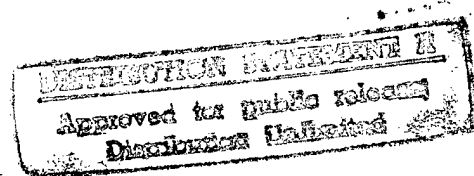


F I N A L R E P O R T

**ENERGY SAVINGS OPPORTUNITY SURVEY
ENERGY ENGINEERING ANALYSIS PROGRAM**

FORT BENNING, GEORGIA



EXECUTIVE SUMMARY

Administered by
Savannah District, Corps of Engineers
Contract No. DACA21-85-C-0614

19971017 112

DTIC QUALITY INSPECTED 2

HEERY

Heery Energy Consultants, Inc.
Atlanta, Georgia

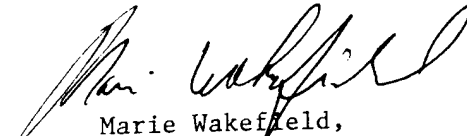


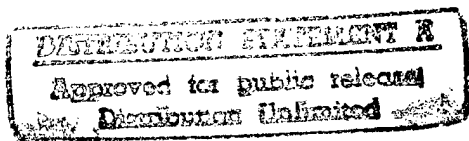
DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF: TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited.
Distribution A. Approved for public release.


Marie Wakefield,
Librarian Engineering



FINAL REPORT

ENERGY SAVINGS OPPORTUNITY SURVEY
ENERGY ENGINEERING ANALYSIS PROGRAM

F O R T B E N N I N G

EXECUTIVE SUMMARY

Administered by
Savannah District Corps of Engineers
Contract No. DACA21-85-C-0614
Job No. 85044

August 24, 1988

Heery Energy Consultants, Inc.
Atlanta, Georgia

EXECUTIVE SUMMARY

TABLE OF CONTENTS	PAGE
I. Introduction	1
II. Results	7
A. Non-Housing	7
B. Family Housing	16
III. Project Scope	22
IV. Summary	23

LIST OF TABLES AND FIGURES

Table	1	Summary of Non-Housing Energy Conservation Projects	2
	2	Summary of Family Housing Energy Conservation Projects	3
	3	Surveyed Buildings List	4
	4	Summary of Feasible ECOs, Non-Housing	8
	5	Summary of Feasible ECOs, Family Housing	17
Figure	1.1	SIR by ECO, Non-Housing	10
	1.2	Dollar Savings by ECO, Non-Housing	12
	1.3	SIR by Project, Non-Housing	14
	1.4	Dollar Savings by Project, Non-Housing	15
	1.5	SIR by ECO, Family Housing	18
	1.6	Dollar Savings by ECO, Family Housing	19
	1.7	SIR by Project, Family Housing	20
	1.8	Dollar Savings by Project, Family Housing	21

EXECUTIVE SUMMARY

I. INTRODUCTION

This is the final submittal of an Energy Savings Opportunity Study (ESOS) performed at Fort Benning, GA. This report presents potential energy conservation projects for this Installation. These projects, consisting of ECOs, are summarized in Tables 1 and 2. The projects were developed based on project packaging instructions from the Installation and on follow-up phone calls with DEH and DRM. The ECOs have been extended to include buildings similar to those surveyed by the AE. Similarity was based on instructions from the Installation and on follow-up phone calls with DEH.

Table 3 lists the buildings surveyed. 120 buildings were surveyed, totaling approximately 3.2 million square feet. Of these, 20 were examples of Family Housing and 100 were examples of non-housing buildings.

Over one hundred ECOs were considered at Fort Benning. Of these, 55 were applicable in non-housing and 13 in Family Housing. These are presented and discussed in Sections 3 and 4 of this report.

ECOs were selected for consideration from a number of sources: Annexes A and B of the Scope of Work, the Army Facility Energy Plan appendix, and Heery's own resources, including the ECOs studied at other Installations. All applicable ECOs were evaluated and found either feasible (SIR greater than or equal to one) or infeasible. Tables 4 and 5 list the feasible ECOs along with SIR, project packaged, and other pertinent data.

The method of analysis employed for heating and cooling ECOs is a multiple measure approach using a modified bin method as outlined in ASHRAE Fundamentals. ECO savings not based upon heating or cooling loads use standard ASHRAE or IEEE formulas. Electronic spreadsheets employing the aforementioned energy analysis methodologies were used by Heery to perform the energy calculations, and produce the LCCA sheets.

All energy savings are first calculated at the building boundary. For those buildings receiving chilled water or high temperature hot water or other energy from a central energy plant, the computed energy savings are then converted to plant energy savings by the use of conversion factors that reflect distribution losses and energy conversion inefficiencies.

A survey of 413 steam traps was also performed, finding that 8.5% of the traps had failed. This wastes 10,830 MBTU/year of steam, worth \$94,500 a year. An ECO was programmed to remedy this.

TABLE 1

**SUMMARY OF ENERGY CONSERVATION PROJECTS (Non-Housing)
FORT BENNING, GEORGIA**

Proj No.	Funding Program	Project Title	ECO No(s).	Energy Savings MBTU/Yr	First Yr. Dollar Savings \$/Yr.	Total Investment Cost \$	Simple Payback Period Yrs.	SIR
1	QRIP	Install Variable Air Volume in Building 396	31	4,591	\$26,103	\$29,623	1.13	11.26
2	QRIP	Improvements to Steam and Hot Water Systems	18,22,23,77	23,268	\$116,811	\$65,821	0.56	16.97
3	QRIP	Lighting System Improvements	40,46,47	4,704	\$63,374	\$72,675	1.15	9.85
4	QRIP	Time Control of HVAC and DHW	49,78	28,192	\$150,526	\$64,412	0.43	31.21
5	QRIP	Reduce Infiltration and Outside Air	7,14	6,075	\$31,430	\$39,636	1.26	11.50
6	PECIP	Boiler Stack Economizer Heat Exchanger	29	7,332	\$33,308	\$81,039	2.43	6.02
7	PECIP	Replace Absorption Chillers with Electric Centrifugal	35	81,786	\$349,361	\$894,935	2.56	5.92
8	PECIP	Improvements to Domestic Hot Water System	10,12	20,493	\$102,567	\$274,892	2.68	3.61
9	PECIP	Lighting and HVAC Improvements	15,28,42,43	13,074	\$152,715	\$281,251	1.84	7.73
10	ECIP	Mechanical System Improvements	11,25,33,37 38,41,JW59	21,534	\$113,761	\$723,023	6.36	2.37
11	ECIP	Insulation and Weatherization	1,2,6,19,52	25,332	\$134,008	\$986,296	7.36	3.04
13	PECIP	Electric Centrifugal for Turbine Drive	36	13,434	\$55,358	\$206,972	3.74	4.13
20	ECIP	Miscellaneous Energy Improvements	4,5,44,45,48 50,51,JW32	15,561	\$115,996	\$745,759	6.43	1.74
Summary				265,376	\$1,445,318	\$4,466,334	3.09	2.45

TABLE 2

**SUMMARY OF FAMILY HOUSING PROJECTS
FORT BENNING, GEORGIA**

Proj. No.	Funding Program	Project Title	ECO No(s)	Energy Savings MBTU/Yr	First Yr. Dollar Savings \$/Yr.	Total Investment Cost \$	Simple Payback Period Yrs.	SIR
14	ECIP	Install Ceiling/Attic Insulation in Family Housing	FH-1	92,211	\$485,917	\$2,178,064	4.48	4.44
15	ECIP	Family Housing Lighting Improvements	FH-8,9	13,759	\$63,205	\$526,789	8.33	1.78
16	ECIP	Whole House Fans in Family Housing	FH-7	579	\$4,684	\$44,003	9.39	1.08
17	PECIP	Family Housing DHW Improvements	FH-3,4	31,854	\$187,330	\$423,925	2.26	8.63
18	ECIP	Furnace Retrofit	FH-11	175,006	\$875,905	\$8,144,910	9.30	1.50
19	ECIP	Weatherstrip/Caulk Windows &/ Doors	FH-2	42,887	\$255,768	\$2,492,342	9.74	1.96
Summary				356,296	\$1,872,809	\$13,810,033	7.37	5.07

TABLE 3

**SURVEYED BUILDINGS LIST
FORT BENNING, GA**

Bldg. No.	Bldg. Usage	Bldg. Area Sq. Ft.
4	GEN INST BLDG	542,492
5	POST HQ BLDG	18,014
9	FIRE STATION	3,538
16	COMMO CENTER	8,927
17	CUARTEL	195,533
30	FAMILY HOUSING	4,323
35	ADMIN GEN PUR	130,010
36	OFF QTR TRANS	13,971
37	OFF QTR TRANS	13,971
38	OFF QTR TRANS	13,981
66	ADMIN GEN PUR	10,338
73	CUARTEL	177,779
76	ADMIN GEN PUR	29,784
85	FIN ADMIN BLD	23,960
89	FIN ADMIN BLD	27,489
90	THTR W/DRESS	25,065
93	LIBRARY MAIN	13,781
100	COLD STORAGE	11,334
107	TNG AIDS CTR	12,823
108	TNG AIDS CTR	27,425
128	OPEN DINE OFF	37,931
129	OPEN DINE OFF	26,213
130	PRINT PLANT	30,698
160	FAMILY HOUSING	1,750
262	FE FACILITY	35,051
280	WAREHOUSE	18,166
302	FLT CON TOW H	3,600
358	ADP BUILDING	15,982
359	CREDIT UNION	7,986
385	BREAD BAKERY	9,803
390	GOLF CLUB HOU	12,291
396	MUSEUM	48,116
399	CUARTEL	319,831
422	FAMILY HOUSING	2,426
455	FAMILY HOUSING	3,386
468	EEO OFFICE	5,376
479	TEL EXCH BLDG	7,577
500	FAMILY HOUSING	4,534
560	TENNIS BLDG	1,841
589	FAMILY HOUSING	2,100
703	FAMILY HOUSING	4,141
791	VIP GUEST QTRS	4,248
812	FAMILY HOUSING	2,825
940	FAMILY HOUSING	1,851
947	FAMILY HOUSING	1,340
972	OFF QTRS TRAN	13,879
973	OFF QTRS MIL	14,240

TABLE 3

**SURVEYED BUILDINGS LIST
FORT BENNING, GA**

Bldg. No.	Bldg. Usage	Bldg. Area Sq. Ft.
974	OFF QTRS MIL	13,879
975	OFF QTRS MIL	20,746
976	OFF QTRS MIL	13,879
1055	GYMNASIUM	12,900
1684	FIRE PREVENTION	2,671
1710	EXCHANGE BRAN	3,250
1711	EXCHANGE BRAN	15,672
1712	EXCHANGE BRAN	3,088
1713	EXCHANGE BRAN	4,934
2027	FAMILY HOUSING	1,525
2282	GEN INST BLDG	3,000
2284	RADAR BUILDING	96
2445	FIRE STATION	2,385
2485	AF OPS BLDG	12,210
2489	AVN OPS BLDG	4,516
2490	AVN OPS BLDG	4,336
2491	MNT HANGAR AV	28,568
2492	MNT HANGAR AV	16,845
2682	OPEN DINE OFF	6,692
2747	ADMIN	17,362
2749	ADMIN	9,843
2760	BARRACKS W/DIN.	79,285
2762	BARRACKS W/DIN.	79,285
2783	SKILLS DEV'L CTR.	26,680
2784	NCO CLUB	27,471
2817	THERMAL PLANT	2,661
2818	GYM	23,142
2825	BAND BLDG	3,555
2827	ADMIN	9,843
2838	BARRACKS W/DIN.	40,536
2839	BARRACKS	40,536
2902	CLIMATIC LAB	1,650
2904	SM ARMS REP SHOP	3,584
2920	VEH MNT SH OR	35,761
2921	VEH MNT SH DS	8,712
2962	VEN MNT SH GS	18,668
3000	TEL EXCH BLDG	1,166
3215	RGT HQ BLDG	9,895
3218	EXCHANGE BRAN	23,203
3305	ENL BKS BASIC	197,100
3350	GYMNASIUM	23,728
3355	EXCHANGE BRAN	8,500
3420	UNIT CHAPEL	9,050
3440	THTR W/DRESS	16,834
3550	MOTOR POOL	800
3552	MAINT SHOP	15,180
7500	INST LAND BLD	80

TABLE 3

**SURVEYED BUILDINGS LIST
FORT BENNING, GA**

Bldg. No.	Bldg. Usage	Bldg. Area Sq. Ft.
7501	INST LAND BLD	80
8783	RANGE HOUSE	460
8823	RANGE HOUSE	800
9000	ADMIN	9,313
9022	BARRACKS W/O DIN.	50,620
9026	EXCHANGE BRAN	3,867
9049	'72ND ENG. CO.	10,136
9050	BDE HQ	9,313
9057	BARRACKS W/DIN.	50,600
9076	THEATRE	10,714
9079	REC CLUB	27,471
9106	SM ARMS REP SHOP	48,000
9107	ARMS MTG/COOL PLT	2,308
9203	OFF QTRS MIL	11,951
9225	TEL EXCH BLDG	3,877
9230	COMMISSARY	117,466
9232	BOWLING CENTER	18,164
9359	FAMILY HOUSING	2,200
9517	FAMILY HOUSING	1,500
10062	FAMILY HOUSING	1,188
10385	FAMILY HOUSING	1,313
10801	FAMILY HOUSING	1,187
10863	FAMILY HOUSING	1,188
10976	FAMILY HOUSING	1,196
11450	FAMILY HOUSING	1,200
11490	FAMILY HOUSING	1,457
TOTAL SQUARE FOOTAGE		3,234,591

II. RESULTS

A. Non-Housing

Of the 55 ECOs found to be applicable in non-housing, 48 had SIRs greater than or equal to one and 43 had paybacks less than ten years. The ECOs were packaged into 13 Projects. Figure 1.1 on pages 10 and 11 illustrates the SIRs for all 55 ECOs and is ranked by ECO number. Table 4 on the following two pages provides ECO names and numbers, SIRs, and other important data.

Figure 1.1 shows that SIRs range from over 40 to less than one. The top nine ECOs have SIRs above 10.0. These ECOs, too, are mostly simple, direct, straight forward and low-tech, which means easy implementation.

Figure 1.2 is similar to 1.1 but shows "first year dollar savings" for each ECO. This figure shows that the most dollar savings don't always come from the ECOs with the highest SIRs. Figures 1.3 and 1.4 illustrates SIRs and dollar savings by Project. The first five are QRIP. Projects 6, 7, 8, 9, and 13 are PECIP and the rest are ECIP.

TABLE 4

**SUMMARY OF NON-HOUSING ECOS
FORT BENNING, GA**

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr	First Yr. Dollar Savings \$/Yr.	Total Cost \$	PB Period Yrs.	SIR
1	Wall Insulation	11	12,168	62,192	442,833	7.1	2.85
2	Ceiling/Attic Insulation	11	3,639	20,507	98,831	4.8	3.97
3	Floor Insulation	--	1,675	8,529	157,622	18.5	1.10
4	New Windows and/or Wall Area	20	663	4,298	38,812	9.0	2.01
5	Solar Film	20	10,169	54,404	356,420	6.6	1.69
6	Weatherstrip/Caulk Doors/Windows	11	6,529	36,272	252,097	7.0	2.87
7	Dock Curtains	5	666	3,421	4,760	1.4	2.05
8	Repair Existing Vestibules	--	160	842	8,815	10.5	1.94
9	Airside Drybulb Economizer Cycles	--	31	250	8,098	N/A	0.31
10	Decentralize DHW System	8	20,147	100,838	269,040	2.7	3.59
11	New DHW Units	10	6,042	30,242	138,215	4.6	2.10
12	Steam Condensate HX to Preheat DHW	8	346	1,732	5,852	3.4	4.14
13	Install Central HVAC	--	690	8,935	530,245	N/A	0.16
14	OA Damper Controls	5	5,334	27,634	34,876	1.3	10.81
15	New Lower Ceiling	9	6,411	34,388	93,747	2.7	7.48
16	Deciduous Shade Trees	--	35	419	10,582	N/A	0.51
17	Storm Windows	--	17	90	1,543	N/A	0.79
18	Pipe Insulation	2	1,257	6,289	9,278	1.5	13.95
19	Insulation on DHW Unit	11	86	469	2,569	5.5	3.47
20	Electric Spark Pilot Retrofit	--	4	18	383	N/A	0.45
21	Steam Condensate Return Piping	--	152	3,521	19,084	5.4	1.87
22	Time Control of HVAC	2	6,282	31,787	19,781	0.6	15.11
23	Outside Temp. Control of Space Heating	2	6,778	33,922	17,445	0.5	27.18
24	Thermostatic Control Valves	--	814	4,075	81,897	N/A	0.70
25	Hot Water Reset	10	305	1,527	7,128	4.7	2.99
26	Chilled Water Reset	--	18	149	9,272	N/A	0.16
27	Calibrate Pneumatic Controls	--	9,091	64,957	104,078	N/A	0.59
28	Air to Air Heat Recovery	9	1,500	7,499	25,892	3.5	4.06
29	Boiler Stack Economizer	6	7,332	33,309	81,039	2.4	6.02
30	Liquid Solar DHW Heating System	--	10,490	52,501	640,200	12.2	1.46
31	Retrofit AHU to VAV	1	4,591	26,100	29,623	1.1	11.26
32	New AHUs	--	50	645	5,568	8.6	1.13
33	New Condenser and/or Compressor	10	410	2,163	13,915	6.4	2.12
34	Variable Speed Pump with 2-Way Valves	--	3,430	44,416	682,913	N/A	0.64
35	Replace Absorp. Chr w/ Elec.	7	81,786	349,359	894,935	2.6	5.92
36	Replace Turbine Drive w/ Elec.	13	13,433	55,355	206,972	3.7	4.13
37	More Efficient Boiler	10	7,609	38,083	347,368	9.1	2.34
38	Two Speed Motors	10	655	5,302	26,429	5.0	2.28
39	Turbo-Modulator	--	173	2,241	29,694	N/A	0.74
40	Lamp Retrofit - Incand. to Fluor.	3	2,618	44,565	45,380	1.0	12.29
41	Fixture Retrofit - Incand. to HID	10	304	5,375	26,056	4.8	2.57
42	Fixture Retrofit - Fluor. to HID	9	762	11,231	29,461	2.6	4.82
43	Fixture Retrofit - Incand. to Fluor.	9	4,400	99,597	131,622	1.3	9.30
44	Fixture Reflector Backs and Delamp	20	423	6,260	41,467	6.6	1.91
45	High Efficiency Motors	20	2,385	30,887	190,397	6.2	1.77
46	Occupancy Sensors	3	1,785	14,437	20,526	1.4	6.13

TABLE 4

**SUMMARY OF NON-HOUSING ECOs
FORT BENNING, GA**

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr	First Yr. Dollar Savings \$/Yr.	Total Cost \$	PB Period Yrs.	SIR
47	Daylighting Controls	3	301	4,367	6,770	1.6	4.74
48	Timers on Lighting	20	648	9,167	53,811	5.9	1.66
49	FM Control for HVAC	4	22,823	123,328	39,496	0.3	41.35
50	High Torque Drive Belts	20	304	5,799	37,673	6.5	1.47
51	Window Back Panel	20	159	1,134	9,959	8.8	1.96
52	Removable Valve Insulation	11	5,910	29,578	189,965	6.4	3.20
53	Test & Balance	--	9,416	54,923	848,216	N/A	0.12
77	Steam Trap Replacement	2	8,951	44,798	19,317	0.4	11.11
78	Time Control of DHW	4	5,369	27,199	24,916	0.9	15.13
JW-31	Install Ceiling and Insulate Floor	--	160	1,179	67,653	N/A	0.30
JW-32	Window Insulation	20	810	4,056	17,220	4.2	1.13
JW-49	Hanger Ceiling & Wall Insulation	--	4,036	20,201	229,930	11.4	1.81
JW-53	Infrared Heating	--	580	2,903	38,861	13.4	1.04
JW-58	100% Outside Air for Building 4	--	610	4,932	257,759	N/A	0.19
JW-59	Condensate Return Line at DIO	10	6,209	31,076	163,699	5.3	2.65

Figure 1.1

SAVINGS/INVESTMENT RATIO (SIR) NON-HOUSING BY ECO

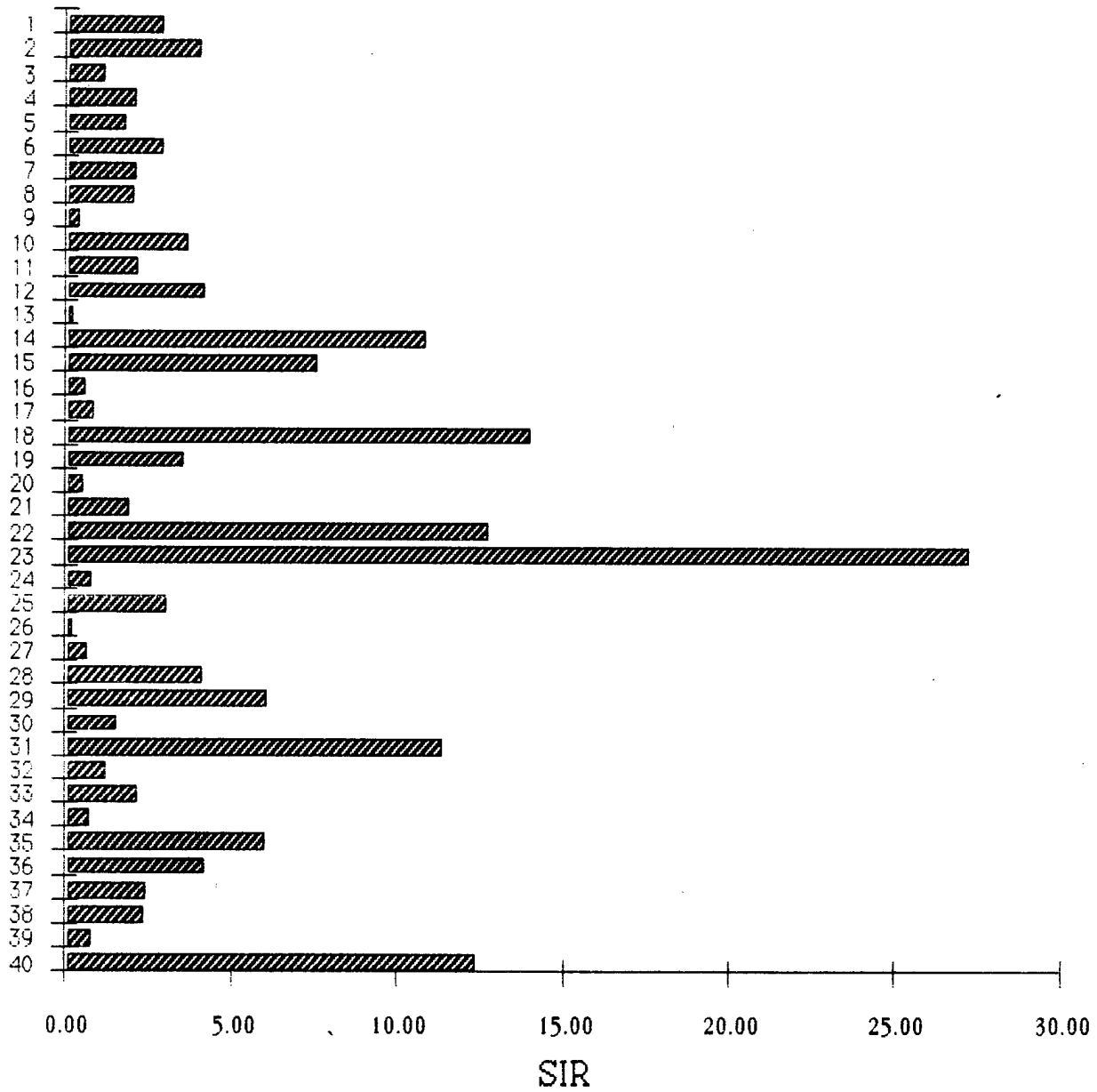


Fig. 1.1

SAVINGS/INVESTMENT RATIO (SIR) NON-HOUSING BY ECO

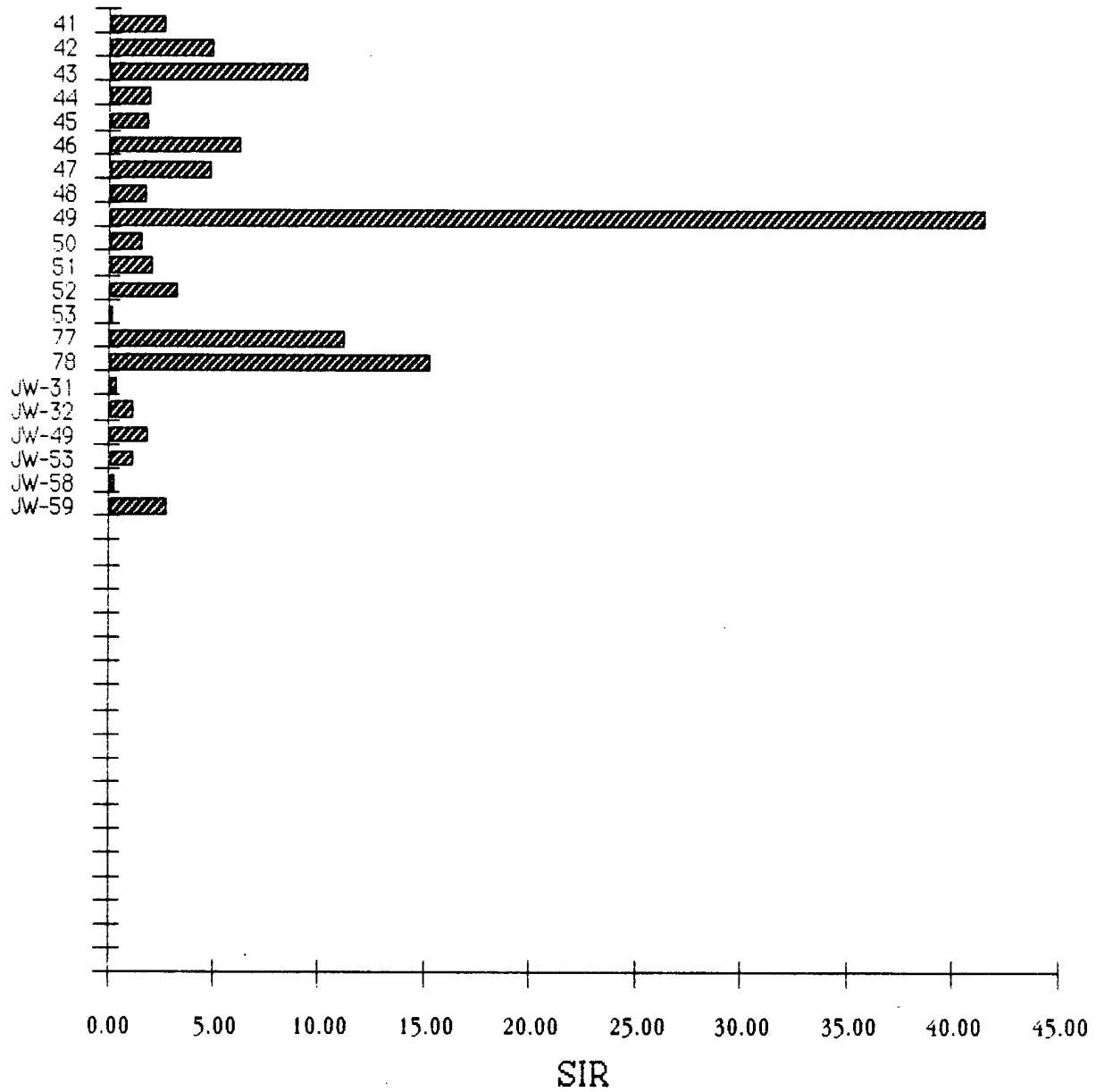


Figure 1.2

FIRST YEAR DOLLAR SAVINGS NON-HOUSING BY ECO

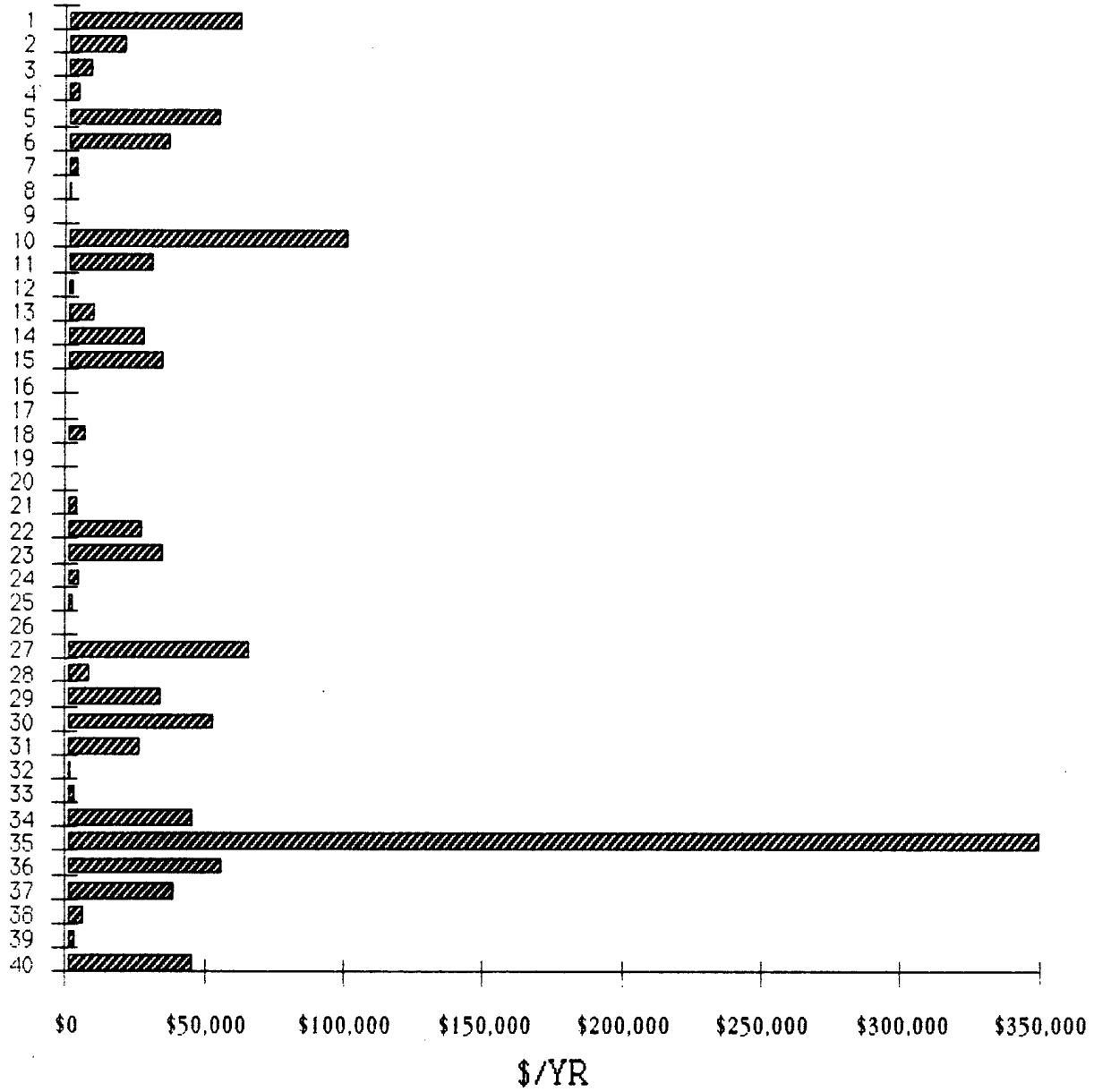


Fig. 1.2

FIRST YEAR DOLLAR SAVINGS NON-HOUSING BY ECO

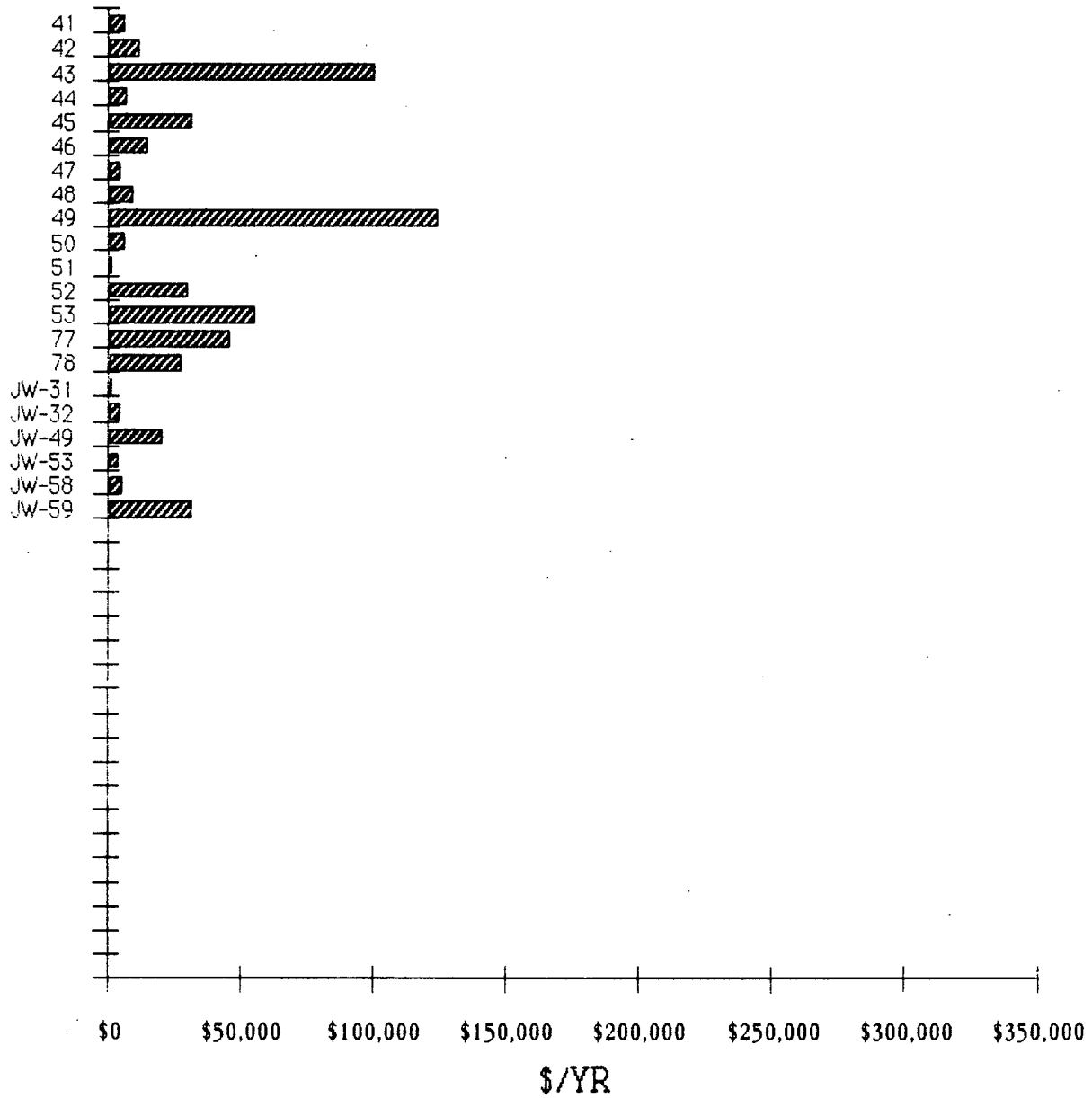


Figure 1.3

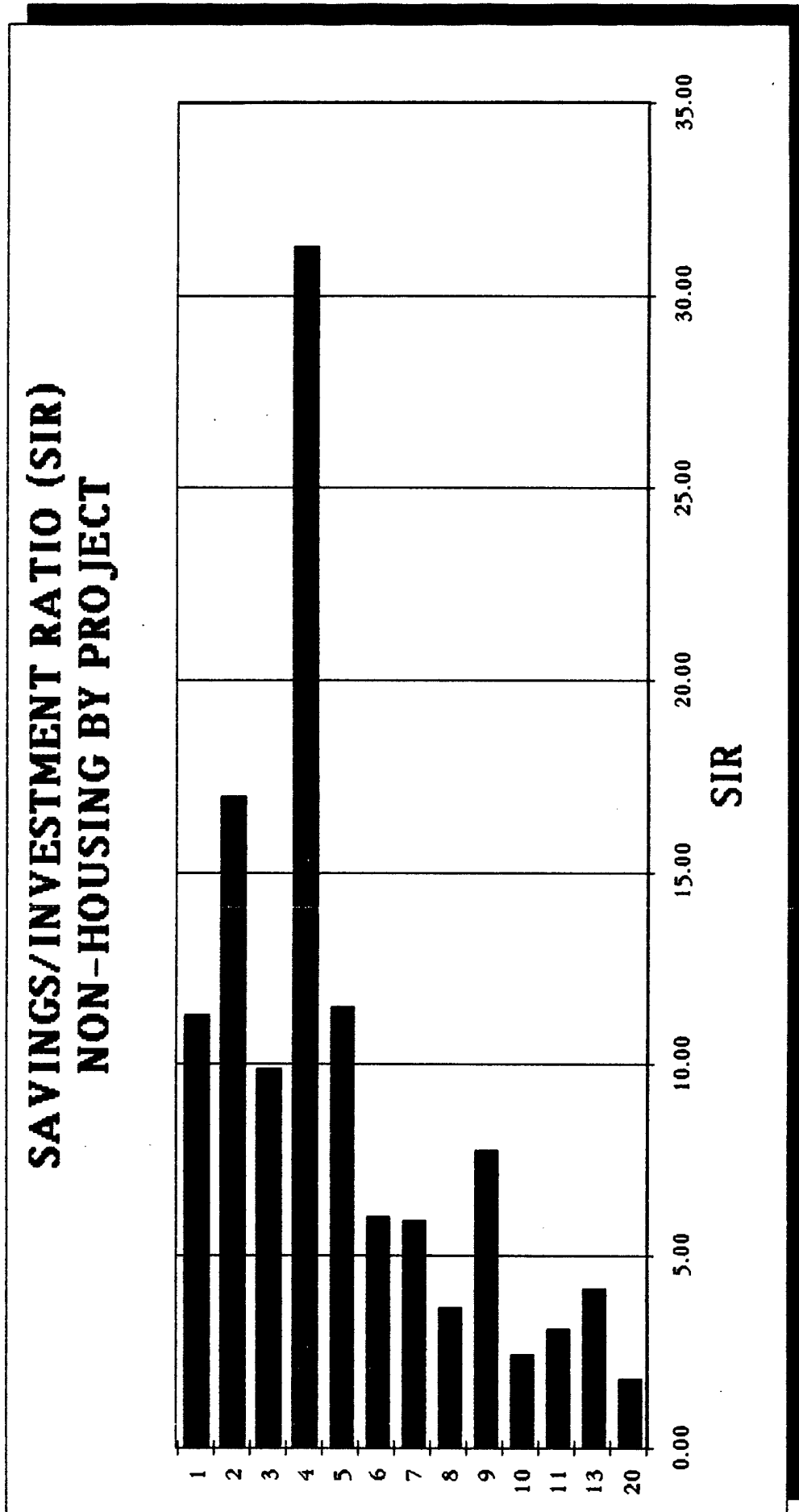
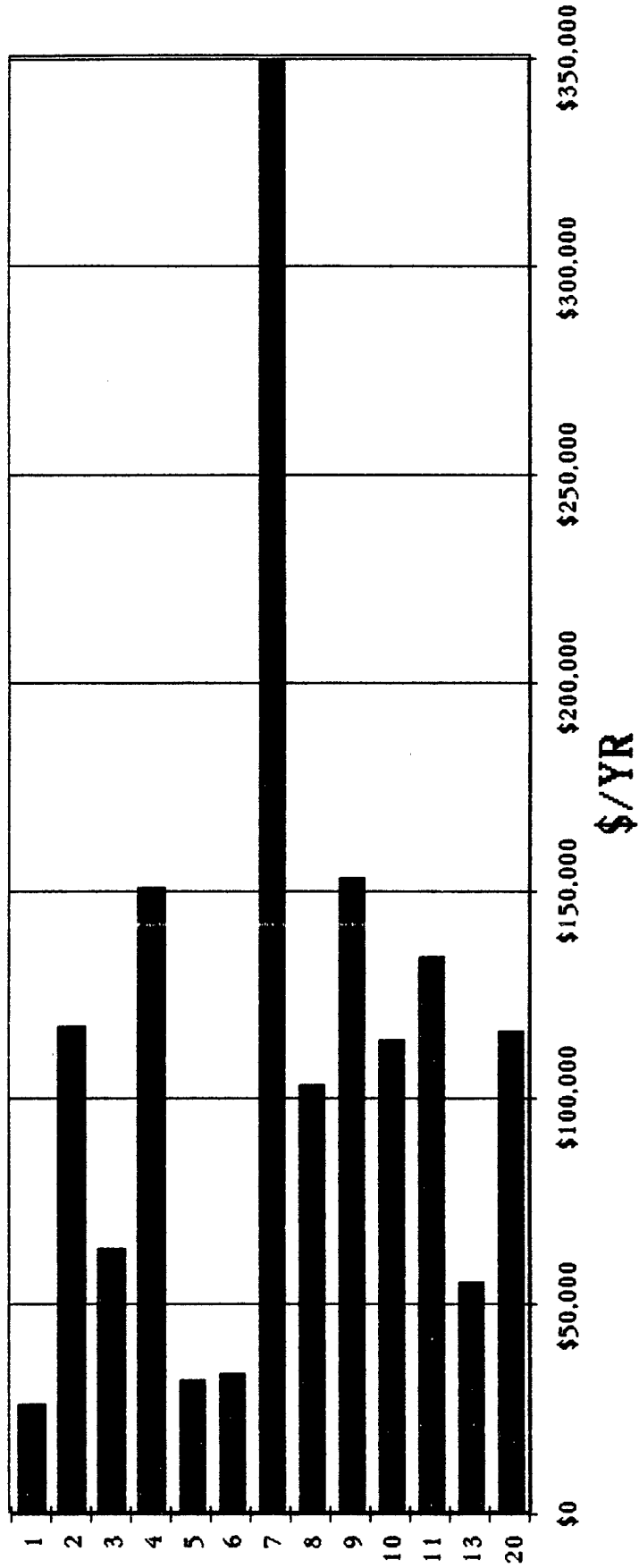


Figure 1.4

FIRST YEAR DOLLAR SAVINGS NON-HOUSING BY PROJECT



B. Family Housing

Of the 13 ECOs found to be applicable in family housing, 9 had SIRs greater than or equal to one and 8 have paybacks of less than ten years. These have been programmed as six projects. Figure 1.5 on page 18 illustrates the SIRs for all 13 ECOs and is ranked by ECO number. Table 5 on page 17 provides ECO names and numbers, and other important data.

The SIRs range from nearly 9 to less than one. The top two ECOs have SIRs above 8.0 and paybacks less than three years. These ECOs, too, are fairly simple, direct, straight forward and low-tech, which means easy implementation.

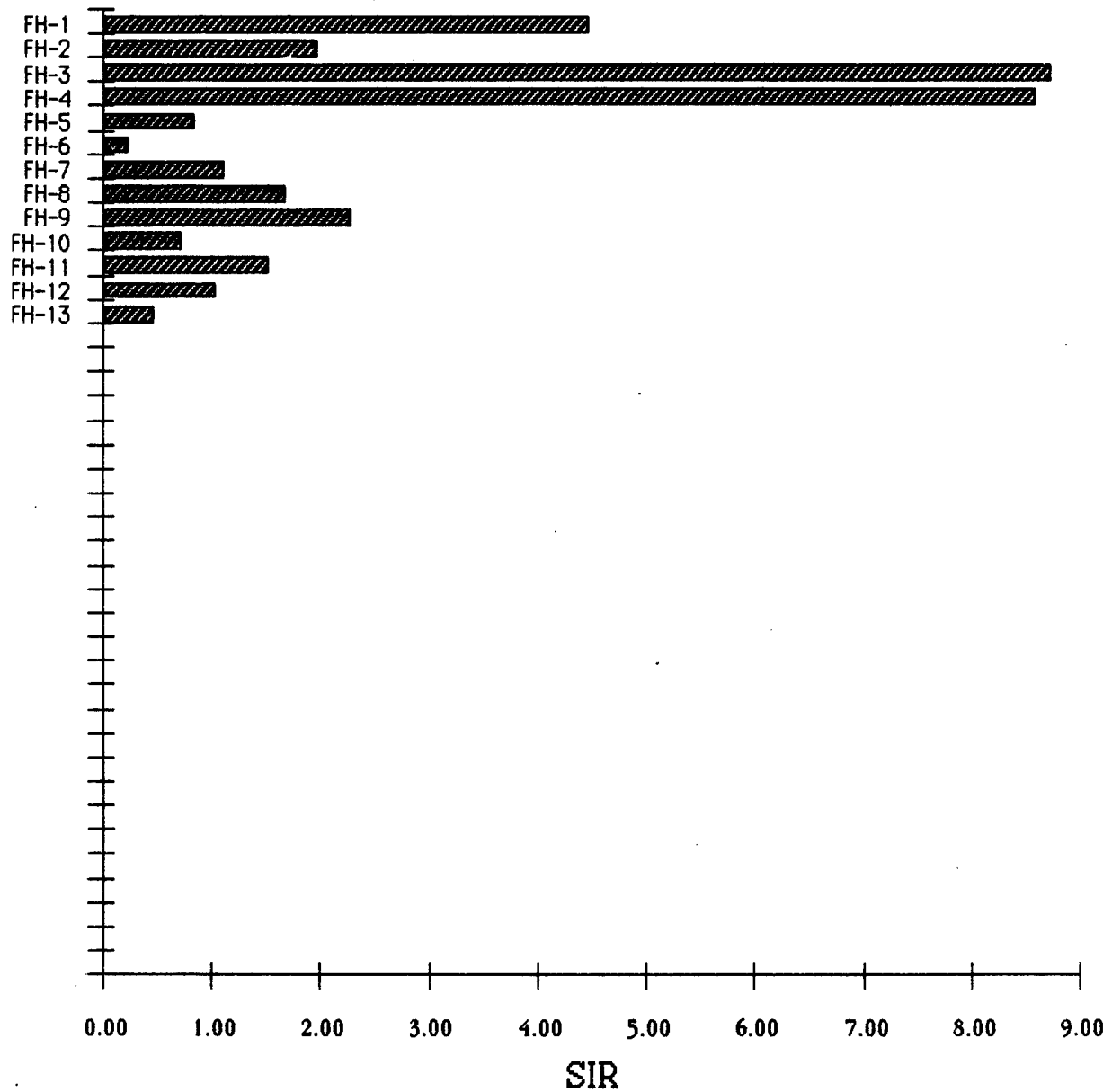
Figure 1.6 is similar to 1.5 but shows "first year dollar savings" for each ECO. This figure shows that the most dollar savings don't always come from the ECOs with the highest SIRs. Figures 1.7 and 1.8 illustrates SIRs and dollar savings by Project. Project 17 is PECIP; the rest are ECIP.

TABLE 5

**SUMMARY OF FAMILY-HOUSING ECOs
FORT BENNING, GA**

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr.	First Yr. Dollar Savings \$/Yr.	Total Cost \$	PB Period Yrs.	SIR
FH-1	Ceiling/Attic Insulation	14	92,211	485,917	2,178,064	4.48	4.44
FH-2	WS/Caulk Windows/Doors	19	42,887	255,768	2,492,342	9.74	1.96
FH-3	Low Flow Showerheads	17	14,646	101,203	216,761	2.1	8.70
FH-4	DHW Pipe Insulation & Heat Traps	17	17,208	86,127	207,164	2.41	8.56
FH-5	Insulation on DHW Unit	--	5,318	26,618	316,110	N/A	0.81
FH-6	New Condenser/Compressor	--	3,578	46,335	2,119,651	N/A	0.21
FH-7	Whole-House Fan	16	579	4,683	44,004	9.40	1.08
FH-8	Lamp Retrofit Incand. to Fluor.	15	12,139	44,349	419,409	9.46	1.66
FH-9	Fixture Retrofit - Incand. to Fluor.	15	1,620	18,853	107,380	5.70	2.27
FH-10	Solar Film	--	4	53	635	N/A	0.70
FH-11	Furnace Retrofit	18	175,006	875,905	8,144,910	9.30	1.50
FH-12	Storm Windows	--	10	49	672	13.67	1.01
FH-13	Electric Spark Pilot Retrofit	--	4	18	383	N/A	0.45

SAVINGS/INVESTMENT RATIO (SIR) FAMILY-HOUSING BY ECO



FIRST YEAR DOLLAR SAVINGS FAMILY-HOUSING BY ECO

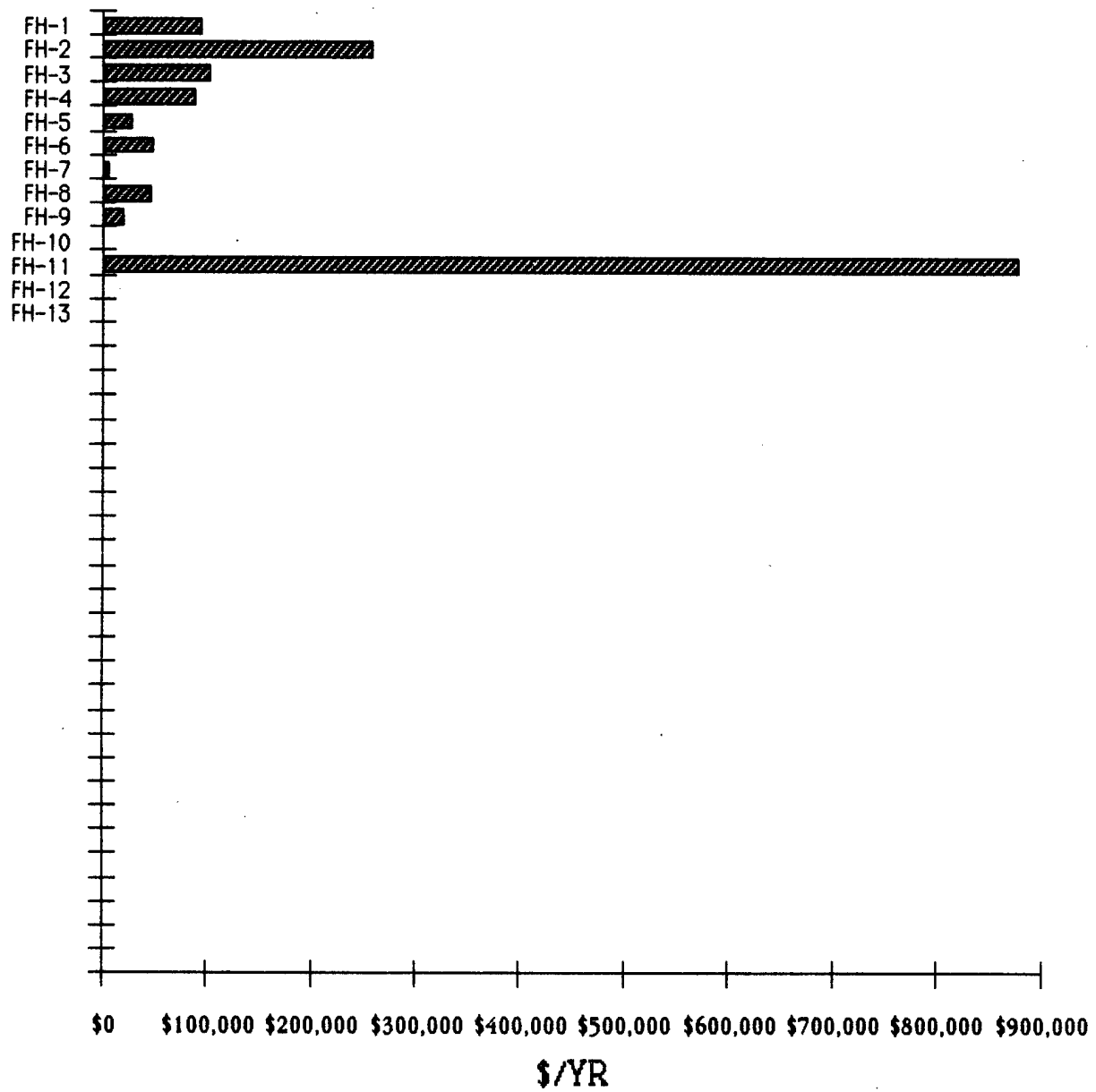


Fig. 1. 7

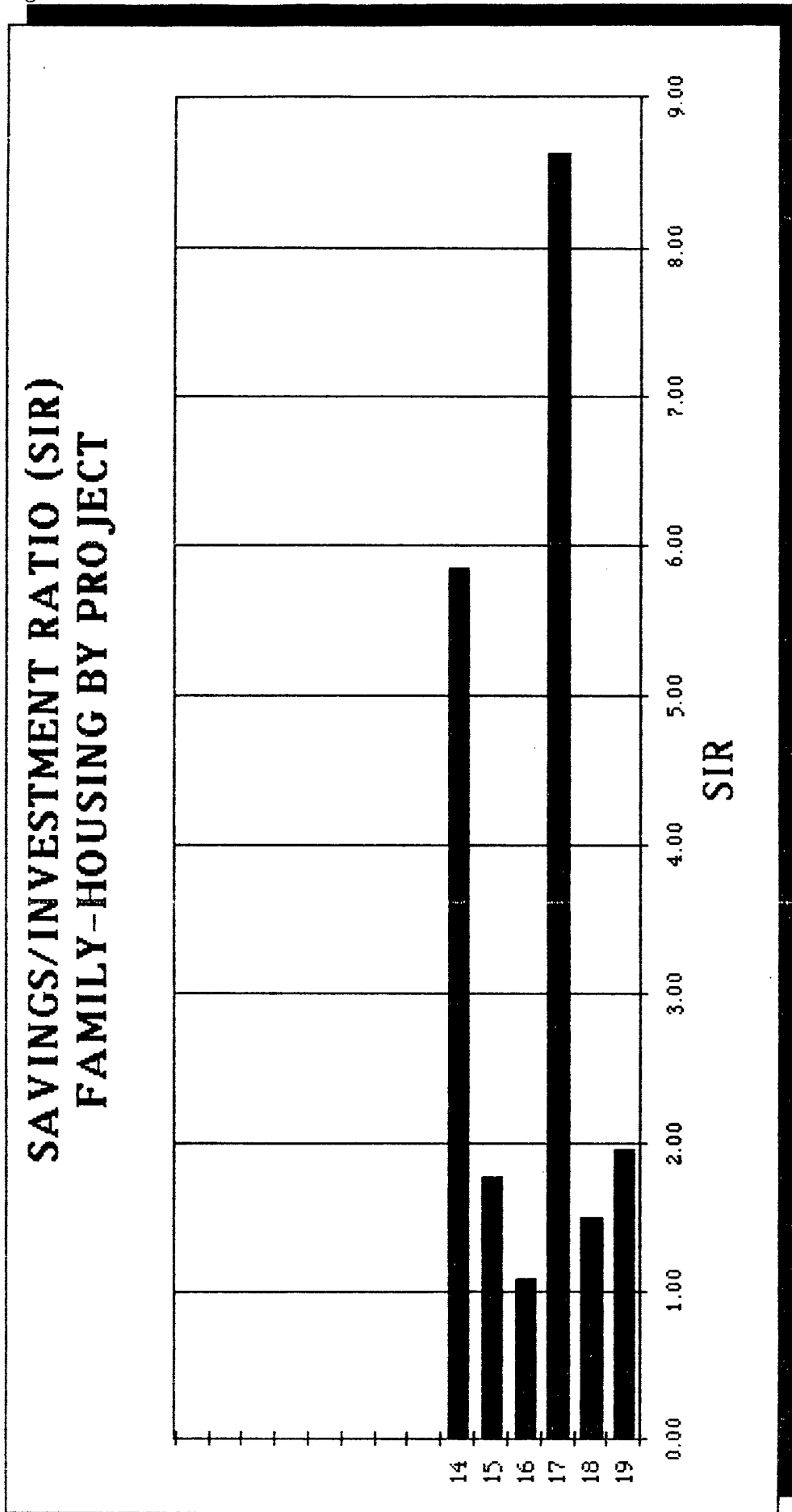
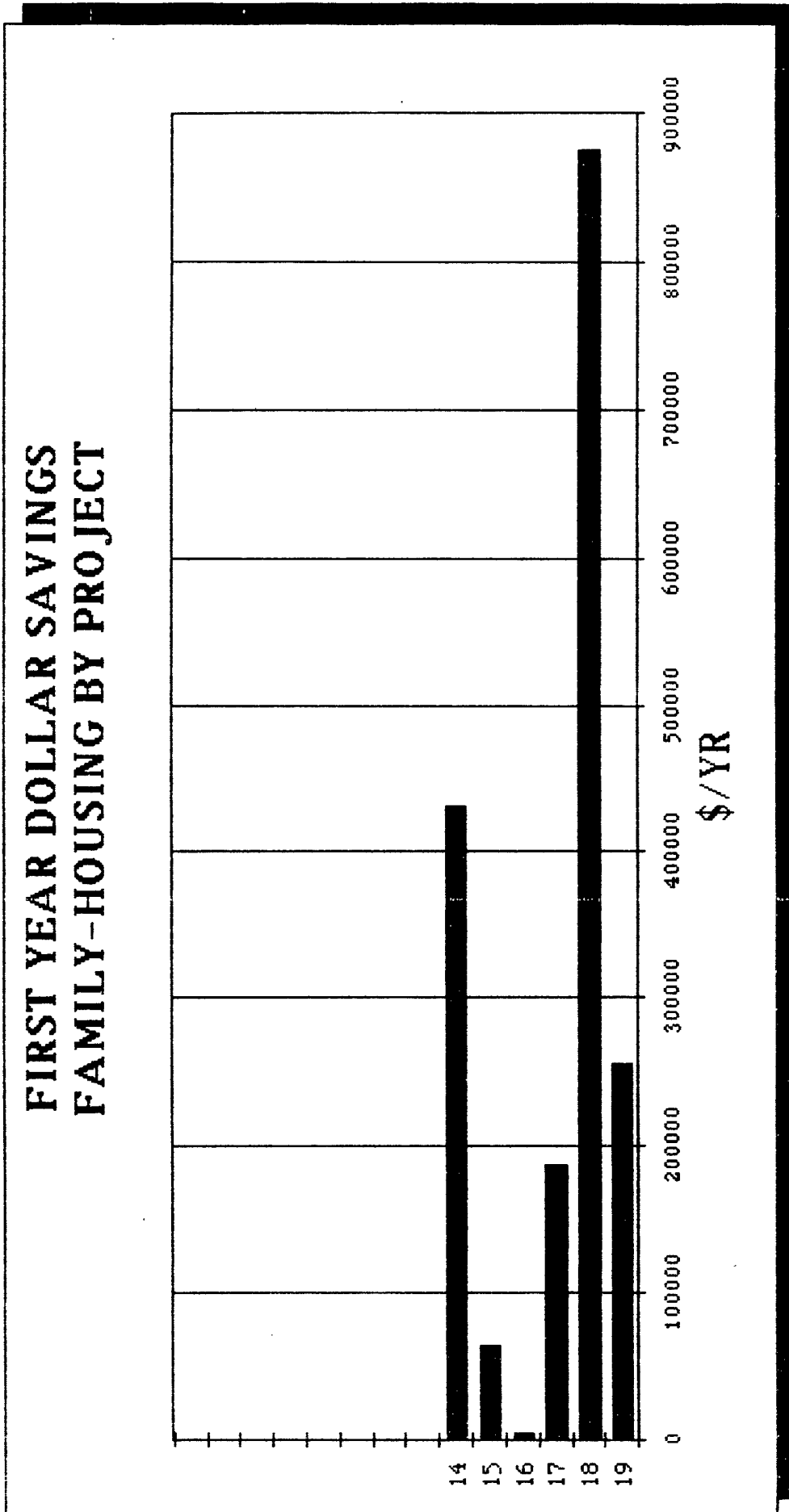


Fig. 1. 8



III. PROJECT SCOPE

Criteria for the study and the documentation have changed since the previous study was completed. The previous study was a basewide EEAP performed in 1979-80 by another AE. The ESOS is intended to re-evaluate selected projects from the previous study and to consider specific ECOs in buildings that may have been overlooked previously or recently identified.

A limited site survey of selected buildings or areas was performed to ensure that any new methods of energy conservation which are practical and have not been evaluated in any previous study have been considered and the results documented. Based upon the interim submittal comments, Heery prepared programming or implementation documentation for all recommended, feasible ECOs (SIR greater than or equal to one) and a comprehensive report on the work, results, and recommendations.

The emphasis in the Scope of Work (SOW) is on ECOs that are practical, appropriate, and not previously accomplished. Also, ECOs that can be eliminated from detailed analysis by a preliminary analysis shall be ruled out.

A "snapshot" approach is taken in this ESOS. In effect, everything is frozen in time, with the base year for this ESOS being 1986. Utility rates used were the previous full year's data available during the base year. For project programming, project costs were escalated to FY 89 per the SOW.

In preparing LCCAs and project packaging, Savannah ECIP Guidance was followed.

As stated in ASHRAE's Heating and Cooling Load Calculation Manual, page 7.1, "a load calculation is not an energy calculation," This is an important distinction when analyzing the ECOs and illustrates that other factors must be considered before drawing conclusions regarding building loads from the energy calculations developed in this report.

Synergistic Effects

All ECOs that use heating or cooling degree hours, or equipment efficiency data in their calculations presume that eight "primary" ECOs, listed below, were implemented first. The eight are ECOs that would affect equipment operating hours or equipment efficiencies. The eight primary ECOs are:

- 14 Damper Controls
- 22 Time Control of HVAC
- 23 Outside Temperature Control of Space Heating
- 24 Thermostatic Control Valves
- 35 Replace Absorption Chiller
- 36 Replace Turbine Drive Chiller
- 37 More Efficient Boilers
- 49 FM Control for HVAC

The eight were chosen because they would cause interactions with other ECOs. In the event that two or more of these were being evaluated for the same building, each one assumed that the other ECO was in place, to account for interactions.

IV. SUMMARY

The number and type of ECOs found applicable or feasible at Fort Benning were numerous because of the great variety of the buildings surveyed. The ages and types of buildings surveyed were also very diverse, ranging from 1920 vintage with central steam heat to 1980 vintage with modern HVAC running on high temperature water.

The total of energy savings from all programmed family housing ECOs is 346,000 MBTU/year and \$1.8 million/year. With a total cost of \$13 million this yields an average payback of 7.2 years and an average SIR of 5.1.

The total of energy savings from all programmed non-housing ECOs is 273,000 MBTU/year and \$1.5 million/year. With a total cost of \$4.6 million this yields an average payback of 3.0 years and an average SIR of 2.4.

Some very fast payback projects have been developed in this report for Fort Benning. These should be implemented as quickly as possible.