
San Diego Gas & Electric Commercial Lighting Retrofit Profile #53

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Executive Summary

San Diego Gas & Electric's Commercial Lighting Retrofit program is one of the most unique and successful programs of its kind in the country. Not only is an unusual sales commission arrangement used to stimulate participation in the program, but the program has exceeded its targets for savings for each of the three years that it has been implemented. Analysts at SDG&E believe this success has been a direct result of the sales commissions paid. Lighting representatives are provided a base salary and then are eligible for a two-tiered commission based on their success. Furthermore, dissatisfied customers cost these reps money, as they have to repay twice the value of their commission on the job as a penalty.

In terms of program expenditures, the Commercial Lighting Retrofit program is SDG&E's largest program. In 1992 SDG&E spent approximately 1/3 of its total electric DSM budget on the program. As a result the program captured 44% of all electric DSM energy savings and 33% of all electric DSM capacity savings for the utility for the year.

The program also is unique in terms of the measures for which incentives are available. SDG&E offers commercial customers cash incentives for two, four, and eight foot fluorescent fixtures (which include lamps, ballasts, and optical reflectors) but the program has also convinced many customers to change out all of their interior lighting equipment for more efficient measures at the same time. SDG&E tries to sell the customer on retrofitting the entire lighting system by providing lighting recommendations and economic calculations for all lighting systems, regardless of type. Thus SDG&E tries to avoid having to perform a second retrofit. In a sense, the program incentives for select lighting efficiency measures leverage more comprehensive lighting energy savings, effectively foreclosing the lost opportunity of the retrofits' potentials. SDG&E will pay incentives for other "custom" measures which are determined to be cost effective and which are based on proven customer savings.

SDG&E conducts a custom bidding process for each job using a pool of precertified contractors who actually perform the retrofits. Through this fixed-price bidding process, SDG&E estimates that lighting retrofit costs are reduced by about 30% for each job. If customers elect to use their own contractors, the job must be initially surveyed by a SDG&E lighting representative, and then the job must meet performance standards before a rebate check is written. Typically the rebate pays for 50% of the total retrofit cost. Because of the different building sizes participating in the program, incentive payments have ranged from \$3,000 to \$500,000. With the SDG&E incentive, customer payback averages about one year for program measures.

Commercial Lighting Retrofit

Utility: San Diego Gas & Electric
Sector: Commercial
Measures: Lighting: two, four, and eight foot fluorescent lamps, ballasts, and optical reflectors
Mechanism: Custom financial incentives for installation of approved lighting measures
History: Started in September 1990

1992 Program Data

Energy savings: 52 GWh
Lifecycle energy savings: 780 GWh
Capacity savings: 13 MW
Cost: \$9,383,700

Cumulative Data (1990 - 1992)

Energy savings: 202 GWh
Lifecycle energy savings: 1,770 GWh
Capacity Savings: 28.9 MW
Cost: \$19,311,200

Conventions

For the entire 1993 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 U.S. Federal Reserve's foreign exchange rates.

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

San Diego Gas & Electric (SDG&E) is an investor-owned utility that was founded in 1881. SDG&E provides electric service to 1,122,000 customers throughout all of San Diego County and the southern part of Orange County. Fully 89% of these customers are residential. Gas is provided to 687,000 customers in San Diego County. In addition to the City of San Diego, SDG&E provides utility service to 17 other cities in San Diego County and to seven cities in Orange County. In 1992 SDG&E remained the lowest cost provider of electricity in the state among investor-owned utilities for the fourth consecutive year. In 1992 SDG&E had 4,249 employees, up 0.8% from 1991.[R#1]

In order to provide electricity at the lowest rate possible, the utility claims to be neutral towards the source of its energy. That is to say that if energy can be purchased on the spot market for less than what SDG&E can generate it for, energy will be purchased instead of generated. In 1992, 50% of SDG&E's energy was purchased through long and short term contracts. SDG&E plans to continue to expand this practice.[R#1]

SDG&E owns part of the San Onofre Nuclear Generating Station Unit 1 ("SONGS 1") which was shut down permanently on November 30, 1992. SDG&E's ownership share is \$111 million. The utility has replaced SONGS 1 output with short-term energy purchases and gas-fired generation.[R#1]

SDG&E 1992 ELECTRIC STATISTICS

Number of Customers	1,122,000
Electricity Sales	15,531 GWh
Electricity Sales Revenues	\$1.344 billion
Peak Demand	3,285 MW
Generating Capacity	3,772 MW
Reserve Margin	15 %
Average Electric Rates	
Residential	10.01 ¢/kWh
Commercial	8.39 ¢/kWh
Industrial	6.84 ¢/kWh
Agricultural	7.56 ¢/kWh

The nationwide recession arrived somewhat late in California and as a result many businesses have left Southern California in the past few years. Recent studies indicate that fewer commercial businesses are being established in California due to the high cost of regulation and taxes. Because of the recession, customer growth slowed to 1% in 1992, adding 10,712 customers. From 1987 through 1990 SDG&E added between 25,000 and 42,000 customers annually. San Diego was hit particularly hard by major cuts in defense spending which brought massive layoffs and company relocations to long-time area employers.[R#1] ☞

Utility Overview(continued)

San Diego remains a center for emerging technologies, such as biotechnology, and biomedical and telecommunications firms. The City of San Diego has a mean annual temperature of 63.8 °F and average annual rainfall of 9.32 inches. On average San Diego has 1,284 heating degree days and 842 cooling degree days.[R#1]

In 1992, SDG&E began Project Vecinos in cooperation with Southern California Gas Company (SCGC) to capitalize on the multiple areas of mutual benefit between San Diego and the Mexican government. SDG&E and SCGC expect to submit a joint proposal to transport natural gas to Mexico. If approved by Mexico and various federal, state, and local agencies, SDG&E would begin construction of an 80-mile pipeline from SCGC's service territory to the Mexican border by late 1993.[R#1]

Electric revenues increased 7% in 1992 (totaling \$1.344 billion) after increasing less than 1% in 1991. The 1992 increase reflects higher authorized costs and higher volume due to warmer weather. Gas revenues for the year totaled \$313,013,379.[R#3]

For 1992, SDG&E's fuel mix was made up of 27.4% natural gas, 22.3% nuclear, and 0.6% fuel oil. The remainder (49.7%) of SDG&E's power was purchased from outside sources.[R#3]

Energy sales for SDG&E totaled 15,531 GWh. Of this total the residential sector accounted for 5,611 GWh (36%), the commercial sector purchased 5,863 GWh (38%), the industrial sector purchased 3,346 GWh (21.6%), the agricultural sector accounted for 204 GWh (1%), street lighting sales totaled 69 GWh (0.4%), and SDG&E had 438 GWh (3%) of off-system sales. SDG&E had a 1992 generating capacity of 3,772 MW, and the peak demand for the year was 3,285 MW, creating a reserve margin of 15%.[R#3]

As part of its energy conservation efforts SDG&E has become involved with promoting electric cars through its position in CALSTART, a consortium of public and private entities created to encourage electric car manufacturing. SDG&E is also interested in natural gas vehicles and as such has opened two new public natural gas filling stations in addition to the station opened in 1991 in cooperation with Shell and Unocal. SDG&E also provided corporate sponsorship to San Diego State University's Solar Car Club to develop a car to send to the World Solar Challenge in Australia in 1993.[R#1] ■

Utility DSM Overview

SDG&E DSM PROGRAMS

A) RESIDENTIAL

Information Programs

- Energy Information Center

- Brochures

- Energy Education

- Customer Energy Awareness

- Cross Cultural Advertising

Energy Management Services

- Residential Audits

- New Construction

Appliance Efficiency Incentives

- High - Efficiency Refrigerators

- Unallocated High-Efficiency Refrigerators

- Compact Fluorescents

- Low - Flow Showerheads

- DSM Replacement Bidding

- Appliance Efficiency Options

Direct Assistance

B) NONRESIDENTIAL

Information Programs

- Commercial Energy Education

- Small C/I Brochures

C/I/A EM Services

- Large C/I Customer Audits

- Small & Medium C/I Customer Audits

- Agricultural EM Services

C/I/A EE Incentives

- Standard & Custom Incentives

- Lighting Retrofit**

- DSM Integrated Bidding

New Construction

- Title 24 Plus

- Lighting Efficiency Incentives

- Prescriptive Efficiency Incentives

SDG&E has been involved with DSM activities since the late 1970s. Early programs included residential energy audits, a streetlighting program, and commercial and industrial energy audits. From 1980 through 1992 SDG&E achieved energy savings of 847.2 GWh and peak capacity savings of 326.6 MW, spending \$215,365,000. In 1992 SDG&E spent 2.5% of its gross electric revenues on DSM programs. [R#9]

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 electric conservation and load management.

In 1990 SDG&E participated in the California collaborative planning process along with representatives of the California Public Utilities Commission (CPUC), the California Energy Commission (CEC), other California utilities, and a variety of organizations representing various customer groups. As part of this process SDG&E negotiated an agreement with CPUC and CEC which provided financial rewards to SDG&E shareholders based on the utility meeting or exceeding specific DSM program goals. Penalties were established in the event that certain levels of implementation were not met. The CPUC authorized additional shareholder rewards for cost containment actions above and beyond program goals. The vast majority of SDG&E's potential reward or penalty was in the Commercial Lighting Retrofit program. After reviewing several program designs, SDG&E selected a "turnkey" operation where the utility proactively sells customers the program, and the utility manages the project from beginning to end. [R#2]

In 1992, SDG&E spent \$32,982,000 on DSM activities, accounting for 117.2 GWh of energy savings and 39.77 MW of peak capacity savings. For the year SDG&E spent \$3.36 million (10% of total DSM expenditures) on DSM monitoring and evaluation. [R#6]

In terms of program expenditures, the Commercial Lighting Retrofit program (the subject of this profile) 

Utility DSM Overview (continued)

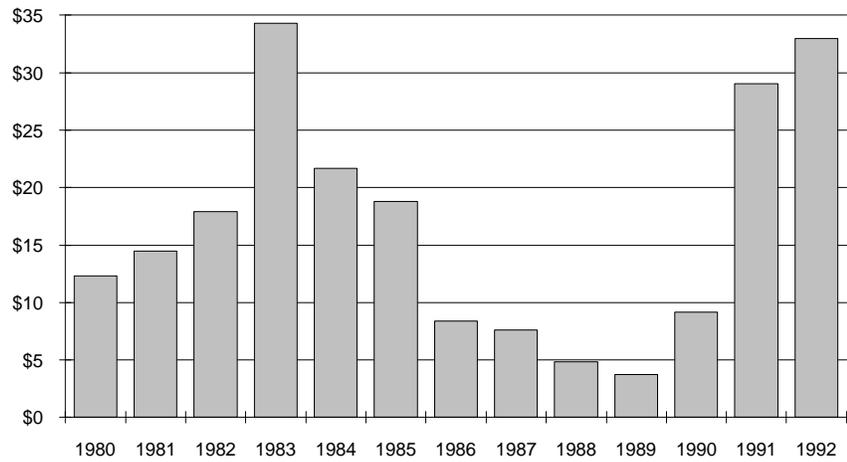
is the utility's largest program. In 1992 SDG&E spent approximately 1/3 of its total electric DSM budget on this program, which captured approximately 44% of all electric DSM energy savings and 33% of all electric DSM capacity savings.[R#6]

SDG&E's Direct Assistance program installed weatherization measures in 11,624 low-income households in 1992. An energy service company hired by SDG&E provides in-home education, needs assessment, and installation of energy efficiency measures. These measures include ceiling insulation, caulking, weatherstripping, low-flow showerheads, water heater blankets, and up to \$300 in minor home repair.[R#6]

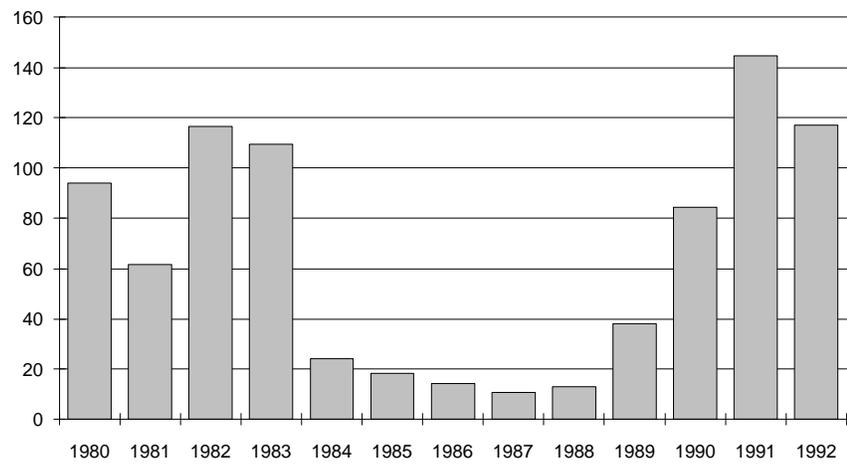
The Appliance Efficiency Incentives program is made up of several components. The refrigerator component of the program paid out \$3.5 million in incentives in 1992 toward the purchase of 46,586 high-efficiency refrigerators, the lighting component distributed 116,173 compact fluorescents, the air conditioning component offered incentives for replacement of central air-conditioners with higher efficiency models, and the low-flow showerhead component provided products at no cost to customers.[R#6] ■

DSM Overview	<i>Annual DSM Expenditure (x1000)</i>	<i>Annual Energy Savings (GWh)</i>	<i>Annual Capacity Savings (MW)</i>
1980	\$12,329	94.1	N/A
1981	\$14,506	61.7	N/A
1982	\$17,920	116.7	25.00
1983	\$34,324	109.4	34.00
1984	\$21,683	24.2	16.00
1985	\$18,826	18.4	13.00
1986	\$8,375	14.4	32.00
1987	\$7,615	10.8	15.00
1988	\$4,852	13.1	24.00
1989	\$3,760	38.2	25.00
1990	\$9,146	84.4	46.00
1991	\$29,045	144.6	56.89
1992	\$32,982	117.2	39.77
Total	\$215,365	847.2	326.66

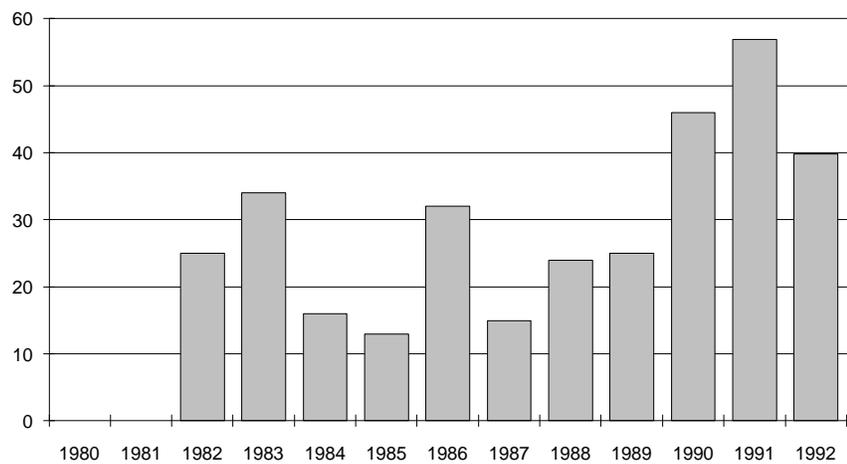
**ANNUAL DSM
EXPENDITURE
(\$1,000,000)**



**ANNUAL
ENERGY
SAVINGS
(GWH)**



**ANNUAL
CAPACITY
SAVINGS
(MW)**



Program Overview

In September 1990, San Diego Gas & Electric began the Commercial Lighting Retrofit program. This program differs in its design from other utility lighting rebate programs, with the biggest difference being the use of commissioned sales staff.[R#2]

The program offers SDG&E's commercial customers cash incentives for two, four, and eight foot fluorescent fixtures (lamps, ballasts, and optical reflectors), but the program has also convinced many customers to change out all of their interior lighting equipment for more efficient measures. Incentives can be offered on other lighting measures in accordance with proven customer savings that pass the total resource cost test. SDG&E tries to sell the customer on retrofitting the entire lighting system by providing lighting recommendations and economic

calculations for all lighting systems, regardless of type. By encouraging customers to change out all of their interior lighting, SDG&E tries to avoid having to perform a second retrofit. Thus in a sense, the program incentives for select lighting efficiency measures leverage more comprehensive lighting energy savings, effectively foreclosing the lost opportunity of the retrofits' potentials.[R#2,3,7]

One of the unique features of the program is a demonstration by SDG&E on every job that shows customers what their new retrofit will look like in their facility. This service reduces call-backs and customer dissatisfaction.[R#3] SDG&E does not currently have any plans to change the design or implementation of the Commercial Lighting Retrofit program. ■

CASE STUDY: SYMPHONY TOWERS

In April 1993 the Symphony Towers building complex in San Diego completed an energy-efficiency retrofit of lighting, HVAC motors, controls, and other building systems. The 530,000 square foot complex includes a 34-story office tower, a five-level enclosed parking garage, and a Marriot Suites hotel.

Frank Mitzel, chief building engineer for the complex, estimates that the lighting portion of the retrofit will reduce energy use by 1,620 MWh annually, accounting for nearly half of the entire retrofit project energy savings. The lighting retrofit cost \$367,000 and SDG&E paid a rebate of \$202,504. The payback period for the project is estimated at just under a year.

The lighting retrofit involved every fixture in the complex. The largest component of the retrofit was replacing lamps and ballasts in about 8,700 three-lamp fluorescent fixtures. The fluorescent fixtures originally contained three four-foot, 40 watt T-12 lamps and two standard magnetic ballasts. Each T-12 lamp was replaced with a 32 watt T-8 lamp by Philips Lighting Co. The magnetic ballasts were replaced with half as many three-lamp Triad low-power electronic ballasts by MagneTek.

In two-by-two fixtures a single U-tube and magnetic ballast were replaced by two 17-watt T-5 compact fluorescent lamps. Previously Symphony Towers used many different technologies for specialty lighting. All of these were replaced with a single type of compact fluorescent lamp fixture, the 700 series flood light by ProLight.

In addition to energy and dollar savings, the lighting retrofit has greatly improved the quality of the office lighting.[R#12]

Implementation

MARKETING

Customer leads for the Large Commercial Lighting program are initially generated by SDG&E account executives who regularly call on the utility's 750 largest customers. Subsequent leads come from direct solicitation of customers by commissioned lighting representatives, known as the program's sales team. SDG&E lighting representatives sell the program to customers with account executive support. [R#2]

In addition, SDG&E publishes a quarterly newsletter for its customers which often contains lighting retrofit case studies along with testimonials from satisfied retrofit customers. [R#4]

DELIVERY

SELECTING A CONTRACTOR

For customers interested in the program, a SDG&E lighting representative performs an audit of the facilities which identifies the equipment to be installed and selects an installation contractor through a competitive bid process. Six program contractors were selected in 1990 on a competitive basis to form a qualified pool of contractors with lighting maintenance experience. This pool was increased to ten contractors in 1992, and currently there are nine contractors working with the program. Program contractors bid each job to provide a firm cost to present to the customer. This bidding process has reduced overall job costs by as much as 30% when SDG&E acts as the project manager. By having SDG&E manage the competitive bidding process, customers are relieved of the time requirement for identifying contractors and obtaining bids. [R#2]

Customers have the option of selecting their own contractor or using in-house labor instead of using SDG&E as the project manager. Customers choosing this route must have the job surveyed by a SDG&E lighting representative before the job is installed, and the installed measures must meet SDG&E's performance standards. [R#2,7]

PROGRAM INCENTIVES

SDG&E provides financial incentives to retrofit customers and presents them with a financial analysis to facilitate decision making. This analysis is provided approximately one week after the initial SDG&E audit is performed and includes customer costs and paybacks. At this point, customers interested in participating sign a contract. Installations are completed within 120 days of the contract signing. [R#2]

Participant incentives are calculated on a customized basis depending on measures installed, customer building type, annual lighting hours, and customer payback. These factors are entered into a computer program which calculates the customer's rebate. Typically the rebate pays for 50% of the total retrofit cost. Because of the different building sizes participating in the program, incentive payments have ranged from \$3,000 to \$500,000. With the SDG&E incentive, customer payback averages about one year for program measures. SDG&E insists on a minimum payback period of at least six months. Previously, SDG&E paid for all of the ballast disposal costs. Starting in 1993 the utility no longer pays for disposal costs on customer-preferred contractors. [R#2]

After all measures are installed, a SDG&E inspector checks the job to insure quality workmanship and proper lighting levels have been achieved. At this point 

Implementation(continued)

customers are also provided with a post installation customer satisfaction survey. After this inspection, the customer receives an incentive check from SDG&E. SDG&E also provides warranty and after-care instructions.[R#2]

SALES COMMISSIONS:

One way that SDG&E attempts to ensure program success is by compensating lighting representatives based on energy savings achieved as a result of their sales. On top of their base salary, lighting representatives are paid 1 mill per kWh saved (1 mill = 1/10 of a cent). Every lighting representative is given an energy savings goal to achieve based on a percentage of the total savings goal of SDG&E for the year. When the representative reaches this goal, all energy savings beyond the goal are compensated at 2 mills per kWh. In addition a 1 mill per kWh bonus is applied retroactively over all of the kWh savings the representative has achieved for the year. If a job is underlit and the customer is unhappy, the lighting representative is required to pay back their commissions at a 2 to 1 ratio. It is not unusual for representatives to achieve commissions equal to their base salary.[R#2,7]

Lighting representatives differ from account representatives in that lighting reps are hired on a temporary basis by SDG&E, and they work only on the Commercial Lighting Retrofit program. All of the lighting reps have previous experience in the lighting field, but they receive additional training from SDG&E. Once a lighting retrofit is completed, the lighting rep is no longer in contact with that customer. Account executives, on the other hand, continue to maintain customer contact. Account executives are permanent, salaried full-time employees who work with individual utility customers. They are responsible for marketing all applicable DSM programs to their clients, and are paid a straight salary with no commission incentives.[R#7]

MEASURES INSTALLED

Installed measures approved for the program include two, four, and eight foot fluorescent lamps, ballasts, and optical reflectors. Specific measures are approved by a senior SDG&E engineer who is a lighting expert.[R#7] ■

Monitoring and Evaluation

MONITORING

SDG&E representatives perform post-installation site inspections of installed measures before customer incentive checks are cut. During the inspection, SDG&E checks to make sure that proper lighting levels have been achieved. [R#2]

Program savings for 1990 through 1993 are based on engineering estimates. These estimates are based on assumptions agreed upon during the California Collaborative planning process.

Currently SDG&E is performing a study of completed projects to calculate more accurately program savings. SDG&E is monitoring approximately 100 sites of 1991 program participants using hours-of-operation meters. Sites were selected which contained a large number of fixture change-outs and for which reported hours of operation already existed. This study will compare reported hours of operation to metered hours of operation. [R#6]

EVALUATION

SDG&E completed a formal program impact evaluation of the Lighting Retrofit program in June 1993. This evaluation examines the demand impact of the program. A set of statistical techniques were applied to the program's database and to data on participants' monthly energy consumption in order to arrive at estimates of the program's energy-demand impact. The statistical results

indicated that approximately 3/4 of the program's forecasted energy-demand impact could be statistically verified with a relatively high degree of confidence. This report does not, however, provide annual or total demand savings for the program. [R#18]

The first phase in this evaluation effort was to modify the pre-program assumptions concerning "base equipment," through analysis of the program's database. Analysis revealed that only half of the lamps that were replaced were so-called F40 lamps, whereas it was assumed prior to the program that 100% of the lamps replaced would be of this type. The remaining half consisted of lower-wattage F34 lamps. Similarly, only 43% of the ballasts that were replaced were the assumed "standard" ballast, while the remaining ballasts were actually somewhat more efficient than expected. Thus the actual base equipment was generally more efficient than assumed. [R#18]

The second phase in this effort was to analyze the database in order to substitute customers' reported hours-of-operation for the pre-program assumptions used. The results indicated that average reported hours-of-operation were 7% lower than assumed. [R#18]

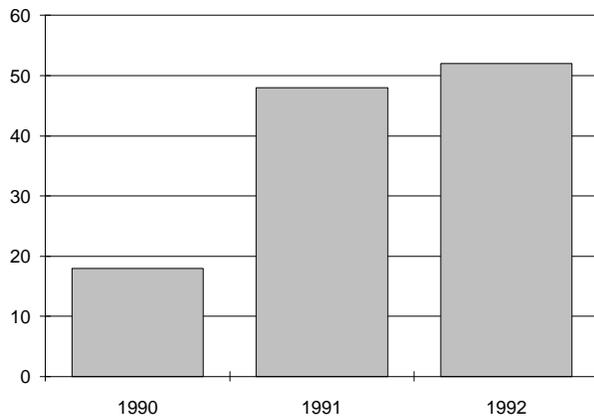
Future research will examine whether the verified savings are less than 100% due to overestimates in hours of operation or to actual demand savings which are in fact less than assumed. [R#18]

In 1991 and 1992 SDG&E completed program process evaluations. The 1992 study indicated that 98% of the 127 respondents would recommend the program to a business associate. [R#6] ■

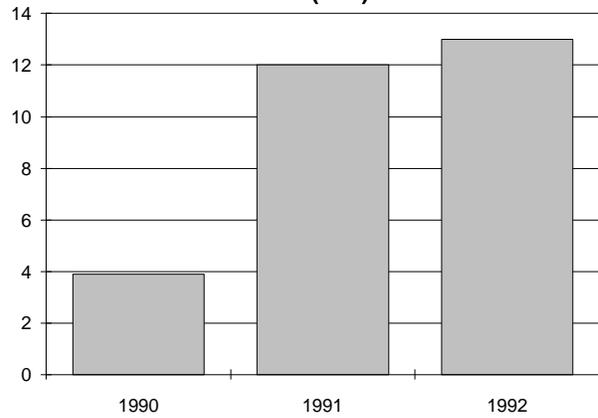
Program Savings

Savings Overview Table	<i>Annual Energy Savings (MWh)</i>	<i>Cumulative Energy Savings (MWh)</i>	<i>Lifecycle Energy Savings (MWh)</i>	<i>Non-Coincident Peak Capacity Savings (MW)</i>	<i>Cumulative Non-Coincident Peak Capacity Savings (MW)</i>
1990	18,000	18,000	270,000	3.90	3.90
1991	48,000	66,000	720,000	12.00	15.90
1992	52,000	118,000	780,000	13.00	28.90
Total	118,000	202,000	1,770,000	28.90	

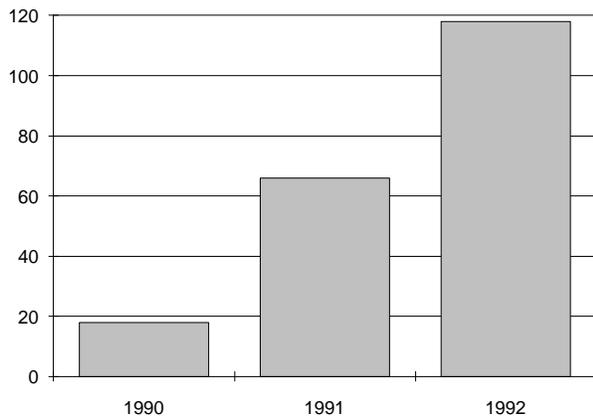
ANNUAL ENERGY SAVINGS (GWH)



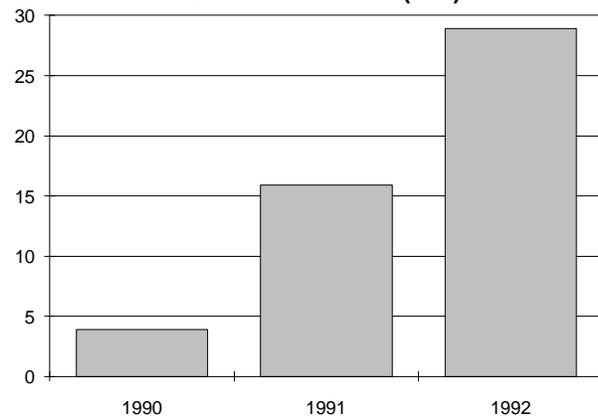
NON-COINCIDENT PEAK CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE NON-COINCIDENT PEAK CAPACITY SAVINGS (MW)



Data Alert: All of the following energy savings numbers are net figures and have been derated for free ridership. Program savings are based on engineering estimates as agreed to in the California Collaborative planning process.[R#4]

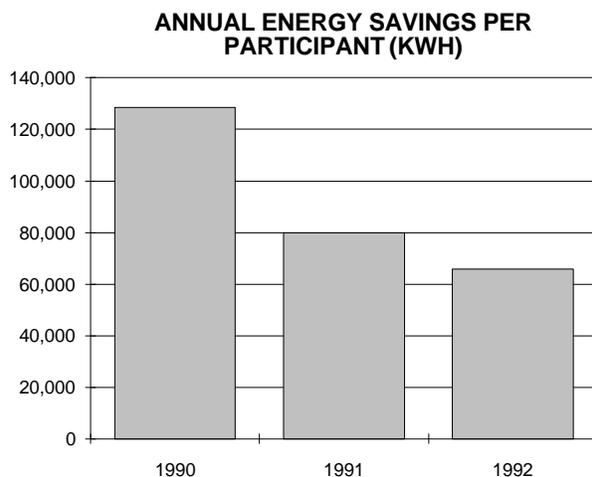
Annual energy savings for the Large Commercial Lighting Retrofit program total 118 GWh. In 1990 (from September through December) the program had savings of 18 GWh. In 1991 program savings increased to 48 GWh and in 1992 the program had annual energy savings of 52 GWh. It is interesting to note that energy savings increased only modestly from 1991 to 1992 while participation numbers and program costs rose significantly. These figures indicate that SDG&E has already reached most of its large commercial customers and that the sales force has shifted its focus to smaller retrofit projects.[R#5,6]

Non-coincident peak demand savings for the program total 28.9 MW. Program demand savings have steadily increased with 3.9 MW of savings in 1990, 12 MW of savings in 1991, and 13 MW of savings for 1992.[R#4]

Lifecycle energy savings for the program total 1,770 GWh and lifecycle energy savings for customers joining the program in 1992 are 780 GWh.

PARTICIPATION RATES

Program participants are defined as customers who have signed job contracts. A contract is signed after the



customer has examined the investment analysis presented by SDG&E. The number of participants reached a high in 1992 of 789 participants. In 1991 there were 600 participants, and in the first year of the program, 1990, there were 140 participants. To date there have been 1,529 participants in the Commercial Lighting Retrofit program.[R#4]

Participation Table	Participants	Annual Energy Savings per Participant (kWh)
1990	140	128,571
1991	600	80,000
1992	789	65,906
Total	1,529	

While the number of program participants has steadily increased, the energy savings per participant have steadily decreased from a high of 128,571 kWh per customer in 1990, to 80,000 kWh in 1991, and 65,906 kWh in 1992.

FREE RIDERSHIP

Energy and capacity savings have been derated for free ridership.

MEASURE LIFETIME

SDG&E assigns an approximate average measure lifetime of 15 years to the Large Commercial Lighting Retrofit program.[R#6]

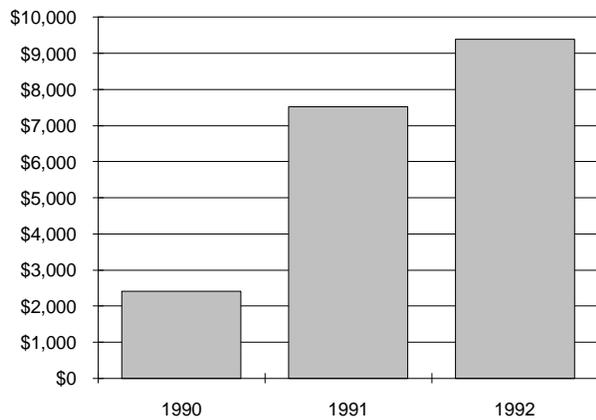
PROJECTED SAVINGS

SDG&E has not set savings goals for the lifetime of the program. Instead, the utility presents annual savings goals. To date the program has surpassed the goals for every year of the program. For 1993, SDG&E has set a program energy savings goal of 38.1 GWh.[R#4] ■

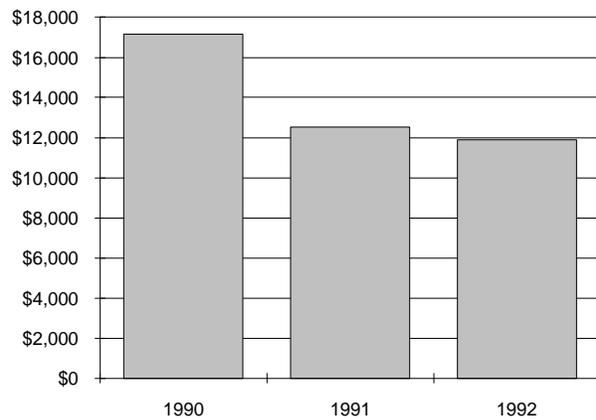
Cost of the Program

Costs Overview Table	<i>Administration (x1000)</i>	<i>Incentives (x1000)</i>	<i>Total Program Cost (x1000)</i>	<i>Cost per Participant</i>
1990	\$361.2	\$2,039.9	\$2,401.1	\$17,151.06
1991	\$700.5	\$6,825.9	\$7,526.4	\$12,543.92
1992	\$1,486.5	\$7,897.2	\$9,383.7	\$11,893.20
Total	\$2,548.2	\$16,763.0	\$19,311.2	

TOTAL PROGRAM COST (x1,000)



COST PER PARTICIPANT



The total cost of the Commercial Lighting Retrofit program from 1990 through 1992 is \$19.31 million. Because the program began in late 1990, expenditures for that year were \$2.40 million. In 1991, the first full year of the program, SDG&E spent \$7.53 million on the program. In 1992 the program cost \$9.38 million.[R#13]

COST EFFECTIVENESS

SDG&E has applied the TRC test to the program, coming up with a value of 4.93. The utility has also used the RIM test.

Based on a 15-year measure lifetime, **The Results Center** calculates that the cost of saved energy for 1992 ranges from a low of 1.51 ¢/kWh at a 3% discount rate to a high of 2.24 ¢/kWh at a 9% discount rate. Based on a 5% discount rate, the cost of saved energy has gradually increased from 1.29 ¢/kWh in 1990 to 1.51 ¢/kWh in 1991, and finally to 1.74 ¢/kWh for 1992.

COST PER PARTICIPANT

The utility's cost per participant was highest in 1990 at \$17,151. The cost per participant dipped to \$12,542 in 1991, and dropped again to \$11,893 in 1992.

COST COMPONENTS

Incentive payments make up the vast majority (87%) of total program expenditures. SDG&E paid out \$2,039,900 in incentives in 1990, \$6,825,900 in 1991, and \$7,897,200 in 1992 for total incentive payments of \$16,763,000. Administration costs include all other program expenses and total \$2,548,200. Administration costs have risen from \$361,200 in 1990 to \$700,500 in 1991, and \$1,486,500 in 1992. In terms of annual program costs, administrative costs were 15% of total costs in 1990, 9% of total costs in 1991, and 16% of total costs in 1992.[R#13] ■

Cost of Saved Energy Table (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
1990	1.12	1.20	1.29	1.37	1.46	1.56	1.65
1991	1.31	1.41	1.51	1.61	1.72	1.83	1.95
1992	1.51	1.62	1.74	1.86	1.98	2.11	2.24

Environmental Benefit Statement

AVOIDED EMISSIONS (Based on 202,000,000 kWh Saved 1990 - 1992)

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%	435,512,000	10,332,000	2,089,000	209,000
B	10,000	1.20%	464,398,000	4,000,000	1,349,000	1,000,000

Controlled Emissions

A	9,400	2.50%	435,512,000	1,033,000	2,089,000	17,000
B	10,000	1.20%	464,398,000	400,000	1,349,000	67,000
C	10,000		464,398,000	2,666,000	1,333,000	67,000

Atmospheric Fluidized Bed Combustion

A	10,000	1.10%	464,398,000	1,222,000	667,000	333,000
B	9,400	2.50%	435,512,000	1,033,000	835,000	63,000

Integrated Gasification Combined Cycle

A	10,000	0.45%	464,398,000	822,000	133,000	333,000
B	9,010		417,736,000	298,000	100,000	20,000

Gas Steam

A	10,400		253,308,000	0	578,000	0
B	9,224		219,978,000	0	1,378,000	65,000

Combined Cycle

1. Existing	9,000		219,978,000	0	844,000	0
2. NSPS*	9,000		219,978,000	0	400,000	0
3. BACT*	9,000		219,978,000	0	56,000	0

Oil Steam--#6 Oil

A	9,840	2.00%	366,630,000	5,555,000	655,000	622,000
B	10,400	2.20%	388,850,000	5,511,000	824,000	400,000
C	10,400	1.00%	388,850,000	787,000	662,000	209,000
D	10,400	0.50%	388,850,000	2,311,000	824,000	127,000

Combustion Turbine

#2 Diesel	13,600	0.30%	486,618,000	969,000	1,504,000	82,000
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Refuse Derived Fuel

Conventional	15,000	0.20%	577,720,000	1,489,000	1,960,000	436,000
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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 San Diego Gas & Electric's level of avoided emissions saved through its Commercial Lighting 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 include 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

One very important key to the rapid success of the Commercial Lighting Retrofit program is the employee compensation plan tied to the program. Lighting representatives are paid a base salary and a two-tiered commission which directly ties their accomplishments to their compensation on a dollars per kWh saved per job along with final goal achievement for the year. In addition, the commissions are at risk if a customer is unhappy with their retrofit installation or post retrofit lighting levels.[R#2]

SDG&E has learned the program must be kept open to all contractors, not just those used by SDG&E. This option is important to keep all customers happy as some customers prefer to use their own lighting contractor.[R#2] SDG&E also learned during the first year of the program that they must require participants to decide very early on in the process whether they will use their own contractor or use a SDG&E contractor. This prevents ongoing bidding wars and avoids wasted time and effort.

SDG&E's program design goal of being a "project manager" for the customer means that SDG&E has a great deal of contact with key executives at their largest customers. The utility typically deals with Presidents, Vice Presidents of Finance, Vice Presidents of Operations, etc., reaching higher level contacts than before the program began.[R#2]

SDG&E lighting experts have become "project managers" by helping participating customers through all phases of lighting retrofit activities; from initial lighting surveys to investment analyses, from competitive bidding of retrofit equipment installation to negotiation and moni-

toring of post installation lighting levels, from collection of co-payments and payment of contractor costs, to final job inspection and complete customer satisfaction.[R#2]

Another lesson learned is the effectiveness that SDG&E has experienced with the contractor bidding system, reducing program equipment installation costs by 30% from cost estimates for similar lighting retrofit jobs before the program began. Each retrofit job is bid separately so that each cost estimate is tailored to that specific customer's facility. As a result of all the contractor options available to the customer, San Diego is known as a market where contractor margins are lower and therefore customers are receiving better value.[R#2]

SDG&E has learned the importance of trade allies as well as the importance of a strong database tracking system.

TRANSFERABILITY

The concept of a commercial lighting retrofit program is not unique; many utilities have such programs. What makes this program different is the use of commissioned lighting representatives. In a sense, SDG&E's hand was forced by the California Collaborative in terms of achieving energy savings. The utility reacted to the collaborative process by deciding to place most of its eggs in the Commercial Lighting Retrofit basket. The use of a commissioned sales staff was viewed as the best way to ensure program success.[R#2]

Other utilities likely would not have the same pressures to get such immediate and impressive results from a lighting retrofit program. As a result, these utilities may not elect to use a commissioned sales staff. ■

Regulatory Incentives and Shareholder Returns

Traditional utility ratemaking, where each and every kilowatt-hour sold provides profit, is a major barrier to utilities' implementation of energy efficiency programs. Several state regulatory commissions and their investor-owned utilities have been pioneers in reforming ratemaking to a) remove the disincentives in utility investment in DSM programs, and b) to provide direct and pronounced incentives so that every marginal dollar spent on DSM provides a more attractive return than the same dollar spent on supply-side resources.

The purpose of this section is to briefly present exciting and innovative incentive ratemaking mechanisms where they're applied. This we trust, will not only provide some understanding to the reader of the context within which the DSM program profiled herein is implemented, but the series of these sections will provide useful snapshots of incentive mechanisms being used and tested across the United States.

THE CALIFORNIA OVERVIEW

Integrated resource planning is in practice in California, principally through the biennial resource plan update process. California utilities are required to file resource plans to which they must apply the integrated cost-effectiveness methodology.

California has been the leading state in terms of wiping away the disincentives for utility investments in demand-side management. The Electricity Revenue Adjustment Mechanism (ERAM) was the first in the nation and provided a system whereby sales and profits were effectively "decoupled," ushering in a new era of regulation surrounding DSM. Not only would California's electric utilities be compensated for their DSM expenditures, but the California Public Utilities Commission had figured out a way of compensating utilities for lost revenues associated with DSM programs.

In the early 1980s the California Public Utilities Commission did experiment with going beyond wiping away the disincentives to DSM by rewarding utilities with additional incentives on an ad hoc basis. Southern California Gas was ordered to achieve a certain level of weatherization services for its customers and faced carrots and sticks for compliance or lack thereof. The utility accomplished its goals and was rewarded with a bonus, asked for more, and was quickly rejected.[R#11]

In 1989, the California PUC authorized the first formal DSM incentive and penalty mechanism for San Diego Gas and Electric on a three-year trial basis. This was followed by the California Collaborative process which brought together the four largest investor-owned utilities in the state and a large group of regulators and intervenors. The collaborative developed plans to stimulate expanded DSM programs through the creation of shareholder incentive mechanisms which were subsequently refined and submitted to the Commission for approval. Of course, some of the lessons learned with the quite rudimentary SDG&E mechanism were incorporated into the statewide incentive mechanism. Before the end of 1990, the Commission had approved incentive mechanisms for each utility. The Commission also identified the need for a rulemaking proceeding to compare the different DSM models, evaluate the long term role of shareholder incentives, and develop statewide policy.[R#10,11]

In February 1992, the Commission provided an interim opinion which adopted 29 rules related to utility gas and electric DSM programs. These comprehensive rules were intended to serve as a body of policies related to all aspects of DSM regulation so that the Commission could respond and rule in a consistent manner regarding DSM between utilities in the state. This rulemaking process is ongoing but allows the Commission to have a durable set of rules applicable to each of the state's utilities over time, putting DSM in the state on a common basis. The rules spell out guidelines for integrated resource planning processes and documentation, present principles governing future shareholder incentives, and address a broad range of DSM policy and implementation issues ☞

Regulatory Incentives (continued)

including guidelines for cost effectiveness, measurement and evaluation issues, and DSM pilot bidding programs. [R#10,11]

One of the interesting aspects of the February 1992 ruling was a provision that calls for “comparable earnings” between demand and supply-side resources. While there has been a good deal of rhetoric surrounding DSM incentives and the need for a marginal dollar invested in efficiency to bear a greater reward for the utility than the same dollar invested in supply-side resources, California’s regulators and ratepayer advocates have fundamentally questioned this tenet. Do incentives for DSM need to be larger than those for supply-side resources? If so, isn’t incentive ratemaking simply an affirmative action, or compensatory action, type of mechanism? [R#10,11]

California has ruled that no such favorable treatment is necessary for DSM. (Perhaps utilities don’t need to be enticed by Brie cheese, but will invest in DSM if they are only offered cheddar!) What California’s rules intend to do is to truly level the playing field. While this is complicated by factors such as the various risks associated with different resources, it represents an evolution of DSM incentive ratemaking... and sets a precedent that will likely be carefully watched, criticized, and then adopted across the country. The comparable earnings policy is expected to be revisited by the Commission in late 1993. [R#10,11]

TREATMENT OF DSM EXPENDITURES

DSM program costs are typically expensed in California. The only exception is for utility-owned equipment, such as cycling devices for some load management programs which can be capitalized. [R#11]

To allow for variation in program costs and savings between rate cases, DSM program costs are tracked through a two-way balancing account and are expensed and recovered through rates. Thus if a utility spends less than its authorized amount on DSM in a given year, the remaining balance is returned to ratepayers plus interest.

Inversely, if the utility has a higher level of participation in a program and achieves greater savings than authorized at higher cost, it can be compensated for exceeding its targets. Note that only specific programs are eligible for the two-way balancing account provision. The programs must be clearly cost effective, such as SDG&E’s large lighting program. [R#10,11]

TREATMENT OF LOST REVENUES

SDG&E’s electric sales revenues, like those of each of the state’s investor-owned utilities, are decoupled from sales through the Electric Revenue Adjustment Mechanism (ERAM). Thus the lost revenues associated with conservation programs, as well as other factors such as inflation rates, weather, etc., are recouped to the utility and spread across all remaining kilowatt-hour sales. [R#10]

Note that ERAM is currently being reviewed by the Commission and may even be abandoned in light of the fundamental restructuring of the electric utility industry. Key issues such as heightened competition and retail wheeling have prompted this review of what is regarded around the country as the most successful and widely-replicated mechanism for addressing utilities’ lost revenue concerns and decoupling sales and revenues. [R#11]

SHAREHOLDER INCENTIVES

San Diego Gas and Electric was the first of California’s four large investor-owned utilities to be able to formally receive incentives for DSM. This occurred as a function of SDG&E’s 1989 general rate case. At that time SDG&E was planning on ramping down their DSM efforts. The California Division of Ratepayer Advocates wanted the utility to at least keep its DSM investments level, if not increase them. (Consumer and environmental groups, naturally, pushed for higher investments in efficiency.) The Division of Ratepayer Advocates urged the Commission to penalize SDG&E in the event that it did not meet the modest targets for DSM which evolved from the rate case. SDG&E responded that if it was to receive a penalty,

then in fairness it should be able to earn an incentive for superior performance. No one anticipated what happened next!

SDG&E ran with the ball and invested in energy efficiency as if there were no tomorrow, fulfilling the intent of the incentive mechanisms provisions. Don Schultz of the Division of Ratepayer Advocates commented that SDG&E was making "obscene profits." Furthermore, there was no cap or maximum that the utility could earn and the mechanism was set up in such a way that there was no verification protocol for savings.[R#11]

As part of the California Collaborative's efforts an incentive mechanism was developed for each of the state's utilities. (Actually for 1.5 years SDG&E operated with 2 incentives, the 1989 rate case mechanism and the mechanism that flowed out of the collaborative. Note that specific programs and elements within programs were tied to one or the other mechanism and no one program could earn incentives on both!) The Collaborative proposed and had accepted a situation in which each of the major utilities could adapt the incentive mechanism somewhat for their particular situation.[R#11]

A third version of incentive mechanisms were approved in SDG&E's 1993 rate case which concluded in December 1992. These mechanisms, which are currently in place, include an "S" curve shared savings incentive mechanism, and a variable rate shared savings mechanism with different rates for residential and nonresidential programs.[R#10,11]

SDG&E'S CURRENT SHAREHOLDER INCENTIVE MECHANISMS:

An S-curve shared-savings mechanism applies to SDG&E's residential appliance efficiency and nonresidential energy efficiency incentive programs including the large lighting program. SDG&E's share of the savings varies with the performance in an S-shaped pattern. The S-curve for each program is uniquely determined by the program's projected cost effectiveness. The curves are cal-

culated so that if the company reaches 100% of its savings goal for a particular program, its savings share is the percentage that will yield the company an amount equal to its program cost times the authorized rate of return on rate base.[R#10]

SDG&E is subject to a penalty if net benefits fall below 50% of the forecast. Positive incentives begin when achieved benefits exceed 50% of the forecast. At higher benefit levels, the savings share climbs steeply at first, then increases at a slower rate, finally leveling off when benefits reach 130% of forecast. There is no cap on the total amount SDG&E may earn.[R#10]

A second set of mechanisms applies different shared-savings rates to certain residential and nonresidential new construction programs. Generally, these mechanisms reward SDG&E for promoting the installation of measures that exceed applicable building efficiency standards. The savings shares have two tiers, with a higher rate for greater efficiency over the standards. The incentive basis, (ie benefits shared) also varies among programs. In some cases penalties are assessed if a minimum performance level is not achieved.[R#10]

A third mechanism, a mark-up on expenditures mechanism, allows SDG&E to receive an additional 5% of expenditures for certain qualifying measures in direct assistance programs and all expenditures in the residential energy management services program. Minimum performance requirements must be met before these incentives are earned.[R#10] ■

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