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# U.S. Environmental Protection Agency

## Green Lights

### Profile #35, 1992

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# Executive Summary

EPA's Green Lights program was officially launched on January 16, 1991 to prevent pollution by encouraging organizations to use energy-efficient lighting technologies in their offices, factories, stores, and warehouses. The Green Lights program offers a substantial opportunity to organizations to prevent pollution and to do so at a profit. If energy-efficient lighting were used wherever profitable, the nation's demand for electricity would be cut by more than 10%, leading to 4% to 7% reductions in total emissions of carbon dioxide, sulfur dioxide, and nitrogen oxides. In terms of carbon dioxide, EPA finds that this reduction in emissions would be the equivalent of removing 44 million cars from the road!

The Green Lights program is strictly voluntary. Upon becoming a participant in the Green Lights program, the involved organization signs a Memorandum of Understanding with EPA. Then the participant must survey the lighting in all of its U.S. facilities and install energy-efficient lighting systems in 90% of their facilities nationwide over a five-year period, where it is profitable and lighting quality is maintained or improved. EPA, in turn, assists the participating organization throughout the retrofit process, providing lists of manufacturers, lighting management companies, and utilities, (all considered "Allies") who produce lighting products and provide efficient lighting services. EPA also provides participants with a computer software program called the Decision Support System that allows corporations to survey lighting systems in their facilities, assess their options, and select the best energy-efficient lighting upgrades which maximize energy savings and are profitable.

By October 31, 1992, 668 organizations had signed Memoranda of Understanding with EPA. These program participants own or lease 3 billion square feet of facility space, which is almost 4% of the national total, equivalent to all of the office space in New York, Chicago, Washington, Los Angeles, and Houston combined!

The Green Lights Program operated in FY 1991 with only 2 full-time staff members and a budget of \$1.4 million. In 1992 the program grew, starting the fiscal year with a full-time staff of 3 and finishing the year with a staff of 10. The FY 1992 budget was almost \$3 million, providing for support such as the Hotline service, recruiting support, technical analysis, and software creation. These expenses have leveraged tremendous savings. Completed Green Lights upgrades as of October 31, 1992 account for annual energy savings of 102.1 GWh and connected load electricity savings of 35.5 MW. Participants' annual electric bills have been reduced by almost \$7 million as the average electricity reduction for lighting for Green Lights participants was 52%. These results only reflect the first year accomplishments of participants who joined through October 1991. Energy savings will grow rapidly as more participants send in their first anniversary report and especially as participants reach their second through fifth anniversaries.

## Green Lights

Agency: U.S. EPA

Sector: Commercial

Measures: Energy-efficient lighting

Mechanism: Green Lights Participants sign Memoranda of Understanding with EPA and receive design and retrofit assistance through computer programs, training workshops, and product information, in exchange for retrofitting 90% of their facilities within a five year timeframe.

History: Started in January, 1991 with 40 participants. Currently 691 organizations are participating.

## Program Data

Annual energy savings: 102.1 GWh

Lifecycle energy savings: 1,225 GWh

1991 budget: \$1,400,000

1992 budget: \$2,800,000

Participating facilities: 3 billion square feet

## 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.

# Agency Overview

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The U.S. Environmental Protection Agency (EPA) was the product of a Congressionally-approved reorganization plan by President Richard Nixon in response to growing public concern over the status of the nation's water, air, and land. Nixon's plan called for EPA to be an independent agency within the executive branch of the federal government, which consolidated 15 components from five executive departments and independent agencies.

When it was established, EPA became responsible for the regulation of air pollution, solid waste management, radiation control, and the drinking water program. The federal program for water pollution control and part of a pesticide research program were taken over from the Department of the Interior. EPA also gained authority to register and regulate the use of pesticides from the Department of Agriculture. EPA gained responsibility for setting limits on pesticides in foods from the Food and Drug Administration. EPA also received responsibility for environmental radiation standards from the Atomic Energy Commission and took over the duties of the Federal Radiation Council.

EPA began its operations on December 2, 1970 with a staff of 5,400 and budget of almost \$3 billion. Today EPA employs 17,000 people and operates with an annual budget of around \$6 billion. From this budget, over \$2 billion goes to sewage treatment construction grants and more than \$1.5 billion goes to the Superfund hazardous waste cleanup program.

EPA is headed by an Administrator who is appointed by the President and confirmed by the Senate. EPA headquarters in Washington, D.C. have almost 6,000 people working on creating environmental policies, setting national standards, and developing regulations for pesticides, toxic substances, hazardous waste, and water. Most of EPA's interactions with the public and regulated industries are handled by 11,000 EPA workers in the ten regional EPA offices. EPA is also involved with several voluntary non-regulatory programs.

EPA's stated mission is to carry out federal laws which protect the natural environment and human health from pollution. EPA shares the job of maintaining environmental quality with a broad range of organizations. Included in this group are other federal agencies, states, localities, businesses, interest groups, and individual citizens. EPA's role can range from providing national environmental goals and guidance to enforcing very specific industry standards. In many circumstances environmental laws are not implemented directly by EPA. Instead, EPA sets standards and defines what needs to be done for compliance with federal laws. [R#2]

# Agency DSM Overview

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In addition to Green Lights, EPA has created three other energy efficiency and pollution reduction programs.

## “GREEN” BUILDINGS

Designed with the same objectives as Green Lights, the “Green” Buildings program is currently under development to secure commitments to purchase energy-efficient heating, cooling, and ventilation technologies. [R#12]

## “GOLDEN CARROT”/SUPER-EFFICIENT REFRIGERATOR PROGRAM

Many diverse groups such as EPA, the American Council for an Energy-Efficient Economy (ACEEE), Bonneville Power Administration, Natural Resources Defense Council, Pacific Gas & Electric, and the Washington State Energy Office, have come together to form a national coalition called the Consortium for Energy Efficiency (CEE). CEE is designed to pursue forward-looking, long-term DSM procurement strategies. EPA’s role in the program is that of a catalyst.

The first CEE project is the Golden Carrot Super-Efficient Refrigerator Program (SERP). SERP’s goal is to promote the development and marketing of a CFC-free refrigerator/freezer (R/F) that consumes at least 30% (and hopefully up to 50%) less energy than the 1993 NAECA standards, by forming a joint utility program. Participating utilities commit to providing incentives to a selected manufacturer for the development of a CFC-free, super-efficient R/F which is to be introduced on the market in 1994.

Utility participation in the Golden Carrot program provides a guaranteed, targeted incentive in return for a product specified well in advance of its market introduction. Utilities commit resources in advance to a winner-take-all award for the manufacturer who can most quickly develop and market the most efficient R/F. Utilities are encouraged to complement their investments in the bid incentive pool with additional incentives for customers to turn-in inefficient R/Fs and replace them with super-efficient R/Fs as well as encouraging turn-ins of second refrigerators.

A pool of about \$30 million will be provided through the Golden Carrot program to the winning manufacturer. To date, approximately 25 utilities and power organizations have contributed. This amount has provided a strong incentive for

manufacturer participation and will offset the capital cost of a new technology. Total utility investments in the SERP will range from \$1.50 to \$2.00 per residential customer and the more money a utility invests in the program, the more super-efficient refrigerators will be shipped to its service territory. [R#13,15]

As of November 1992, 14 R/F manufacturers had submitted bids. Frigidaire and Whirlpool were selected in December as the two finalists to build prototype R/Fs. [R#15]

## ENERGY STAR

The EPA Energy Star Computers program is a voluntary, market-based partnership effort between EPA and computer manufacturers. Computer industry partners agree to manufacture and market equipment that features both high performance and increased energy efficiency. Although a regulatory approach could perhaps achieve more rapid and more certain penetrations of a given technology, market-based programs have a greater potential for achieving ongoing achievements beyond the threshold of a given standard, and they are the preferred approach to EPA’s pollution prevention initiatives. [R#12,14]

Energy Star, like Green Lights, contains a Memorandum of Understanding which is signed by both EPA and the manufacturer. By signing the Memorandum of Understanding, the manufacturer agrees to produce computers capable of entering a low-power state with a reduction to 30 Watts or less, which is about a 70% savings from normal usage. This specification was chosen because it will allow most manufacturers to market Energy Star computers in a very short time. The computers will automatically go into a low power state after a certain period of inactivity or following a command from the user.

For participants in the Energy Star program EPA makes available the Energy Star logo to identify the high efficiency models for consumers. This logo can be used by Energy Star Computers participants on products, literature, and advertisements for products. Currently EPA is pursuing the goal of having most computer companies that sell in the United States signed up for the program. To date 14 computer companies have signed up to participate in the Energy Star program. [R#12,14]

# Program Overview

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EPA's Green Lights program was officially launched on January 16, 1991 and is designed to prevent pollution by encouraging organizations to use energy-efficient lighting technologies in their offices, factories, stores, and warehouses.

Lighting is directly and indirectly responsible for about 25% of the national total for electricity use, and more than half the electricity used for lighting is wasted by inefficient technology and design practices. The Green Lights program offers a substantial opportunity to prevent pollution and to do so at a profit since investments in energy-efficient lighting typically yield 20% to 30% rates of return per year. If energy-efficient lighting were used wherever profitable, the nation's demand for electricity would be cut by more than 10%, leading to 4% to 7% reductions in total emissions of carbon dioxide, sulfur dioxide, and nitrogen oxides. In terms of carbon dioxide, EPA finds that this reduction in emissions would be the equivalent of removing 44 million cars from the road!

The Green Lights program is strictly voluntary. Upon becoming a participant in the Green Lights program, the involved organization signs a Memorandum of Understanding with EPA which outlines the commitments of both EPA and the company.

There are three types of Green Lights participants: Partners, Allies, and Endorsers. Partners include corporations, hospitals, universities, and state and local government offices. Allies are typically manufacturers, utilities, or contractors who produce lighting products and provide efficient lighting services. (Both Partners and Allies have the same upgrade responsibilities once they sign the Memorandum of Understanding.) Endorsers support Green Lights but are not committed to participate in the retrofit aspect of the program. Endorsers are non-profit organizations and associations, who agree to educate their members about the relationship between energy-efficient lighting and pollution prevention.

By signing the Memorandum of Understanding, the participant agrees to appoint an implementation manager to coordinate the program. In addition, the participant must survey the lighting in all of its U.S. facilities. The Memorandum of Understanding also requires the participant to install

energy-efficient lighting systems in 90% of its facilities nationwide over a five-year period. Installation of new equipment is required only where it is cost effective (the upgrade must create a return on investment of at least the prime interest rate plus 6%) and where the lighting quality will be at least as good or better than the current lighting. The participant also agrees to purchase efficient lighting systems for newly constructed buildings. Finally, the Green Lights participants agree to educate their employees about the benefits of energy-efficient lighting.

With the signing of the Memorandum of Understanding, EPA agrees to provide assistance to participating organizations throughout the Green Lights process. EPA offers participants a computer software program, called the Decision Support System, which allows organizations to survey lighting systems in their facilities, assess their options, and select the best energy-efficient lighting upgrades. EPA training workshops are offered nationwide which provide information on the Decision Support System as well as lighting fundamentals, technology, project management, and Green Lights reporting. Also provided is the National Lighting Product Information Program which contains objective testing information on name-brand efficient lighting technologies.

A database program containing listings of utility-sponsored financial assistance resources such as auditing and technical support, lighting design services, free installation, rebates, and loans is also given to Green Lights organizations. EPA's Lighting Services Group offers technical support and training for the installation of energy-efficient lighting. Specialized meetings with Green Lights support can also be held at participants' buildings. Green Lights runs four telephone hotlines. The Customer Service Center line answers general questions about the program while the Lighting Services Group provides Partners with answers to technical questions. Finally, EPA helps Partners gain public recognition for their participation in Green Lights.

# Implementation

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## MARKETING

While developing a marketing plan for the Green Lights program, EPA identified existing obstacles to widespread installation of energy-efficient lighting. One hurdle is the feeling by many organizations that lighting is not a high priority issue. In addition, energy-efficient lighting technology and designs can be rather complex, and attempting to upgrade an entire lighting system can require information and products from a vast number of sources. Organizations also tend to view lighting improvements as an expense rather than a cost-saving measure. Organizations often have little incentive to reduce their energy consumption because many leases charge renters a fixed percentage of the building's total energy bill. Finally, energy-efficient lighting is still expensive on a per unit basis when compared to traditional lighting due in part to the limited market penetration of efficient lighting.

Taking these considerations into mind, EPA drafted a Green Lights Memorandum of Understanding which was given to a small number of corporations to review. After several rounds of reviews and revisions, EPA came up with the existing Memorandum of Understanding.

EPA initially focused its marketing efforts towards large corporations because they are major end users of electricity. By January 31, 1991, Green Lights had 40 participants. As of November 30, 1992, 691 companies had signed Memoranda of Understanding with EPA.[R#4]

Because of the program's voluntary nature, EPA realized that various marketing tools were needed to recruit members. Green Lights conducted three large marketing conferences in 1991 which were attended by representatives of 600 corporations. These conferences took place in Washington, D.C.; Portland, Oregon; and Atlanta, Georgia. In addition, Green Lights staff have visited hundreds of facilities. This process has been accelerated by the inauguration of a full-time travelling recruiting campaign in October 1991.

In July 1991 the Green Lights office created a telemarketing system with a database containing 14,000 contacts. Green Lights also uses news coverage and public service advertising to reach a broader audience. Hundreds of news stories have been published on Green Lights. Green Lights advertising is visible in the popular, business, and trade press.[R#3]

Ironically, EPA's marketing goal is to make Green Lights so successful that the program is no longer necessary! EPA hopes that energy-efficient lighting will become standard and will be used at the outset of building construction without extra effort on the part of the customer, vendor, or lighting consultant.

## DELIVERY

The typical organization takes about 4 months to decide to join Green lights. The process starts with an EPA presentation, a piece of direct mail, an article in a newspaper, or an ad in a magazine. Several rounds of visits, telephone communications, and technical support follow. Many different groups within the organization usually become involved including facilities management, environmental compliance, energy, finance, strategic planning, and public affairs. Each department may require direct contact with EPA. The final step is the signing of the Memorandum of Understanding by a senior official.

Green Lights participants have five years to finish their lighting upgrades. Typically a Green Lights organization will be expected to use the first two years to survey buildings, gain expertise, train staff, and acquire budgets. Limited lighting upgrades take place at this time. EPA recommends that employee feedback be gathered after a trial installation. The third and fourth years of the program are when major upgrades are expected to occur.

## MEASURES INSTALLED

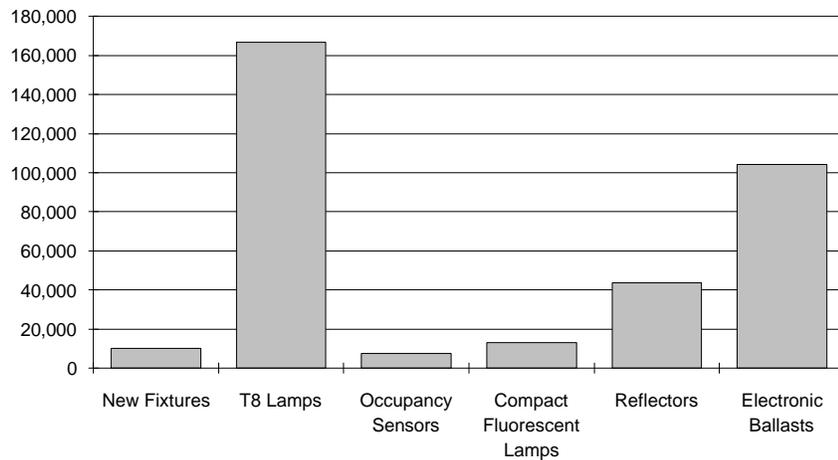
There are no prescriptive paths for lighting upgrades. Instead, the Allies, as well as other lighting vendors and manufacturers, have promoted a variety of lighting technologies for specific applications. Lighting products installed to date include:

- New Fixtures
- T8 Lamps
- Occupancy Sensors
- Compact Fluorescent Lamps
- Reflectors
- Electronic Ballasts
- High Intensity Discharge lamps

## STAFFING REQUIREMENTS

The Green Lights Program operated in FY 1991 with 2 full time staff members and a budget of \$1.4 million. In 1992 the program started the fiscal year with a full-time staff of 3 and a budget of almost \$3 million for support (Hotline service, recruiting, technical analysis, and software creation). The Green Lights Program finished FY 1992 with a staff of 10.

### HARDWARE INSTALLATIONS



# Monitoring and Evaluation

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## **MONITORING AND EVALUATION**

Green Lights monitoring is based on the reporting to EPA by Partners and Allies. These reports are provided to EPA every year on the anniversary of the date that the organization joined Green Lights. Data gathered for the anniversary reports does not go beyond information that the organization would gather for its own use. In addition EPA often contacts and questions Green Lights participants on the results contained in anniversary reports. Green Lights staff also visit one to five participants per month. Often included in these visits is a walk-through review of recent upgrades.

EPA is currently designing a more extensive evaluation process for the program.

## **DATA QUALITY**

The numbers contained in the program savings, program costs, and environmental benefits sections reflect progress reported by participants who joined the program between January 1991 and October 1991. It is important to remember that Green Lights participants only report on an anniversary basis. As an example of how this reporting system affects the data presented, consider that an organization joining Green Lights in January 1991 reported their progress in January 1992. Any progress occurring from January 1992 to October 1992 is thus not yet reported. The number of Green Lights participants, however, in the participants table is cumulative to October 31, 1992.

# Program Savings

Savings Overview Table	Annual Energy Savings (GWh)	Capacity Savings (kW)	Electric Bill Savings (x1,000,000)	Lifecycle Energy Savings (GWh)
Completed Upgrades	102.1	35,506	\$6.5	1,225
5 Year Implementation by Current Participants	13,600	3,700,000	\$952**	163,200
U.S. Gov't Target (Entire U.S., Year 2000)	226,400	39,800,000*	\$15,800 **	2,716,800

[R#4]

\*Assumes connected load reduction has a 65% capacity factor

\*\*Calculated using \$.07 per kWh saved

Completed Green Lights upgrades account for annual energy savings of 102.1 GWh and connected load electricity savings of 35.5 MW. Participants' electric bills have been reduced by more than \$6 million. The average electricity reduction for lighting for Green Lights participants was 52% (average weighted to square footage). Utility rebates received by participants exceeded \$6 million and the new power plant investments avoided for utilities (at \$1,500/kW) were almost \$50 million. [R#4]

## PARTICIPATION RATES

As of October 31, 1992 there were 668 Green Lights participants. Current program participants own or lease 3 billion square feet of facility space, which is approximately 4% of the national total. This amount is equivalent to all of the office space in New York, Chicago, Washington, Los Angeles, and Houston combined. EPA's goal is to have most major U.S. institutions participating in the Green Lights program, where it is profitable and lighting quality is maintained or improved. [R#1,4]

## MEASURE LIFETIME

Individual measure lifetimes have a broad range. For example, T8 lamps have lifetimes of 10,500 hours, while electronic ballasts have a lifetime of 60,000 hours, and fixtures tend to be in place for more than 20 years. For the purposes of this profile we assume an average lifetime of 12 years. (This

Green Lights Participants	Cumulative Number of Partners	Cumulative Number of Allies	Cumulative Total
1991			
Jan	29	19	48
Feb	41	31	72
Mar	49	88	137
Apr	56	99	155
May	64	112	176
Jun	82	132	214
Jul	98	148	246
Aug	107	167	274
Sep	125	176	301
Oct	140	189	329
Nov	161	203	364
Dec	170	211	381
1992			
Jan	180	221	401
Feb	193	232	425
Mar	219	237	456
Apr	237	254	491
May	262	268	530
Jun	283	276	559
Jul	294	276	570
Aug	312	285	597
Sep	N/A	N/A	651
Oct	N/A	N/A	668

[R#4] Green Lights Endorsers are not reflected in this table.

## Program Savings (continued)

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is used to generate lifecycle energy savings and to calculate the cost of saved energy.)

### **PROJECTED SAVINGS**

EPA expects the 5-year implementation by current participants to account for 13,600 GWh in energy savings, 3,700 MW in connected load savings, and annual electric bill savings of \$952 million. The U.S. Government goal for the Green Lights program for the year 2000 is to produce 226,400 GWh in energy savings, 39,800 MW in connected load savings, and annual electric bill savings of \$15.8 billion. [R#4]

# Cost of the Program

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EPA operated Green Lights in FY 1991 with a budget of \$1.4 million and two full-time staff. In FY 1992, the program had a budget of \$2.8 million. [R#1]

## COST EFFECTIVENESS

One of the most interesting features of this program is its exceptionally low cost. While it is certainly intuitive that the program, being strictly voluntary and thus its costs are administrative, marketing, and technical, would have a low cost of saved energy, the costs are strikingly low and further validate EPA's formula for savings. Unlike utility lighting retrofit programs, that bear costs of saved energy values from a half a cent to 2-4¢/kWh, Green Lights comes in several orders of magnitude cheaper!

At a 5% real discount rate, when considering only the savings accrued to date – and note that the savings are based only on reported savings which reflect only partial savings (see Data Quality) while the costs are total values – the cost of saved energy is 0.4641¢/kWh, less than a half a cent per

kilowatt-hour saved. When savings values for projected implementation over five years are included, and based only on current participants, the cost of saved energy plummets to three and one-half thousandths of a cent per kilowatt-hour! This is clearly the most cost effective program, from an agency or utility standpoint, that we have profiled.

## COST PER PARTICIPANT

The average cost per participant for the Green Lights program as of October 31, 1992 was \$6,363.

## FREE RIDERSHIP

EPA does not calculate free ridership. Because Green Lights is a voluntary program, free ridership is not of any real concern to EPA and dollars are certainly not being expended to give large financial incentives to customers who would have made the investments on their own.

Cost of Saved Energy Table (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
Completed Upgrades	0.4133	0.4383	0.4641	0.4907	0.5179	0.5459	0.5745
5 Year Implementation	0.3100	0.3300	0.3500	0.3700	0.3900	0.4100	0.4300

# 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%	220,128,000	5,222,000	1,056,000	106,000
B	10,000	1.20%	234,728,000	2,022,000	682,000	505,000

## Controlled Emissions

A	9,400	2.50%	220,128,000	522,000	1,056,000	8,000
B	10,000	1.20%	234,728,000	202,000	682,000	34,000
C	10,000		234,728,000	1,348,000	674,000	34,000

## Atmospheric Fluidized Bed Combustion

A	10,000	1.10%	234,728,000	618,000	337,000	168,000
B	9,400	2.50%	220,128,000	522,000	422,000	32,000

## Integrated Gasification Combined Cycle

A	10,000	0.45%	234,728,000	416,000	67,000	168,000
B	9,010		211,143,000	150,000	51,000	10,000

## Gas Steam

A	10,400		128,033,000	0	292,000	0
B	9,224		111,187,000	0	696,000	33,000

## Combined Cycle

1. Existing	9,000		111,187,000	0	427,000	0
2. NSPS*	9,000		111,187,000	0	202,000	0
3. BACT*	9,000		111,187,000	0	28,000	0

## Oil Steam--#6 Oil

A	9,840	2.00%	185,312,000	2,808,000	331,000	314,000
B	10,400	2.20%	196,543,000	2,785,000	417,000	202,000
C	10,400	1.00%	196,543,000	398,000	335,000	106,000
D	10,400	0.50%	196,543,000	1,168,000	417,000	64,000

## Combustion Turbine

#2 Diesel	13,600	0.30%	245,959,000	490,000	760,000	42,000
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## Refuse Derived Fuel

Conventional	15,000	0.20%	292,006,000	752,000	991,000	220,000
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**Avoided Emissions Based on 102,100,000 kWh Saved (First Year Only)**

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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 the EPA's level of avoided emissions saved through its Green Lights 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.

## EPA GREEN LIGHTS AVOIDED EMISSIONS

The primary goal of the Green Lights program is to reduce emissions that result from generating electricity. Note that in this section we present The Results Center marginal power plant analysis, that allows the reader to apply his or her

### \* Acronyms used in the table

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

marginal power plant to the specific savings that Green Lights has accrued, as well as EPA's own calculations of avoided emissions based on the avoided emissions of "an average American kilowatt-hour not sold," a far more simplistic analytical tool.

As of October 31, 1992, according to EPA's calculations, completed upgrades by Green Lights participants have resulted in avoided emissions of 134.4 million pounds of CO<sub>2</sub>, 1.2 million pounds of SO<sub>2</sub>, and 486,500 pounds of NO<sub>x</sub>. EPA

forecasts that the five year program implementation by current participants will account for 8.8 million metric tons (9.8 million U.S. tons) of avoided CO<sub>2</sub> emissions, 70,655 metric tons (79,133 U.S. tons) of avoided SO<sub>2</sub> emissions, and 30,000 metric tons (33,600 U.S. tons) of avoided NO<sub>x</sub> emissions. The U.S. government calculates that by the year 2000, avoided emissions resulting from the Green Lights program will total 202 million metric tons (226 million U.S. tons) of CO<sub>2</sub>, 1.3 million metric tons (1.4 million U.S. tons) of SO<sub>2</sub>, and 0.6 million metric tons (0.7 million U.S. tons) of NO<sub>x</sub>.

<b>Annual Pollution Prevention (pounds/tons)</b>	<b>CO<sub>2</sub></b>	<b>SO<sub>2</sub></b>	<b>NO<sub>x</sub></b>
Completed Upgrades	134.4 million pounds	1.2 million pounds	486,500 pounds
5 Year Implementation* by Current Participants	9.8 million tons	79,133 tons	33,600 tons
U.S. Gov't Target (Entire U.S., Year 2000)*	226 million tons	1.4 million tons	0.7 million tons

[R#4]

\*Emission reductions from "current participants" and "U.S. Gov't. Target" cannot be directly compared due to different emission factors used for 1992 and 2000.

# Lessons Learned / Transferability

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## LESSONS LEARNED

The following lessons learned were prepared by Program Manager, Bob Kwartin [R#1]:

- Perhaps the primary lesson learned from the implementation of Green Lights is that corporate leadership can be a great help in transforming a market. The eagerness of many large companies to join the Green Lights program had a tremendous impact on the energy-efficient lighting market. Energy-efficient lighting sales have increased markedly and prices of these products have decreased as a result. (While certainly not completely attributable to Green Lights, these trends will likely continue as Green Lights participation and implementation continues.) Green Lights and other lighting efficiency programs are projected to increase the market share of energy-efficient lighting products from its current 5% to around 40% by 1995. Prices of some lighting products have already fallen by as much as 25%. [R#3]

- The Green Lights program also indicates that corporations do not base all decisions on bottom line numbers. The financial benefits of energy-efficient lighting were fairly well known prior to Green Lights, but most companies chose not to purchase efficient lighting technologies.

- EPA also discovered that marketing a program of this nature is much more efficient when contact is made with senior level management. This way lighting decisions are treated as strategic business decisions involving the entire corporation.

- A wide range of involvement on the part of Green Lights Allies quickly emerged. Many Allies have been strong advocates for the program and the environment. Other Allies are simply meeting minimum EPA program guidelines but do nothing more, while enjoying the marketing benefits of the Allies program.

- The importance of program flexibility to the success of the Green Lights program is another lesson learned by EPA. Participation in a voluntary program would be almost impossible to achieve if the program required strict goals, intense micromanagement, and detailed reporting of results. Green Lights participants expressed appreciation for the open-ended program guidelines. Participating companies are given a broad goal and then allowed to pursue the goal in the manner they deem best. Similarly, reporting demands on participants are kept minimal as the only program data that companies are required to supply to EPA is data that would be gathered by the company anyway.

- Green Lights also illustrates that program participation is easy to achieve when the program offered provides a win-win situation. Green Lights participants only install energy-efficient lighting where it is cost effective and provides at least the same quality level of lighting. The Green Lights program also insures that energy consumption is reduced, energy bills are reduced, and pollution is reduced.

## DISPOSAL OF FLUORESCENT LAMPS

One consequence of joining the Green Lights program which has caused some participants difficulty is the disposal of both fluorescent lamps and pcb-containing ballasts. EPA has issued fact sheets on these subjects and devoted a chapter of their "Lighting Upgrade Manual" to waste management of old, inefficient lighting components, but confusion about disposal still exists.

Under the Resource Conservation and Recovery Act (RCRA), used fluorescent lamps are subject to evaluation against the RCRA hazardous waste characteristics of ignitability, corrosivity, reactivity, and toxicity. The generator of the waste is responsible for making this determination. Fluorescent lamps, for example, contain mercury which is a toxic constituent considered hazardous under the RCRA. EPA's Office of Solid Waste is currently reassessing the hazards of mercury-containing wastes via land disposal. The full range of options is being considered on this issue, which could result in deregulation. In the interim, EPA encourages participants to handle fluorescent lamps as a hazardous waste. The RCRA Hotline provides answers to specific questions about handling fluorescent lamps as a hazardous waste. [R#5,10]

It is important to note that energy-efficient lighting keeps more mercury out of the environment than leaving inefficient lighting in place. More mercury is emitted from power plants supplying electricity to lamps than is found in the lamps themselves. Mercury emissions are reduced by 60% through reduced power plant emissions when inefficient lighting is replaced by efficient lighting. [R#5,10]

Organizations should not be deterred from joining Green Lights for fear of hazardous waste regulations because all lamp disposers are subject to these regulations. A comprehensive energy-efficient lighting program, such as Green Lights, can often actually reduce the cost of complying with these regulations.

### **TRANSFERABILITY**

The Green Lights Program is highly transferable in several ways. First, it can be expanded, as planned, to additional types of participants. To date the program has focused primarily on various large organizations including corporations, universities, and hospitals. This can be expanded to smaller commercial users and even residential accounts with some modification. In fact, EPA plans to expand its participant pool by marketing Green Lights to the residential sector.

Second, the program's concept can be applied to other end-uses of electricity. Already EPA has used the Green Lights concept to design the Energy Star Computer program, the Super Efficient Refrigerator program, and the Green Buildings program.

Finally, the possibility of expanding the Green Lights program to an international arena is currently being discussed by EPA. Whether promoted by EPA, or other national energy ministries, a federal program, which can garner a tremendous amount of credibility in a short time frame, and which effectively relies on the public/private partnership best exemplified by EPA's Green Lights, is a model worthy of transfer around the world.

# References

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