarly, some industrial customers may be building new offices as well as new production facilities. The commercial and industrial programs will need to work closely on these jobs. In fact, it may make sense to combine these programs into a single program, but with separate marketing efforts and services directed at the commercial new construction, commercial remodeling, and industrial new construction/remodeling markets.

Our understanding is that the current measure list is just a starting point. Among the measures we would suggest adding are building shell measures such as improved glazing (low U and SC values) and insulation; speed control for fans and pumps; high efficiency cooling towers, condensers and terminal units; controls besides energy management systems; storage cooling systems; high-efficiency motors; and high efficiency refrigeration systems. For ideas on measures to include it would be useful to examine program brochures from other leading commercial new construction programs including programs offered by PG&E, SCE, LADWP, BPA, WEPCo, NEES, and NU. In addition to adding measures, we recommend that PSI increase the present incentives for lighting controls. Lighting controls such as occupancy sensors, daylight dimming, task tuning, and lumen maintenance are not well established in the field. In order to help establish these technologies, we recommend that PSI pay 80% of measure costs until the technologies become established and incentives can be lowered.

To our knowledge, PSI does not presently have overall savings and participation goals for this program. Based on experience with United Illuminating's (UI) Energy Blueprint program, supplemented with data from Pacific Gas & Electric's (PG&E) and Northeast Utilities' (NU) commercial new construction programs, we recommend that PSI target a participation rate by year three of 25% (i.e. 25% of new commercial space built in the third year is covered by the program) and 50% in year five. Based on the experience of these utilities, average savings of 3 kWh/ft^2 should be achievable, which represents approximately 15% of the energy use of a typical commercial building in the PSI service area (Xenergy 1991).

COMMERCIAL NEW CONSTRUCTION PROGRAM - revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2010	
Program type	Technical assistance and incentives for upgrading all energy-related features when buildings are being built.	
TECHNOLOGY:		
Technology description	A wide array of measures including lighting, HVAC, control, and shell improvements.	
Incremental equip. cost	$0.78 per sq.ft.	Based on PSI's early program experience (PSI 1994).
Incremental install. cost	$0 per sq.ft.	Included in above.
Incremental annual O&M	$0 per sq.ft.	Will generally be similar to those for conventional buildings.
Annual kWh savings	3.3 kWh/sq.ft.	Based on The Results Center 1993: UI Energy Blueprint program.
Peak savings	0.67 W/sq.ft.	Based on ratio of annual kWh to peak kW for PSI commercial buildings (August peak) as derived from Xenergy 1991.
Measure life	15 years for lighting measures 18 years for other measures	PSI standard estimates. By way of comparison, the weighted average measure life for all commercial new construction, as determined separately by UI and NU, is 18 years. (The Results Center 1992: NU, The Results Center 1993: UI).
Replacement rate	50%	ACEEE estimate.
Load shape	General commercial	
PARTICIPATION:		
# eligible	3.978 million sq. ft.	PSI forecast for 1994-95 (PSI 1994).
Annual growth rate	0%	Incorporated into above.
Annual participation rate	5,12,25,37,50% = = >end.	Based on participation rates achieved and targeted by UI, PG&E and NU new construction programs (The Results Center 1992: NU and PG&E, The Results Center 1993: UI).
Free rider proportion	20%	ACEEE estimate based on limited interviews conducted with participants in UI's program (The Results Center 1993: UI).
UTILITY COSTS:		
Rebate costs	$0.62 per sq.ft.	80% of incremental costs.
Admininstrative costs	$0.16 per sq.ft.	Average costs for UI's program including administration, training, labor, and marketing (The Results Center 1993: UI).
Staff --- number	4	Based on UI program which serves approximately same floor area each year as PSI expects to serve. Of the UI staff, approximately 2/3's handle commercial projects and are listed here. The remaining 1/3 handle industrial and are listed under the Industrial New Construction program. Staff costs are included under administrative costs in the line above.

INDUSTRIAL NEW CONSTRUCTION PROGRAM (Revised 10/7/93)

ACEEE proposes that PSI offer an Industrial New Construction Program to begin to capture the cost-effective lost conservation opportunities in the new plant and new process line market. Limited data indicate that the typical industrial process line is changed every 10-15 years (although many lines are changed on slower or more rapid schedules). This renovation rate implies that approximately 8% of industrial process lines are renovated every year. By working with this renovation cycle, utilities can capture significant energy savings without the plant downtime required for retrofit projects.

Currently, there are few utilities offering stand alone industrial new construction programs (e.g. BC Hydro), there are a number of utilities who have targeted industrial new construction projects within a broader-based DSM program (e.g., C&I new construction programs). Such utilities include Bonneville Power Administration (BPA), NEES, and United Illuminating (UI).

To encourage the consideration of energy-efficient equipment and processes in plant and process design, PSI should offer design assistance and design grants to architects and design engineers of new industrial facilities or existing facilities undergoing major renovations. In addition to design assistance, PSI should offer custom incentives for the installation of energy-efficient measures. One possible incentive structure is to offer 80% of the incremental equipment and installation costs, or the value of the energy savings, whichever is less. One utility offering an industrial new construction program has design engineers and plant owners sign an "Energy-Efficiency Agreement" in which the participants agree to consider energy efficiency when selecting equipment and designing processes. In addition, this utility offers 50% of the costs of studying alternative, energy-efficient processes or equipment, up to a maximum of $10,000 per participant (Fleming 1993).

PSI must set the baseline for each facility (i.e. the estimated electricity consumption of the new or expanding facility if the customer hadn't participated in the program). Process and other efficiency measures which bring consumption below the baseline should be considered for an incentive. Two utilities noted that properly setting the baseline requires the ability to accurately detect customer "bluffs" ("bluffing" occurs when the customer would have performed certain "efficiency" measures anyway, but states otherwise). PSI should hire consultants with experience in particular industries to determine baselines and to offer design assistance.

Staff at one utility offering an industrial new construction program, BC Hydro, noted that industrial firms who are undergoing facility expansion or new facility construction generally have a two- to three-year time lag between final upper management approval of the financing of the project and actual commissioning of the facility. Therefore, industrial participants often must know, for example, 1995 rebates and other program information in 1993. Staff at BC Hydro also indicated that it is important to understand the budget cycles of predominant industries in a utility's service territory; participation in an industrial new construction program can fluctuate significantly in different years depending on these cycles (Fleming 1993).

We estimate that the above program design would lead to electricity savings of 20% of the baseline, based on experience at BPA, BC Hydro, and UI (Balinskas 1993, Fleming 1993, Schimmels 1993). This would translate into annual savings of 250 MWh per facility. The incentive for such a project would equal approximately $30,000, based on 80% of the incremental equipment and installation costs. Typical equipment and installation costs were derived from BPA and UI information. Design assistance and design grants are estimated at $5,000 per participant, based on UI's program.

INDUSTRIAL NEW CONSTRUCTION PROGRAM: revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2010	
Program type	Technical assistance and incentives to increase the energy-efficiency of new industrial facilities as well as existing facilities undergoing major renovations. Design assistance, equipment selection assistance, design grants to architects and engineers. Custom incentives offered (possible structure: incentive covers 80% of the incremental installation and equipment costs up to the value of the energy savings to the utility).	
TECHNOLOGY:		
Technology description	PSI must determine the "baseline" projected kWh consumption for each participant's facility (perhaps hire experienced consultant). Process and other efficiency measures that reduce consumption below this baseline will be eligible for incentives.	
Incremental equip. + installation costs	$40,000 per participant	PSI estimate -- $0.20/1st yr. kWh saved. Based on bids received for PSI's large customer/national account program (Dave Mukdner, PSI). UI's Energy Blueprint program has also had average equipment and installation costs/1st year kWh savings for industrial new construction projects of $0.20 (Schimmels 1993). Does not include design assistance costs.
Incremental annual O&M	$0 per participant	O&M costs will vary from facility to facility but on average O&M costs are not likely to deviate significantly from baseline levels.
Annual kWh savings	200,000 per participant	Assume 20% of projected baseline kWh use is saved/participant on average, based on taking the average of UI's estimate (25%), the midpoint of results from 3 industrial new construction projects under BPA's ESP program (25%), and the midpoint of BC Hydro's estimated range of 10-15% (Balinskas 1993, Fleming 1993, Schimmels 1993). Assume typical participant and will be larger than the average industrial facility -- 250 kW. Based on rough ACEEE calculations, we estimate (20%) * (250 kW baseline new facility) * (4000 operating hours/yr) = 200 MWh saved.
Coincident kW deferred	34.9 per participant	(Annual kWh savings) * (peak kW/annual kWh consumed), using the weekday 4 pm September 1990 peak (1990 PSI Load Characteristics, Section 6).
Measure life	13	Based on number eligible -- see below. By way of comparison BPA staff estimate is an average lifetime of 15 years for measures installed in their industrial new construction projects (Schimmels 1993).
Replacement rate	50%	ACEEE estimate.
Load shape	Industrial	
PARTICIPATION:		
# eligible in 1992	236	ACEEE estimate. PSI had 2,960 industrial customers in 1992. Assume 8% of existing customers expand/add facilities each year, based on estimate that there are process changes every 10-15 years.
Annual participation rate	3, 10, 25, 40, 50% -> end	ACEEE estimate. UI estimates that in their third year of the program, they have achieved at least a 60% participation for industrial new construction projects (Balinskas 1993).
Annual growth rate	0.34%	Derived from PSI 1992 Forecast Databook.
Free rider proportion	5%	PSI estimate, based on process evaluation of PSI's current industrial programs.
UTILITY COSTS:		
Rebate	$32,000 per participant	Based on a utility payment of 80% of the total project cost or the value of the energy savings, whichever is less. Calculation here assumes 80% of incremental costs.
Design Assistance	$5,000 per participant	Based on UI's experience with costs of design assistance and grants per industrial participant (Balinskas 1993).
Administrative costs	$8,440 per participant	UI's design assistance + administrative costs for the industrial portion of their program are 42% of rebate costs (Balinskas 1993). Subtracting out design costs, we are left with figure shown here.
Staffing requirements	4 FT staff + contractors who ar experts in particular industries	ACEEE estimate, based loosely on UI staffing, making allowances for the relative size of UI and PSI. These costs are included in administrative costs above.

SMALL INDUSTRIAL DIRECT INSTALLATION PROGRAM (Revised 6/27/94)

Small industrial customers require different treatment than larger industrial customers for a number of reasons. Some of the unique aspects of smaller firms include: lack of capital for energy-efficiency improvements, absence of staff with time or expertise to oversee the implementation of energy-efficiency projects, and, in many cases, use of relatively simple processes.

At the present time, PSI offers limited DSM services to industrial customers under 1 MW in size. These customers generally receive information on how to improve their efficiency and how to identify projects. According to PSI's 1992 DSM Implementation Update, these smaller customers qualify of free audits for lighting, building shell, and HVAC systems under the Commercial Audit program. In addition, a few small industrial customers have been served on a pilot basis through PSI's Small Commercial program.

More is needed to address the conservation opportunities in small industrial facilities. One way to begin addressing these needs is to offer a Small Industrial Direct Installation program for customers less than 250 kW in size. Such a program would be a nice complement to the present Small Commercial direct installation program and could be structured as an expansion of the Small Commercial program.

Under the Small Industrial program, free audits of lighting, and water heating systems would be offered to eligible customers. Based on audit results, free retrofits of these systems would be available. If PSI wants to reduce utility costs, participating customers could be required to make a payment based on the expected value of annual energy savings (e.g. one year payback to participating customers). Such payments would probably reduce customer participation rates below the values shown here. Alternatively, a one year payback requirement could be levied for several years, and once the market was saturated at the one year payback level, utility incentives could be increased to cover all costs. However, if the customer wants to increase lighting levels due to having a substandard existing lighting system, the customer should be expected to pay 100% of the additional costs. The Portland Energy Conservation Inc./Bonneville Power Administration (PECI/BPA) Industrial Lighting program offered in the late 1980s found that the need for increases was common, but that there were still significant electricity savings.

Another option which is more difficult but provides lower utility program costs is to buydown the customer's project payback to one year. However, one utility offering a similar retrofit program at no cost to small commercial and industrial customers noted that in their experience, when you require small industrial customers to pay any costs, it actually may increase utility costs, because marketing efforts will need to be increased greatly (Horton 1993). This was affirmed by one lighting expert at Lawrence Berkeley Laboratory (Krause 1993).

Lighting measures to be assessed could include HID upgrades (this measure will predominate), electronic ballasts, T8 lamps, compact fluorescent lamps and fixtures, specular reflectors, occupancy sensors, as well as other cost-effective lighting technologies. Water heating measures, such as thermostats, time clocks, and hot water heater tank wraps, should also be assessed.

The estimated savings and cost per participant are based on the results of several pilot installations done by PSI. These savings are slightly greater and the costs slightly less than the savings and costs in the PECI/BPA program. Participation rates are expected to gradually ramp up to 50% in year ten, partially based on participation rates in NEES' Small C&I Direct Installation Program.

The program will require a full-time PSI staff person as well as labor and product vendors to assist in the program marketing, customer audits, and equipment installations. Energy audits and equipment installations could be performed by the same contractors, who should be experienced lighting designers for industrial facilities.

PSI should monitor industrial customers in the 250 kW to 500 kW range in other programs available to these customers to determine the degree of participation from this class of customers. The utility may want to expand the eligibility of this program to customers under 500 kW or to introduce a new medium-sized industrial conservation program for customers between 250 and 1000 kW.

SMALL INDUSTRIAL DIRECT INSTALLATION PROGRAM: revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year	1995	
End year	2000	
Program type	For industrial customers less than 250 kW in size. Free audit of lighting and water heating systems. Free retrofit based on results of audit.	
TECHNOLOGY:		
Technology description	Facilities will be assessed for the following measures: HID upgrades and refixturing, electronic ballasts, T8 lamps, compact fluorescent lamps and fixtures, specular reflectors, occupancy sensors, as well as other cost-effective lighting technologies. In addition, certain HVAC and water heating measures will be assessed, such as thermostat controls, time clocks, economizer air cooling systems, and water heater tank wraps.	
Incremental equip., audit & installation costs	$3,078 per participant	Based on the total audit, equipment, and installation costs for BPA's Industrial Lighting Program: $0.25/1st year kWh saved. (Wolfe and McAllister 1989).
Incremental annual O&M	$0 per participant	Variable, but probably negative in most cases.
Annual kWh savings	12,312 per participant	Based on results from a limited number of industrial jobs handled by PSI's small commercial program.
Coincident kW deferred	5.0 per participant	Based on results from a limited number of industrial jobs handled by PSI's small commercial program.
Measure life	15 years	Same assumption as made in BECo and NEES Small C&I programs (The Results Center 1992: BECo, The Results Center 1992: NEES).
Replacement rate	50%	ACEEE estimate.
Load shape	Industrial	
PARTICIPATION:		
# eligible in 1992	2,000	Estimate by Steve Hoeppner, PSI.
Annual participation rate	5, 10, 14, 17, 20, 25, 30, 35, 40, 50%	PSI estimate.
Annual growth rate	0.34%	Derived from PSI forecast in PSI 1992 Forecast Databook.
Free rider proportion	5%	ACEEE estimate. Little activity will occur with smaller customers unless services and rebates are offered. NEES estimates a free-ridership of 5%, BECo a free-ridership of 12% (The Results Center 1992: BECo, The Results Center 1992: NEES, Vandini 1993). We assume free-ridership for industrial customers is lower than it is for C&I combined.
UTILITY COSTS:		
Rebate costs	$2,309 per participant	Based on results from a limited number of industrial jobs handled by PSI's small commercial program.
Administrative costs	$739 per participant	ACEEE estimate. Based on experience of BPA's Industrial Lighting Program, where marketing, evaluation, planning & development, administration, PCB research, coordination, and disposal,and staffing cost $0.06/1st yr kWh saved.
Staffing requirements	1 FT + labor and product vendors	ACEEE estimate. This is an add-on to the small commercial program. These costs are included under administrative costs in the line above.

ENHANCED INDUSTRIAL EFFICIENCY IMPROVEMENT PROGRAM

We suggest that PSI offer an Enhanced Industrial Efficiency Improvement Pilot Program to complement the existing I-1 program, which focuses on lighting, motors, and other auxiliary system measures. The pilot program will address improved energy efficiency in the industrial processes within a participant's facility and should target the approximately 240 PSI customers over 1 MW in size.

A number of utilities already offer successful industrial efficiency programs with a process component, including Wisconsin Electric, Puget Power, BC Hydro, Carolina Power & Light, and BPA. All of these utilities hire experienced engineering consultants to perform process-oriented audits of participants' facilities. Rebates often cover at least 50% of a detailed energy analysis (along the lines of PSI's current incentives for Detailed Measure Analyses [DMA]) and a significant portion of the incremental equipment and installation costs of a project.

Wisconsin Electric (WEPCo) generally focuses on a few key processes within an industrial facility which have been noted by auditors as having high conservation potentials. BC Hydro negotiates process-oriented project incentives with their customers on a case-by-case basis, including in the calculation the benefits of increased production, improved worker safety, and reduced operation and maintenance where applicable. Carolina Power & Light has a crew of in-house employees that are highly experienced industrial engineers who perform in-depth industrial audits, with attention given to electricity, gas, and water efficiency improvements. There is significant variance in the design and marketing approach of these programs (Jordan and Nadel 1993).

In order to address the site-specific process efficiency improvements in targeted industries, it is important to hire engineering consultants with direct experience in pertinent industrial processes to conduct process-oriented audits. Industrial participants may bring in their own auditor, pending PSI approval. An initial survey of a facility's processes should be performed. After the initial process audit is performed, PSI should collaborate with the auditor and the customer and choose a few specific areas to target for efficiency improvements. If necessary, an in-depth survey can then be performed for these areas to indicate the cost-effective efficiency improvement opportunities. As with the DMA's, PSI should pay for 50% of this in-depth audit. Two utilities noted that targeting a few areas within industrial processes saves much time and money compared to scoping out numerous energy-efficiency opportunities in industrial processes (Hawley 1993, Ingram 1993). Incentives should be offered to cover a significant proportion of the incremental equipment and installation costs for the measures. PSI could keep the existing incentive structure offered under the I-1 program, adding into the incentive calculation the multiple customer benefits of a project (i.e. production improvements, reduction in labor costs, improved worker safety, etc.).

Since "pure" process changes are generally expensive and can rarely be performed for the energy-efficiency gains alone (unless very large financial incentives are offered), it is important to have close customer relations in order to understand what the customer is interested in doing and when the customer expects to perform process changes anyway. For example, according to a few experienced utilities, process changes are generally driven by environmental and safety regulations and it is therefore important to inform customers of the potential benefits from performing efficiency measures at this time (Banister 1992, Ingram 1993). It should be noted that two utilities said process changes require more involvement from more people within an industrial facility and require more downtime than lighting or motor-related projects (Ingram 1993, Rogers 1993). In addition, projects require a significantly longer time frame from initial customer contact to final project completion.

A number of utilities noted that the in-depth process-oriented surveys cost more than in-depth HVAC, lighting, or motor surveys, generally due to the expertise required in performing the audits. However, all the utilities offering the successful programs have noted that the cost-effective savings associated with auditing processes outweigh the increased program costs (Hawley 1993, Hesson 1993, Stolarski 1993, Ingram 1993).

Due to the many variables involved, any estimate of the increased costs and savings due to adding a process component will be highly circumspect. One utility noted that, on average, experienced engineering consultants understanding the process at hand often charge fees that are roughly 30% higher than the run-of-the-mill lighting or HVAC auditor (Stolarski 1993). Another utility estimated that, in their program, the average process-oriented survey costs roughly two to three times more than the average motor, HVAC, and lighting systems audit (Hawley 1993). We estimate that an in-depth process-oriented audit costs roughly $20,000 per participant on average, based on conversations with staff at Puget Power and WEPCo.

Puget Power has roughly estimated that the typical participant saves 20% of their pre-program electricity use, with 80% of these savings coming from process-related measures. However, motor system measures are included under "process" (Stolarski 1993). One pilot project at a food processing facility at one northeastern utility led to 33% electricity savings relative to pre-program electricity consumption, with only 4% of this coming from motors, lighting, and HVAC measures and the remaining savings coming from process changes (Robertson 1993). However, it must be noted that this was an old facility and the utility put great effort into this one pilot project. Conversations with these and other utilities, as well as with an industrial energy analyst, has led to an estimated savings per participant for PSI's pilot of roughly 10% of the participant's pre-program electricity consumption in addition to savings from lighting, motor, and auxiliary measures (Elliott 1993, Hawley 1993).

Using data derived from PSI's 1992 DSM Implementation Update, we estimate that the typical participant will save approximately 3,818 MWh per year. Using the average rebate level estimated for PSI's I-1 program, we calculate an average incentive of $339,000 per participant. Administrative costs are estimated at approximately $115,000 per participant.

It should be emphasized that our estimates of costs, savings, and participation are highly approximate and need to be tested by offering this program on a pilot basis.

ENHANCED INDUSTRIAL EFFICIENCY IMPROVEMENT PROGRAM: revised 6/9/94

VARIABLE	ASSUMPTION	NOTES
Start year End year	1995 2010	Continue until the market is saturated -- if the pilot is not successful, it will be ended earlier.
Program type	Initial energy surveys are performed on the processes within an industrial participant's facilities. Target areas are chosen. In-depth industrial process audits are performed for these areas by engineering consultants having experience in these particular processes. PSI pays for 50% of the costs of the in-depth survey. Custom rebates should be offered for qualifying energy-efficiency measures, with calculations made on the multiple customer benefits of the project (production improvements, labor, safety, etc.). This pilot will complement the existing I-1 program and will initially target PSI's largest 236 customers.	
TECHNOLOGY:		
Incremental audit costs	$20,000 per participant	ACEEE estimate, based on "middle-of-the-road" estimates by staff at Puget Power's Industrial Conservation program and WEPCo's Smart Money program (Hawley 1993, Stolarski 1993), and information on PSI's I-1 program (PSI DSM Implementation Update 1992). Using rough estimates made by staff at Puget Power, we assume that fees for consultants having particular expertise with relevant industrial processes are approximately twice that of typical non-process auditors (Stolarski 1993). Assuming a lighting, HVAC, and motor audit costs roughly $10,000, incremental costs = (2 * $10,000) = $20,000.
Annual kWh savings	******** per participant	Based on conversation with 1 industrial energy-efficiency analyst and 3 utility staff-persons at BC Hydro, BPA, and Puget Power, we roughly estimate that the savings from this program are roughly 10% of the industrial customer's pre-program electricity consumption, in addition to savings from lighting, motor, and auxiliary measures (Elliott 1993, Hesson 1993, Schimmels 1993, Stolarski 1993). Using information in PSI's 1992 DSM Implementation Update (p.47), we estimate that the typical eligible customer consumes 38,176 MWh/yr on average. (38,176 MWh) * 10% = 3,817,600 kWh savings per participant.
Coincident kW deferred	677 per participant	(Annual kWh savings) * (peak kW/annual kWh consumed), using the weekday 4 pm September 1990 peak (1990 PSI Load Characteristics, Section 6).
Measure life	10 years	From Jordan and Nadel 1993. Industrial equipment is often removed before its useful life during changes to production processes.
Load shape	Industrial	
PARTICIPATION:		
# eligible in 1992	236	Of PSI's 2,960 industrial customers, 236 were targeted for the I-1 program in 1992 (PSI DSM Implementation Update 1992). Without further information, we assume that there are 236 customers in the 1 MW+ size range.
Annual participation rate	1, 4, 8, 10, 13, 17, 22, 25, 28, 32, 35, 38, 41, 45, 48, 50%	ACEEE and PSI estimate; the first two years are based partially on early experience in WEPCo's Smart Money program (Jordan and Nadel 1993).
Free rider proportion	10%	Based on conversations with staff at Puget Power and WEPCo (Hawley 1993, Stolarski 1993).
UTILITY COSTS:		
Rebate/participant	$338,600 per participant	We suggest that PSI continue to use the I-1 program rebate structure while still taking into account the multiple customer benefits (production improvements, reduced labor costs, etc.) when calculating each incentive. In PSI's 1992 DSM Implementation Update, the average incentive level is estimated at $500/kW deferred. Therefore ($500/kW) * (677 kW deferred/participant) = $338,621.
Administrative costs	$114,600 per participant	This estimate includes the utility's audit, marketing, staffing, and other administrative costs. Under WEPCo's and Puget Power's programs, the administrative costs are 30% of the rebate and audit costs (Jordan and Nadel 1993). Using this information, we estimate that the total non-audit administrative costs are [30%*(audit + rebate costs)] = $114,586. The utility contribution to audit costs adds an additional $10,000 per participant.
Staff --- number	4FT + engineering consultants	ACEEE estimate. These costs are included in the line above.

PSI Energy Demand-Side Management Programs
Annual Program Costs ($000)
Existing Programs

Year	R-1 Wtr Ht Wrap-up	R-8 Seal-u	WH/AC Cycling	R-9 Low Income	Smart $aver Conservatio	R-2 Res. Lighting	C1/C2 Co Audits & I	C3 Sm Co Lighting	I1/I2 Ind. Efficiency	Peak Reductio	Time-of Use	Planergy	Total
1994	539	1,188	855	187	6,361	1,915	6,991	4,752	7,454	1,234	178	157	$31,811
1995	407	766	843	193	7,292	469	5,310	3,687	5,720	1,172	287	75	$26,221
1996	406	769	681	200	8,009	201	4,183	4,074	5,745	1,172	255	0	$25,695
1997	411	771	603	208	8,577	203	4,368	4,074	5,877	1,172	265	167	$26,696
1998	430	813	186	217	9,056	206	4,568	4,074	6,017	1,172	276	167	$27,182
1999	437	821	195	226	9,639	209	4,782	4,074	6,167	1,172	287	167	$28,176
2000	443	830	203	236	10,304	212	5,012	0	6,330	1,172	299	167	$25,208
2001	446	833	227	246	11,061	0	5,258	0	6,505	1,172	344	167	$26,259
2002	453	842	235	257	11,880	0	6,022	0	6,691	1,172	420	167	$28,139
2003	460	852	248	269	12,804	0	6,319	0	6,886	1,172	567	167	$29,744
2004	478	901	253	281	13,757	0	6,625	0	7,085	1,172	658	167	$31,377
2005	486	912	266	294	14,680	0	6,942	0	7,294	1,172	757	0	$32,803
2006	494	923	275	307	15,631	0	7,278	0	7,512	1,172	426	0	$34,018
2007	514	977	288	321	16,583	0	7,635	0	7,744	1,172	445	0	$35,679
2008	523	989	305	337	17,484	0	8,358	0	7,993	1,172	465	0	$37,626
2009	533	1,002	314	352	18,164	0	8,768	0	8,253	1,172	487	0	$39,045
2010	555	1,060	327	369	18,770	0	9,205	0	8,526	1,172	509	0	$40,493
2011	551	1,031	336	386	19,438	0	9,649	0	8,805	1,172	532	0	$41,900
2012	561	1,046	244	405	18,811	0	10,152	0	9,123	1,172	842	0	$42,356
2013	585	1,109	258	425	0	0	10,677	0	9,456	1,172	584	0	$24,266
2014	597	1,125	267	0	0	0	11,236	0	9,821	1,172	924	0	$25,142
2015	609	1,142	184	0	0	0	11,812	0	10,174	1,172	968	0	$26,061

PSI Energy Demand-Side Management Programs
Annual Program Costs ($000)
ACEEE Proposed Programs

Year	2nd Refrig. Turn-In	Res. HP Water Htr	Clothes Washr Re	Enhance Smart $a Duct Sea	Com. Equip Replacement	C. HVA Retiremn /Upgrade	Commercia Remodelin	Com. New Constructio	Ind. New Constructio	Ind. Dire Install	Enhance Ind. Eff	Total
1994	0	0	0	0	0	0	0	0	0	0	0	$0
1995	0	10	0	253	682	563	67	98	437	301	0	$2,411
1996	0	39	0	205	935	1,324	168	239	884	306	0	$4,100
1997	1,019	119	0	131	1,087	1,909	257	503	1,343	248	906	$7,522
1998	627	349	42	131	1,877	1,638	313	755	1,814	188	3,201	$10,935
1999	889	490	173	88	2,728	1,168	389	1,032	2,297	193	4,616	$14,063
2000	1,021	690	440	88	3,049	885	449	1,045	2,328	327	2,330	$12,652
2001	0	900	896	88	3,084	496	456	1,058	2,360	327	3,294	$12,959
2002	0	1,170	1,371	88	3,125	301	464	1,072	2,393	336	4,278	$14,598
2003	0	1,506	0	88	3,157	304	472	1,086	2,468	340	5,763	$15,184
2004	0	1,839	0	88	3,175	410	481	1,101	2,504	346	3,398	$13,342
2005	0	2,215	0	88	0	311	489	1,116	2,541	353	3,435	$10,548
2006	0	2,522	0	88	0	315	498	1,132	2,580	0	4,962	$12,097
2007	0	2,654	0	88	0	318	507	1,148	2,620	0	3,513	$10,848
2008	0	2,671	0	88	0	322	517	1,166	2,705	0	3,554	$11,023
2009	0	2,687	0	88	0	0	527	1,183	2,749	0	3,597	$10,831
2010	0	2,705	0	88	0	0	537	1,202	2,794	0	4,681	$12,007
2011	0	0	0	88	0	0	548	1,220	2,842	0	3,686	$8,384
2012	0	0	0	88	0	0	0	0	0	0	2,667	$2,755
2013	0	0	0	88	0	0	0	0	0	0	0	$88
2014	0	0	0	0	0	0	0	0	0	0	0	$0
2015	0	0	0	0	0	0	0	0	0	0	0	$0

REFERENCES

Anker, Suzanne, 1993, personal communication, Portland, OR: Bonneville Power Administration, 503-230-3306.

Applied Energy Group, 1989, *Massachusetts Joint Utility End Use Monitoring Project: Final Report*, Woodbury, NY: Applied Energy Group, Inc.

Balinskas, Michael, 1993, personal communication, New Haven, CT: United Illuminating, 203-499-2042.

Banister, Bob, 1993, personal communication, Bellevue, WA: Puget Power, 206-462-3726.

Barbian, Kathy, 1993, personal communication, Milwaukee, WI: Wisconsin Electric Power Co., 414-221-2855.

Berry, Linda, 1989, *The Administrative Costs of Energy Conservation Programs* (ORNL/CON-294), Oak Ridge, TN: Oak Ridge National Laboratory.

BC Hydro, 1988, *Heat Pump Water Heater Information Sheet* (draft), British Columbia, Canada: British Columbia Hydro.

Carls, Randy, 1993, personal communication, Madison, WI: Wisconsin Power & Light, 608-252-3236.

CEE 1994a, *Residential and Small Commercial High Efficiency Lighting Initiative, draft,* Boston, MA: Consortium for Energy Efficiency.

CEE 1994b, *Residential Heat Pump Water Heater Initiative, draft*, Boston, MA: Consortium for Energy Efficiency.

Doring, Otto, 1993, personal communication, West Lafayette, IN: Purdue University, 317-494-4226.

DSTR, 1994, "Top-Loading, Horizontal Axis Washing Machine Debuts", *Demand-Side Technology Report*, Vol. 1, No. 3, November.

Edwards, P. and M. Lithgow, 1991, "Washability and Energy Use Evaluation of a North American and a European Clothes Washer", prepared by Ortech International, Toronto, Ontario: Ontario Hydro.

Elliott, Neal, 1993, personal communication, Washington, D.C.: American Council for an Energy-Efficient Economy, 202-429-8873.

EPA, 1993, *Space Conditioning: The Next Frontier*, Washington, D.C.: U.S. Environmental Protection Agency.

EPRI, 1993, *Electric Water Heating News*, Vol. 6, No. 3, Fall, Palo Alto, CA: Electric Power Research Institute.

Fleming, Alex, 1993, personal communication, Vancouver, British Columbia: British Columbia Hydro, 604-662-3314.

Goett, A., Van Liere, K., and D. Quigley, "Customer Acceptance and Use of Compact Fluorescents: Results from a Comprehensive Evaluation of PG&E's Program", *Proceedings 1992 Summer Study on Energy Efficiency in Buildings*, Berkeley, CA: American Council for an Energy-Efficient Economy.

Granda, C., 1992, "A Statistically-Based Impact Evaluation of a Direct Install Compact Fluorescent Distribution Program", *Proceedings 1992 Summer Study on Energy Efficiency in Buildings*, Berkeley, CA: American Council for an Energy-Efficient Economy.

Grimm, Bill, 1993, personal comunication, Rosemead, CA: Southern California Edison.

Hawley, Tom, 1993, personal communication, Milwaukee, WI: Wisconsin Electric Power Co. 414-221-3887.

Hesson, John, 1993, personal communication, British Columbia, Canada: British Columbia Hydro, 604-685-2206.

HFD, 1993, "Doubly Efficient Washer Due From Frigidaire in '94," *Home Furnishings Daily*, August 30.

Horton, Michael, 1993, personal communication, Westborough, MA: New England Electric System, 508-366-9011.

Ingram, Al, 1993, personal communication, Portland, OR: Bonneville Power Administration (503-230-4062).

Johnson, Russell, 1993, personal communication, Hartford, CT: Northeast Utilities, 203-665-4664.

Jones, B., C. Roberston, and J. Wolpert, 1993, "Proposal by Maryland Office of People's Counsel for PEPCo HVAC Retirement Program Design", Boulder, CO: E-Cube, Inc.

Jordan, J. and S. Nadel, 1993, *Industrial Demand-Side Management Programs: What's Happened, What Works, What's Needed*, Washington, D.C.: American Council for an Energy-Efficient Economy.

Kesselring, John, 1993, personal communication, Palo Alto, CA: Electric Power Research Institute.

Krause, Florentin, 1993, personal communication, Berkeley, CA: Lawrence Berkeley Laboratory, 510-486-7260.

Lebot, B., Turiel, I., and G. Rosenquist, 1990, "Horizontal Axis Domestic Washers: An Alternative Technology That Can Reduce Residential Energy and Water Use", *Proceedings 1990 Summer Study on Energy Efficiency in Buildings*, Berkeley, CA: American Council for an Energy-Efficient Economy.

Levene, Nancy, 1993, personal communication, Mahwah, NJ: Sharp Corporation, 201-529-8631.

Lovett, C. D., 1981, "An Evaluation of Assigning Credit/Debit to the Energy Factor of Clothes Washers Based on Water Extraction Performance", NBSIR 81-2309, Washington, D.C.: National Bureau of Standards.

Mah, Ed and Lauren Casentini, 1993, fax to ACEEE, San Francisco, CA: Pacific Gas & Electric.

Michelson, L, and Lonergan, B., 1992, "Bright Ideas in Residential Lighting", *Proceedings ACEEE 1992 Summer Study on Energy Efficiency in Buildings*, Berkeley, CA: American Council for an Energy-Efficient Economy.

Mittelstaedt, Bernie, 1993, personal communication, Madison, WI: DEC International Therma-Stor Products, 608-222-5301.

Nadel, S. and H. Tress, 1990, *The Achievable Conservation Potential in New York State from Utility Demand-Side Management Programs*, Washington, D.C.: American Council for an Energy-Efficient Economy.

Nadel, S., 1992, speadsheet analysis on lighting efficiency measure cost and savings, prepared for ASHRAE 90.1 criteria development panel (with input from 90.1 lighting panel), Washington, D.C.: American Council for an Energy-Efficient Economy.

Nadel, S., 1993, "Using Utility Demand-Side Management Programs to Spur the Development of More Efficient Appliances", *Interntaional Appliance Technical Conference, May 1993*, Columbus, OH.

Nadel, S., Bourne, D., Shepard, M., Rainer, L., and L. Smith, 1993, *Emerging Technologies to Improve Energy Efficiency in the Residential and Commercial Sectors*, Washington, D.C.: American Council for an Energy-Efficient Economy.

Nadel, S., Pye, M., and J. Jordan, 1994, *Achieving High Participation Rates: Lessons Taught by Successful DSM Programs*, Washington, D.C.: American Council for an Energy-Efficient Economy.

Neal, Kevin, 1993, personal communication & memorandum, Plainfield, IN: PSI Energy, 317-

839-9611.

NEES, 1993, *1992 DSM Performance Measurement Report*, Westborough, MA: New England Electric System.

Nelson, Carol, 1993, personal communication, San Francisco, CA: Pacific Gas & Electric, 415-973-4081.

Office of the Commissioner of Agriculture, 1992, *Indiana Agriculture* (pamphlet), Indianapolis, IN: Office of the Commissioner of Agriculture.

Otter Tail Power, 1993, *Appliance Recycling Project: Residential Expansion Project* (Draft Filing), Fergus Falls, MN: Otter Tail Power Company.

PG&E, 1992, *Compact Fluorescent Light Program Measurement Results*, San Francisco, CA: Pacific Gas & Electric.

Pope, E. and M. Slavin, 1992, "Energy Efficient Horizontal Axis Washing Machines, Technology Assessment and Cost Effectiveness Evaluation", Olympia, WA: Washington State Energy Office.

Proctor, John, 1991, "Pacific Gas & Electric Appliance Doctor Pilot Program", Larkspur, CA: Proctor Engineering Group.

PSI Energy, 1990, *Load Characteristics* (Section 6), Plainfield, IN: PSI Energy.

PSI Energy, 1991, *Commercial End-Use Load Shape Study*, Plainfield, IN: PSI Energy.

PSI Energy, 1991, *1990 Customer Appliance Saturation Survey Data Book*, Plainfield, IN: PSI Energy.

PSI Energy, 1992, *Forecasts: Energy and Peak Demand 1992-2005 Data Book*, Plainfield, IN: PSI Energy.

PSI Energy, 1992, *Demand-Side Management Implementation Update*, Plainfield, IN: PSI Energy.

PSI Energy, 1993, *Smart $aver Impacts (spreadsheet printout - 10/22/93)*, Plainfield, IN: PSI Energy.

PSI Energy, 1993, forecast of total new commercial square footage (spreadsheet printout from Marketing Department, 5/17/93), Plainfield, IN: PSI Energy.

PSI Energy, 1994, *PSI Changes to ACE^3 Programs*, Plainfield, IN: PSI Energy.

Robertson, Chris, 1993, personal communication, Portland, OR: independent consultant, 503-

287-5477.

Rogers, Jim, 1993, personal communication, Westborough, MA: New England Electric Systems, 508-366-9011.

SCE, 1993, *Annual DSM Summary Report, 1992 Results - 1993 Plans*, Rosemead, CA: Southern California Edison.

Schimmels, Nancy, 1993, personal communication, Spokane, WA: Bonneville Power Administration, 509-353-2900.

Scotland, Jeffrey, 1993, personal communication, Vancouver, British Columbia, Canada: British Columbia Hydro, 604-663-1972.

Shepard, M., A. Lovins, J. Neymark, D. Houghton, and H.R. Heede, 1990, *The State of the Art: Appliances*, Snowmass, CO: Rocky Mountain Institute.

Simpson, Glenn, 1993, personal communication, Washington, D.C.: Potomac Edison Power Company, 202-872-7973.

Skumatz, Lisa A., K. M. Lorberau, R.J. Moe, R.D. Bordner, and R.D. Chandler, 1991, *Bonneville Measure Life Study: Effect of Commercial Building Changes on Energy Using Equipment*, Bala Cywn, PA: Synergic Resources Corporation.

Smith, Loretta, and Steven Nadel, 1993, *Energy Efficiency Codes and Standards for Illinois (draft)*, Washington, D.C.: American Council for an Energy-Efficient Economy.

Spang, Nick, 1993, personal communication, Milwaukee, WI: Wisconsin Electric Power Company, 414-221-3046.

Stein, Jay, C. Robertson, and J.S. Wolpert, 1993, "HVAC Retirement: A New Demand-Side Management Program Strategy", *Proceedings of the 16th World Energy Engineering Congress*, Atlanta, GA: Association of Energy Engineers.

Stolarski, Bob, 1993, personal communication, Bellevue, WA: Puget Power, 206-462-3042.

Stouppe, D.E., and T.Y.S. Lau, 1988, "Refrigeration and Air Conditioning Equipment Failures", *The Locomotive*, Vol. 66, No. 1, Hartford, CT: Hartford Steam Boiler Inspection and Insurance Company.

Sweetland, Susan, 1993, personal communication, Syracuse, NY: Niagara Mohawk Power Company, 315-428-6692.

The Results Center, 1992, *Boston Edison Small C&I Program*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1992, *BC Hydro Power Smart Refrigerator Buy-Back Pilot*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1992, *Burlington Electric Department Smartlight Program*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1992, *New England Electric System Small C&I Program*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1992, *Northeast Utiltities Energy Conscious Construction Program*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1992, *Pacific Gas & Electric Commercial New Construction Program*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1992, *Wisconsin Electric Appliance Turn-In Program*, Aspen, CO: IRT Environment, Inc.

The Results Center, 1993, *United Illuminating Energy Blueprint Program*, Aspen, CO: IRT Environment, Inc.

Turcotte, Pat, 1993, personal communication, Eau Claire, WI: Northern States Power Company (Wisconsin), 715-839-2596.

U.S. DOE, 1990, *Technical Support Document: Energy Conservation Standards for Consumer Products: Dishwashers, Clothes Washers, and Clothes Dryers*, DOE/CE-0299P, Washington, D.C.: U.S. Department of Energy.

U.S. DOE, 1993, *Technical Support Document: Energy Efficiency Standards for Consumer Products: Room Air Conditioners, Water Heaters, Direct Heating Equipment, Mobile Home Furnaces, Kitchen Ranges and Ovens, Pool Heaters, Fluorescent Lamp Ballasts & Television Sets*, DOE/EE-0009, Washington, D.C.: U.S. Department of Energy.

Vandini, Mark, 1993, personal communication, Boston, MA: Boston Edison, 617-424-2451.

Viccarro, Michael, 1993, personal communication, Berlin, CT: Northeast Utilities, 203-665-2715.

Wajcs, Frederick F., 1990, "A Utility Program for Improving the Energy-Efficiency of New Nonresidential Construction", in *Proceedings ACEEE 1990 Summer Study on Energy Efficiency in Buildings, Volume 8*, Berkeley, CA: American Council for an Energy-Efficient Economy.

Wiedemeier, Leonard, 1993, personal communication, Green Bay, WI: Wisconsin Public Service Corporation, 414-433-4919.

WEPCo, 1992, *Smart Money for Farms* (Program Brochure), Milwaukee, WI: Wisconsin Electric Power Company.

Wolfe, P. and L. McAllister, 1989, "The Industrial Lighting Incentive Program: Process and Impact Evaluation", *Energy Conservation Program Evaluation: Conservation and Resource Management, Proceedings of the August 23-25, 1989 Conference*, Argonne, IL: Argonne National Laboratory.

Xenergy, Inc., 1991, *PSI Energy Commercial End-Use Load Shap*e Study, Burlington, MA: Xenergy, Inc.

APPENDIX B

DIFFERENCES IN ANALYTIC ASSUMPTIONS BETWEEN OPTIMISTIC AND CONSERVATIVE ENHANCED PROGRAM CASES

ACEEE Proposed DSM Programs
Assumption Differences for the Conservative Scenario

Farm Efficiency Program

Penetration Rates Eligible in 1994 - 700

Year	ACEEE	PSI
1995	10%	10%
1996	25%	20%
1997	45%	25%
1998	60%	30%
1999	75%	35%
2000	75%	35%
2001	75%	35%
2002	75%	35%
2003	75%	35%
2004	75%	35%

Industrial New Construction

Free Riders ACEEE 20% PSI 5%

Incentives ACEEE 80% of incremental costs
PSI 60% of incremental costs

Penetration Rates Eligible in 1994 - 236

Year	ACEEE	PSI
1995	3%	5%
1996	10%	10%
1997	25%	15%
1998	40%	20%
1999	50%	25%
.	.	.
.	.	.
2010	50%	25%

ACEEE Proposed DSM Programs
Assumption Differences for the Conservative Scenario

Commercial Remodeling Program

Incentives	ACEEE	$0.50 per sq. ft.
	PSI	$0.25 per sq. ft.

Penetration Rates Eligible in 1994 - 236

Year	ACEEE	PSI
1995	5%	4%
1996	12%	10%
1997	25%	15%
1998	37%	18%
1999	50%	22%
2000	50%	25%
.	.	.
.	.	.
2011	50%	25%

Commercial Equipment Replacement Program

Incentives	ACEEE	100% of incremental costs
	PSI	50% of incremental costs

Penetration Rates

Motors

Year	ACEEE	PSI
1995	5%	3%
1996	10%	6%
1997	20%	9%
1998	30%	13%
1999	40%	22%
2000	50%	25%
.	.	.
.	.	.
2004	50%	25%

ACEEE Proposed DSM Programs
Differences in Assumptions between PSI and ACEEE

Commercial Equipment Replacement Program cont.

Penetration Rates

Fl. Ballasts

Year	ACEEE	PSI
1995	5%	1%
1996	10%	3%
1997	20%	5%
1998	30%	7%
1999	30%	9%
2000	30%	10%
.	.	.
.	.	.
2004	30%	10%

Chillers

Year	ACEEE	PSI
1995	5%	3%
1996	10%	5%
1997	20%	8%
1998	30%	13%
1999	30%	17%
2000	30%	20%
2001	30%	23%
2002	30%	25%
2003	30%	25%
2004	30%	25%

Refrigeration

Year	ACEEE	PSI
1995	5%	3%
1996	10%	6%
1997	20%	9%
1998	30%	13%
1999	30%	22%
2000	30%	25%
2001	30%	25%
2002	30%	25%
2003	30%	25%
2004	30%	25%

ACEEE Proposed DSM Programs
Differences in Assumptions between PSI and ACEEE

Commercial HVAC Retirement/Upgrade Program

Penetration Rates

Year	ACEEE	PSI
1995	.5%	.2%
1996	1.2%	.5%
1997	2.5%	.7%
1998	3.7%	.6%
1999	5.0%	.4%
2000	5.0%	.3%
2001	5.0%	.2%
2002	5.0%	.1%
2003	5.0%	.1%
2004	4.5%	.1%
2005	3.8%	.1%
2006	2.5%	.1%
2007	1.3%	.1%

Energy Savings	ACEEE	35% of annual kWh - 525,000 kWh/part.
	PSI	25% of annual kWh - 375,000 kWh/part
Measure Life	ACEEE	21 years
	PSI	16 years

The incremental equip. and installation costs, rebate/participant and admin. cost change due to the difference in kWh savings.

	ACEEE	PSI
incremental equip. cost	$131,250	$93,750
rebate/participant	$98,437	$70,312
Admin. costs	$32,812	$23,437

APPENDIX C

DETAILED TABLES SUMMARIZING ENERGY, DEMAND, EMISSIONS, AND SAVINGS RESULTS

ACEEE Proposed Programs Analysis
Benefit/Cost Ratios - 0 End Effects
PSI Conservative Scenario

Program	UC	TRC	PARTICIPANT	RIM
2ND refrig. Turn-in	1.28	1.40	inf.	0.35
CF Coupon Program	2.13	1.63	4.01	0.40
Heat Pump/Water Heater	1.67	1.19	2.88	0.51
Clothes Washer Rebate	1.71	1.53	3.69	0.50
Farm Efficiency	1.18	0.89	2.84	0.40
Enhanced S$ - Duct Seal	3.27	2.70	4.57	0.59
Commercial Equipment Replacement	2.30	1.52	2.45	0.72
Commercial HVAC Retirement Upgrade	2.60	2.18	3.64	0.72
Commercial Remodeling - Lighting	2.91	2.07	3.44	0.80
Commercial New Construction	3.44	3.86	7.29	0.84
Industrial New Construction	2.43	1.81	3.01	0.76
Small Industrial Direct Installation	1.93	1.62	2.81	0.67
Enhanced Industrial Efficiency	3.01	8.81	96.92	0.77
Total ACEEE Programs	2.55	2.55	5.10	0.70

ACEEE Proposed Programs Analysis
Benefit/Cost Ratios - 0 End Effects
ACEEE Optimistic Scenario

Program	UC	TRC	PARTICIPANT	RIM
2ND refrig. Turn-in	1.28	1.40	inf.	0.35
CF Coupon Program	2.13	1.63	4.01	0.40
Heat Pump/Water Heater	1.67	1.19	2.88	0.51
Clothes Washer Rebate	1.71	1.53	3.69	0.50
Farm Efficiency	1.30	0.98	3.07	0.42
Enhanced S$ - Duct Seal	3.27	2.70	4.57	0.59
Commercial Equipment Replacement	1.48	1.60	3.14	0.61
Commercial HVAC Retirement Upgrade	2.74	2.31	3.64	0.78
Commercial Remodeling - Lighting	2.40	2.06	3.62	0.77
Commercial New Construction	3.44	3.86	7.29	0.84
Industrial New Construction	1.71	1.71	3.38	0.67
Small Industrial Direct Installation	1.93	1.62	2.81	0.67
Enhanced Industrial Efficiency	3.01	8.81	96.92	0.77
Total ACEEE Programs	2.39	2.33	4.20	0.72

ACEEE Proposed Programs Analysis
Annual Energy (GWh) Impacts
PSI Conservative Scenario

Year	2nd Refrig. Turn-in	CF Coupon	Heat Pump Water Heater	Cl. Washer Rebates	Farm Efficiency	Enhanced S$ Duct Seal	Com. Eq. Replacement	Com. HVAC Ret. Upgrade	Com. Remodeling	Com. New Construction	Ind. New Construction	Small Ind. Direct Install	Enhanced Ind. Efficiency	Total ACEEE Programs
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	8.433	7.395	0.027	0.151	0.262	1.242	1.406	2.414	0.348	0.575	2.518	1.292	7.590	33.653
1996	13.461	14.936	0.130	0.760	0.528	2.250	4.346	8.046	1.215	1.959	7.555	2.597	34.156	91.939
1997	19.079	21.369	0.574	2.297	0.666	3.110	8.920	16.091	2.515	4.835	15.111	3.643	72.108	170.318
1998	25.351	27.927	1.862	5.402	0.808	3.969	15.579	22.930	4.076	9.098	25.184	4.431	91.083	237.700
1999	25.351	34.614	3.982	10.106	0.954	4.828	24.678	27.757	5.986	14.855	37.776	5.232	117.649	313.768
2000	25.351	41.430	6.937	10.106	0.962	5.687	35.395	31.378	8.155	20.614	50.369	6.576	151.805	394.765
2001	25.351	48.378	10.741	10.106	0.973	6.546	46.231	33.389	10.325	26.371	62.961	7.907	197.347	486.626
2002	25.351	55.459	15.623	10.106	0.980	7.405	57.193	34.596	12.494	32.130	75.553	9.263	223.913	560.066
2003	16.909	55.281	21.830	10.106	0.992	8.264	68.266	35.803	14.664	37.887	88.355	10.620	250.479	619.456
2004	11.890	47.740	29.311	10.106	1.003	9.123	79.405	37.412	16.834	43.646	101.157	11.989	288.430	688.046
2005	6.272	41.307	38.208	10.106	0.741	9.983	79.405	38.619	19.003	49.402	113.959	13.372	307.406	727.783
2006	0.000	34.748	48.210	10.106	0.475	10.842	79.405	39.825	21.173	55.162	126.761	13.372	307.406	747.485
2007	0.000	28.062	58.581	10.106	0.337	11.701	79.405	41.032	23.342	60.918	139.563	13.372	296.021	762.440
2008	0.000	21.246	68.852	10.106	0.195	12.560	79.405	42.239	25.512	66.678	152.575	13.372	311.201	803.941
2009	0.000	14.298	79.019	9.955	0.049	13.419	79.405	42.239	27.682	72.434	165.587	13.372	311.201	828.660
2010	0.000	7.217	89.058	9.346	0.041	14.278	78.076	42.239	29.503	78.194	176.080	12.080	296.021	832.133
2011	0.000	0.000	88.955	7.809	0.030	15.137	75.317	39.825	30.806	83.950	184.055	10.775	250.479	787.138
2012	0.000	0.000	88.512	4.704	0.022	15.997	70.883	34.193	29.505	83.950	176.500	9.728	223.913	737.907
2013	0.000	0.000	87.223	0.000	0.011	16.856	64.397	26.148	27.944	83.375	166.426	8.940	197.347	678.667

ACEEE Proposed Programs Analysis
Annual Energy (GWh) Impacts
ACEEE Optimistic Scenario

Year	2nd Refrig. Turn-in	CF Coupon	Heat Pump Water Heater	Cl. Washer Rebates	Farm Efficiency	Enhanced S$ Duct Seal	Com. Eq. Replacement	Com. HVAC Ret. Upgrade	Com. Remodeling	Com. New Construction	Ind. New Construction	Small Ind. Direct Install	Enhanced Ind. Efficiency	Total ACEEE Programs
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	8.433	7.395	0.027	0.151	0.262	1.242	2.692	7.885	0.910	0.575	1.237	1.292	7.590	39.691
1996	13.461	14.936	0.130	0.760	0.662	2.250	8.128	27.033	3.142	1.959	5.479	2.597	34.156	114.693
1997	19.079	21.369	0.574	2.297	1.201	3.110	19.094	67.019	7.901	4.835	15.906	3.643	72.108	238.136
1998	25.351	27.927	1.862	5.402	1.620	3.969	35.674	127.280	15.109	9.098	32.695	4.431	91.083	381.501
1999	25.351	34.614	3.982	10.106	2.043	4.828	45.342	209.505	25.070	14.855	53.903	5.232	117.649	552.480
2000	25.351	41.430	6.937	10.106	2.065	5.687	59.398	292.294	35.262	20.614	75.111	6.576	151.805	732.636
2001	25.351	48.378	10.741	10.106	2.084	6.546	73.577	376.209	45.688	26.371	96.319	7.907	197.347	926.624
2002	25.351	55.459	15.623	10.106	2.103	7.405	87.880	460.687	56.354	32.130	117.703	9.263	223.913	1103.977
2003	16.909	55.281	21.830	10.106	2.125	8.264	102.318	545.728	67.265	37.887	139.088	10.620	250.479	1267.900
2004	11.890	47.740	29.311	10.106	2.148	9.123	116.881	631.895	78.427	43.646	160.649	11.989	288.430	1442.235
2005	6.272	41.307	38.208	10.106	1.886	9.983	116.881	710.178	89.846	49.402	182.210	13.372	307.406	1577.057
2006	0.000	34.748	48.210	10.106	1.486	10.842	116.881	777.198	101.527	55.162	203.772	13.372	307.406	1680.710
2007	0.000	28.062	58.581	10.106	0.947	11.701	116.881	821.689	113.475	60.918	225.510	13.372	296.021	1757.263
2008	0.000	21.248	68.852	10.106	0.528	12.560	116.881	844.780	125.700	66.678	247.248	13.372	311.201	1839.152
2009	0.000	14.298	79.019	9.955	0.105	13.419	116.881	844.780	138.208	72.434	269.162	13.372	311.201	1882.834
2010	0.000	7.217	89.058	9.348	0.082	14.278	114.524	844.780	150.092	78.194	290.547	12.080	296.021	1906.219
2011	0.000	0.000	88.955	7.809	0.064	15.137	109.756	844.780	160.946	83.950	310.341	10.775	250.479	1882.992
2012	0.000	0.000	88.512	4.704	0.045	15.997	100.146	844.780	156.187	83.950	299.914	9.728	223.913	1827.876
2013	0.000	0.000	87.223	0.000	0.022	16.856	85.620	844.780	148.980	83.375	283.124	8.940	197.347	1756.267

ACEEE Proposed Programs Analysis
Peak Demand (MW) Impacts
PSI Conservative Scenario

Year	2nd Refrig. Turn-In	CF Coupon	Heat Pump Water Heater	Cl. Washer Rebates	Farm Efficiency	Enhanced S$ Duct Seal	Com. Eq. Replacement	Com. HVAC Ret. Upgrade	Com. Remodeling	Com. New Construction	Ind. New Construction	Small Ind. Direct Install	Enhanced Ind. Efficiency	Total ACEEE Programs
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.422	0.076	0.002	0.023	0.034	0.168	0.350	0.602	0.087	0.144	0.335	0.172	1.010	3.425
1996	0.673	0.154	0.010	0.114	0.068	0.305	1.084	2.006	0.303	0.488	1.006	0.346	4.547	11.104
1997	0.954	0.220	0.044	0.343	0.085	0.421	2.224	4.013	0.627	1.206	2.011	0.485	9.599	22.232
1998	1.267	0.288	0.142	0.806	0.104	0.538	3.886	5.723	1.017	2.269	3.353	0.590	12.125	32.108
1999	1.267	0.356	0.305	1.509	0.123	0.654	6.159	6.927	1.494	3.708	5.029	0.696	15.661	43.888
2000	1.267	0.427	0.531	1.509	0.124	0.771	8.835	7.825	2.035	5.145	6.705	0.875	20.208	56.257
2001	1.267	0.499	0.823	1.509	0.125	0.887	11.530	8.327	2.575	6.577	8.381	1.053	26.270	69.823
2002	1.267	0.571	1.197	1.509	0.126	1.004	14.264	8.628	3.116	8.013	10.057	1.233	29.807	80.792
2003	0.845	0.570	1.672	1.509	0.127	1.120	17.024	8.936	3.657	9.448	11.761	1.414	33.343	91.426
2004	0.594	0.492	2.246	1.509	0.129	1.237	19.817	9.337	4.201	10.893	13.466	1.596	38.395	103.912
2005	0.313	0.426	2.927	1.509	0.095	1.353	19.817	9.638	4.743	12.330	15.170	1.780	40.921	111.022
2006	0.000	0.358	3.695	1.509	0.061	1.470	19.817	9.932	5.284	13.767	16.874	1.780	40.921	115.468
2007	0.000	0.289	4.489	1.509	0.043	1.586	19.803	10.233	5.821	15.192	18.578	1.780	39.405	118.728
2008	0.000	0.219	5.276	1.509	0.025	1.703	19.802	10.534	6.362	16.628	20.310	1.780	41.426	125.574
2009	0.000	0.147	6.055	1.487	0.006	1.819	19.802	10.542	6.903	18.064	22.042	1.780	41.426	130.073
2010	0.000	0.074	6.825	1.398	0.005	1.936	19.486	10.542	7.363	19.515	23.439	1.608	39.405	131.594
2011	0.000	0.000	6.817	1.168	0.004	2.052	18.797	9.932	7.688	20.952	24.500	1.434	33.343	126.685
2012	0.000	0.000	6.783	0.703	0.003	2.168	17.678	8.527	7.358	20.936	23.495	1.295	29.807	118.753
2013	0.000	0.000	6.684	0.000	0.001	2.285	16.060	8.521	6.989	20.792	22.154	1.190	26.270	108.926

ACEEE Proposed Programs Analysis
Peak Demand (MW) Impacts
ACEEE Optimistic Scenario

Year	2nd Refrig. Turn-In	CF Coupon	Heat Pump Water Heater	Cl. Washer Rebates	Farm Efficiency	Enhanced S$ Duct Seal	Com. Eq. Replacement	Com. HVAC Ret. Upgrade	Com. Remodeling	Com. New Construction	Ind. New Construction	Small Ind. Direct Install	Enhanced Ind. Efficiency	Total ACEEE Programs
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.422	0.076	0.002	0.023	0.034	0.168	0.672	1.966	0.227	0.144	0.165	0.172	1.010	5.081
1996	0.673	0.154	0.010	0.114	0.085	0.305	2.027	6.742	0.784	0.488	0.729	0.346	4.547	17.004
1997	0.954	0.220	0.044	0.343	0.154	0.421	4.762	18.714	1.971	1.206	2.117	0.485	9.599	38.990
1998	1.267	0.288	0.142	0.806	0.208	0.538	8.897	31.766	3.768	2.269	4.352	0.590	12.125	67.016
1999	1.267	0.356	0.305	1.509	0.262	0.654	11.316	52.288	6.257	3.708	7.175	0.696	15.661	101.454
2000	1.267	0.427	0.531	1.509	0.265	0.771	14.824	72.894	8.800	5.145	9.999	0.875	20.208	137.515
2001	1.267	0.499	0.823	1.509	0.267	0.887	18.349	93.821	11.394	6.577	12.822	1.053	26.270	175.538
2002	1.267	0.571	1.197	1.509	0.270	1.004	21.916	114.889	14.054	8.013	15.668	1.233	29.807	211.398
2003	0.845	0.570	1.672	1.509	0.273	1.120	25.516	136.200	16.775	9.448	18.515	1.414	33.343	247.200
2004	0.594	0.492	2.246	1.509	0.276	1.237	29.171	157.706	19.573	10.893	21.385	1.596	38.395	285.073
2005	0.313	0.426	2.927	1.509	0.242	1.353	29.171	177.243	22.423	12.330	24.255	1.780	40.921	314.893
2006	0.000	0.358	3.695	1.509	0.191	1.470	29.171	193.822	25.339	13.767	27.125	1.780	40.921	339.148
2007	0.000	0.289	4.489	1.509	0.122	1.586	29.148	204.918	28.299	15.192	30.019	1.780	39.405	356.756
2008	0.000	0.219	5.276	1.509	0.068	1.703	29.148	210.676	31.348	16.628	32.913	1.780	41.426	372.694
2009	0.000	0.147	6.055	1.487	0.014	1.819	29.148	210.836	34.467	18.064	35.830	1.780	41.426	381.073
2010	0.000	0.074	6.825	1.396	0.011	1.936	28.583	210.836	37.459	19.515	38.676	1.608	39.405	386.324
2011	0.000	0.000	6.817	1.166	0.008	2.052	27.393	210.676	40.168	20.952	41.312	1.434	33.343	385.321
2012	0.000	0.000	6.783	0.703	0.006	2.168	24.975	210.676	38.951	20.936	39.923	1.295	29.807	376.223
2013	0.000	0.000	6.684	0.000	0.003	2.285	21.354	210.676	37.153	20.792	37.688	1.190	26.270	364.095

PSI Energy and ACEEE DSM Programs Analysis
Annual Energy (GWh) Impacts

Year	Current PSI Programs	Current PSI Programs less overlap	ACEEE Optimistic Scenario	ACEEE Conservative Scenario	PSI + ACEEE Opt. Scenario	PSI + ACEEE Con. Scenario	CAC CINergy Target	PSI CAC Target
1994	259.399	259.232	0.000	0.000	259.232	259.399		289.2
1995	414.145	413.941	39.691	33.653	453.632	447.798	612.000	519.2
1996	582.373	582.197	114.693	91.939	696.890	674.312	1062.000	749.2
1997	797.399	759.451	238.136	170.318	997.587	967.717	1516.000	981.2
1998	975.627	899.925	381.501	237.700	1281.426	1213.327	1977.000	1217.2
1999	1125.227	1011.740	552.480	313.768	1564.220	1438.995	2445.000	1457.2
2000	1232.031	1080.764	732.636	394.765	1813.400	1626.796		
2001	1327.418	1138.377	926.624	486.626	2065.001	1814.044		
2002	1474.474	1239.304	1103.977	560.066	2343.281	2034.540		
2003	1530.712	1280.917	1267.900	619.456	2548.817	2150.168		
2004	1585.594	1321.173	1442.235	688.046	2763.408	2273.640		
2005	1642.234	1363.297	1577.057	727.783	2940.354	2370.017		
2006	1693.278	1399.934	1680.710	747.485	3080.644	2440.763		
2007	1743.007	1441.471	1757.263	762.440	3198.734	2505.447		
2008	1777.224	1467.600	1839.152	803.941	3306.752	2581.165		
2009	1804.714	1487.105	1882.834	828.660	3369.939	2633.374		
2010	1830.527	1504.940	1906.219	832.133	3411.159	2662.660		
2011	1856.333	1522.833	1882.992	787.138	3405.825	2643.471		
2012	1877.415	1536.791	1827.876	737.907	3364.667	2615.322		
2013	1749.713	1455.961	1756.267	678.667	3212.228	2428.380		

PSI Energy and ACEEE DSM Programs Analysis
Peak Demand (MW) Impacts

Year	Current PSI Programs	Current PSI Programs less overlap	ACEEE Optimistic Scenario	ACEEE Conservative Acenario	PSI + ACEEE Opt. Scenario	PSI + ACEEE Con. Scenario	CAC CINergy Target	PSI CAC Target
1994	88.768	81.309	0.000	0.000	81.309	88.768		83
1995	117.969	110.510	5.081	3.425	115.591	121.394	222.000	122
1996	149.103	141.644	17.004	11.104	158.648	160.207	305.000	162
1997	179.642	162.595	38.990	22.232	201.585	201.874	389.000	202
1998	207.746	181.168	67.016	32.108	248.184	239.854	474.000	242
1999	230.074	193.938	101.454	43.888	295.392	273.962	560.000	282
2000	244.486	198.677	137.515	56.257	336.192	300.743		
2001	257.501	202.106	175.538	69.823	377.644	327.324		
2002	273.901	206.803	211.398	80.792	418.201	354.693		
2003	263.311	192.691	247.200	91.426	439.891	354.737		
2004	270.582	196.265	285.073	103.912	481.338	374.494		
2005	278.882	200.869	314.893	111.022	515.762	389.904		
2006	285.993	204.064	339.148	115.468	543.212	401.461		
2007	292.317	208.275	356.756	118.728	565.031	411.045		
2008	297.659	211.503	372.694	125.574	584.197	423.233		
2009	302.740	214.706	381.073	130.073	595.779	432.813		
2010	307.882	217.739	386.324	131.594	604.063	439.476		
2011	313.393	220.894	385.321	126.685	606.215	440.078		
2012	318.447	224.099	376.223	118.753	600.322	437.200		
2013	294.971	212.325	364.095	108.926	576.420	403.897		

ACPSIIMP.XLS
6/11/94

Lost Revenue Analysis with ACEEE Optimistic Scenario

Year	System Energy Sales (GWh)	Current PSI DSM Impacts (GWh)	ACEEE DSM Impacts (GWh)	Energy Sales Net of Current DSM (GWh)	Energy Sales Net of Current DSM and ACEEE(GWh)	Revenue Loss with PSI DSM ($000)	Fuel Savings with PSI DSM ($000)	Revenue Loss with ACEEE DSM ($000)	Fuel Savings with ACEEE DSM ($000)	Total Lost Revenue	Lost Revenue $/kWh
1994	27387	259	0	27127.768	27127.768	$10,419	$3,510	$0	$0	$6,909,000	0.00025
1995	27784	414	40	27370.059	27330.368	$17,853	$6,703	$1,767	$633	$12,284,000	0.00045
1996	28179	582	115	27596.803	27482.11	$26,796	$8,813	$5,179	$1,806	$21,356,000	0.00078
1997	28726	759	238	27966.549	27728.413	$35,530	$13,061	$11,074	$4,045	$29,498,000	0.00106
1998	29471	900	382	28571.075	28189.574	$44,728	$17,145	$18,218	$6,905	$38,896,000	0.00138
1999	30162	· 1012	552	29150.26	28597.78	$54,561	$21,474	$28,199	$11,015	$50,271,000	0.00176
2000	30578	1081	733	29497.236	28764.6	$66,521	$26,869	$41,659	$16,539	$64,772,000	0.00225
2001	31126	1138	927	29987.623	29060.999	$75,737	$31,377	$56,212	$22,752	$77,820,000	0.00268
2002	31798	1239	1104	30558.696	29454.719	$82,135	$37,515	$69,893	$29,055	$85,458,000	0.00290
2003	32576	1281	1268	31295.083	30027.183	$87,588	$41,764	$82,183	$35,209	$92,798,000	0.00309
2004	33586	1321	1442	32264.827	30822.592	$92,394	$49,865	$96,218	$46,067	$92,680,000	0.00301
2005	34514	1363	1577	33150.703	31573.646	$98,505	$58,395	$109,584	$56,752	$92,942,000	0.00294
2006	35628	1400	1681	34228.066	32547.356	$102,330	$37,238	$119,959	$32,567	$152,484,000	0.00468
2007	36495	1441	1757	35053.529	33296.266	$109,228	$40,544	$131,212	$34,893	$165,003,000	0.00496
2008	37372	1468	1839	35904.4	34065.248	$113,511	$44,967	$142,358	$41,403	$169,499,000	0.00498
2009	38024	1487	1883	36536.895	34654.061	$120,349	$48,373	$153,295	$43,402	$181,869,000	0.00525
2010	38751	1505	1906	37246.06	35339.841	$122,448	$53,002	$163,305	$49,574	$183,177,000	0.00518
2011	39560	1523	1883	38037.167	36154.175	$133,054	$56,643	$169,762	$49,595	$196,578,000	0.00544
2012	40372	1537	1828	38835.209	37007.333	$139,334	$61,422	$172,300	$54,662	$195,550,000	0.00528
2013	41183	1456	1756	39727.039	37970.772	$134,083	$74,345	$172,370	$69,111	$162,997,000	0.00429
PV	422969	14068	12653	408901	396248	$536,034	$229,650	$549,635	$197,643	$658,376,000	0.00166

Lost Revenue Analysis with ACEEE Conservative Scenario

Year	System Energy Sales (GWh)	Current PSI DSM Impacts (GWh)	ACEEE DSM Impacts (GWh)	Energy Sales Net of Current DSM (GWh)	Energy Sales Net of Current DSM and ACEEE(GWh)	Revenue Loss with PSI DSM ($000)	Fuel Savings with PSI DSM ($000)	Revenue Loss with ACEEE DSM ($000)	Fuel Savings with ACEEE DSM ($000)	Total Lost Revenue	Lost Revenue $/kWh
1994	27387	259	0	27127.768	27127.768	$10,419	$3,510	$0	$0	$6,909,000	0.00025
1995	27784	414	34	27370.059	27336.406	$17,853	$6,703	$1,467	$532	$12,085,000	0.00044
1996	28179	582	92	27596.803	27504.864	$26,796	$8,813	$4,025	$1,454	$20,554,000	0.00075
1997	28726	759	170	27966.549	27796.231	$35,530	$13,061	$7,618	$2,855	$27,232,000	0.00098
1998	29471	900	238	28571.075	28333.375	$44,728	$17,145	$10,980	$4,277	$34,286,000	0.00121
1999	30162	1012	314	29150.26	28836.492	$54,561	$21,474	$15,174	$6,174	$42,087,000	0.00146
2000	30578	1081	395	29497.236	29102.471	$66,521	$26,869	$20,875	$8,869	$51,658,000	0.00178
2001	31126	1138	487	29987.623	29500.997	$75,737	$31,377	$27,650	$11,696	$60,314,000	0.00204
2002	31798	1239	560	30558.696	29998.63	$82,135	$37,515	$33,480	$14,576	$63,524,000	0.00212
2003	32576	1281	619	31295.083	30675.627	$87,588	$41,764	$37,796	$17,001	$66,619,000	0.00217
2004	33586	1321	688	32264.827	31576.781	$92,394	$49,865	$42,901	$21,782	$63,648,000	0.00202
2005	34514	1363	728	33150.703	32422.92	$98,505	$58,395	$46,935	$26,007	$61,038,000	0.00188
2006	35628	1400	747	34228.066	33480.581	$102,330	$37,238	$49,728	$16,000	$98,820,000	0.00295
2007	36495	1441	762	35053.529	34291.089	$109,228	$40,544	$52,699	$17,110	$104,273,000	0.00304
2008	37372	1468	804	35904.4	35100.459	$113,511	$44,967	$57,860	$19,630	$106,774,000	0.00304
2009	38024	1487	829	36536.895	35708.235	$120,349	$48,373	$62,478	$21,173	$113,281,000	0.00317
2010	38751	1505	832	37246.06	36413.927	$122,448	$53,002	$66,314	$23,225	$112,535,000	0.00309
2011	39560	1523	787	38037.167	37250.029	$133,054	$56,643	$66,134	$22,599	$119,946,000	0.00322
2012	40372	1537	738	38835.209	38097.302	$139,334	$61,422	$64,966	$23,655	$119,223,000	0.00313
2013	41183	1456	679	39727.039	39048.372	$134,083	$74,345	$61,847	$31,964	$89,621,000	0.00230
PV	422969	14068	5942	408901	402959	$536,034	$229,650	$240,664	$97,110	$449,938,000	0.00112

ACEEE Lost Revenue Analysis - Optimistic Scenario
1994-2013 Present Value

Program	Impacts (GWh)	System Sales Net of Impacts (GWh)	Revenue Loss ($000)	Fuel Savings ($000)	Total Lost Revenue ($000)	Lost Revenue Levelized $/kWh
2ND refrig. Turn-in	150.574	422818.426	$7,201	$2,394	$4,807	0.00001
CF Coupon Program	333.571	422635.429	$16,192	$5,760	$10,432	0.00002
Heat Pump/Water Heater	372.322	422596.678	$18,304	$6,478	$11,826	0.00003
Clothes Washer Rebate	85.973	422883.027	$4,188	$1,483	$2,705	0.00001
Farm Efficiency	14.485	422954.515	$699	$249	$450	0.00000
Enhanced S$ - Duct Seal	96.06	422872.94	$4,675	$1,609	$3,066	0.00001
Commercial Equipment Replacement	875.064	422093.936	$41,060	$14,288	$26,772	0.00006
Commercial HVAC Retirement Upgrade	5519.943	417449.057	$259,755	$86,433	$173,322	0.00042
Commercial Remodeling - Lighting	805.205	422163.795	$37,965	$12,644	$25,321	0.00006
Commercial New Construction	439.82	422529.18	$20,731	$6,974	$13,757	0.00003
Industrial New Construction	1603.717	421365.283	$56,525	$26,211	$30,314	0.00007
Small Industrial Direct Installation	99.401	422869.599	$3,464	$1,643	$1,821	0.00000
Enhanced Industrial Efficiency	2257.128	420711.872	$78,876	$37,169	$41,707	0.00010
Total ACEEE Programs	12653.263	410315.737	549635	197643	$351,992	0.00086

ACEEE Lost Revenue Analysis - Conservative Scenario
1994-2013 Present Value

Program	Impacts (GWh)	System Sales Net of Impacts (GWh)	Revenue Loss ($000)	Fuel Savings ($000)	Total Lost Revenue ($000)	Lost Revenue Levelized $/kWh
2ND refrig. Turn-in	150.574	422818.426	$7,201	$2,394	$4,807	0.00001
CF Coupon Program	333.571	422635.429	$16,192	$5,760	$10,432	0.00002
Heat Pump/Water Heater	372.322	422596.678	$18,304	$6,478	$11,826	0.00003
Clothes Washer Rebate	85.973	422883.027	$4,188	$1,483	$2,705	0.00001
Farm Efficiency	6.433	422962.567	$309	$108	$201	0.00000
Enhanced S$ - Duct Seal	96.06	422872.94	$4,675	$1,609	$3,066	0.00001
Commercial Equipment Replacement	575.43	422393.57	$27,046	$9,412	$17,634	0.00004
Commercial HVAC Retirement Upgrade	351.408	422617.592	$16,398	$5,718	$10,680	0.00003
Commercial Remodeling - Lighting	167.307	422801.693	$7,877	$2,664	$5,213	0.00001
Commercial New Construction	439.82	422529.18	$20,731	$6,974	$13,757	0.00003
Industrial New Construction	1006.49	421962.51	$35,404	$16,460	$18,944	0.00004
Small Industrial Direct Installation	99.401	422869.599	$3,464	$1,643	$1,821	0.00000
Enhanced Industrial Efficiency	2257.128	420711.872	$78,876	$37,169	$41,707	0.00010
Total ACEEE Programs	5941.917	417027.083	240665	$97,110	$143,555	0.00034

PSI Energy Demand-Side Management Programs
Peak Demand (MW) Impacts
Base Year 1993

Year	R-1 Water Heater Wrap-up	R-8 Seal-up	R-5 Storage WH	WH/AC Cycling	R-9 Low Income	Smart $aver Conservation	C1/C2 Com. Audits & Inc.	C3 Sm. Com. Lighting	I1/I2 Ind. Efficiency	Peak Reduction	Time-of-Use	Planergy	1992 Historical DSM	Total
1994	1.053	1.224	0.000	0.000	0.175	13.118	14.118	4.233	9.992	21.214	0.787	5.641	17.213	88.768
1995	1.546	1.775	0.110	2.400	0.243	16.715	23.483	5.875	19.983	21.214	1.771	5.641	17.213	117.969
1996	2.230	2.214	0.330	4.799	0.310	19.703	33.070	7.690	32.130	21.214	2.559	5.641	17.213	149.103
1997	2.915	2.420	0.769	7.200	0.378	22.499	42.658	9.504	43.885	21.214	3.346	5.641	17.213	179.642
1998	4.452	2.627	1.648	7.200	0.445	25.298	52.092	11.319	54.464	21.214	4.133	5.641	17.213	207.746
1999	6.020	2.833	2.548	7.200	0.512	28.097	57.854	13.133	62.889	21.214	4.920	5.641	17.213	230.074
2000	7.618	3.040	3.469	7.200	0.580	30.946	59.958	13.133	68.766	21.214	5.708	5.641	17.213	244.486
2001	9.026	3.246	4.413	7.200	0.648	33.836	61.772	13.133	73.664	21.214	6.495	5.641	17.213	257.501
2002	9.789	3.685	5.380	7.200	0.716	36.645	65.481	13.133	80.325	21.214	7.479	5.641	17.213	273.901
2003	10.012	3.685	6.370	7.200	0.675	39.408	67.927	13.133	84.831	21.214	8.856	0.000	0.000	263.311
2004	10.083	3.806	7.383	7.200	0.675	41.991	70.035	13.133	85.418	21.214	9.644	0.000	0.000	270.582
2005	9.590	3.927	8.420	7.200	0.675	44.184	72.143	13.133	87.965	21.214	10.431	0.000	0.000	278.882
2006	8.906	3.927	9.483	7.200	0.772	45.945	74.470	13.133	90.512	21.214	10.431	0.000	0.000	285.993
2007	8.221	3.927	10.571	7.200	0.675	47.303	76.583	13.133	93.059	21.214	10.431	0.000	0.000	292.317
2008	6.684	3.927	11.685	7.200	0.675	48.407	78.697	13.133	95.606	21.214	10.431	0.000	0.000	297.659
2009	5.116	3.927	12.827	7.200	0.675	49.489	80.575	13.133	98.153	21.214	10.431	0.000	0.000	302.740
2010	3.518	3.927	13.885	7.200	0.675	50.515	82.684	13.133	100.700	21.214	10.431	0.000	0.000	307.882
2011	2.110	3.927	14.862	7.200	0.675	51.554	85.040	13.133	103.247	21.214	10.431	0.000	0.000	313.393
2012	1.347	3.927	15.648	7.200	0.675	51.796	86.889	13.133	105.793	21.214	10.825	0.000	0.000	318.447
2013	1.347	3.254	14.769	7.200	0.608	51.796	75.187	11.017	99.132	21.214	9.447	0.000	0.000	294.971

PSIDSVIM.XLS
6/11/94

PSI Energy Demand-Side Management Programs
Annual Energy (GWh) Impacts
Base Year 1993

Year	R-1 Water Heater Wrap-up	R-8 Seal-up	R-5 Storage WH	WH/AC Cycling	R-9 Low Income	Smart $aver Conservation	C1/C2 Com. Audits & Inc.	C3 Sm. Com. Lighting	I1/I2 Ind. Efficiency	Peak Reduction	Time-of-Use	Planergy	1992 Historical DSM	Total
1994	15.269	27.621	0.000	0.000	2.815	35.221	55.588	26.081	72.435	0.859	0.323	0.609	22.578	259.399
1995	22.411	40.066	0.140	0.087	3.927	48.526	92.464	36.198	144.871	1.222	0.726	0.929	22.578	414.145
1996	32.337	49.972	0.419	0.136	5.039	58.582	130.214	47.377	232.930	1.004	1.051	0.734	22.578	582.373
1997	42.263	54.629	0.978	0.228	6.151	122.673	167.965	58.557	318.148	1.077	1.372	0.780	22.578	797.399
1998	64.556	59.286	2.097	0.230	7.263	145.792	205.715	69.736	394.844	1.073	1.695	0.762	22.578	975.627
1999	87.285	63.943	3.241	0.278	8.375	169.944	228.466	80.915	455.917	1.313	2.018	0.954	22.578	1125.227
2000	110.457	68.600	4.415	0.312	9.487	195.792	236.073	80.915	498.526	1.460	2.345	1.071	22.578	1232.031
2001	130.866	73.257	5.615	0.359	10.599	220.373	243.214	80.915	534.034	1.683	2.663	1.262	22.578	1327.418
2002	141.936	83.165	6.844	0.483	11.710	279.636	257.807	80.915	582.324	2.231	3.067	1.778	22.578	1474.474
2003	145.165	83.165	8.104	0.575	11.119	312.196	268.221	80.915	614.991	2.629	3.632	0.000	0.000	1530.712
2004	146.197	85.895	9.395	0.850	11.119	347.741	276.547	80.915	619.252	3.721	3.962	0.000	0.000	1585.594
2005	139.055	88.625	10.713	1.153	11.119	379.131	284.872	80.915	637.716	4.658	4.277	0.000	0.000	1642.234
2006	129.129	88.625	12.065	1.389	11.119	410.736	293.198	80.915	656.180	5.645	4.277	0.000	0.000	1693.278
2007	119.203	88.625	13.449	1.584	12.503	440.172	301.523	80.915	674.644	6.112	4.277	0.000	0.000	1743.007
2008	96.910	88.625	14.870	1.738	11.119	469.116	309.849	80.915	693.108	6.689	4.285	0.000	0.000	1777.224
2009	74.181	88.625	16.318	1.944	11.119	490.395	318.175	80.915	711.572	7.193	4.277	0.000	0.000	1804.714
2010	51.009	88.625	17.665	2.095	11.119	510.737	326.500	80.915	730.036	7.549	4.277	0.000	0.000	1830.527
2011	30.600	88.625	18.908	2.270	11.119	528.460	334.826	80.915	748.500	7.833	4.277	0.000	0.000	1856.333
2012	19.530	88.625	19.912	2.355	11.119	533.527	342.107	80.915	766.964	7.914	4.447	0.000	0.000	1877.415
2013	19.530	73.450	18.790	2.571	10.007	530.771	296.031	67.875	718.673	8.141	3.874	0.000	0.000	1749.713

PSI Energy and ACEEE DSM Program Analysis
Environmental Benefits SO2

Year	"Current" SO2 Impacts (Lbs/MWh)	"Current" PSI Energy (GWh)	"Current" SO2 Savings (Tons)	"PSI Energy Plus ACEEE Conservative" SO2 Impacts (Lbs/MWh)	"ACEEE Conservative" (GWh)	"PSI Energy Plus ACEEE Conservative" (GWh)	"PSI Energy Plus ACEEE Conservative" SO2 Impacts (Tons)	"PSI Energy Plus ACEEE Optimistic" SO2 Impacts (Lbs/MWh)	"ACEEE Optimistic" (GWh)	"PSI Energy Plus ACEEE Optimistic" (GWh)	"PSI Energy Plus ACEEE Optimistic" SO2 Impacts (Tons)
1995	16.01	414	3,313	16.01	34	448	3,583	16.01	40	454	3,632
1996	12.63	582	3,677	12.63	92	674	4,255	12.62	115	697	4,398
1997	12.54	797	4,999	12.53	170	968	6,061	12.52	238	1,035	6,483
1998	13.01	975	6,347	13.00	238	1,213	7,886	13.00	382	1,357	8,818
1999	12.84	1,125	7,222	12.84	314	1,439	9,237	12.83	553	1,678	10,764
2000	16.11	1,232	9,921	16.11	395	1,627	13,098	16.08	733	1,964	15,791
2001	16.29	1,327	10,808	16.26	487	1,814	14,747	16.26	927	2,254	18,317
2002	16.35	1,474	12,047	16.31	560	2,034	16,589	16.29	1,104	2,578	20,999
2003	16.41	1,530	12,554	16.37	620	2,150	17,599	16.35	1,268	2,798	22,870
2004	16.37	1,585	12,972	16.32	688	2,273	18,554	16.30	1,442	3,027	24,676
2005	16.14	1,642	13,250	16.13	728	2,370	19,114	16.10	1,577	3,219	25,916
2006	16.43	1,693	13,905	16.41	748	2,441	20,019	16.40	1,681	3,374	27,670
2007	16.01	1,743	13,949	15.98	762	2,505	20,022	15.98	1,757	3,500	27,962
2008	15.89	1,777	14,121	15.90	804	2,581	20,517	15.88	1,839	3,617	28,719
2009	15.65	1,805	14,126	15.73	829	2,634	20,711	15.72	1,883	3,688	28,987
2010	15.42	1,831	14,118	14.74	832	2,664	19,631	15.55	1,906	3,738	29,058
2011	14.25	1,858	13,231	14.31	787	2,645	18,918	14.31	1,883	3,741	26,768
2012	14.43	1,879	13,553	14.50	738	2,617	18,972	14.51	1,828	3,707	26,895
2013	14.12	1,752	12,370	13.55	679	2,431	16,468	13.53	1,756	3,508	23,732

PSI Energy and ACEEE DSM Program Analysis
Environmental Benefits CO2

Year	"Current" Heat Rate (btu/kWh)	"Current" PSI Energy (GWh)	"Current" CO2 Savings (Tons)	"PSI Energy Plus ACEEE Conservative" Heat Rate (btu/kWh)	"ACEEE Conservative" (GWh)	"PSI Energy Plus ACEEE Conservative" (GWh)	"PSI Energy Plus ACEEE Conservative" CO2 Impacts (Tons)	"PSI Energy Plus ACEEE Optimistic" Heat Rate (btu/kWh)	"ACEEE Optimistic" (GWh)	"PSI Energy Plus ACEEE Optimistic" (GWh)	"PSI Energy Plus ACEEE Optimistic" CO2 Impacts (Tons)
1995	10,034	414	430,258	10,034	34	448	465,290	10,034	40	454	471,527
1996	10,036	582	605,331	10,036	92	674	700,882	10,036	115	697	724,588
1997	9,928	797	819,953	9,928	170	968	995,113	9,925	238	1,035	1,064,527
1998	9,981	975	1,008,594	9,983	238	1,213	1,254,635	9,983	382	1,357	1,403,359
1999	10,006	1,125	1,166,199	9,988	314	1,439	1,488,808	9,989	553	1,678	1,735,978
2000	9,871	1,232	1,259,683	9,869	395	1,627	1,663,082	9,866	733	1,964	2,007,848
2001	9,884	1,327	1,358,927	9,882	487	1,814	1,856,821	9,882	927	2,254	2,307,282
2002	9,894	1,474	1,510,980	9,891	560	2,034	2,084,460	9,890	1,104	2,578	2,641,532
2003	10,048	1,530	1,593,001	10,050	620	2,150	2,238,329	10,050	1,268	2,798	2,913,430
2004	10,033	1,585	1,647,687	10,033	688	2,273	2,362,807	10,034	1,442	3,027	3,147,050
2005	10,019	1,642	1,704,240	10,020	728	2,370	2,459,919	10,016	1,577	3,219	3,340,220
2006	10,023	1,693	1,758,086	10,014	748	2,441	2,532,001	10,014	1,681	3,374	3,500,150
2007	10,027	1,743	1,810,624	10,021	762	2,505	2,601,045	10,021	1,757	3,500	3,633,926
2008	10,024	1,777	1,845,806	10,023	804	2,581	2,680,378	10,018	1,839	3,617	3,753,542
2009	10,013	1,805	1,872,722	10,034	829	2,634	2,738,102	10,030	1,883	3,688	3,832,334
2010	9,995	1,831	1,896,382	9,986	832	2,664	2,755,523	10,024	1,906	3,738	3,881,447
2011	9,975	1,858	1,919,766	9,998	787	2,645	2,739,465	9,995	1,883	3,741	3,873,428
2012	9,976	1,879	1,941,869	9,997	738	2,617	2,710,191	9,994	1,828	3,707	3,837,941
2013	9,946	1,752	1,805,271	9,967	679	2,431	2,509,895	9,964	1,756	3,508	3,621,514

PSI Energy and ACEEE DSM Program Analysis
Environmental Benefits NOx

Year	"Current" Heat Rate (btu/kWh)	"Current" PSI Energy (GWh)	"Current" NOx Savings (Tons)	"PSI Energy Plus ACEEE Conservative" Heat Rate (btu/kWh)	"ACEEE Conservative" (GWh)	"PSI Energy Plus ACEEE Conservative" (GWh)	"PSI Energy Plus ACEEE Conservative" NOx Impacts (Tons)	"PSI Energy Plus ACEEE Optimistic" Heat Rate (btu/kWh)	"ACEEE Optimistic" (GWh)	"PSI Energy Plus ACEEE Optimistic" (GWh)	"PSI Energy Plus ACEEE Optimistic" NOx Impacts (Tons)
1995	10,034	414	934	10,034	34	448	1,011	10,034	40	454	1,024
1996	10,036	582	1,315	10,036	92	674	1,522	10,036	115	697	1,574
1997	9,928	797	1,781	9,928	170	968	2,161	9,925	238	1,035	2,312
1998	9,981	975	2,190	9,983	238	1,213	2,725	9,983	382	1,357	3,048
1999	10,006	1,125	2,533	9,988	314	1,439	3,233	9,989	553	1,678	3,770
2000	9,871	1,232	2,736	9,869	395	1,627	3,612	9,866	733	1,964	4,361
2001	9,884	1,327	2,951	9,882	487	1,814	4,033	9,882	927	2,254	5,011
2002	9,894	1,474	3,282	9,891	560	2,034	4,527	9,890	1,104	2,578	5,737
2003	10,048	1,530	3,460	10,050	620	2,150	4,861	10,050	1,268	2,798	6,327
2004	10,033	1,585	3,578	10,033	688	2,273	5,132	10,034	1,442	3,027	6,835
2005	10,019	1,642	3,701	10,020	728	2,370	5,342	10,016	1,577	3,219	7,254
2006	10,023	1,693	3,818	10,014	748	2,441	5,499	10,014	1,681	3,374	7,602
2007	10,027	1,743	3,932	10,021	762	2,505	5,649	10,021	1,757	3,500	7,892
2008	10,024	1,777	4,009	10,023	804	2,581	5,821	10,018	1,839	3,617	8,152
2009	10,013	1,805	4,067	10,034	829	2,634	5,947	10,030	1,883	3,688	8,323
2010	9,995	1,831	4,119	9,986	832	2,664	5,984	10,024	1,906	3,738	8,430
2011	9,975	1,858	4,169	9,998	787	2,645	5,950	9,995	1,883	3,741	8,412
2012	9,976	1,879	4,217	9,997	738	2,617	5,886	9,994	1,828	3,707	8,335
2013	9,946	1,752	3,921	9,967	679	2,431	5,451	9,964	1,756	3,508	7,865