Metrics as a Tool to Adapt Program Activities in Response to Energy Markets and Policy

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ABSTRACT

A systematic approach to program performance metrics provides an essential tool for performance tracking and the design and adaptation of energy efficiency programs. The BestPractices (BP) and Industrial Assessment Centers (IAC) sub-programs, under the U.S. Department of Energy's Industrial Technologies Program (ITP), use established, peer reviewed methodologies and systems for performance measurement and planning. The BP/IAC approach has four key components: 1) Recordkeeping, 2) Methodology, 3) Reporting, and 4) Planning and Management Feedback. Through seamless integration and iteration, these key components comprise the foundation for creating metrics that are consistent, defensible, and a valuable tool for responding to policy requirements and fluctuating energy markets.

The paper provides an overview of the four key metrics components, touching briefly on critical issues within each that in aggregate establish the success of the approach. Examples of elements of the first three components include characterization of baseline consumption and savings potential for IAC/BP participants, centralized and uniform collection of participant data, prioritization of quantifiable activities, and reporting consistency. The paper will reveal how performance metrics are used in planning IAC and BestPractices activities to help the U.S. manufacturing industry respond to high energy prices.

Within the Industrial Technologies Program and within DOE's portfolio of Energy Efficiency and Renewable Energy Programs, both IAC and BP are recognized for their high standard of performance metrics. The intent of the paper is to share this comprehensive approach with program stakeholders, program managers, and policymakers to demonstrate its value with respect to energy program design and implementation.

Introduction

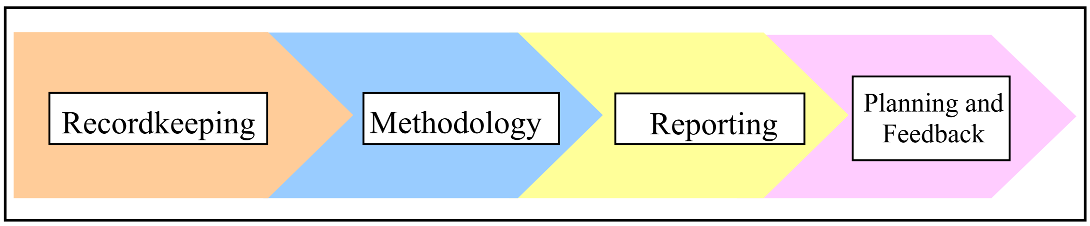
Within the Industrial Technologies Program (ITP) in the U.S. Department of Energy's (DOE) Energy Efficiency and Renewable Energy Office, deployment efforts are focused on reducing the energy intensity of manufacturing plants in the industrial sector. Two sub-programs within ITP, BestPractices and Industrial Assessment Centers (IAC), are on the front lines of DOE's efforts to quickly respond to unpredictable energy markets and implement national energy policy. ITP currently relies on these two sub-programs to provide near-term solutions[1]

[1] ITP deployment activities delivered by BestPractices and the Industrial Assessment Centers include energy assessments, industrial plant end-user training, engineering student training, analysis software, web-based tools such as the IAC database and the Plant Energy Profiler (PEP), DOE-qualified energy specialists, and a new partnership with the U.S. Commerce Department's Manufacturing Extension Partnership program. BestPractices targets approximately 4000 large U.S. manufacturers with energy costs greater than $3M, while the Industrial Assessment Centers target approximately 112,000 medium-size U.S. manufacturers with energy costs between $100K and $3M. For more information on ITP's Technology Deployment programs see: http://www1.eere.energy.gov/industry/program_areas/ .

while it implements longer-term R&D strategies for the industrial sector; a function recently advocated by ACEEE in a discussion on the roles of energy efficiency programs in national energy policy (Elliott 2006).

For the IAC and BestPractices, establishing and maintaining program performance metrics has proven to be an essential tool that supports adaptation of program activities in response to energy markets and public policy. Beyond the standard use of metrics for identifying program achievements, ITP uses results gathered for metrics purposes for program planning and decision-making purposes. In this role, ITP has adopted a systematic approach that includes four key components: 1) Recordkeeping, 2) Methodology, 3) Reporting, and 4) Planning and Management Feedback (Figure 1). The seamless integration and iteration among these four components, along with a continuous metrics quality improvement effort, has provided ITP with a consistent, defensible tool for both planning and tracking program performance for IAC and BestPractices.

Figure 1. Key Components of ITP's IAC and BestPractices Metrics



The core of the metrics effort is a peer-reviewed methodology that undergoes continuous quality improvement. A peer review conducted in 2004 identified areas for improvement, which have been addressed and continue to be addressed in the years following the review. These areas included: improved characterization of manufacturing customer base and program participants, maintaining records for both identified and implemented savings data from assessments conducted, improved consistency of registry interfaces for software users, and prioritization of metrics efforts on activities with highest potential savings. The metrics peer review improved the organization and defensibility of the metrics by prioritizing activities to be addressed and supporting consistency and completeness for recordkeeping efforts.

This paper provides an overview of each of the key components of the IAC and BestPractices metrics approach and how these components contribute to efforts to adapt program activities to meet market challenges and policy updates. This discussion includes the scope and definition for each component, issues to be considered for each component, and examples from the IAC and BestPractices metrics effort.

Recordkeeping

Recordkeeping, or the collection and recording of program performance data, is a fundamental element in a program's performance metrics effort, yet it is often an afterthought in program planning and implementation activities. With the evolution of information technology and tight competition for federally funded programs, there are few reasons for not executing a smart recordkeeping effort. A meaningful approach to recordkeeping should clearly identify the data to be collected, implement a consistent and reliable collection and recording system, and ensure data accessibility.

Data requirements should ideally be identified with the inception of new program activities, or with major changes to existing situations. The scope of data to be collected must be closely tied to current and predicted near-term program expectations at all management levels, as well as to the methodology employed for estimating program performance. To this extent, data on program outputs (e.g., products and services delivered) and outcomes (e.g., effects that program produces) should be recorded.[2] Examples of IAC and BestPractices program outputs include the number of plants receiving assessments, participating in training, or using software. Similarly, examples of outcomes include number of large, energy-intensive plants implementing savings, energy savings identified, and energy savings implemented.

Consideration should also be given to recording data that may be required to support near-term adjustments in program activities resulting from energy markets or changes in policy. While predicting if and when these adjustments will occur is an extremely complex exercise, defining and accommodating corresponding data consequences is relatively straightforward. Moreover, the effort to collect and record the additional data is minimized when it is part of the original recordkeeping effort. For example, the IAC's primary goal is to address energy efficiency in medium-sized manufacturing plants. This requires baseline data on energy consumption and intensity, as well as estimated energy savings resulting from program participation. An unpredictable, yet not so infrequent event such as a wide-scale power disruption in an overloaded grid may expand the goals of the IACs to include demand reduction. By including a baseline for peak demand and estimates of demand savings in the original data requirements, program managers may use this data to respond more quickly to the program expansion by identifying appropriate candidates for demand reduction and recognizing demand impacts achieved through recent energy assessments.

After data requirements have been established, a consistent and reliable collection and recording system should be implemented. A centrally located database or series of related databases should be structured to record this information through an on-line, limited-access interface. The database should also include automated, real-time data validation that occurs with input, as well as a periodic manual review of records to ensure data quality. Expandability is a mandatory requirement. Both BestPractices and the IAC have a series of centrally located (for the most part) databases that collect and record metrics data. These databases are defined in Table 1. The IAC database is a comprehensive collection of assessment data that includes identified and implemented savings and covers 1981 through 2007. The IAC also has a registry for participating students. BestPractices has a series of databases ranging from the BestPractices Tracking System (for all BP activities) to the newer Energy Savings Assessment Management System. The design and integration of these databases has evolved significantly over time to support metrics requirements.

[2] Program inputs, outputs, outcomes, and impacts should be identified through a program logic model (DOE 2006).

Table 1. Inventory of IAC and BP Databases Used for Metrics

Database[a]	Purpose	Key Metrics Collected	Format	Input/Output Interface	Update Frequency	Accessi-bility
BPTS	Records BP activities including trainings, qualified specialists, and registered software users	Dates, activity, participant data, plant affiliation	Electronic database	Web-based input forms and output queries	Contin-uous	Program Internal
ESAMS	Records assessment data for large plants receiving "Energy Saving Assessments" or "ESAs"	SIC/NAIC, baseline consumption, demand, identified and implemented energy and cost savings	Electronic database	Spreadsheet uploads, manual output queries	Monthly	Program Internal
TMS	Requisition system for training, also records participant data and training statistics	Dates, training type, participant data, plant affiliation	Electronic database	PDF request uploads, Web-based output queries	Contin-uous	Program Internal
LEUMS	Database of large U.S. industrial energy users	Organization name, plant location, SIC, number of employees	Electronic database	Web-based input forms and output queries	Periodic	Program Internal
IAC	Record assessment data for medium-sized plants	SIC/NAIC, baseline consumption, demand, production levels, identified and implemented energy and cost savings	Electronic database	Web-based input forms and output queries	Contin-uous	Public
IAC Student Registry	Records data on IAC student participants	Student name, center, dates of program entry/exit, number of assessments conducted	Electronic database	Web-based input forms and output queries	Contin-uous	Program Internal

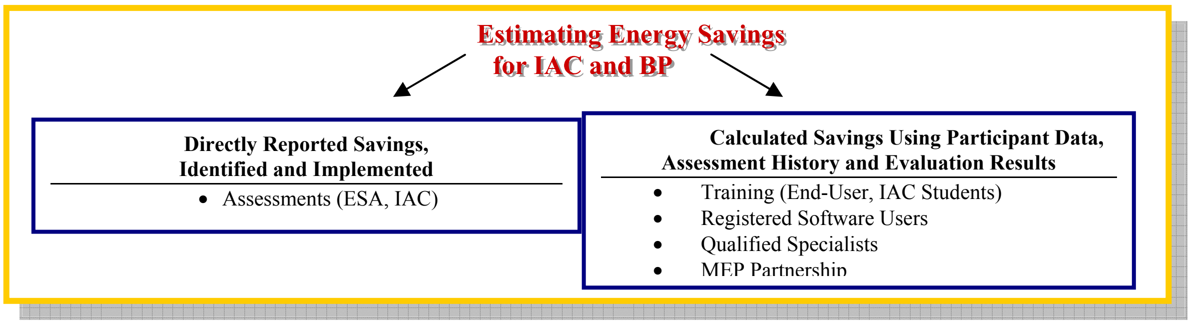
[a]BPTS = BestPractices Tracking System, ESAMS = Energy Savings Assessments Management System, TMS = Training Management System, LEUMS = Large Energy User Management System, IAC DB = Industrial Assessment Centers Database.

Methodology

Methodology is defined as the plan by which performance estimates will be developed. As one of the initial steps in metrics development, methodology should be designed to provide answers to questions about program performance. Methodology covers recordkeeping, evaluation, modeling, and analysis. The primary product of the methodology will be estimates of performance to support goals at the program, office, and agency levels. A successful methodology must be well-grounded, cost-efficient and continuously improved.

The methodology used for BestPractices and IAC relies on a combination of participant data, assessment data, and evaluation data to develop estimates for program performance (Figure 2). Early metrics efforts for BestPractices relied on manual collection of participant and assessment data from a variety of sources and in a variety of formats. Currently all participating plant and assessment data for both BestPractices and IAC are stored in the recordkeeping system in an integrated and consistent format. Assessment data includes baseline information on energy and costs, and identified and implemented savings from engineering estimates reported directly from the assessments. Savings estimates for training, software users, Qualified Specialists, and MEP-partnership participants are calculated. These calculations rely on the characterization of a subset of participants identified as directly representing a large or small/medium-sized plant using the Large Energy User Database, and the corresponding savings potential for the energy system[3] addressed by the activity. Participants from other entities, such as governments, educational institutions, consulting organizations, and utilities are not included in outcome estimates. Evaluation data is then used to reduce the number of participating plants into the number of plants that take action to implement savings. As a final step, aggregate and individual plant savings data are compared to data from the 2002 Manufacturing Energy Consumption Survey to determine reasonableness of savings estimates.

Figure 2. Methodology for Estimating Savings from the IAC and BestPractices



Cost plays heavily into the design of a methodology for estimating program savings. Not many programs have the resources to implement a gold-standard methodology that includes automated recordkeeping systems, complete savings data for all activities, savings measurement and verification, and experimental evaluation design strategies. The Office of Management and Budget expects federal programs to progress to the gold-standard; however, with limited budgets, this is usually only achievable on a gradual and incremental basis. Therefore, priorities must be established, and the methodology and data that support it must undergo continuous improvement.

Peer review is a valuable tool for establishing priorities, vetting results, and identifying future improvements. As mentioned previously, the 2004 Peer Review of BestPractices made several recommendations, including limiting performance estimates to include only those activities with the highest potential for savings, establishing consistent registry interfaces and databases, including implementation data for assessments, and improving reduction factors through evaluation. In the years following the peer review, both BestPractices and IAC have gradually employed most of the recommendations, and are continuing to make improvements. The result of this effort is performance metrics that are consistent over time and defensible.

Reporting

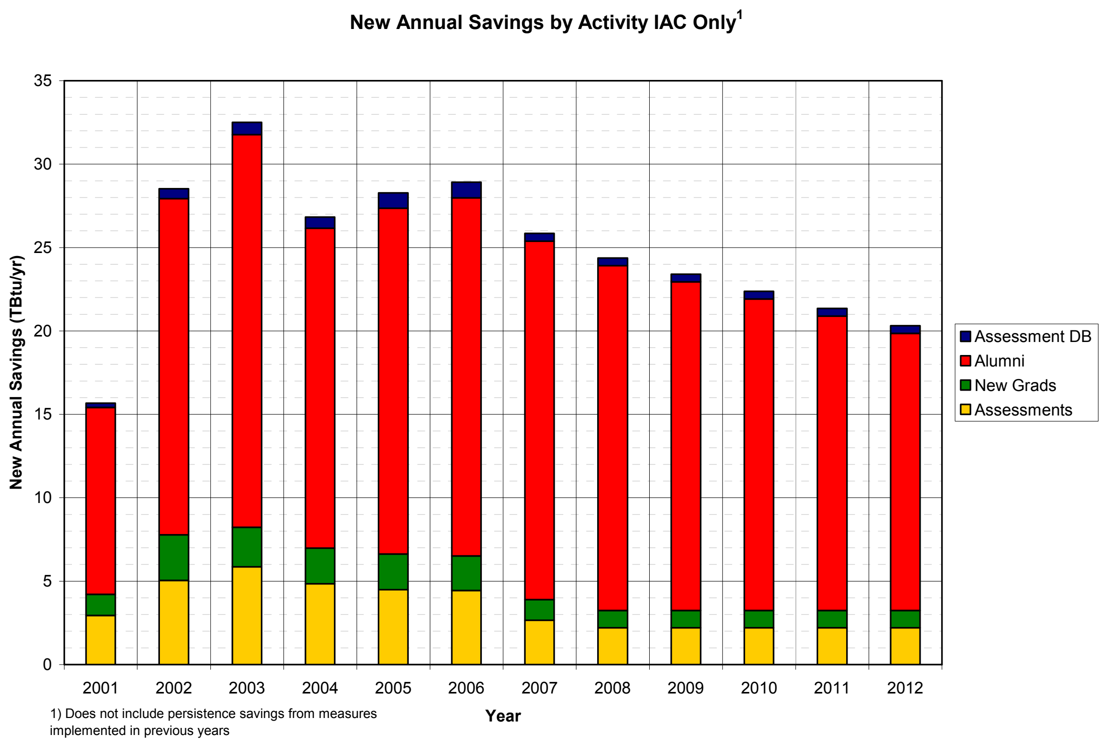
Dissemination of program performance results to a wide selection of audiences is achieved through reporting. While the methodology will establish which primary performance metrics will be estimated and how this will be achieved, reporting efforts may go well beyond the primary performance metrics to address a wider or more detailed range of issues. BestPractices and IAC issue a standard set of reports each year that cover Joule, ITP Impacts,

[3] Energy systems addressed by BestPractices and IAC activities include steam, compressed air, process heating, fans, motors, pumping, and comprehensive. Per-plant savings potential is estimated using assessment data categorized by energy system from both IAC (small/medium plants) and BestPractices (large plants).

and the Government Performance and Results Act (GPRA). Data requirements for each of these differ slightly. For example, the GPRA report examines projected program savings and the Impacts report covers the history of program savings. Additionally, other ad hoc reports are made to respond to DOE-internal and congressional inquiries and for use in planning models, and the data requirements for these vary more dramatically.

Figures 3 and 4 illustrate a history (program years ≤ FY2005) and projection (program years ≥ FY2006) of new annual energy savings in trillion Btu per year for IAC and BestPractices. These figures show how the primary program activities[4] contribute to overall annual savings. For example, assessments serve as the foundation for IAC energy savings and training of students, but the effort of a large alumni population (nearly 700 active members from a total of more than 2600 total student participants over the history of the program) is the largest contributor to program savings. Additionally, aggregate savings for the IAC from FY2002 through FY2005 are relatively consistent, reflecting slight shifts in program emphasis. The reduction in projected IAC savings beginning in FY2007 reflects a proposed budget cut. Similarly, the growth in savings demonstrated by the BestPractices chart reflects a significant shift in program direction to support the current Save Energy Now Initiative.

Figure 3. New Annual Energy Savings Generated by the IAC, Historical and Projected

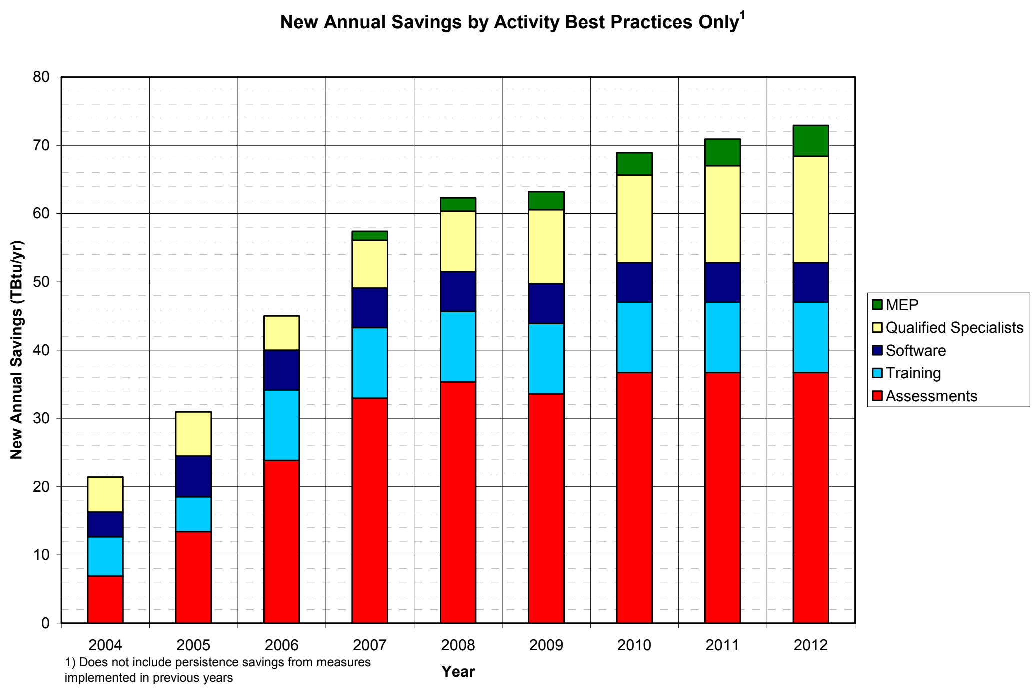


Note**:** While assessments are the foundation of the IAC, significant impacts occur as the large alumni population applies its assessment experience in their professional careers.

[4] IAC activities include Assessments, New Graduates, Alumni, and the Web-based Database; BP activities include Assessments, End-User Training, Qualified Specialists, Registered Software Users, and the Manufacturing Extension Partnership (MEP).

As a program's metrics capacity matures, the demand for improved reporting capabilities significantly increases, as does the pressure for reporting consistency. Occasional updates to the recordkeeping system and methodology may be necessary to meet unexpected reporting needs. Data accessibility from the recordkeeping system is extremely important, and the design of the system's output capability should be flexible to allow for quick, standardized data queries as well as detailed, customized queries. An established methodology and recordkeeping system will support reporting consistency, but additional 'sanity checks' with the aggregate data set or using the MECS data are also helpful.

Figure 4. New Annual Energy Savings Generated by BestPractices, Historical and Projected



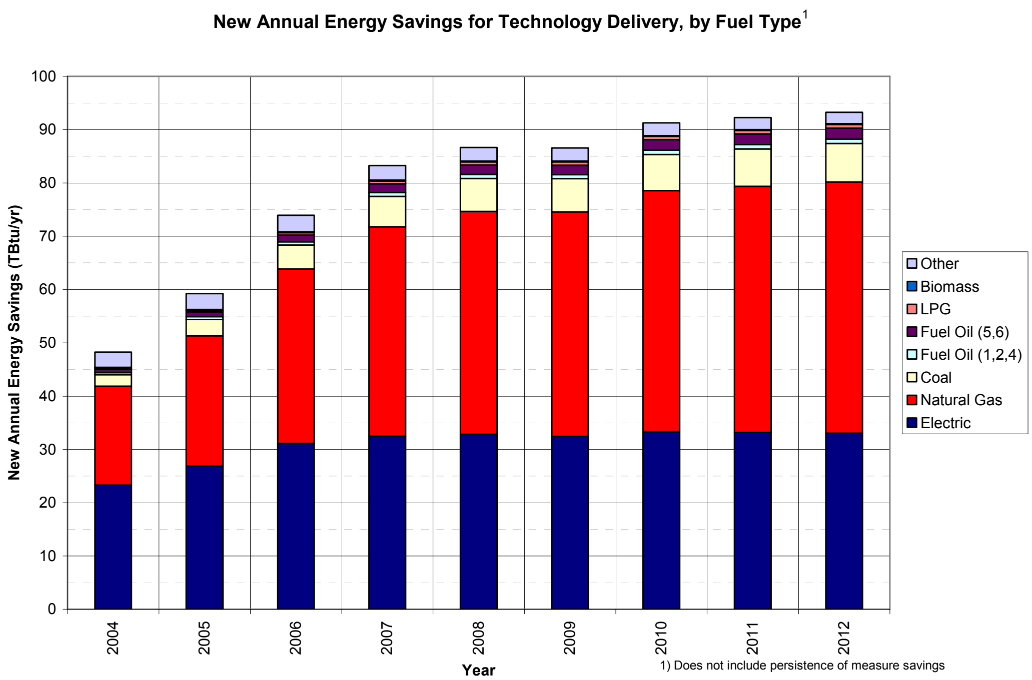
Note**:** The growth in savings is due to the Save Energy Now Initiative which offers energy assessments to energy-intensive industries.

Planning and Management Feedback

The final key component to using metrics as a tool to adapt program activities is planning and management feedback. While the methodology, recordkeeping, and reporting components support an accounting of performance history, this information may also be used to develop planning models and provide critical input for management decisions. The planning and feedback function may not be fully deployable for a program until the methodology and recordkeeping efforts are relatively mature and capable of producing a complete and consistent picture of program savings. At this point of maturity, performance metrics can become an essential tool for planning and management decisions.

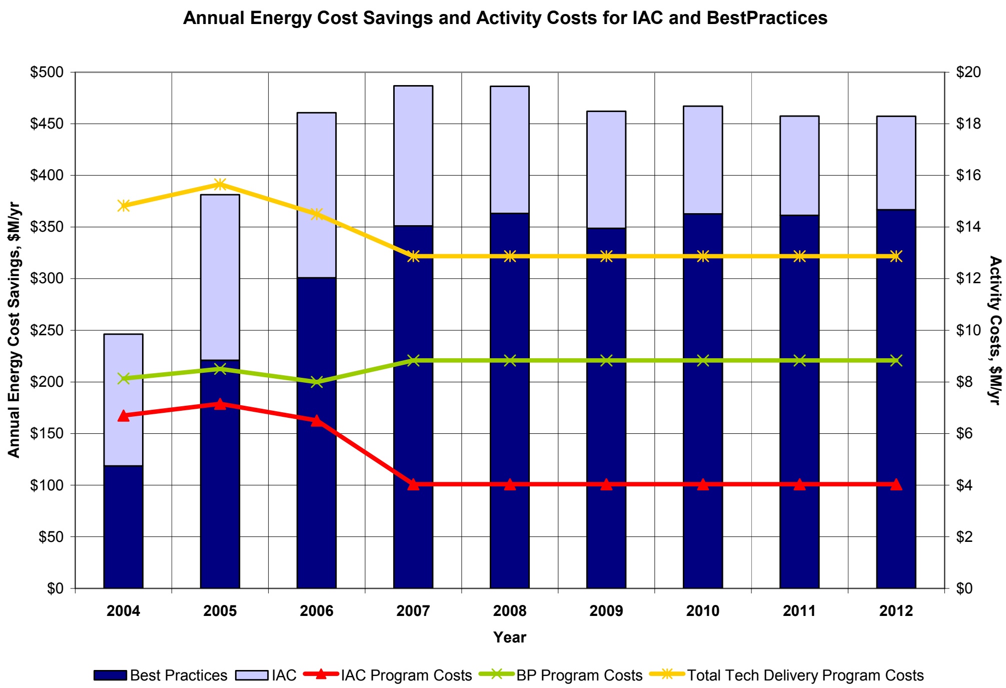
As mentioned previously, Figures 3 and 4 include projections of IAC and BestPractices savings outcomes. These projections were developed using program performance and budget data. The projections demonstrate a 30% budget cut for the IAC in FY2007 and a shift in focus to large-plant energy assessments for BestPractices, in support of the FY2006 Save Energy Now Initiative. Figure 5 presents new energy savings, by energy source, for IAC and BestPractices combined. The 2006 Save Energy Now Initiative included a focus on natural gas reduction by providing assessments for process heating and steam systems to energy-intensive industrial plants. This shift in IAC and BestPractices priorities to reducing natural gas consumption is evident in 2006 and beyond. Additionally, using the planning model, the programs are continuously shaped to get greater benefit for the money spent, as shown in Figure 6. As this paper was being written, ITP was examining the impacts and potential effectiveness of program activities that would support Energy Policy Act (EPACT) goals for industrial energy intensity. The model presented here will be modified to include EPACT activities and provide ITP with a tool for examining EPACT effectiveness and integration with existing activities

Figure 5. Energy Savings by Fuel Source for IAC and BestPractices, Historical and Projected



Note: The model is used to estimate natural gas savings, a primary goal of the Save Energy Now Initiative.

Figure 6. Costs and Cost Savings for IAC and BP Activities that Directly Contribute to Energy Savings



Note: ITP uses metrics-driven models such as this to examine impacts and effectiveness of program activities historically, and for planning purposes.

Conclusions

The Industrial Assessment Centers and BestPractices sub-programs within DOE's Industrial Technologies Program have established an effective metrics approach that provides an essential tool for tracking program performance and adapting program activities to address changes in energy markets and public policy. The approach is also used internally to evaluate cost-effectiveness of BestPractices and IAC activities and to adjust program activities accordingly. Implementation of this approach occurred incrementally over time, adhering to budget restrictions and following recommendations established in a 2004 peer review. Improvements are made on a continual basis to improve robustness — including in 2007 an expansion of the ESAMS database capabilities and participant surveys. The result is a tool that has been used not only to report historical program performance, but also to predict potential outcomes from adjustments in program focus.

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