INDUSTRIAL ENERGY RETROFITS - AN UNDERUTILIZED RESOURCE

Alexander J. Willman
ACEC Research & Management Foundation

BACKGROUND

The impressive reduction in energy use over the past 10 years in the industrial sector is well known to have exceeded the energy reduction in the commercial and residential building sector. One of the ways this has been accomplished is the retrofit of existing manufacturing buildings and processes. To increase the knowledge base of the many innovative techniques which have been applied, the American Consulting Engineers Council Research and Management Foundation (ACEC/RMF) has conducted a wide review and compilation of state of the art industrial retrofit technologies. This summary will review the data collection methods employed and the ways in which the results of this major effort have been compiled and disseminated.

INDUSTRIAL RETROFIT DATA COLLECTION

Rather than a global effort to collect all types of industrial energy retrofit data, ACEC/RMF focused its project on specific, high opportunity industrial subsectors. In concert with the recommendation of experienced industrial consulting engineers, three industry subsectors (SIC, Standard Industrial Classification) were selected: SIC 20 (Food and Kindred Products), SIC 22 (Textile Mill Products), and SIC 30 (Rubber and Plastic Products).

The method of data collection for each SIC was to seek information which was up to date, industry-accepted, and cost effective. This necessitated a dual approach:

- Finding the best data from government sources
- Obtaining reliable data from documented industry sources

Government Data Sources

The most prolific source was the DOE sponsored Energy Analysis and Diagnostics Centers (EADC) program, managed by a university research center. This program, in existence since 1980, provides free one day industrial energy audits to small and medium sized industries in a specific radius of the auditor. University professors are the designated industrial energy

auditors, and their unbiased reports to the plant management were an excellent source of data for the three industries under study.

Figure 1 provides the three year results of energy conservation opportunities (ECOs) recommended and implemented in seven different industrial retrofit technologies. It is worth noting that the process equipment changes were the largest cost savings recommended, but significantly smaller in terms of number of ECOs referenced.

Industry Data Sources

Data from the three industries was obtained from a variety of sources via engineering firms which were very familiar with the three particular industrial subsectors. This data included specific case studies documented in industry trade journals, personal communication with plant managers, discussions with equipment suppliers, and individual experiences from company files. This step yielded positive results of varying quality.

DATA COMPILATON AND DISSEMINATION

The approach chosen to clearly provide the results of this collection exercise was two fold:

- Analyze and document the specific industrial retrofit processes and successful strategies applied
- Assemble a diverse audience of engineering educators who could use the results of this effort as new material for students

Industrial Retrofit Documents

Three separate volumes were assembled, one for each SIC, to accurately describe the industrial processes and the myriad opportunities for industrial retrofit. Each book included graphic process flow diagrams of a typical industrial process within each SIC, and then described the many examples from both the public and private sector data collection effort.

Engineering Education Program

A three day working forum was held for professors of engineering, with the purpose of providing them with a variety of resources to use in structuring courses on the topic of industrial energy management. All participants were given copies of the industrial energy retrofit books. To heighten their perception of retrofit opportunities, the participants viewed a video industrial energy audit and were required to detect and document their recommendations of specific industrial energy retrofit strategies.

Table I. ENERGY CONSERVATION AND COST SAVINGS IMPLEMENTED AND RECOMMENDED FOR EACH ECO TYPE

1981-83 EADC PROGRAM

MAJOR GROUP	SUBGROUP	DESCRIPTION	IMPLEMENTED			RECOMMENDED		
			NO. OF OCCURRENCES	ENERGY CONSERVATION (BTUx10 /yr.)	COST SAVINGS ($/yr.)	NO. OF OCCURRENCES	ENERGY CONSERVATION (BTUx10 /yr.)	COST SAVINGS ($/yr.)
10 Combustion	11	Equipment efficiency: operational	146	229,245	867,944	174	296,800	1,065,451
	12	Equiptment maintenance & replacement	11	21,569	99,993	16	30,045	139,774
	13	Combustion heat recovery	31	113,296	553,727	54	199,039	868,796
	14	Combustion heat confinement	43	23,609	91,964	69	36,103	135,764
	Total		231	407,719	1,613,628	313	561,989	2,209,785
20 Steam	21	Steam system equipment upgrade/repair	83	139,982	528,232	94	146,385	549,008
	22	Steam system changes	5	15,529	51,432	7	16,926	57,906
	Total		88	155,241	579,664	101	163,311	606,914
30 Other Utilities	31	Electricity	91	2714	435,699	106	2834	588,183
	32	Compressed Air	190	32,479	368,151	238	36,793	417,584
	33	Water	8	4325	57,393	10	4953	61,964
	Total		269	39,518	861,243	354	44,580	1,067,731
40 Scheduling Shipping/ Handling	41	Equipment scheduling	81	89,871	503,793	117	102,168	680,892
	42	Plant scheduling	1	164	1843	2	-245	36,048
	43	Packaging, shipping, and handling	1	1079	9000	3	1604	13,043
	Total		83	91,114	514,636	122	103,527	730,343
50 Process Equipment and Process Changes	51	Equipment maintenance, repair, replacement	68	48,502	556,856	106	88,788	941,575
	52	Operations & Process design	16	21,443	111,478	23	28,274	163,237
	53	Specific process techniques	73	203,288	953,156	89	303,239	1,380,283
	54	Process heat recovery	63	320,419	1,375,695	82	379,424	1,757,041
	55	Process heat confinement	80	86,866	411,293	113	110,892	494,273
	Total		300	680,518	3,408,478	413	910,617	4,736,409
60 Buildings and Grounds	61	Lighting	378	94,952	1,368,798	487	112,224	1,619,983
	62	Space heating, cooling	404	389,331	1,772,001	532	498,603	2,392,952
	Total		782	484,283	3,140,799	1019	610,827	4,012,935
90 Alternate Fuels	91	Waste & byproducts as fuel	5	-70,321	620,829	8	-77,760	754,208
	92	Conversion to more efficient/economical energy source	23	33,897	514,280	40	53,159	787,038
	93	Cogeneration	-	-	-	2	64,480	584,582
	94	Solar energy	1	93	826	1	93	826
	Total		29	-36,331	1,135,935	51	39,972	2,126,654