
Pacific Gas & Electric Retrofit Program Profile #25, 1992

Executive Summary	2
Utility Overview	3
<i>1991 PG&E Sources of Electrical Energy Table; PG&E 1991 Electric Statistics Table</i>	
Utility DSM Overview	4
<i>Current PG&E DSM Programs Table; Utility DSM Overview Table; Annual Electric C&LM Expenditure (chart); Annual Energy Savings (chart); Annual Capacity Savings (chart)</i>	
Program Overview	6
Implementation	7
<i>Marketing; Delivery; Measures Installed; Staffing Requirements; PG&E 1992 Retrofit Program Rebate Amounts Table</i>	
Monitoring and Evaluation	10
<i>Monitoring; Evaluation; Data Quality</i>	
Program Savings	12
<i>Savings Overview Table; Annual Energy Savings (chart); Cumulative Energy Savings (chart); Annual Capacity Savings (chart); Cumulative Capacity Savings (chart); Participation Rates; Savings per Participant Table; Measure Lifetime; Projected Savings</i>	
Cost of the Program	14
<i>Cost Overview Table; Total Program Cost (chart); Cost Effectiveness; Cost of Saved Energy Table; Cost per Participant; Free Ridership; Cost Components</i>	
Environmental Benefit Statement	16
<i>Avoided Emissions Analysis Table</i>	
Lessons Learned / Transferability	18
Regulatory Incentives / Shareholder Returns	19
References	20

Executive Summary

PG&E's Retrofit Program for commercial, industrial and agricultural customers encompasses five basic end-use areas: air-conditioning, motors, lighting, agricultural, and refrigeration & cooking. Through the Retrofit Program, eligible customers receive incentives in the form of rebates for improving the efficiency of their facilities by using qualifying, high efficiency equipment. While the Retrofit Program is marketed primarily to small and medium non-residential customers, any non-residential account may apply for rebates under the program. Commercial lighting is the largest component of the program. In 1991, 59% of the lifecycle savings realized through the program resulted from lighting projects, and commercial customers' retrofits represented 78% of those savings.

In order to participate in the program, the customer fills out a one-page application form after purchasing and installing the qualifying products, attaches the original paid invoice, and mails the form to PG&E. Upon receipt of the completed application and applicable invoices, program staff verify that the application is correct, and a rebate check is sent to the customer. The maximum rebate is \$100,000 per customer per year.

Annual energy savings due to the Retrofit Program more than doubled between 1990 and 1991, peak capacity savings increased by 24%, and lifecycle savings nearly quadrupled. This increase in savings was due to a shift in program focus to lighting measures, as well as the increased activity inspired by the California Collaborative which called for a dramatic increase in DSM expenditures and emphasis on measured savings. Whereas lighting projects in all sectors made up 22% of the annual savings in 1990, lighting accounted for 41.2% of the annual program savings in 1991. The Retrofit Program's expenditures increased six-fold between 1989 and 1990, to \$6.2 million, and then doubled to \$12 million in 1991. The majority of PG&E's costs for implementing the Retrofit Program are incentive payments in the form of rebates. In 1991, incentive payments were almost \$11 million, while administrative costs were approximately \$1.1 million.

Perhaps the most successful part of the program, second only to the actual savings achieved, is its evolution. Through a continual process of feedback from its customers, and through comprehensive evaluation, PG&E has been able to refine the program to increase its efficacy. For instance, PG&E found that its rebate application forms were cumbersome, so it standardized the forms for simplicity. Additionally, rebate levels were increased for some measures, making them more attractive. Conversely, some rebate levels were lowered to better reflect the incentive required by the measure. Finally, the Retrofit Program is nicely dovetailed with PG&E's Customized Rebate Program. (See Profile #4) As technologies and state-of-the-art applications become common in the customized incentive program, what were innovative efficiency measures are shifted over to and incorporated into the more straightforward Retrofit Program, serving to transform the market for energy efficiency retrofits.

Retrofit Program

Utility:	Pacific Gas and Electric
Sector:	Commercial, Industrial, Agricultural
Measures:	Air conditioning, motors, lighting, agricultural measures, refrigeration and cooking.
Mechanism:	Rebates
History:	Modified program began in 1990

1991 Program Data

Energy savings:	200 GWh
Lifecycle energy savings:	2,517 GWh
Capacity savings:	47.6 MW
Cost:	\$12,141,300

Cumulative Data (1990-1991)

Energy savings:	390 GWh
Lifecycle energy savings:	3,168 GWh
Capacity savings:	86 MW
Cost:	\$18,407,200

Conventions

For the entire 1992 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor's Consumer Price Index and the International Monetary Fund's International Financial Statistics Yearbook: 1991.

The Results Center uses three conventions for presenting program savings. **Annual savings** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **Cumulative savings** represent the savings in a given year for all measures installed to date. **Lifecycle savings** are calculated by multiplying the annual savings by the assumed average measure lifetime. **Caution:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

Utility Overview

Pacific Gas and Electric (PG&E) is an investor-owned gas and electric utility with a service territory that is subdivided into 25 divisions and which encompasses 94,000 square miles in northern and central California. In 1991, PG&E serviced 4.26 million electric customer accounts and 3.5 million gas customer accounts.

Electric sales exceed gas sales and represent 75% and 25% respectively of the company's total operating revenues. In 1991, PG&E's electric sales volume increased slightly compared to 1990, to 74,196 GWh. During the same year gas sales dropped as PG&E began shifting its focus from gas sales to expanding its gas transmission capability.

PG&E has developed its electric supply plan with four main objectives: maximizing customer energy efficiency, reducing dependence on oil for power generation, participating in the competitive bulk power supply market, and conducting aggressive research and development of renewable energy resources.

1991 PG&E SOURCES OF ELECTRICAL ENERGY

PG&E Owned	
Hydro	7.6%
Natural Gas	22.5%
Oil	0.2%
Geothermal	7.2%
Nuclear	15.5%
subtotal	53.0%
Qualifying Facilities	
Gas Cogeneration	12.0%
Hydro	1.0%
Geothermal	0.6%
Solar	0.2%
Wind	3.6%
Biomass	2.6%
subtotal	20.0%
Other purchases	27.0%

PG&E 1991 ELECTRIC STATISTICS

Number of Customers	4,257,145
Electricity Sales	74,196 GWh
Electricity Sales Revenue	\$6.971 billion
Summer Peak Demand	16,630 MW
Generating Capacity	20,312 MW
Average Electric Rates	
Residential	10.97 ¢/kWh
Commercial	10.08 ¢/kWh
Industrial	6.81 ¢/kWh
Agricultural	9.54 ¢/kWh

[R#1]

In 1991 PG&E's electricity supply came from three general sources: 53% from PG&E owned and operated facilities, 20% from Qualifying Facilities (QFs), and 27% from a variety of purchases and other production. The 20% contribution from QFs is relatively large compared to most other utilities and is the result of a deliberate effort by PG&E to diversify its electricity supply and expand the role of renewable energy. The table at left contains a breakdown of the contributions from PG&E-owned facilities and its Qualifying Facilities. The 27% that is mostly purchased power is not broken down by energy source because of the complicated nature of these purchases. [R#1,2]

Utility DSM Overview

Pacific Gas and Electric has been a leading U.S. utility in demand-side management since 1976. Over the years the giant west coast utility has spent over \$2 billion on its conservation and load management activities, including a small sum for solar DSM programs. In California DSM is defined in four ways: conservation, load management, fuel substitution, and load building and retention. The data presented in this section refers only to conservation and load management and expenditures are expressed in leveled dollars.

PG&E refers to its DSM programs as Customer Energy Efficiency (CEE) programs. These programs were significantly expanded in 1990 when the California Public Utilities Commission issued a decision authorizing the utility to implement new DSM programs and enhance existing ones. The combined goal of all of the CEE programs is to achieve a total 2,500 MW reduction in peak electric demand growth by the year 2000. In 1991, CEE program expenditures were equivalent to 2% of the utility's total energy revenues [R#3,4].

CURRENT PG&E DSM PROGRAMS

Residential

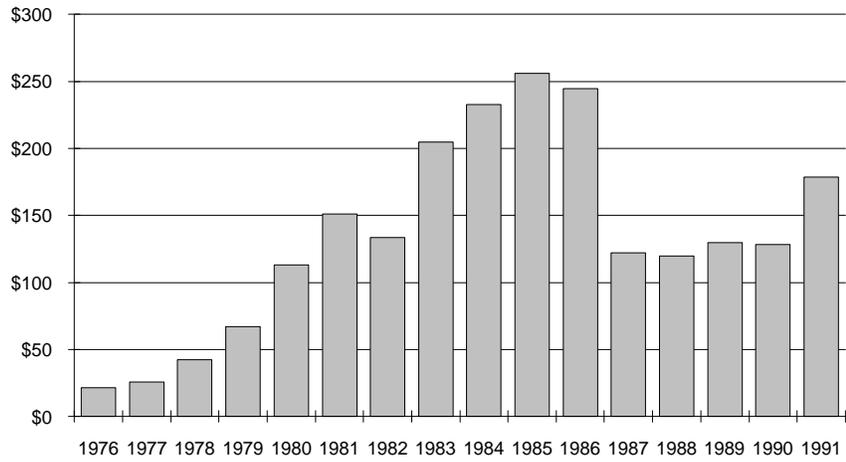
- New Construction Program
- Appliance Efficiency Incentives Programs
- Direct Assistance for Low-Income Customers
- Energy Management Services
- Information Programs

Nonresidential

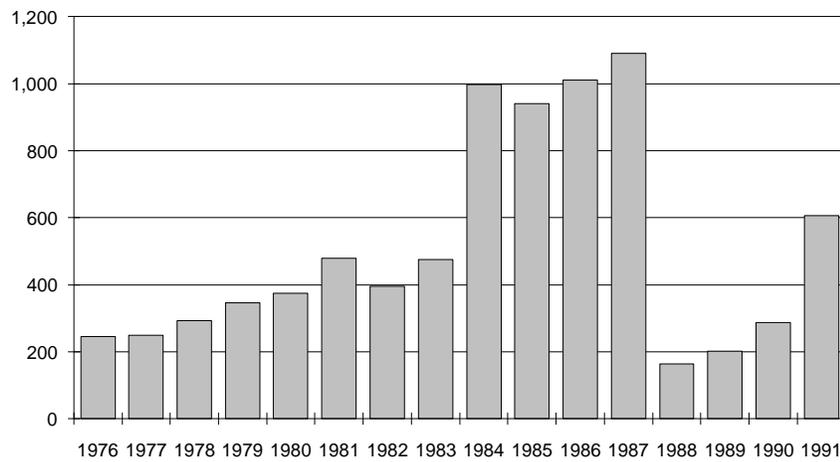
- Commercial New Construction Rebates
- Nonresidential Energy Efficiency Incentive
- Retrofit Program**
- Customized Electric Rebates
- Customized Gas Rebates
- CIA Energy Efficiency Incentives
- Commercial Market Sector Pilot Projects
- CIA Energy Management Services
- Nonresidential Information Programs
- Load Management Programs
- Fuel Substitution
- Load Retention and Load Building
- CEE Demonstration Projects

Utility DSM Overview Table	Annual C & LM Expenditure (x1,000)	Annual Energy Savings (GWh)	Annual Capacity Savings (MW)	Annual Gas Savings (Therms Millions)
1976	\$21,413	246	64	47
1977	\$25,737	249	48	67
1978	\$42,245	292	59	50
1979	\$67,246	347	175	76
1980	\$113,082	375	277	66
1981	\$151,093	479	81	87
1982	\$133,601	396	63	99
1983	\$204,913	476	84	75
1984	\$232,788	997	211	59
1985	\$256,044	941	110	119
1986	\$244,701	1,010	129	140
1987	\$121,931	1,091	498	48
1988	\$119,708	163	296	12
1989	\$129,593	202	97	14
1990	\$128,292	288	676	25
1991	\$178,767	607	676	32
Total	\$2,171,154	8,159	3,544	1,016

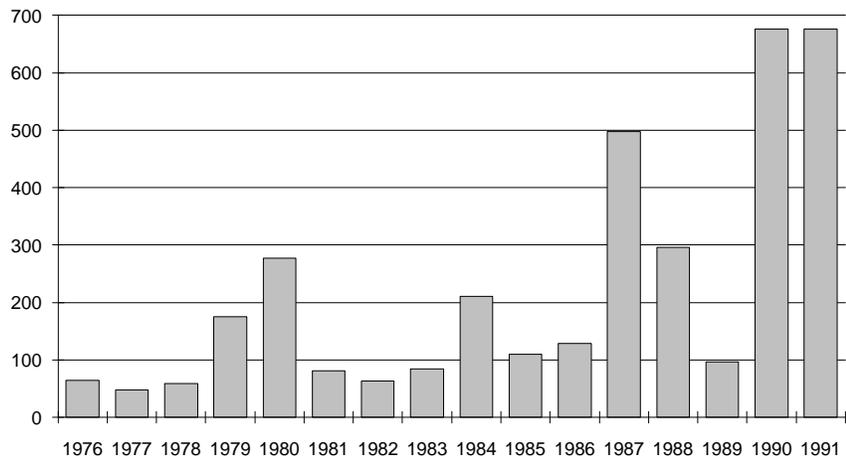
**ANNUAL ELECTRIC
C&LM EXPENDITURE
(\$1,000,000)**



**ANNUAL ENERGY
SAVINGS (GWH)**



**ANNUAL CAPACITY
SAVINGS (MW)**



Program Overview

PG&E's Retrofit Program for commercial, industrial and agricultural customers has five components: air conditioning, motors, lighting, agricultural, and refrigeration & cooking. Through the Retrofit Program eligible customers receive incentives in the form of rebates for improving the efficiency of their facilities by retrofitting with qualifying, high efficiency equipment. All of the Retrofit Programs are marketed primarily to small and medium non-residential customers, although any non-residential account may apply for rebates under the programs.[R#3]

Commercial lighting is the largest component of the comprehensive Commercial, Industrial, and Agricultural Retrofit Program. In 1991, 59% of the lifecycle savings realized through the Retrofit Program resulted from lighting projects and commercial customers represented 78% of those savings. The program has also realized significant savings from installations of energy-efficient air conditioning equipment, motors, pumps and irrigation equipment, and refrigeration and cooking equipment.

In order to participate in the program, the customer fills out a one-page application form after purchasing and installing the qualifying products, attaches the original paid invoice, and mails the form to PG&E. (A few rebate items require PG&E verification of existing equipment before the customer purchases and installs the replacement equipment.) Upon receipt of the completed application and applicable invoices, program staff verify that the application is correct, and a rebate check is sent to the customer.

Prior to 1992, the Retrofit Program was known as the Direct Rebate program, in which commercial, industrial, and agricultural components were administered as separate energy management entities. The 1992 name change was part of a major redesign that improved the program's marketability and efficacy. New application forms were developed, with separate forms for each end-use, and several new items were

added to the program, while some were deleted. Rebate levels were reset, and changes were made in the assumptions used in energy and capacity savings calculations. Additionally, PG&E stepped up its association with trade allies, such as equipment vendors, recognizing the importance of their support in influencing customers to choose energy-efficient equipment.

The 1992 changes in the Retrofit Program are the culmination of several years of analysis and evaluation of PG&E's non-residential incentive programs. Since the mid-1980s PG&E has used a variety of marketing and implementation approaches to deliver rebates to non-residential customers who install energy-efficient equipment. The program has grown from 27 eligible rebate items in 1985 to over 50 in 1992. While the maximum rebate level has remained constant at \$100,000, limits within each end-use category were imposed for a number of years but then dropped for the 1992 program. In addition, the minimum rebate level was lowered from \$500 to \$100 in 1987, before it was ultimately eliminated completely. Thus in the 1992 program, customers may receive rebates in any amount up to \$100,000 per year for any combination of the air conditioning, motors, lighting, agricultural, and refrigeration & cooking retrofit applications.

Implementation

MARKETING

Over the years that PG&E has offered rebates for its commercial, industrial, and agricultural customers, a number of marketing approaches have been used. PG&E tested bill inserts, for example, but found them to be largely ineffective. According to John Chin, the program manager for 1992, the best way of making customers aware of the rebates for energy-efficient equipment, and in fact to make customers aware of the potentials for energy efficiency, is to literally have someone tell them about it. "The bottom line is that you need some form of personal contact," says Chin.

The Retrofit Program is actively promoted by PG&E's commercial and industrial marketing representatives, but currently there are too few representatives for the smaller eligible customers to get the job done effectively. While industrial customer representatives are assigned for each industrial customer, and the same is true for most large commercial customers, the program's current prime targets – small commercial customers – are not typically assigned customer representatives. This has become somewhat problematic, causing PG&E program staff to look carefully at how to increase the role of trade allies, such as equipment vendors, to capture the technical potentials that the program design has promoted. This is discussed further in the Lessons Learned section. [R#16]

Currently the program is being marketed in four ways.

1. Workshops conducted by PG&E for customers. The utility hosts breakfasts and luncheons at which staff or invited speakers make presentations that illuminate the potentials for efficiency in different end-use areas and how to participate in PG&E's incentives.
2. As discussed above, customer representatives provide direct information to their assigned customers and educate these customers about their efficiency potentials and how to take advantage of PG&E's incentives.
3. Some direct mail pieces are sent to customers but with little apparent effect. [R#16]
4. PG&E also hosts vendor meetings which focus on the

potential that vendors have to use energy efficiency as a marketing tool for their own sales and services. Knowing about the potentials for efficiency is essentially a value-added aspect of the salesperson's repertoire, and PG&E is recognizing that this route may be a highly effective and low cost means of increasing participation in the Retrofit Program.

DELIVERY

The program application forms and instructions are distributed in an attractive folder to eligible customers. Customers then follow the instructions for filling out the proper form(s) and determining their rebate amount(s). Once PG&E receives the completed application and accompanying invoices, the installation is confirmed, and the rebate check is mailed.

Verification of pre-existing equipment is required for certain installations, typically 25-50% of all installations, and is carried out by field representatives who are generally familiar with the customers who take advantage of the incentives. Incandescent conversions, optical reflector installations, interior high-intensity discharge fixture installations, evaporative cooler installations, and installation of many of the refrigeration items are subject to pre-existing equipment verifications.

PG&E has turned its attention toward trade allies in the marketing plan for 1992. Recognizing the unique opportunity for saving presented when motors, air conditioning equipment, or refrigeration systems fail, PG&E has worked toward encouraging manufacturers and distributors of such equipment to encourage customers to replace their failed systems with more efficient technologies. By ensuring that these trade allies can inform customers of potential savings with efficient equipment, and by promoting the availability of such products, PG&E hopes to influence customer's decisions, even when they do not have any contact with a PG&E representative. [R#12]

MEASURES INSTALLED

For the commercial rebates, the largest energy savings resulted from pump adjustments (spring tune-ups), evaporative coolers, and high intensity discharge fixtures. For the

Implementation (continued)

industrial rebates, evaporative coolers, high intensity discharge fixtures, and 5-7.5 HP motor retrofits yielded the most savings. For the agricultural side of the program the biggest energy savers were surge valves (greater than 6"), pump adjustments, and heat recovery systems for well water plates. [R#3]

As shown in the 1992 Rebate Amounts Table, a number of items are eligible for rebates under PG&E's 1992 Retrofit Program. In no case will a rebate be paid for more than 100% of the customer's investment. The maximum rebate per customer account is \$100,000 per year. (Rebate amounts reported in this section are in 1992 dollars.) The following paragraphs highlight the classes of technologies that are eligible for rebates in each end-use area.

LIGHTING

Fixture replacement, fluorescent lamp retrofits, and a variety of other measures that enhance lighting efficiency are eligible for rebates.

MOTORS

Energy-efficient motors that adhere to the NEMA Standard may be rebated at up to 50% of the marginal cost between the energy-efficient motor and a standard-efficiency motor. Premium-efficiency motors that adhere to the NEMA Future Design Standard may be rebated at up to 75% of the marginal cost between the premium-efficiency motor and a standard-efficiency motor.

In 1993 PG&E will be rolling out a new element of the motors aspect of the Retrofit Program. Vendors will get \$5 for every energy-efficient or premium-efficient motor that they sell. (PG&E decided not to offer a bounty for each horsepower, because this might lead to vendors selling oversized motors.) In addition, the vendors will get another \$5/motor for each rebate application that they help the customers complete.

AIR CONDITIONING

Air conditioning system replacements and maintenance, as well as many measures that improve air conditioning efficiency, are eligible for rebates. Water chillers and air-cooled or evaporative-cooled single package or split systems that exceed applicable federal or California Title 24 standards may qualify for rebates. However, minimum rebate levels are in effect for those measures, preventing the installation of equipment that just exceeds the standard.

REFRIGERATION AND COOKING

Refrigeration system replacements and maintenance, as well as many measures that improve refrigeration efficiency, are eligible for rebates. Infrared fryers with capacity between 35 and 50 pounds and infrared griddles are also eligible for rebates.

STAFFING REQUIREMENTS

The Retrofit Program is administered by a "skeleton" crew. The program manager, a position that has rotated among five program sponsors, spends about half full time equivalent (0.5 FTE) running the program and developing plans for subsequent years. The other four program sponsors, who are responsible for end-use areas such as agriculture, lighting, refrigeration, and air conditioning, spend approximately 50% time on the program (2 FTE). A technical counselor spends about a third time on the Retrofit Program (0.3). A regulatory counselor spends about 10% time on the program, making sure that the program complies with regulatory requirements (0.1). The program manager has an assistant who spends approximately 20% time on the program (0.2 FTE). Another 50% (0.5 FTE) "of a body" accounts for personnel time in program planning and evaluation.

In addition to the headquarters staffing requirements, approximately 250 field representatives work with the program. John Chin estimates that they spend about 40-50% of their time on the two rebate program elements (customized and direct) and about 25% of their time on the Retrofit Program (direct rebate). Thus another 62.5 FTE run the program in the field for a total program staffing commitment of 66.1 FTE. [R#16]

STAFFING SUMMARY (IN FULL-TIME EQUIVALENTS):

Program manager	0.5
Four program sponsors	2.0
Technical counselor	0.3
Regulatory counselor	0.1
Program manager's assistant	0.2
Program planning and evaluation	0.5
Field Representatives	62.5
Total	66.1

PG&E 1992 RETROFIT PROGRAM REBATE AMOUNTS

LIGHTING

Halogen infrared lamps	\$2.75/lamp
Compact fluorescent lamps	
Screw-in lamp and ballast	\$3 to \$6/unit
Hardwire or exit sign retrofit kits	\$15/fixture
Fluorescent or T-8 lamp/ballast retrofits or fixtures	\$10 - \$40/fixture
Energy-saving fluorescent lamps	\$0.90 - \$1.25/lamp
Electronic ballasts	\$5/lamp controlled
Optical reflectors	\$8 - \$14/lamp removed
High-intensity discharge retrofit kits or fixtures	\$25 - \$100/fixture
Controls	\$10 - \$80

AIR CONDITIONING

A/C units	\$35 - \$45/ton-EER or SEER
Remote condensing units	\$20 - \$25/ton-EER
Water chillers	\$25 - \$50
Evaporative condensers and cooling towers	\$5/ton per degree
Early Replacement of equipment	\$2.50 - \$10/ton-year
Economizers	Hours/100 x Tons x # Units x \$10
Reflective window film	\$0.50/square foot
Evaporative coolers	Hours/100 x Tons x # Units x \$10
Condenser coil cleaning	\$7.50/coil or \$1/ton
Controls	\$10 - \$45

MOTORS

Energy-efficient or Premium-efficiency motors	50% or 75% of incremental cost over standard motor
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AGRICULTURAL

Pump retrofits	Maximum: 50% of project cost
Pump adjustments	\$35/adjustment
Well-water measurement devices	\$1/foot
Low-pressure sprinkler nozzles	\$0.50
Surge valves	\$450
Greenhouse coverings and heat curtains	\$0.10 - \$0.20/square foot
Time clocks with batteries or springwound backups	\$80

REFRIGERATION AND COOKING

High-capacity condensers	\$7.50 - \$100/ton-F.
High-efficiency evaporator fan motors	\$4/linear foot
Energy-efficient display case lighting	\$6/linear foot of case
Strip curtains or strip doors	\$1 - \$5/linear foot
Glass or acrylic doors	\$20 - \$30/linear foot
New refrigeration cases with glass or acrylic doors	\$50 - \$60/linear foot
Humidistat controls for anti-sweat heaters	\$5/linear foot
Energy-efficient compressors	\$2,500/ton-EER
Equipment that enhances refrigeration efficiency	\$15 - \$75/ton
Condenser coil cleaning	\$7.50/coil or \$1/ton
Infrared fryers	\$75
Infrared griddles	\$32/foot of griddle width

Monitoring and Evaluation

MONITORING

PG&E has an extensive monitoring and evaluation process that encompasses all of its DSM programs. Each year, PG&E compiles a summary report on all of its demand-side management programs. In that report, PG&E presents its plan for measurement and evaluation which includes: program evaluation, load metering, new technology assessment, customer surveys, forecasting, CPUC compliance activities, and economic analysis.

In 1990, PG&E initiated a load research study in which 5 to 15 participants in the Retrofit Program were end-use monitored. In 1991, additional participants were monitored.

A scoping study was completed in 1991 which identified the vital components of a comprehensive evaluation plan specifically for PG&E's non-residential incentive programs. The scoping study outlined a plan to document the results of the incentive programs through surveys, billing analyses, on-site audits, statistical modelling, field monitoring, and other tracking methods.

EVALUATION

An engineering study of first-year savings for the Retrofit Program was completed in 1991. The study updated estimates of first-year savings for all direct rebate measures based on manufacturer data and published research. The study found that the engineering estimates used in the Retrofit Program were generally appropriate and within the range of values used and reported elsewhere. Additionally, the study recommended that different hours of operation be applied to different building types instead of one average figure being used for all building types. Another result of this evaluation was the elimination of several technologies from incentives and the addition of others. [R#3,10]

Additionally, a short-term commercial metering project of lighting retrofits was completed in 1991. In this study, nine sites were metered for two weeks prior to a lighting retrofit, and for two weeks following the retrofit. Most of the retrofits involved installation of optical reflectors and removal of two lamps from four-lamp fixtures. This study confirmed that high efficiency lighting systems performed as predicted. However, capacity and energy savings were somewhat lower than expected, with percentage reductions in kW demand averaging 36.2%, and reductions in energy use averaging 34%. These discrepancies were determined to have resulted from inaccurate assumptions regarding lighting utilization factors. As a result, new guidelines for PG&E application reviewers were developed and implemented in the 1992 program. [R#3,11]

Two other short-term metering studies that relate directly to the Retrofit Program have been completed. Three sites where commercial and industrial customers installed energy-efficient motors were metered to determine the validity of short-term metering for this application. The study determined that random fluctuations in motor load must be less than 20% of the energy savings in order for valid analysis to be possible.

The second study was a side-by-side comparison of refrigeration installations which revealed that weather adjusted energy savings of 37.3% could be realized from the use of a state-of-the-art refrigeration system in a 117,000 square foot wholesale discount store. These savings were higher than the 28% savings estimated using manufacturer's data. [R#3,11]

DATA QUALITY

The California Collaborative Process, which was initiated to facilitate the negotiation process between the California Public Utilities Commission, California's utilities, and consumer advocacy groups, has had a positive effect on the quality and accessibility of data concerning PG&E's DSM programs. The collaborative process resulted in the overhaul and expansion of most of PG&E's DSM programs, including the Customized Electric Program. The process has also resulted in PG&E being required to make a much more careful accounting of its DSM expenditures. Because its DSM expenditures (including rebates paid to customers) are more carefully scrutinized than before, PG&E has become much more careful in checking rebate application forms. For these reasons, data reported after 1989 are much more easily analyzed and compared, and are probably more accurate, than data reported prior to 1989. Therefore, although the various forms of the program have been operating since 1985, only 1990 and 1991 data are included in this profile. [R#1]

The Retrofit Program offers both electric and gas efficiency rebates, and the cost data presented in this profile reflect both electric and gas savings. (Since the avoided costs for gas are low, PG&E has focused the program on electric efficiency measures. In fact, 90% of the expenditures and savings have been related to electric measures. [R#16])

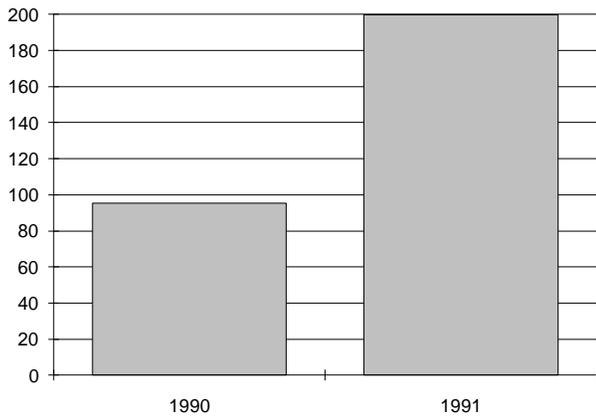
In 1992, PG&E implemented major changes in the algorithms used for energy and capacity saving calculations. These changes will affect the comparability of the figures presented in this profile with those that will be generated in the future but does not invalidate the savings and cost figures presented herein. The results of end-use metering projects have shown that the algorithms used previously tended to underestimate savings. The new assumptions regarding measure lifetimes and operating hours will make the resulting savings estimates closer to the actual savings experienced when these measures are implemented.

PG&E does not report its administrative and marketing costs separately for each of its DSM programs. Administrative costs shown in the Cost Overview Table are estimates based on reported figures used in several PG&E documents. In the 1992 Economic Analysis presented in "Commercial, Industrial, and Agricultural Programs, 1992 Retrofit Program", [R#12] it is reported that administrative costs are approximately 10% of the rebate incentive cost for the Retrofit Program. Additionally, in "1990 - 1992 Energy Efficiency Programs", [R#14], budgets are presented for the three years 1990 to 1992, with administrative costs for commercial, industrial, and agricultural incentive programs averaging 11% of the incentive costs. Thus, 10% of incentive costs seems to be an accurate representation of the administrative expenditures for the Retrofit Program.

Program Savings

Savings Overview Table	Annual Energy Savings (MWh)	Cumulative Energy Savings (MWh)	Lifecycle Energy Savings (MWh)	Annual Capacity Savings (MW)	Cumulative Capacity Savings (MW)
1990	95,391	95,391	650,702	38.3	38.3
1991	199,716	295,108	2,516,971	47.6	86.0
Total	295,108	390,499	3,167,674	86.0	

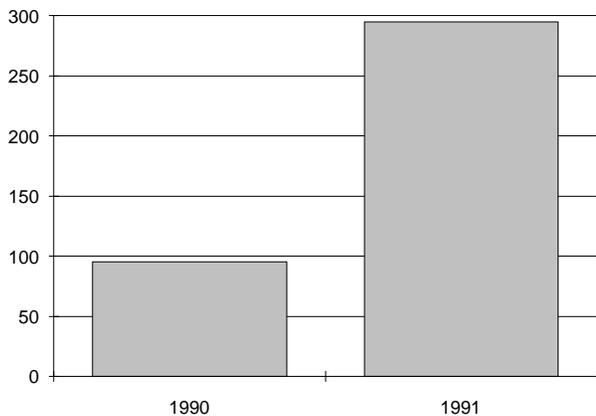
ANNUAL ENERGY SAVINGS (GWH)



ANNUAL CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE CAPACITY SAVINGS (MW)



Between 1990 and 1991, the Retrofit Program has resulted in total annual energy savings of 295,108 MWh and lifecycle energy savings of 3,167,674 MWh. In terms of capacity the program has provided 86 MW of annual capacity savings.

Annual energy savings due to the Retrofit Program more than doubled between 1990 and 1991. Capacity savings increased by 24% in that period, and lifecycle savings nearly quadrupled. This change in savings configuration was due to a shift in program focus to lighting measures, as well as the increased activity inspired by the California Collaborative. Whereas lighting projects in all sectors made up 22% of the annual savings in 1990, lighting accounted for 41.2% of the annual program savings in 1991. This increase was accompanied by a decrease in annual savings from space conditioning projects, from 22.3% of the 1990 total to just 8.4% of the 1991 total.

PARTICIPATION RATES

PG&E reports program participation for the Retrofit Program by number of measures, number of applications, and square footage. More than 23 million measures were installed through the program in 1991, more than triple the

Savings Per Participant Table	Number of Items Rebated	Number of Applications	Average Energy Savings per Application (kWh)
1990	6,800,592	N/A	N/A
1991	23,270,720	14,314	13,953
Total	30,071,312		

number installed in 1990. PG&E reported the number of applications received for the Retrofit Program in 1991 was 14,314. This figure does not equal the number of customers served, however, and John Chin estimates that in 1991 some 8-9,000 customer applied for rebates under the program, of which about 6,000 customer rebates were processed. Comparable application figures were not available for 1990. [R#3,9,16]

Square footage of buildings in which projects occurred is also reported by PG&E, however, these figures do not necessarily represent the area over which retrofits were applied; additionally, many commercial projects do not report square footage at all. In 1990, buildings with nearly 235 million square feet of floor space were involved in the Retrofit Program, and in 1991, almost 392 million square feet were involved. [R#3,9]

MEASURE LIFETIME

In calculating lifecycle savings, PG&E applies a specific lifetime for each measure implemented through the Retrofit Program. Lifetimes range from 1 to 20 years, with the average weighted useful life being 6.8 years in 1990 and 12.6 years in 1991. This change reflects the shift in focus to lighting, with a significant number of high lifetime retrofits being included in the 1991 program. For example, the number of lighting measures retrofitted that had 20-year lifetimes (which includes optical reflectors, high intensity discharge lamps, and electronic ballasts) increased from 16,000 in 1990 to over 60,000 in 1991. Additionally, the number of refrigeration measures implemented that had 20 to 25-year lifetimes (including compact refrigerators, oversized evaporative condensers, and refrigeration cases with doors), increased from 244 measures in 1990 to over 5,600 in 1991. [R#3,9]

Assumed lifetimes in 1992 were changed for many of the lighting measures. The number of operating hours for seven market sectors was specified in CPUC Advice letters 1638G and 1350E in 1991. Thus the measure lifetime varies by sector, depending on the rated product life and the agreed upon hours of operation. [R#12]

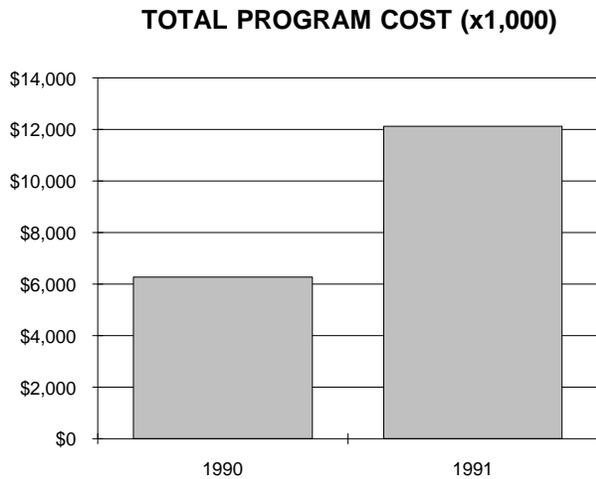
PROJECTED SAVINGS

Based on the measures installed in 1991 the Retrofit Program will provide lifecycle savings of 2,517 GWh for each year that it operates at 1991 participation rates.

PG&E seeks to cut 2,500 MW from its overall demand by the year 2000. However, no specific projections are made for the Retrofit Program in isolation.

Cost of the Program

Cost Overview Table	Administration (x1000)	Incentives (x1000)	Total Program Cost (x1000)	Average Cost per Application
1990	\$626.6	\$5,639.3	\$6,265.9	Not Available
1991	\$1,214.1	\$10,927.2	\$12,141.3	\$848
Total	\$1,840.7	\$16,566.5	\$18,407.2	



Between 1990 and 1991, PG&E spent a total of \$18.4 million on the program. Of this total, \$16.6 million has been directly spent on customer incentives. As a result of the California Collaborative, expenditures increased six-fold between 1989 and 1990, to \$6 million, and doubled to \$12 million in 1991.

COST EFFECTIVENESS

PG&E uses the CPUC/CEC Standard Practice Manual for Economic Analysis of Demand-Side Management Program to determine the cost effectiveness of each of its

Cost of Saved Energy Table (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
1990	1.08	1.12	1.16	1.20	1.24	1.29	1.33
1991	0.59	0.62	0.66	0.70	0.74	0.78	0.83

programs. This methodology compares DSM program costs to marginal costs on a life-cycle basis to determine benefit cost ratio from a variety of perspectives.

Each component, commercial/industrial/agricultural, of the Retrofit Program (including both customized and direct components) has been screened individually in 1991 for the Total Resource Cost Test (TRC) and the Rate Impact Measure Test (RIM).

Commercial Electric Incentives	TRC	RIM
Large	5.19	0.73
Medium/Small	5.6	0.62
Industrial Electric Incentives		
Large	6.19	0.73
Medium/Small	5.61	0.55
Agricultural Electric Incentives	4.14	0.57

PG&E conducted an economic analysis of the CIA Retrofit Program to establish new rebate levels for the 1993 program. Almost all of the measures included in the 1992 Retrofit Program had TRC ratios greater than 1. However, a few measures for which the TRC was less than 1 were included in the program regardless, if inclusion was deemed necessary to introduce effective technologies into the market. [R#12]

The Results Center calculated cost of saved energy for the Retrofit Program at various discount rates, as shown in the Cost of Saved Energy Table. At 5%, the cost of saved energy in 1990 and 1991 was 1.16 ¢/kWh and 0.66 ¢/kWh, respectively.

COST PER PARTICIPANT

Because of the difficulty in defining participation for the Retrofit Program, (see Participation Rates in the Program Savings section) The Results Center only calculated cost per application for 1991. In 1991, the average application received rebates for 1,625 individual items. The resulting PG&E cost was \$848 per application, or about \$0.52 per item.

FREE RIDERSHIP

In PG&E's annual summary reports documenting the results of demand-side management programs in 1990 and 1991, PG&E uses a net-to-gross ratio of 0.7, indicating a free ridership factor of 30%. The ratio is based on the results of a survey conducted in 1989, which examined free ridership. The surveys also indicated that vendors were promoting energy-efficient measures and that they can have a significant impact on customers' purchase decisions. [R#3]

COST COMPONENTS

The majority of PG&E's costs for implementing the Retrofit Program are in incentive payments. In 1991, incentive payments were almost \$11 million, while administrative costs were approximately \$1.2 million. Administrative costs include monitoring and evaluation, marketing, and program implementation staff payroll.

Environmental Benefit Statement

Marginal Power Plant	Heat Rate BTU/kWh	% Sulfur in Fuel	CO2 (lbs)	SO2 (lbs)	NOx (lbs)	TSP* (lbs)
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Coal Uncontrolled Emissions

A	9,400	2.50%	841,916,000	19,974,000	4,038,000	404,000
B	10,000	1.20%	897,757,000	7,732,000	2,607,000	1,933,000

Controlled Emissions

A	9,400	2.50%	841,916,000	1,997,000	4,038,000	32,000
B	10,000	1.20%	897,757,000	773,000	2,607,000	129,000
C	10,000		897,757,000	5,155,000	2,577,000	129,000

Atmospheric Fluidized Bed Combustion

A	10,000	1.10%	897,757,000	2,363,000	1,289,000	644,000
B	9,400	2.50%	841,916,000	1,997,000	1,615,000	121,000

Integrated Gasification Combined Cycle

A	10,000	0.45%	897,757,000	1,589,000	258,000	644,000
B	9,010		807,552,000	576,000	194,000	39,000

Gas Steam

A	10,400		489,686,000	0	1,117,000	0
B	9,224		425,253,000	0	2,663,000	126,000

Combined Cycle

1. Existing	9,000		425,253,000	0	1,632,000	0
2. NSPS*	9,000		425,253,000	0	773,000	0
3. BACT*	9,000		425,253,000	0	107,000	0

Oil Steam--#6 Oil

A	9,840	2.00%	708,755,000	10,739,000	1,267,000	1,203,000
B	10,400	2.20%	751,710,000	10,653,000	1,594,000	773,000
C	10,400	1.00%	751,710,000	1,521,000	1,280,000	404,000
D	10,400	0.50%	751,710,000	4,467,000	1,594,000	246,000

Combustion Turbine

#2 Diesel	13,600	0.30%	940,712,000	1,873,000	2,908,000	159,000
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Refuse Derived Fuel

Conventional	15,000	0.20%	1,116,827,000	2,878,000	3,789,000	842,000
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Avoided Emissions Based on 390,498,857 kWh Saved (1990-1991)

In addition to the traditional costs and benefits there are several hidden environmental costs of electricity use that are incurred when one considers the whole system of electrical generation from the mine-mouth to the wall outlet. These costs, which to date have been considered externalities, are real and have profound long term effects and are borne by society as a whole. Some environmental costs are beginning to be factored into utility resource planning. Because energy efficiency programs present the opportunity for utilities to avoid environmental damages, environmental considerations can be considered a benefit in addition to the direct dollar savings to customers from reduced electricity use.

The environmental benefits of energy efficiency programs can include avoided pollution of the air, the land, and the water. Because of immediate concerns about urban air quality, acid deposition, and global warming, the first step in calculating the environmental benefit of a particular DSM program focuses on avoided air pollution. Within this domain we have limited our presentation to the emission of carbon dioxide, sulfur dioxide, nitrous oxides, and particulates. (Dollar values for environmental benefits are not presented given the variety of values currently being used in various states.)

HOW TO USE THE TABLE

1. The purpose of the previous page is to allow any user of this profile to apply PG&E's level of avoided emissions saved through its Retrofit Program to a particular situation. Simply move down the left-hand column to your marginal power plant type, and then read across the page to determine the values for avoided emissions that you will accrue should you implement this DSM program. Note that several generic power plants (labelled A, B, C,...) are presented which reflect differences in heat rate and fuel sulfur content.

2. All of the values for avoided emissions presented in both tables includes a 10% credit for DSM savings to reflect the avoided transmission and distribution losses associated with supply-side resources.

3. Various forms of power generation create specific pollutants. Coal-fired generation, for example, creates bottom ash (a solid waste issue) and methane, while garbage-burning plants release toxic airborne emissions including dioxin and furans and solid wastes which contain an array of heavy metals. We recommend that when calculating the environmental benefit for a particular program that credit is taken for the air pollutants listed below, plus air pollutants unique to a form of marginal generation, plus key land and water pollutants for a particular form of marginal power generation.

4. All the values presented represent approximations and were drawn largely from "The Environmental Costs of Electricity" (Ottinger et al, Oceana Publications, 1990). The coefficients used in the formulas that determine the values in the tables presented are drawn from a variety of government and independent sources.

* Acronyms used in the table

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

Lessons Learned / Transferability

LESSONS LEARNED

PG&E's Retrofit Program is an excellent example of the evolution of a comprehensive incentive program. Through years of experience and evaluation, PG&E has learned which measures were desirable, what types of application processes worked, how customers could best be influenced to participate, and how well measures actually performed in specific applications. The 1992 Retrofit Program was significantly changed from previous years incorporating the information generated regarding how best to implement the program.

After seven years of operation, PG&E has had many opportunities to look at how the non-residential incentive programs were operating and make well thought-out decisions on how best to reach the fundamental goal of the program, influencing electric customers to install energy-efficient equipment. The 1992 Retrofit Program reflects the changes made in PG&E's approach toward this goal. First, customer expectations were considered. Because customers indicated that application procedures involved in the Customized Rebate program were cumbersome, PG&E standardized many of the calculations for popular measures and incorporated them into the Retrofit Program. Additionally, rebate levels were increased for some measures, making them more attractive. Conversely, some rebate levels were lowered to better reflect the incentive required by the measure.

In selecting measures for inclusion in the 1992 program, PG&E used detailed criteria in an attempt to ensure the persistence of savings generated by the program. Factors assessed included: future persistence of demand for the measure, market potential, payback period, leading edge technologies, market life, and applicability across different market segments.

PG&E has recognized the importance of flexibility in its Retrofit Program. As measures become accepted within the market, they are dropped from inclusion in the program. High rebate levels are used to encourage installation of new and promising measures. Measures that prove popular in the Customized program are moved into the simpler Retrofit Program to encourage more widespread use. Through such adaptations, PG&E demonstrates its recognition of the importance of making changes to the program as new information is generated and evaluated.

According to John Chin, PG&E has taken care of the technical side of the program, but the marketing end needs more attention. The utility has been highly effective at transforming new energy efficiency applications (which were given incentives through the customized rebate program) into the direct rebate program discussed in this profile. But according to Chin, the marketing aspect of the program has lagged behind its technical aspect and this now frames the direction that the program must move in for maximum effectiveness.

Chin also believes that the basic element of the program that has been neglected is market research. Knowing more about the market would help PG&E tailor the program to the needs of its customers. Chin notes that PG&E does not know the market potential for its rebates, nor the penetration rates that the utility and its customers have already achieved, and thus the utility and its DSM staff do not know which aspects of the program to emphasize. This, according to Chin, is the real key to the future direction of the program. While market research is costly, Chin believes that it ought to be a fundamental core of the program's success and that without it, the already quite effective program is "flying in the dark."

TRANSFERABILITY

Rebates for energy-efficient equipment ought to be a core ingredient in most utilities' DSM efforts. Utilities, as PG&E has demonstrated, have the ability to carefully adjust rebate levels to 1) stimulate the market for energy efficiency, and to 2) transform the market by making such purchases the norm. As the transition occurs, utilities have the opportunity to ramp back on the incentives paid. Rebate programs also can benefit from having two discrete components. The first is a customized component in which the utility will pay for any proven energy savings. (See Profile #4). The second is a menu-driven rebate program such as the one described in this profile. By offering the two together, PG&E has shown the natural synergy between innovation in efficiency and basic incentives for efficient equipment. As the former become more common, these measures can be added to the list for the Retrofit Program. This format will likely be highly effective at all utilities genuinely interested in promoting efficiency with the ability to emphasize various end-use areas and technologies at different times.

Regulatory Incentives and Shareholder Returns

The California Public Utilities Commission (CPUC) considers the Retrofit Program to be a “resource program” for the purpose of assigning it an appropriate incentive mechanism. Resource programs typically apply technologies that reduce customers’ energy use while maintaining or improving their living standards, if they are residential customers, or their output levels, if they are commercial, industrial, or agricultural customers. Resource programs are cost-effective alternatives to supply-side resources and are thus valuable as “resources” to the utility. (Non-resource programs include education or auditing programs which are very important to successful implementation of a utility’s entire DSM portfolio, but do not produce easily quantifiable energy savings.)

The relatively simple incentive mechanism approved by the CPUC for PG&E’s resource programs includes both rewards and penalties. Every year each resource program is assigned a minimum performance standard (MPS). The MPS is the level of the net present value (NPV) of lifecycle benefits that a program must achieve to avoid penalties. The lifecycle benefits include both actual and committed results and are computed by the utility cost test (the avoided energy costs minus the utility’s costs to implement the program). When program achievements are greater than the MPS, the utility receives 15% of the NPV of the lifecycle benefits of the program. When program achievements are less than the MPS, the utility is required to pay a penalty of 15% of the difference between the MPS and the NPV of the achieved lifecycle benefits.

In 1991 PG&E CEE resource programs generated actual first-year energy savings of 104 MW, 518 GWh, and 23 million therms. As a result these programs generated net benefits which would result in \$58 million in shareholder earnings. PG&E, however, claimed \$47.4 million, slightly less than the earnings cap established for the year by the CPUC.[R#3]

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