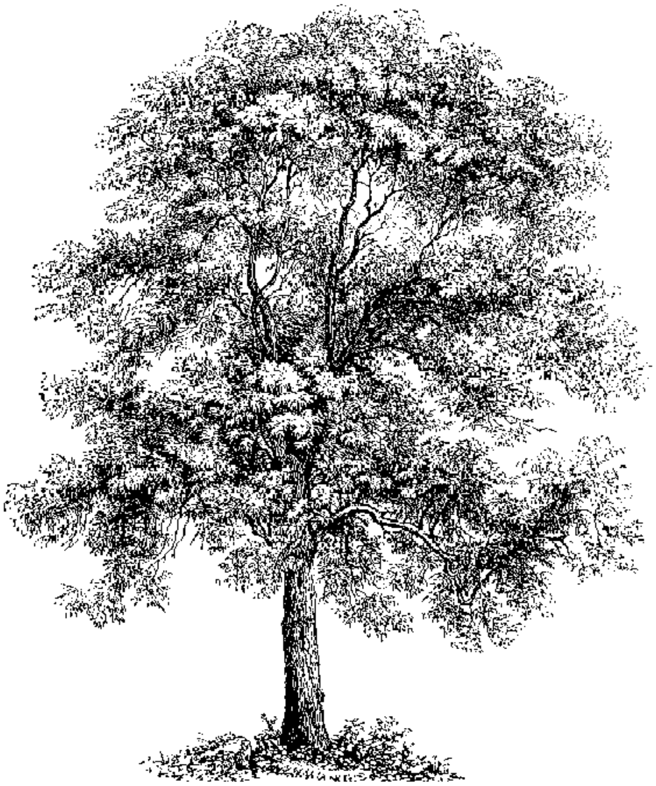

The DOE Industrial Assessment Database

User Information
Version 8.2

Sponsored By:
US Department of Energy
Office of Energy Efficiency and Renewable Energy
Industrial Technologies Program

Original Version: April 1993; Updated Version: July. 2004
Michael R. Muller - Director
Fred W. Glaeser

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

The Center for Advanced Energy Systems
Department of Mechanical and Aerospace Engineering

Disclaimer

This document is intended to supplement the DOE sponsored Industrial Assessment Center Program database. The database is now available for public distribution at no cost via Internet access through the Office of Industrial Productivity and Energy Assessment located in the College of Engineering, Rutgers University. CAES maintains this database under contract with the U.S. DOE. This data is available at no charge and no warranty with respect to the accuracy, completeness, or usefulness of the data is expressed or implied. The database will be updated regularly as additional data becomes available. This document may be reproduced and freely distributed.

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What's New for Version 8.2

On-Line Database Access

New "Interactive Database Page" that contains an assessment search engine and recommendation search engine that allow for many ways to search and contain pop-ups to help the user. Constantly being updated, the searches provide answers to common questions without having to download the data files and manipulate the data on a local computer. Also contained in this page is glossary of terms, a top ten list, recommendation index, industry index and much more.

The office of Industrial Productivity and Energy Assessment (OIPEA) has become The Center for Advanced Energy Systems (CAES).

Updated the list of contributing universities

The list now includes the 8 new schools added in Fiscal Year 2001.

Field Size Changes and additions

ASSES###.DBF
- "comments" field changes from 240 character to 250 character length.
- "tdays" added assessment days field
- "naics" added The North American Industry Classification System field

RECC####.DBF
- "descript" field changed from 72 character to 150 character length.
- "imp-comm" field changes from 120 character to 200 character length.
- "ic-capital" added the capital (equip. & material) cost of a recommendation.
- "ic-other" added implementation costs that are not capital costs.
- "p3-ees" added effective energy savings resulting from an improvement in energy efficiency.
- "payback" added Payback period for recommendation.

Added section "7.4.3 Primary Product with improvement in energy efficiency – P3.

Acknowledgements

The authors would like to acknowledge the support of the Office of Energy Efficiency and Renewable Energy of the US Department of Energy for producing this manual. **Ms. Sandy Glatt**, program manager for the IAC program, is also acknowledged for her continuous support of our efforts.

The authors would also like to recognize previous contributors to this work- **Donald J. Kasten** and **Michael B. Muller.**

1. Program Introduction

1.1 The IAC Program

The U.S. Department of Energy (DOE) has been funding industrial energy assessments for small and medium sized manufacturing firms under the auspices of the Energy Analysis and Diagnostic Center/Industrial Assessment Center (EADC/IAC) program since 1974. In October 1995, the centers were tasked to perform only industrial assessments and the name of the program officially changed to the Industrial Assessment Center Program. The IAC program is directed by Charles J. Glaser of the Office of Industrial Technologies. The assessments are performed by teams of faculty and students from accredited engineering schools at universities and have resulted in more than 12,000 assessments and 87,500 recommendations. “Industrial Assessment” centers now target waste streams and productivity improvements in addition to the traditional energy streams.

The IAC program not only benefits the manufacturers served, but it also provides a unique opportunity for the students involved in the program to see a range of manufacturing processes. The government has been able to provide direct support to small and medium sized manufacturers, which in turn, become more profitable through increased energy efficiency and pollution prevention measures and therefore pay more taxes, and in the process, underwrite the program.

The program is very specific about what plants qualify for these assessments; it is directed at the small and medium size manufacturers. Large manufacturers are expected to be able to fund such studies independently, through the consulting industry, and the scope of the assessment being necessarily limited would result in an unacceptably sketchy review of plant operations if large plants were selected as clients. The audit is available for all types of manufacturing provided the plant's products are within the standard industrial classification codes 20 through 39 and the facility is located within a reasonable distance of the host campus. The plant must also meet the following criteria:

- Have gross annual sales of $100 million or less
- Consume energy at a cost greater than $100,000 and less than $2 million per year
- Employ no more than 500 people
- Have no technical staff whose primary duty is energy analysis

The current IACs are located strategically around the country.

1.2 IAC Program Participants

Twenty-six universities currently contribute to the IAC Program. Of these 26 schools, 20 are state universities and 6 are private institutions. Schools become active program participants via response to an open solicitation of all ABET accredited universities with engineering programs. A complete list of current participating schools and schools contributing in the past is included in the section entitled "University Contributions".

Using the database developed from the assessments (discussed in detail below), the characteristics of the clients served by the IACs can be studied. Certain industries, such as food products or fabricated metals, have a much higher presence in small and medium sized manufacturing operations than the pulp and paper industry or petroleum refining.

1.3 CAES/OIPEA

Rutgers, the State University of New Jersey participated directly in the Energy Analysis and Diagnostic Center Program as an EADC from 1987-92. Professor Michael Muller established this EADC to provide mechanical engineering outreach to small and medium size industries within one hundred and fifty miles of Piscataway, NJ. One hundred and sixty five assessments were performed by the Rutgers EADC.

The Office of Industrial Productivity and Energy Assessment was established by Rutgers University in 1992 as furtherance of the Universities' commitment to community service by helping the industry with energy, waste, pollution prevention and productivity issues. In 2002 OIPEA became "The Center for Advanced Energy Systems – CAES". Its mission is to provide a range of engineering extension services to the community through the creation and maintenance of partnerships among government, business, interest groups, and educational facilities. As a result of this effort, CAES now contracts with the DOE to participate in field management of the IAC program. Additionally, since 1992, management of the Industrial Assessment Database has been the responsibility of CAES. The CAES is part of the Department of Mechanical and Aerospace Engineering located in the School of Engineering on Busch Campus in Piscataway, New Jersey.

Under the direction of Dr. Michael R. Muller, database operations have been updated and automated to the point where information becomes available to the public within days of receipt by Rutgers. Data transfers are now handled electronically and the information contained within the database is the responsibility of the IAC which produced the report and associated data upload.

Some of the most important benefits of the activities of the programs ongoing at the CAES are harder to quantify but define some of its unique benefits and provide a rationale for its existence at a major state university. In addition to the technology transfer, one of the major goals of the university based technical assistance programs like those managed by the CAES is to train students in practical aspects of mechanical engineering for manufacturing.

A major benefit of Rutgers' role in participating in various federal and state programs is the access it gives to policy makers on several levels. In the recent past Professor Muller has testified before congress, worked with the Office of Technology Assessment (of the Congress) on technical assistance program issues, attended several White House Conferences, sat on numerous government panels, addressed national meetings of state energy officials, and served as a member of the peer review group for EPRI's Industrial Programs.

Most state universities have, as part of their charter, a service mission to their states and communities. While service takes many forms, technical assistance is very common. Most schools also have an active program in continuing education. The development of agricultural extension services either located at or coordinated by the state university has also occurred in most states. Engineering extension services are less well developed. Some schools have adopted a model similar to the agricultural extension whereby an engineering extension faculty is identified, separate from the academic faculty, and charged with performed a variety of extension services.

The engineering extension model being adopted at Rutgers through the CAES is different. Faculty involved are normal tenured professors with active research programs, teaching and other normal duties. By devoting only part of their efforts to extension work, the impact is clearly reduced. But the technical challenges of industry today are so sophisticated as to require such highly qualified people to staff the program. Critical, expensive decisions often result from recommendations made by university personnel and it is imperative that the university insure that the highest quality information is provided. This is requiring a change of attitudes at universities and Rutgers is leading the way. It is likely that accountability will become an important issue at state schools in the near future and operations like the CAES will add important contributions to the overall "deliverables" of the university.

For more information about CAES, please contact:

The Center for Advanced Energy Systems

School of Engineering, Rutgers University

Piscataway, NJ 08854-8003

Voice: (732) 445-5540 Fax: (732) 445-0730

email: database@caes.rutgers.edu

2. Program Components

2.1 The Industrial Assessment Process

Industrial assessment clients may be located by a Center as a result of direct solicitation, client referral, or contact via business associations and trade groups. An extensive data gathering function ensues during which energy/waste bills are screened and the potential client is qualified. Clients must meet criteria concerning energy usage, plant size, geographical location, and number of employees. Next the University's professor led team normally performs a one day site visit at an industrial plant. The visit entails discussions with plant management, plant tours, and measurement of various operational parameters.

Following the site visit, the assessment team prepares a written report for the manufacturer which includes information about the plant's energy use, processes, waste handling and other operations. In addition, each report contains several specific recommendations (termed Assessment Recommendations or ARs) written up with sufficient engineering design to provide for anticipated savings, implementation costs, and simple payback. Data from this report is also formatted into a spreadsheet boilerplate that is transmitted electronically (uploaded) to the database managers via the Internet for inclusion in the program database.

Following an appropriate interval (usually between six and nine months) the IAC again contacts the manufacturer to follow up on the recommendations made in the report to determine the level of implementation. Implementation reports are also formatted to boilerplates and electronically transferred for inclusion in the program database (for more information regarding data uploads by centers, see the section entitled "Data Uploads").

2.2 The IAC Database

Another benefit derived from the program is the provision of a unique opportunity to quantify the effectiveness of energy management issues, pollution prevention measures, and productivity enhancements in small and medium sized industry. Since 1980, the data resulting from the assessments performed under this program have been collected into a database which is available to the general public. This data is free of charge and available via computer network (see "Accessing the Industrial Assessment Database") through the Office of Industrial Productivity and Energy Assessment (OIPEA) at Rutgers University (for more information about the IAC Program Database, see the section "Overview of the Database").

2.3 Supporting Documents

2.3.1 The Assessment Recommendation Coding System (ARC)

The ARC system was devised in late 1993 by OIPEA in response to program needs for systemic categorization of assessment recommendations present in the program database. Center personnel choose the appropriate classification numbers for their recommendations. Design flexibility incorporated within this expert system allows for adaptations meeting the growing assessment foci in areas such as pollution prevention and total quality management.

The ARC system is updated continually as new concepts and ideas are advanced by center directors and other experts in the field. The ARC manual containing the classification codes is key toward interpreting information presented in the program database. A new ARC manual version has just been released to coincide with this database manual (version numbers should always be in agreement between the database and ARC manuals). As a living document, the ARC manual is available for download in Adobe's PDF format. To view and print the ARC manual, Adobe Acrobat Reader will be necessary which can be downloaded free of charge from Adobe's web site (www.adobe.com). The ARC system and manual may be copied and distributed without penalty.

2.3.2 Boilerplates (Data Uploading Instructions)

Data transfer from the IACs to the database is accomplished through the usage of standardized boilerplates. Boilerplates exist for each of the two main transfer operations: assessment and implementation reports (two boilerplates are uploaded per IAC assessment). Boilerplates are updated when major program data requirements are altered.

In an effort to accommodate users of all computer platforms, boilerplates begin as either spreadsheet documents or tab delimited text formats residing in the /export/iacs/boilers directory on the OIPEA/Rutgers node (camp.rutgers.edu). Blank and/or worked example documents can be downloaded by IACs on an as-needed basis. Data is then entered into specific locations or place holders in the boilerplates by IAC personnel before electronic transmittal to OIPEA for inclusion in the database.

2.3.3 Others

Periodically reports, papers and analysis are prepared from the database. Some of these items are made available on the OIPEA web site (oipea-www.rutgers.edu).

3. Overview of the Database

The data is appended to the database using MS Visual FoxPro. FoxPro is one of the fastest and most capable database managers and is available for both Macintosh and Windows computers, however, FoxPro is not needed to manipulate the data. Other database handlers like MS Access which can read standard DBF files. FoxPro uses Xbase language, one of the most popular database languages in the world. The records that store data, are fixed length, thus making all different manipulations much faster than if they were variable length. As explained below, we are really talking about two databases which are relational. Different information can be easily extracted making the database excellent dynamical tool for the users.

3.1 Database Contents

The database currently contains information collected from virtually every state within the continental United States representing over 12,000 industrial site visits and 87,500 Assessment Recommendations from thirty six contributing centers. Portrayed within the database, $1B in savings identified since 1980 and an implementation rate of nearly 50% of these recommendations illustrate the core success of the IAC Program.

Database fields include items such as SIC codes, production and sales figures, resource conservation, and implementation costs. A complete description of the fields in the database are found in the section "Database Structure".

3.2 Document Version Numbers

The database and associated documentation are classified and related through group version numbers. The database is numbered as follows: ASSESxxy.DBF (or RECCxxy.DBF), where the first two digits, xx, represent the current version and the third digit, y, reflects minor revisions. For example, consider the database coded ASSES042.DBF. The "04" represents the overall structural version, where the "2" represents a minor change in the database. This is in essence version 4.2 of the database. This is representative of all database documentation: the Database Manual, ARC Manual, assessment boilerplate, and implementation boilerplate. From the examples, it can be seen that the number "4" is the relating version number.

3.3 Data Compression

To facilitate transfer of the data over the Internet, the files have been compressed using commonly PKZip. Expansion of the documents is recommended when approximately 50MB of hard disk space is available (compressed files are less than 7MB each).

3.4 University Contributions

The following table gives a current breakdown of the contributions of the various IACs to the database.

Abbr.	University	First FY	Last FY	First Report No.	Last Report No.
AM	Texas A&M - College Station	87	04	1	473
AR	Univ. of Arkansas - Little Rock	93	00	1	197
AS	Arizona State University	90	04	1	390
AT	North Carolina A&T	85	89	1	126
BD	Bradley University	94	04	1	273
CO	Colorado State University	84	04	1	554
DS	South Dakota State University	94	00	1	175
GT	Georgia Tech Research Institute	82	04	110	792
HO	Hofstra University	91	00	1	238
IA	Iowa State University	91	04	1	356
IC	University of Illinois - Chicago	01	04	1	91
LE	Lehigh University	01	04	101	202
LL	Louisiana University - Lafayette	01	04	101	208
LM	Loyola Marymount University	01	04	1	84
KG	Texas A&M - Kingsville	94	97	1	100
KU	Kansas University	81	00	16	554
LT	Louisiana Tech	84	89	1	144
MA	University of Massachusetts	84	04	1	565
ME	University of Maine	93	00	101	305
MI	University of Miami	01	04	101	262
MO	University of Missouri - Rolla	90	00	1	295
MS	Mississippi State University	94	04	1	262
NC	North Carolina State University	93	04	1	301
ND	Notre Dame University	91	00	1	366
NV	University of Nevada	94	00	1	170
OD	Old Dominion University	94	00	1	175
OK	Oklahoma State University	82	04	17	697
OR	Oregon State University	87	04	1	470
TP	Prairie View A&M	99	00	1	19
RU	Rutgers, The State Univ. of NJ	87	92	1	165
SD	San Diego State University	91	04	1	352
SF	San Francisco State University	93	04	1	294
SU	Syracuse University	01	04	101	197
ST	Stevens Institute of Technology	84	86	1	80
TA	University of Texas - Arlington	01	04	1	87
TN	University of Tennessee	81	00	102	696
TS	Tri-Cities University	84	85	1	33
UD	University of Dayton	81	04	16	702
UF	University of Florida	91	04	1	352
UL	University of Louisville	94	00	101	249
UM	University of Michigan - Ann Arbor	94	04	1	271
UU	University of Utah	01	04	1	67
WI	Univ. of Wisconsin - Milwaukee	87	04	1	480
WV	West Virginia University	93	04	1	307

Table 1. University Contributions To The IAC Database

4. Accessing the Industrial Assessment Database

The Industrial Assessment Database, stored in a computer located At The Center of Advanced Energy Systems at Rutgers University, is offered to the general public at no charge. The database is available for download to any computer via the World-Wide Web. Please, contact **database@caes.rutgers.edu** for information.

4.1 World-Wide Web (WWW)

Database access has been made available to Internet travelers via the World-Wide Web (W3). The World-Wide Web provides users from various operating systems the ability to access and transfer text, sound, images, and files across the internet. By selecting (clicking) key words or images, hyperlinks are established internally to directories and files or externally to other systems.

Netscape and MS Internet Explorer are two popular web browsers. They are user friendly and everybody can become efficient in a very short time. CAES has created its own world wide web site for database access with the Uniform Resource Locator (URL):

http://www.caes.rutgers.edu

Web users can transfer data anonymously eliminating the need to contact OIPEA for a guest account. Of course, users are still encouraged to reach out to OIPEA for support or assistance when necessary. The OIPEA-WWW site will continually be updated as cutting edge developments occur striving to keep the IAC database access “state of the art”.

4.2 On-Line Access

New to the CAES web site is an area where users can go to and search the database without having to download the data files to their machines. Constantly being updated, the page contains queries such as database status, product search, IAC Locator, SIC search, assessment finder and a breakdown of audits performed by state. It contains some of the more common questions asked by users of the IAC Program database. Look for the link to the “Interactive Database Page” by following the link for the “Industrial Assessment Databases” on the home page.

5. Database Structure

Data from the Industrial Assessments performed under the DOE’s IAC program are contained in two separate databases made available to the public. The first file contains assessment specific data whereas the second file contains recommendation specific information. The wildcard ### refers to the version and release number (see the section entitled Document Version Numbers for more information).

The relationship between the two databases is based on the combination of the eadc_iac and repnum fields which together comprise the id field in the assessment database and a portion of the superid field in the recommendation database. To speed data transfer, most derived fields such as the id field in the recommendation data set have been left to the use.

5.1 ASSES###.DBF

Information pertinent to each individual assessment is found in this database. There is one entry per assessment.

The setup of the various fields in the ASSES database.

Field	Field Name	Type	W	Description
1	id	Character	16	Unique identifying number given to all records based on IAC Name and Report Number. This number is used when linking the two databases.
2	iac	Character	2	The identifier assigned to each IAC (see "University Contributions").
3	repnum	Numeric	4	The number assigned by the IAC to their visit and subsequent report.
4	visitdate	Date	8	The date the assessment was performed.
5	sic	Numeric	4	The Standard Industrial Classification that represents the principle product manufactured by the plant.
6	sales	Numeric	9	The annual sales in dollars for the site reported by the client.
7	employees	Numeric	4	The total number of employees on the site as reported by the assessment client.
8	plant_area	Numeric	7	The total amount in square feet of area used for production and office support purposes.
9	products	Character	72	Principle products of the plant (in words).
10	resources	Numeric	2	Total number of resources tracked at the plant.
11	produnits	Numeric	1	The units of production for the principle product (see "Produnits Coding").
12	prodlevel	Numeric	12	The total number of units produced annually as reported by the assessment client.
13	prodhours	Numeric	5	Client reported annual production hours.
14	numars	Numeric	2	The total number of ARs recommended in this report.
15	sourc_elec	Numeric	11	Energy consumed at source to produce consumed electricity at site.
16-42	----------	Numeric	---	The annual usage and cost of electrical consumption, electrical demand, electrical fees, natural gas, L.P.G., fuel oil #2, fuel oil #4, fuel oil #6, coal, wood, paper, other gases and others – taken from actual bills provided by the client prior to the assessment (see "Resource Identification Code").
43	nrgcosttot	Numeric	11	Total energy cost for this client. Figure is produced by summing energy costs reported in columns 15-38.
44-55	-----------	Numeric	---	The annual production and cost of waste: water disposal, non-hazardous liquid, hazardous liquid, non-hazardous solid, hazardous solid, and gaseous waste in dollars and waste stream units. (see "Resource Identification Code").
56	wstcosttot	Numeric	11	Total waste cost for the client. Figure is produced by summing the waste costs reported in columns 40-51.
57	comments	Character	250	General comments about the assessment.
58	fy	Numeric	4	The fiscal year in which the assessment was performed.
59	state	Character	2	The state in which the assessment was performed.
60	tdays	Numeric	3	The amount of days spent on site doing assessment
61	NAICS	Numeric	6	The North American Industry Classification System

Table 2. Fields in the ASSES### Database

5.2 RECC###.DBF

The Assessment Recommendations from each of the assessments found in the ASSES### database are contained in the second file [numbers (###) refer to version number of the database]. Each recommendation is allowed one entry. The setup of the various fields in the RECC database:

Field	Field Name	Type	W	Description
1	superid	Character	16	The unique identifying number given to all records based on IAC Name, Report Number and the Assessment Recommendation Number. This number is used when linking to the assessment database(s).
2	id	Character	16	Unique identifying number given to all records based on IAC Name and Report Number. This number is used when linking the two databases
3	ar_number	Numeric	2	The recommendation number as it appears in the report.
4	appcode	Character	2	Application for recommendation (see ARC List).
5	arctype	Character	2	Recommendation type (see ARC List).
6	arc	Character	16	The code representing the specific recommendation made (see ARC List).
7	impdate	Date	8	Client reported date of implementation of this Assessment Recommendation. This date may be estimated if the Assessment Recommendation is not implemented by the time of client contact.
8	impstatus	Character	1	Client reported implementation status of this Assessment Recommendation (see “Implementation Status”).
9	impcost	Numeric	8	Client reported implementation cost. This cost may be estimated if the Assessment Recommendation is not yet implemented by the time of client contact.
10	psourccode	Character	3	The Primary Resource coded per “Resource Identification Code”. This resource may not necessarily be the most important resource involved in the Assessment Recommendation, but it is usually chosen based on greatest usage before conservation measures are suggested.
11	pconserved	Numeric	10	The amount of primary resource conserved (see “Resource Identification Code”).
12	psourconsv	Numeric	8	The primary energy consumed at the source needed to produce the consumed electricity at site
13	psaved	Numeric	8	The primary resource’s dollar savings for this Assessment Recommendation.
14	ssourccode	Character	3	The Secondary Resource involved in this Assessment Recommendation (see also “Resource Identification Code”). This resource is usually chosen based on second highest amount of usage before conservation measures are suggested.
15	sconserved	Numeric	10	The amount of secondary resource conserved (see “Resource Identification Code” for units).
16	ssourconsv	Numeric	8	The secondary energy consumed at the source needed to produce the consumed electricity at site
17	ssaved	Numeric	8	The secondary resource’s dollar savings for this Assessment Recommendation.

Table 3. Fields in the RECC### Database

18	Tsourccode	Character	3	. The Tertiary Resource involved in this Assessment Recommendation (see "Resource Identification Code"). This resource is usually chosen based on second lowest amount of usage before conservation measures are suggested.
19	tconserved	Numeric	10	. The amount of tertiary resource conserved
20	tsourconsv	Numeric	8	The tertiary energy consumed at the source needed to produce the consumed electricity at site
21	tsaved	Numeric	8	The tertiary resource's dollar savings for this Assessment Recommendation.
22	qsourcode	Character	3	The Quaternary Resource involved in this Assessment Recommendation (see "Resource Identification Code"). This resource is usually chosen based on the least amount of usage before conservation measures are suggested
23	qconserved	Numeric	10	The amount of quaternary resource conserved
24	qsourconsv	Numeric	8	The Quaternary energy consumed at the source needed to produce the consumed electricity at site
25	qsaved	Numeric	8	The quaternary resource's dollar savings for this Assessment Recommendation.
26	rebate	Character	1	Indicative whether the Assessment Recommendation included a rebate for implementation.
27	incremental	Character	1	Indicates if the Assessment Recommendation is to be implemented on an incremental basis. Incremental data is included in the database for the first two years only.
28	descript	Character	150	Description in words of the individual Assessment Recommendation.
29	imp_comm	Character	200	Description in words of any variation between the suggested recommendation and the actual implementation.
30	fy	Numeric	4	The fiscal year in which the assessment was performed.
31	Ic_capital	Numeric	8	The capital (equip. & material) cost of a recommendation.
32	Ic_other	Numeric	8	Implementation costs that are not capital costs.
33	p3-ees	Numeric	8	Effective energy savings resulting from an improvement in energy efficiency.
34	Payback	Numeric	8	Payback period for recommendation.

Table 3 (continued). Fields in the RECC### Database

6. Coding Systems Used In the Database

6.1 Implementation Status

The database uses a numerical code to represent the status of implementation. The following table provides details to the coding scheme:

Code	Implementation Status
I	**IMPLEMENTED** Was completely implemented at the time of the call, or plans definitely made to complete implementation within 12 months of call (not exceed 24 months from the assessment date)
P	**PENDING** This status is for recommendations with implementation costs of $10,000 or more. Delay in implementation should be attributable to large capital investment.
N	**NOT IMPLEMENTED**
K	**DATA EXCLUDED OR UNAVAILABLE** K status may be assigned ONLY by field managers.

Table 4. Implementation Status

- Codes A list of "pending" implementations will be kept for each center; for each Pending implementation, a yearly report will be required from the center until the implementation can be identified as either Implemented or Not Implemented.
- If, after 3 years, a Pending implementation cannot be identified as Implemented, it shall be changed to Not Implemented.
- Pending implementations will not be counted when determining which implementations are Implemented and Not Implemented

6.2 Produnits Coding

The database uses a numerical code to represent units of production. In some industries such units are not very informative and so in many cases this item is left out. The following table provides details to the coding scheme.

Code	Units
0	Not Available
1	Pieces
2	Pounds
3	Tons
4	BBL
5	Thousand Gallons
6	Thousand Feet or Thousand Square Feet
7	Bushels

Table 5. Production Unit Codes

6.3 Rejection Codes

When a recommendation is not adopted, attempts are made to determine the reasons surrounding the negative decision. The database uses a numerical code to represent the reason for rejection. The following table provides details to the coding scheme.

Rejection Codes 12 & 13 will no longer be used per Version #8 of this manual.

Code	Reason
1	Unsuitable return on investment
2	Too expensive initially
3	Cash flow prevents implementation
4	Unacceptable operating changes
5	Impractical
6	Process and/or equipment changes
7	Facility change
8	Personnel changes
9	Production schedule changes
10	Material restrictions
11	Bureaucratic restrictions
~~12~~	~~To be implemented after 2 years~~
~~13~~	~~Considering~~
14	Lack of staff for analysis and/or implementation
15	Not worthwhile
16	Disagree
17	Risk or inconvenience to personnel
18	Suspected risk or problem with equipment or product
19	Rejected after implementation failed
20	Unknown
21	Could not contact plant
22	Other

Table 6. Rejection Codes

Note: This field is currently not included in the public database. Users interested in rejection coding should contact database@camp.rutgers.edu.

6.4 Resource Identification Code[1]

The database uses a numerical code to represent the various resource streams tracked. The following table provides details to the coding scheme.

STREAM TYPE	STREAM	CODE	CONSUMPTION UNITS
ENERGY	Electrical Consumption	EC	KWH(site) ** MMBtu(source)
“	Electrical Demand	ED	kW–months/year
“	Other Electrical Fees	EF	n/a
“	Electricity	E1*	KWH(site)**
“	Natural Gas	E2	MMBtu
“	L.P.G.	E3	MMBtu
“	#1 Fuel Oil	E4	MMBtu
“	#2 Fuel Oil	E5	MMBtu
“	#4 Fuel Oil	E6	MMBtu
“	#6 Fuel Oil	E7	MMBtu
“	Coal	E8	MMBtu
“	Wood	E9	MMBtu
“	Paper	E10	MMBtu
“	Other Gas	E11	MMBtu
“	Other Energy	E12	MMBtu
WASTE REDUCTION	Water Disposal	W1	Gallons
“	Other Liquid (non-haz)	W2	Gallons
“	Other Liquid (haz)	W3	Gallons
“	Solid Waste (non-haz)	W4	Pounds
“	Solid Waste (haz)	W5	Pounds
“	Gaseous Waste	W6	Pounds
RESOURCE COSTS	Personnel Changes	R1	n/a
“	Administrative Costs	R2	n/a
“	Primary Raw Material	R3	n/a
“	Ancillary Material Cost	R4	n/a
“	Water Consumption	R5	n/a
“	One-time Revenue or Avoided Cost	R6	n/a
PRODUCTION	Primary Product	P1	n/a
“	By-product Production	P2	n/a
“	Increase in Production	P3	%

Table 7. Resource Codes

*Note: E1 represents electrical energy savings for all reports dated through FY 95 (9/30/95).

**Note: As of Version # 8: EC & E1 units for site are being changed from MMBtu’s to KWH’s.

1 Description of the various streams in this table and their correct use is discussed in the section “Resource Streams”.

7. Resource Streams

Resources are an important consideration when evaluating plant operations. Tracking waste streams, resource costs, and production streams in addition to the traditional energy resource streams helps break out interrelationships previously buried within recommendations.

7.1 Energy Streams

The energy streams, with the exception of electricity, remain unchanged in the data sets. All units are in MMBTU for comparison purposes. With quaternary data reporting and subsequent database inclusion, the possibility exists for recommendations to include four energy streams. The energy sources tracked:

Electricity
Natural Gas
L.P.G.
#1 Fuel Oil
#2 Fuel Oil
#4 Fuel Oil
#6 Fuel Oil
Coal
Wood
Paper
Other Gas
Other Energy

7.1.1 Electrical Consumption

Electrical consumption, EC, refers to actual electric energy used in the facility. The units for this resource are in KWHs. On Version #8 the units were changed from MMBtus to KWHs for clarity.

> Ex. Lighting throughout the plant is currently provided by conventional light bulbs. Recommended action is to replace existing bulbs with reduced wattage ones. There will be savings in electrical energy consumption (EC) and also in demand (ED) based on annual demand avoided which is calculated from the differential wattage of all bulbs in a given year.

7.1.2 Electrical Demand

Electrical demand, ED, accounts for any charge applied by the utility company to serve peak loads. Demand should be reported in kilowatt-months /year.

> Ex. Certain equipment in the plant is operated intermittently during an 18-hour period. Recommended action is to move all operations of the equipment to nighttime off-peak hours. Though there will be no energy savings (EC), the electrical demand (ED) will be reduced.

7.1.3 Other Electrical Fees

Electrical fees is total electric billing less the consumption cost and the demand cost. Electric consumption, demand and fees must add up to the electric bill. There are no units associated with this stream.

> Ex. The manufacturing company pays its electrical bills. Filing for sales tax credit for electricity used in manufacturing process is recommended. The total tax burden will be lowered (EF).

> Ex. A company is operating an electric annealing furnace. The recommendation for the company is to switch from the electric furnace to a gas one. The electrical consumption charge (EC), demand charge (ED), and the electrical service fees (EF) will be lower, however there is an increase in gas usage (E2).

7.2 Waste Streams

Waste stream tracking is integral to pollution prevention and waste minimization opportunity analysis. Waste stream classification is by physical properties such as liquid, solid, or gas and capability for causing harm, hazardous versus non-hazardous. A brief description of each waste stream type and a brief example illustrating the application of each classification follows:

7.2.1 Water Disposal

Water disposal, W1, refers simply to any water-based solution leaving the plant through the public sewage system for treatment. The units associated with water disposal are gallons.

> Ex. Water used as process coolant is currently dumped into the manufacturers' metered sewage system in large quantity. The recommended IAC measure includes the installation of a heat exchanger and water circulator. Water disposal cost and volume reductions are coded as W1. Additional savings relate to energy cost reduction coded in a similar fashion (EC, electrical consumption, in this case) and water purchase reductions (R5).

7.2.2 Other Liquid (non-hazardous)

Waste Stream W2 applies to liquid waste leaving the facility by means other than the public sewer. This liquid is classified as non-hazardous. The units for the stream are in gallons.

> Ex. Ethylene glycol is used in a plant to cool equipment. The recommended action specifies the collection of the used liquid as opposed to the prior practice of waste disposal into the sewer. The ethylene glycol collected (W2, liquid non-hazardous) is to be sold to an outside recycling firm.

7.2.3 Other Liquid (hazardous)

Other liquid (hazardous), W3, refers to hazardous liquid material requiring treatment before disposal. The units are in gallons.

Ex. A plant uses trichloroethane-1,1,1 for cleaning process material before painting. Currently, the company pays an outside firm to dispose of this liquid hazardous waste. A still is recommended to recycle the polluted solvent. The resulting reduction in the amount of liquid waste produced (W3) from the cleaning process lowers the disposal cost of the trichloroethane-1,1,1 liquid. Additional savings will be realized from smaller purchase needs of cleaning fluid (not coded) while new expenses accrue from still bottom disposal (solid hazardous waste, W5).

7.2.4 Solid Waste (non-hazardous)

Waste stream W4 refers to solid materials classified as non-hazardous. The waste units are pounds.

Ex. Raw materials are shipped into a plant in bags stacked on wood pallets for easy forklift handling. Currently the company personnel is disposing of the pallets in the dumpster. The recommendation presented suggests burning the pallets to provide process heat. Solid non-hazardous waste volume (W4) decreases along with energy purchases, in this case natural gas (E2).

7.2.5 Solid Waste (hazardous)

In contrast to waste stream W4, the waste stream W5 refers to those substances which are classified as hazardous solid waste. The units for this waste stream are also in pounds.

Ex. Energy efficient lighting measures are currently being implemented by a manufacturer to save electricity costs. Changing out the light bulbs also requires replacement of the old ballasts. These older model ballasts contain hazardous PCBs. When thee ballasts are removed, the plant is charged for disposal based on the combined total weight of the ballast (approximately 3 pounds) and the PCB containing capacitor (approximately 1 ounce each). If the contaminated capacitor is removed and disposed of separately as hazardous waste (W4), the remaining portion of the ballast can be recycled. Hazardous waste volume and associated cost decreases substantially and are partially offset by the recycling income (not coded).

7.2.6 Gaseous Waste

The waste stream W6 refers to gases emitted into the atmosphere. The units for this stream are pounds.

> Ex. A metal separation and recycling plant pays permitting fees and heavy emission fines as a function of the amount of cyanide fumes released into the atmosphere. These emissions result from uncovered liquid vats losing product to evaporation. The recommendation for the installation of fume collection and condensation units for each vat will result in gaseous waste (W6) savings, ancillary material (R4) purchase savings, administrative cost reductions (R2), and a slight increase in electricity usage (not coded).

7.3 Resource Costs

Resources other than energy are directly tracked in the IAC program database. Important matters such as personnel changes, material costs, water costs and administrative considerations can be broken down into separate recommendations.

7.3.1 Personnel Changes

For many Assessment Recommendations an additional amount of work may result (the opposite may also be true). Thus, personnel changes (R1) must be considered.

> Ex. For a natural gas refinery, the installation of a cogeneration system is recommended for in-house electricity generation and the sale of excess energy production. To manage the system properly, a skilled professional must be added to the payroll as a recurring cost. This is not a one-time cost. This personnel cost (R1) is tracked along with electricity production (EC) and natural gas usage (E2).

7.3.2 Administrative Costs

Administrative costs (R2) represent any fees or charges which are not directly related to the production process. These costs include taxes, inventory control, and late fees on billing.

> Ex. The purchase of a manufacturing facility's process equipment is recommended in lieu of current leasing agreements In this instance, there are greater tax deductions allowed for equipment depreciation with ownership compared to the benefits of leasing. A net decrease in tax payments (administrative costs- R2) help improve the payback of the process machinery purchases.

7.3.3 Primary Raw Material

Many process changes may result in the savings of a primary raw material. Therefore, raw material costs (R3) can be considered while assessing recommendations.

> Ex. A plastics plant rejects deformed bottles as part of the quality control process. If these bottles can be reground and reused in the process as recommended, the primary raw material (R3) cost can be reduced. Additional savings will result from decreased non-hazardous solid waste disposal (W4) and electricity costs (EC) will increase.

7.3.4 Ancillary Material Cost

As with the cost of primary raw materials, a cost savings may result from a decrease in the use of an ancillary material. An ancillary material is any additional material other than the primary materials.

> Ex. A children's furniture manufacturer uses standard spray guns to paint the exterior of each item. Overspray reduction recommendations require installation of high volume, low pressure paint nozzles. The ancillary cost (R4) for paint will decrease. There will also be a reduction in gaseous waste (W6) for environmental losses and reduced electrical usage (EC) due to the lower compressed air pressure.

7.3.5 Water Consumption

Although water consumption (R5) is usually overlooked when assessing utility bills, it is usually a large cost to the plant. This consumption is recorded in dollars.

> Ex. A chemical plant currently ships their product as an aqueous based solution. Process alterations are recommended by the IAC allowing the company to package the product in bulk powder form. Savings result from water consumption (R5) reductions and decreased transportation costs (Fuel E11). Additional cost accrues from increased product handling requirements (Personnel changes R1).

7.3.6 One-time Revenue or Avoided Cost

There are times when a recommendation not only includes annualized savings, but also a one-time cost savings or increase in revenue. A new resource stream, R6, has been introduced in the database for such cases of one-time savings. In the past, these types of cost benefits were included in the implementation cost and should now be reported as its own resource stream.

Ex. A facility is in the process of replacing an old 100 hp compressor with a new, more efficient 100 hp compressor. The IAC has determined that this unit is oversized and that a new and efficient 80 hp unit should be purchased instead. Since the facility already budgeted for the 100 hp unit and since the 80 hp unit is cheaper and will consume less energy, there will be a yearly electricity consumption (EC) savings as well as a one-time avoided cost (R6) by purchasing the smaller compressor. The AR will also reflect a $0 implementation cost.

Ex. A glass company produces both clear and colored glass. The clear glass can be remelt in the furnaces as cullet, but the colored glass cannot. 1,500 tons per year of colored glass is rejected and over the years, the company has acquired many tons of the rejected glass and has stored it outside of the facility. A recycler has been located which will come and haul away the scrap and will also contract with the glass manufacturer to buy the yearly production of rejected colored glass. There will be a yearly income from the recycler (P2) and also a one-time revenue for the initial sale of the "alps" to the recycler (R6).

7.4 Production Streams

Production stream tracking will allow data analysis of recommendations involving productivity methods such as Total Quality Management initiatives and other innovative strategies.

7.4.1 Primary Product without improvement in energy efficiency – P1.

The primary product stream (P1) refers to anything which directly effects cost of production but not energy efficiency. This may include any changes which effect production cost per unit or the amount of time needed for production.

Ex. Improve Packaging of Product to prevent damage in shipment. Previously a number of products shipped to customers were damaged in transit and had to be shipped back to the manufacturer for repair. Improved Packaging has reduced the number of products damaged in shipping.

7.4.2 By-product Production – P2

By-products (P2) are salable items which are a secondary result of the primary product. It is anticipated that markets can be found for these items, thereby improving the profits of the plant.

> Ex. A furniture maker is currently burning sawdust produced and collected by his main process. A local horse breeder is found who can purchase the sawdust. Increased income due to sale of the sawdust appears as increased by-product production (P2). There would also be an increase in energy costs due to the reduction in wood burning (E9).

7.4.3 Primary Product with improvement in energy efficiency – P3.

The primary product stream (P3) refers to anything which directly effects energy needed to produce a given number of products. This may include any changes which effect production cost per unit or the amount of time needed for production.

> Ex. A manufacturer currently produces 100 garbage cans in one hour of which 5 are rejected by plant inspection personnel. The quality control problems are linked to unreadable instruments on key machinery. This situation was rectified through the recommended instrument cleaning program resulting in a usable production of 99 cans per hour, an increase of 4% (P3). With out an increase in use of energy, this resulted in the energy needed to produce a garbage can to have declined.

7.5 How to Upload (IAC's only)

- Create an assessment or implementation upload by following the guidelines laid out in this manual.

- Centers are able to upload assessment data to the IAC database located on the 'CAES' server by pasting a spreadsheet formatted specifically for uploading using the IAC upload filter page. The filter prompts the user to make corrections before data can be added to the IAC database. The host name/address is 'caes.rutgers.edu'. Industrial Assessment Centers (IAC) acquire a User-ID and Password from CAES.

- Implementation uploads also have a filter associated with them, but they are done different. A form is filled in with the data already uploaded to the database by the assessment upload. The user then fills in the missing data by typing or pasting. This filter also prompts the user to make corrections before data can be added to the IAC database. Again the host name/address is 'caes.rutgers.edu'. Industrial Assessment Centers (IAC) acquire a User-ID and Password from CAES.

7.6 Boilerplate for Assessment Data Uploads

ASSESSMENT REPORT # should begin with 2 letters, followed by 4 numbers.

All Dates should be formatted yyyy/mm/dd

Two faculty names may be entered by sepaarating the names with a slash, e.g. Muller/Briggs.

Plant Location: Enter city and two letter abreviation for state, separated by a comma, with no spaces in the entry.

All NUMERICAL INFORMATION should contain only whole numbers, with no dollar signs, spaces, extraneous characters, or text.

Plant Area: Enter the area, in square feet, of all space utilized for pproduction and office needs. Omit areas such as storage unless enclosed and environmentally maintained.

LOCATION OF NEW BOILERPLATES ON CAES

Assessment #:	RU0999
Assessment Date:	2000/11/15
Faculty Leader:	Dr David Briggs
# of Student Asst.:	2
SIC Code:	2651
Plant Location:	Newark, NJ
Plant Zipcode:	07524
Annual Sales ($):	2,000,000
# of Employees:	150
Plant Area (sqft.):	260000
Principal Product:	Fuzzy dice
Production Unit Code:	1
Annual Production:	8000
Prodution Hrs. Annual:	2080

Production Unit Codes

Code	Unit
0	Not Available
1	Piece
2	Pounds
3	Tons
4	BBL's
5	Gallons (thousand)
6	Feet or Square Feet (thousand)
7	Bushels

Rebate/Incremental Status: Only Y or N should be entered. Do not use entire words Yes and No. Do not enter extraneous text.

Resource Stream Units: For Resources Streram Codes and Units, please refer to the database manual.

Implementation Costs have two elements Capital Cost (hardware) and all other costs

Resource Tracked: Primary Resource should be the stream with largest amount.

Resource Tracked:	A	B	C	D	E		
Resource Code:	EC	ED	EF	E2	W1	W2	W3
Resource Name:	Electricity	Demand	Other Elec Fees	Natural Gas	Water Disposal	non-haz liquid	haz liquid
Yearly Consumption:	9320	6957		3681	7456700	1689	1264
Yearly Cost:	68389	65097	14767	20687	30428	13512	15168

AR #:	AR Description	ARC	Primary Resource Code	Primary Resource Saved	Primary Cost Savings	Secondary Resource Code	Secondary Resource Saved	Secondary Cost Savings	Tertiary Resource Code	Tertiary Resource Saved	Tertiary Cost Savings	Quaternary Resource Code	Quaternary Resource Saved	Quaternary Cost Savings	Imp. Cost Capital Cost	Imp. Cost Other Costs	Incr. (Y/N)	Rebates (Y/N)
1	Reduce Space Heating/Cooling During Non-working Hours	2.7224.3	EC	14655	370	E2	15	84							423		N	N
2	Install a Cogen System	2.3415.2	EC	4209795	105392	ED	3701	25908	E2	-12992	-37546	R1		-15879	375000		N	Y
3	Manufacturers Sales Tax Credit	2.8121.4	EF		5970										0		N	N
4	System for Cleaning and Reuse of Metal Working Fluid	3.5146.1	W2		2136	EC	239	1785							4732		N	N
5	Reduce Solution Drag-out to Prevent Solution Loss	3.1244.1	R3		17103	W3	44	528							7600		N	N
Comments:																		

Comments: 250 character max

Recommendation Description: 200 character max

Assessment Recommendaation Code (ARC)

X.YYYY.Z
Type.Code.Application

Codes, Costs, and Savings
Round all costs and savings to the nearest dollar. Resource Saved and Cost Savings Data should contain only whole numbers, with no dollar signs, commas, spaces, extraneous characters, or text. Resource Codes are listed in Section 6.4 of the databasse manual.

IMPORTANT

Never change the location of ANY data items. Do not alter this boilerplate at any time. Accurate data transmittal requires information specific to cell addresses.

7.7 Boilerplate for Implementation Data Uploads

Implementation Status (See Section 6.1 of the Database Manual)
If Implemented, enter date of implementation;
If Pending, enter P;
If Not Implemented, enter N+Rejection Code from Section 6.2
For multiple Rejection Codes, enter a single N+codes seperated by a comma; do not leave spaces.

LOCATION OF NEW BOILERPLATES ON CAES

Supplied data shaded

IMPLEMENTATION REPORT	
IAC:	Rutgers
ASSESSMENT REPORT #:	RU0777
DATE OF SITE VISIT (yyyymm/dd):	1999/06/24
DATE ASSESSMENT REPORT SUBMITTED (yyyy/mm/dd):	1999/08/27
DATE OF IMPLEMENTATION INTERVIEW (yyyy/mm/dd):	2000/08/31
NAME OF INTERVIEWER:	Jo Student
TITLE OF INTERVIEWEE:	Plant Manager
TOTAL NUMBER OF AR'S:	7

ASSESSMENT REPORT #
Should begin with 2 letters, followed by 4 numbers.

All **Dates** should be formatted yyyy/mm/dd

ASSESSMENT REPLICATION COMMENTS:	Shared report with corp. next bldg. will implement some of these rec's.
REPLICATION SAVINGS MULTIPLIER:	Increase in assessment savings, 1 equals no increase
ASSESSMENT SPINOFF COMMENTS:	Was able to save an Additional 500 KWH insulating additional equipment.
ASSESSMENT SPINOFF MULTIPLIER	Increase in assessment savings, 1 equals no increase
GENERAL ASSESSMENT COMMENTS:	CEO is impressed

General Comments:
250 character max

	AR1	AR2	AR3	AR4	AR5	AR6	AR7
Narrative Title:	Install Energy Efficient Motors	Boiler Electronics	Install Skylights	Repair Condensate Line	Insulate Cover	Power Factor	Occupancy Sensors
Implementation Status	2000/05/01	N3,15	N15	N3	2000/06/01	N3	2000/06/01
Clients Estimate of Implementation Cost($):	2670	324	204	500	43	4500	520
Was Rebate Utilized (Y or N):	Y	N	N	N	N	N	N
Incrementally Implemented (Y or N):	N	N			N	N	
Narrative Comments:							
Rejection Comments:							
Certification:							
______________________							
IAC Director:							

Narrative Comments: If the client's estimate of Resources Conserved or Dollar Savings is different than the Recommended values, please note in Narrative Comments. Include the Resource Code, Conservation (with units), and Dollar Savings. 200 character max

Rejection Comments: Reason that client has not implemented recommendation. 200 character max

Rebate/Incremental Status: Only Y or N should be entered. Do not use entire words Yes and No. Do not enter extraneous text.

IMPORTANT

Never change the location of ANY data items. Do not alter this boilerplate at any time. Accurate data transmittal requires information specific to cell addresses.

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