



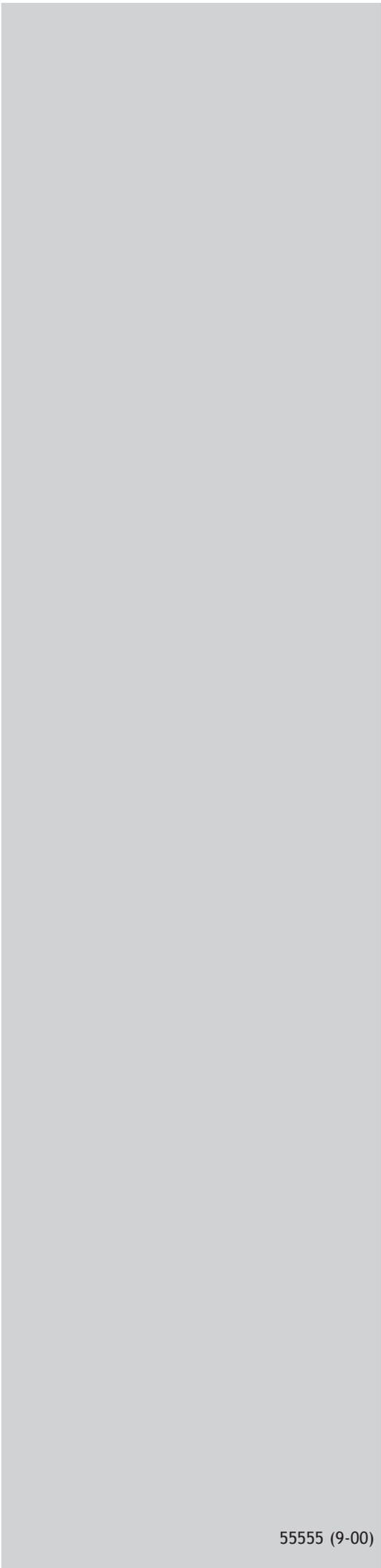
Industrial Sector Energy Savings & Cost-Effectiveness (1988-1999)

Evaluation Unit
Energy Management Services Division

September 2000



Seattle City Light



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**Industrial Sector Energy Savings
& Cost-Effectiveness, 1988–1999**

Dennis Pearson

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I. Introduction and Purpose

In March and May of 1998 two reports were issued summarizing the cumulative industrial sector energy savings and cost-effectiveness covering the period 1988 through 1997.¹ The purpose of this report is to update both of these earlier studies with savings and cost-effectiveness information through 1999, including:

1. **Cumulative energy savings:** The cumulative 1988-1999 industrial sector energy savings achieved for all incentivized contracted and completed projects in the:
 - Energy Savings Plan program (ESP),
 - Energy Smart Design (ESD) projects in industrial facilities,²
 - Industrial Research and Demonstration (IRD) projects (1988-1991),
 - Non-incentivized Air Compressor Efficiency Service, and
 - Other non-incentive service projects in the industrial sector.³

Energy savings include completed projects (incentive paid) and contracted projects (contract signed) and savings were increased by a factor of 1.052 to adjust for the effective savings due to avoided transmission and distribution (T&D) loss. These savings are crosstabulated by major industrial type and end-use.

The conclusions section of the report (pp. 15-19) contains a comparison of industrial sector energy savings attained to date with expected industrial savings forecasted in the 1992 Conservation Implementation Plan (CIP) and the 1996 amended savings goals in the 1996 Energy Management Services Plan (EMSP).

2. **Cost-Effectiveness:** Levelized cost and benefit-cost ratios are presented from the utility, customer, service area, and regional perspectives for ESP, industrial sector ESD projects, and IRD projects. Because the CITS database does not contain the necessary cost data for non-incentivized projects, non-incentivized projects will be excluded from the cost-effectiveness analysis.

¹ *Cumulative 1988-1997 Industrial Energy Savings by Major Industrial Type and End-Use*, Dennis Pearson, Seattle City Light (March 1998). *Industrial Sector Program Cost-Effectiveness (1988-97), by Program and Industrial Type and End-Use*, Dennis Pearson, Seattle City Light (May 1998).

² Although ESD is primarily a commercial sector program, a number of ESD projects are in the industrial sector. These industrial projects involve customers whose SIC code is industrial (SIC 2000-3999) and/or the customer type is industrial.

³ In addition to energy savings resulting from incentives paid to customers for the installation of energy saving measures, non-incentive services to customers have resulted in savings since 1996 and will be included in the savings portion of this update report. However, these non-incentive savings will be excluded from the cost-effectiveness analysis, due to the lack of complete cost data.

II. Background

Industrial Research and Demonstration Project: In early 1986 Larry Gunn, then Director of the Energy Management Services Division (EMSD), established the need for a “...modest R&D project...” to demonstrate the energy saving potential of the industrial sector in Seattle City Light’s (SCL) service area.⁴ That policy decision eventually became the Industrial Research and Demonstration Project (IRDP). That program was the first application of incentive-based demand-side management for industrial customers in SCL’s service area.

Energy Savings Plan (ESP): In 1987 the Bonneville Power Administration (BPA) began a series of five direct-funded ESP industrial incentive projects in SCL’s service area. Beginning in 1991 and continuing through 1996 SCL and the BPA jointly-funded and administered ESP projects for SCL’s industrial customers. Since 1997 all ESP and ESD projects contracted in SCL’s service area have been funded and administered solely through SCL’s Commercial/Industrial Section. In the ESP program engineering estimates of energy savings are calculated during the project contract phase and verified through on-site metering after the incentivized measures have been installed.

The Air Compressor Efficiency service (ACE): The ACE service began in late 1996 and ran through most of 1997, delivering comprehensive air compressor system audits and cost-effective recommendations to a total of 18 of SCL’s industrial customers. Customers could either fund the installation of ACE – recommended measures themselves or seek financial incentives from SCL.

Non-Incentive Industrial projects: Beginning in 1997, several types of non-incentivized services were provided to commercial and industrial customers. The services include the BPA’s Conservation Resource Acquisition (CRA) program, Facility Assessment Follow-up, Facility Assessment, and other non-incentivized services. Although the customer receives no incentives for participating in these services, they can chose to fund and install energy savings measures recommended as part of these services.

⁴ Larry Gunn, SCL memorandum dated January 14, 1986.

III. Method

A. Energy Savings

Energy savings and cost data for all completed or contracted industrial incentive projects (ESP, ESD industrial projects, and non-incentive projects) were extracted from the Commercial/Industrial Tracking System (CITS). Savings for the Air Compressor Efficiency service (ACE) are engineering estimates of savings derived from the ACE audit reports and interviews with 14 of the 18 ACE participants.⁵

Savings and cost data for IRDP projects were taken from “I.R.D.: The Industrial Research and Demonstration Project, 1987 to 1992”, written by Deb Das, Jim Healy, Jeremy Battis, and Cynthia Blazina.

Energy savings for all incentive and non-incentivized projects were increased by a factor of 1.052 to adjust for effective savings due to transmission and distribution (T&D) loss.

B. Cost-Effectiveness Methods

1. Levelized Costs

Levelized costs and benefit-cost ratios were calculated for all incentivized projects (ESP, ESD industrial, and IRDP). Due to the lack of complete project cost data for non-incentive projects, non-incentive projects are excluded from the cost-effectiveness analysis. Projects excluded from the cost-effectiveness analysis included ACE projects that did not result in ESD or ESP incentive projects and all other non-incentivized Commercial/Industrial projects. Table 1 lists the costs and benefits used for each economic perspective in the cost-effectiveness analyses. All costs and benefits are in 1999 dollars.

Levelized costs and benefit-cost ratios are presented for each of four economic perspectives; utility, customer, service area, and regional, by program, measure and industrial type.⁶ In addition, cost-effectiveness indices will be presented, over two time periods; 1) for projects contracted from the beginning of 1988 through 1996, when the BPA provided all incentive payments to program participating customers, and 2) for projects contracted from the beginning of 1997 through 1999, when SCL became the source of incentive payments to customers.

⁵ *Air Compressor (ACE) Service: Customer & Staff Feedback Survey*, Lisa Skumatz, Robert Bordner, for Dennis Pearson, Seattle City Light (July 1998).

⁶ For incentivized projects contracted prior to January 1, 1997 the BPA supplied incentive payments to participating customers and are included in the regional cost analysis. For incentivized projects contracted since January 1, 1997 SCL began to supply all customer incentives and administrative costs. Consequently, for projects contracted since the beginning of 1997, service area and regional costs are identical.

Table 1. Costs and Benefits used in Cost-Effectiveness Analyses

Economic Perspective	Costs (1999\$)	Benefits (1999\$)
Utility	SCL incentive payments to customers + SCL administrative cost – (minus) BPA incentive and administrative cost reimbursement to SCL	Levelized cost: Present value (PV) of total kWh savings Benefit cost ratio: PV of lifetime marginal value of energy (MVE) with externalities
Customer	Customer portion of measure purchase and installation cost	Levelized cost: PV of total kWh electricity savings Benefit cost ratio: PV of lifetime customer's bill savings
Service Area	SCL incentive payments to customers + customer portion of measure purchase and installation cost + SCL administrative cost – (minus) BPA incentive and administrative cost reimbursement to SCL	Levelized cost: PV of total kWh savings Benefit cost ratio: PV of lifetime marginal value of energy (MVE) with externalities
Regional	SCL incentive payments to customers + SCL administrative cost + BPA incentive payment to customers + BPA administrative cost reimbursement to SCL + customer portion of measure purchase and installation cost	Levelized cost: PV of total kWh savings Benefit cost ratio: PV of lifetime marginal value of energy (MVE) with externalities

The levelized costs were calculated using the following method:

1. All program costs were adjusted to 1999 dollars. Refer to Table 1 for a description of the cost and benefit categories included in each of the four economic perspectives.

For example:

$$\text{Total regional costs (admin. + incentive + customer cost)} = \$27,063,852 \text{ (1999\$)}$$

2. Cumulative industrial energy savings were multiplied by the Transmission and Distribution (T&D) adjustment factor (1.052) to yield the effective energy savings, including that portion lost during transmission.

$$90,763,070 \text{ kWh} \times 1.052 = 95,482,750 \text{ kWh (incentivized projects only)}$$

3. The present value of kWh savings was calculated using a 3% discount rate for the utility, service area, and regional perspectives, and 10% for the customer perspective. Estimated average measure life is 15 years.

Excel present value (PV) formula = PV (discount rate, life of discount period, cumulative first year savings) = PV (0.03, 15, 96,031,336 kWh) = 1,123,833,675 discounted kWh over 15 years.

4. The program costs for each of the four economic perspectives were divided by the net present value of the T&D-adjusted kWh savings to calculate the levelized cost.

$$\text{Regional levelized cost} = \$27,063,852 / 1,123,833,675 \text{ kWh} = \mathbf{\$.0241 / kWh = 24.1 \text{ mills/kWh}}$$

2. Benefit-Cost Ratio

The benefit-cost ratio is another index of the lifetime economic value of conservation projects relative to the combined cost of the incentives, program administration and customer costs. In levelized cost calculations the benefit is expressed as the discounted present value of the lifetime kWh savings, whereas in benefit-cost ratios the benefits are expressed as the discounted present value of lifetime dollar savings of the conservation measures. For the utility, service area and regional perspectives, the dollar value of energy savings is the Marginal Value of Energy (MVE). The MVE is the cost to the utility of purchased power and the estimated cost of the “environmental externalities”. From the customer’s perspective the value of energy savings is simply the discounted value of their electricity bill savings over the life of the measures.

Benefit-cost ratios of greater than one (1) indicate that the net value of energy savings is greater than the cost of obtaining those savings. Ratios less than one demonstrate that the cost of achieving the energy savings is greater than their lifetime economic benefit.

IV. Findings

A. Cumulative Industrial Energy Savings

1. Energy Savings by Program

Figure 1 and Table 2 present total cumulative industrial energy savings for both incentivized and non-incentivized programs and services. **A total of 13.7 aMW of industrial energy savings have accrued from 1988 through 1999. Of these 13.7 aMW, 10.9 aMW were acquired through ESP, ESD projects in and IRD projects. The remaining 2.8 aMW were achieved through the industrial facilities Air Compressor Efficiency service and other non-incentive services and programs.**

Figure 1. Cumulative Industrial Energy Savings (aMW), 1988–1999
(Transmission and Distribution (T&D) Adjusted)

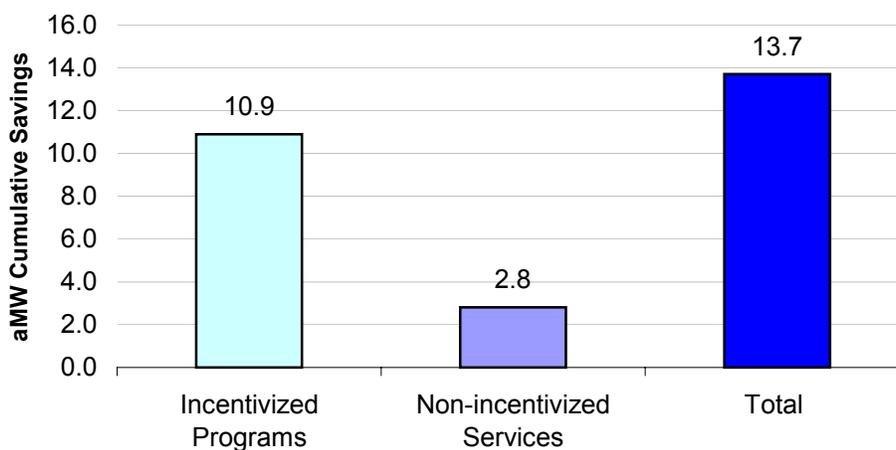


Table 2. Industrial Sector Cumulative Energy Savings by Program/Service Type, 1988–1999

Service Type	Total kWh	aMW	Percent of Total Savings
Incentive Programs			
ESP (N=77)	65,150,140	7.44	54 %
ESD Projects in Industrial Sector (N=72)	26,970,173	3.08	22 %
IRDP (1988-1992) (N=15)	3,262,436	0.38	3 %
Incentive Program Subtotal (N=164)	95,482,749	10.90	79 %
Non-Incentive Services (Industrial Sector only)			
Air Compressor Efficiency, ACE (N=9)	10,439,285	1.19	9%
Other Non-incentive Services (N=12)	14,400,089	1.64	12%
Non-incentive Program Subtotal (N=21)	24,839,374	2.83	21%
Total (N=185)	120,322,123	13.73	100.0%

2. Energy Savings by End-Use

Table 3 lists the total energy savings by end-use. **Lighting comprises the largest savings end-use, at 43% of total savings. Motors and air compressors combined provide 30% of savings.** Process heat and furnace loads supply 13% of total industrial savings. Refrigeration and HVAC/other end-uses constitute small shares of total energy savings, 8% and 6% of total, respectively.

Table 3. Industrial Sector Cumulative Energy Savings by End Use (1988–1999) ⁷

End Use	Total kWh	aMW	Percent of Total Savings
Lighting (N=79)	52,203,454	6.0	43 %
HVAC/Other (N=21)	6,646,252	0.7	6 %
Motors (N=31)	16,148,995	1.8	13 %
Process Heat/Furnaces (N=11)	15,783,252	1.8	13 %
Refrigeration (N=15)	9,543,068	1.1	8 %
Welding (N=1)	37,872	0.004	0.03 %
Air Compressors (N=27)	19,959,232	2.3	17 %
Total (N=185)	120,322,123	13.7	100 %

3. Energy Savings by Industrial Type

Aerospace and stone, clay, or glass manufacturers claim the greatest share of overall industrial savings by major industrial type. Table 4 reveals that these two industrial categories makeup over half of all industrial energy savings (33% and 24%, respectively). Metals and food processing industries provide 18% and 15% of total savings. Shipbuilding and all other industrial types supply the remaining 10% of savings.

⁷ Energy Savings include both incentivized and nonincentivized projects. Table 3 breaks savings down by end use within incentivized and nonincentivized programs and services.

Table 4. Industrial Sector Cumulative Energy Savings Industrial Type (1988–1999)

Industrial Type	Total kWh	aMW	Percent of Total Savings
Food (N=45)	17,952,447	2.0	15 %
Stone/Clay/Glass (N=35)	29,247,643	3.3	24 %
Metals (N=31)	21,501,976	2.5	18 %
Aerospace (N=20)	39,492,989	4.5	33 %
Shipbuilding (N=12)	2,811,822	0.3	2 %
Other Industries (N=42)	9,315,246	1.1	8 %
Total (N=185)	120,322,123	13.7	100 %

B. Cost-Effectiveness

1. Levelized Cost

a. Levelized Cost by Program

Overall, industrial conservation has been cost-effective from all economic perspectives.

Table 5 illustrates that from a utility perspective, industrial energy savings have been acquired at an average levelized cost of 7.8 mills/kWh (1999 \$). **The average utility levelized cost varies from a minimum of 6.4 mills for all ESP projects, to 9.2 mills/kWh for industrial ESD projects, and 23.4 mills/kWh for IRDP projects.** It needs to be pointed out that the IRDP projects were funded entirely with SCL funds, whereas incentive payments to participating customers for the ESP and ESD projects were paid by the BPA for all projects contracted prior to January 1, 1997. Consequently, the levelized utility cost of IRD projects was higher than for ESD and ESP projects, from all economic perspectives.

The average customer levelized cost was 16.2 mills/kWh. Customer levelized costs were calculated using a 10% discount rate, rather than the 3% used in all other perspectives. Using the less conservative 3% discount rate the customer's average cost would be 10.4 mills/kWh. The higher discount rate for customers reflects the business community's use of higher discount rates. The result of this higher rate causes the levelized costs to increase.

Table 5. Levelized Cost by Program Type (1988–1999) ⁸

Program	1999 Mills / kWh			
	Utility (3% Discount Rate)	Customer (10% Discount Rate)	Service Area (3% Discount Rate)	Regional (3% Discount Rate)
ESP (N=77)	6.4	10.9	13.5	21.0
ESD, Industrial (N= 72)	9.2	25.4	25.4	27.8
IRDP (N=15)	23.4	46.2	52.8	52.8
Total (N=164)	7.8	16.2 ⁹	18.3	24.1

Customer costs varied from a low of 10.9 mills for ESP participants, to 25.4 mills for ESD, to a high of 46.2 mills for IRDP participants.

Service area costs reflect the combined costs and benefits to the utility and to the customer. **The average service area perspective levelized cost is 18.3 mills/kWh, well below the average marginal value of electricity to the utility with an estimate of the environmental costs included (48.8 mills/kWh).**¹⁰

The IRDP service area costs are, again, high relative to ESP and ESD industrial participants. It needs to be mentioned that the IRDP pilot service was SCL’s first industrial customer-specific program and was funded solely by SCL and the customer, with no administrative or incentive reimbursement from the BPA.

The total cost of industrial conservation is also below the current MVE from the regional perspective. The regional, or total cost perspective, includes all SCL, customer, and BPA costs and is the broadest indicator of the cost of conservation. **The regional cost for all ESP projects is 21.0 mills/kWh, 27.8 for all ESD industrial projects, and 52.8 mills/kWh for all IRDP projects.**

⁸ Levelized costs include only incentivized projects. All non-incentive projects are excluded from the cost-effectiveness tables. All levelized costs are based on an annual discount rate of 3% over a 15 year measure life, except for the customer perspective, where the annual discount rate was increased to 10% to reflect the larger discount rates used in customer’s economic decisions.

⁹ Average customer levelized cost was 10.5 mills/kWh using a 3% discount rate.

¹⁰ The MVE used for this analysis is the wholesale cost of energy plus its transmission and distribution cost and the estimated environmental “externality cost”. The externality costs include the estimated societal cost of the air, water, and soil pollution associated with the generation of purchased energy. (Source: City Light Rates Unit, Garry Crane, Mid-Columbia Price + Externalities Excel worksheet, May 1999). As of May 1999, the MVE was 48.8 mills/kWh. During 2000, the price of energy has increased and become more volatile. However, since the cost-effectiveness analysis in this report is based on 1999 dollars, the MVE in effect during 1999 was used.

b. Levelized Cost by Source of Incentive Funding

Table 6 shows the effect of SCL’s assumption of all incentive payments to customers beginning with projects contracted from January 1, 1997. As the table reveals, the average utility levelized cost for industrial projects increased from 5.8 to 11.1 mills/kWh (+ 91%) since 1997. As expected, the shift from the BPA to SCL funding of incentives had little effect from the customer perspective – decreasing from 16.6 to 15.6 mills/kWh. This difference is an indication of the relative decrease in the cost of each kWh of saved energy from the customer’s perspective since 1997, and has little or nothing to do with the change in the source of incentive funding.

Table 6. Levelized Cost by Source of Customer Incentive (1988–1999) ¹¹

Time Period and Source of Incentive Payment to Customer	1999 Mills / kWh			
	Utility (3% Discount Rate)	Customer (10% Discount Rate)	Service Area (3% Discount Rate)	Regional (3% Discount Rate)
Contracted 1988-1996 Bonneville Power Administration (N=104)	5.8	16.6	16.6	25.9
Contracted 1997-1999 Seattle City Light (N=60)	11.1	15.6	21.0	21.0
Total (N=164)	7.8	16.2	18.3	24.1

The service area levelized cost increased from 16.6 to 21.0 mills/kWh (+ 26%) since the change in the source of incentive funding occurred. As expected, the regional and service area costs are equal from SCL’s perspective, at 21.0 mills/kWh since 1997. This is simply due to the fact that since 1997 SCL and the customer are absorbing all project costs, both at the service area and regional perspectives.

c. Levelized Cost by End-Use

Table 7 breaks the levelized costs down by major industrial end-use. **From the utility perspective, the levelized costs are, in ascending order; lighting, air compressors, motors, process heat/furnaces, refrigeration and HVAC/other.** The very high cost of the welding project is based on only a single project result, and may not be an accurate indication of future welding end-use projects. **From the customer perspective, the end-uses with the lowest costs are, in ascending order, motors, process heat/furnaces, air compressors, refrigeration, lighting and HVAC/other.** The single welding project was not cost effective from all perspectives.

¹¹ Table 6 illustrates the effect of SCL’s assumption of incentive payments to customers for all projects contracted from the beginning of 1997. The primary impact of this change in funding source is a substantial increase in utility and service area costs. The drop in regional costs is a reflection of the overall decrease in total costs/kWh from 1997 through 1999.

Table 7. Levelized Cost by End-Use Type (1988–1999)

Program	1999 Mills / kWh			
	Utility (3% Discount Rate)	Customer (10% Discount Rate)	Service Area (3% Discount Rate)	Regional (3% Discount Rate)
Lighting (N=77)	6.9	17.8	18.2	24.2
HVAC/Other (N=20)	14.0	27.4	35.6	38.1
Motors (N=27)	7.8	11.5	15.2	23.8
Process Heat/Furnaces (N=10)	7.9	11.8	15.4	17.5
Refrigeration (N=15)	8.6	17.6	19.8	26.2
Welding (N=1)	107.0 ¹²	108.8	176.3	176.3
Air Compressors (N=14)	7.5	12.5	15.4	21.7
Total (N=164)	7.8	16.2	18.3	24.1

The order of service area and regional levelized costs by end use are very similar: motors, process heat/furnaces, air compressors, lighting, refrigeration, HVAC/other, and welding.

d. Levelized Cost by Industrial Type

Utility levelized cost by industrial group varies from a low of 4.9 mills for aerospace to a high of 14.2 mills for “other industries” (see Table 8). The customer levelized costs were, in ascending order, metals, stone/clay/glass, shipbuilding, aerospace, food processing and other industries.

From the service area perspective, stone/clay/glass, metals, and aerospace shared the lowest cost projects, while food processing, shipbuilding and other industrial types cost 25 to 33 mills/kWh.

The regional cost is the best indicator of the total cost of conservation programs. Since 1997 it is equivalent to service area costs, since the BPA ceased providing incentive funding for all projects contracted on or after January 1, 1997. Here again, metals, aerospace and stone/clay/glass were among the most cost-effective industrial groups, with regional levelized costs below 25 mills/kWh. The least cost effective were food processing, shipbuilding and projects in other industrial types.

¹² Only one welding project has been completed. This high levelized cost may not be representative of other welding end-use applications.

Table 8. Levelized Cost by Type of Industry (1988–1999)

Program	1999 Mills / kWh			
	Utility (3% Discount Rate)	Customer (10% Discount Rate)	Service Area (3% Discount Rate)	Regional (3% Discount Rate)
Food (N=42)	11.1	21.9	25.1	31.3
Stone/Clay/Glass (N=28)	5.3	11.9	12.9	22.3
Metals (N=25)	9.2	9.3	15.1	17.2
Aerospace (N=18)	4.9	17.8	16.2	21.0
Shipbuilding (N=11)	13.6	14.1	22.6	27.3
Other Industries (N=40)	14.2	24.6	32.6	39.9
Total (N=164)	7.8	16.2	18.3	24.1

2. Benefit-Cost Ratios

The overall utility-perspective benefit-cost ratio was 6.3 across all industrial incentive programs combined – demonstrating a strong economic return to the utility that is over six times greater the utility’s cost of acquiring the industrial energy savings (see Table 9). The highest return results from ESP projects, with the present value of lifetime dollar benefits being 7.7 times greater than their cost. The value of ESD industrial projects were 5.3 times greater than their associated costs. IRDP’s had a relatively low utility benefit-cost ratio of 2.1. As in the case of IRDP’s utility levelized cost is primarily due to the fact that SCL absorbed all of the administrative and incentive costs of IRDP, whereas ESP and ESD incentive costs were paid by the BPA for all projects contracted through 1996.

From the customer perspective, the cost-benefit ratios varied between 0.7 for IRDP to a high of 3.0 for ESP projects, with an average of 1.9 across all three industrial programs. This indicates that from the customer’s perspective the economic return to them, although generally positive, is only 30% of the utility’s ratio of 6.3

From the service area and regional perspective, the average benefit-cost ratios were 2.7 and 2.0, respectively.

Table 9. Benefit-Cost Ratios by Program Type (1999\$) ¹³

Program	1999 Mills / kWh			
	Utility (3% Discount Rate)	Customer (10% Discount Rate)	Service Area (3% Discount Rate)	Regional (3% Discount Rate)
ESP	7.7	3.0	3.7	2.4
ESD, Industrial	5.3	1.2	1.9	1.7
IRD	2.1	0.7	0.9	0.9
Total	6.3	1.9 ¹⁴	2.7	2.0

¹³ The benefit-cost ratio is the total present value of the lifetime dollar benefit divided by the cost of the program. If the ratio is greater than 1.0 the net economic value is positive. The larger the ratio, the greater the net lifetime value.

¹⁴ The customer benefit-cost ratio is 3.1 if a 3% discount rate is used.

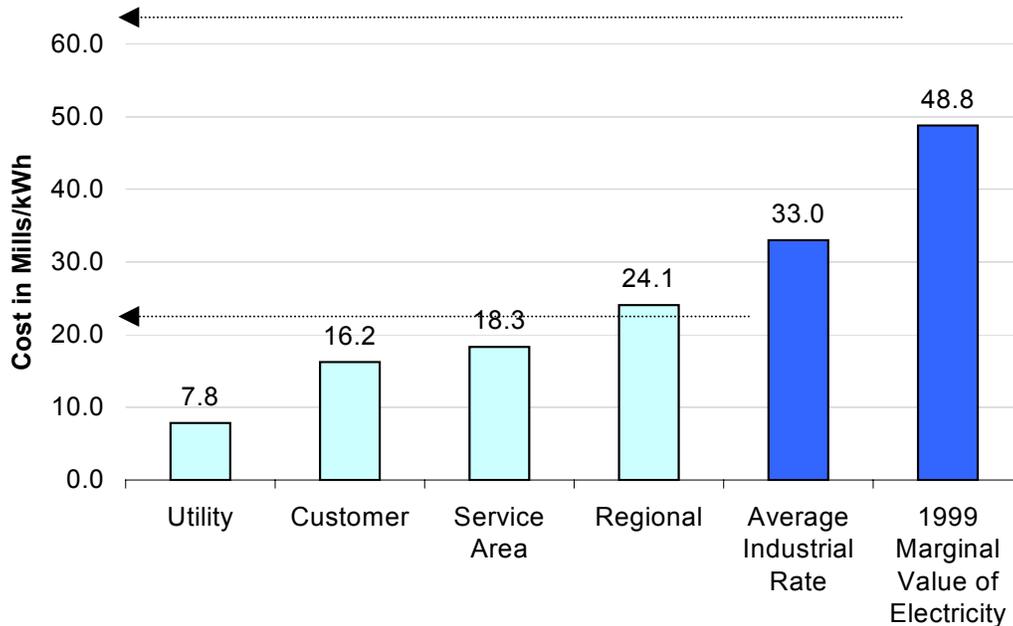
V. Conclusion and Recommendation

Summary of Findings

Since 1988 a total of 185 incentivized and non-incentivized industrial conservation projects have been completed or contracted, accounting for a total of 13.7 aMW of energy savings. Ten point nine (10.9) aMW, or 79% of total savings, resulted from ESP, ESD industrial, or IRDP incentivized projects. The remaining 2.8 aMW (21% of total industrial savings) occurred in non-incentivized services (Figure 1 and Table 2, pp. 6-7). The largest energy savings are in lighting, air compressor and motors projects, and process heat/furnace end-uses in aerospace, stone/clay/glass, and metals industrial firms (Tables 3 and 4, pp.8-9).

Overall, EMSD's incentivized industrial energy conservation programs are cost-effective from all economic perspectives. Figure 2 below summarizes the levelized cost of industrial conservation from each economic perspective and compares these levelized costs to the average 1999 industrial cost of electricity and the 1999 Marginal Value of Electricity (MVE), including the cost of environmental externalities. Figure 2 clearly illustrates how much below the customer's 1999 industrial electricity rate the customer's participation costs are, and how much below the 1999 MVE the utility, service area, and regional industrial conservation costs are. The regional cost is the most comprehensive indicator of total program costs per kWh of savings, and because of this, it provides the most relevant comparison to the MVE value of 48.8 mills/kWh.

Figure 2. Comparison of Industrial Program Levelized Cost with Average Industrial Rate and Marginal Value of Electricity



From the utility perspective, ESP project savings are the most cost-effective, at 6.4 mills/kWh. ESD industrial facility projects cost an average of 9.2 mills/kWh and IRDP projects were than 23.4 mills/kWh (Table 5, p. 10). IRDP costs are significantly higher than ESP and ESD-industrial projects because all IRDP incentive and administrative costs were paid by SCL.

From the customer perspective, ESP projects, on average, cost the participant about 11 mills/kWh, or about a third of their 1999 cost of electricity (33 mills/kWh). ESD projects in industrial facilities cost about three-fourths of the average industrial customer rate. IRDP projects were slightly more than 13 mills/kWh more than the average industrial customer cost of electricity.

Finally, the average service area and regional costs are, again, well below the marginal value of energy, including externalities costs.

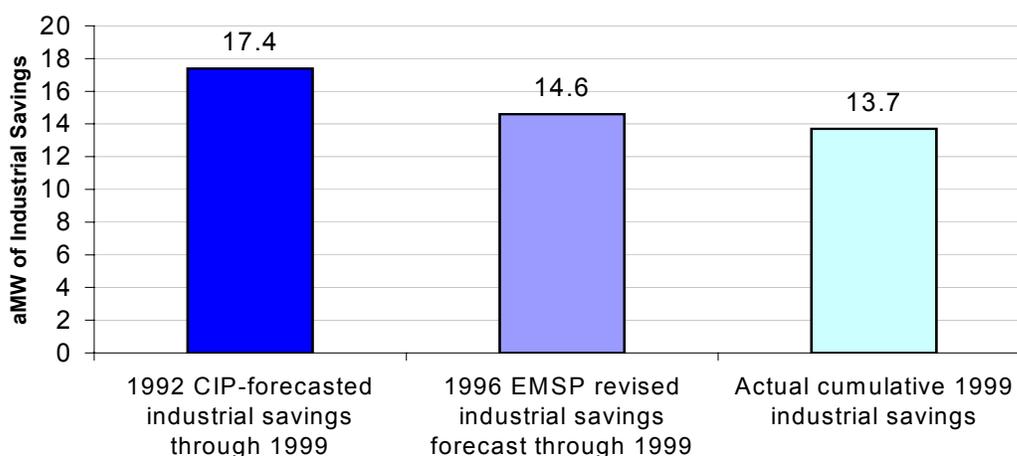
Industrial Energy Savings—Comparison of Achieved and Forecasted Savings

By comparing the achieved energy savings and program cost-effectiveness presented in this report to forecasted industrial savings potentials done in the past, and more recently as part of the Conservation Potentials Assessment (CPA), we can:

- 1) Determine how close we have come to past estimates of potential industrial energy savings
- 2) Calculate how much potential remains in comparison to the recent CPA, and
- 3) Use this information, along with program staffing and cost data, to estimate the budget and staffing needed to help achieve, along with commercial and residential sectors, the higher level of energy conservation called for by City Light's Strategic Resources Assessment (SRA).

The 13.7 aMWs of cumulative industrial savings achieved through 1999 represent 79% of the 17.4 aMWs of achievable savings forecasted for 1999 as part of the 1992 EMSD Conservation Implementation Plan (CIP), and were 95% of the 1996 Energy Management Services Plan (EMSP) revised energy savings goals (see Figure 3).^{15, 16}

Figure 3. Forecasted and Actual Industrial Energy Savings through 1999



The original 1992 CIP forecasted a total EMSD goal of 100 aMW of conservation savings from 1993 through 2002, with 26 aMW of that total to be acquired through industrial conservation services. The CIP forecasted that by the end of 1999, 17.4 of the 26 aMW forecasted by the end of 2002 could be achieved, given the budget and staffing resource assumptions in place in 1992. Since that time the BPA funding of incentives stopped in 1997 and budgeted EMSD staff resources have been reduced from 83.5 budgeted FTE positions in 1992 to 69.5 FTE in 1999 – a staffing decrease of 17%.

¹⁵ *Conservation Implementation Plan*, Energy Management Services Division, Seattle City Light, November 16, 1992.

¹⁶ *Energy Management Services Plan*, Energy Management Services Division, Seattle City Light, August 23, 1996.

In 1996 the EMSP lowered the overall CIP forecast to take account of the loss of BPA funding and staffing decreases not anticipated in the original 1992 CIP. The 1996 EMSD Plan lowered the CIP's goal of 100 aMW by the year 2002 to 84 aMW, a decrease of 16%. If this 16% drop is applied to the original CIP-forecasted 17.4 aMW of industrial savings, then the EMSP-revised industrial goal would be 14.6 aMW for the end of 1999. This means that the 13.7 aMW of actual industrial savings through 1999 represent 79% of the original 1992 CIP forecast and 94% of the revised 1996 EMSP forecasted industrial savings goal for 1999 (see Figure 3). If non-incentivized savings are excluded from total achieved savings through 1999, the 10.9 aMW of incentivized savings are 75% of the revised EMSD plan industrial goal of 14.6 aMW. This provides strong evidence that despite limited staffing, actual industrial energy savings are near where they were expected to be, particularly in the 1996 EMSP.

Remaining Industrial Energy Conservation Potential—2000 through 2020

In 2000 the Conservation Potentials Assessment (CPA) forecasted the remaining technical and achievable energy savings in all three major customer sectors over the next 20 years, 2000 – 2020. The CPA was a collaborative research effort of the Evaluation Unit of SCL and the Northwest Power Planning Council. The purpose of the CPA was to estimate the remaining conservation potential under new avoided costs being proposed under SCL's new Strategic Resource Assessment. That is, what is the remaining conservation potential at or below the SRA-set cost-effectiveness threshold? These new conservation potentials also provide guidelines for setting annual conservation goals for each customer sector and provide the rationale for estimating the budget, staffing and time requirements needed to obtain these potential energy savings.

The CPA savings estimates represent new potential savings, over and above those already achieved through 1999. Because of this, the actual achieved industrial savings reported in this document are compared to the older 1992 CIP-based forecast, as amended in the 1996 EMSP. New achieved industrial energy savings for all projects contracted from the beginning of 2000-on will be compared to the new CPA savings forecasted in 2000.

The total CPA-revised industrial sector “technical” saving potential is 92 aMW from 2000 through 2020. Of this total potential, 72 aMW are estimated to be available at a service area levelized cost of 50 mills/kWh, or less. Of these 72 aMW, between 50 and 61 aMW are assumed to be programmatically achievable.

Future Tracking of Achieved and CPA-forecasted Energy Savings

Industrial savings and cost-effectiveness will continue to be assessed and compared to the changing customer costs of electricity and Seattle City Light's fluctuating Marginal Value of Energy and the estimated cost of environmental externalities. Future savings will be measured in terms of the new Conservation Potential Assessment completed in mid-2000.

At the time of this writing, EMSD is beginning to plan for an acceleration of the its conservation efforts. The Conservation Acceleration Plan (CPA) is part of a broader, utility-wide effort to:

- 1) Meet the growth in demand for electric power without increasing the SCL's contribution to greenhouse gas emissions
- 2) Prevent or lessen the impact of future shortfalls in energy capacity, and
- 3) Lessen the rate impacts of purchasing energy – energy that has increased dramatically in cost during 2000.

Exactly what impact the current EMSD conservation acceleration planning will have on the annual industrial energy conservation goal remains to be seen. However, since the EMSD's annual combined sector conservation goal is to increase by 50%, from 6 aMW to 9 aMW per year, the annual industrial goal could increase proportionately from 1.5 aMW to 2.25 aMW. If 2.25 aMW were sustained over time, it would take 23 years (not adjusting for measure life attrition) to achieve 51 aMW of new achievable industrial conservation, and a total of 27 years to acquire 60 aMW of new industrial conservation.¹⁷ To attain all 60 aMW of potential cost-effective industrial savings by the year 2020, it would require an annual industrial savings goal of 3 aMW – double the current goal of 1.5 aMW.

Recommendation: Implications for Future Industrial Program Resource Allocation

EMSD has been directed to double its current programmatic energy conservation goal from 6 to 9 aMW each year (excluding the additional three aMW from market transformation and energy code enhancements).

The energy savings and very favorable cost-effectiveness resulting from industrial projects, coupled with the remaining industrial conservation potential, provide clear justification for either seeking new budget and staffing resources or reallocating existing resources to capture these industrial savings opportunities. Given the greater demand for energy conservation resulting from SCL's recently drafted Strategic Resources Assessment, the impetus for increased industrial conservation is even stronger.

¹⁷ This is in addition to the 13.7aMW already acquired (1988-1999).

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