Savings Generated by the Industrial Assessment Center Program: Fiscal Year 2000

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I. Introduction

Established in 1976 as a result of oil shortages and the increased awareness of the importance of energy conservation, the Energy Analysis and Diagnostic Center (EADC) program grew from the original four schools to thirty in Fiscal Year 1994. The Centers conducted energy audits for small to medium sized manufacturers through funding provided by the Office of Industrial Technologies (OIT) of the U.S. Department of Energy.

Since the inception of the program, there have been 38 Universities involved with the program. Nearly 100 faculty members have had the opportunity to enhance their classroom activities by taking students into the field, or more accurately, the factory floor. Most importantly, perhaps is the continued contribution that the over 2375 students who have "graduated' from the program are making to the industrial and commercial sector in which they now work.

In FY94, the EADC program was modified to include waste reduction and pollution prevention, with new combination Centers called "Industrial Assessment Centers" (IAC). It was decided to start with a small group of experienced Centers to provide a smooth transitional period. For this first year, the six IACs each conducted a minimum of ten combination, or industrial, assessments.

The remaining experienced EADCs were trained in August of 1994 to bring them into the IAC program with the start of Fiscal Year 1995. By Fiscal Year 1996 all centers were conducting "Industrial Assessments" and the title "Energy and Diagnostic Center" (EADC) was retired in favor of Industrial Assessment Center. In FY2000, the 30 Centers performed 700 assessments (formerly called energy audits), including recommendations for both energy conservation and waste reduction/pollution prevention.

In FY96, changes were made to the reporting of electricity use and savings to better reflect the method of billing by most electric utilities. In the past, average cost of electricity (per kilowatt/hour) was used; starting in FY96 this value was broken up into electric consumption (kwh), demand charges (kw-month/year), and other electric fees. Also in August of 1996 the center directors were trained in productivity enhancing recommendations.

IAC assessments consist of faculty led teams from accredited engineering universities performing a one-day visit to a manufacturing plant following an extensive data gathering function. Manufacturers qualified for assessments if they met three of these four requirements: employment was under 500 persons at the site, annual sales were less than $75 million, annual energy bills under $1.75 million, and no professional staff were on hand to do the analyses.

Introduction (continued)

The resulting report produced for the manufacturer included data about the plant's energy use, waste production, processes and other information.

In addition, the reports produced contained several assessment recommendations, written with sufficient detail to provide anticipated energy, waste, or productivity cost savings, as well as implementation costs and simple paybacks. Within one year the staff of each Center conducted a survey of the assessed manufacturers to determine which recommended conservation measures were adopted.

For the eighth year, management duties were divided into two regions with Rutgers, The State University of New Jersey providing direction for the Eastern Region and the University City Science Center, Philadelphia, PA continuing in the West. Rutgers University also maintained the database for the entire program.

This report contains sections on general programs statistics; assessment recommendations with related implementation results, and field management reports by region. The database manager at Rutgers University generated program statistics analysis and graphics. Section III, standard Financial Calculations, was produced by the University City Science Center. Field management reports were contributed by each management organization respectively.

This report changes how we calculate MMBtu’s saved, MMBtu’s saved is the sum of site fuels saved and the MMBtu’s needed to generate the electricity consumed at the site. Site usage of KWH is now being reported.

II. Program Statistics

A. General

In Fiscal Year 2000, 700 assessments were performed, bringing the program database total to 9,775 assessments since FY1981, the first year these records were kept. As only fifteen assessments were performed in FY1981, the data shown in this report date back to 1982. The number of assessments in this data set is 9,760. Unless otherwise noted, figures are for FY2000. Table 1 shows the number of assessments performed by Fiscal Year.

Fiscal Year	Total No. of Assessments Performed	No. of Industrial Assessments Performed
1982	253	n/a
1983	211	n/a
1984	248	n/a
1985	368	n/a
1986	298	n/a
1987	324	n/a
1988	388	n/a
1989	340	n/a
1990	360	n/a
1991	455	n/a
1992	531	n/a
1993	585	n/a
1994	776	61
1995	879	237
1996	867	867
1997	720	720
1998	723	723
1999	734	734
2000	700	700
Total	**9,760**	**4,042**

Table 1. Assessments Performed by Fiscal Year

The total amount of recommended Energy Conservation measures in FY2000 was approximately 6,537,000 Million British Thermal Units (MMBTU) with a dollar value of almost $37 million. Waste Reduction and Pollution Prevention cost savings amounted to over $11 million, and Productivity recommendations were over $91 million. The resultant total recommended savings were almost $140 million.

The FY2000 implementation survey conducted by the Centers revealed that the amount of energy saved by manufacturers through implementation of recommendations contained in reports resulting from assessments, as reported by the clients, was 1,746,000 MMBTU, with a dollar value of $9.4 million. This equates to 300,000 barrels of oil measured in barrels of oil equivalent (BOE), and 36,000 metric tons of carbon avoided measured in carbon equivalent (CE).[1] . The implemented Waste Reduction and Pollution Prevention (P2) measures amounted to $3 million and Productivity measures realized over $16 million. The total amount of money saved by clients as a result of implemented measures was over $28 million. If all implemented energy saving recommendations made over the past 7 years are still in place, the energy savings to the clients would be 14,472,000 MMBTU's.

[1] Carbon avoidance is a generally accepted method of quantifying the production of Carbon Dioxide (CO_2), a known "greenhouse" gas, by the combustion of fossil fuels.

B. Client Profile

Each Center operates in a geographic area based on its location and the state that it resides in. The distribution of assessments in FY2000 is shown in the following table by state. In FY2000, the IACs served manufacturers in 40 states.

STATE	No. of Assessments Performed in Each State	Industrial Assessment Center	No. of Assessments Performed by Each IAC	Percent of Assessments Performed in Each State
Alabama	3	Georgia Tech. Mississippi State University	1 2	33% 67%
Arizona	25	Arizona State University	25	100%
Arkansas	15	Univ. of Arkansas - Little Rock	15	100%
California	66	University of Nevada Oregon State University San Diego State University San Francisco State University	15 1 25 25	22% 2% 38% 38%
Colorado	23	Colorado State University	23	100%
Connecticut	2	Hofstra University University of Massachusetts	1 1	50% 50%
Florida	25	University of Florida	25	100%
Georgia	24	Georgia Tech.	24	100%
Idaho	4	Orgon State University	4	100%
Illinois	48	Bradley University University of Missouri – Rolla Univ. of Wisconsin - Milwaukee	25 1 22	52% 2% 46%
Indiana	20	University of Dayton Notre Dame University University of Louisville	2 16 2	10% 80% 10%
Iowa	18	Iowa State University	18	100%
Kansas	9	University of Kansas	9	100%
Kentucky	14	University of Louisville University of Tennessee	10 4	71% 29%
Maine	21	University of Maine	21	100%
Massachusetts	15	University of Massachusetts	15	100%
Michigan	34	Notre Dame University University of Michigan	9 25	26% 74%
Minnesota	22	Iowa State University South Dakota State University	3 19	14% 86%
Mississippi	23	Mississippi State University	23	100%
Missouri	31	University of Kansas University of Missouri - Rolla	7 24	23% 77%

Table 2. Geographic Distribution of Assessments by State

STATE	No. of Assessments Performed in Each State	Industrial Assessment Center	No. of Assessments Performed by Each IAC	Percent of Assessments Performed in Each State
Nebraska	6	Iowa State University	4	67%
		University of Kansas	2	33%
Nevada	10	University of Nevada	10	100%
New Hampshire	6	University of Maine	4	67%
		University of Massachusetts	2	33%
New Jersey	4	Hofstra University	4	100%
New York	11	Hofstra University	8	73%
		University of Massachusetts	3	27%
North Carolina	32	North Carolina State Univ.	25	78%
		Old Dominion University	2	6%
		University of Tennessee	5	16%
Ohio	27	University of Dayton	23	85%
		West Virginia University	4	15%
Oklahoma	21	Oklahoma State University	21	100%
Oregon	18	Oregon State University	18	100%
Pennsylvania	17	Hofstra University	11	65%
		West Virginia University	6	35%
Rhode Island	4	University of Massachusetts	4	100%
South Carolina	1	University of Tennessee	1	100%
South Dakota	6	South Dakota State Univ.	6	100%
Tennessee	16	Univ. of Arkansas - Little Rock	2	13%
		University of Tennessee	14	87%
Texas	34	Oklahoma State University	1	3%
		Texas A&M – College Station	23	68%
		Texas A&M – Prairie View	10	29%
Virginia	24	Old Dominion University	23	94%
		University of Tennessee	1	4%
Washington	2	Oregon State University	2	100%
West Virginia	15	West Virginia University	15	100%
Wisconsin	3	Univ. of Wisconsin - Milwaukee	3	100%
Wyoming	1	Colorado State University	1	100%

Table 2. (continued) Geographic Distribution of Assessments by State

Table 3 indicates the geographic distribution of the assessments broken down by IAC.

Industrial Assessment Center	No. of Assessments Performed by Each IAC	STATE	No. of Assessments Performed in Each State	Percent of Assessments Performed by IAC in a State
Arizona State University	25	Arizona	25	100%
Bradley University	25	Illinois	25	100%
Colorado State University	24	Colorado	23	80%
		Wyoming	1	4%
Georgia Tech.	25	Alabama	1	4%
		Georgia	24	96%
Hofstra University	24	Connecticut	1	28%
		New Jersey	4	28%
		New York	8	36%
		Pennsylvania	11	8%
Iowa State University	25	Iowa	18	84%
		Minnesota	3	8%
		Nebraska	4	8%
Mississippi State Univ.	25	Alabama	2	8%
		Mississippi	23	92%
North Carolina State Univ.	25	North Carolina	25	96%
Notre Dame University	25	Indiana	16	84%
		Michigan	9	16%
Oklahoma State Univ.	22	Oklahoma	21	95
		Texas	1	5
Old Dominion University	25	North Carolina	2	8%
		Virginia	23	88%
Oregon State University	25	California	1	4%
		Idaho	4	16%
		Oregon	18	72%
		Washington	2	8%
San Diego State University	25	California	25	100%
San Francisco State Univ.	25	California	25	100%
South Dakota State Univ.	25	Minnesota	19	76%
		South Dakota	6	24%
Texas A&M - College Station	23	Texas	23	100%
Texas A&M – Prairie View	10	Texas	10	100%
Univ. of Arkansas - Little Rock	17	Arkansas	15	88%
		Tennessee	2	12%
University of Dayton	25	Ohio	23	92%
		Indiana	2	8%
University of Florida	25	Florida	25	100%

Table 3. Geographic Distribution of Assessments by Center

Industrial Assessment Center	No. of Assessments Performed by Each IAC	STATE	No. of Assessments Performed in Each State	Percent of Assessments Performed by IAC in a State
University of Kansas	18	Kansas	9	50%
		Missouri	7	39%
		Nebraska	2	11%
University of Louisville	12	Indiana	2	17%
		Kentucky	10	83%
University of Maine	25	Maine	21	84%
		New Hampshire	4	16%
University of Massachusetts	25	Connecticut	1	4%
		Massachusetts	15	60%
		New Hampshire	2	8%
		New York	3	12%
		Rhode Island	4	16%
Univ. of Michigan - Ann Arbor	25	Michigan	25	100%
University of Missouri - Rolla	25	Illinois	1	4%
		Missouri	24	96%
University of Nevada	25	California	15	60%
		Nevada	10	40%
University of Tennessee	25	Kentucky	4	16%
		North Carolina	5	20%
		South Carolina	1	4%
		Tennessee	14	56%
		Virginia	1	4%
Univ. of Wisconsin - Milwaukee	25	Illinois	22	88%
		Wisconsin	3	12%
West Virginia University	25	Ohio	4	16%
		Pennsylvania	6	24%
		West Virginia	15	60%

Table 3. (continued) Geographic Distribution of Assessments by Center

The IAC program serves manufacturers with a two digit Standard Industrial Classification (SIC) from 20 to 39 inclusive (Table 4). Figure 1 shows the distribution of assessments performed in each classification for FY2000.

2-digit SIC Code	Industry	No. of Assessments Performed
20	Food and Kindred Products	74
21	Tobacco Products	0
22	Textile Mill Products	20
23	Apparel and Other Textile Products	14
24	Lumber and Wood Products	61
25	Furniture and Fixtures	26
26	Paper and Allied Products	29
27	Printing and Publishing	30
28	Chemicals and Allied Products	38
29	Petroleum and Coal Products	5
30	Rubber and Misc. Plastics Products	68
31	Leather and Leather Products	2
32	Stone, Clay, and Glass Products	24
33	Primary Metal Industries	54
34	Fabricated Metal Products	90
35	Industrial Machinery and Equipment	69
36	Electronic and Other Electric Equip.	37
37	Transportation Equipment	28
38	Instruments and Related Products	16
39	Miscellaneous Manufacturing Industries	15
Total		**700**

Table 4. Number of Assessments Performed by Industry Type

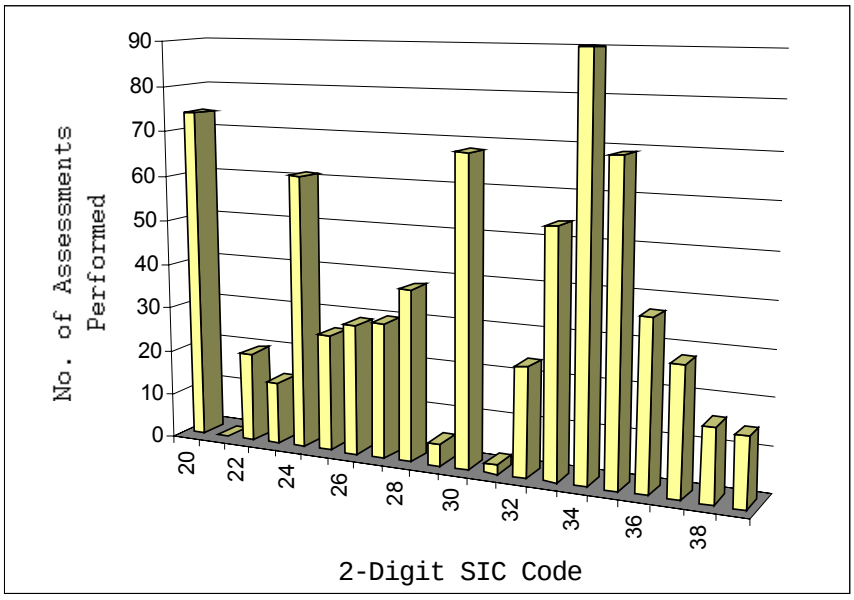


Figure 1. Plants Served in FY2000 by Industry Type

Assessments are available for small to medium size plants that meet three of the following requirements:

- Gross sales below $75 million
- A maximum of 500 employees at the site
- Annual energy bills below $1.75 million
- Lack of professional staff to do energy analyses

In FY2000, the total energy usage of the clients was 83 million MMBTU, costing $ 360 million. There was an average of 165 employees at each location. The companies had total sales of $ 23 billion.

The average sales and energy use of the clients by Fiscal Year is shown in Table 5.

Fiscal Year	Average Yearly Sales($)	Average Yearly Energy Usage (MMBtu)	Average Yearly Energy Cost ($)
1982	16,558,654	59,472	231,913
1983	15,439,405	76,980	320,200
1984	13,543,984	65,989	312,849
1985	14,308,457	76,586	329,205
1986	21,558,916	96,056	416,228
1987	19,438,333	81,140	334,472
1988	18,515,013	104,010	361,374
1989	23,309,162	105,757	413,965
1990	25,126,931	116,491	441,287
1991	25,707,204	104,961	382,786
1992	24,500,738	143,617	428,295
1993	27,333,166	129,428	499,311
1994	28,090,421	97,643	437,531
1995	29,077,218	90,974	412,759
1996	30,609,175	92528	419,120
1997	29,801,416	82,843	386,008
1998	31,756,512	108,847	481,024
1999	28,255,145	105,316	451,489
2000	32,994,566	119,236	513,877

Table 5. Average Client Energy Use and Sales by Fiscal Year

Figure 2 shows the average sales figures for the IAC clients over the years since FY1982.

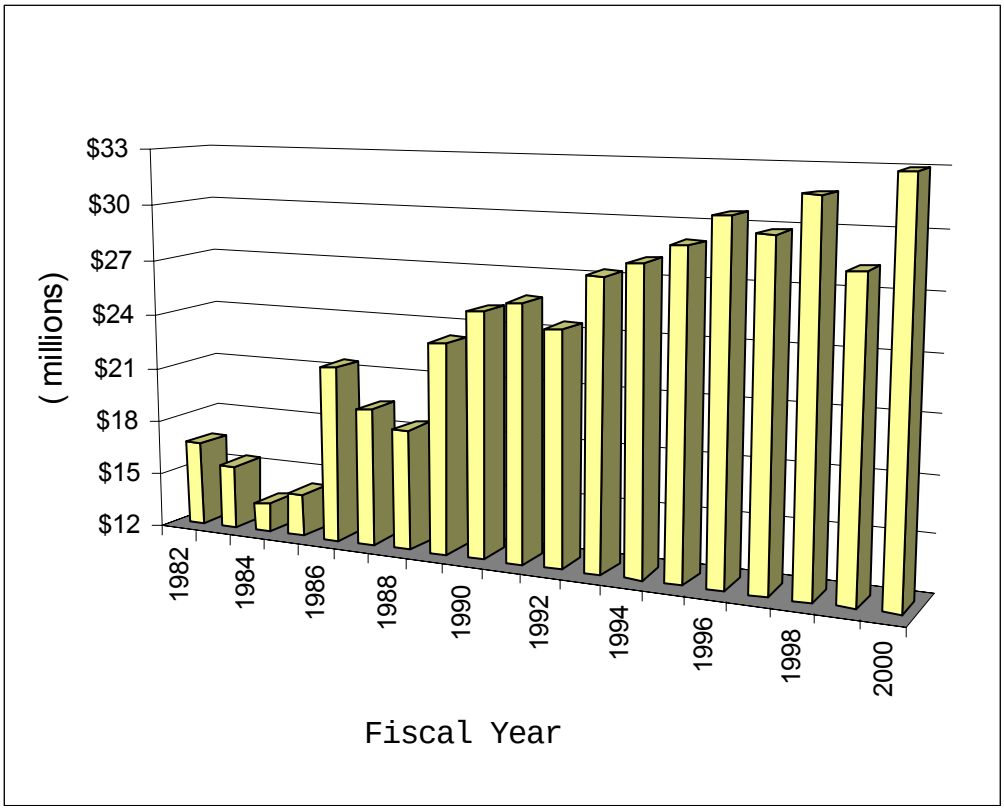


Figure 2. Average Client Sales by Fiscal Year

The average plant served in FY2000 had purchased energy use of 119,000 MMBTU (Source) with an associated cost of $514,000. Electricity cost the typical client $15.39/ MMBTU (Site) and natural gas cost $3.24/ MMBTU. (Site) The average energy use and associated costs are shown in Figures 3 and 4. The DOE estimates that it takes 10,250 BTU's of thermal energy to get 1 KWH of electricity this equals an efficiency of about 33.29%.

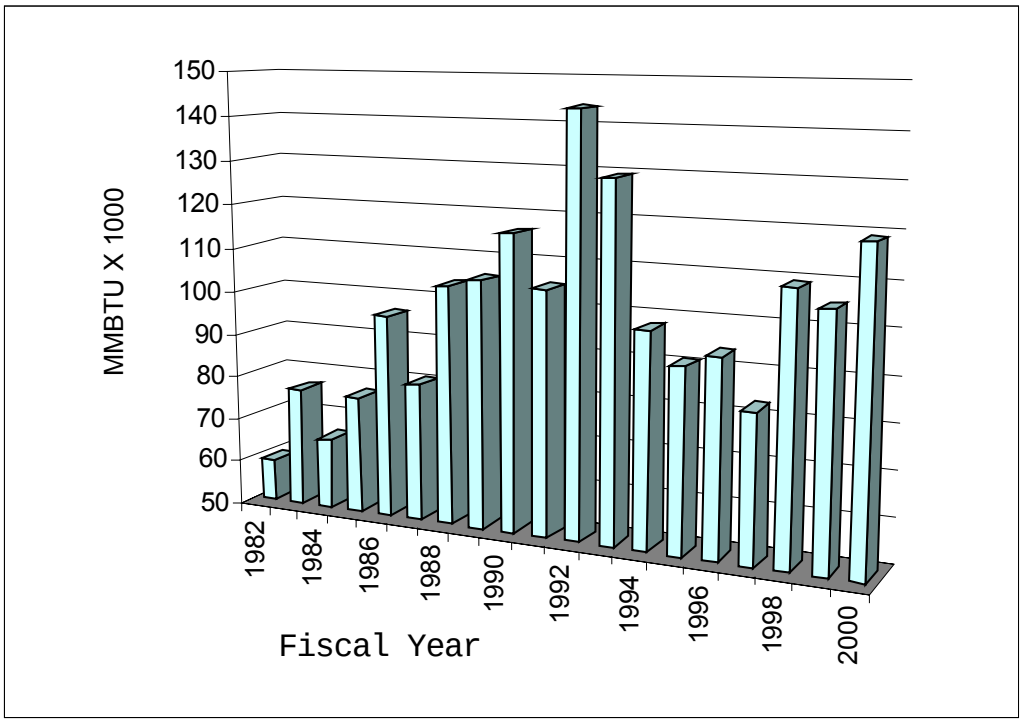


Figure 3. Average Client Energy Usage by Fiscal Year

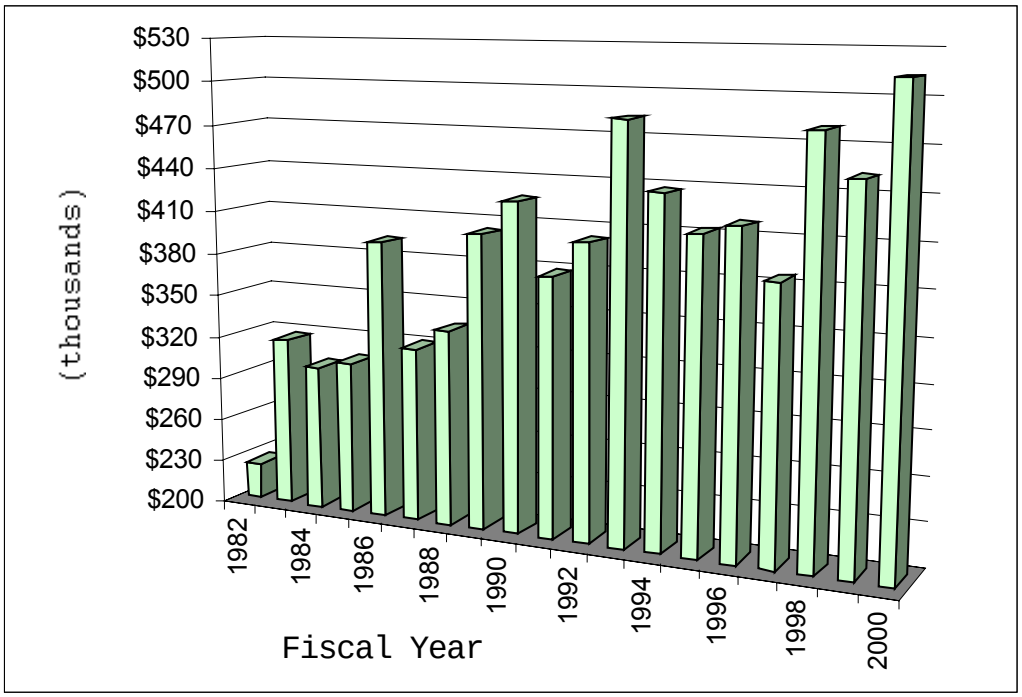


Figure 4. Average Client Energy Costs by Fiscal Year

The program database breaks energy use into eleven specific streams and one category for "other" energy. “Other Energy” in FY2000 was mainly coke. The breakdown of the different energy streams is shown in Table 6, and Figures 5 and 6.

Energy Stream	Energy Usage (MMBtu) Unless Noted	Total Cost ($)
Electricity		
Demand	12,911,310 KW-months/yr	73,003,189
Fees		6,712,242
Consumption		
Site(KWH)	4,743,958,904	169,350,568
Source(MMBtu)	48,625,568	
Natural Gas	29,750,718	96,439,615
L. P. G.	1,698,528	4,003,773
Fuel Oil #1	3,576	26,189
Fuel Oil #2	251,756	1,227,934
Fuel Oil #4	123,663	509,823
Fuel Oil #6	1,007,485	3,106,386
Coal	0	0
Wood	1,056,600	2,018,056
Paper	0	0
Other Gas	6,101	152,078
Other Energy	941,527	3,163,960
Totals	**83,465,522**	**359,713,813**

Table 6. Energy Use and Cost by Energy Streams

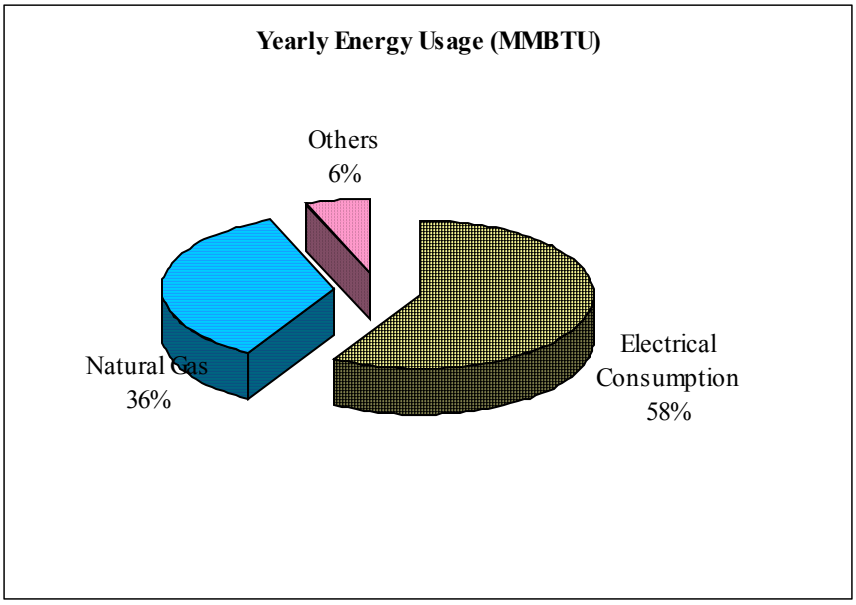


Figure 5. Energy Use of Plants Served in FY2000 by Energy Stream

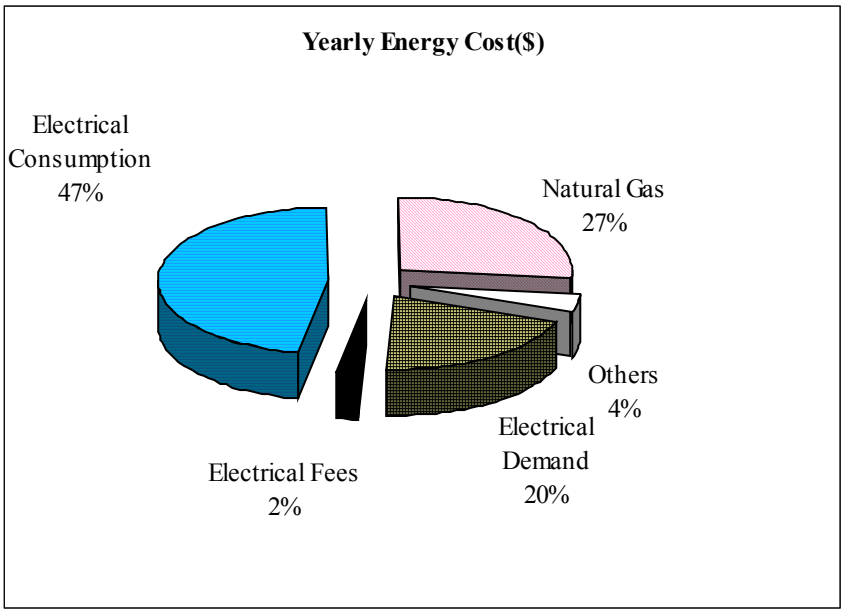


Figure 6. Energy Costs of Plants Served in FY2000 by Energy Stream

C. Assessment Recommendations

i. General

Table 7 indicates the recommended energy saved in millions of BTUs, dollars, barrels of oil equivalent, and carbon equivalent, for FY2000 and previous years. Due to the growth of the program into conducting Industrial Assessments, non-energy savings (water, waste, administrative savings, etc.) were recorded separately in the program database beginning in FY1993. Starting in FY1999 the total energy savings is calculated using both the energy needed to generate electricity at the source and the site use of fuels.

Fiscal Year	Recommended Energy Conservation						Recommended Cost Savings ($)			
	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
1982	62,096,114	636,439	894,877	1,531,316	260,428	35,418	6,699,075	n/a	n/a	6,699,075
1983	60,832,937	633,505	1,313,411	1,946,916	331,108	45,031	8,712,422	n/a	n/a	8,712,422
1984	59,031,622	605,003	1,078,172	1,683,175	286,254	38,931	8,970,862	n/a	n/a	8,970,862
1985	119,194,572	1,221,632	1,779,864	3,001,496	510,459	69,422	13,917,009	n/a	n/a	13,917,009
1986	165,818,543	1,699,559	1,097,081	2,796,640	475,619	64,684	13,670,029	n/a	n/a	13,670,029
1987	140,209,513	1,437,032	623,132	2,060,164	350,368	47,650	10,742,173	n/a	n/a	10,742,173
1988	185,648,245	1,902,772	868,209	2,770,981	471,255	64,091	13,585,868	n/a	n/a	13,585,868
1989	135,267,821	1,386,395	1,310,232	2,696,627	458,610	62,371	13,052,451	n/a	n/a	13,052,451
1990	160,188,406	1,641,815	1,019,706	2,661,521	452,640	61,559	13,970,285	n/a	n/a	13,970,285
1991	230,266,921	2,360,082	504,660	2,864,742	487,201	66,259	17,369,605	n/a	n/a	17,369,605
1992	275,096,064	2,819,542	1,089,038	3,908,580	664,724	90,403	21,749,395	n/a	n/a	21,749,395
1993	341,994,623	3,505,204	1,263,902	4,769,106	811,072	110,306	26,253,156	66,793	3,323,992	29,643,941
1994	505,826,680	5,184,444	1,796,790	6,981,234	1,187,285	161,471	34,764,310	3,410,391	3,463,564	41,638,265
1995	471,717,398	4,834,817	1,041,729	5,876,546	999,413	132,281	32,918,127	10,459,571	6,741,345	50,119,043
1996	306,900,235	3,145,448	682,091	3,827,539	650,942	84,129	24,081,673	26,439,503	14,477,738	64,998,914
1997	256,344,303	2,627,338	1,685,195	4,312,533	733,424	88,364	23,115,188	15,088,878	104,279,472	142,483,538
1998	360,308,430	3,692,982	772,447	4,465,429	759,427	100,427	25,799,269	22,597,667	88,073,618	136,470,554
1999	467,127,428	4,838,173	1,455,191	6,293,364	1,070,300	139,146	31,781,311	12,911,453	89,943,157	134,635,921
2000	564,176,890	5,783,930	753,615	6,537,545	1,111,827	148,533	35,514,217	11,381,081	91,474,861	138,370,159
Totals	4,868,046,745	49,956,112	21,029,342	70,985,454	12,072,356	1,610,476	376,666,425	102,355,337	401,777,747	880,799,509

Table 7. Recommended Savings Figures by Fiscal Year

The Figures 7 through 11, and Table 8 show average recommended savings figures per assessment by Fiscal Year.

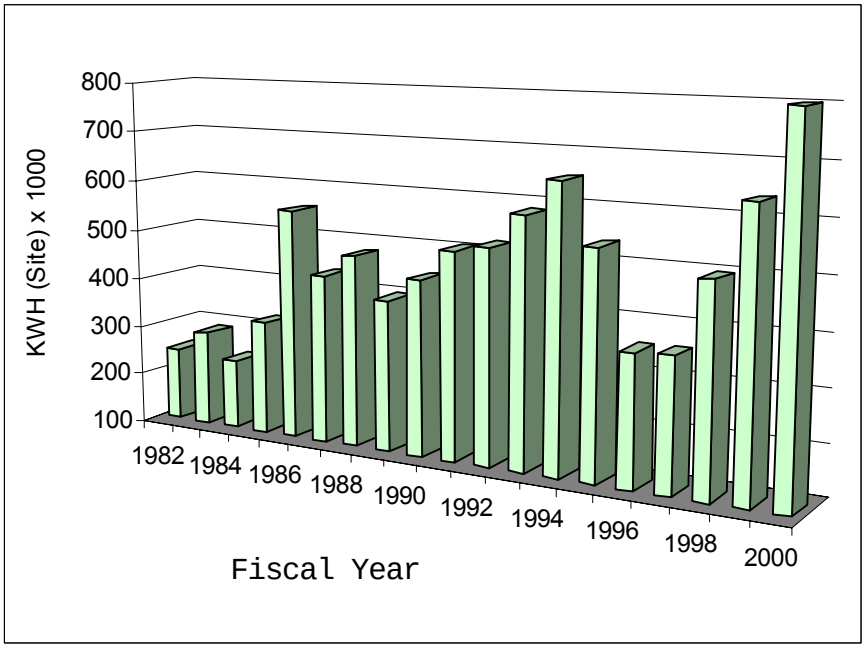


Figure 7: Average Recommended Electric Consumption Conserved Per Assessment by Fiscal Year

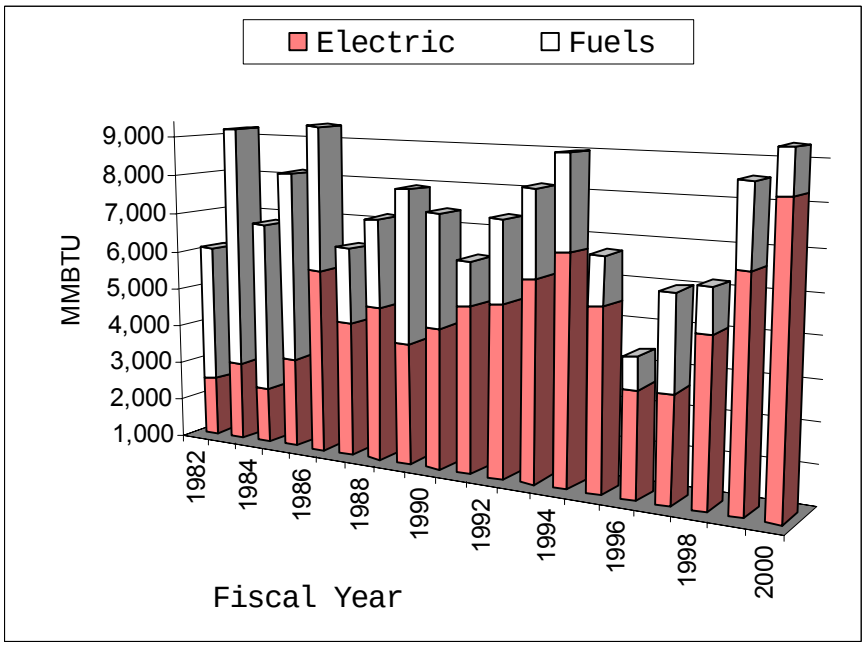


Figure 8. Average Recommended Energy Conserved by Fiscal Year

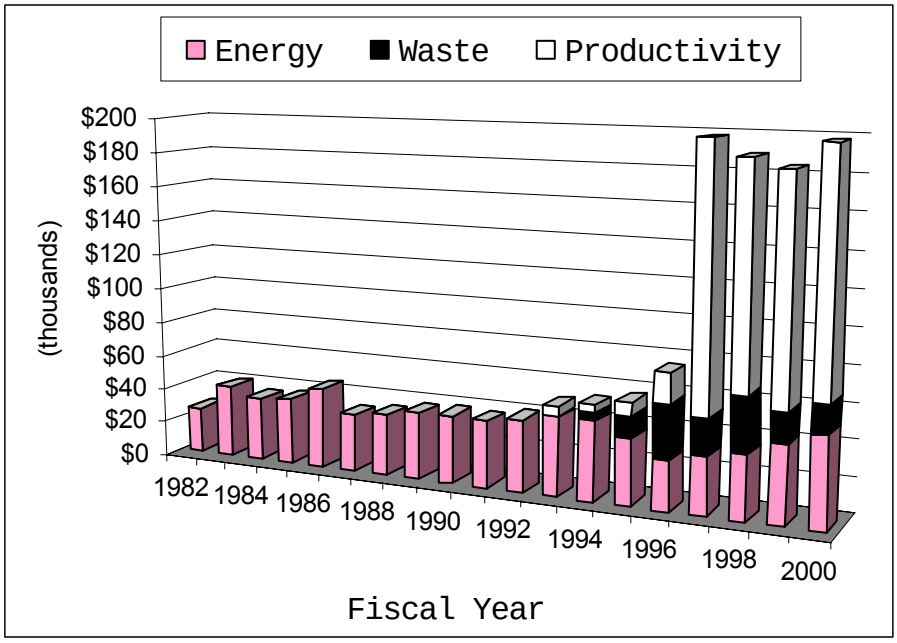


Figure 9. Average Recommended Cost Savings by Fiscal Year

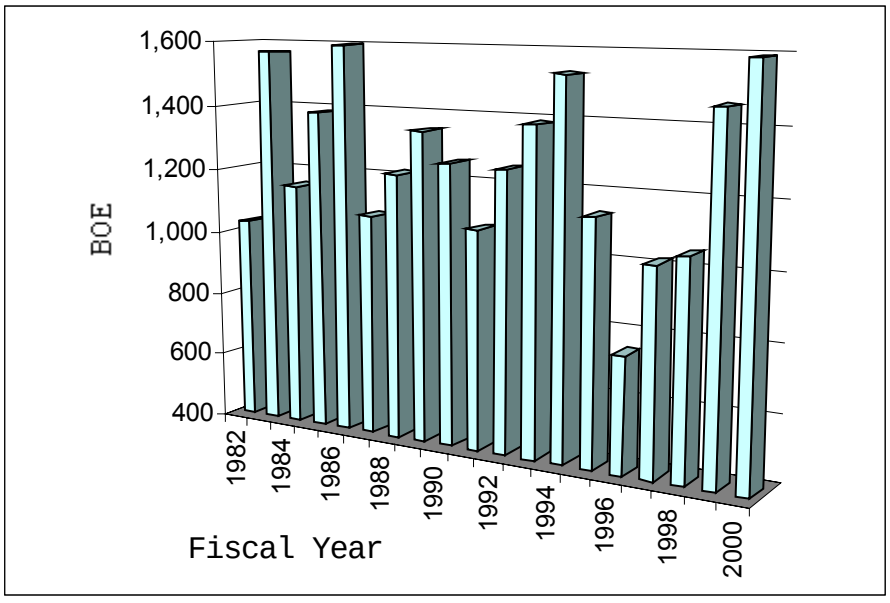


Figure 10. Average Recommended Barrels of Oil Avoided by Fiscal Year

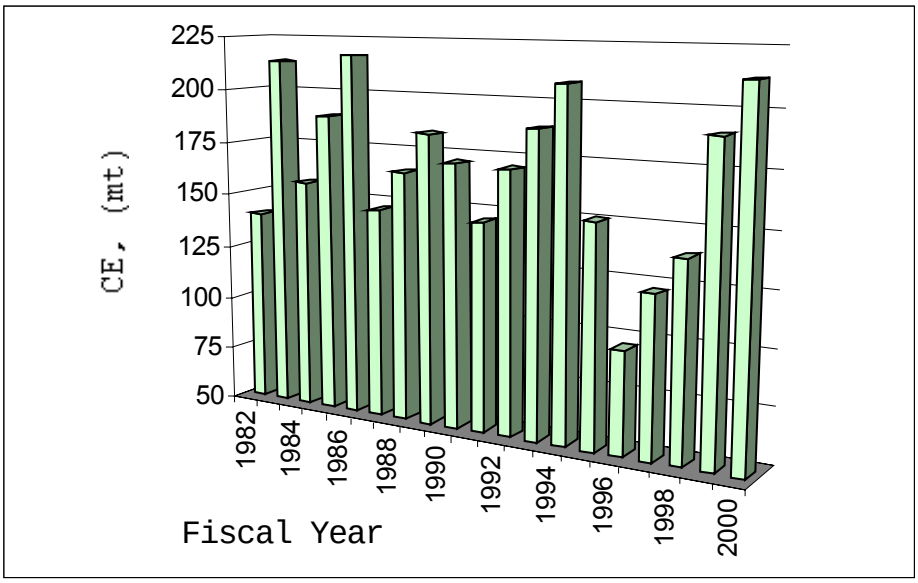


Figure 11. Average Recommended Carbon Avoided by Fiscal Year

Fiscal Year	Recommended Energy Conservation						Recommended Cost Savings ($)			
	Site (KWH)	Source Electric (MMBTU)	Site Fuels (MMBTU)	(MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
1982	245,439	2,516	3,537	6,053	1,029	140	26,479	N/A	N/A	26,479
1983	288,308	3,002	6,225	9,227	1,569	213	41,291	N/A	N/A	41,291
1984	238,031	2,440	4,347	6,787	1,154	157	36,173	N/A	N/A	36,173
1985	323,898	3,320	4,837	8,156	1,387	189	37,818	N/A	N/A	37,818
1986	556,438	5,703	3,681	9,385	1,596	217	45,873	N/A	N/A	45,873
1987	432,745	4,435	1,923	6,359	1,081	147	33,155	N/A	N/A	33,155
1988	478,475	4,904	2,238	7,142	1,215	165	35,015	N/A	N/A	35,015
1989	397,847	4,078	3,854	7,931	1,349	183	38,390	N/A	N/A	38,390
1990	444,968	4,561	2,833	7,393	1,257	171	38,806	N/A	N/A	38,806
1991	506,081	5,187	1,109	6,296	1,071	146	38,175	N/A	N/A	38,175
1992	518,072	5,310	2,051	7,361	1,252	170	40,959	N/A	N/A	40,959
1993	584,606	5,992	2,161	8,152	1,386	189	44,877	114	5,682	50,673
1994	651,839	6,681	2,315	8,996	1,530	208	44,799	4,395	4,463	53,658
1995	536,652	5,500	1,185	6,685	1,137	150	37,450	11,899	7,669	57,018
1996	353,980	3,628	787	4,415	751	97	27,776	30,495	16,699	74,970
1997	356,034	3,649	2,341	5,990	1,019	123	32,104	20,957	144,833	197,894
1998	498,352	5,108	1,068	6,176	1,050	139	35,684	31,255	121,817	188,756
1999	636,413	6,592	1,983	8,574	1,458	190	43,299	17,591	122,538	183,428
2000	805,967	8,263	1,077	9,339	1,588	212	50,735	16,259	130,678	197,672
Totals	466,008	4,782	2,608	7,390	1,257	169	38,361	21,409	90,706	74,537

Table 8. Average Recommended Energy Conservation and Cost Savings

ii. Recommended Savings by Industry Type

Savings recommended by industry type in Fiscal Year 2000 is shown in Table 9 and Figures 12 through 16. The largest amount of recommended energy conserved occurred during SIC 28 (Chemical Products) assessments replacing SIC 24 (Wood Products) in FY1999. The largest recommended cost savings was in SIC 32 (Stone & Glass Products) There were no recommendations performed for SIC 21 (Tobacco Products).

		Recommended Energy Conservation						Recommended Cost Savings ($)			
SIC Code	Industry Description	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
20	Foods	37,578,619	385,168	-659	384,509	65,393	8,736	2,181,478	1,413,497	6,626,753	10,221,728
21	Tobacco Prod.	0	0	0	0	0	0	0	0	0	0
22	Textile Mills	15,215,374	155,957	245,884	401,841	68,340	9,130	1,591,844	279,594	527,446	2,398,884
23	Apparel	3,741,499	38,343	87,452	125,795	21,394	2,858	620,446	67,409	1,668,467	2,356,322
24	Wood Prod.	106,190,101	1,088,435	-509,072	579,363	98,531	13,163	5,523,844	27,468	7,280,696	12,832,008
25	Furniture	6,722,893	68,900	9,897	78,797	13,401	1,790	462,550	127,961	1,125,788	1,716,299
26	Paper Prod.	11,974,310	122,738	143,425	266,163	45,266	6,047	1,133,876	1,048,414	2,825,653	5,007,943
27	Printing	43,645,082	447,351	-84,646	362,705	61,685	8,241	1,870,823	306,380	5,682,286	7,859,489
28	Chemical Prod.	119,678,539	1,226,699	142,172	1,368,871	232,801	31,101	3,660,321	351,454	9,190,012	13,201,787
29	Petroleum	7,196,106	73,760	-61,872	11,888	2,022	270	401,052	3,622	248,815	653,489
30	Rubber & Plast.	40,922,957	419,444	-6,692	412,752	70,196	9,378	2,584,239	1,406,145	5,984,461	9,974,845
31	Leather Prod.	1,133,937	11,622	-1,401	10,221	1,738	232	98,303	92,750	5,750	196,803
32	Stone & Glass	12,730,857	130,486	50,205	180,691	30,730	4,105	2,611,437	860,208	17,512,981	20,984,626
33	Primary Metal	39,460,015	404,457	330,584	735,041	125,007	16,700	3,489,000	2,454,661	8,181,181	14,124,842
34	Fab. Metal	29,933,382	306,786	338,394	645,180	109,724	14,658	2,691,616	967,678	6,889,051	10,548,345
35	Ind. Machinery	29,023,469	297,469	9,576	307,045	52,219	6,976	1,927,239	726,425	3,517,200	6,170,864
36	Electronics	44,824,083	459,441	-112,371	347,070	59,026	7,885	3,112,539	454,181	9,490,227	13,056,947
37	Trans. Equip.	6,715,869	70,110	157,695	227,805	38,742	5,176	1,077,334	696,923	1,802,149	3,576,406
38	Instruments	3,962,249	40,611	6,656	47,267	8,039	1,074	249,691	58,101	1,015,023	1,322,815
39	Misc. Manuf.	3,527,549	36,153	8,388	44,541	7,575	1,012	226,585	38,210	1,900,922	2,165,717
Totals		**564,176,890**	**5,783,930**	**753,615**	**6,537,545**	**1,111,827**	**148,533**	**35,514,217**	**11,381,081**	**91,474,861**	**138,370,159**

Table 9. Recommended Cost and Energy Savings by Industry Type

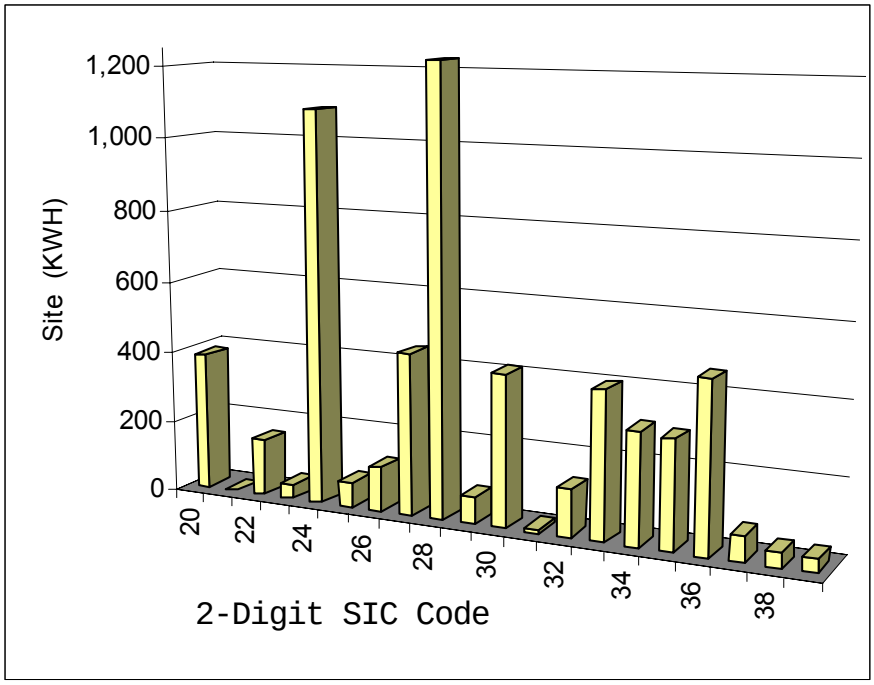


Figure 12. Recommended Electric Consumption Conserved by Industry Type

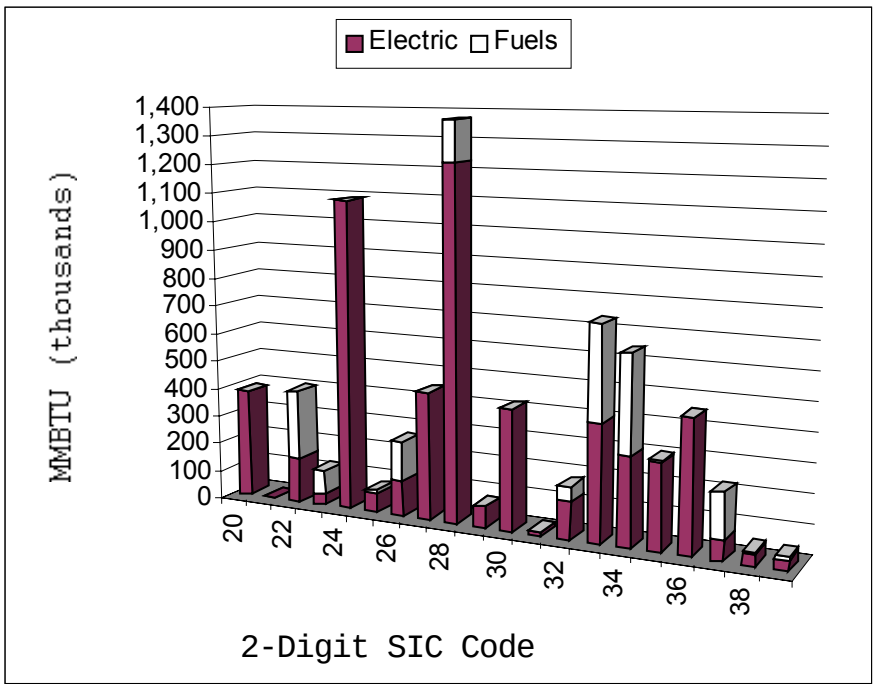


Figure 13. Recommended Energy Conserved by Industry Type

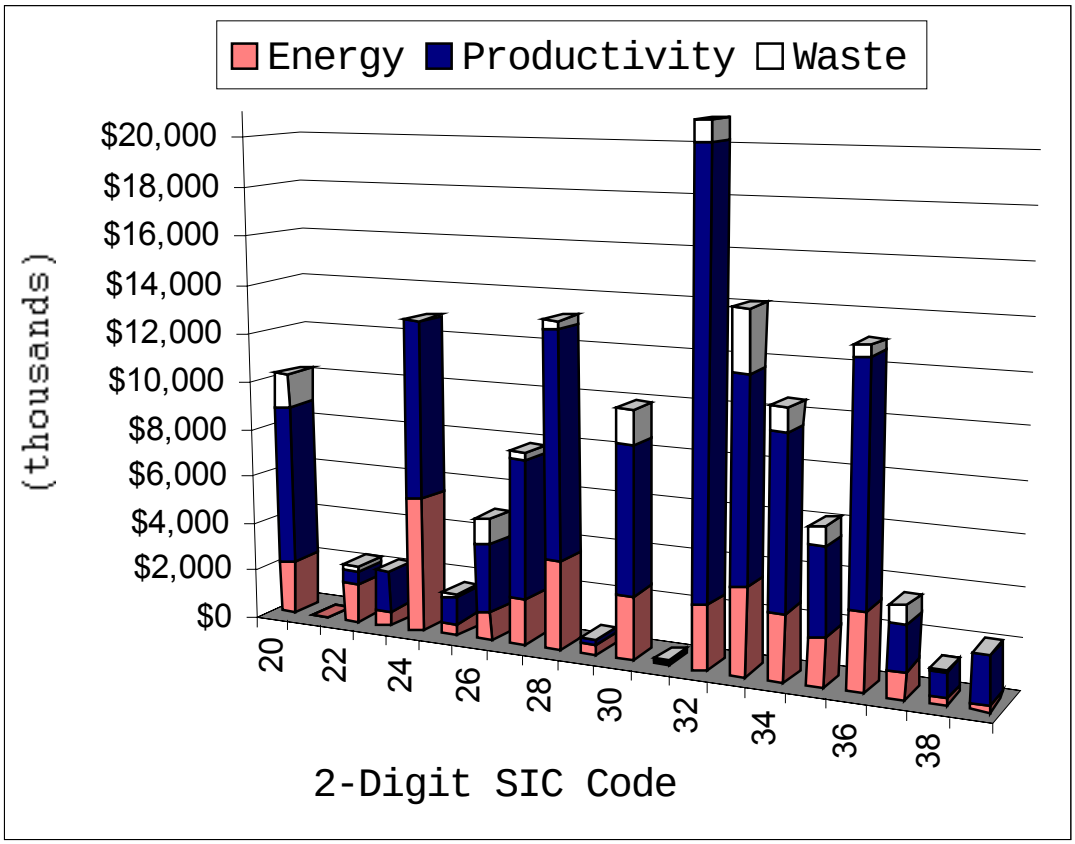


Figure 14. Recommended Cost Savings by Industry Type

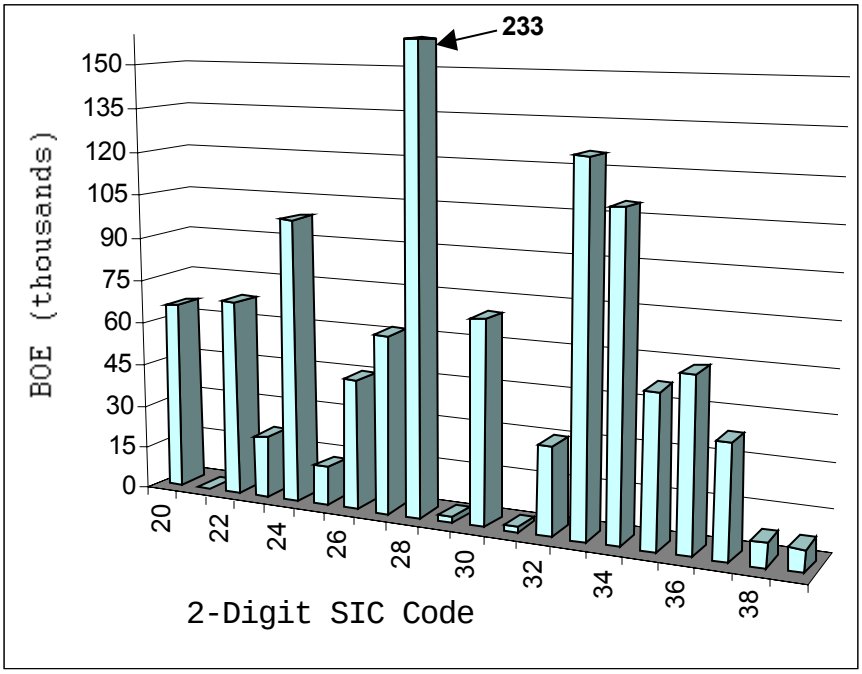


Figure 15. Recommended Barrels of Oil Avoided by Industry Type

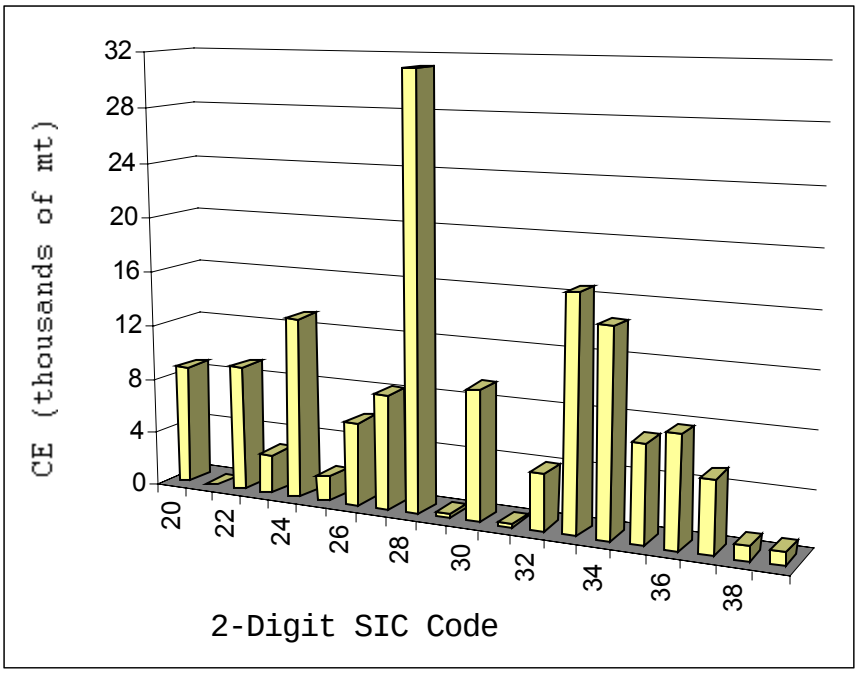
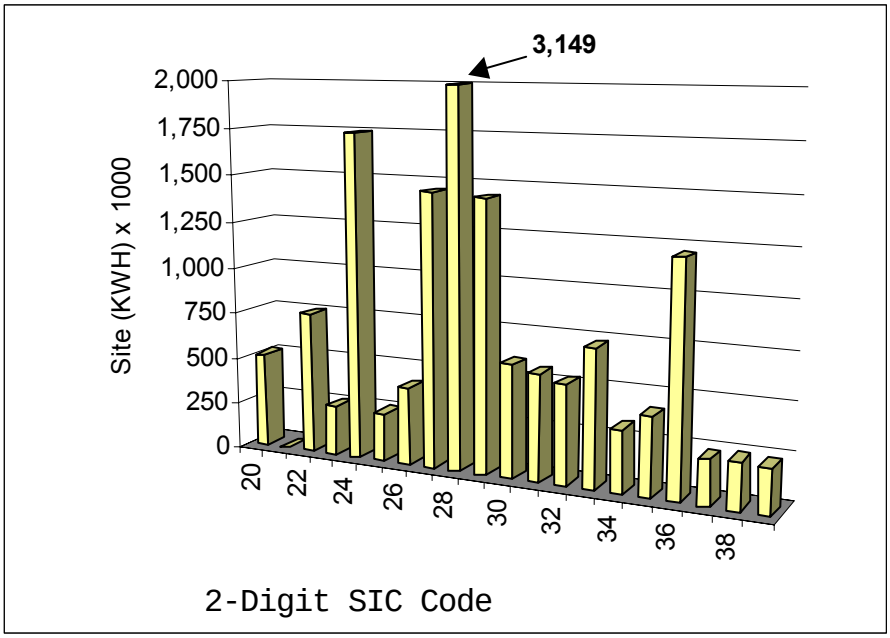


Figure 16. Recommended Carbon Avoided by Industry Type

Average recommended figures per assessment are shown in Table 10, and Figures 15 through 18.

SIC Code	Industry Description	Recommended Energy Conservation						Recommended Cost Savings ($)			
		Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
20	Foods	507,819	5,205	-9	5,196	884	118	29,479	19,101	89,551	138,131
21	Tabacco Prod.	0	0	0	0	0	0	0	0	0	0
22	Textile Mills	760,769	7,798	12,294	20,092	3,417	456	79,592	13,980	26,372	119,944
23	Apparel	267,250	2,739	6,247	8,985	1,528	204	44,318	4,815	119,176	168,309
24	Wood Prod.	1,740,821	17,843	-8,345	9,498	1,615	216	90,555	450	119,356	210,361
25	Furniture	258,573	2,650	381	3,031	515	69	17,790	4,922	43,300	66,012
26	Paper Prod.	412,907	4,232	4,946	9,178	1,561	209	39,099	36,152	97,436	172,688
27	Printing	1,454,836	14,912	-2,822	12,090	2,056	275	62,361	10,213	189,410	261,983
28	Chemical Prod.	3,149,435	32,282	3,741	36,023	6,126	818	96,324	9,249	241,842	347,415
29	Petroleum	1,439,221	14,752	-12,374	2,378	404	54	80,210	724	49,763	130,698
30	Rubber & Plast.	601,808	6,168	-98	6,070	1,032	138	38,004	20,679	88,007	146,689
31	Leather Prod.	566,969	5,811	-701	5,111	869	116	49,152	46,375	2,875	98,402
32	Stone & Glass	530,452	5,437	2,092	7,529	1,280	171	108,810	35,842	729,708	874,359
33	Primary Metal	730,741	7,490	6,122	13,612	2,315	309	64,611	45,457	151,503	261,571
34	Fab. Metal	332,593	3,409	3,760	7,169	1,219	163	29,907	10,752	76,545	117,204
35	Ind. Machinery	420,630	4,311	139	4,450	757	101	27,931	10,528	50,974	89,433
36	Electronics	1,211,462	12,417	-3,037	9,380	1,595	213	84,123	12,275	256,493	352,890
37	Trans. Equip.	239,852	2,504	5,632	8,136	1,384	185	38,476	24,890	64,362	127,729
38	Instruments	247,641	2,538	416	2,954	502	67	15,606	3,631	63,439	82,676
39	Misc. Manuf.	235,170	2,410	559	2,969	505	67	15,106	2,547	126,728	144,381
Average		**805,967**	**8,263**	**1,077**	**9,339**	**1,588**	**212**	**50,735**	**16,259**	**130,678**	**197,672**

Table 10. Average Recommended Conservation and Cost Savings by Industry TypeFigure



17. Average Recommended Electric Consumption Conserved by Industry Type

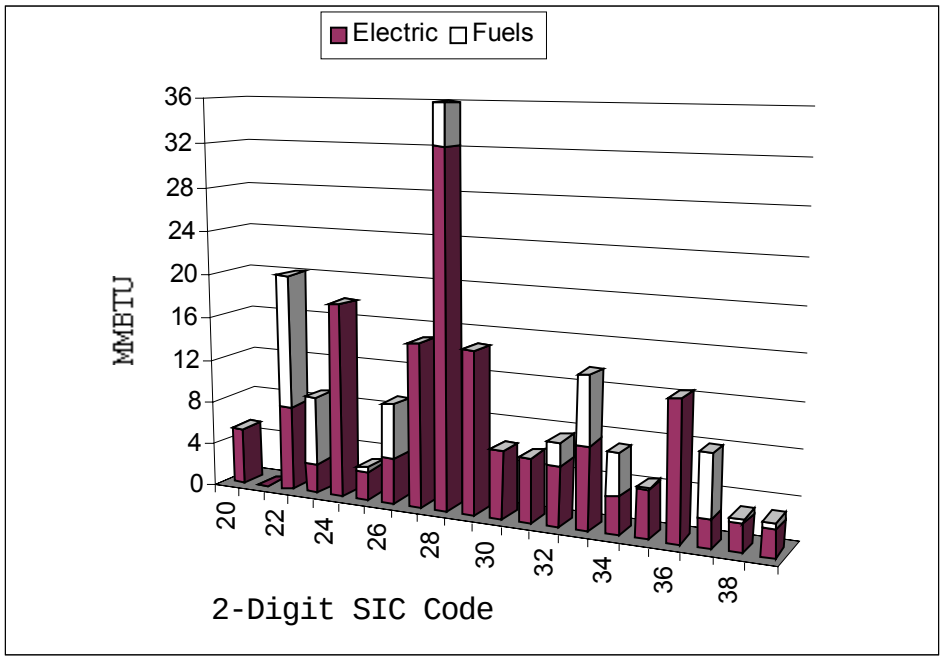


Figure 18. Average Recommended Energy Saved by Industry Type

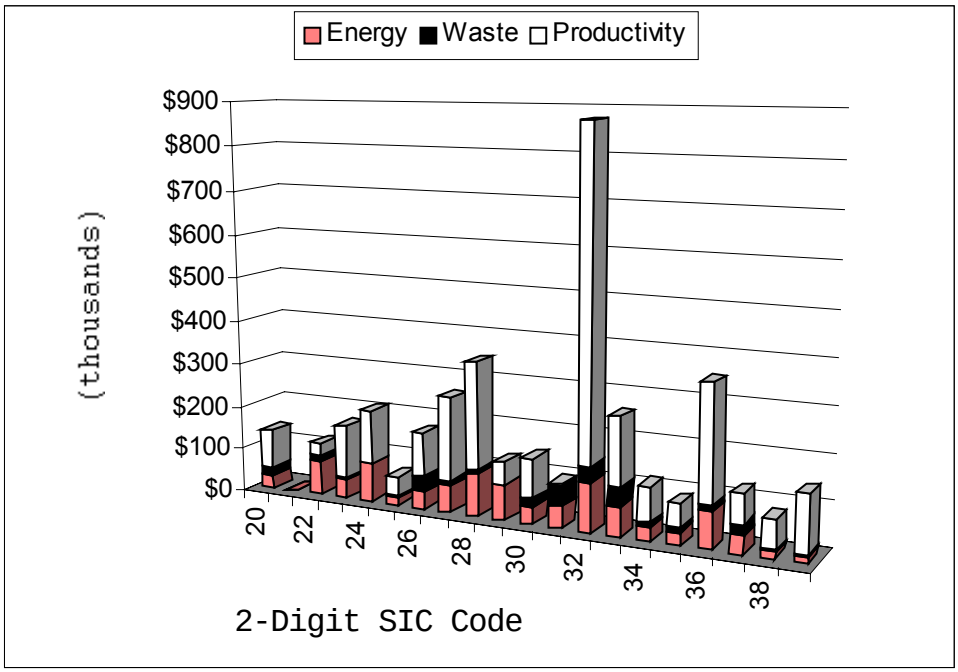


Figure 19. Average Recommended Cost Savings by Industry Type

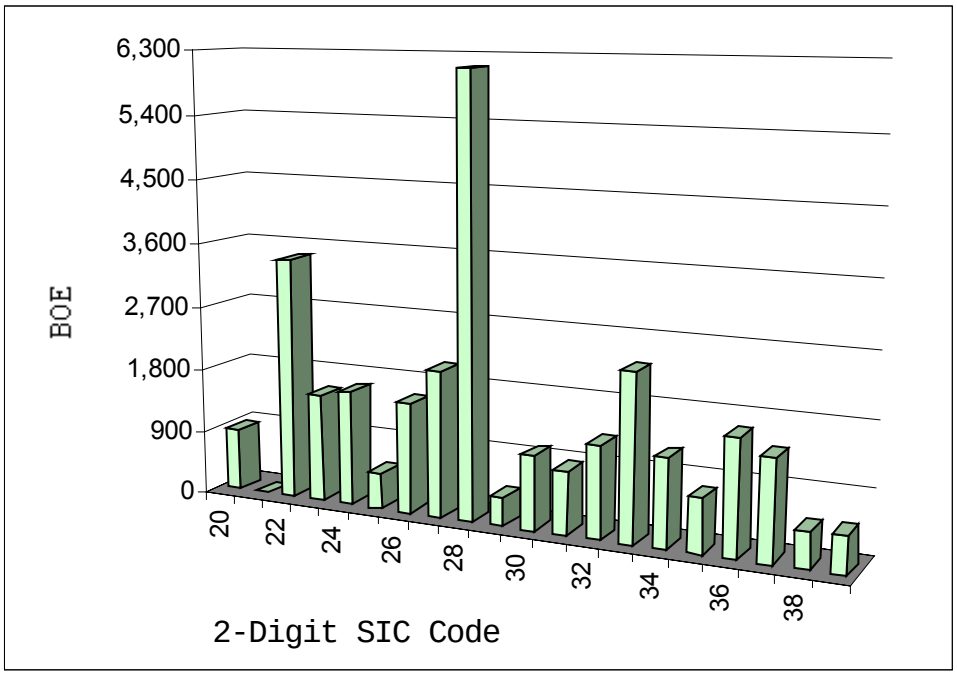


Figure 20. Average Recommended Barrels of Oil Saved by Industry Type

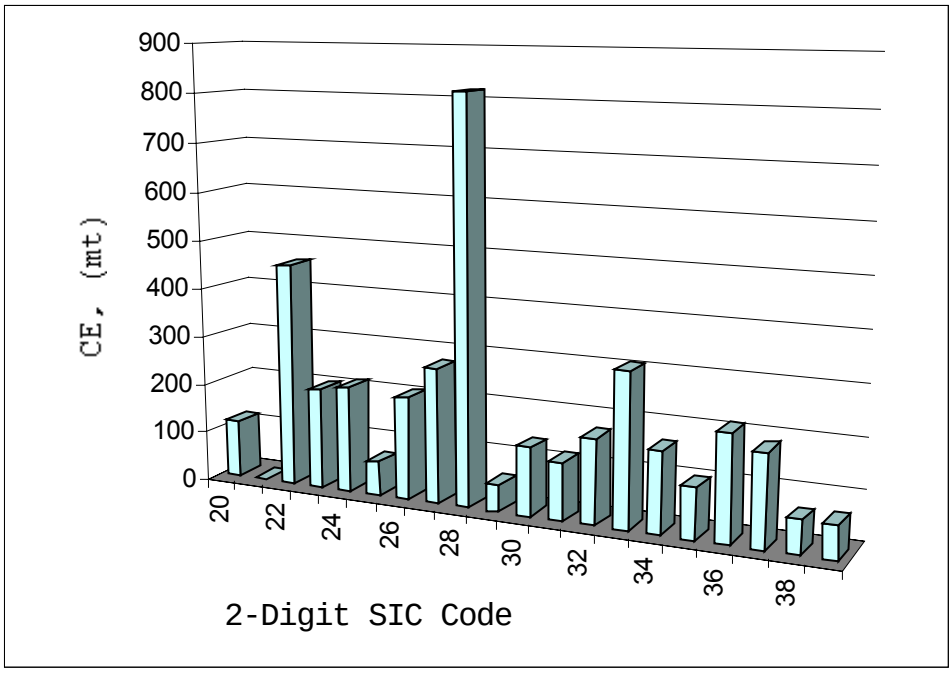


Figure 21. Average Recommended Carbon Avoided by Industry Type

iii. Recommended Savings by Resource Stream

Energy recommendations are broken into 12 different fuel types: Electricity, Natural Gas, Liquid Petroleum Gas, Fuel Oil (#1, #2, #4, #6), Coal, Wood, Paper, Other Gas, and a general category for "Other Energy". Starting in FY93, non-energy savings were separately tracked. The amount of energy savings recommended in FY2000 was 6.5 million MMBTUs, with a dollar amount of almost $37 Million. Including non-energy dollars, the total recommended savings in FY2000 amounted to $138.4 Million. This data is shown in Table 11, with the percentages by energy type in Figures 19 and 20. For the sake of clarity, it should be pointed out that some recommendations, such as co-generation and fuel switching, result in increased energy consumption (negative energy savings) wood savings is an example of this. 90% of the other energy savings is steam.

Energy Stream	Recommended Energy Conservation (MMBTU) Unless Noted	Recommended Energy Cost Savings ($)
Electricity		
Demand	1,055,738 KW-months/yr	8,225,941
Fees		1,239,430
Consumption – Site	564,176,890 KWH	
Consumption - Source	5,783,930	21,501,967
Natural Gas	729,969	2,863,934
L. P. G.	43,444	348,197
Fuel Oil #2	3,117	19,807
Fuel Oil #4	68,849	414,673
Fuel Oil #6	7,124	30,079
Coal	221,904	699,627
Wood	-346,486	-88,610
Other gas	1412	23058
Other Energy	24,282	236,114
Energy Totals	**6,537,545**	**35,514,217**
Waste	n/a	11,381,081
Productivity	n/a	91,474,861
Program Totals	**6,537,545**	**138,370,159**

Table 11. Recommended Conservation and Cost Savings by Resource Stream

Examination of the data shows that electricity and natural gas comprise the vast majority of energy and dollar savings.

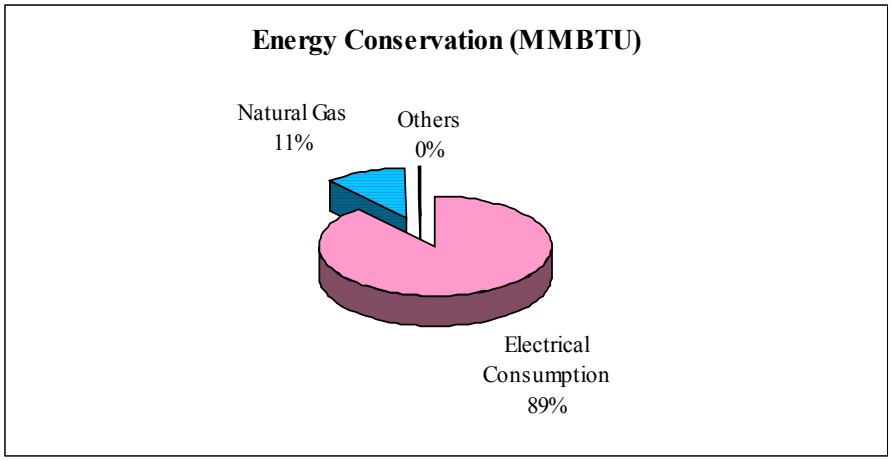


Figure 22. Composition of Recommended Energy Conserved by Energy Stream

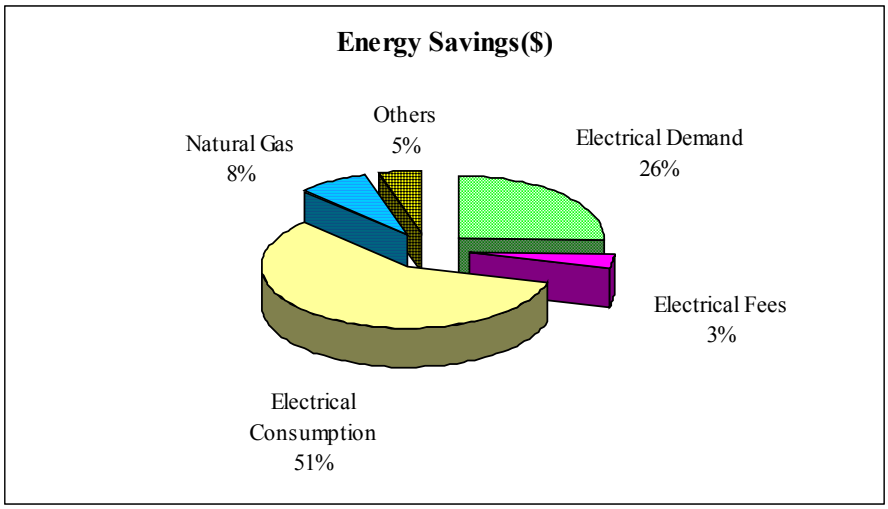


Figure 23. Composition of Recommended Cost Savings by Energy Stream

The database is broken into four resource stream types: energy, waste reduction, resource costs, and production. Table 12 shows the recommended cost savings grouped by non-energy resource type. Figure 24 shows the composition of the recommended non-energy cost savings.

Stream Type	Total Recommended Non-Energy Cost Savings ($)
Production	
Primary Product	39,274,097
Byproduct Production	4,745,685
Resource Costs	
Personnel Changes	24,525,528
Administrative Costs	12,248,633
Primary Raw Material	3,673,050
Ancillary Material Cost	2,296,735
Water Consumption	443,489
One Time Revenue of Avoided Costs	4,267,644
Waste Reduction	
Water Disposal	2,976,074
Other Liquid (non-haz)	749,175
Other Liquid (haz)	1,479,081
Solid Waste (non-haz)	5,920,518
Solid Waste (haz)	228,295
Gaseous Waste (haz)	27,938
Non-Energy Total	**102,855,942**

Table 12. Recommended Non-Energy Cost Savings by Resource Type

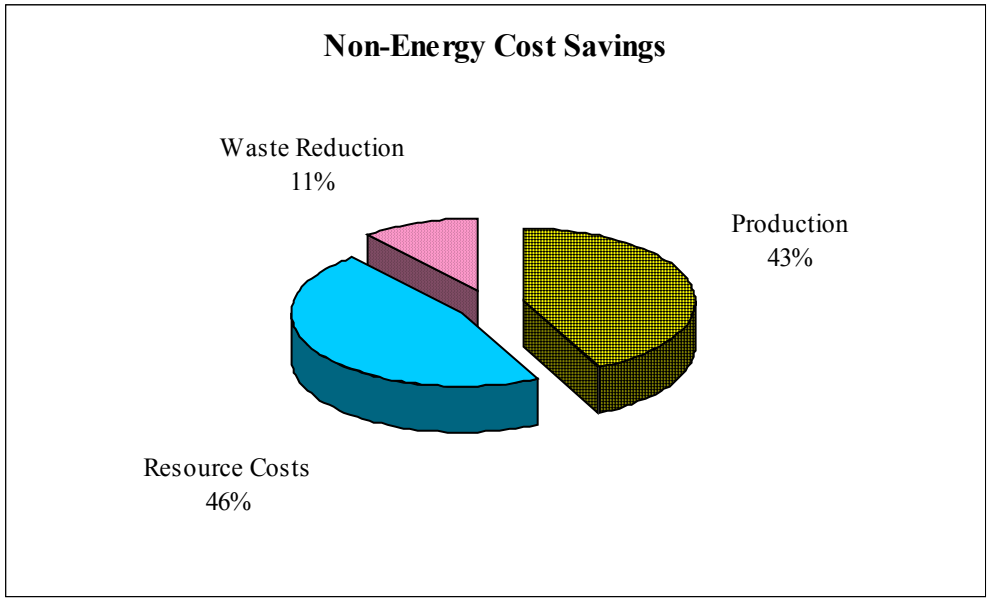


Figure 24. Recommended Non-Energy Cost Savings

Figure 24 indicates the composition of the total recommendations by resource stream for FY2000.

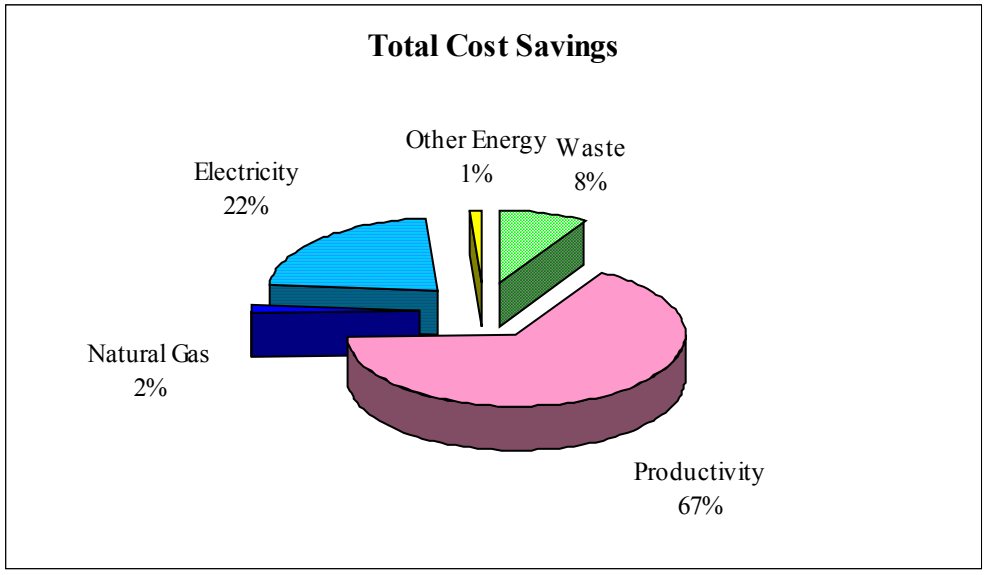


Figure 25. Recommended Cost Savings by Resource Stream

iv. Recommended Savings by Recommendation Type

Energy conservation recommendations are categorized by use of a detailed expert system known as Assessment Recommendation Codes (ARC). There were more than 400 coded recommendations broken into 9 major 2-digit categories for energy. Fiscal Year 1994 saw the introduction of the single digit categories 3 (waste minimization and pollution prevention) and 4 (productivity enhancements). There were over 350 different recommendations in these categories. Table 13 shows the category description and number of recommendations by assessment recommendation (AR) type for FY2000. Figure 23 shows the frequency of the recommendations.. The average number of recommendations was about eight. 110 recommendations were used only once. And 204 recommendations were used three or less times. A review of Table 13 and Figure 26 further illustrate the fact that most recommendations were process oriented.

2-Digit ARC Code	Category Description	No. of Recommendations
2.1	Combustion Systems	223
2.2	Thermal Systems	500
2.3	Electrical Power	191
2.4	Motor Systems	1264
2.5	Industrial Design	10
2.6	Operations	126
2.7	Buildings and Grounds	1197
2.8	Ancillary Costs	143
2.9	Alternate Energy Use	2
3.1	Operations	58
3.2	Equipment	38
3.3	Post Generation Treatment/Minimization	30
3.4	Water Use	183
3.5	Recycling	316
3.6	Waste Disposal	149
3.7	Maintenance	57
3.8	Raw Materials	38
4.1	Manufacturing Enhancements	181
4.2	Purchasing	34
4.3	Inventory	27
4.4	Labor Optimization	265
4.5	Space Utilization	88
4.6	Reduction of Downtime	141
4.7	Management Practices	14
4.8	Other Administrative Savings	58
	Total	**5333**

Table 13. Recommendations by Recommendation Type

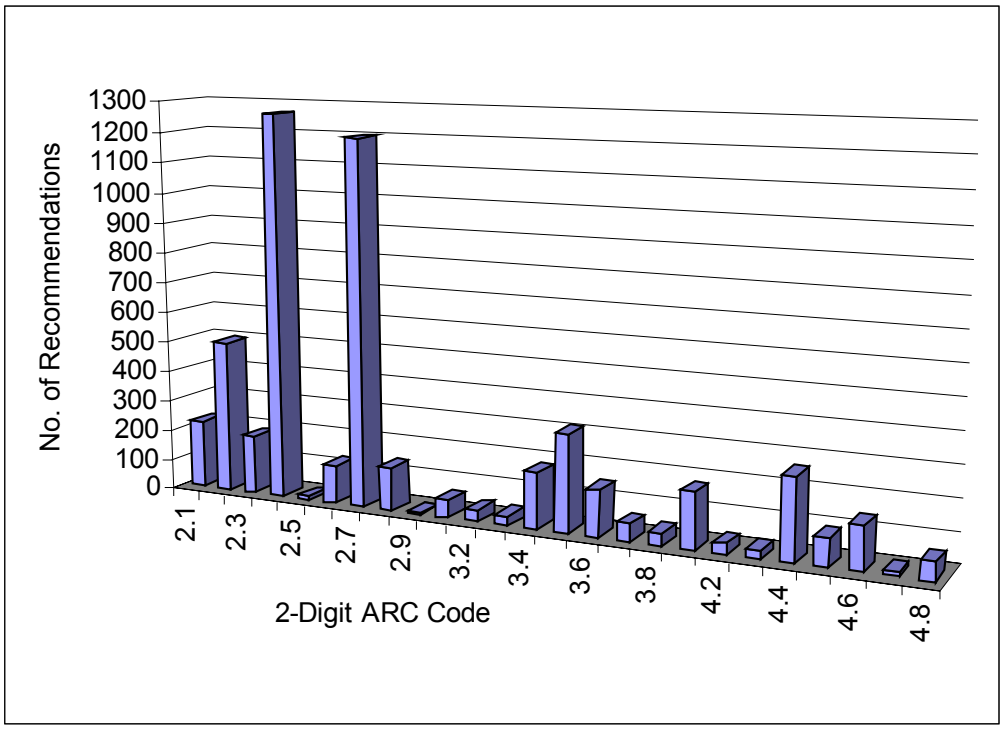


Figure 26. Number of Recommendations by Recommendation Type

D. Implementation Results

i. General

The IAC program has historically enjoyed a high rate of implementation of recommendations. The results of the 2000 program year showed an implementation rate of almost 45%. This rate represents the ratio of the number of recommendations that are adopted, as reported by the clients, to the number of recommendations with known results made by the Centers. The implementation rate as defined as the amount of energy (MMBTU) saved compared to the amount recommended was 46%, and as energy cost ($) saved to recommended was 24%. This was the last year in the program for 25% of the schools. Tables 14 through 24, and Figures 27 through 57 are all related to implementation results.

Fiscal year	Energy Recommendations			Waste Recommendations			Productivity Recommendations			All Recommendations		
	Recommendations with Known Results	Implemented	% Implemented	Recommendations with Known Results	Implemented	% Implemented	Recommendations with Known Results	Implemented	% Implemented	Recommendations with Known Results	Implemented	% Implemented
1982	1,152	317	28%	N/A	N/A	N/A	N/A	N/A	N/A	1,152	317	28%
1983	1,150	352	31%	N/A	N/A	N/A	N/A	N/A	N/A	1,150	352	31%
1984	1,746	1,050	60%	N/A	N/A	N/A	N/A	N/A	N/A	1,746	1,050	60%
1985	2,377	1,400	59%	N/A	N/A	N/A	N/A	N/A	N/A	2,377	1,400	59%
1986	1,998	1,254	63%	N/A	N/A	N/A	N/A	N/A	N/A	1,998	1,254	63%
1987	2,175	1,404	65%	N/A	N/A	N/A	N/A	N/A	N/A	2,175	1,404	65%
1988	2,629	1,581	60%	N/A	N/A	N/A	N/A	N/A	N/A	2,629	1,581	60%
1989	2,380	1,402	59%	N/A	N/A	N/A	N/A	N/A	N/A	2,380	1,402	59%
1990	2,417	1,395	58%	N/A	N/A	N/A	N/A	N/A	N/A	2,417	1,395	58%
1991	3,091	1,766	57%	N/A	N/A	N/A	N/A	N/A	N/A	3,091	1,766	57%
1992	3,749	1,828	49%	N/A	N/A	N/A	N/A	N/A	N/A	3,749	1,828	49%
1993	3,963	2,041	52%	29	11	38%	1	0	0%	3,993	2,052	51%
1994	5,104	2,516	49%	169	66	39%	8	3	38%	5,281	2,585	49%
1995	5,339	2,846	53%	475	203	43%	12	7	58%	5,826	3,056	52%
1996	4,912	2,715	55%	1,267	573	45%	59	33	56%	6,238	3,321	53%
1997	3,532	1,866	53%	1,304	537	41%	678	328	48%	5,514	2,731	50%
1998	3,624	1,853	51%	1,155	486	42%	791	356	45%	5,570	2,695	48%
1999	3,365	1,494	44%	952	350	37%	798	315	39%	5,115	2,159	42%
2000	3,379	1,553	46%	802	295	37%	749	235	31%	4,930	2,083	42%
Totals	**58,082**	**30,633**	**53%**	**6,153**	**2,521**	**41%**	**3,096**	**1,277**	**41%**	**67,331**	**34,431**	**51%**

Table 14. No. of Recommendations and Implemented Recommendations by Fiscal Year

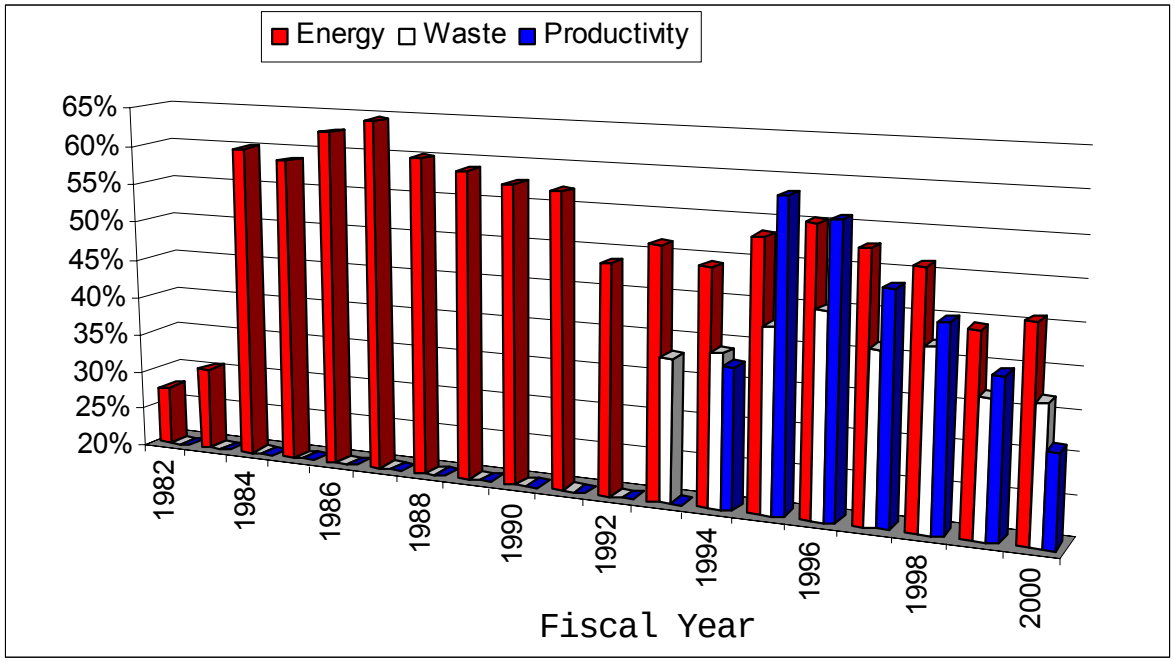


Figure 27. Percent of Recommendations Implemented by Fiscal Year

Fiscal Year	Implemented Energy Conservation						Implemented Cost Savings ($)			
	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
1982	13,269,047	135,989	308,724	444,713	75,631	10,286	1,839,122	N/A	N/A	1,839,122
1983	11,012,604	112,873	313,856	426,729	72,573	9,870	1,923,834	N/A	N/A	1,923,834
1984	29,029,583	297,507	557,897	855,404	145,477	19,785	4,583,098	N/A	N/A	4,583,098
1985	57,900,606	593,407	928,192	1,521,599	258,775	35,193	7,006,147	N/A	N/A	7,006,147
1986	60,748,216	622,620	696,206	1,318,826	224,290	30,503	6,667,801	N/A	N/A	6,667,801
1987	59,721,543	612,062	623,212	1,235,274	210,081	28,571	5,866,646	N/A	N/A	5,866,646
1988	60,931,075	624,469	838,100	1,462,569	248,736	33,828	6,132,078	N/A	N/A	6,132,078
1989	84,842,878	869,577	697,287	1,566,864	266,473	36,240	7,479,996	N/A	N/A	7,479,996
1990	70,986,485	727,539	615,259	1,342,798	228,367	31,058	6,570,825	N/A	N/A	6,570,825
1991	91,441,640	937,190	479,719	1,416,909	240,971	32,772	8,460,459	N/A	N/A	8,460,459
1992	125,912,635	1,290,512	744,351	2,034,863	346,065	47,065	10,168,974	N/A	N/A	10,168,974
1993	107,599,596	1,102,764	786,084	1,888,848	321,233	43,688	9,366,098	15,800	1,591,917	10,973,815
1994	154,128,321	1,579,680	734,560	2,314,240	393,578	53,527	12,107,654	1,688,656	1,488,956	15,285,266
1995	185,512,579	1,901,352	630,148	2,531,500	430,527	54,782	13,242,626	4,557,805	2,637,179	20,437,610
1996	190,188,971	1,949,277	564,934	2,514,211	427,587	54,734	13,300,146	7,061,972	6,852,226	27,214,344
1997	115,360,456	1,182,335	563,999	1,746,334	296,996	36,952	9,549,476	5,207,156	24,192,763	38,949,395
1998	109,050,528	1,117,669	411,651	1,529,320	260,088	32,269	7,954,389	4,811,688	29,942,987	42,709,064
1999	106,036,607	1,137,083	943,443	2,080,526	353,831	44,419	8,036,200	5,555,137	25,369,872	38,961,209
2000	108,063,343	1,108,847	649,145	1,757,992	298,978	36,197	8,393,376	2,967,243	16,618,401	27,979,020
Totals	1,741,736,713	17,902,752	12,086,767	29,989,519	5,100,258	671,740	148,648,945	31,865,457	108,694,301	289,208,703

Table 15. Implemented Savings by Fiscal Year

Figure 28 and Table 16 show a comparison of the simple payback of the measures recommended to the simple payback of the measures that were implemented. In FY2000, the directors used over 408 different recommendations, of which 284 were implemented

Fiscal Year	Recommended Quantities			Implemented Quantities			% of Recommended Cost Savings Implemented
	Cost Savings ($)	Implemention Cost ($)	Simple Payback Period (years)	Cost Savings ($)	Implemention Cost ($)	Simple Payback Period (years)	
1982	6,699,075	9,158,809	1.4	1,839,122	2,047,222	1.1	27%
1983	8,449,809	10,385,259	1.2	1,924,094	1,708,454	0.9	23%
1984	8,991,122	8,847,422	1.0	4,598,839	3,222,790	0.7	51%
1985	14,153,056	18,538,810	1.3	7,022,498	4,517,755	0.6	50%
1986	13,945,808	17,469,216	1.3	6,880,489	3,984,805	0.6	49%
1987	11,517,583	15,057,528	1.3	5,947,899	7,613,376	1.3	52%
1988	13,942,973	16,533,416	1.2	6,550,084	4,392,033	0.7	47%
1989	14,562,259	16,496,742	1.1	8,027,428	6,338,466	0.8	55%
1990	14,919,268	19,176,962	1.3	7,588,905	7,191,266	0.9	51%
1991	18,148,895	16,303,282	0.9	8,862,728	8,155,209	0.9	49%
1992	22,441,561	35,954,528	1.6	11,179,352	16,777,959	1.5	50%
1993	29,643,941	45,521,405	1.5	10,973,815	9,447,658	0.9	37%
1994	41,638,265	65,574,847	1.6	15,285,266	16,990,827	1.1	37%
1995	50,119,043	72,855,526	1.5	20,437,610	23,834,919	1.2	41%
1996	64,998,914	71,511,907	1.1	27,214,344	29,659,638	1.1	42%
1997	142,483,538	100,564,895	0.7	38,949,395	26,314,346	0.7	27%
1998	136,470,554	143,787,752	1.1	42,709,064	31,014,386	0.7	31%
1999	134,635,921	149,689,551	1.1	38,961,209	23,631,262	0.6	29%
2000	138,370,159	163,000,312	1.2	27,979,002	17,232,627	0.6	20%
Totals	**886,131,744**	**996,428,169**	**1.1**	**292,931,143**	**244,074,998**	**0.8**	**33%**

Table 16. Recommended and Implemented Simple Payback

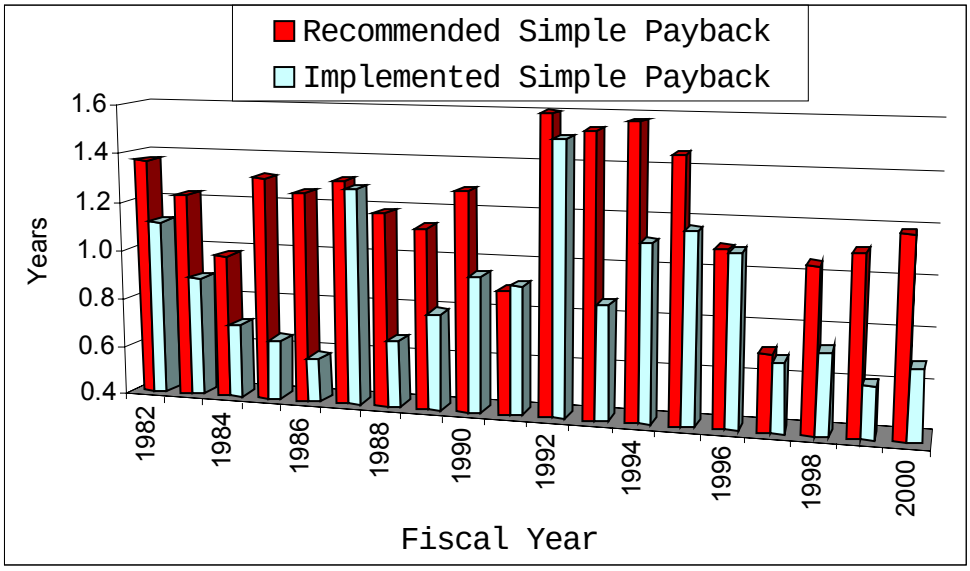


Figure 28. Recommended vs. Implemented Simple Payback

Assuming that the useful life of any one implemented energy conservation measure is not indefinite; Table 17 and Figures 29 through 32 show the cumulative effect of these measures if each remained in place over a seven-year time frame.

Fiscal Year	Implemented Energy Conservation (in thousands)						Implemented Cost Savings ($) (in thousands)			
	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
82	13,269	136	309	445	76	10	1,839	N/A	N/A	1,839
82-83	24,282	249	623	871	150	20	3,763	N/A	N/A	3,763
82-84	53,311	546	1,180	1,727	296	40	8,346	N/A	N/A	8,346
82-85	111,212	1,140	2,109	3,248	558	75	15,352	N/A	N/A	15,352
82-86	171,960	1,762	2,805	4,567	784	106	22,020	N/A	N/A	22,020
82-87	231,682	2,374	3,428	5,803	996	134	27,887	N/A	N/A	27,887
82-88	292,613	2,999	4,266	7,265	1,247	168	34,019	N/A	N/A	34,019
83-89	364,187	3,733	4,655	8,387	1,440	194	39,660	N/A	N/A	39,660
84-90	424,160	4,347	4,956	9,303	1,597	215	44,307	N/A	N/A	44,307
85-91	486,572	4,987	4,878	9,865	1,694	228	48,184	N/A	N/A	48,184
86-92	554,584	5,684	4,694	10,378	1,782	240	51,347	N/A	N/A	51,347
87-93	601,436	6,164	4,784	10,948	1,880	253	54,045	16	1,592	55,653
88-94	695,843	7,132	4,895	12,027	2,065	278	60,286	1,704	3,081	65,071
89-95	820,424	8,409	4,687	13,096	2,248	299	67,397	6,262	5,718	79,377
90-96	925,770	9,488	4,555	14,043	2,411	318	73,217	13,324	12,570	99,111
91-97	970,144	9,943	4,504	14,447	2,480	324	76,195	18,531	36,763	131,490
92-98	987,753	10,124	4,436	14,559	2,476	323	75,689	23,343	66,706	165,738
93-99	967,877	9,970	4,635	14,605	2,484	320	73,557	28,898	92,076	194,531
94-00	968,341	9,976	4,498	14,474	2,462	313	72,584	31,850	107,102	211,536
Totals	9,665,420	99,163	70,897	170,060	29,125	3,859	849,692	123,929	325,608	1,299,230

Table 17. Seven Year Cumulative Conservation and Cost Savings

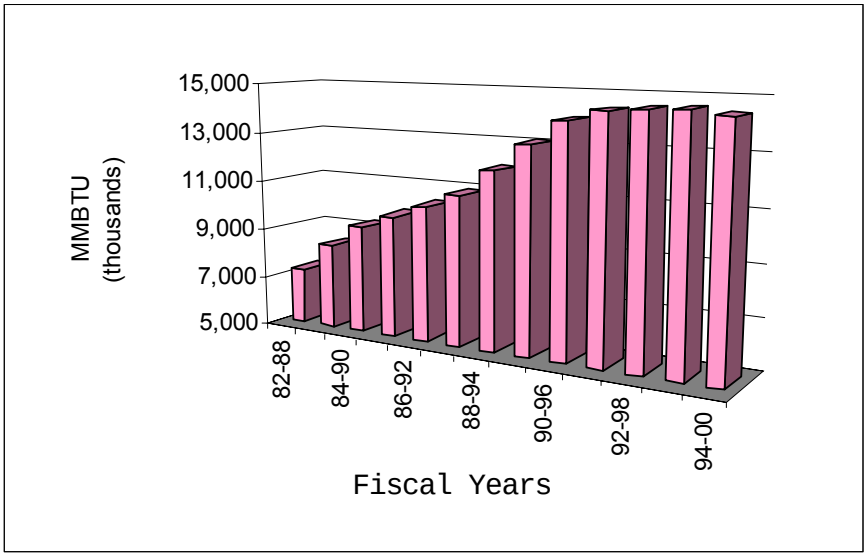


Figure 29. Seven Year Cumulative Energy Savings

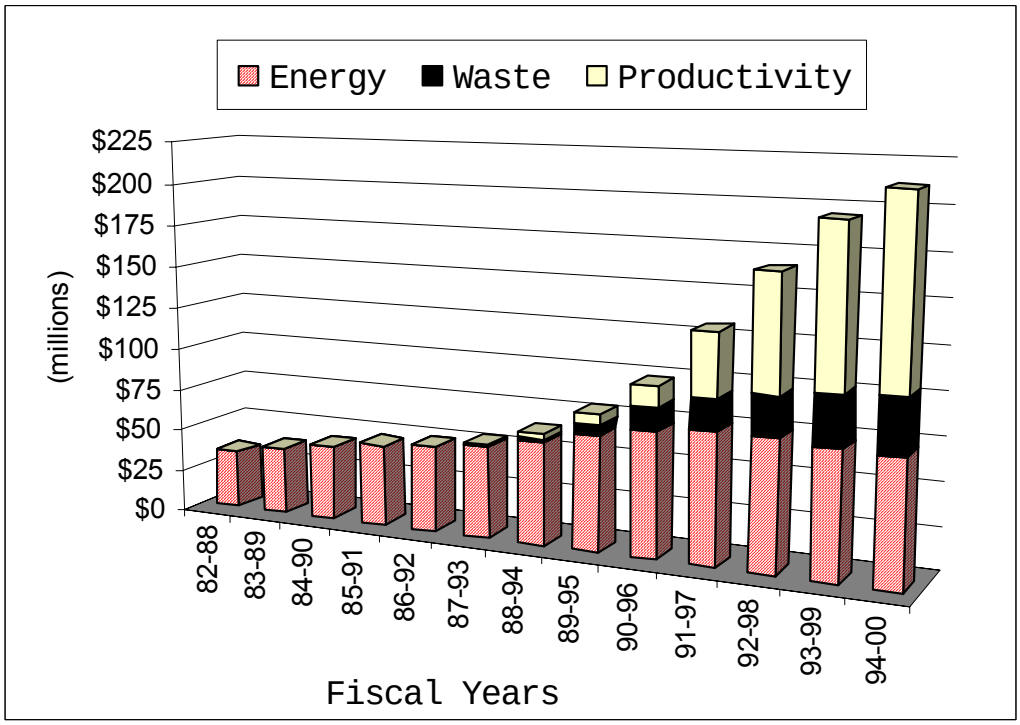


Figure 30. Seven Year Cumulative Cost Savings

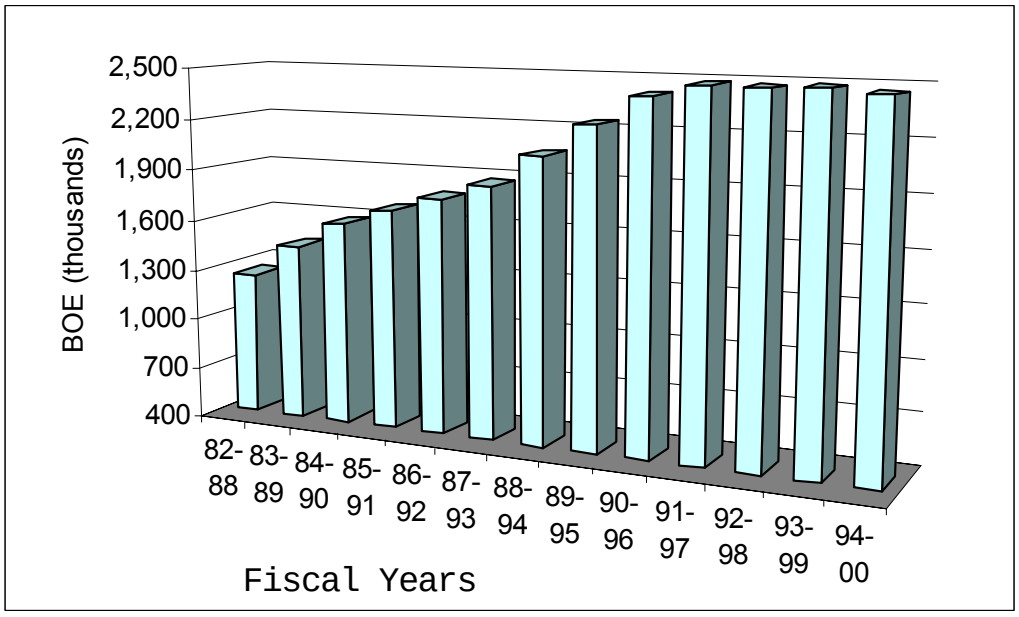


Figure 31. Seven Year Cumulative Barrels of Oil Avoided

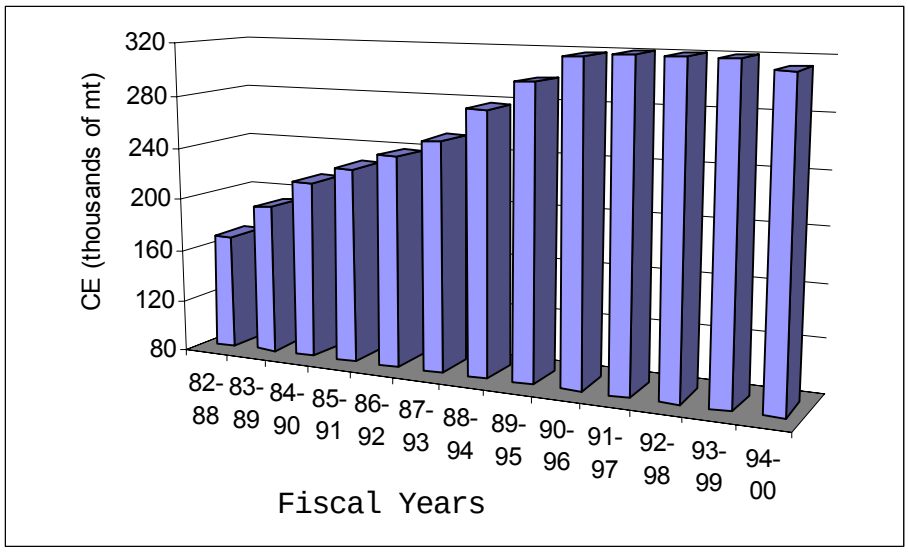


Figure 32. Seven Year Cumulative Carbon Avoided

Similar to the charts in the previous section showing recommended savings, the average and median energy and cost saved due to the implementation of recommended measures is shown per assessment for FY2000 and as a three year average. This can be seen in Table 18-19 and Figures 33-40.

Fiscal Year	Implemented Energy Conservation						Implemented Cost Savings ($)			
	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
1982	52,447	538	1,220	1,758	299	41	7,269	N/A	N/A	7,269
1983	52,192	535	1,487	2,022	344	47	9,118	N/A	N/A	9,118
1984	117,055	1,200	2,250	3,449	587	80	18,480	N/A	N/A	18,480
1985	157,339	1,613	2,522	4,135	703	96	19,038	N/A	N/A	19,038
1986	203,853	2,089	2,336	4,426	753	102	22,375	N/A	N/A	22,375
1987	184,326	1,889	1,923	3,813	648	88	18,107	N/A	N/A	18,107
1988	157,039	1,609	2,160	3,770	641	87	15,804	N/A	N/A	15,804
1989	249,538	2,558	2,051	4,608	784	107	22,000	N/A	N/A	22,000
1990	197,185	2,021	1,709	3,730	634	86	18,252	N/A	N/A	18,252
1991	200,971	2,060	1,054	3,114	530	72	18,594	N/A	N/A	18,594
1992	238,923	2,449	1,412	3,861	657	89	19,296	N/A	N/A	19,296
1993	190,105	1,948	1,389	3,337	568	77	16,548	28	2,813	19,388
1994	206,054	2,112	982	3,094	526	72	16,187	2,258	1,991	20,435
1995	218,507	2,240	742	2,982	507	65	15,598	5,368	3,106	24,073
1996	224,810	2,304	668	2,972	505	65	15,721	8,347	8,100	32,168
1997	174,789	1,791	855	2,646	450	56	14,469	7,890	36,656	59,014
1998	158,966	1,629	600	2,229	379	47	11,595	7,014	43,649	62,258
1999	153,899	1,650	1,369	3,020	514	64	11,664	8,063	36,821	56,547
2000	168,323	1,727	1,011	2,738	466	56	13,074	4,622	25,885	43,581

Table 18. Average Implemented Energy and Cost Savings by Fiscal Year

Fiscal Year	Implemented Energy Conservation (MMBtu)	(B.O.E.)	(C.E., mt)	Implemented Cost Savings ($) Energy
1982	395	67	9	5,502
1983	570	97	13	7,873
1984	550	94	13	10,965
1985	663	113	15	10,616
1986	891	152	21	11,929
1987	727	124	17	10,228
1988	792	135	18	9,785
1989	862	147	20	11,504
1990	846	144	20	11,167
1991	1,315	224	30	17,438
1992	932	159	22	9,461
1993	1,065	181	25	9,942
1994	1,236	210	29	9,940
1995	1,151	196	25	9,273
1996	1,084	184	24	8,841
1997	960	163	20	7,276
1998	850	145	18	6,676
1999	820	139	18	6,179
2000	1,006	171	21	7,015

Table 19. Median Implemented Energy and Cost Savings by Fiscal Year

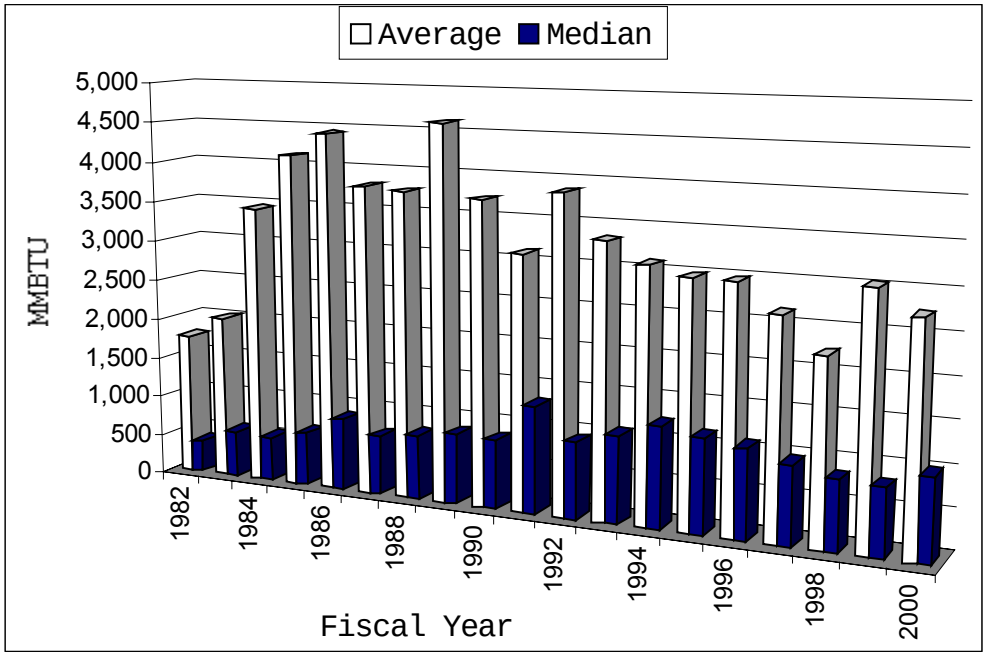


Figure 33. Average and Median Implemented Energy Conservation by Fiscal Year

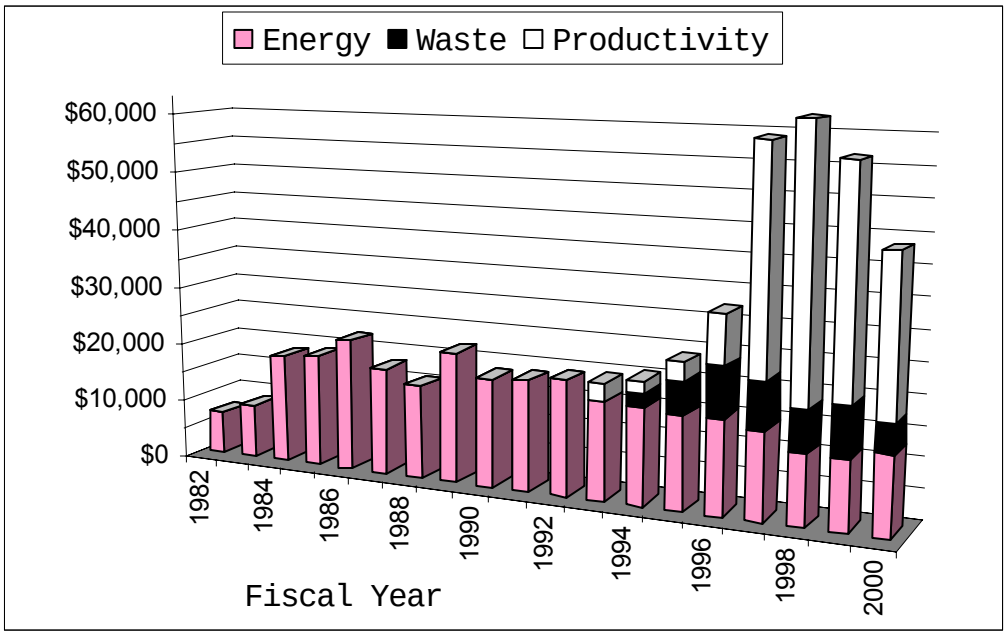


Figure 34. Average Implemented Cost Savings by Fiscal Year

Due to the low distribution of data, the values of median dollars approach zero, and therefore are not shown in Figure 34.

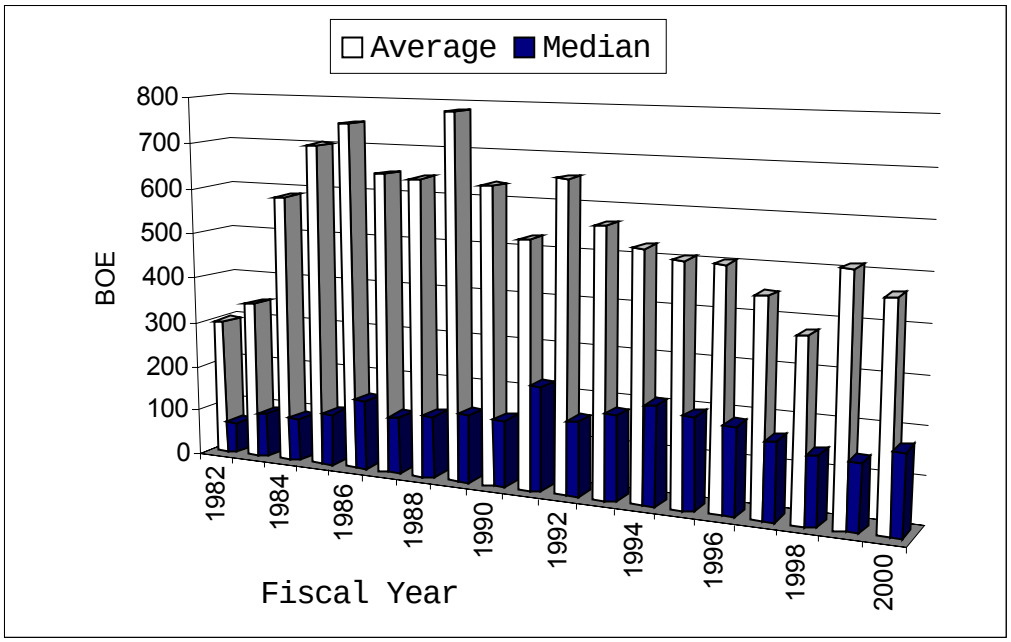


Figure 35. Average Implemented Barrels of Oil Avoided by Fiscal Year

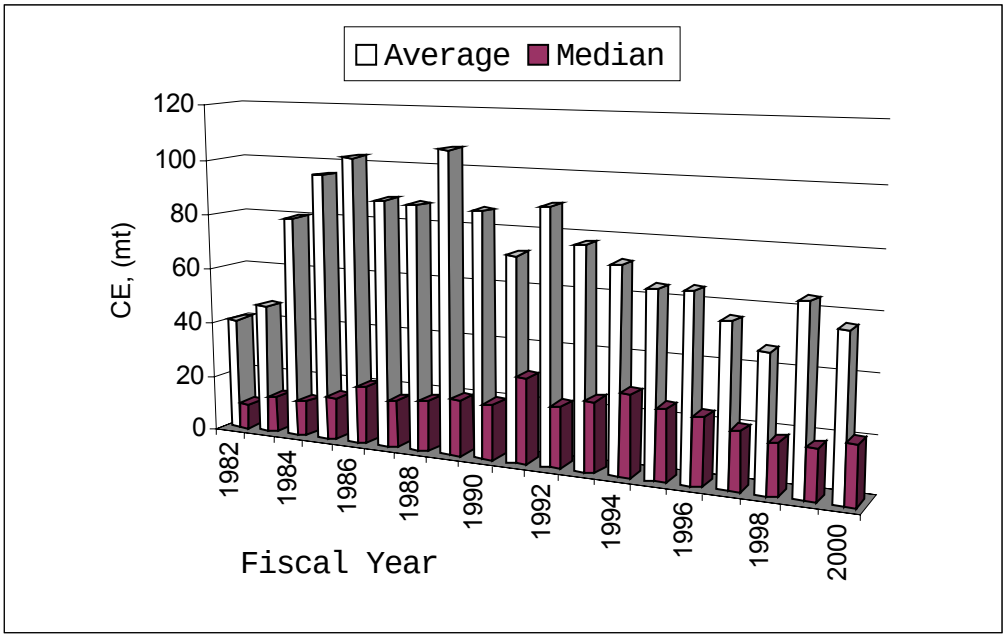


Figure 36. Average Implemented Carbon Avoided by Fiscal Year

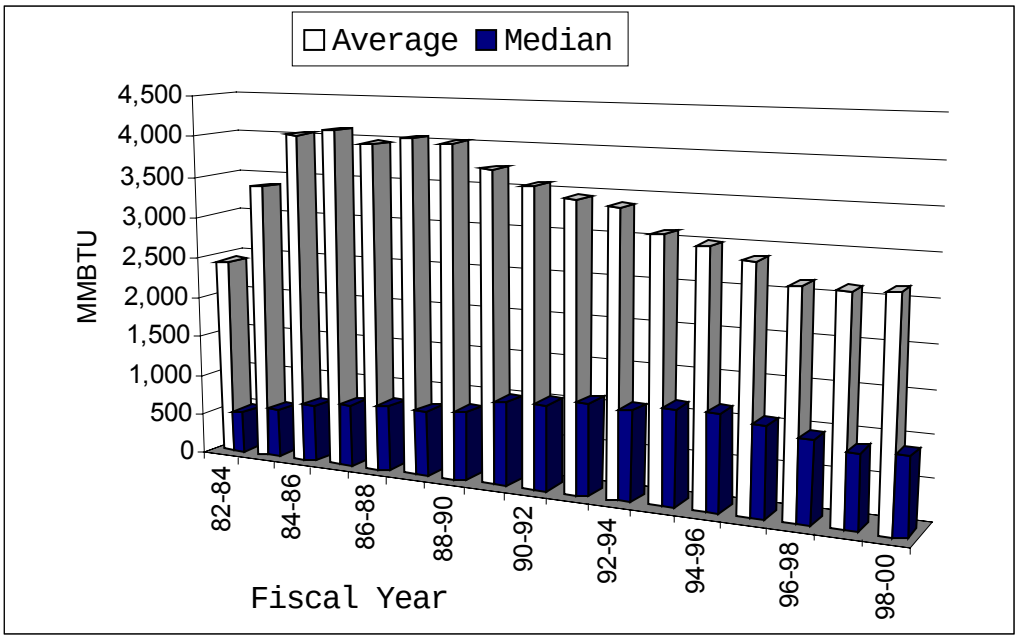


Figure 37. Average and Median Implemented Energy Conserved Per Assessment (3 Year Average)

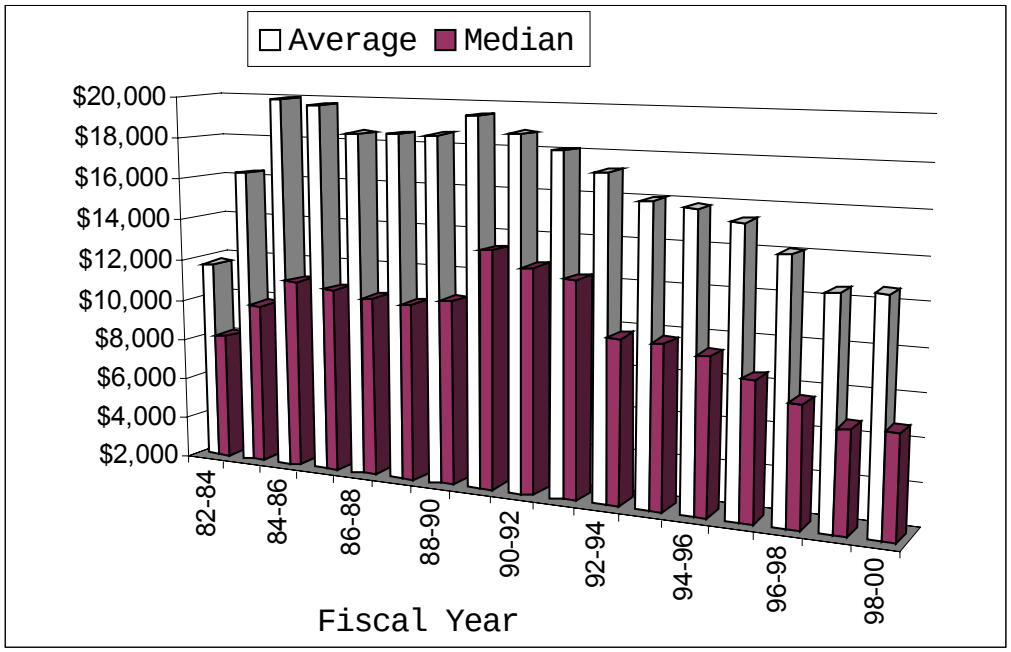


Figure 38. Average and Median Implemented Energy Cost Savings Per Assessment (3 Year Average)

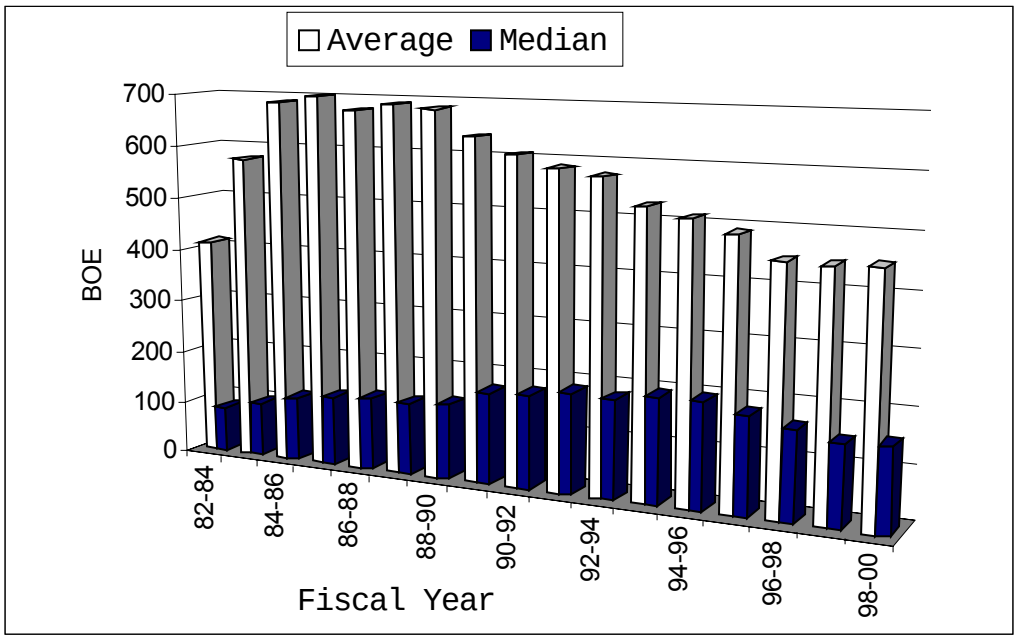


Figure 39. Average and Median Implemented Barrels of Oil Avoided Per Assessment (3 Year Average)

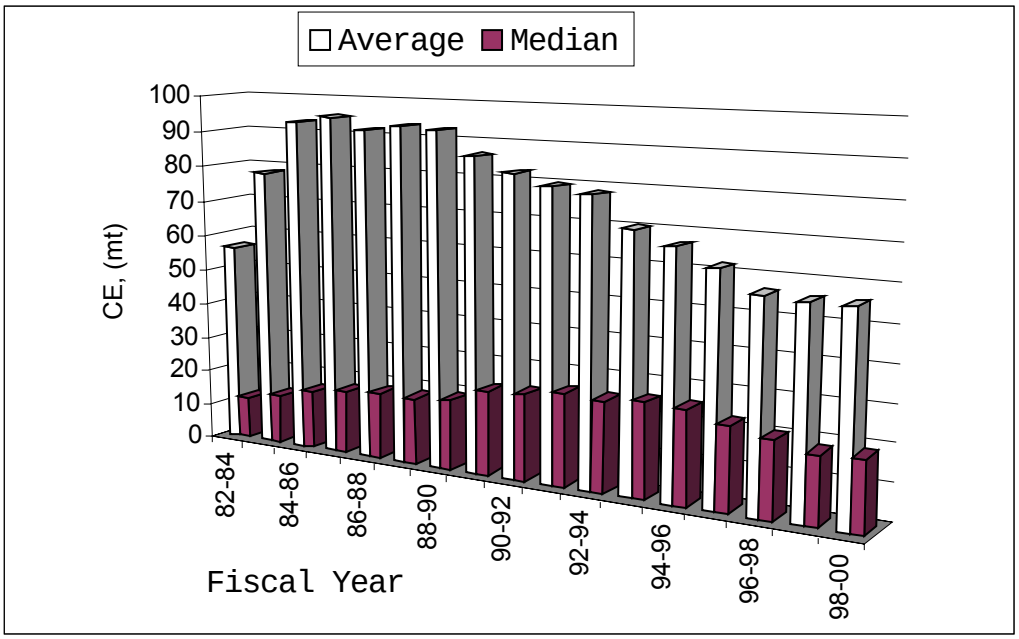


Figure 40. Average and Median Implemented Carbon Avoided Per Assessment (3 Year Average)

In some cases, immediate implementation of a measure was not recommended due to financial restrictions, time constraints, or other considerations. Starting in FY92 these recommendations (called incremental) were flagged to prevent skewing the program database. Table 20 and Figures 41 through 45 show the average first year energy and dollars conserved per assessment. A comparison with Table 18 shows the effect that incremental recommendations represent.

Fiscal Year	Implemented Energy Conservation						Implemented Cost Savings ($)			
	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	(MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
1982	52,447	538	1,220	1,758	299	41	7,269	N/A	N/A	7,269
1983	52,192	535	1,487	2,022	344	47	9,118	N/A	N/A	9,118
1984	117,055	1,200	2,250	3,449	587	80	18,480	N/A	N/A	18,480
1985	157,339	1,613	2,522	4,135	703	96	19,038	N/A	N/A	19,038
1986	203,853	2,089	2,336	4,426	753	102	22,375	N/A	N/A	22,375
1987	184,326	1,889	1,923	3,813	648	88	18,107	N/A	N/A	18,107
1988	157,039	1,609	2,160	3,770	641	87	15,804	N/A	N/A	15,804
1989	249,538	2,558	2,051	4,608	784	107	22,000	N/A	N/A	22,000
1990	197,185	2,021	1,709	3,730	634	86	18,252	N/A	N/A	18,252
1991	200,971	2,060	1,054	3,114	530	72	18,594	N/A	N/A	18,594
1992	238,923	2,298	1,393	3,691	628	85	18,406	N/A	N/A	18,406
1993	139,680	1,432	1,330	2,762	470	64	13,558	28	2,805	16,392
1994	154,228	1,581	936	2,516	428	58	12,944	2,193	1,979	17,116
1995	154,639	1,585	731	2,316	394	50	12,195	5,329	2,942	20,467
1996	177,845	1,823	657	2,479	422	54	12,962	8,071	7,262	28,295
1997	138,923	1,424	822	2,246	382	48	12,165	7,660	35,035	54,859
1998	130,166	1,334	583	1,917	326	40	9,833	6,776	41,253	57,863
1999	137,687	1,484	1,326	2,811	478	60	10,415	7,791	35,305	53,511
2000	143,169	1,469	1,004	2,473	421	51	11,709	4,340	25,175	41,224

Table 20. Average First Year Implemented Savings by Fiscal Year

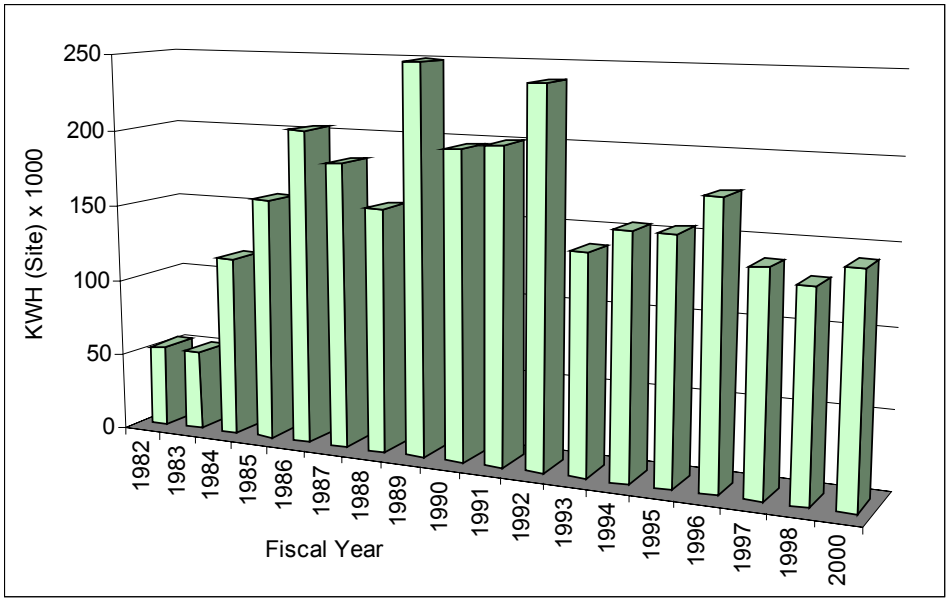


Figure 41. Average First Year Implemented Electric Consumption Conserved by Fiscal Year

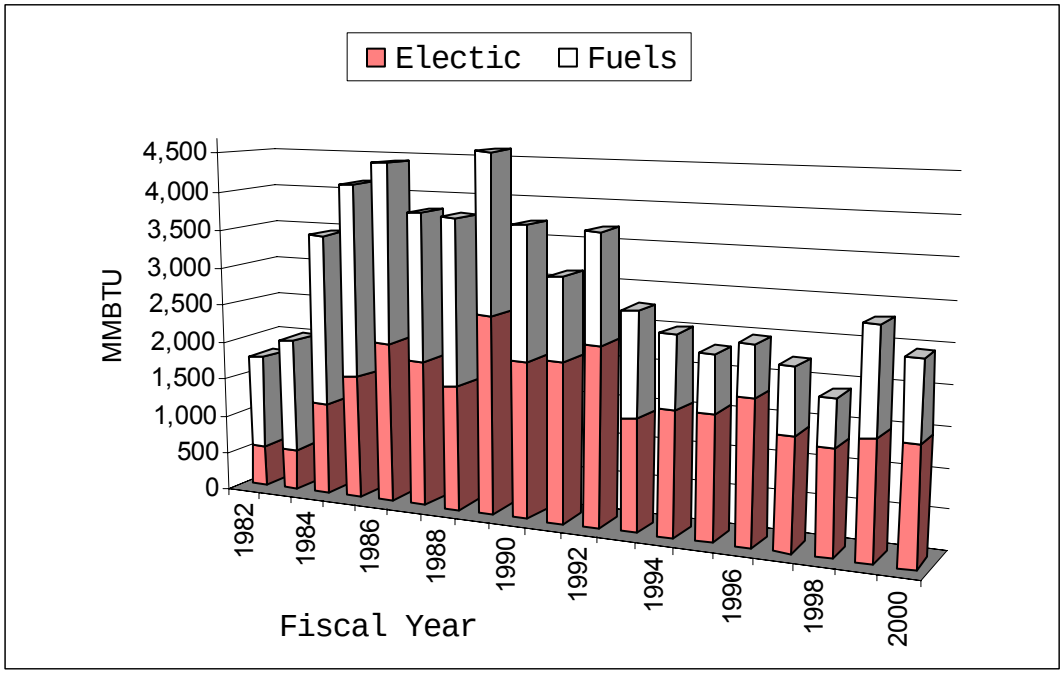


Figure 42. Average First Year Implemented Energy Conserved by Fiscal Year

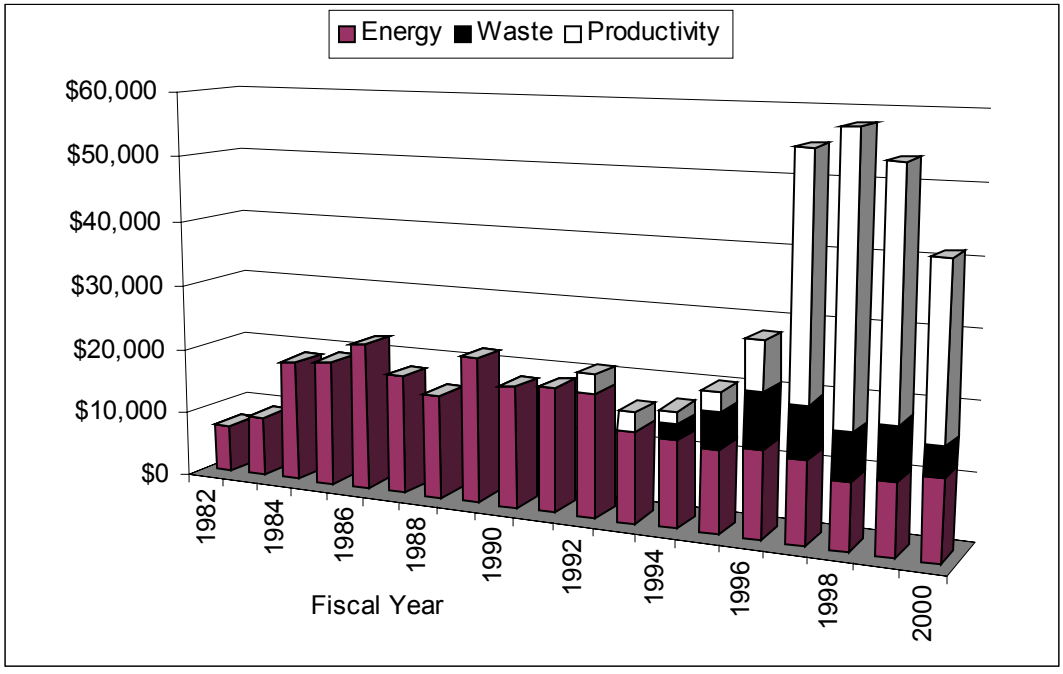


Figure 43. Average First Year Implemented Cost Savings by Fiscal Year

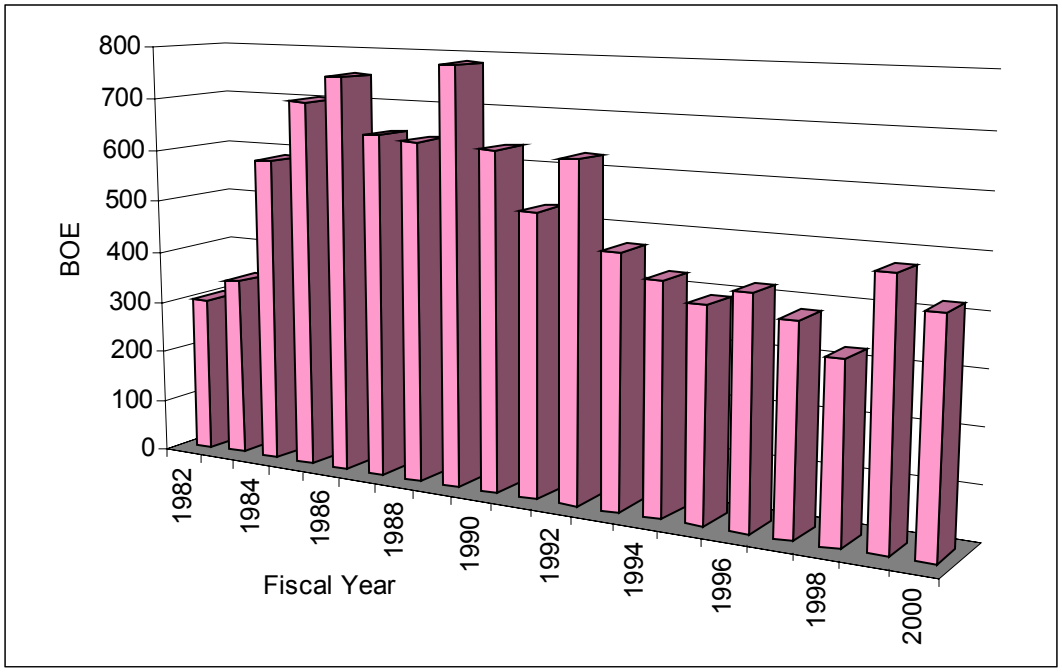


Figure 44. Average First Year Implemented Barrels of Oil Avoided by Fiscal Year

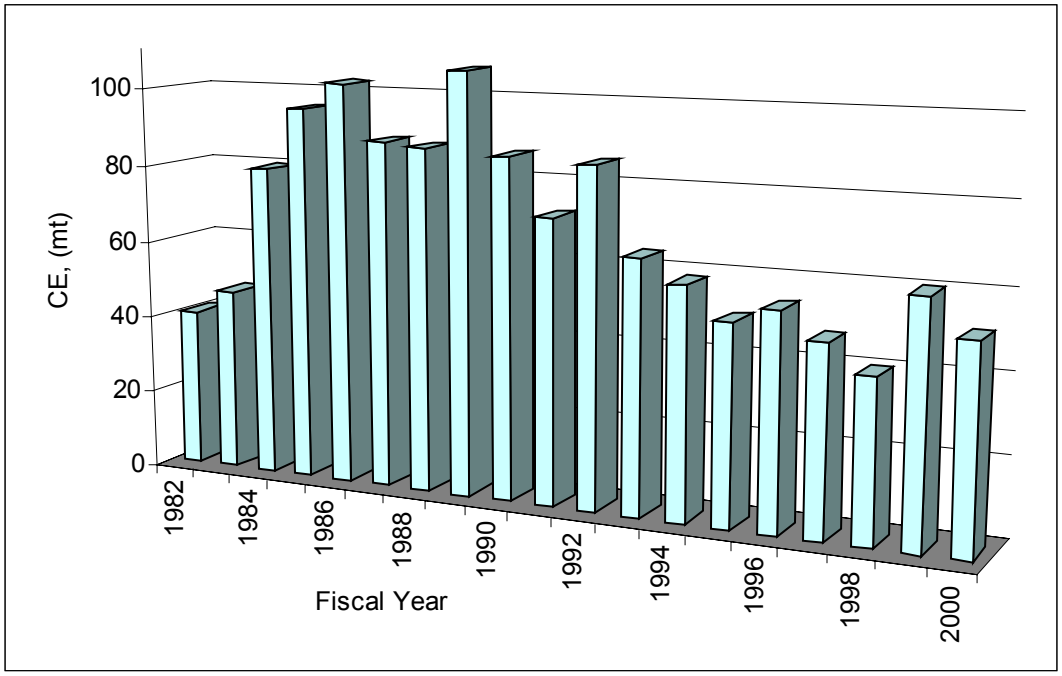


Figure 45. Average First Year Implemented Carbon Avoided by Fiscal Year

ii. Implemented Savings by Industry Type

Energy conservation and cost savings resulting from implemented recommendations by industry type is shown in Table 21 and Figures 46-50. The greatest amount of energy conserved was in SIC 30 (Rubber & Plastic Products); the largest in cost savings was SIC 36 (Electronic Products).

SIC Code	Industry Description	Implemented Energy Conservation						Implemented Cost Savings ($)			
		Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
20	Foods	6,974,414	71,483	29,692	101,175	17,207	2,083	503,374	390,931	976,395	1,870,700
21	Tobacco Products	0	0	0	0	0	0	0	0	0	0
22	Textile Mills	4,013,443	41,139	13,149	54,288	9,233	1,118	269,993	25,496	169,981	465,470
23	Apparel	2,162,368	22,159	42,192	64,351	10,944	1,325	310,107	30,798	345,267	686,172
24	Wood Prod.	14,153,773	145,068	80,526	225,594	38,366	4,645	778,159	53,609	981,049	1,812,817
25	Furniture	2,613,360	26,783	3,459	30,242	5,143	623	189,483	27,941	491,459	708,883
26	Paper Prod.	5,020,752	51,463	28,710	80,173	13,635	1,651	362,549	133,462	766,764	1,262,775
27	Printing	2,628,075	26,931	1,959	28,890	4,913	595	147,885	144,417	1,437,139	1,729,441
28	Chemical Prod.	3,440,308	35,260	136,600	171,860	29,228	3,539	634,324	114,171	543,997	1,292,492
29	Petroleum	111,700	1,145	0	1,145	195	24	6,722	0	1,738	8,460
30	Rubber & Plast.	16,753,644	171,716	245	171,961	29,245	3,541	980,451	299,995	1,713,372	2,993,818
31	Leather Prod.	918,228	9,411	0	9,411	1,601	194	52,844	46,375	3,750	102,969
32	Stone & Glass	5,196,072	53,257	4,614	57,871	9,842	1,192	426,158	136,648	480,193	1,042,999
33	Primary Metal	11,894,469	121,914	165,514	287,428	48,882	5,918	1,290,315	417,895	1,208,736	2,916,946
34	Fab. Metal	12,285,897	125,922	57,089	183,011	31,124	3,768	1,010,216	432,073	1,699,196	3,141,485
35	Ind. Machinery	10,449,321	107,094	19,160	126,254	21,472	2,600	634,251	334,007	620,427	1,588,685
36	Electronics	3,490,529	35,774	1,324	37,098	6,309	764	223,930	67,422	4,467,016	4,758,368
37	Trans. Equip.	3,573,089	37,897	59,675	97,572	16,594	2,009	399,406	284,954	345,615	1,029,975
38	Instruments	1,675,814	17,175	648	17,823	3,031	367	97,197	23,871	339,894	460,962
39	Misc. Manuf.	708,087	7,256	5,965	13,221	2,248	272	76,012	3,178	26,413	105,603
Totals		**108,063,343**	**1,108,847**	**650,521**	**1,759,368**	**299,212**	**36,225**	**8,393,376**	**2,967,243**	**16,618,401**	**27,979,020**

Table 21. Implemented Energy and Cost Savings by Industry Type

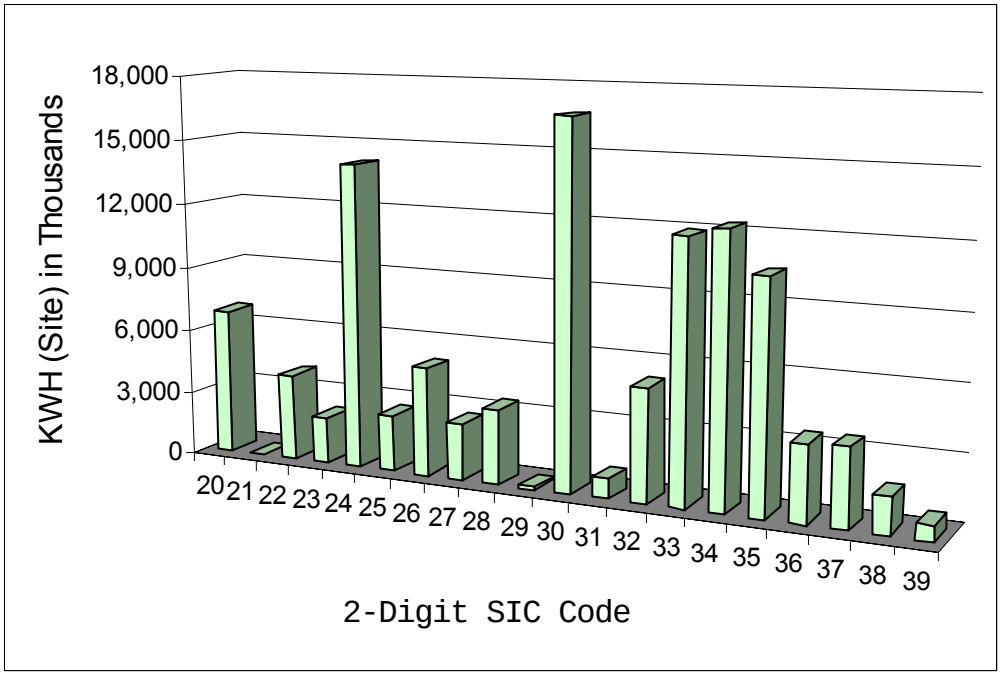


Figure 46. Implemented Electric Consumption by Industry Type

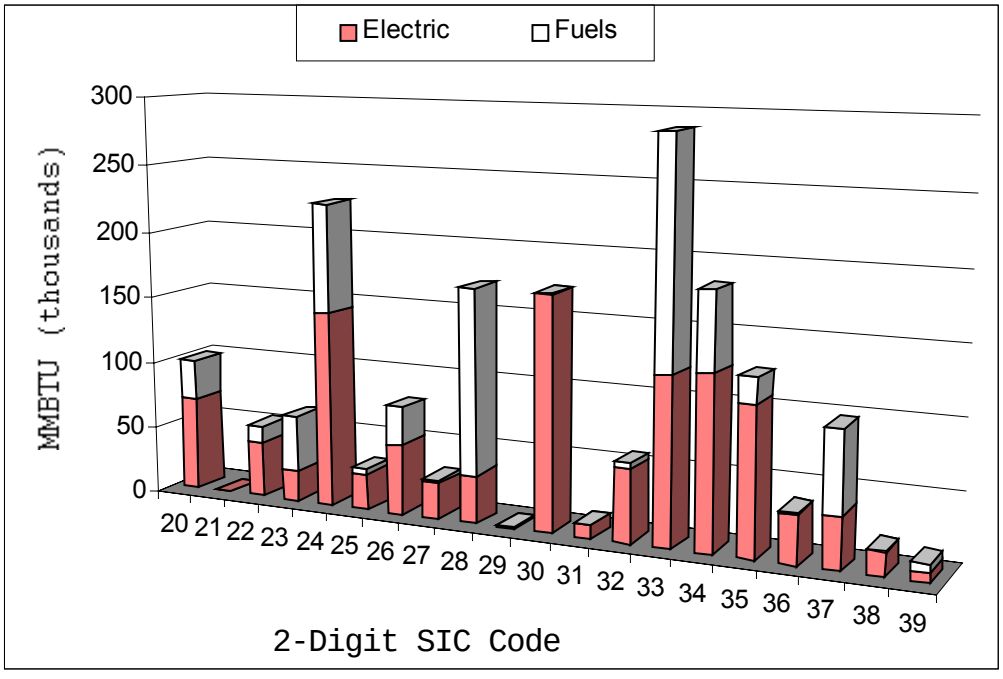


Figure 47. Implemented Energy Conserved by Industry Type

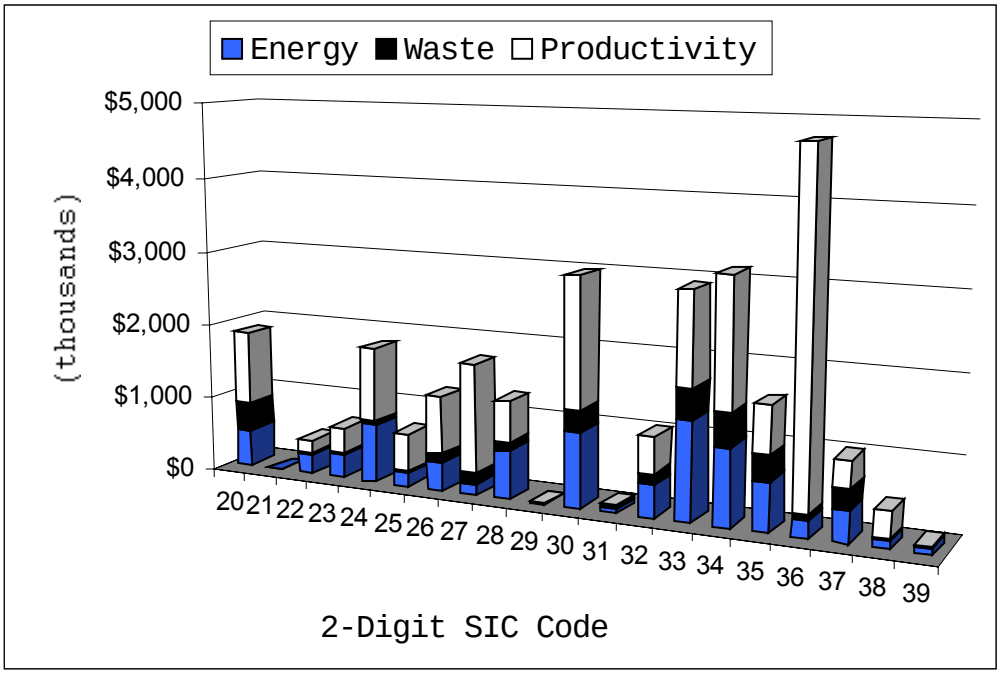


Figure 48. Implemented Cost Savings by Industry Type

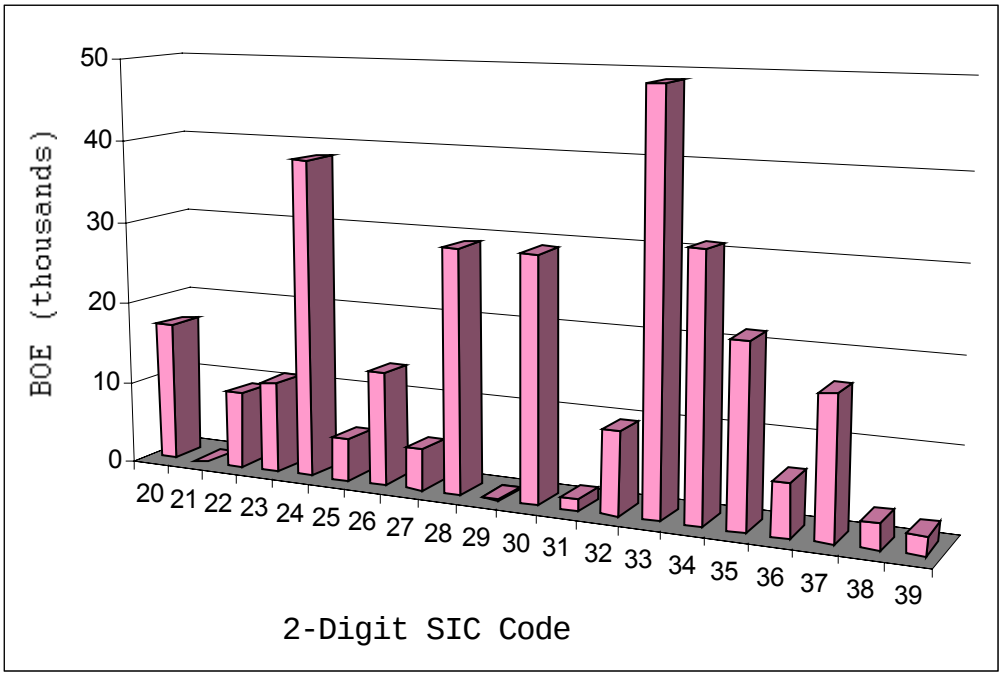


Figure 49. Implemented Barrels of Oil Avoided by Industry Type

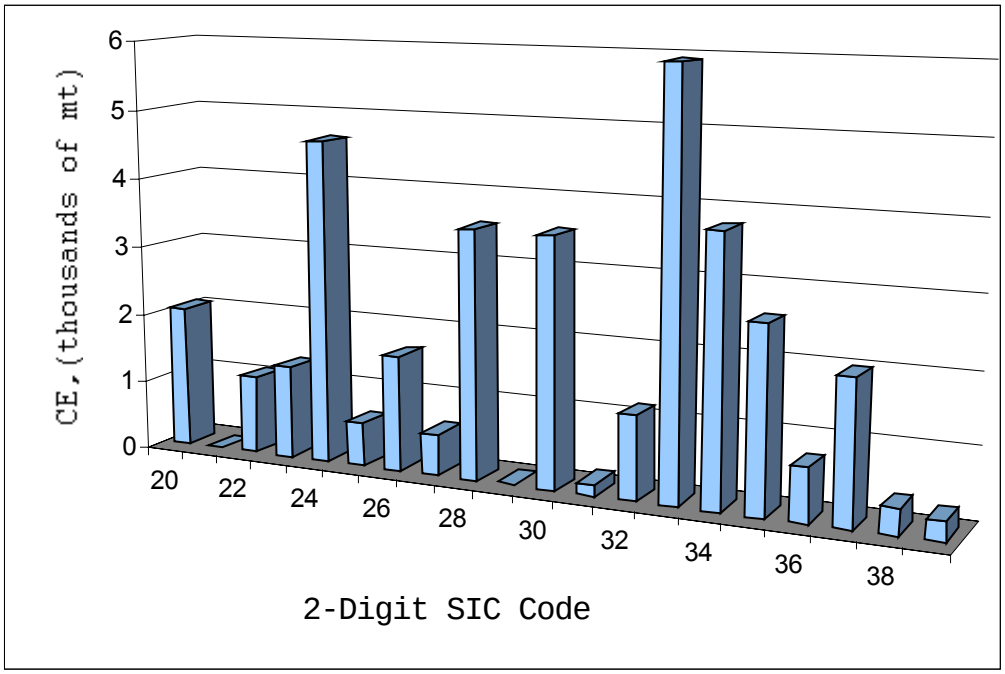


Figure 50. Implemented Carbon Avoided by Industry Type

Table 22 and Figures 51-54 show the average implemented energy and cost savings by industry type per assessment.

		Implemented Energy Conservation (thousands)						Implemented Cost Savings (thousands $)			
SIC Code	Industry Description	Site (KWH)	Source Electric (MMBtu)	Site Fuels (MMBtu)	Total (MMBtu)	(B.O.E.)	(C.E., mt)	Energy	Waste	Productivity	Total
20	Foods	105,673	1,083	450	1,533	261	32	7,627	5,923	14,794	28,344
21	Tobacco Products	0	0	0	0	0	0	0	0	0	0
22	Textile Mills	250,840	2,571	822	3,393	577	70	16,875	1,594	10,624	29,092
23	Apparel	166,336	1,705	3,246	4,950	842	102	23,854	2,369	26,559	52,782
24	Wood Prod.	248,312	2,545	1,413	3,958	673	81	13,652	941	17,211	31,804
25	Furniture	108,890	1,116	144	1,260	214	26	7,895	1,164	20,477	29,537
26	Paper Prod.	173,129	1,775	990	2,765	470	57	12,502	4,602	26,440	43,544
27	Printing	105,123	1,077	78	1,156	197	24	5,915	5,777	57,486	69,178
28	Chemical Prod.	98,295	1,007	3,903	4,910	835	101	18,124	3,262	15,543	36,928
29	Petroleum	27,925	286	0	286	49	6	1,681	0	435	2,115
30	Rubber & Plast.	265,931	2,726	4	2,730	464	56	15,563	4,762	27,196	47,521
31	Leather Prod.	459,114	4,706	0	4,706	800	97	26,422	23,188	1,875	51,485
32	Stone & Glass	236,185	2,421	210	2,631	447	54	19,371	6,211	21,827	47,409
33	Primary Metal	228,740	2,345	3,183	5,527	940	114	24,814	8,036	23,245	56,095
34	Fab. Metal	148,023	1,517	688	2,205	375	45	12,171	5,206	20,472	37,849
35	Ind. Machinery	165,862	1,700	304	2,004	341	41	10,067	5,302	9,848	25,217
36	Electronics	96,959	994	37	1,031	175	21	6,220	1,873	124,084	132,177
37	Trans. Equip.	137,427	1,458	2,295	3,753	638	77	15,362	10,960	13,293	39,614
38	Instruments	128,909	1,321	50	1,371	233	28	7,477	1,836	26,146	35,459
39	Misc. Manuf.	54,468	558	459	1,017	173	21	5,847	244	2,032	8,123
Average		**168,323**	**1,727**	**1,011**	**2,738**	**466**	**56**	**13,074**	**4,622**	**25,885**	**43,581**

Table 22. Average Implemented Energy and Cost Savings by Industry Type

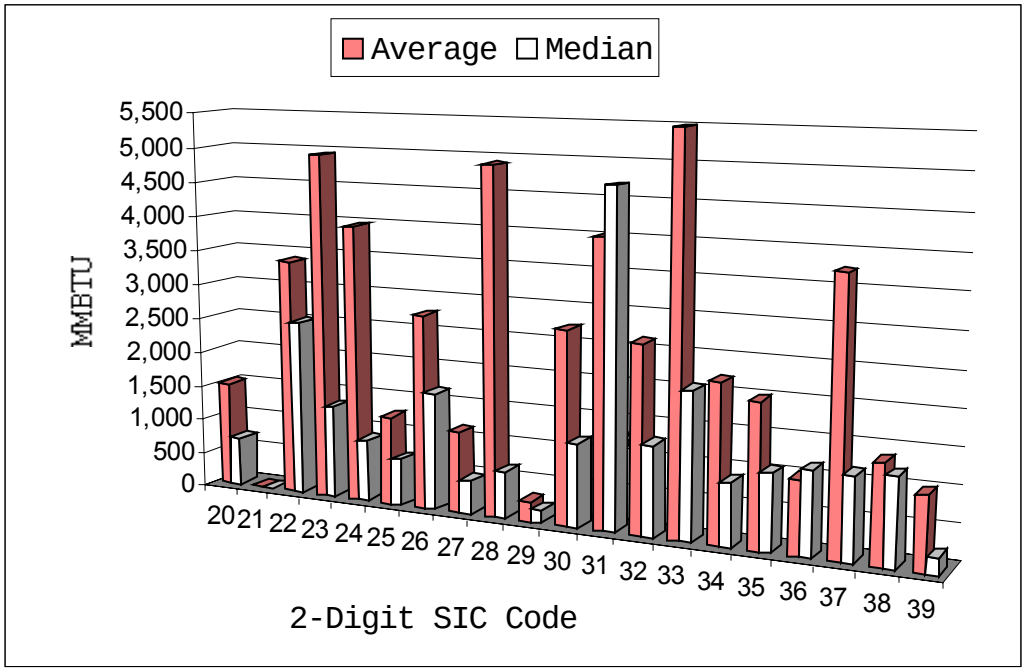


Figure 51. Average and Median Implemented Electric Consumption by Industry Type

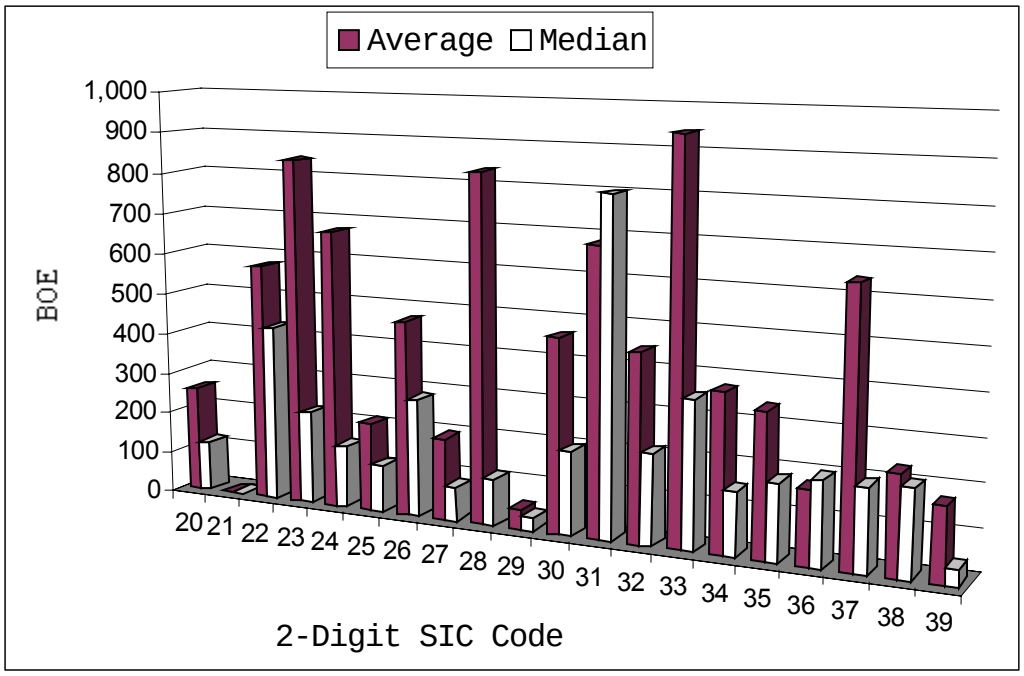


Figure 52. Average and Median Implemented Barrels of Oil Avoided by Industry Type

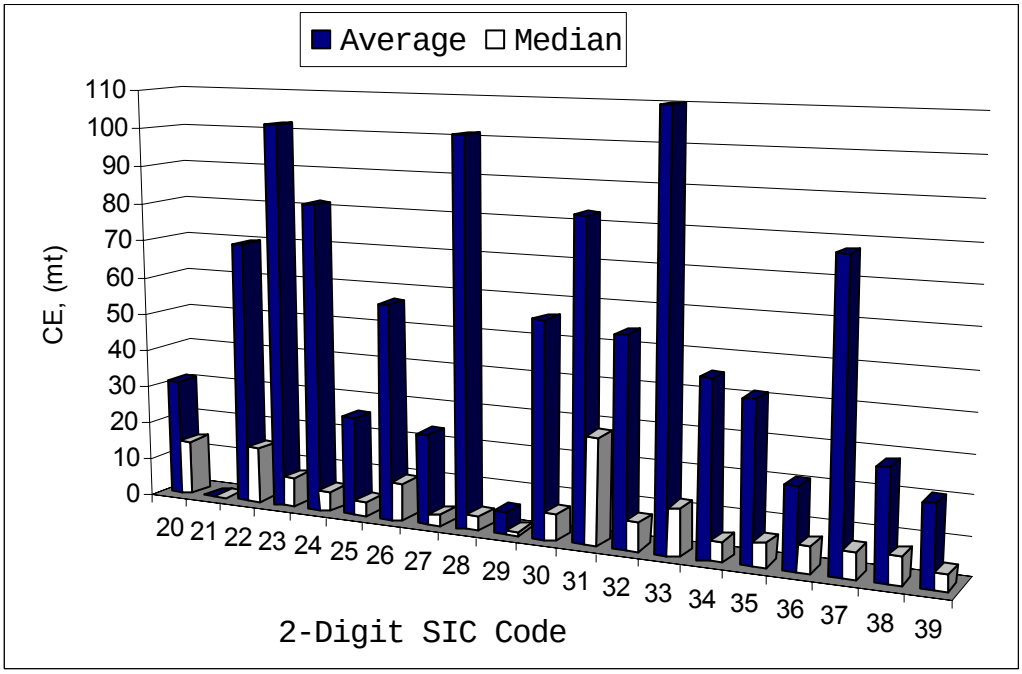


Figure 53. Average and Median Implemented Carbon Avoided by Industry Type

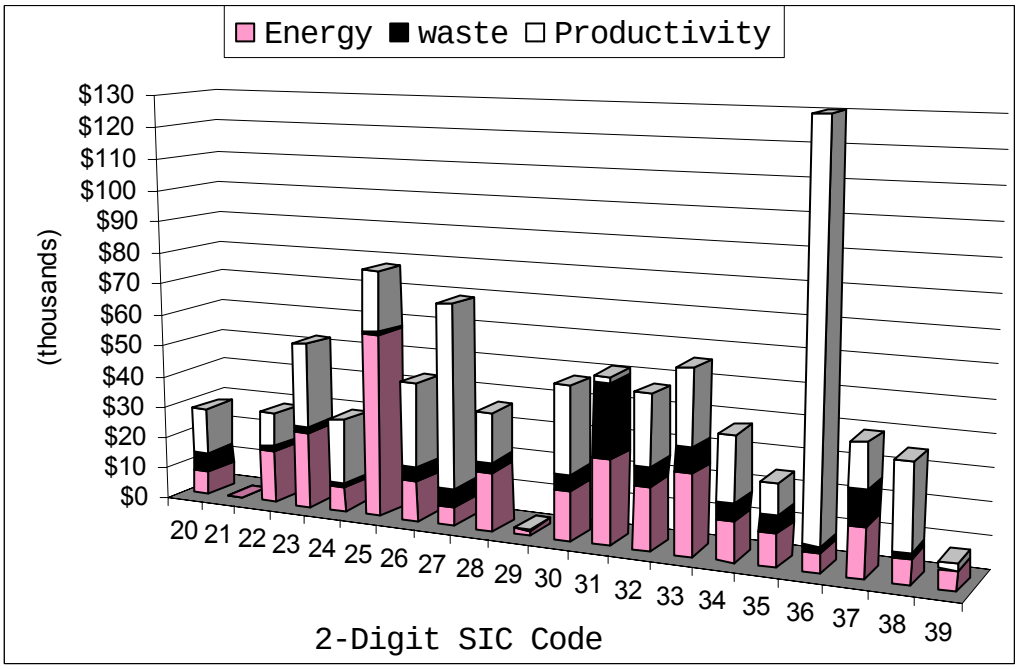


Figure 54. Average Implemented Cost Savings by Industry Type

iii. Implemented Savings by Resource Stream

Table 23 and Figures 55-56 reflect implemented energy and cost savings broken down by energy stream.

Energy Stream	Implemented Energy Conservation (MMBTU)	Implemented Energy Cost Savings ($)
Electricity		
Demand	169,439 KW-months/yr	1,525,608
Fees		197,099
Consumption - Site	107,890,717 KWH	
Consumption - Source	1,108,847	4,176,205
Natural Gas	582,374	2,330,032
L. P. G.	988	-7,234
Fuel Oil #1	35	366
Fuel Oil #2	2,079	8,879
Fuel Oil #4	878	5,876
Fuel Oil #6	16,526	56,705
Coal	0	0
Wood	45,804	117,529
Other Gas	0	0
Other Energy	461	-17,689
Energy Totals	**1,757,992**	**8,393,376**
Non-Energy	n/a	19,585,644
Program Totals	**1,757,992**	**27,979,020**

Table 23. Implemented Energy and Cost Savings by Resource Stream

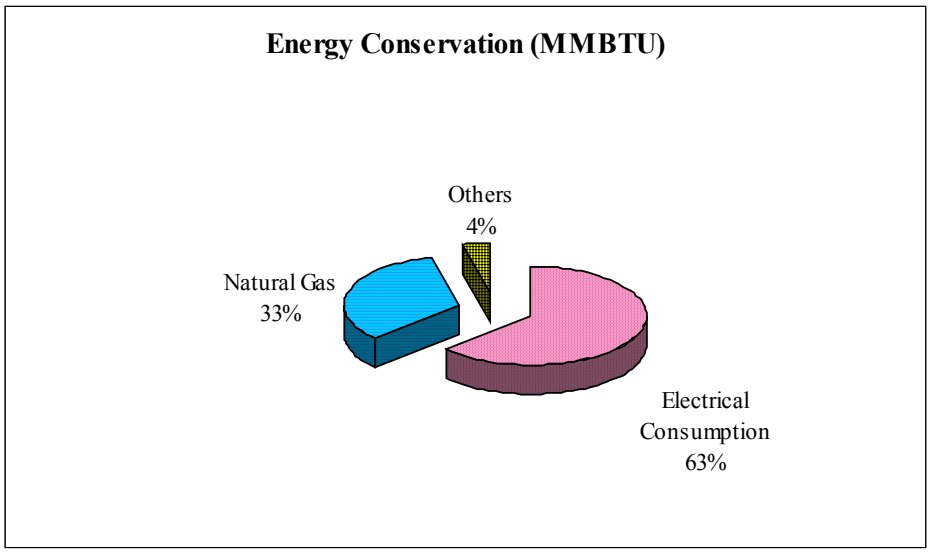


Figure 55. Composition of Implemented Energy Conserved by Energy Stream

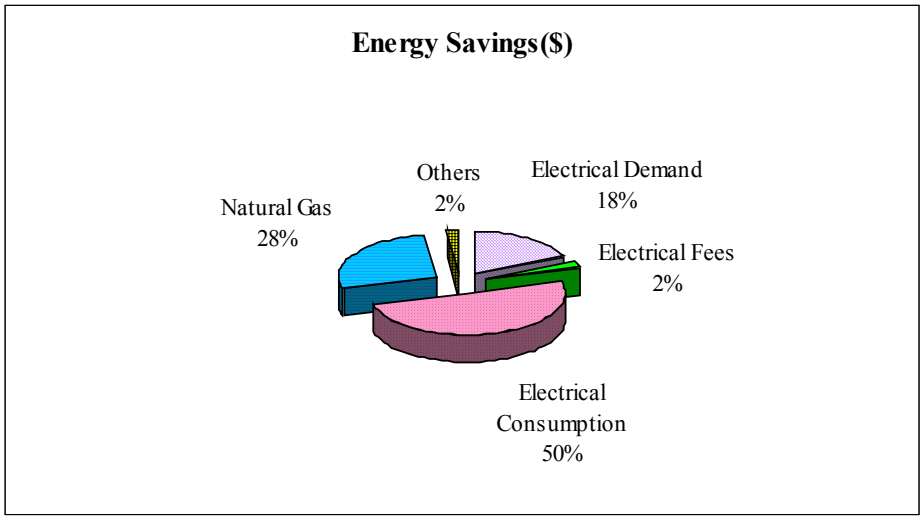


Figure 56. Composition of Implemented Energy Cost Savings by Energy Stream

The breakdown of non-energy savings by resource stream type is shown in Table 24, and Figure 57. The total implemented cost savings by resource stream are shown in Figure 58.

Stream Type	Total Implemented Non-Energy Cost Savings ($)
Primary Product	6,160,216
Byproduct Production	148,549
Resource Costs	
Personnel Changes	5,386,215
Administrative Costs	2,873,922
Primary Raw Material	568,931
Ancillary Material Cost	414,495
Water Consumption	159,460
One-time Revenue or Avoided Cost	906,613
Waste Reduction	
Water Disposal	636,182
Other Liquid (non-haz)	315,736
Other Liquid (haz)	198,134
Solid Waste (non-haz)	1,796,352
Solid Waste (haz)	20,839
Gaseous Waste (haz)	0
Non-Energy Total	**19,585,644**

Table 24. Total Implemented Non-Energy Cost Savings

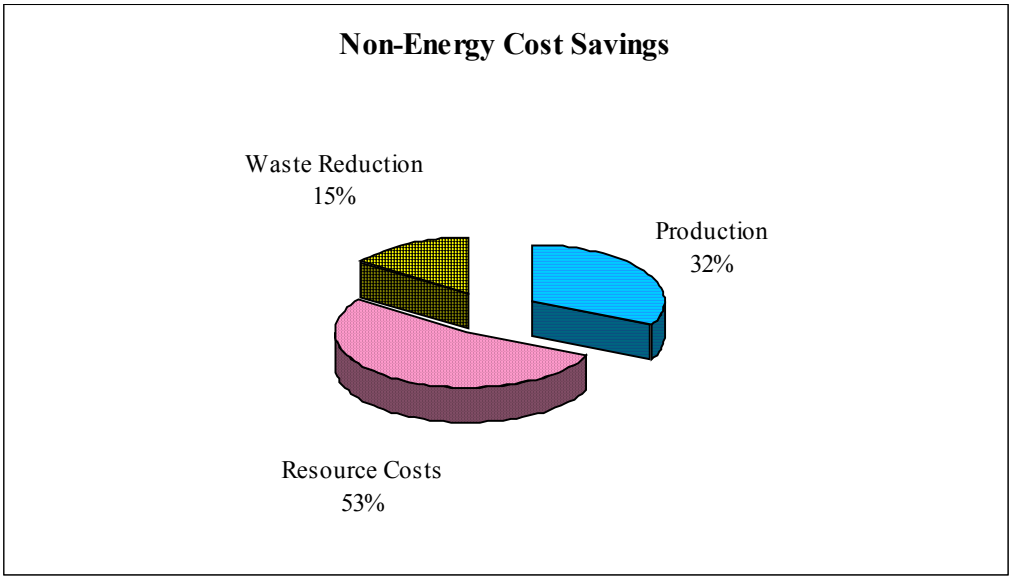


Figure 57. Composition of Non-Energy Implemented Savings

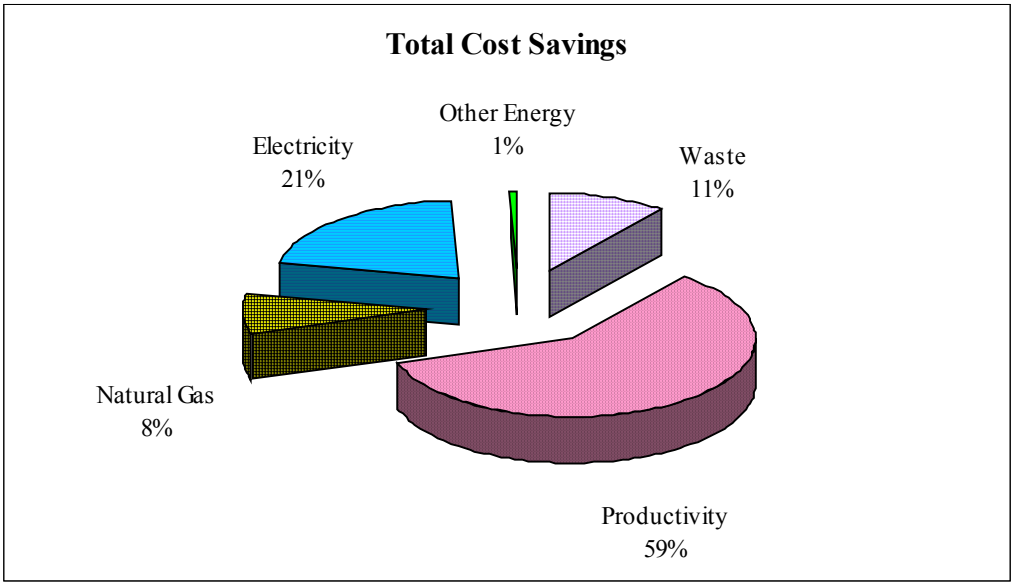


Figure 58. Composition of Total Implemented Cost Savings

iv. Implemented Savings by Recommendation Type

Finally, the number of implemented recommendations by type for Fiscal Year 2000 is shown in Table 25 and Figure 59.

2-Digit ARC Code	Category Description	No. of Implemented Recommendations	No. of Recommendations with client followups	% of Implemented Recommendations
2.1	Combustion Systems	61	203	30.0%
2.2	Thermal Systems	159	477	33.3%
2.3	Electrical Power	56	178	31.5%
2.4	Motor Systems	651	1176	55.4%
2.5	Industrial Design	2	10	20.0%
2.6	Operations	75	118	63.6%
2.7	Buildings and Grounds	488	1095	44.6%
2.8	Ancillary Costs	61	120	50.8%
2.9	Alternate Energy Use	0	2	0.0%
3.1	Operations	15	50	30.0%
3.2	Equipment	10	35	28.6%
3.3	Post Generation Treatment / Minimization	11	29	37.9%
3.4	Water Use	70	165	42.4%
3.5	Recycling	119	291	40.9%
3.6	Waste Disposal	42	139	30.2%
3.7	Maintenance	19	56	33.9%
3.8	Raw Materials	9	37	24.3%
4.1	Manufacturing Enhancements	46	171	26.9%
4.2	Purchasing	7	33	21.2%
4.3	Inventory	7	25	28.0%
4.4	Labor Optimization	74	244	30.3%
4.5	Space Utilization	19	80	23.8%
4.6	Reduction of Downtime	49	129	38.0%
4.7	Management Practices	2	14	14.3%
4.8	Other Administrative Savings	31	53	58.5%
	Total	**2083**	**4930**	**42.3%**

Table 25. Number of Implemented Recommendations by Recommendation Type

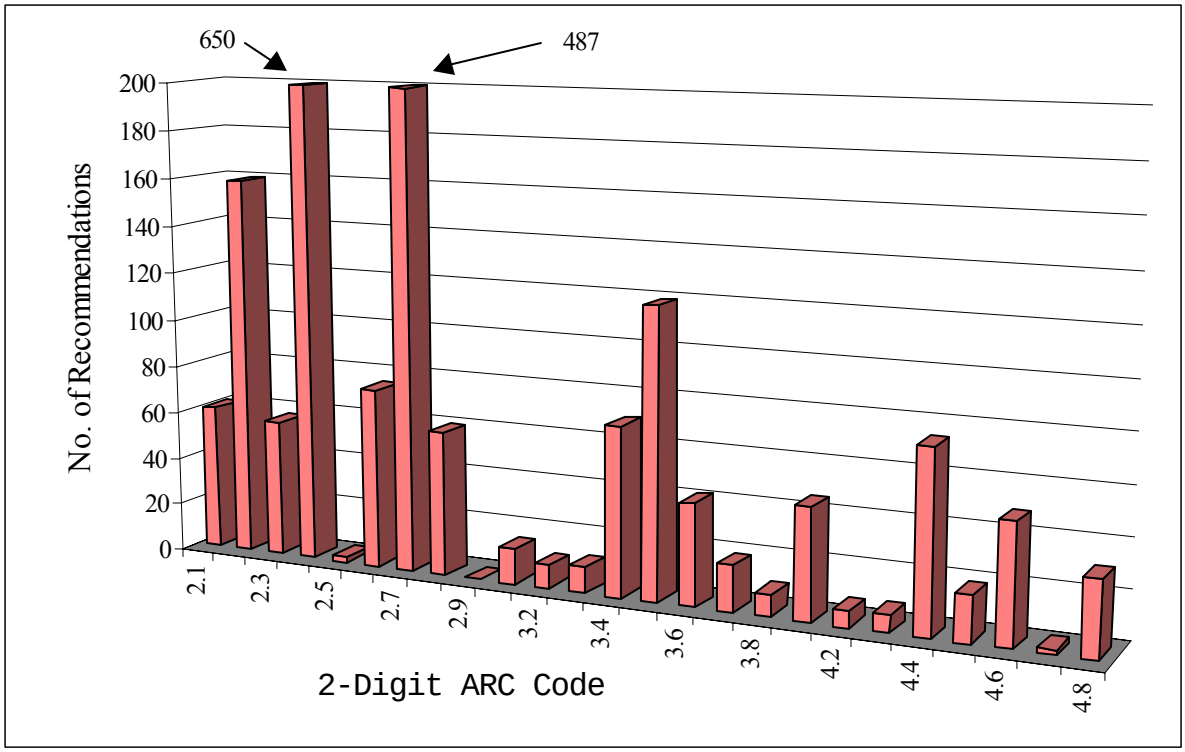


Figure 59. Number of Implemented Recommendations by Recommendation Type

2.1	Combustion Systems.	3.1	Operations	4.1	Manufacturing
2.2	Thermal Systems	3.2	Equipment	4.2	Purchasing
2.3	Electrical Power	3.3	Post Generation Treatment	4.3	Inventory
2.4	Motor Systems	3.4	Water Use	4.4	Labor Optimization
2.5	Industrial Design	3.5	Recycling	4.5	Space Utilization
2.6	Operations	3.6	Waste Disposal	4.6	Downtime
2.7	Building / Grounds	3.7	Maintenance	4.7	Mgt. Practices
2.8	Ancillary Costs	3.8	Raw Materials	4.8	Administrative Savings
2.9	Alternate Energy				

III. Standard Financial Calculations

Standard Financial Calculations, FY2000

Standard financial calculations of the IAC program results have been made by ITEM staff on the basis of data obtained from the IAC database maintained by Rutgers University. These calculations show financial returns to the federal government and to manufacturers from their investments in generating and implementing energy-conserving and cost-saving recommendations.

Results are summarized in Table 26 for a variety of parameters: growth rate of implementation costs, growth rate of cost savings, and borrowing rate.

These results were calculated according to standard financial methods, which specify IRR as the rate of return at which the sum of discounted future cash flows (until all loans have been amortized) equals the initial investment, or the rate at which net present value is zero. Mathematically, IRR is expressed by this equation:

$$0 = CF_0 + \{CF_1/(1 + i)\} + \{CF_2/(1 + i)^2\} +...+ \{CF_n/(1 + i)^n\}$$

in which CF = cash flow

$CF_{subscript}$ = the year in which the cash flow occurs

i = IRR

A similar net present value method was used to calculate leverage ratios or profitability indices. For the same series of annual cash flows (until all loans have been amortized) based upon actual implementation, a rate (for example, 10%) is assumed in order to discount these future cash flows to the initial period of the investment. The leverage ratio for manufacturers is the ratio of the sum of discounted future cash flows to the sum of all capital investments made to implement the assessment recommendations. For the federal government, the leverage ratio is the ratio of the sum of discounted future cash flows to the program support provided by the federal government for FY2000.

These leverage ratios (or profitability indices) show that, at a 10% discount rate, the federal government will realize $2.66 to $3.79 for every federal dollar spent on the program in FY2000. Similarly, manufacturers will, as a group, receive $4.52 to $5.92 for every dollar invested in implementing cost-saving measures.

Standard Financial Calculations of IAC Results

IMPCOST GROWTH	ENSAV GROWTH	BORR RATE	FEDERAL GOVERNMENT			MANUFACTURERS		
%	%	%	IRR	LR_{10}	LR_{15}	IRR	LR_{10}	LR_{15}
3	3	3	64.1	3.26	2.54	664	5.25	4.37
3	3	6	62.8	3.21	2.49	591	5.19	4.31
3	3	9	61.5	3.16	2.45	531	5.13	4.26
3	3	6	62.8	3.21	2.49	591	5.19	4.31
6	3	6	62.6	3.20	2.48	589	5.18	4.30
6	0	6	57.2	2.66	2.95	563	4.52	3.77
6	3	6	62.6	3.20	2.48	589	5.18	4.30
6	6	6	67.9	3.79	2.96	614	5.92	4.89
12	6	6	67.5	3.77	2.94	609	5.88	4.86

Table 26. Standard Financial Calculations of IAC Results

GLOSSARY

IMPCOST GROWTH	=	annual growth rate of the cost of implementing IACs' recommendations.
ENSAV GROWTH	=	annual growth rate of energy cost savings from implementation of IACs' recommendations.
BORR RATE	=	annual borrowing rate for debt service on funds borrowed to implement IACs' recommendations.
IRR	=	internal rate of return
LR_{10}, LR_{15}	=	leverage ratio for five-year cash flows discounted at 10 or 15% to the initial time period and compared to the program investment by the government and the capital investment by the manufacturers.

IV. Regional Reports

A. Eastern Region

Major Activities and Highlights of the Eastern Region

In Fiscal Year 2000, Field Management for the Eastern IAC region was the responsibility of the Office of Industrial Productivity and Energy Assessment (OIPEA) at Rutgers, The State University of New Jersey. OIPEA is an office of the department of Mechanical and Aerospace Engineering at Rutgers. In addition to the field management responsibilities, in FY93, Rutgers was tasked with the responsibility of maintaining the IAC database for the entire program.

In FY2000, the Eastern Region was comprised of fifteen experienced Centers performing approximately 25 assessments. The addresses and phone numbers of all Centers can be found on the OIPEA web "www.oipea.rutgers.edu". The schools and directors participating in the program in FY2000 are shown below.

(GT)	Georgia Institute of Technology	Mr. William A. Meffert
(HO)	Hofstra University	Dr. Richard Jensen
(MA)	University of Massachusetts	Dr. Lawrence A. Ambs
(ME)	University of Maine	Mr. Scott C. Dunning
(MS)	Mississippi State University	Dr. B. K. Hodge
(NC)	North Carolina State University	Dr. James Leach
(ND)	University of Notre Dame	Dr. John W. Lucey
(OD)	Old Dominion University	Dr. Sidney Roberts
(TN)	University of Tennessee	Dr. Richard J. Jendrucko
(UD)	University of Dayton	Dr. Kelly Kisock
(UF)	University of Florida	Dr. Dale Kirmse
(UL)	University of Louisville	Dr. Geoffery Cobourn
(UM)	University of Michigan	Dr. Arvind Atreya
(WI)	University of Wisconsin	Dr. Umesh Saxena
(WV)	University of West Virginia	Dr. Ralph Plummer

The history of the Centers, the directors' experience, and the student participation is shown in Table 27. The eastern region boasts an experienced and stable group of directors, with a total of over 120 years of experience in the program and an average of over 8 years.

Centers	Date Entered Program	2000 Assessments Completed	Director's Years in Program	Student Participation	
				Graduate	Under Grad.
GT	FY82	25	10	0	35
HO	FY92	25	5	1	7
MA	FY84	25	17	2	7
ME	FY93	25	8	0	12
MS	FY94	25	7	1	19
NC	FY93	25	7	3	5
ND	FY91	25	10	1	20
OD	FY94	25	7	3	7
TN	FY76	25	25	7	12
UD	FY76	25	3	9	1
UF	FY91	25	1	8	19
UL	FY94	25	3	7	2
UM	FY94	25	7	10	4
WI	FY87	25	14	6	0
WV	FY93	25	8	1	5

Table 27. History of Eastern Centers

OIPEA and the Hofstra University IAC conducted a two-day assessment at Leone Industries, a commodity glass container company, continuing the focus on the Industries of the Future approach. This is the reason that the record shows that Hofstra only conducted 24 assessments in FY2000.

On the international front, OIPEA conducted two trips to Africa. Dr. Ogot and Carole Trabachino collaborated with agencies in Kenya, and Dr. Ogot and Fred Glaeser worked with the University of Science and Technology in Kumasi Ghana in FY2000 consulting with these organizations in setting up IAC style industrial energy technical assistance programs in Kenya and Ghana.

B. Western Region

I. Major Activities and Highlights

During FY 2000, the Industrial Technology and Energy Management division (ITEM) of the University City Science Center provided field management for the western region where 15 centers served a total of 339 manufacturers. The western region IACs are listed below, along with the IAC director and student participation during FY 2000. The addresses and phone numbers of the western region directors are given in the Appendix.

					Student Participation	
IAC	Date Entered Program	FY 2000 Director	Years as Director	FY 2000 Plants	Graduate	Under-graduate
Arizona State University	FY 90	Patrick E. Phelan	4	25	7	7
Univ. of Arkansas-Little Rock	FY 93	Mamdouh Bakr	5	17	0	17
Bradley University	FY 94	D. Paul Mehta	7	25	4	7
Colorado State University	FY 84	Harry W. Edwards	4	24	1	12
Iowa State University	FY 91	Gregory M. Maxwell	2	25	4	17
University of Kansas	FY 81	Peter Tempas	1	18	1	10
University of Missouri-Rolla	FY 90	John Sheffield	2	25	1	9
University of Nevada-Reno	FY 94	Byrad Wood	1	25	1	9
Oklahoma State University	FY 81	Clint Christenson	2	22	8	5
Oregon State University	FY 87	George M. Wheeler	14	25	2	22
Prairie View A&M University	FY 99	Paul O. Biney	2	10	0	5
San Diego State University	FY 91	Asfaw Beyene	4	25	4	4
San Francisco State University	FY 93	Ahmad Ganji	8	25	3	8
South Dakota State University	FY 94	Kurt Bassett	7	25	2	5
Texas A&M University	FY 87	Warren M. Heffington	14	23	5	15

The western region IACs performed a total of 4 extended assessment days during the program period. The additional time at the plant sites permitted the IACs to obtain additional data to support specific assessment recommendations.

Special IOF assessments were done by three western region IACs. Oklahoma State University spent several days in a large glass plant, finding potential cost savings of over $14.6 x 10^6/yr. Colorado State University served a plant manufacturing extruded aluminum products, which resulted in ten measures that could potentially save approximately $840,000/yr. Finally, Texas A&M University performed a three-day assessment at a fiberglass plant and found potential cost savings of over $2.7 x 10^6/yr.

Special projects, which were funded at the Colorado State University, South Dakota State University, and Texas A&M University IACs last fiscal year, were completed. Colorado State University's project was to develop a Theory of Constraints Productivity Tool for IAC students used to prepare IAC students for tasks related to productivity improvement recommendations. South Dakota State University's project focused on the experimental validation of predicted energy savings for typical compressed air energy conservation opportunities. The focus of Texas A&M's special project was the determination of correlations between annual energy savings and implementation costs for selected, often-recommended assessment recommendations.

The program announcement for competitive selection of participants in the IAC program was issued in March of 2000 to deans of engineering and engineering technology departments with ABET-accredited programs. Fifty-seven proposals were received in response to the solicitation and underwent review. Finalists were identified to be interviewed, selections to be made in FY 2001.

In FY00, the western region IACs recommended 2,473 total measures with potential cost savings of $66.4 x 10^6/yr. Manufacturers implemented 966 recommendations, or 43% of all measures with known results, with total cost savings of $13.4 x 10^6/yr. On average, each plant was able to save $39,655/yr/plant.

Energy conservation opportunities accounted for 27% of all implemented cost savings, while productivity improvement and waste reduction opportunities accounted for the remaining 57% and 16%, respectively. Based on recommendations with known results, 47% of all energy conservation measures were implemented. Likewise, 33% of recommended productivity improvement measures and 37% of recommended waster reduction measures were implemented.

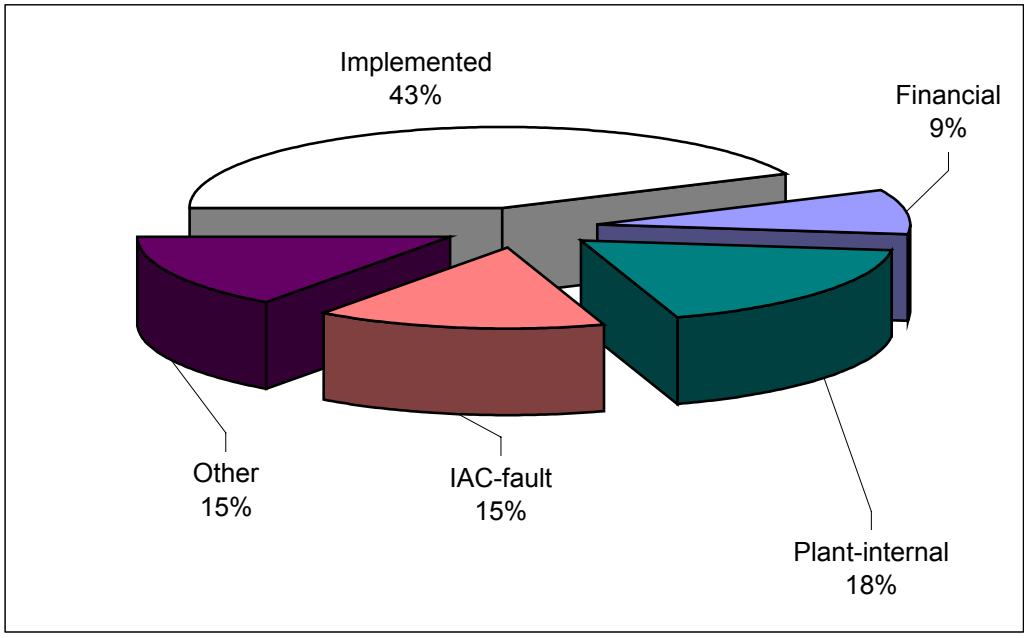
The average cost savings among implemented energy conservation recommendations was $5,195/yr per AR. Productivity and waste measures had higher averages per recommendation, as can be expected. The average cost savings per implemented recommendation was $14,463/yr for waste ARs and $62,074/yr for productivity ARs.

Although this year resulted in the $39,655/yr of implemented cost savings per plant, there was still about $45.0 x 10^6/yr or an average of about $133,000/yr/plant of non-implemented cost savings potential identified by the IACs in FY2000. About 28% of the non-implemented savings were in energy conservation category, 18% in waste minimization, and 54% in productivity enhancement.

Reasons for non-implementation were grouped into 4 major categories: plant-internal, financial, IAC-fault, and other. The plant-internal category includes reasons such as process, facility, or personnel changes that served as obstacles to implementation. Financial includes unsuitable ROI, too much up-front cost, or inadequate cash flow. The IAC-fault category reflects instances where the plant had a problem with the credibility, practicality, or nature of the IACs' recommendations. The "Other" category is used for non-specific reasons. Non-implemented percentages for the major categories are summarized below:

Reason	% of Non-Implemented
Plant Internal	18%
Financial	34%
IAC-fault	33%
Other	15%

Note that 52% of non-implemented cost saving measures was attributed to plant-internal and financial factors while 33% are due to the fault of the IAC. As a whole, the recommendations which manufacturers viewed as poor quality ARs only represents 15% of the recommended cost saving measures as shown in Figure 60.



Note: The shaded regions represents total non-implemented cost saving measures.

(FY 2000 Western Region)

Figure 60. Breakdown of Total Recommended Cost Saving Measurres

Appendix I.

Assumptions Used in Carbon Equivalent Calculations

1.) Carbon Avoided was calculated for three sources; natural gas, electricity, and other (fuel oil)
2.) These sources were calculated separately by percentage for Recommended Savings and for Implemented Savings.
3.) Efficiencies for on site fossil fuel savings (natural gas, fuel oil) are inherent in the reported values.
4.) Carbon Avoided for Electricity saved was calculated using average US generation values.
5.) Electric generation site to source MMBtu's relationship is:

3412 MMBtu's site = 10,250 Source MMBtu's

This is a Fossil Fuel generation efficiency of 33.29%

6.) For purposes of this report those values were:

Coal	80.0 %
Natural Gas	15.0 %
Fuel Oil	5.0 %
Fossil Fuel Total	100%

Carbon Equivalents

CE_{coal}: 56.669 lb. of Carbon per MMBtu

CE_{oil}: 43.439 lb. of Carbon per MMBtu

CE_{gas}: 32.414 lb. of Carbon per MMBtu

$CE_{electricity}$: 119.8 lb. of Carbon per MMBtu

FY2000 Implemented Average 69.6 lb. of Carbon per MMBtu