ORNL/TM-2003/227

OAK RIDGE NATIONAL LABORATORY
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ESTIMATION OF ENERGY SAVINGS RESULTING FROM THE BESTPRACTICES PROGRAM, FISCAL YEAR 2002

September 2003

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September 2003

Prepared for the
BESTPRACTICES PROGRAM
Office of Industrial Technologies
U.S. DEPARTMENT OF ENERGY
Washington, D.C.

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
managed by
UT-BATTELLE, LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-00OR22725

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ACRONYMS AND INITIALISMS

3E Plus	Insulation Tool
B	Billion
BBtu	Billion British Thermal Units
BP	BestPractices
Btu	British Thermal Units
CAC	Compressed Air Challenge
CD	Compact Disk
CTA	Collaborative Targeted Assessment
DOE	Department of Energy
DTCD	Decision Tool Compact Disc
EERE	Energy Efficiency and Renewable Energy
FY	Fiscal Year
IAC	Industrial Assessment Center
ITP	Industrial Technologies Program
kWhr	Kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
MM	Million
NA	Not Applicable
NAICS	North American Industry Classification System
NEMA	National Electrical Manufacturers' Association
NREL	National Renewable Energy Laboratory
ORC	Opinion Research Corporation
ORNL	Oak Ridge National Laboratory
PDF	Portable Document Format
PHAST	Process Heating Assessment Tool
PPC	Project Performance Corporation
PSAT	Pumping System Analysis Tool
PWA	Plant-wide Assessment
SEP	State Energy Program
U.S.	United States

EXECUTIVE SUMMARY

Within the U.S. Department of Energy (DOE), the Office of Energy Efficiency and Renewable Energy (EERE) has a vision of a future with clean, abundant, reliable, and affordable energy. Within EERE, the Industrial Technologies Program (ITP), formerly the Office of Industrial Technologies, works in partnership with industry to increase energy efficiency, improve environmental performance, and boost productivity. The BestPractices (BP) Program, within ITP, works directly with industries to encourage energy efficiency.

The purpose of the BP Program is to improve energy utilization and management practices in the industrial sector. The program targets distinct technology areas, including pumps, process heating, steam, compressed air, motors, and insulation. This targeting is accomplished with a variety of delivery channels, such as computer software, printed publications, Internet-based resources, technical training, technical assessments, and other technical assistance. A team of program evaluators from Oak Ridge National Laboratory (ORNL) was tasked to evaluate the fiscal year 2002 (FY02) energy savings of the program.

The ORNL assessment enumerates levels of program activity for technology areas across delivery channels. In addition, several mechanisms that target multiple technology areas – e.g., Plant-wide Assessments (PWAs), the *Energy Matters* newsletter, and special events – are also evaluated for their impacts.

When possible, the assessment relies on published reports and the Industrial Assessment Center (IAC) database for estimates of energy savings that result from particular actions. Data were also provided by ORNL, Lawrence Berkeley National Laboratory (LBNL) and Project Performance Corporation (PPC), the ITP Clearinghouse at Washington State University, the National Renewable Energy Laboratory (NREL), Energetics Inc., and the Industrial Technologies Program Office.

The estimated energy savings in FY02 resulting from activities of the BP Program are almost 81.9 trillion Btu (0.0819 Quad), which is about 0.25% of the 32.5 Quads of energy consumed during FY02 by the industrial sector in the United States. The technology area with the largest estimated savings is steam, with 32% of the total energy savings. The delivery mechanism with the largest savings is that of software systems distribution, encompassing 44% of the total savings. Training results in an energy savings of 33%. Energy savings from PWAs and PWA replications equal 10%.

Sources of overestimation of energy savings might derive from (1) a possible overlap of energy savings resulting from separate events (delivery channels) occurring in conjunction with one another (e.g., a training event and CTA at the same plant), and (2) a possible issue with the use of the average CTA value to assess savings for training and software distribution. Any overestimation attributable to these sources probably is outweighed by underestimations caused by the exclusion of savings resulting from general awareness workshops, data not submitted to the ITP Tracking Database, omission of savings attributable to web downloads of publications, use of

BP products by participants over multiple years, and the continued utilization of equipment installed or replaced in previous years.

Next steps in improving these energy savings estimates include continuing to enhance the design of the ITP Tracking Database and to improve reporting of program activities for the distribution of products and services; obtaining more detailed information on implementation rates and savings estimates for software training, tools, and assessments; continuing attempts to quantify savings based on Qualified Specialist activities; defining a methodology for assessing savings based on web downloads of publications; establishing a protocol for evaluating savings from other BP-sponsored events and activities; and continuing to refine the estimation methodology and reduction factors.

1. INTRODUCTION

Within the U.S. Department of Energy (DOE), the Office of Energy Efficiency and Renewable Energy (EERE) has a vision of a future with clean, abundant, reliable, and affordable energy. Within EERE, the Industrial Technologies Program (ITP), formerly the Office of Industrial Technologies, works in partnership with industry to increase energy efficiency, improve environmental performance, and boost productivity. The BestPractices (BP) Program, within ITP, works directly with industrial manufacturing plants to identify opportunities to save energy and reduce harmful emissions. Its purpose is to improve energy utilization and management practices within the industrial sector.

Recognizing the huge energy use by industrial systems used in manufacturing, ITP's BP Program creates opportunities for organizations to take advantage of the expertise and proven technologies offered by ITP. BP is an information program aimed at improving energy utilization and management practices in the industrial sector. The BP Program is defined and described in detail on its website.[1]

1.1 BACKGROUND

Motor Challenge, an early component of the BP Program, started in 1993. Motor Challenge, which addressed energy savings for motors and pumps, was followed by the Compressed Air Challenge (CAC). Although Motor Challenge as a distinct program was phased out by 1999, motors and pumps remain technology areas targeted by BP. The Allied Partners Program, begun in 1996, targets all technology areas rather than just motors. Under Allied Partners, individual firms sign an agreement with DOE to undertake various actions to promote energy efficiency in their own facilities. Additionally, the Allied Partners Program is another outreach mechanism for serving companies outside that program by providing technology-specific information, workshops, and demonstrations.

1.2 TECHNOLOGY AREAS

Currently, the BP Program targets the following technology areas: pumping systems, process heating, steam systems, compressed air systems, motors, and insulation. The BP Program has been working with U.S. industries to save energy for several years to address unique needs of energy-intensive sectors. For example, motor-driven equipment consumes 65% of the electricity used by U.S. industries, and 45% of the fuel used by manufacturers is used to produce steam.[2]

A report by Resource Dynamics[3] assesses steam generation and use in three industries (pulp and paper, chemical manufacturing, and petroleum refining). An estimate of the annual steam use for the three industries equals 5.4 Quad. According to the Resource Dynamics study, the energy

[1] "ITP: BestPractices Home Page," http://www.oit.doe.gov/bestpractices/ .
[2] "ITP: Motors," http://www.oit.doe.gov/bestpractices/motors/ .
[3] Resource Dynamics Corporation, *Steam System Opportunity Assessment for the Pulp and Paper, Chemical Manufacturing, and Petroleum Refining Industries,* no date.

savings potential for these three industries is between 12.2% and 12.6%, or about 0.73 Quad. In another article on steam systems energy use and efficiency improvements,[4] the authors estimate that the total annual energy use of boilers in U.S. industry equals 6.1 Quads. The authors also estimate that 18-20% of total boiler use could be saved through energy efficiency measures.

In this report, an attempt has been made to estimate energy savings to the six technology areas noted above by delivery channel (Section 1.3). Appendix A identifies the data sources on which the estimates rely and also details certain limitations and constraints. Some savings, however, are cross-cutting and apply to more than a single area. In these cases, the savings are attributed to a general, comprehensive category. Examples of this type of savings are given in Section 1.3.8.

1.3 DELIVERY CHANNELS

During FY02, a variety of communication mechanisms and channels, such as computer software, training, assessments, publications, Internet-based resources, and technical assistance were used to reach the targeted end users. Relationships between the technology areas and the delivery channels are shown in Table 1. Each of these delivery channels is described more fully below the table.

Table 1. Structure of the BestPractices energy management program: technology areas and delivery channels, FY02

Delivery channel	Technology area						
	Pumps	**Process heat**	**Steam**	**Comp. air**	**Motors**	**Insulation**	**Compre-hensive**
Collaborative Targeted Assessments	X[a]	X	X	X			
Training	X	X	X	X	X		
Software distribution	X		X	X	X	X	
Printed materials[b]	X	X	X	X	X		
Technical assistance calls	X		X	X	X	X	X
Case Studies	X		X	X	X		X
Plant-wide Assessments							X
Other publications and events[c]							X

[a]X implies that the delivery method is applied in this technology area.
[b]Printed materials (hard copies) include tip sheets and publications related to specific technology areas.
[c]Other publications and events include publication shipments and technical assistance calls that were not covered in specific technology areas, as well as the *Energy Matters* newsletter and energy events.

[4] Einstein, et al., "Steam Systems in Industry: Energy Use and Energy Efficiency Improvement Potentials," 2001.

As shown in Table 1, the BP Program employs several different delivery channels for sharing energy savings information. Although not listed as a separate delivery channel in Table 1, the Internet is a powerful element for distributing the program's software tools; the BP website also provides a means for distributing BP publications and notification of training schedules and other relevant events. Because of the potential for overlap with the software delivery channel, calculation of energy savings based on Internet software downloads is provided separately for information purposes only (Section 4.8) and is not included in the aggregate totals as a separate category. Savings based on downloads of portable document format (pdf) files are not counted in this metrics evaluation (Section 4.8).

1.3.1 Collaborative Targeted Assessments

A Collaborative Targeted Assessment (CTA) is a walk-through examination of one or more technology areas of an energy-intensive industrial facility. At least one of the software tools is used to examine the facility's opportunities for saving energy by applying specific changes in equipment or practice. In FY02, it was possible to conduct a CTA before a corporate training event so the results could be used in the training. The estimation of energy savings documented in this report separates results based on training workshops from results based on CTAs. Because of the possibility of concurrent training and assessment events, however, there is a chance that double-counting energy savings may occur. In the version of the tracking system used for the FY02 metrics evaluation, it was not possible to eliminate this possibility.

It should be noted that the protocol for conducting CTAs changed in December 2002. The purpose of CTAs in FY03 is to reinforce the information presented in training of the software tools. Therefore, prior to a CTA, the industrial plant lead will have attended a BP training workshop in the subject CTA area. This change in protocol will be considered for the FY03 metrics evaluation.

1.3.2 Training

Training workshops are sponsored by the BP Program and are also offered through several other mechanisms (e.g., Allied Partners). These training sessions include end-user software training, system optimization training, Qualified Specialist training, and a general awareness or introductory type of training.

End-user training involves training the participants on the software tools. The users may then apply the tools at their own plants to identify areas for energy savings. Energy savings in this report are based on the participation of unique plants (i.e., not the number of attendees) in training sessions. The training sessions included in this evaluation report are for end-user training during fiscal year 2002 (FY02) on the software tools described in Section 1.3.3.

The purpose of the Qualified Specialist training session is to certify trainees in a particular area of expertise in order to encourage more rapid dissemination and understanding of the software tools. In FY02, savings resulting from Qualified Specialist training were limited to specialists who had received training during FY01 on the Pumping System Assessment Tool (PSAT). A limited number of these individuals were contacted to determine energy savings during FY02.

The results of these limited interviews with PSAT Qualified Specialists (who received qualification in FY01) were documented, and these savings were recorded (see Section 2.2.2 and Appendix B).

During FY02, Qualified Specialist training sessions were held for AIRMaster, PSAT, and the Process Heating Assessment Tool (PHAST). However, no savings were derived from these sessions for the FY02 metrics estimation. It is assumed that Qualified Specialists trained during FY02 will more fully apply their expertise within their own plants or within other plants during FY03. Thus, for the current (FY02) metrics estimation, savings realized from the FY02 Qualified Specialist training sessions held during FY02 were excluded.

General awareness workshops provide an introduction to the BP Program and the software tools. Participation in the general awareness and introductory training sessions is being tracked by the ITP Tracking Database; however, potential energy savings from these sessions are not included because the value of the energy savings has not been determined.

1.3.3 Software Distribution

One technology delivery channel used by the BP Program is that of technical software tools that can help a firm identify opportunities to improve its operations in specific technology areas. In FY02, software tools were available for motors (MotorMaster+3.0), pumps (PSAT), steam (Steam System Scoping Tool 1.0c), compressed air (AIRMaster+), and insulation (3E Plus). All five of these tools were available on a single compact disk (CD), entitled the Decision Tools for Industry CD (DTCD).[5] Another software tool for process heat (PHAST) was available in Beta version to a limited number of users during FY02.

Descriptions of these tools and details on how to obtain them are provided on the BP website. Some of the tools can be downloaded directly from the website; some must be ordered from the ITP Clearinghouse at Washington State University. In addition, Allied Partners and IAC's provide distributions of the DTCD.[6]

1.3.4 Printed Materials

BestPractices publishes a variety of materials on technical and market-related subjects. Most of these documents can be ordered from the Clearinghouse, some are disseminated by Allied Partners, and others are available on request or through direct web download. Almost 250 titles are available.[7] The categories of publications are technical fact sheets and handbooks, tip sheets (two-page reports providing quick technical advice), BestPractices Resources (ranging from topics like "Improving Pumping System Performance: A Sourcebook for Industry" to "Pump Life Cycle Costs"), market assessments, resource/reference materials, training materials, Case

[5] "Decision Tools for Industry: A Portfolio of Powerful Assessment Tools," version 4.00.00, July 2001, CD available from the ITP Clearinghouse, 800-862-2086.
[6] It should be noted that updated versions of the individual tools and of the CD have been produced since the time period covered by this metrics evaluation.
[7] Blackburn, Lee, University of Tennessee, "Publications Review for Energy BestPractices," spreadsheet-based inventory of BP publications, May 2, 2003.

Studies of plants that have made significant energy-efficient improvements, and repair documents. In the FY02 metrics evaluation, only hard-copy distributions are counted for estimating savings.

1.3.5 Technical Assistance Calls

Technical assistance is provided by the ITP Clearinghouse via email, fax, or a technical assistance phone line. Technical assistance phone calls are fielded by engineers or by other research/technical staff members of the Clearinghouse. Energy savings have been estimated in the $100,000/year per call for some of the assistance provided.[8] In this report, only technical assistance provided over the phone has been considered. No attempt has been made to estimate energy savings from email and fax responses.

1.3.6 Case Studies

Case Studies profile demonstrated energy projects at the plant level. The Case Studies provide "how to" guidelines for replicating the practices that have been proven to work. In the structure of the FY02 evaluation, the Case Studies delivery channel represents Case Studies conducted after referral by an Allied Partner or other EERE source. The savings estimates from this channel represent the Case Study project and not the dissemination of the results. Savings resulting from the printed Case Study are captured under the delivery channel for printed materials.

1.3.7 Plant-wide Assessments and Replications

In addition to the CTA described in Section 1.3.1, there is another type of assessment conducted by the BP Program. The Plant-wide Assessment (PWA), which was initiated in 1999, is a cost-shared assessment of utility and process-related energy efficiency opportunities across a plant. Plants within energy-intensive industries are eligible for PWAs through competitive solicitation, while non-competitive awards are made for Showcase plants (see also Section 1.3.8).

After a PWA has been conducted and plant energy savings have been realized, the plants are encouraged to replicate their results at sister plants. These replications can result in significant savings.

1.3.8 Other Publications and Events Not Reported in Technology Areas

The BP Program also publishes a newsletter, *Energy Matters*. The newsletter, issued bimonthly, carries articles from experts, helpful hints for energy optimization, and other news. Over 30,000 copies of the newsletter were printed in FY02; almost 8,000 separate facilities received copies. According to a survey conducted by Xenergy, about one-third of the plants receiving the newsletter implement energy improvements based on information found in the newsletter.[9]

Showcase demonstrations are public events to publicize and demonstrate energy savings practices. At a Showcase, several concurrent activities (e.g., PWA, CTA, training, facility tour)

[8] Link, Lee, Clearinghouse, email message, April 27, 2003.
[9] Xenergy Inc., *Final Report, Evaluation of the Motor Challenge Program,* May 2000, p. 3-17.

will demonstrate how a systems approach can result in significant savings. Because of the possibility of double-counting, savings from Showcase events are not included in this evaluation.

Energy events are yet another mechanism for addressing specific energy issues. The California Energy Fairs in FY02 were examples of energy events. The goal of energy events is to provide a venue for an interdisciplinary, systems approach to solving energy problems.

Savings resulting from Case Studies, technical assistance calls, and the distribution of hard-copy publications are reported in specific technology areas. In addition, these activities sometimes apply to multiple areas; in these cases, savings are counted in the comprehensive category.

1.3.9 Internet

Information is also disseminated via Internet access.[10] From the BP website, internet users may download software (Section 1.3.3) and a full-range of documents from the publications library (Section 1.3.4). In addition, there are numerous links to other energy-saving sites, a list of Allied Partners, and overviews concerning the suite of BP programs.

1.3.10 Summary

These multiple sources of information and assistance act in concert to provide technical information and practical solutions to energy managers in industrial facilities. For example, a particular energy manager at a specific industrial facility may have received the newsletter, downloaded all the steam tip sheets from the website, and received a DTCD from the Clearinghouse with the Steam System Scoping Tool. The newsletter may have whetted his or her appetite for more specific information, which one or more of the tip sheets may have encouraged but not satisfied. He may have then acquired the software to get a better estimate of what benefits he would experience by implementing a number of specific measures. Finally, convinced that some changes would make a material difference in his facility's energy bill, he contracted with an outside company to make a detailed study of his facility and propose a project to be implemented.

In this report, an effort has been made to evaluate and separate the impact of each of these delivery channels.

1.4 PURPOSE OF THIS REPORT

This report describes the process for estimation of the energy savings of the BP Program. Energy savings were estimated for each of the separate technology areas by each of the delivery channels.

The overlapping and interactive structure of these program components leads to the possibility of double counting the energy savings when estimating savings attributable to each component of the Program separately. Nonetheless, it is these separate components that offer quantification to

[10] "ITP, BestPractices, Tools and Publications," http://www.oit.doe.gov/bestpractices/pubs.shtml .

an evaluation of the Program's accomplishments, and this report focuses on savings possibilities from the individual components. Attempts have been made to identify areas where double counting is possible, and efforts to avoid double counting are documented in the report.

The purpose of the evaluation effort is to provide an organized and defensible estimate of total energy savings resulting from BP Program products and activities.

2. METHODOLOGY FOR ESTIMATING ENERGY SAVINGS

Although BP is an extremely diverse deployment program, a consistent methodology has been adopted to estimate energy savings. The basic metrics model contains three factors:

1. The number of unique plants touched by the BP Program activity.
2. The unit energy savings for the action.
3. The proportion of plants taking an action to implement savings or the fraction of energy savings achieved.

The process for determining savings (Figure 1) is followed for each delivery channel within each technology area.

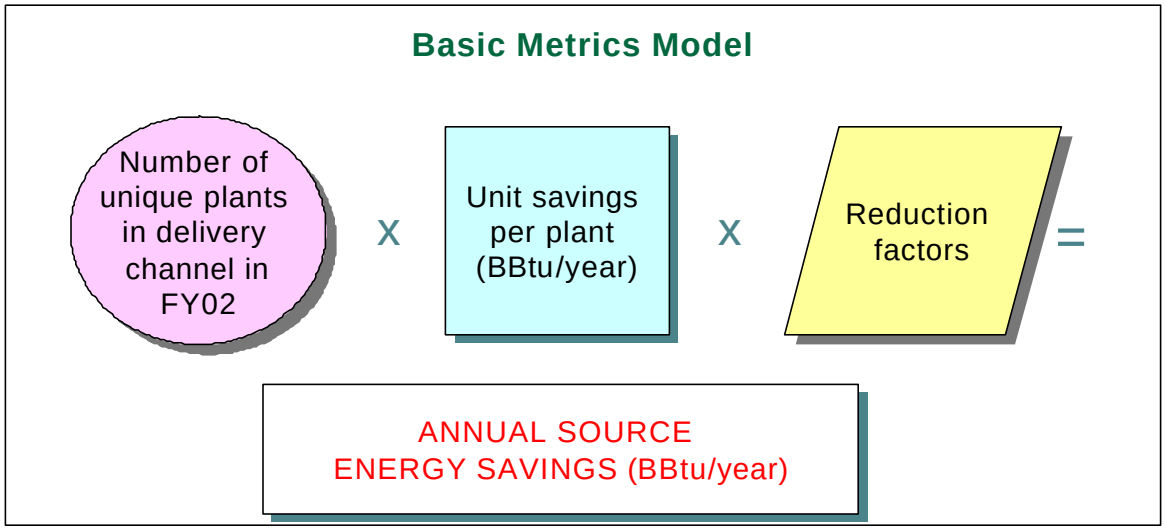

Figure 1. Basic metrics model for estimating energy savings from components of the BP Program.

To calculate estimated energy savings, information on BP plant activities, energy savings, and reduction factors from appropriate data sources across delivery channels were gathered. For example, the total energy savings attributed to the steam area in FY02 was assessed based on numbers of CTAs, steam training, software tools distribution, distribution of printed materials specific to steam (e.g., tip sheets and technical publication shipments), steam-related technical assistance telephone calls fielded by the Clearinghouse, and Case Studies directly related to steam systems.

Because energy savings are assessed at the plant level, it was necessary to determine participation at that particular level. Therefore, when the number of "individuals" participating in an activity was known, this number had to be converted to the number of "unique plants" involved. Through the ITP Tracking Database [administered by Lawrence Berkeley National Laboratory (LBNL) and Project Performance Corporation (PPC)], this conversion was conducted when sufficient information had been submitted to the Tracking Database to make the determination. When the Tracking Database had information on an event but did not have

sufficient information to identify the number of unique plants at an event, a factor based on other data sources was applied to determine the number of unique plants.

The definition of "unique" plant does not imply that the plant has never been touched by a BP Program activity. A plant that received the benefits of a PSAT training session in FY01, for example, might repeat the training for additional employees in FY02. That plant would be counted as a unique plant in both FY01 and FY02.

In addition to itemizing and evaluating the activity levels within each technology area, a separate assessment was included for the energy savings attributable to those cross-cutting areas that were not specific to a particular technology area. These activities included PWAs and PWA replications; the *Energy Matters* newsletter; Showcases; energy events; and additional publications, technical assistance calls, and Case Studies not reported in the technology areas.

2.1 DATA SOURCES

The following resources, most of which are members of the BP implementation team, provided data which were used in the development of BP program savings estimates: Oak Ridge National Laboratory (ORNL),[11] LBNL, PPC, the ITP Clearinghouse at Washington State University, the National Renewable Energy Laboratory (NREL), Energetics Inc., and the Industrial Technologies Program Office.

In addition, several published documents were also used. Finally, other resources were searched to substantiate the metrics [e.g., the Industrial Assessment Center (IAC) database]. All sources of information, whether published documents or personal communications, are provided in the Sources listing at the end of this document. It should be noted, however, that not all of the references included in this list are publicly available.

2.1.1 Oak Ridge National Laboratory

The ORNL Industrial Energy Efficiency Group supplied information on savings resulting from CTAs and PWAs.

The "ORNL 2002 Activities Report" was used to obtain energy savings from CTAs conducted during FY02. These CTAs identified both electricity savings and energy savings. Generally, a CTA was able to survey only one-third to as much as three-quarters of an industrial facility, depending on the facility's size, so this transfer of energy savings was likely to offer a low estimate of using the software tool over an entire plant. Therefore, CTA savings were reported by ORNL as implemented energy savings.

In addition, a two-year (FY01-FY02) average of savings estimates from CTAs was used to represent savings that could be obtained from training and from application of the corresponding software tool. Average energy savings were derived by adding the savings for all successful

[11] It should be recognized that the team of ORNL evaluators who developed this metrics report is not part of the ORNL Industrial Energy Efficiency Group, which is a member of the BP implementation team.

CTAs conducted during FY01-FY02, by technology area, and dividing by the number of successful CTAs conducted in that area.

All PWAs were conducted on a cost-share basis and were monitored by ORNL. In addition to the "ORNL 2002 Activities Report," the "Plant-wide Assessments – Status Report" was used to obtain energy savings from PWAs and PWA replications. Following a PWA, four out of five plants will implement all recommendations and will experience greater energy savings than expected. Using the total energy savings values identified during a PWA assumes that the four plants that achieved greater savings would outweigh the single plant that did not implement all recommendations. All values for PWA replications are implemented savings.

2.1.2 Lawrence Berkeley National Laboratory and Project Performance Corporation

LBNL and PPC worked together to design and develop a database to collect, validate, and analyze information on attendees at events, recipients of software, and Allied Partners activities. Thus, the primary data source on counts of training and DTCD distribution activities was the ITP Tracking Database, which provided specific activity counts by number of unique plants involved, when known. Information was provided in the form of spreadsheets with detailed information. Implementation of the centralized Tracking Database was an extremely important improvement made in FY 02 to the tracking process. Being able to rely on a single source for most of the counts of activities greatly streamlined the process of metrics estimation.

Because the Tracking Database collects affiliation information, the number of unique plants, by plant type, can be determined for an activity category. For the metrics report, the entity types to be considered are plants (industrial end users), probable plants (unknown but fairly sure of designation), and other companies (suppliers/consultants). The Training Activities Report from the Tracking Database provided these counts for training sessions. Usually, multiple plants are represented at the training sessions; for example, for 72 total training sessions, there were 569 total entities (including associations, utilities, and other) that participated. When attendee lists are provided, then the Tracking Database is able to provide the number of unique entities (i.e., plants). For some sessions, however, there are no attendee lists. In training sessions with no attendee lists, the total number of attendees is usually known. For these sessions, a different factor (see Section 2.2.2) was used to estimate the number of unique plants represented.

The Tracking Database provides the total number of DTCDs distributed through a training, a bulk fulfillment request, or an event, conference, meeting, etc., for which attendee lists make it possible to determine the number of unique plant recipients. As with the training participants, this number of plants includes ONLY plants, probable plants, and other companies (supplier/consultants). It excludes the tracking categories of associations, utilities, and other. To obtain the number of DTCDs distributed via NON-training events, all participants at training events were subtracted. Thus, the possibility of double counting overlapping energy savings between training and software distribution was eliminated.

In addition to the Tracking Database information and data, LBNL provided information on Case Study energy savings results.[12]

2.1.3 Clearinghouse

The ITP Information Clearinghouse at Washington State University assembled information on tip sheet and publication package distribution by technology area.[13] As noted by the Clearinghouse contact, it was sometimes impossible to separate the publication shipments into a particular technology area. In these cases, the publications were counted in the "comprehensive" or cross-cutting distribution category.

The Clearinghouse also provided information on technical assistance calls.[14] The analysis was limited to technical assistance phone calls and, further, to only those calls with topics that might directly relate to energy savings. Unfortunately, this eliminated some cases with energy-savings impacts. (Thus, many in-depth cases involving programmatic issues, technical issues in the roadmaps or other technical documents, as well as the technical application of industrial technologies where the interest was in the technology, not in the energy-savings aspects per se, were eliminated.) The cases were further limited to three categories that had a substantive investment in technical staff time and were then broken down again by the end-use topics (motors, steam, etc.). A "multiple/other" category was added because much of the energy savings would come from areas such as combined heat and power, chillers, heat recovery, specialized industrial processes, refrigeration, water heating, etc.

This method uses time-on-case as a proxy for the size of the energy-savings outcome, which will not always be true. Large savings could still result from only modest investments of staff time.

2.1.4 National Renewable Energy Laboratory

NREL supplied information on distributions of both hard-copy materials and publications downloaded from the web. NREL manages the contract with Opinion Research Corporation (ORC) Macro. ORC Macro supports the BP Program by supplying publication packages as requested. These counts of publication packages also include documents sent to the DOE Resource Room.[15] Counts of these publications were not sorted by technology category; hence, all were placed and counted in the comprehensive or cross-cutting distribution category.

In addition, NREL supplied information on the number of publication downloads from the BP website. Data were not available on pdf downloads until just prior to the delivery of the draft version of this report. Therefore, energy savings from pdf downloads were not included in this report

[12] McKane, Aimee, and Bruce Lung, email messages, May 14, 2003.
[13] Link, Lee, Clearinghouse, email message, March 23, 2003.
[14] Link, Lee, Clearinghouse, email message, April 17, 2003.
[15] Sosa-Mallory, Michele, NREL, email message, May 2, 2003.

2.1.5 Other Documents and Sources

The assessment relies on published evaluations, where possible, for estimates of energy savings from particular actions. These source materials include reports by Xenergy, *Final Report, Evaluation of the Motor Challenge Program* and *Evaluation of the Compressed Air Challenge Training Program*, and by the National Electrical Manufacturers Association (NEMA), *NEMA Standards Publication No. MG-1-1998 (Revision 2, 2001), Motors and Generators.* In addition, the IAC database was used to determine the fraction of plants implementing actions and the average value of energy savings from tip sheets. The IAC database contains detailed data on over 11,000 assessments conducted from 1987 to 2002. The data includes energy and cost savings estimates for over 80,000 IAC assessment recommendations.[16] Numerical counts of certain events and actions were taken from the *Technology Delivery Fiscal Year 2002 Activity Report* (February 2003).[17] These counts included information about Showcases, Case Studies, energy events, software downloads, and web statistics.

Additional sources were used as appropriate to modify or moderate assumptions, to validate savings estimates from other sources, or to arrive at a minimum savings based on available data. For example, to calculate energy savings resulting from energy events that occurred during FY02, responses were taken from the "Energy Event Overview,"[18] a report based on follow-up interviews with participants at the three Energy Solutions for California Industry events. Surveys conducted by an Allied Partner at the company's 2003 National Sales Conference were analyzed to determine steam software, tip sheet, and publication package usage and importance.[19] Summary evaluations of BestPractices Steam Workshops were used to validate these numbers.[20] Estimates of energy savings were collected from a published study of IAC steam assessments conducted using BP steam tools.[21] These estimates were used to develop a reduction factor for energy savings generated by untrained users of BestPractices software.[22]

The ORNL evaluation team contracted with the Energy, Environment and Resources Center of the University of Tennessee to conduct a limited number of interviews with recipients of BP software tools. Some of the interviewees had participated in training sessions, and some had not. Persons trained as PSAT Qualified Specialists in FY01 were interviewed to determine how they had used their expertise during FY02. The interviews were limited by the necessity of interviewing no more than nine individuals in each category. Completed interviews with persons who completed the Qualified Specialist training course in FY01 indicated that these persons were not using their knowledge to apply the tool in their own facilities; however, they were using their skills in other facilities and to train other users. The energy savings that were identified as

[16] "The IAC Database," http://www.oit.doe.gov/iac/tools.shtml .
[17] Margolis, Nancy, Energetics Inc., February-May, 2003.
[18] "Energy Event Overview," Prepared by Lawrence Berkeley National Laboratory and Project Performance Corporation, November 27, 2002.
[19] Martin, Michaela, compilation and summary of results of survey conducted by Spirax Sarco of their sales force, May 15, 2003.
[20] Salmon-Cox, Peter, and Fred Hart, personal communication, April 14, 2003.
[21] Wright, Anthony, et al., "Results from the Industrial Assessment Center (IAC) Steam Tool Benchmarking Support Project," Winter 2003.
[22] Martin, Michaela, review of energy savings from IAC steam assessments identified in Wright et al., May 12, 2003.

occurring during FY02 by Qualified Specialists who were trained in FY01 were documented (Appendix B) for the current metrics evaluation.

A literature search was conducted and additional resources were reviewed. These documents and reports are listed in the Sources listing at the end of this report. They are discussed, as appropriate, in other sections of the report.

2.2 SPREADSHEET STRUCTURE AND CALCULATIONS

The BP metrics spreadsheet is organized by technology area, plus a comprehensive area for assessing energy savings that cannot be assigned to a single technology area. All savings are expressed in billion British thermal units (BBtu) of source energy.

2.2.1 Calculations by Technology Area

As noted earlier, the observational unit taking an action that saves energy is the individual industrial plant. The number of unique facilities receiving one of the information products or services is multiplied by the proportion of those facilities that implement some action on the basis of the information. The result is the number of facilities taking an action. That number multiplied by the average unit energy savings that a particular mechanism identifies yields the total energy savings estimated to have derived from the distribution of that particular information product or service.

Within each technology area (pumps, process heat, steam, compressed air, motors, and insulation), the spreadsheet is set up to calculate energy savings by delivery channels (CTAs, training, software distribution, tip sheets, technical assistance calls, publication packages, and Case Studies). As shown in Table 1, not all delivery channels are used in all technology areas. A total savings for each technology area is derived.

In addition, there is a comprehensive area, which is used to calculate energy savings for those delivery channels that are not specific to a single technology area but are cross-cutting over all technology areas.

2.2.2 Calculations by Delivery Channel

CTAs

In general, when a facility receives a CTA, it will implement most if not all of the recommended actions; thus, no additional reduction factor is taken to account for the fraction of plants that might implement an action. A CTA is targeted to a particular area of a plant and is not a comprehensive system-wide assessment; thus, additional savings may be found in other areas of the facility fairly easily by plant personnel. Therefore, the energy savings value identified by a CTA is a conservative estimate of total savings for these activities. Within each technology area, the combined savings for all CTAs conducted in that area are counted.

An example of the basic metrics model for assessing CTA savings is shown in Figure 2. This example shows the calculation of energy savings in the steam technology area. The total CTAs that had savings recommendations and the unit savings in each technology area for FY02 are shown in Table 2.

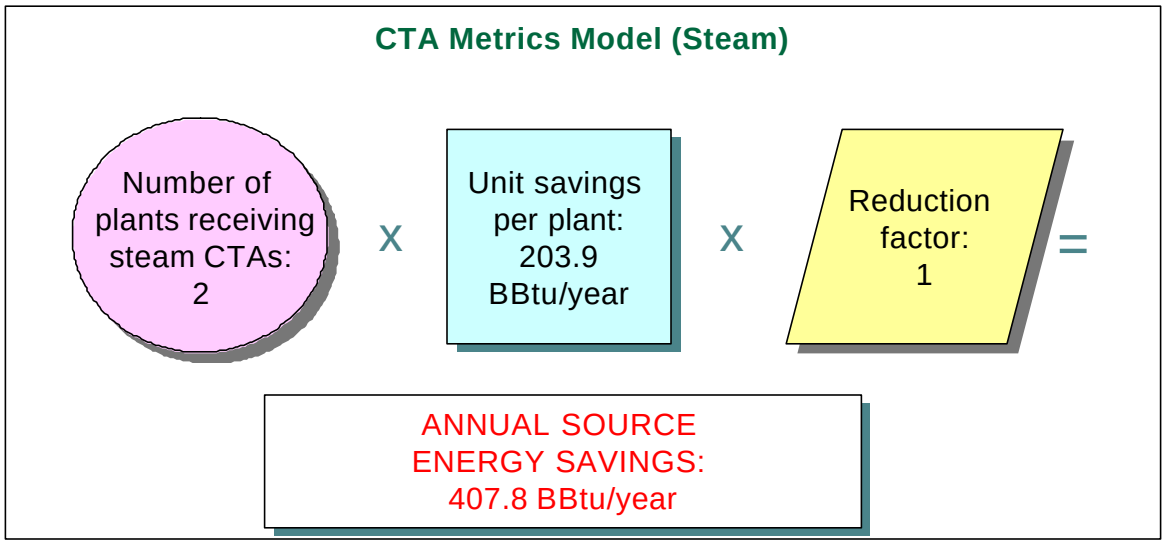

Figure 2. Basic metrics model representing CTA savings, using steam as the example technology area.

Table 2. Unique plants, reduction factor, unit savings, and total savings (billion Btu) for CTAs by technology area, FY02

	Pumps	Process heat	Steam	Compressed air	Motors	Insulation
Total unique plants[a]	10	2	2	6	0	0
Reduction factor	1	1	1	1	1	1
Unit savings	18.4	266.3	203.9	26.3	NA[b]	NA
Total savings[c]	183.8	532.5	407.8	157.8	0	0
Total energy savings for all technology areas = 1,281.9 BBtu						

[a]This is the number of CTAs conducted that had actual savings recommendations.
[b]Not applicable.
[c]Totals may not compute precisely because of rounding.

The two-year average of the identified energy savings for CTAs in each technology area was calculated for use as a measure of unit energy savings that a plant might experience if it instituted appropriate energy savings improvements from training and software distribution channels. Savings identified through CTAs for FY01 and FY02 and the average over both years is given in Table 3.

Table 3. Number of CTAs conducted and average energy savings (billion Btu) for CTAs conducted during FY01 and FY02

Technology area	FY01		FY02		Average savings over FY01-FY02[b]	Percent change, FY01 to FY02
	CTAs[a]	Savings	CTAs	Savings		
Pumps	11	90.1	10	18.4	55.9	-80%
Process heat	8	284.4	2	266.3	280.8	-6%
Steam	14	121.4	2	203.9	131.7	68%
Compressed air	8	45.5	6	26.3	37.3	-42%
Motors[c]	0	NA[d]	0	NA	1.1	NA
Insulation[e]	5	71.5	0	NA	71.5	NA

[a]This is the number of CTAs conducted that had actual savings recommendations.

[b]The average over both years is calculated based on the total savings (not the average savings) for both years divided by the total number of CTAs conducted during both years.

[c]There were no CTAs in the motors technology area for either FY01 or FY02. As a surrogate for an average energy savings, a value of 1.1 BBtu was used; this number was calculated based on relevant motor recommendations from the IAC database.

[d]Not applicable.

[e]There were no CTAs in the insulation technology area for FY02; thus, the overall average is the same as the FY01 average value.

Sources: ORNL, "ORNL 2001 Activities Report" and "ORNL 2002 Activities Report" for all technology areas except motors. For motors, see note *c*.

As noted in Table 3, there can be significant changes in the average CTA savings from year to year. In FY01, more time was spent in each plant; therefore, FY02 results may not be as representative of total savings as FY01 because less time was spent on-site conducting the CTAs. In addition, the averages each year are based on the total number of CTAs conducted that year; thus, the impact from a single CTA with extreme results (either very large or very small savings) will affect the average based on the total number of CTAs conducted in that technology area.

Training

To determine the energy savings in each technology area for the training delivery channel, the first task was to determine the number of plants involved in training. As noted in Section 2.2.1, the Tracking Database provided the number of unique plants when known. For all other training sessions, the reduction factor shown in Table 4 was used to derive the number of unique plants at training sessions.

Table 4. Derivation of number of unique plants attending training sessions, FY02				
Technology	**Known unique plants** + (**Attendees without affiliation** X **Reduction factor for unique plants**[a]) =			**Unique plants**
Pumps	165[b]	165	0.56	247
Process heat	24	53	0.46	48
Steam	103	31	0.46	117
Compressed air	238	118	0.37	281
Motors	89	20	0.46	98
Insulation	0	0	0	0

[a]Pumps and compressed air values were noted by the Xenergy Motor Challenge and CAC Training Evaluation reports; for others, the average of the pumps and compressed air values were used.

[b]This number of known unique plants includes ten plants that implemented actions based on recommendations of Qualified Specialists, as reported in the survey conducted by the ORNL evaluation team.

The ORNL evaluation team contracted with the University of Tennessee to conduct interviews with individuals who had been trained as PSAT Qualified Specialists in FY01. (In FY01, only the pumping tool was used in Qualified Specialist training.) Energy savings identified in these interviews were applied to the FY02 evaluation. The total number of unique plants identified by the Qualified Specialists as implementing actions was multiplied by the unit savings to derive energy savings from Qualified Specialist activities.

The basic metrics model for training is shown in Figure 3. This example shows the calculation of energy savings in the compressed air technology area. The process flow to calculate the total energy savings based on training for a specific technology area is shown in Appendix C, Figure C.1.

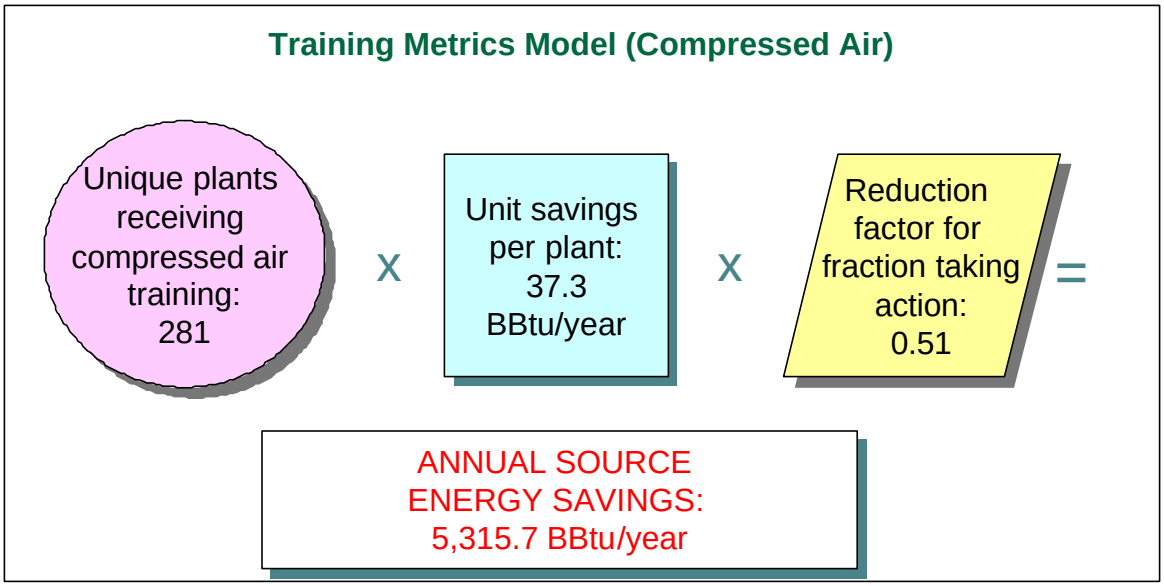

Figure 3. Basic metrics model representing energy savings based on training sessions, using compressed air as the example technology area.

The total plants represented at training sessions were multiplied by a factor representing the fraction of plants that will actually implement energy savings. As discussed previously, the two-year CTA average was used to represent an average unit energy savings per plant implementing actions. Table 5 provides the total unique plants, action reduction factor, unit savings, and total savings by technology area.

Table 5. Unique plants, reduction factor, unit savings, and total savings (billion Btu) for training sessions by technology area, FY02

	Pumps	Process heat	Steam	Compressed air	Motors	Insulation
Total unique plants	247[a]	48	117	281	98	0
Reduction factor for fraction taking action[b]	0.48	0.49	0.49	0.51	0.49	0.49
Unit savings	55.9	280.8	131.7	37.3	1.1	NA[c]
Total savings[d]	7,201.1[e]	6,696.3	7,615.7	5,315.7	53.4	0
Total energy savings for all technology areas = 26,882.1 BBtu						

[a]Number of unique plants in end-user training, including ten plants that were known to have implemented actions based on recommendations of Qualified Specialists.

[b]Pumps and compressed air factors are from the Xenergy Motor Challenge and Compressed Air Challenge reports. Other factors are an average of pumps and motors. The ORNL evaluation team conducted a survey of seven individuals who had received PSAT training and learned that three out of seven (43%) used the software to identify and implement projects. This is in line with the 0.48 factor for pumps.

[c]Not applicable.

[d]Totals may not compute precisely because of rounding.

[e]Includes both FY02 end-user training sessions and results from activities of Qualified Specialists trained in FY01.

Software distribution

Another source of energy savings is based on application of the software tools. The tools, which may be downloaded directly from the Internet as individual software packages, may also be acquired as part of the DTCD at events or requested from the Clearinghouse. In 2002, the DTCD included the following software: MotorMaster, PSAT, Steam System Scoping Tool, AirMaster, and 3E+. PHAST was available only on a limited basis, as a Beta version, in FY02.

When a recipient acquires a DTCD, it contains five different software tools. Thus, it was necessary to determine the share of usage for each software package from the DTCD. To do this, counts of each of the individual software tools downloaded in FY02 were taken from the *Technology Delivery Fiscal Year 2002 Activity Report*, p. 19. For MotorMaster, a separation of downloads for U.S. and international recipients was available; therefore, in the spreadsheet for calculating savings based on receipt of the motor software tool, only U.S. downloads were counted. To calculate the percentage of downloads for each the tools, both U.S. and international downloads were counted because separation of international downloads was not available for tools other than MotorMaster.

The numbers of individual software downloads during FY02 for each software package were then summed, and the percentage of each to the total was calculated (Table 6). Thus, AirMaster = 30.2%; MotorMaster (both international and U.S.) = 25.33%; PSAT = 9.04%; Steam = 17.02%; and 3E+ = 18.41%. These percentages were applied to the total number of unique plants receiving the DTCD to derive the share of usage per software tool. This reduction applies a conservative approach, which assumes that any plant that receives the entire DTCD will only apply one of the five tools. These percentages were applied only to DTCD usage, not to the individual software packages that were downloaded from the web.

Table 6. Percentage of each software tool downloaded from the Internet, FY02

Software tool[a]	Number downloaded	Percentage downloaded[b]
PSAT	1,459	9%
PHAST	NA	NA
Steam System Scoping Tool	2,748	17%
AIRMaster	4,876	30%
MotorMaster	4,089[c]	25%
3E+ (insulation tool)	2,972	18%

[a]The process heat software tool (PHAST) was not available in FY02.
[b]Total does not add to 100% because of rounding.
[c]To calculate the percentage of downloads for each tool, both U.S. and international downloads were counted.
Source: *Technology Delivery Fiscal Year 2002 Activity Report*, p. 19.

The Tracking Database provides the total number of DTCDs distributed through training sessions, a bulk fulfillment request, or an event, conference, meeting, etc. To obtain the number of DTCDs distributed via NON-training events (to avoid double counting), the number of participants at training events was subtracted from the number of total DTCD recipients. (The

number of participants at Compressed Air Fundamentals and Compressed Air Advanced training sessions was not subtracted because the DTCD was not used at these sessions.) The resulting number of DTCD recipients without training was used in EVERY technology area except process heat, because the DTCD could be used for any of the five possible tools.

After determining the number of software recipients who had received the DTCD at non-training events, this number was added to the number of DTCDs sent by the Clearinghouse and multiplied by the reduction factor for the share (Table 6) of usage of the tools on the DTCD. The result was added to the number of individual software downloads from the web. The total number of software tool recipients was multiplied by a reduction factor to determine the number of unique plants receiving the software (Table 7). This factor was derived from the Tracking Database of known unique recipients of DTCDs.

Table 7. Derivation of number of unique plants receiving software tools, FY02

Technology	(Total DTCDs dist.[a]	X Red. factor for DTCD tools[b]	+ Software down-loads)	X (Red. factor for unique plants[c]) =	Unique plants[d]
Pumps	2,217	0.09	1,459	0.57	946
Process heat	0	NA[e]	NA	NA	0
Steam	2,217	0.17	2,748	0.57	1,782
Comp. air	2,217	0.30	4,876	0.57	3,161
Motors	2,217	0.25	2,583[f]	0.57	1,792
Insulation	2,217	0.18	2,972	0.57	1,927

[a]Includes DTCDs distributed at non-training events (meeting, conference, etc.) and by the Clearinghouse.
[b]For the explanation of this reduction factor, see Table 6.
[c]Reduction factor based on the Tracking Database of known unique recipients of the DTCD.
[d]Totals may not compute precisely because of rounding.
[e]Not applicable.
[f]Does not include international downloads.

After estimating the number of unique plants that use BP software tools, additional reduction factors are applied to emulate typical energy savings generated by these plants. As with the other delivery channels, a reduction factor was applied in order to determine the number of unique plants that implement an action after receiving the software.[23] Unlike other delivery channels, an additional reduction factor, the energy savings reduction factor, was developed to scale down savings estimates to emulate likely savings generated from software use. Based on very limited discussions with BP software tool users, it is believed that users who do not receive software training are less likely to experience the full benefit of the tools. Additionally, CTAs (the basis for unit energy savings for most BP delivery channels) are conducted on large, energy-intensive facilities; however, plant personnel who download software or acquire a DTCD may be associated with plants that are much smaller than those for which CTAs are normally conducted. Energy savings data from a study of 18 IAC assessments conducted using the Steam System

[23] Xenergy, Inc., *Final Report, Evaluation of the Motor Challenge Program*, May 2000, p. 3-2.

Scoping Tool and 16 steam CTAs conducted in FY01 and FY02 were used to develop the reduction factor of 0.37.[24,25]

Table 8 provides the total number of unique plants receiving each of the software tools, each of the reduction factors discussed above, the unit savings for the tool by technology area, and the total savings.

Table 8. Unique plants, reduction factors, unit savings, and total savings (billion Btu) for the software delivery channel by technology area, FY02

	Pumps	Process heat	Steam	Compressed air	Motors	Insulation
Total unique plants	946	0	1,782	3,161	1,792	1,927
Fraction of plants implementing actions[a]	0.18	0.18	0.18	0.18	0.18	0.18
Fraction of energy savings achieved[b]	0.37	0.37	0.37	0.37	NA[c]	0.37
Unit savings	55.9	280.7	131.7	37.3	1.1	71.5
Total savings[d]	3,488.1	0	15,473.6	7,767.8	352.0	9,086.5
Total energy savings for all technology areas = 36,168 BBtu						

[a]From Xenergy, Motor Challenge report p. 3-2.
[b]For all but motors, a further reduction factor of 0.37 was applied, based on Martin's conversion of cost figures in the article by Wright, et al.
[c]Not applicable.
[d]Totals may not compute precisely because of rounding.

Software tools are an important product of the BP Program. When an Allied Partner surveyed its sales staff to learn which BP tools were most useful to them and their customers, the number one tool was the new Steam System Assessment Tool, followed by Case Studies, tip sheets, and the Steam System Scoping Tool. Sales team comments included, "I have never had these tools available. I am sure having them will help us and our customers create awareness and see the importance the government is giving energy savings." Another comment, "Provide a 'video' file on CD to explain how to use tools examples," illustrates the importance of providing training with software distribution – if a vendor feels that it is needed, then end-users would likely benefit from training.[26]

[24] Wright, Anthony, et al., "Results from the Industrial Assessment Center (IAC) Steam Tool Benchmarking Support Project," Winter 2003.

[25] The savings factor is the ratio of the average savings (49.2 BBtu/year) from 18 IAC steam assessments over the average savings (131.7 BBtu/year) from 16 steam CTAs. This reduction factor was applied to all technology areas except motors (because the Xenergy Motor Challenge report is well-documented in this area, no additional factor was applied to motors). Because technology-focused IAC assessments were conducted only for steam, conservative unit savings estimates for the other software technology areas are calculated by extrapolating the steam findings using the savings reduction factor. That is, the fraction of IAC to CTA savings experienced in the steam technology category, 0.37, is applied to the other technologies to identify more conservative estimates for energy savings in each.

[26] Martin, Michaela, compilation and summary of results of survey conducted by Spirax Sarco of their sales force, May 15, 2003.

When an end-user is particularly satisfied with a software tool, that user is likely to try other BP tools. For example, a plant that had been using the Clearinghouse for about six years and MotorMaster for about a year downloaded the AIRMaster software. The plant is currently combining suggestions from the software with additional assistance from Clearinghouse staff; the Clearinghouse expects this plant to identify savings opportunities of 20-40%.[27]

The basic model for estimating energy savings from the software delivery channel is shown in Figure 4, using the pumping technology area as an example. The process flow to calculate the total energy savings based on distribution of the software tool in a specific technology area is shown in Appendix C, Figure C.2.

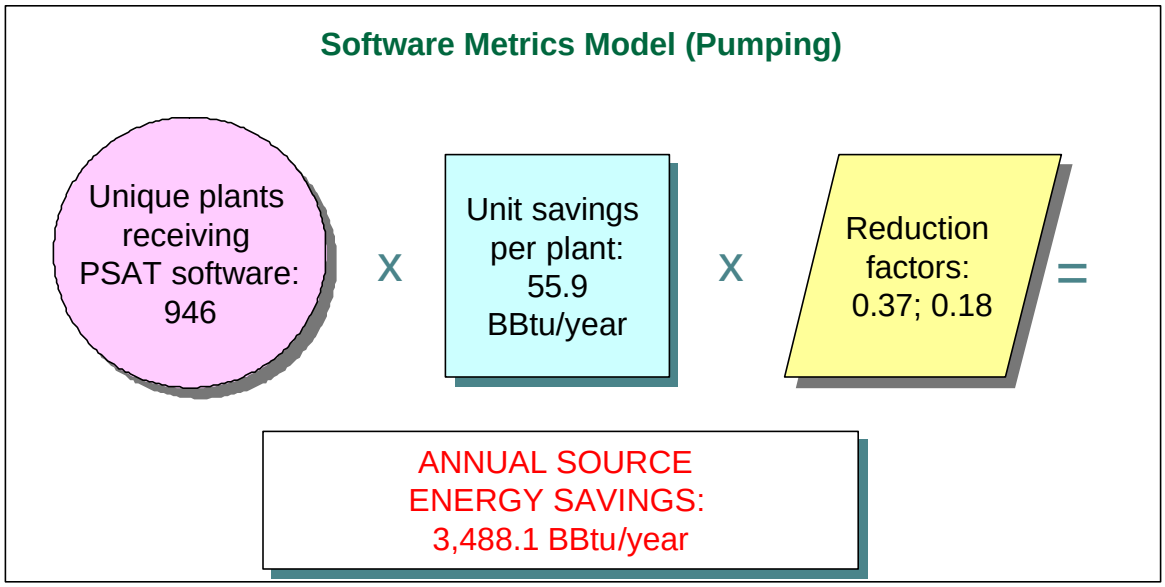

Figure 4. Basic metrics model representing energy savings based on distribution of the software tools, using pumping as the example technology area.

Tip sheets

Tip sheets may be acquired from the ITP Information Clearinghouse, Macro, or the DOE Resource Room. They may also be downloaded from the BP website. There was no record, however, of the total number of tip sheets that were downloaded from the web in FY02. The total number of hard-copy tip sheets distributed was multiplied by a factor for determining the number of unique plants receiving tip sheets (Table 9). This factor was based on the average factor of unique plants receiving software (0.57).

[27] Penney, Rob, ITP Clearinghouse at Washington State University, "OIT Clearinghouse Anecdotal Success Stories," email message, May 29, 2003.

Table 9. Derivation of number of unique plants receiving tip sheets, FY02				
Technology	**Known unique plants** + (**Counts of tip sheets distributed**[a] X **Reduction factor for unique plants**[b]) =			**Unique plants**
Pumps	0	0	0.57	0
Process heat	0	112	0.57	64
Steam	0	2,504	0.57	1,427
Compressed air	0	674	0.57	384
Motors	0	1,638	0.57	934
Insulation	0	0	0.57	0

[a]Data supplied by Clearinghouse, March 2003.
[b]Based on average of unique plants receiving software as calculated from the Tracking Database.

The estimate of unit energy savings from implementing the specific recommendations from individual tip sheets was calculated using technical information from the IAC database, the Xenergy Motor Challenge report, and the *NEMA Standards Publication No. MG-1-1998 (Revision 2, 2001), Motors and Generators.* To derive the total savings for a technology area, the number of unique plants receiving tip sheets was further reduced by a factor representing the fraction of plants implementing actions (Table 10). The factor for plants implementing actions (0.52) was based on responses from the survey conducted by an Allied Partner.[28] According to this survey, it was clear that tip sheets and documented Case Studies were just as useful to the sales personnel as was the software.

After determining the number of plants implementing actions, the result was then multiplied by the average energy savings for the tip sheets in a particular technology area. Table 10 shows the unique recipients of tip sheets by technology area, unit savings, and total savings for FY02. The basic metrics model for tip sheets is shown in Figure 5, using process heat as an example.

[28] Martin, Michaela, compilation and summary of results of survey conducted by Spirax Sarco of their sales force, May 15, 2003.

Table 10. Unique recipients, reduction factor, unit savings, and total savings (billion Btu) for tip sheets by technology area, FY02						
	Pumps	**Process heat**	**Steam**	**Compressed air**	**Motors**	**Insulation**
Total unique plants	0	64	1,427	384	934	0
Fraction of plants implementing actions[a]	0.52	0.52	0.52	0.52	0.52	0.52
Unit savings[b]	NA[c]	2.4	2.3	0.8	0.6	0.9[d]
Total savings[e]	0	80.9	1,690.7	162.0	301.0	0
Total energy savings for all technology areas =2,234.6 BBtu						

[a]Based on results of a survey conducted by an Allied Partner.
[b]Average tip sheet savings derived from the IAC database.
[c]Not applicable; the pumping tip sheets are included under motors.
[d]Insulation is a subset of the steam tip sheets.
[e]Totals may not compute precisely because of rounding.

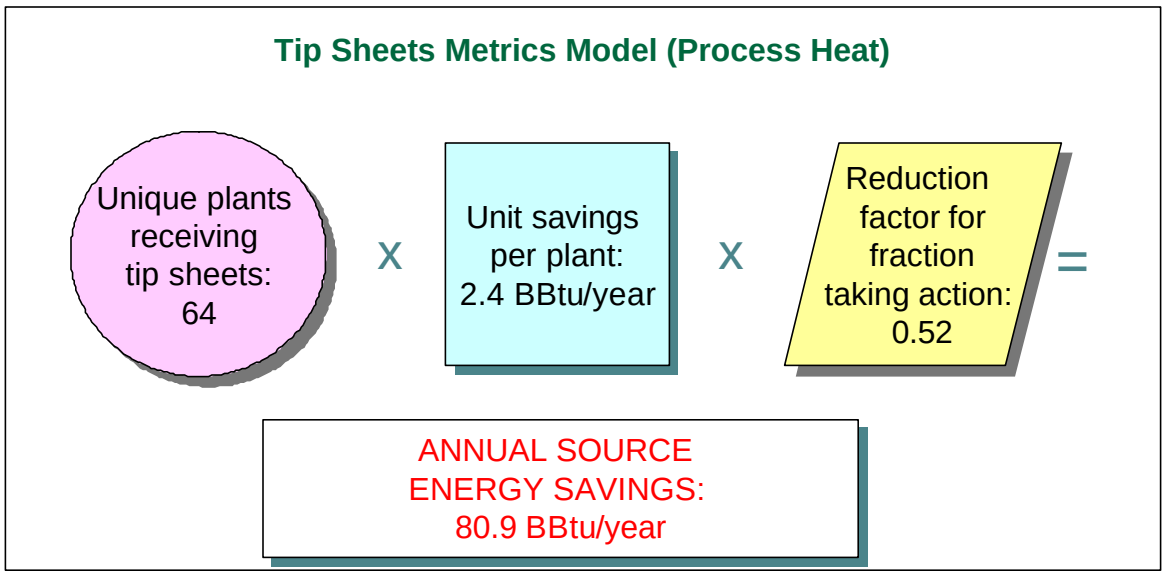

Figure 5. Basic metrics model representing energy savings based on tip sheets, using process heat as the example technology area.

Publication packages

Publications have been distributed by the ITP Clearinghouse, the DOE Reading Room, by Macro, and by Allied Partners. These publication packages do not include downloads from the web. Counts of publication shipments from the Clearinghouse, excluding counts of tip sheets, are shown in Table 11. These publications were separated into specific technology areas. The number of publications distributed by the Clearinghouse was reduced to estimate unique recipients. The reduction factor is the same as that used to determine the unique plants receiving software (0.57).

Table 11. Publications distributed by the Clearinghouse in specific technology areas			
	Publications sent from the Clearinghouse[a]	**Reduction factor to estimate unique recipients[b]**	**Unique recipients of publication packages**
Pumps	2,420	0.57	1,379
Process heat	1	0.57	1
Steam	1,607	0.57	916
Compressed air	1,068	0.57	609
Motors	6,158	0.57	3,510
Insulation	0	0.57	0

[a]Link, Lee, email, March 23, 2003.
[b]Based on fraction of unique plants receiving software from Tracking Database.

For the publication packages that could be attributed to a particular technology area, the energy savings were counted in that area. For publication shipments that could not be attributed to a specific technology area, the savings were counted in the cross-cutting or comprehensive category. Table 12 shows publications shipments that were not separated into specific technology areas. The total number of publications distributed was reduced to estimate unique recipients. Based on guidance supplied by the Clearinghouse, the reduction factor used to determine unique recipients of documents distributed by the Clearinghouse was set equal to 0.57, the same factor used to determine unique plants receiving software. Because Macro makes bulk distribution (e.g., 50 copies of a single publication to one recipient who then provides further distribution), a reduction factor of 0.2 was applied to estimate unique plants. This same reduction factor was applied to publications distributed from the DOE Resource Room and by Allied Partners. This factor, which is about one-third of the factor used to determine unique recipients of Clearinghouse publication packages, is a best estimate. The fraction of unique plants receiving publications based on these bulk distributions of publications is unknown.

Table 12. Publications distributed in the comprehensive category			
	Publications	**Reduction factor to estimate unique recipients**	**Unique recipients of publication packages**
Macro[a]	17,735	0.2	3,352
DOE Resource Room	8,075	0.2	1,526
Allied Partners	1,621	0.2	306
Clearinghouse[b]	4,034	0.57	2,299
Total[c]	31,465		7,484

[a]Excluding publications counted in categories of Resource Room, Allied Partners, or the Clearinghouse.
[b]These publications were classified by the Clearinghouse as representing more than one technology area.
[c]Totals may not compute precisely because of rounding.

The number of unique plants receiving publications was multiplied times a fraction of recipients that will implement some action. This fraction (0.38) was based on results of the Allied Partner

survey.[29] The result was multiplied times the average energy savings per publication package. This value was set at the value of the tip sheets in the individual technology areas. Because the pumps area has no tip sheets, another value for publication packages related to pumps was needed. The value of the tip sheets in the motors area was used as a surrogate for pumps. For insulation, the average tip sheet value was based on the insulation component of the steam tip sheets, as calculated from the IAC database. These values and the total energy savings from hard-copy publications, including the comprehensive category, are shown in Table 13.

Table 13. Unique recipients, reduction factor, unit savings, and total savings (billion Btu) for publications by technology area, FY02

	Pumps	Process heat	Steam	Comp. air	Motors	Insulation	Compre-hensive
Total unique plants	1,379	1	916	609	3,510	0	7,484
Fraction of plants implementing actions[a]	0.38	0.38	0.38	0.38	0.38	NA[b]	0.38
Unit savings[c]	0.6[d]	2.4	2.3	0.8	0.6	NA	1.4[e]
Total savings[f]	324.9	0.9	792.9	187.7	827.0	0	3,850.2
Total energy savings for all technology areas =5,983.6 BBtu							

[a]Based on results of a survey conducted by an Allied Partner.
[b]Not applicable.
[c]Based on value of average tip sheet savings, derived from the IAC database.
[d]The pumping value is based on tip sheets included under motors.
[e]Unit savings for the comprehensive category is derived from a weighted average based on the value of each tip sheet times the total number of publications available in each technology area.
[f]Totals may not compute precisely because of rounding.

The basic metrics model for estimating savings resulting from distribution of hard-copy publications is shown in Figure 6, using the technology area of steam as an example.

[29] Martin, Michaela, compilation and summary of results of survey conducted by Spriax Sarco of their sales force, May 15, 2003.

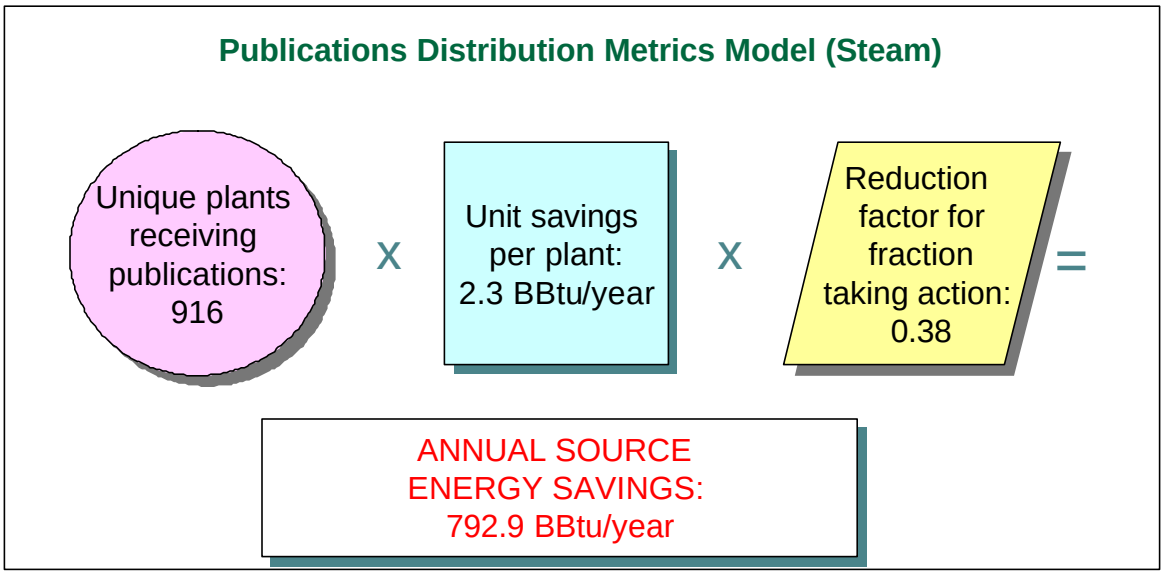

Figure 6. Basic metrics model representing energy savings based on distribution of hard-copy publications, using steam as the example technology area.

Technical assistance calls

The ITP Clearinghouse has both engineering and other research/technical staff available to provide technical assistance to industry concerning possible energy-saving measures. These calls were separated by technology area insofar as possible.

It should be noted that no reduction was taken to the number of technical assistance calls to determine unique plants because it was assumed that no two callers from the same plant would call with the same request for assistance. The number of technical assistance calls was multiplied by a factor to determine the number of callers taking action. The factor used was the same as the fraction of plants taking action following training sessions (see Table 5). This result was multiplied by the average energy savings addressed per call. No explicit energy savings value was placed on the technical assistance calls by the Clearinghouse; therefore, a value was estimated based on average tip sheet values (see Table 10). Values for tip sheets in the pumps and insulation technology areas were derived as explained in the previous section. The average steam tip sheet value was used for the multiple/other category. Calls that lasted longer than 2 hours and were handled by engineering staff were multiplied by a factor of 3.3 because it was assumed that the energy savings derived would be greater.[30] Table 14 shows the number of technical assistance calls and the estimated value of the calls by staff type and duration of call.

[30] Penney, Rob, Clearinghouse, phone conversations, May 2003.

Table 14. Number[a] and individual value[b] (billion Btu) of technical assistance calls during FY02 by staff type and duration of call									
	Engineering staff, <2 hours		Engineering staff, 2-10 hours		Other technical staff, any duration		Total number of calls, red. factor, and total savings		
Technology area	Number of calls	Unit savings[c]	Number of calls	Unit savings	Number of calls	Unit savings	Calls	Red. factor[d]	Savings
Pumps	7	0.6	1	2.0	3	0.6	11	0.48	4.0
Process heat	0	2.4	0	8.0	0	2.4	0	0.49	0
Steam	61	2.3	3	7.5	7	2.3	71	0.49	87.5
Compressed air	62	0.8	5	2.7	1	0.8	68	0.51	32.7
Motors	221	0.6	4	2.0	23	0.6	248	0.49	78.6
Insulation	0	0.9	1	2.9	0	0.9	1	0.49	1.9
Total calls and total savings in technology areas							399		204.6
Multiple/other[e]	115	2.3	10	7.5	60	2.3	185	0.49	233.6
Total calls and total savings							584		438.2

[a]Source: Link, Lee, email, March 23, 2003.
[b]Based on average tip sheet values.
[c]The pumping value is based on tip sheets included under motors; the insulation value is based on the insulation component of the steam tip sheets.
[d]Reduction factor based on fraction taking action after a training session.
[e]These were calls that could not be applied to a single technology area

The basic model for estimating the energy savings from technical assistance calls is shown in Figure 7, using motors data as an example.

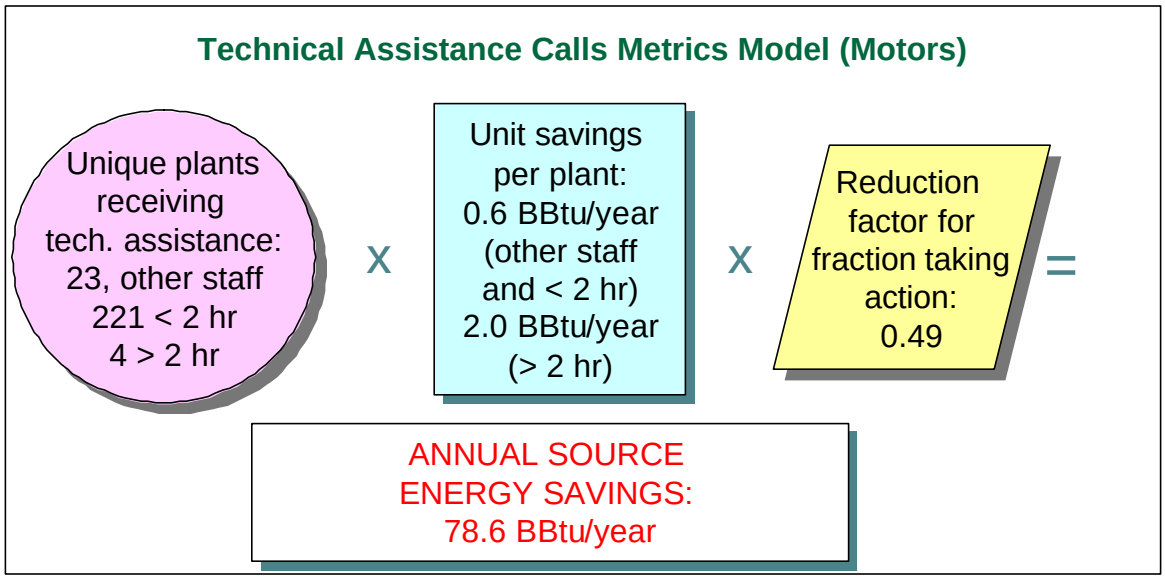

Figure 7. Basic metrics model representing energy savings based on technical assistance calls, using motors as the example technology area.

Technical assistance calls from a particular plant may span several areas. For example, one plant superintendent called for some simple motor systems assistance. The Clearinghouse engineering staff helped the company figure out why motors needed to be replaced frequently. Subsequent discussions opened up opportunities in process heating, steam, and compressed air. This particular customer, who had been unfamiliar with ITP resources, was pleased with the services provided.[31]

Case Studies

All of the 21 Case Studies included in the FY02 metrics report were Allied Partner related. The energy savings for the Case Studies resulted from four pump studies, five motor studies, two steam studies, and nine compressed air studies. In addition, one Case Study, with savings included in the comprehensive area had a BP topic area of Distributed Energy Resources. None of the Case Studies were related to PWAs, CTAs, or software distribution; therefore, no energy savings were double counted.[32] The basic metrics model representing energy savings from Case Studies is shown in Figure 8, using the pumping technology area.

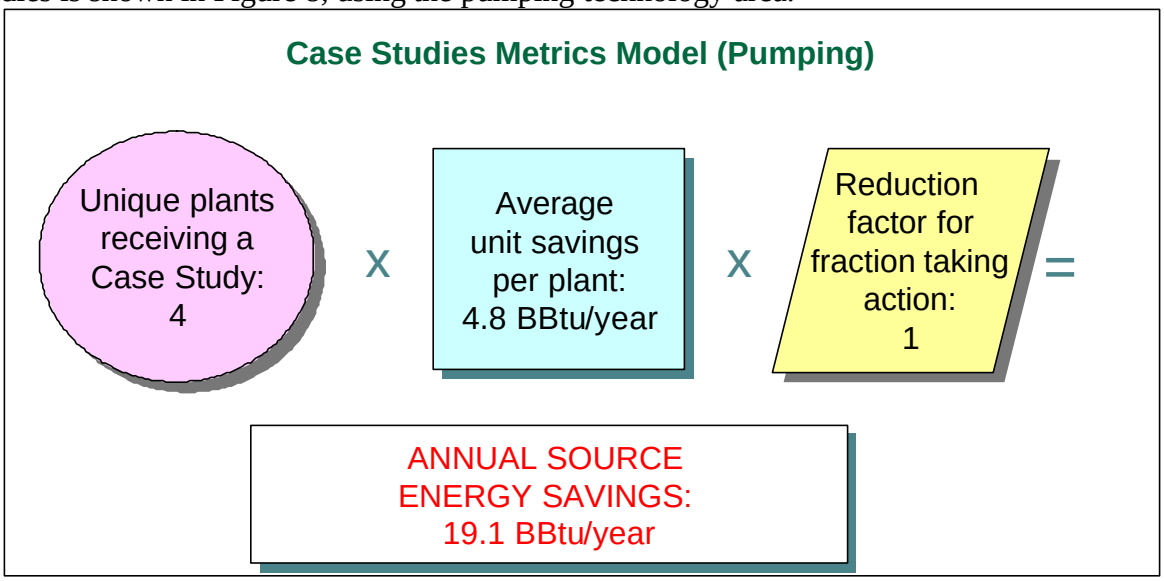

Figure 8. Basic metrics model representing energy savings based on Case Studies, using pumping as the example technology area.

Case Studies have only been completed at a limited number of facilities. It is probable that savings have also been realized at other facilities as a result of Allied Partner efforts. However, because they have not been recorded, they are not included in this estimation. Table 15 shows the number of Case Studies and total savings by technology area for FY02.

[31] Penney, Rob, ITP Clearinghouse at Washington State University, "OIT Clearinghouse Anecdotal Success Stories," email message, May 29, 2003.
[32] Lung, Bruce, email, May 14, 2003.

Table 15. Number and savings from Case Studies (billion Btu), FY02			
Technology area	**Number of Case Studies**	**Reduction factor**	**Total savings**
Pumps	4	1	19.1
Process heat	0	1	0
Steam	2	1	16.6
Compressed air	9	1	199.2
Motors	5	1	62.6
Insulation	0	1	0
Comprehensive	1	1	16.6
Total	21		314.2
Source: McKane, Aimee, and Bruce Lung, email messages, May 14, 2003.			

PWAs

Determination of energy savings is straightforward for PWAs. ORNL conducted follow-up interviews with plants that had received PWAs. Out of five plants, four would implement all of the recommendations and one would do nothing. For those plants implementing the recommendations, the actual savings would be greater than expected. Therefore, because the energy savings values identified by PWAs are good estimates of actual savings for these activities, the reduction factor for plants taking action is 1.

During FY02, replications of PWAs at "sister" plants were documented. Four plants successfully replicated their PWA recommendations at an additional ten facilities. Total savings from PWA replications are counted, with no further reduction. Table 16 shows the total PWAs and PWA replications for FY02, the reduction factor, and the total savings.

Table 16. Summary of PWAs, replications, and resulting savings (billion Btu), FY02			
	Number of plants	**Reduction factor**	**Total savings**
PWAs	17	1	5,163.1
PWA replications	10	1	3,011.0
Total savings			8,174.1

Alcoa (aluminum plant) is an excellent example of the importance of PWAs. As a result of PWAs, which resulted in significant savings, Alcoa hosted training sessions for managers; Alcoa then embarked on additional 100%-plant-funded PWAs. The additional assessments were for ten U.S.-based plants and will be completed within 12 months. In all BestPractices areas (pumps, steam, process heating, and compressed air) included in the PWA effort, Alcoa is requiring the contractors that conduct the PWAs to use the DOE tools in their assessments to identify opportunities for savings. In essence, the contractors are conducting CTAs of each of the plant utility systems to arrive at the PWA.

Another example of PWA value is that of Rohm & Haas. Rohm & Haas has 13 small plants in the United States. Taking the results of a PWA conducted at the Knoxville, Tennessee, plant, Rohn & Haas is applying this knowledge at all of the smaller plants, each of which is comparable to the Knoxville plant. Two assessments have been completed.

Showcases

Energy savings resulting from Showcases were included in various delivery channels in this report and were not counted as a separate category in this evaluation. The logic for this decision is shown in Figure 9.

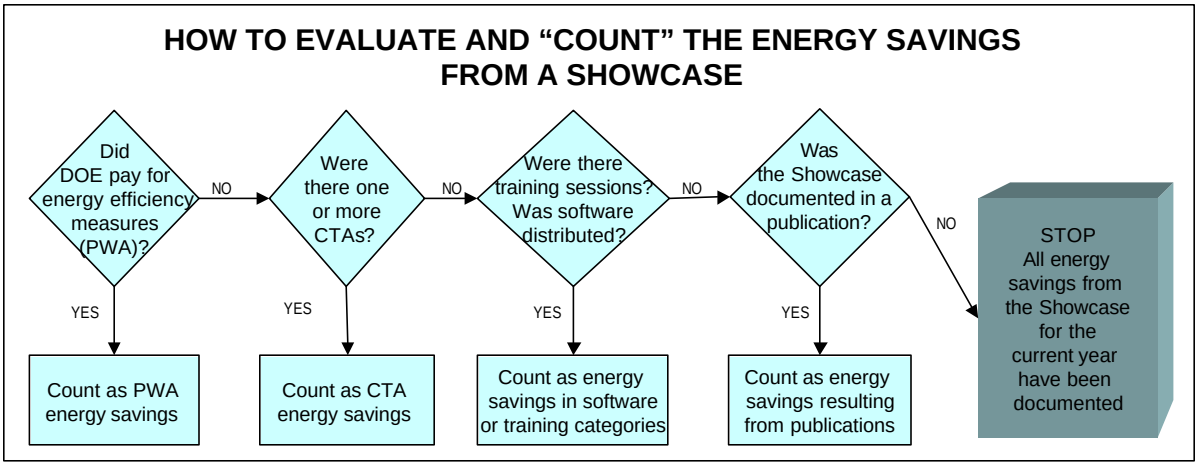

Figure 9. How the energy savings from a Showcase event were considered in other delivery channels for the BP metrics evaluation.

Newsletter

The *Energy Matters* newsletter conducted a reader questionnaire in 2002 to determine the usefulness and relevance of the publication. There were about 900 responses (4.5% response rate). When asked whether they had achieved some energy savings as a result of articles in the newsletter, 63% of the respondents to the question indicated that they had.[33] These results appear to validate results from earlier surveys conducted by the newsletter. The survey, however, did not request specific information about savings. To calculate a program benefit of the newsletter, Xenergy used the results of an earlier survey and a weighted average of impacts from training components. Xenergy calculated the annual energy savings of the newsletter at over 350 billion Btu.[34] ORNL used the Xenergy value for newsletter savings in the FY02 metrics evaluation.

Energy events

In FY02, two energy events were held in California. Based on telephone assessments conducted after the events, an energy savings benefit was calculated for each of three areas – speaker session, exhibit area, and tool demonstration. For each area, the total number of respondents who indicated that the session would have a major effect (likely to yield savings of 15% or more) or some effect (savings of less than 15%) was multiplied by the average tip sheet savings of all tip sheets distributed (1.4 billion Btu). This result was reduced by a factor (0.46) representing the

[33] ITP, "We Asked, You Responded that *Energy Matters* Matters," *Energy Matters*, Summer 2002, p. 5.
[34] Xenergy Inc., *Final Report, Evaluation of the Motor Challenge Program*, May 2000, p. 3-17.

fraction of unique plants at training events. The assumption is made that there is no overlap in estimated savings in the three areas.

Internet resources

In the FY02 metrics evaluation, the only Internet resources that are included in the energy savings are software downloads. These software downloads, however, are not included as a *separate* energy savings distribution channel in the metrics evaluation because these savings are already counted in the software distribution channel. For information purposes, a value attributed to savings gained from Internet access for software downloads has been computed and is shown in Section 4.8.

In addition to the software downloads, almost 661,500 documents were downloaded from the BP website in FY02.[35] NREL maintains data on the publication downloads and provided data for FY02 to the ORNL evaluation team. Table 17 shows the number of documents that were downloaded by technology area for the top 20 documents that were downloaded. These document downloads, however, have not been included as a source of energy savings because there was no methodology in place in FY02 for assessing the number of unique plants downloading materials. Nor was there a mechanism for distinguishing between domestic versus international downloads. In addition, there was no documentation available for assessing the fraction of plants that will implement some action based on a document that had been printed from the web. These document downloads may be a source for large energy savings, and an attempt will be made during FY03 to track their distribution and to evaluate their application.

Table 17. Counts of file downloads, FY02, by technology area[a]

Technology area	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Total FY02
Pumps	6,781	10,982	3,883	5,477	27,123
Process heat	0				0
Steam	33,009	14,451	39,268	45,307	132,035
Compressed air	6,793	10,111	5,999	4,269	27,172
Motors	26,799	29,026	29,915	21,457	107,197
Comprehensive	8,570	9,424	10,836	5,451	34,281
Total	81,952	73,994	89,901	81,961	327,808

[a]Counts of publication downloads were for Quarters 2-4 only; counts for Quarter 1 were extrapolated. Because counts are only for the top 20 most down-loaded files, the "total" publications downloaded is only about half of the actual total number of file downloads.

Source: Sosa-Mallory, Michele, email message, July 16, 2003.

[35] *Technology Delivery Fiscal Year 2002 Activity Report*, p. 27.

3. RESULTS IN TECHNOLOGY AREAS

The total estimated energy savings resulting from activities sponsored by the BP Program in FY02 is 81.9 trillion Btu (0.0819 Quad), which is about 0.25% of the 32.5 Quad of energy consumed during FY02 by the industrial sector in the United States.[36] This savings represents a 5.6% increase over FY01 total energy savings attributable to BP activities. The technology area with the largest estimated savings is steam, and the technology area with the lowest estimated savings is motors.

Table 18 reports estimated energy savings, in billion Btu, by technology area. Savings estimates are reported separately for BP products that cut across technology areas. Additional explanations for each technology area are provided in Sections 3.1-3.7.

Table 18. Estimated energy savings by technology area, FY02

Technology area	Energy savings, FY02 (billion Btu)	Energy savings, FY02 (% of total)
Pumps	11,220.9	13.7%
Process heat	7,310.7	8.9%
Steam	26,084.7	31.9%
Compressed air	13,822.9	16.9%
Motors	1,674.6	2.0%
Insulation	9,088.4	11.1%
Comprehensive (general, cross-cutting area)	12,670.4	15.5%
Totals	81,872.6	

Figure 10 shows the FY02 shares of total energy savings by technology area.

[36] Energy Information Administration, "Monthly Energy Review, Energy Consumption by Sector, Industrial Sector Energy Consumption," http://www.eia.doe.gov/emeu/mer/consump.html , Table 2.4 in *Monthly Energy Review.*

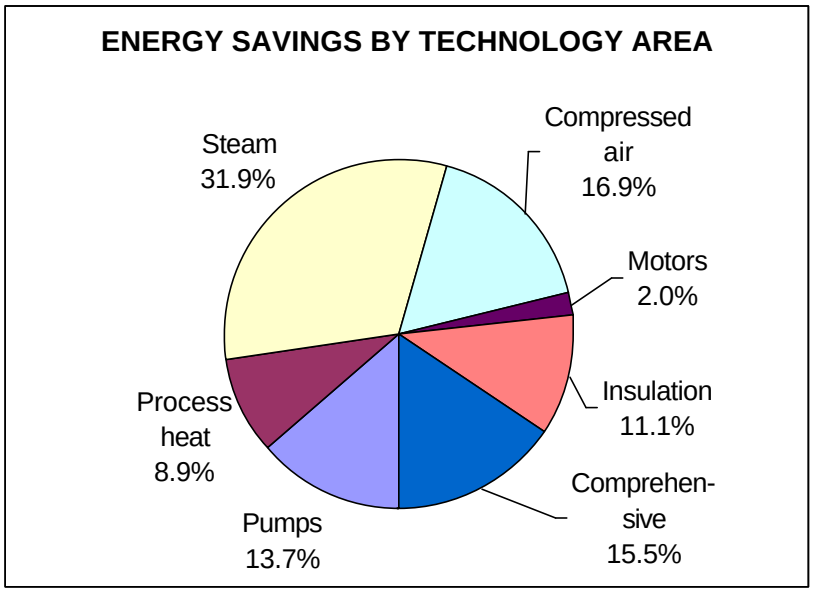

Figure 10. A comparison of energy savings by technology area. The comprehensive area is a general, cross-cutting area that contains energy savings that cannot be attributed to a single technology area.

3.1 PUMPS

Although the pumps technology area represents 13.7% of the total energy savings based on the BP Program, this area saw a large decrease in total energy savings between FY01 and FY02. This decrease was primarily caused by a decrease in the average value of CTAs. Because the average two-year CTA savings (see Table 3) is the basis of the unit energy savings estimate for pump training and software distribution, this decrease permeated all three areas (i.e., CTA, training, and software) of the pump evaluation. The greatest energy savings for pumps resulted from end-user training.

Pumps: savings breakdown by delivery channel: Total = 11.2 TBtu

CTAs	1.6%
Training	64.2%
Software	31.1%
All others	3.1%

To attempt to validate the fraction of users of the PSAT software tool, a limited set of interviews were conducted with PSAT users. Interviews were held with persons who had received end-user training, persons who had received Qualified Specialist training (in FY01), and persons who had received the PSAT software but no training. These interviews generally supported the factors used in the metrics evaluation. A summary of the interview results is provided in Appendix B.

As explained in Section 1.3.2, energy savings resulting from PSAT Qualified Specialist training in FY02 was not included in the FY02 metrics estimation because it was assumed that Qualified Specialists more fully apply their expertise in the year following their training. In FY02, a limited number of Qualified Specialists who were trained in FY01 were interviewed for the FY02 metrics evaluation. Based on these interviews, ten unique plants implemented actions,

resulting in an energy savings of 559.3 billion Btu. This savings was added to the energy savings resulting from FY02 end-user PSAT training (6,641.8 billion Btu) to arrive at a total savings for pumping training activities.

3.2 PROCESS HEAT

BP Program activities in the area of process heat represent almost 9% of the total energy savings. Almost all of the savings (92%) resulted from end-user training. The PHAST tool was not available for distribution during FY02. For training purposes, a beta version of the software was used.

Because the process heat efforts were just getting started in FY01 and began to reach fruition in FY02, there was a large increase in energy savings in this technology area. Further increases are expected in FY03 because the PHAST tool will be released some time during the year.

Process heat: savings breakdown by delivery channel: Total = 7.3 TBtu

CTAs	7.3%
Training	91.6%
Software	0.0%
All others	1.1%

3.3 STEAM

Steam savings represent almost a third of all savings resulting from the BP Program. This area was also an area that saw large energy savings in FY02 over FY01. Steam savings have resulted primarily from software systems distribution (almost 60% of the total savings resulting from steam activities) and training (nearly 30%). There was an increase in the value of the average identified savings for steam CTAs in FY02, the only area of CTAs which saw an increase.

Steam: savings breakdown by delivery channel: Total = 26.1 TBtu

CTAs	1.6%
Training	29.2%
Software	59.3%
All others	9.9%

3.4 COMPRESSED AIR

Compressed air is the technology area with the second largest energy savings (almost 17% of the total). Fifty-six percent of the energy savings in the area of compressed air were derived from software distribution; another 39% were from compressed air systems training. Compressed air is a technology area that saw a large increase in energy savings in FY02. Although the average identified savings for CTAs (see Table 3) dropped by 42% from FY01 to FY02, there were significant increases in the training and software distribution delivery channels.

Compressed air: savings breakdown by delivery channel: Total = 13.8 TBtu

CTAs	1.1%
Training	38.5%
Software	56.2%
All others	4.2%

3.5 MOTORS

Although the motors technology area continues to be a component of the BP Program, the energy savings from motors activities has become a very small part of the total – only about 2%. There were no CTAs for motors in FY02, and there were very few training sessions. The most significant savings contribution in the motors area results from distribution of publication packages, which almost half of the savings. Savings resulting from tip sheets were of the next greatest importance (18%) and software distribution was next in importance (21%). Pumps and motors were the only technology areas in which software distribution was not the predominant distribution channel for savings.

Motors: savings breakdown by delivery channel: Total = 1.7 TBtu

CTAs	0.0%
Training	3.2%
Software	21.0%
Pubs	49.4%
Tip sheets	18.0%
All others	8.4%

3.6 INSULATION

Energy savings resulting from the insulation program in FY02 were almost entirely based on software distribution. In FY02, there were no CTAs, training sessions, tip sheets, or Case Studies for insulation. Although only two delivery channels (software distribution, at over 99.9%, and technical assistance calls, at only 0.02%) provide savings, a significant percentage of the entire BP Program energy savings (over 9% of the total) were realized in this technology area.

Insulation: savings breakdown by delivery channel: Total = 9.1 TBtu

CTAs	0.0%
Training	0.0%
Software	99.98%
All others	0.02%

3.7 COMPREHENSIVE

This technology area is a general, cross-cutting area and contains energy savings that cannot be attributed to a single technology area. Savings resulting from the *Energy Matters* newsletter are included in this area. In addition, savings from publications packages, technical assistance calls, and Case Studies that cannot be attributed to a specific technology area are included here. Showcases and energy events are considered, and any savings that have not been counted elsewhere are included. The total savings from this category also include PWAs and PWA replications. Because there was a very large increase in the energy savings of PWAs and because savings from PWA replications were documented during FY02, this technology area saw a large increase over FY01.

Comprehensive: savings breakdown by delivery channel: Total = 12.7 TBtu

PWAs	40.8%
PWA reps	23.8%
Publications	30.3%
Newsletter	2.8%
Case Studies	0.1%
Tech. calls	1.8%
Events	0.3%

Energy savings calculated for the comprehensive area was almost 12.7 trillion Btu – over 15% of the total savings for FY02.

4. RESULTS BY DELIVERY CHANNEL

Table 19 presents the energy savings estimates for FY02 by delivery channel (CTAs, training, etc.), in billion Btu. The mechanism with the largest savings is software distribution, representing about 45% of the total energy savings. The next largest delivery channel is training followed by PWAs and PWA replications.

Table 19. Estimated energy savings by delivery channel, FY02

Delivery channel	Energy savings, FY02 (billion Btu)	Energy savings in FY02 (% of total)
CTAs	1,281.9	1.6%
Training	26,882.1	32.8%
Software distribution[a]	36,168.0	44.2%
Printed materials in technology areas[b]	4,368.0	5.3%
Technical assistance calls in technology areas	204.6[c]	0.2%
Case Studies in technology areas	297.6[c]	0.4%
PWAs and PWA replications	8,174.1	10.0%
Other publications and events[d]	4,496.3	5.5%
Totals	81,872.6	

[a]Software distribution results in a total energy savings of 36,168 BBtu (44.2% of the total). Of this savings, 31,780.6 BBtu were based on Internet software downloads; this savings represents 38.8% of the total energy savings for FY02. This fact serves to show the impact of on-line access to BP software tools. Note that this savings total does not include impacts of file downloads of published documents.

[b]Printed materials include tip sheets and publications related to specific technology areas.

[c]Less than 1 percent of the total savings.

[d]Other publications and events include the *Energy Matters* newsletter; energy events; and miscellaneous publication packages, technical assistance calls, and Case Studies that were not covered in specific technology areas.

For a discussion of the methodologies for calculating energy savings within each delivery channel, see Section 2.2.2. Figure 11 shows the impact by delivery channel. Discussions of the actual savings by delivery channel in comparison with other delivery channels are provided in Sections 4.1-4.8.

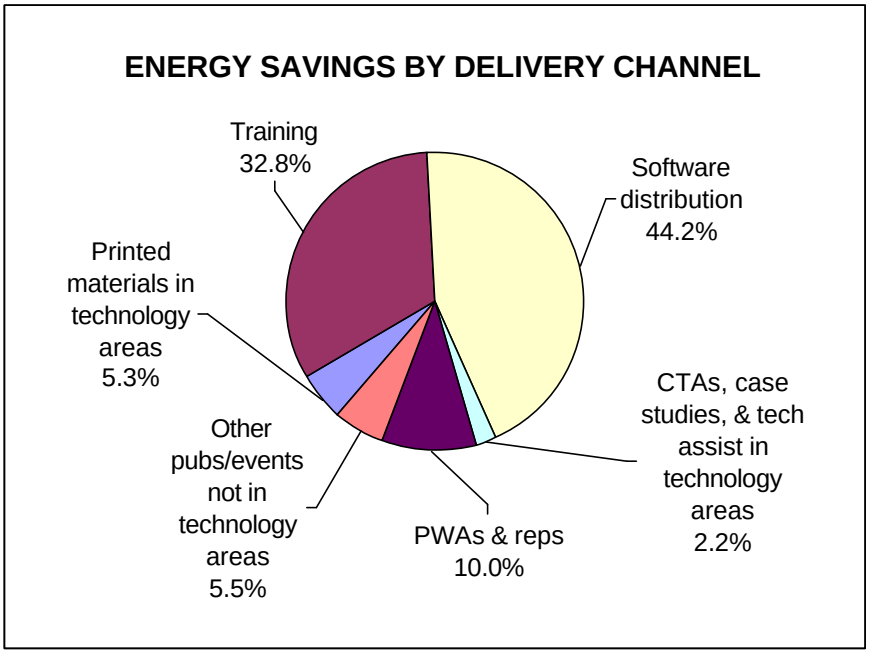

Figure 11. A comparison of energy savings by delivery channel.

4.1 COLLABORATIVE TARGETED ASSESSMENTS

The total savings attributable to CTAs decreased by 77% from FY01 to FY02. This decrease is partially attributable to the fact that only half as many CTAs were conducted in FY02 as were completed in FY01. In addition, the CTAs in all technology areas except steam did not, on the average, identify the same level of energy savings as they had in FY01. As noted in Section 2.2.2, the CTA savings identified in FY02 may not be as representative of total potential savings as were CTA savings identified in FY01 because, in FY02, a lower level of effort was focused on CTAs.

4.2 TRAINING

Between FY01 and FY02, there was almost a three-fold increase in energy savings for the training delivery channel. This increase in numbers is possibly because the ITP Tracking Database has improved on capturing the training attendance data. In fact, if all attendee lists had been submitted to the Tracking Database, it is possible that the training area could have seen an even greater impact.

The limited set of interviews of persons regarding use of software tools (see Appendix B) suggests that persons who are trained in the software may be more likely to use it than those who receive the software without the training. One PSAT user who had been trained on the tool

concluded that training is extremely important and remarked, "I wouldn't have bothered to use [PSAT] if it weren't for seeing what it could do at the training session."[37]

4.3 SOFTWARE DISTRIBUTION

Software distribution seems to be the most significant avenue for energy savings by the BP Program. In FY02, software distribution resulted in over 44% of the total savings. In FY02, there was a slight change to the metrics estimation procedure to ensure that DTCDs distributed with training were not also counted in the software distribution category. Based on the sheer number of DTCDs distributed and individual software tools requested, this is an immensely efficient mechanism for distributing energy savings assistance to industry.

For each delivery channel of this metrics evaluation, the energy savings were estimated after (1) determining the number of unique plants and (2) determining the fraction of plants expected to implement an action. The distribution of software without the added benefit of training was further discounted by an additional factor for determining the fraction of energy savings achieved. The limited phone survey procured by ORNL suggested that training in the software is an important indicator of the likelihood that the software will be used. Users who do not participate in BP training are probably less likely to identify the full savings potential, and thus will reap fewer savings than those who have been trained.

One Qualified Specialist who was interviewed by ORNL made this comment, "Using a DOE tool lends great credibility to my work for my clients. They are assured that the analysis I'm providing them isn't a pitch from a vendor trying to sell equipment that doesn't improve their systems."[38]

4.4 PRINTED MATERIALS

Printed materials attributed to the technology areas include tip sheets and publication packages. There was a large decrease in number of printed tip sheets requested between FY01 and FY02. The number of publication packages sent out, however, more than doubled if all publication packages are added together (including those which cannot be attributed to a specific technology area). Based on the evaluation forms collected following workshops and other meetings, publications – especially short summaries – are very useful.[39]

It is possible that this area is having a greater impact than is being measured. Assessments from the BP steam workshops indicate that attendees like short help sheets. Additional tracking of

[37] Schexnayder, Susan, University of Tennessee, "Results of Limited Set of Interviews with Persons Regarding Use of Software Tools," report on BP tools used in FY02, May 2003.
[38] Schexnayder, Susan, University of Tennessee, "Results of Limited Set of Interviews with Persons Regarding Use of Software Tools," report on BP tools used in FY02, May 2003.
[39] As shown, for example, in two references: Salmon-Cox, Peter, and Fred Hart, DOE, personal communication with results of evaluations of Awareness Training sessions, April 15, 2003; and Martin, Michaela, compilation and summary of results of survey conducted by Spirax Sarco of their sales force, May 15, 2003.

printed materials and web downloads is needed to properly evaluate the energy savings of this delivery channel.

4.5 TECHNICAL ASSISTANCE CALLS

Although technical assistance calls provide only a small amount of energy savings (less than 1% of the total), they are important sources. They solve problems for individual industrial clients. For example, the Clearinghouse has helped one particular client for over five years. The calls began with questions on motors, progressing to questions about improvements to the efficiency of refrigeration and finally to compressed air systems. Only recently, the company called about a potential new plant to be located adjacent to another industry that could make use of the waste heat.[40] The success of this interaction is obviously important.

It is possible that the value of these calls has been underestimated. The value of a average tip sheet in each technology area has been used as the "measuring stick" for technical assistance calls. This usage may be an underestimate or an overestimate; there is, however, no definitive metric for the value of assistance provided via a telephone call at this time. (See also Section 6.3.)

4.6 CASE STUDIES

As noted in Section 2.2.2, savings resulting from 21 Case Studies are reported in the FY02 metrics evaluation. Counting the savings from these Case Studies does not double count savings from any other area.

In FY01, the Case Studies were not divided into technology areas. The total savings for FY01 were listed as 789.9 billion Btu. In FY02, all but one of the Case Studies were attributed to specific technology areas. The total savings for **all** Case Studies in FY02 were 314.2 billion Btu. This value is for the Case Studies at the original plants, not the savings generated by dissemination of the printed Case Studies (at other plants). The dissemination value for Case Study documents is given equal weight with other publications and estimated in the general publications delivery channel (see Section 4.8.2).

4.7 PWAs AND PWA REPLICATIONS

In FY02, PWAs experienced a great increase in energy savings over the savings recorded in FY01. Identified savings from the PWA delivery channel increased from 0.67 trillion Btu in FY01 to over 5 trillion Btu in FY02. In addition, energy savings from PWA replications, which were counted this year for the first time, added another 3 trillion Btu.

[40] Penney, Rob, ITP Clearinghouse at Washington State University, "OIT Clearinghouse Anecdotal Success Stories," email message, May 29, 2003.

4.8 OTHER PUBLICATIONS AND EVENTS NOT REPORTED IN TECHNOLOGY AREAS

4.8.1 Newsletter

The *Energy Matters* newsletter had essentially the same number of issues and unique plant recipients as in FY01. As stated in Section 2.2.2, the energy savings of the newsletter (over 350 billion Btu) are taken from the Xenergy Motor Challenge report.

4.8.2 Publication Packages, Technical Assistance Calls, and Case Studies Not Listed in Technology Areas

When possible, energy savings based on publication packages, technical assistance calls, and Case Studies (i.e., the individual Case Study projects) were attributed to the appropriate technology areas. In some cases, however, the savings could not be assigned to a single area. These savings were applied in the comprehensive or cross-cutting category. The identified savings of publication packages not otherwise assigned was over 4 trillion Btu. The savings for cross-cutting technical assistance calls was almost 233.6 billion Btu. One Case Study not otherwise counted in a technology area resulted in a savings of 16.6 billion Btu.

4.8.3 Showcases and Energy Events

No additional energy savings were included for the FY02 Augusta Newsprint Showcase. Energy savings resulting from this Showcase have been recorded elsewhere under categories of training, CTA, or PWA. A post-evaluation of Showcases from prior years indicates that there are significant energy savings resulting from Showcases. These savings have not been included in the current metrics evaluation, however, because DOE did not contribute funding to the actual energy efficiency measures that were implemented as a result of the Showcase event. In addition, the practice in this document has been to record the initial savings that occur in a particular year and not to continue to count savings in following years. However, because no savings from Showcases were included in the FY01 metrics report, this omission does not represent a loss or gain for this distribution category.

Energy events represent a calculated energy savings of over 44 billion Btu. Because no savings were included in this category in the FY01 metrics report, this was a new area of evaluation.

4.9 INTERNET RESOURCES

The Internet provided a tremendous avenue for distributing BP products; over 31.8 trillion Btu (almost 40% of the total BP Program energy savings) could be attributed to the downloading of the software tools from the Internet.

As noted in Section 2.2, no energy savings have been counted as a result of information being downloaded from the Internet via pdf files (over a half million files downloaded); nor have any

savings been attributed to persons who access and view BP web pages. This area represents a potentially large area of underestimated savings. During FY03, attempts will be made to develop a methodology for assessing these savings.

5. CONSTRAINTS AND QUALIFICATIONS

Appendix A identifies the data sources on which the estimates rely and also details certain limitations and constraints. This chapter describes noteworthy issues in more detail.

5.1 POSSIBLE SOURCES OF OVERESTIMATION

The average identified savings based on CTAs varies from year to year. This variation, however, should "calm down" over time. Using the two-year average for each technology area will moderate these changes. It should be noted, however, that the plants receiving CTAs are generally large facilities and that the identified savings from these plants may be greater than for smaller plants. Even though the software savings were reduced by an additional factor (0.37) not applied to other delivery channels (Section 2.2, Table 8), the average unit savings value used to estimate energy savings in the delivery channels of training and software distribution may be overestimated. (See also Section 5.2.)

In a recently published article, Wright et al. documented cost savings identified by six IACs applying the steam scoping tool at 18 different plants.[41] Martin examined the reports of these assessments and culled corresponding energy savings.[42] These recommended source annual energy savings ranged from 1.1 billion Btu/year to 638.9 billion Btu/year; average recommended savings were 49.2 billion Btu/year. This value is only 37% of the average identified CTA energy savings for steam, most likely because the majority of the work was completed in IAC plants, which are smaller than typical BP plants. (Implementation data on the IAC steam assessments was not available.) To moderate somewhat the use of average CTA values, for the software distribution delivery channel (without training), a reduction factor of 0.37 was applied across the board to all technologies (except motors).

In the current version of the ITP Tracking Database, there is no way to determine when a training event occurs in conjunction with a CTA or PWA. It is possible that there has been double-counting of savings in cases when multiple BP events occur together.

5.2 POSSIBLE SOURCES OF UNDERESTIMATION

As noted in Section 5.1, CTA-based energy savings could be a source of overestimating savings. On the other hand, the use of a unit value based on CTAs could also be a source of underestimates. Because of time constraints, personnel conducting CTAs search for the most obvious solutions. When these solutions are applied plant-wide, the savings are much greater than those identified during the CTAs.

[41] Wright, Anthony, et al., "Results from the Industrial Assessment Center (IAC) Steam Tool Benchmarking Support Project," Winter 2003.
[42] Martin, Michaela, review of energy savings from IAC steam assessments identified in Wright et al., May 12, 2003.

The FY01 report documenting the BP energy savings excluded savings for the qualification training ("train the trainer") workshops. Working through how these training sessions would save energy, it was clear that all the savings attributed to these newly trained Qualified Specialists would show up in the savings achieved by trainees in subsequent assessments. For FY02, attendees who were certified at qualification training sessions in FY01 were contacted to obtain information on their activities during FY02. This process provided an estimation of energy savings that occurred in FY02 which resulted from Qualified Specialist training that actually occurred in FY01. These interviews were limited in scope, and it is possible that savings resulting from efforts of Qualified Specialists were underestimated.

As noted in Section 1.3.2, any energy savings resulting from the General Awareness Workshops are not included in this report. It should be noted, however, that impacts from these workshops could be significant. For example, participants in six BP Steam Workshops held between October 2002 and April 2003 completed workshop evaluation forms and overwhelmingly (about 70%) indicated that they were very likely to implement energy savings actions based on the information they received in the workshop.[43] Over a third of the participants indicated that they would implement changes within the next six months.

As noted in Section 2.2.2, savings from Showcases were not included because of the potential for double-counting. Although it appears that all savings have been recorded in other areas, it is possible that some savings have been left uncounted.

The ITP Tracking Database has greatly improved since FY01 data were collected and is an excellent repository of usage information; however, it is not complete. Attendee lists for training sessions were not always submitted to the Tracking Database for recording, and, therefore, the number of unique plants touched by the BP Program for those sessions could not be determined. This number was estimated for the metrics evaluation; because conservative assumptions were applied, estimation of savings from training sessions for which there are no attendee lists could be a source of underestimation.

Information from the DOE Resource Room was unavailable except for the number of publications sent from Macro to the Resource Room. Lack of this information might be a source of underestimation. It should also be noted that the DOE Resource Room was not fully functional for the entire year. It is possible that Xerox copies of publications were made and distributed from this source for which there was no accounting.

Distribution of BP publications and software packages by the IAC program is not currently identified in the Tracking Database. The IAC actively distributes this information to IAC clients and to industrial plants that do not qualify for IAC assessments. This area could be a source of underestimation.

No effort has been made to assess the synergistic effect among program elements – e.g., how a combination of publications, software tools, and technical assistance might be more effective than each as a separate entity.

[43] Salmon-Cox, Peter, personal communication with Michaela Martin, April 1, 2003.

No effort has been made to count savings based on the "shelf life" of BP products (e.g., software, publications, training). Therefore, for products distributed prior to FY02, which might have also been used in FY02, no energy savings were counted in FY02.

In addition, no savings persistence ("life-time") values are counted. It is possible that significant savings were achieved in FY02 based on products initially acquired or implemented in past years; however, these results were not included in the FY02 evaluation.

5.3 OTHER ISSUES

The BP DTCD is being used in a senior-level mechanical engineering class at Tennessee Technological University.[44] Other BP publications are also being used in the class to simulate a "real-world" systems approach. Northampton Community College has recently added a new Industrial Energy Efficiency diploma program which relies heavily on BestPractices software and publications for course materials.[45] The BP Program should consider including these activities in the Tracking Database. Savings resulting from this form of training may be estimated using methodology similar to that adopted by the IAC program.

Results of the Allied Partner administered questionnaire[46] were applied as reduction factors to three distribution channels – software distribution, tip sheets, and publications. Because this survey was limited to the sales staff of a single company, it could be a source of over- or underestimation. The Program should consider encouraging other Allied Partners to conduct similar reviews.

In the motors technology area, the value for the average CTA (1.1 billion Btu) was calculated based on average implemented savings for relevant motor measures in the IAC database. This value is much less than the average value of savings (26 billion Btu) identified in a peer-reviewed paper by Lung, McKane, and Olzewski.[47] Comparison of these two values, however, is not appropriate. The IAC number is based on a motor-component-level savings, attributed to optimizing a motor. The savings in the Lung et al. article is a total system-level savings.

[44] Cunningham, Glenn T., Tennessee Technological University, personal communication with Chris Cockrill, April 13, 2003.
[45] Northampton Community College Industrial Energy Efficiency Specialized Diploma Program, Bethlehem, PA.
[46] Martin, Michaela, compilation and summary of results of survey conducted by Spirax Sarco of their sales force, May 15, 2003.
[47] Lung, et al., "Industrial Motor System Optimization Projects in the US: An Impact Study," 2003.

6. SUMMARY AND RECOMMENDATIONS

A summary of findings (Section 6.1) is provided to show the level of activity in each area of the BP Program. Recommendations for possible improvements to the metrics evaluation process are given in Sections 6.2-6.3. The data collection effort pointed to a number of actions that would improve monitoring of the program's accomplishments in future years and provide more precise estimates of energy savings.

6.1 SUMMARY OF FINDINGS

Table 20 summarizes the number of program activities in each technology area for FY02. Table 21 provides a summary of energy savings by delivery channel across technology areas.

Table 20. Number of program activities for each delivery channel by technology area, FY02

Delivery channel	Technology area							
	Pumps	Process heat	Steam	Comp. air	Motors	Insula-tion	Compre-hensive	Total
CTAs[a]	11	3	2	6	0	0		22
Training (number of unique plants)	247	48	117	281	98	0		791
Software tools[b]	3,676	0	4,965	7,093	4,800	5,189		16,855
Printed materials[c]	2,420	113	4,111	1,742	7,796	0	31,465	47,647
Technical assistance calls[d]	11	0	71	68	248	1	185	584
Case Studies	4	0	2	9	5	0	1	21
PWAs and PWA replications[e]							27	27
Other publications and events not covered above								
- Newsletter distribution							30,000	30,000
- Energy events							2	2

[a]The number of CTAs listed in this table includes **all** CTAs for which any costs were incurred, whether or not any energy savings information was available or any actions for saving energy were recommended.

[b]The number of tools includes individual software packages plus a TOTAL count of DTCDs for each area. That is, each DTCD is counted five times – once for each of the five technology areas with a software tool on the DTCD. The total column reflects total DTCDs distributed (counted only once) plus software downloads.

[c]Printed materials include tip sheets and other publications; the number in this table is the number distributed.

[d]The count of technical assistance calls includes calls of any duration and staff type.

[e]This count includes 15 PWAs, 2 Showcase PWAs, and 10 PWA replications.

Table 21. Energy savings of program activities for each delivery channel by technology area, FY02 (billion Btu)								
Delivery channel	**Technology area**							
	Pumps	**Process heat**	**Steam**	**Comp. air**	**Motors**	**Insula-tion**	**Compre-hensive**	**Totals**
CTAs	183.8	532.5	407.8	157.8	0	0		1,281.9
Training	7,201.1	6,696.3	7,615.7	5,315.7	53,351	0		26,882.1
Software tools[a]	3,488.1	0	15,473.6	7,767.8	352.0	9,086.5		36,168.0
Printed materials[b]	324.9	81.8	2,483.6	349.7	1,128.0	0		4,368.0
Technical assistance calls[c]	4.0	0	87.5	32.7	78.6	1.9		204.6
Case Studies	19.1	0	16.6	199.2	62.6	0	16.6	314.2
PWAs[d]							8,174.1	8,174.1
Other publications and events[e]							4,479.7	4,479.7
Totals	11,220.9	7,310.7	26,084.7	13,822.9	1,674.5	9,088.4	12,670.4	81,872.6
Percentage	13.7	9.0	31.9	16.9	2.1	11.1	15.5	

[a]The energy savings of each tool is derived as explained in Section 2.2.2.
[b]Printed materials include tip sheets and publications related to specific technology areas.
[c]The energy savings of technical assistance calls depends on the call duration and staff type.
[d]This count includes 15 PWAs, 2 Showcase PWAs, and 5 PWA replications.
[e]Other publications and events include publication packages and technical assistance calls that were not covered in specific technology areas, as well as the *Energy Matters* newsletter and energy events.

As noted previously, the largest energy savings resulting from the BP Program is in the steam technology area. This area has a large potential for additional savings.

6.2 RECOMMENDATIONS FOR IMPROVED TRACKING

HIGH PRIORITY

- *Submit training attendee lists.* Attendee lists from all training sessions need to be submitted for inclusion in the ITP Tracking Database. The attendee lists are used to identify unique plants. All BP Program participants should be encouraged to submit their activities for recording in the Tracking Database to ensure that they receive credit for all of their efforts.

- *Track materials acquired via the Web.* Tracking of web requests, including software downloads, pdf files downloaded from the Web, and other information requests, should be tracked by technology area to the extent feasible. In addition, if possible, the origin of the request – either U.S. or international should be tracked. These data should be submitted for inclusion in the Tracking Database and aggregation with other data sources.

- *Identify training sessions that also include a CTA or PWA.* In the ITP Tracking Database, an indicator for which CTAs and/or PWAs are conducted in conjunction with training sessions

would ensure that there is no double counting of events that occur concurrently or in close association.

- *Assist with characterizing BP clients.* The ITP Tracking Database could help the BP metrics team to characterize BP participants if additional minor information on plant characteristics were supplied and tracked. These data – for example, plant size (sales, number of employees), North American Industry Classification System (NAICS) code, annual energy costs – would help to determine the typical plant served by BP products.

MEDIUM PRIORITY

- *Maintain consistent records.* The parties responsible for the different dissemination channels (e.g., Allied Partners, IACs, Information Clearinghouse, DOE Resource Room, and Macro) need to maintain consistent records when they distribute the same materials and coordinate these records with PPC for inclusion in the Tracking Database. The data quality procedures in force in the Tracking Database would ensure that there is no double counting of these records.

- *Identify BP distributions from the IAC program.* Distribution of BP publications and software from the IAC program is not currently identified in the Tracking Database. Whether or not the savings generated from this activity is credited to the IAC program or to the BP Program, it should be included in the Tracking Database.

- *Track activities of Qualified Specialists.* Activities of Qualified Specialists related to the BP Program should be tracked in the ITP Tracking Database.

LOW PRIORITY

- *Use of BP tools by educational institutions.* Tracking of education programs that utilize BP tools (e.g., Northampton, Tennessee Tech) should be included in the Tracking Database. Additionally, if these activities are tracked, energy savings estimates should also be estimated.

- *Use of BP products over time.* The ability to determine what BP products specific plants have received over time should be developed. This ability would form the basis for a powerful analysis of the relative effectiveness (or persuasiveness) of different BP products. This tracking could be accomplished by the ITP Tracking Database as it continues to develop and the quality of incoming data improves.

6.3 RECOMMENDATIONS FOR IMPROVING THE ENERGY ESTIMATES

HIGH PRIORITY

- *Develop a methodology for estimating savings of website downloads.* Develop a separate metric value of website materials distributed, including the energy savings that result from the number of publications downloaded from the websites.

- *Continue to refine the estimation methodology and reduction factors.* Refinements of the estimation of unit savings for each distribution channel include increasing the sample of CTAs, investigating PWA reports for additional savings data, conducting IAC technology-focused assessments, and developing a statistical model to adjust CTA/PWA/IAC data to more consistently reflect the activities of relevant BP clients and to help characterize what is meant by the term "unique plant." In addition, more data are needed to improve the calculation of the action reduction factors for use of BP products such as software, tip sheets, and publications. These data can be acquired through limited surveys, workshop evaluations, and continued literature reviews.

- *Share metrics data with ORNL evaluation team.* Program management should encourage authors of independent studies or analyses that are conducted on a sub-program basis to include the ORNL evaluation team early on in the process. ORNL is willing to provide guidance so that results will be in a format that is beneficial to improving program metrics. Such efforts could be helpful in refining or validating the metrics used in the ORNL energy savings evaluation. Workshop evaluations and other surveys are very helpful in validating the metrics derived from published sources. The results of such assessments and surveys should be submitted directly to the ORNL evaluation team.

- *Provide engineering estimates of energy savings for BP assistance.* Whenever possible, if some type of technical assistance is provided (PWAs, CTAs, technical assistance via a phone call, etc.), the engineer involved in the technical assistance should provide an estimate of the energy savings identified/recommended. Furthermore, the engineer should be encouraged to conduct a follow-up investigation to estimate the actual implemented savings (similar to the follow-up analysis conducted for the IAC program). BP should consider adopting the IAC's assessment reporting methodology for all BP CTA's, PWA's and technical assistance. This documentation would serve to provide detailed assessment data, in database format, for these activities and would maintain consistency on savings reporting between the two deployment programs. It would also help support and defend the unit savings estimates.

MEDIUM PRIORITY

- *Continue limited surveys.* Continuation of the surveys with recipients of software and with Qualified Specialists, even with a small sample size, is recommended. The collection of this information is helpful and will be more useful over time. Based on ORNL's limited phone survey, there is some evidence that software with training is more effective than software without. Indications are that recipients of the DTCD, acquired at a workshop or other event, may not use the DTCD without the encouragement of training. This indication may not be

true of the individual software packages downloaded from the web. Additional examination of this area is warranted.

LOW PRIORITY

- *Examine the stock effect and other impacts of BP products.* Re-use of BP products in years following their initial use is possible; however, no energy savings are currently attributed to this usage. It is recommended that the stock effect of the BP products be quantified. In-depth data are needed about how plants make use of the broad portfolio of BP products and services. Such data are needed to better deal with difficult methodological issues. For a number of plants, data would need to be collected about what BP products were received over a several-year period, how and how often the products were used, and what energy savings can be attributed to the products.

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APPENDIX A
DATA SOURCES BY DELIVERY CHANNEL

This appendix provides details about the data sources used to derive energy savings estimates for the BestPractices Energy Management Program. Table A.1 documents the data sources by delivery channel for the information used in the assessment. It also provides limitations and qualifications of each data source. Fuller documentation of these data sources is provided in the References.

The first column of Table A.1 is a breakdown of the delivery channels for potential energy savings. This column also presents factors used to adjust the impact that each product or service may have on energy savings estimates. The second column references each source of information used in this assessment. The third column provides additional information on limitations and qualifications of the savings estimates. Also noted in the third column are assumptions for two adjustment factors: (1) the number of plants represented at training sessions, by users of software, by callers for technical assistance, or by recipients of publications and newsletters; and (2) estimates of the fraction of plants taking action based on using a software system, receiving some training, requesting technical assistance, or reading program materials.

Table A.1. Limitations and Qualifications of Data Sources by Delivery Channel[a]		
Delivery channel	**Reference source**	**Limitations and qualifications**
Collaborative Targeted Assessments (CTAs)		
- Number of CTAs in each technology area - Average energy savings per CTA by technology area - Average 2-year energy savings (FY01-FY02) per CTA by technology area	- ORNL Activity Reports for FY01 and FY02	- CTAs were conducted in these technical areas: pumps, process heat, steam, compressed air - Averages were derived based on CTAs completed. If the CTA resulted in an energy savings of zero, it was not used to derive the average energy savings - An average value for insulation CTAs was derived based on five CTAs conducted June 2001 - An average value for motors CTAs was derived from the IAC database
Training: Software Training and Qualified Specialist Training		
- Number of plants, probable plants, and other companies at training sessions, when known	- Tracking Database	Software systems encompassed in this analysis: PSAT, Steam System Scoping Tool, AirMaster and Air "Rule of Thumb," and MotorMaster. Training savings counted for end-user sessions only for training conducted during FY02.
- Number of attendees at training sessions when unique plants were not known	- Tracking Database	For Qualified Specialists certified in FY01, a random sample of trainees were selected by the Tracking Database for interviewing by ORNL.
- Fraction of unique plants	- Xenergy Motor Challenge and CAC reports	
- Fraction of plants implementing actions	- Xenergy Motor Challenge Report	
- Average energy savings per plant implementing actions	- Based on 2-year average for CTAs	
- Impact of Qualified Specialist training	- ORNL interviews	
Software Distribution		
- Downloaded from Web or sent as part of Decision Tool CD, either at events or by Clearinghouse	- Technology Delivery FY02 Activity Report and Tracking Database	Software systems encompassed in this analysis: PSAT, Steam System Scoping Tool, AirMaster, 3E+, MotorMaster. All five are included in the Decision Tool CD.
- Number of unique plants receiving software	- Tracking Database and Xenergy	To derive fraction of unique plants receiving software, used Xenergy for motors area only; for all other areas used Tracking Database.
- Fraction of plants implementing actions	- Xenergy Motor Challenge Report	To derive fraction of plants implementing action, used Xenergy factor (0.178).
- Fraction of energy savings achieved	- Based on article by A. Wright	For all but motors, applied an additional reduction factor (0.37) to account for actual energy savings achieved
- Average energy savings per plant implementing actions	- Based on 2-year average for CTAs	

Table A.1. Limitations and Qualifications of Data Sources by Delivery Channel[a]		
Delivery channel	**Reference source**	**Limitations and qualifications**
Tip Sheets		
- Number of sheets in technical area - Number distributed in each technical area - Number of unique plants receiving tip sheets - Fraction of plants implementing actions - Average energy savings per tip sheet	- BestPractices website - Clearinghouse database - Average of unique plants receiving software (0.57 for all) - Spirax Sarco survey (0.52) - Calculated from IAC database	Tips sheets have been prepared for the following technical areas: process heat, steam, compressed air, and motors. Energy savings per tip sheet were calculated using average energy savings for related measures found in the IAC database.
Technical Assistance Calls		
- Number of calls in technical area - Duration of call and role of staff member providing response - Fraction of callers taking action - Average energy savings per call	- Clearinghouse database - Clearinghouse database - Xenergy Motor Challenge and CAC reports - Based on tip sheet savings	Technical assistance calls fell into these technical areas: pumps, steam, compressed air, motors, insulation, and "multiple" – i.e., calls where energy savings would arise from more than one technical area. Fraction of callers taking action based on fractions of plants taking actions after training events. For pumps, used value for motors; for insulation, used insulation component of steam tip sheets; for "multiple" category, used value for steam
Publication Shipments in Technology Areas		
-Number of requests distributed in each technical area by Clearinghouse and Macro - Number of unique recipients - Fraction of publication package recipients implementing actions - Average energy savings per publication shipment	- Clearinghouse database - Recommended by Clearinghouse (0.57) - Spirax Sarco (0.38) - Based on tip sheet savings	Publications were distributed in all technical areas. Publications considered here include case studies, technical reports, manuals, and reference documents. Not included in this category are tip sheets and the *Energy Matters* newsletter. Note that all NREL publications are in comprehensive category
Plant-wide Assessments and Replications		
- Total energy savings identified in PWAs and resulting from PWA replications	- ORNL PWA 2002 Summary Report	PWA energy savings could not be attributed to individual technology areas.

Table A.1. Limitations and Qualifications of Data Sources by Delivery Channel[a]		
Delivery channel	**Reference source**	**Limitations and qualifications**
Publications and Other Events Not Reported in Technology Areas		
- Miscellaneous information about the *Energy Matters* newsletter	- Technology Delivery FY02 Activity Report	Newsletter savings could not be attributed to individual technology areas. Value of savings taken directly from Xenergy Motor Challenge Report.
- Average energy savings per newsletter	- Xenergy Motor Challenge Report	
- Number of additional publications in technology areas	- Clearinghouse and NREL and Tracking Database (Allied Partners)	
- Number of unique recipients	- 0.57 for Clearinghouse; 0.189 for others	
- Fraction of recipients implementing actions	- Spirax Sarco survey (0.38)	
- Average energy savings per package	- Average tip sheet value	Tip sheet values in technology areas derived from IAC database. To find average tip sheet value (for use in Comprehensive area), the value of tip sheets in specific areas were multiplied by the total number of publications available in that area and then divided by the total number of publications
- Additional technical assistance calls	- Clearinghouse	For savings, applied value of steam tip sheets
- Number of Showcases	-Technology Delivery FY02	No additional savings for Showcases; all savings were counted in other areas.
- Number of Case Studies	-Technology Delivery FY02	
- Energy savings from Case Studies, not counted elsewhere	-LBNL	Savings supplied by LBNL and Bruce Lung; no reduction factors applied; one "general" Case Study in area of Distributed Energy Resources
- Number of Energy Events	-Technology Delivery FY02	
- Energy savings from Energy Events, not counted elsewhere	-"Energy Event Overview"	Savings for energy events are based on responses to telephone assessments of the events and average tip sheet values.

[a]For an explanation of the abbreviations used in this table, please see the Acronyms and Initialisms list.

APPENDIX B

RESULTS OF LIMITED SET OF INTERVIEWS WITH PERSONS REGARDING USE OF SOFTWARE TOOLS

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Knoxville, Tennessee

1. Introduction and Executive Summary

The Department of Energy's BestPractices Program provides software to industries that allows the user to benchmark his system's energy usage against energy usage achieved under best-practice circumstances, e.g., the Steam System Scoping Tool, and to analyze his system's energy usage and identify opportunities for energy savings, e.g., the Pumping System Assessment Tool and the 3E+ insulation program. These software packages are delivered to potential users through various means and may involve different amounts of training and contact with BestPractices staff. Some potential software users download it from the BestPractices web site or pick up a DTCD at a conference. These individuals receive no training in using the software. Other potential users attend training classes and receive the software. For the Pumping System Assessment Tool only, more rigorous training and "Qualified Specialist" certification is available for individuals who intend to train others, widely use the software, or market their skill at using the software to potential clients.

Oak Ridge National Laboratory has previously developed estimates of savings achieved through the BestPractices software programs. There exists, however, a need to further refine these estimates. Accordingly, under contract to the Department of Energy, Oak Ridge National Laboratory and The University of Tennessee have conducted research to begin to refine the estimates. Researchers contacted individuals who have received the software and, using information-collection protocols for each different software type and training level, collected information from a limited number of software recipients.

The two primary questions addressed by this research were

- What percentage of persons who receive the various BestPractices software programs are applying it; and
- What are the outcomes of the use of the software, and, more specifically, what percentage of the recommended energy savings was achieved?

Furthermore, researchers sought feedback on the strengths and limitations of the software and the benefit of training.

The BestPractices software—particularly the PSAT program, can help companies achieve substantial energy and cost savings, but savings do not approach 100% of the recommended savings, whether the software is applied by a PSAT Qualified Specialist or someone who has received PSAT training. Furthermore, about one-third of the PSAT Qualified Specialists and, perhaps, as many as 70% of the trained PSAT users apply the software. The total savings per

PSAT user depends a great deal on the type of user, with consultants and service vendors having opportunities to generate savings at many sites, whereas an end user who concentrates on a single site does not have the same opportunity.

Although trained users seem more likely to apply the software than PSAT Qualified Specialists, the latter may have a significant impact on industrial energy savings that is not currently being recorded. It is clear that training increases the likelihood that the recipient will use the software. Many individuals who acquire the software without training did not recall having gotten the software. Those who did found that when they returned to their job-site, the everyday demands of their work took precedence over learning and applying the software.

Accordingly we recommend the following actions.

- Routinely collect information from PSAT Qualified Specialists about the number of individuals they train to use PSAT software.
- Contact persons who receive software, both with and without training, within two months of their receiving it. The follow-up can be a phone, mail, or email reminder of the software they have acquired and how it can benefit their facility.
- Assure that every person who attends training is provided the relevant software.
- When DOE distributes the software, the recipient should be asked to self-identify as an end-user (one or multiple sites), a consultant, a service vendor, or an equipment vendor.

The following sections of this report provide a summary of the research methods and the results of this research, organized by software type.

2. Methods

Researchers determined the two primary questions to be addressed through this research to be

- What percentage of persons who receive the various BestPractices software programs are applying it; and
- What are the outcomes of the use of the software, and, more specifically, what percentage of the recommended energy savings was achieved?

Furthermore, researchers sought feedback on the strengths and limitations of the software and the benefit of training.

To address these questions, the team of researchers developed a set of information-collection protocols that were then used to gather information from individuals who have received the BestPractices software. In addition to questions that address the two primary issues, above, contextual information was gathered. This included the type of user (end-user, equipment vendor, services vendor, or consultant) and data about the plants to which the software was applied. Samples of the information-collection protocols appear in Section 7 of this appendix.

Researchers acquired contact information for the software recipients from the Industrial Technologies Program Tracking Database, administered by Lawrence Berkley Lab and Project Performance Corporation.[48] The Project Performance Corporation generated a random sample of

[48] Project Performance Corporation did not have record of the recipients of the 3E+ software, so they could not be included in this research.

persons to whom DOE had distributed software in 2002. The sample sizes for each type of software and the number of successful contacts, i.e., the number of persons whom researchers were able to reach for interview, are included in Table 1. The sample size represents the number of persons whom researchers attempted to contact. Each individual in the sample received two or more phone calls. When the person sought was unavailable, the researcher left a detailed message about the reason for the call.

Table 1. Sample size (number of individuals contacted) and number of individuals providing information (in parenthesis)

User type	BestPractices Software		
	PSAT	Steam System Scoping Tool	DTCD
Qualified Specialist	24 (15)	NA	NA
With training	25 (8)	25 (6)	NA
Without training	25 (1)	25 (5)	50 (5)

NA= Not Applicable

The response rates to the researcher's inquiries correspond to the level of previous interaction with BestPractices representatives who created the software and conducted the training. More specifically, the more interaction an individual had with DOE staff or consultants, the greater the likelihood that the person would accept or return the researcher's phone calls. Thus, the volume of information acquired through this research activity was greatest for PSAT Qualified Specialists and least for individuals who have received software with no training.

3. PSAT Recipients

3.1 PSAT Recipients With and Without Training

Of the seven persons with PSAT training who provided information for the evaluation, three—43%—used the software. These results, as well as results for other types of PSAT users and other software programs, are shown in Table 2.

Among PSAT users, savings ranged from zero (no savings) to an average of $50,000/annually per client for one PSAT user. The "no savings" situation occurs when no recommendations are implemented.

This collected information suggests a wide range of outcomes from use of PSAT. The outcome may differ significantly depending on the type of PSAT user. An "end-user," i.e., an employee of a single facility with pump systems, an "end-user" who serves several different sites owned by his company, and a consultant who devotes 100% of her time to evaluating pump systems are three different types of users identified. The latter two are likely to apply the tool at multiple facilities and/or sites, and, thus, can produce greater energy savings. Accordingly, collecting this type of information from the software recipient at the point of distribution could facilitate subsequent estimations of the software's impact.

Table 2. Number of Software Recipients Contacted and Number Using Software (in parenthesis)

User type	BestPractices Software		
	PSAT	Steam System Scoping Tool	DTCD
Qualified Specialist	15 (5)	Na	Na
With training	7[a](3)	5[b] (0)	Na
Without training	1 (0)	5 (0)	5 (0)

[a] While researchers successfully contacted eight individuals, it was found that one of the eight had been trained in using the software but never received a copy of it. To better represent the percentage of persons with software who use it, seven individuals are counted here.
[b] As above, one trained individual did not receive the software, so the number of individuals who were trained and had the software is five, while the number of trained individuals is actually six.

Reasons for not using the software are varied. Half of the software recipients who have not used the software said they had recently loaded it or were working with their corporate IT staff to get it loaded. This suggests a high likelihood that the software will be used. If we count these soon-to-be users, then the percentage of trained software recipients who use the software goes up to 71%. The recipients who have not used the software have not done so because they have not seen a potential application of the software.

Those trained to use PSAT software describe the training as "very helpful." One software user commented that he "wouldn't have bothered with it if not for the training." This comment is possibly the best explanation for the low percentage of users among those who have received PSAT (and other software) without training.

Only one individual who received the PSAT software without training responded to this evaluation. He reported that he did not use the software.

3.2 PSAT Qualified Specialists

Of the 15 PSAT Qualified Specialists (Specialists) contacted, five have conducted assessments with the PSAT software. These results are shown in Table 2. Six of the Specialists said their primary reason for becoming a Specialist was to teach the PSAT program to others. Two of these PSAT Qualified Specialists have begun training others in PSAT use and together have trained a total of 645 people.

The Specialists have applied the PSAT software at 24 unique facilities, with 1000+ pumps altogether. Specialists characterize some of these applications of the software as less than "full-blown assessments," with the application of the software, nevertheless, resulting in recommendations. Each of the Specialists is a service vendor/consultant, a type of user less likely than end-users to have information regarding the implementation of the software's

recommendations. In this case, two of the Specialists have no implementation information. The three Specialists with implementation information report that, altogether, about 10 of the recommended projects have been implemented, with more expected, especially for recently performed assessments. At sites where implementation has occurred, 25 to 50% of the recommended savings are achieved. Specialists cite the capital costs of the recommended actions as the reason for non-implementation. They further suggest that the economic climate of 2002 has been a deterrent to capital investment by municipalities and industry, and this has affected implementation of the PSAT software's recommendations.

Specialists have described some of their uses of the software as "not as designed" and as less than "full-blown" assessments. Specialists (and one of the trained PSAT users discussed in the previous section) use the software to access the pump system data directly; to do pump-to-pump comparisons to identify the most efficient pumps in a system with redundant pumps; to test "what if" scenarios; to evaluate proposed capital purchases; and to give credibility to the consultant's assessment.

4. Steam System Scoping Tool Recipients

As indicated in Tables 1 and 2, researchers attempted to contact 25 individuals who have been trained to use the Steam System Scoping Tool and 25 individuals who have the software but have had no training. Eleven individuals—six with training and five without—provided information. None of these individuals has used the software. Those who have received training explained that they have not used the tool either because they found using the tool to be a low priority item, their job functions have changed and they no longer are in a position to use the software. In one case the person trained as a DOE consultant no longer performs that function. Most of the respondents who have received the software without training did not recall having it.

5. DTCD Recipients

Researchers attempted to contact each of the 50 individuals who have received the BestPractices Software DTCD. Five individuals responded. (DTCD recipients received only two calls, compared to the three or more calls placed to PSAT and Steam recipients.) None of the individuals had used the software. As with the Steam recipients who had no training, other activities took precedence over learning and implementing the software, so the software was not used.

6. Conclusions and Recommendations

The BestPractices software can help companies achieve substantial energy and cost savings, but savings do not approach 100% of the recommended savings, whether the software is applied by a PSAT Qualified Specialist or someone who has received PSAT training. Based on the information collected through this effort, actual savings appears to fall between 25 and 50% of the recommended savings when the software is applied. Furthermore, about one-third of the PSAT Qualified Specialists and perhaps as many as 70% of the trained PSAT users apply the software. The total savings per PSAT user depends a great deal on the type of user, with consultants and service vendors having opportunities to generate savings at many sites, whereas

an end user who concentrates on a single site does not have the same opportunity. Collecting information about the type of user, when the software is distributed, will aid future efforts to estimate savings generated by the software.

Although proportionally trained users seem more likely to apply the software than PSAT Qualified Specialists, the latter may have a significant impact on industrial energy savings that is not currently being recorded. Because a number of the Specialists are training or intend to train other PSAT users, savings may be occurring at the Specialist-trained users' sites. Data should be collected on the number of persons trained by PSAT Specialists.

It is clear that training affects the likelihood that an individual will use the software, as this effort did not identify any software users who had not received training. Typically the software is being acquired at a conference or seminar. Many of these software recipients did not recall having gotten the software. Those who did found that when they returned to their job-site, the everyday demands of their work took precedence over learning and applying the software. The likelihood that recipients use the software could be increased by re-contacting (by mail or email) the recipients once they have returned to their work sites. This reminder of their possession of the software and the benefit it can provide may prompt them to explore it or assign it as a task to a peer or employee.

Because this effort identified a small number of individuals who had been trained in software use, but not actually received the software, it is suggested that a tracking system be implemented to assure that all trained users receive a copy of the relevant software.

7. Information-collection Protocols

I. PSAT with training

INTRODUCTION (see intro sheet)

1. Has your plant used the Pumping System Assessment Tool (PSAT) software at all since the training session?

a. No
Is there a specific reason it hasn't been used? (stop)

b. Yes
Are you the primary user of the software? (if no, get name and contact info of that person)

c. Not sure (get name and number of primary user and contact that person)

2.a. How many 'technical projects' have you identified with the software?____

2.b. How many have you implemented? _____

3. What percentage of the total energy savings recommended by the software have you achieved? ____

4. Overall, how many people in your plant have used the software? _____
(If more than 1) Have you included projects and savings from their use in your responses? Y N (If not reask Q2 and Q3)

5. Does PSAT adequately address energy-saving opportunities in your pumping system?

6. What were the limitations of PSAT?

7. What have you found to be the strong aspects of the software?

8. How helpful was the PSAT training in preparing you to use the software?
a. very helpful b. helpful c. not very helpful

9. Has your use of the software

a. Influenced your decisions to purchase energy saving equipment? Y N (explain)

b. Influenced your decisions to upgrade systems? Y N (explain)

c. Influenced your decision to change maintenance and/or operating procedures in order to save energy and reduce energy costs? Y N (explain)

d. Influenced you to procure energy services from your local utility or energy service company? Y N (explain)

10. How many years do you suppose that the software will be of value to your plant before it becomes outdated or has no value?

11.a Has the software been shared with other plants within your organization? If so, how many? _____

11b. Do you know if it has been used to actually implement similar projects at the other plants? Y N

12.a. What is the size of your facility (sq. ft)?

12.b How many employees are at the facility?

12.c What's the SIC of your facility or what does your facility produce?

12.d. What are your annual utility costs ($)?

II. DTCD Recipients (no training)

INTRODUCTION (see intro sheet)

1. Has your plant used the Decision Tools for Industry DTCD since you received it?

d. No
Is there a specific reason it hasn't been used? (stop)

e. Yes
Are you the primary user of the software? (if no, get name and contact info of that person)

f. Not sure (get name and number of primary user and contact that person)

Fill in the Table. (this table has been reformatted to conserve space in this report)

		PSAT	STEAM Scoping Tool	3E+	Motor Master+	Air Master
2. Which software systems have been used in your plant? (Ck all)						
For PSAT, 3E+, Motor, and Air 3.a. How many 'technical projects' have you identified with the software?____	**For Steam** 3.a How many steam system and/or boiler plant projects have you identified with the software?					
3.b. How many have you implemented?	3.b. How many steam or boiler projects have you implemented?					
4. What percentage of the total energy savings recommended by the software have you achieved?						
5. Overall, how many people in your plant have used the software?						
6. Would training have helped you in preparing you to use the software? a. Yes b. No c. not sure						
7. What have you found to be the strengths and weaknesses of the software?						
8. What have you found to be the software's weaknesses, and how can it be improved?						

9. Has your use of the software

e. Influenced your decisions to purchase energy saving equipment? Y N (explain)

f. Influenced your decisions to upgrade systems? Y N (explain)

g. Influenced your decision to change maintenance and/or operating procedures in order to save energy and reduce energy costs? Y N (explain)

h. Influenced you to procure energy services from your local utility or energy service company? Y N (explain)

10. How many years do you suppose that the software will be of value to your plant before it becomes outdated or has no value?

11.a Has the software been shared with other plants within your organization? If so, how many? _____

11b. Do you know if it has been used to actually implement similar projects at the other plants? Y N

12.a. What is the size of your facility (sq. ft)?

12.b How many employees are at the facility?

12.c What's the SIC of your facility **or** what does your facility produce?

12.d. What are your annual utility costs ($)?

APPENDIX C
PROCESS FLOWS FOR ESTIMATION OF
ENERGY SAVINGS FOR TRAINING AND SOFTWARE
BY DISTRIBUTION CHANNELS

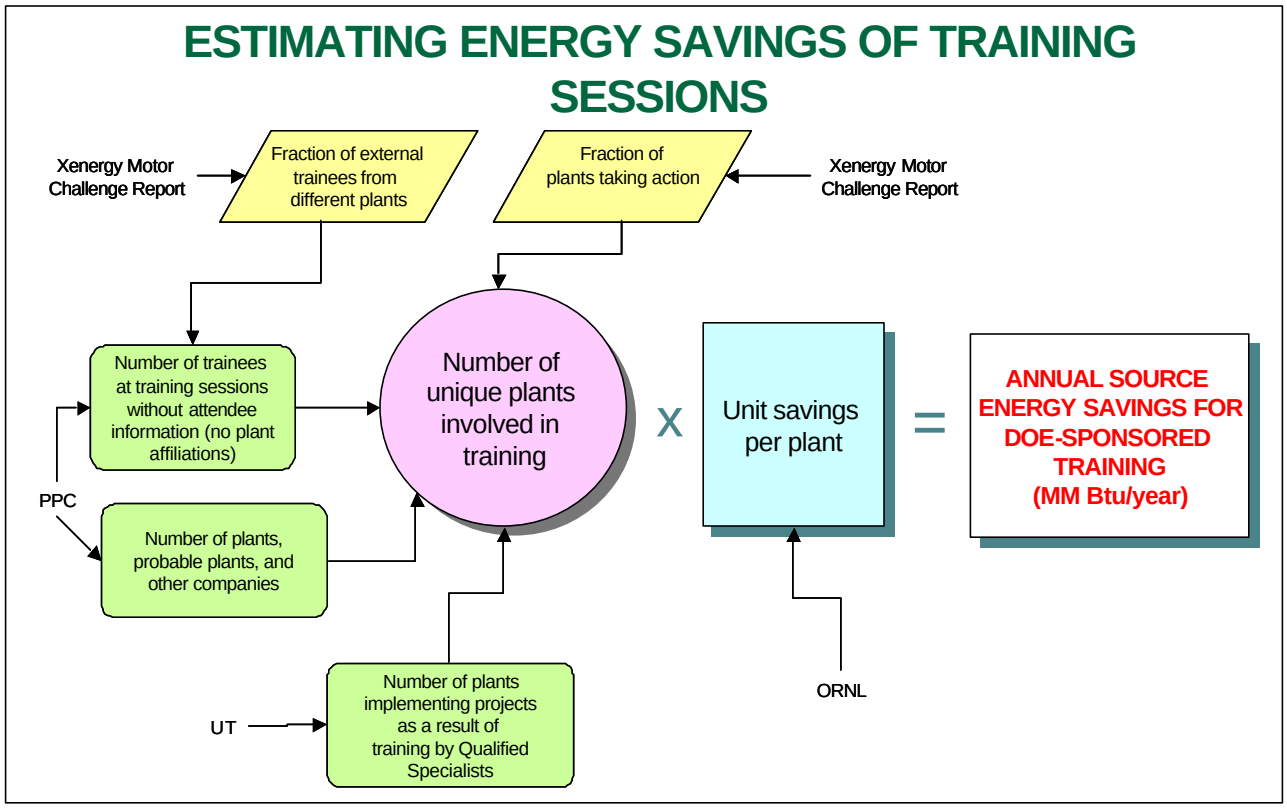

Figure C1. Process flow for estimating energy savings of training sessions.

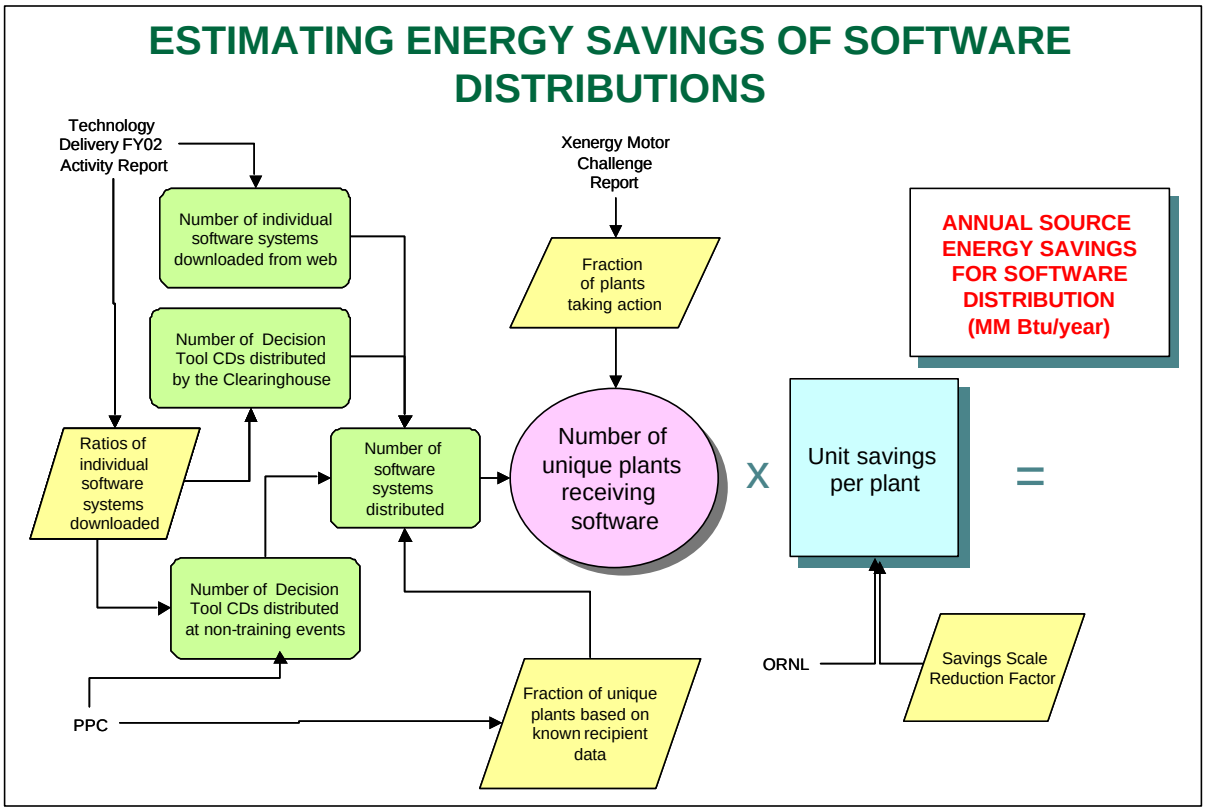

Figure C2. Process flow for estimating energy savings of software distributions.