

EVALUATION OF THE SUPER ESPC PROGRAM — REPORTED ENERGY AND COST SAVINGS

Interim Report

May 2007

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Engineering Science and Technology Division

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— INTERIM REPORT —

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May 2007

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managed by
UT-BATTELLE, LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-00OR22725

Abbreviations

ORNL	Oak Ridge National Laboratory
M&V	Measurement and verification
ESCO	Energy services company
ESPC	Energy savings performance contract(ing)
FEMP	Federal Energy Management Program
IDIQ	Indefinite-delivery, indefinite-quantity (contract)
DOE	U.S. Department of Energy
ECM	Energy conservation measure
O&M	Operations and maintenance
R&R	Repair and replacement
DO	Delivery order

Executive Summary

Oak Ridge National Laboratory (ORNL) is carrying out an evaluation to compare predicted and guaranteed Super ESPC cost and energy savings with the savings actually achieved in the U.S. Department of Energy's Super Energy Savings Performance Contracts (Super ESPCs), program-wide. The evaluation uses a three-tier, nested design, with increasingly more intensive and rigorous methods being applied to smaller and smaller samples. This interim report presents the results of the first tier of the evaluation, which involved collection and review of the latest available measurement and verification (M&V) report for all ongoing Super ESPC projects that are in the performance period and have produced at least one M&V report.

In all, M&V reports were collected for 102 projects. Information was extracted from these reports to determine reported, estimated, and guaranteed cost savings, and reported and estimated energy savings for the previous contract year. Because the quality of the reports varied, it was not possible to determine all of these parameters for each project. However, for the 100 reports that contained sufficient information to make the comparison, the total guaranteed cost savings for the reporting periods covered was \$42.9 million, and the total reported cost savings was \$46.4 million. Thus in the aggregate, the projects reported 108% of their guaranteed cost savings.

For 91 of the 102 projects, sufficient information was provided to compare estimated, reported, and guaranteed savings. For this group, the total estimated cost savings for the reporting periods addressed was \$45.3 million, total reported cost savings was \$44.8 million, and total guaranteed cost savings was \$41.4 million. This means that on average, the ESPC contractors guarantee about 91% of the estimated cost savings. Projects report achieving about 99% of the estimated cost savings.

For 95 of the ongoing projects it was possible to compare estimated and predicted energy savings. On the basis of site energy, those projects reported savings of 2.913 million MMBtu during the previous year, whereas estimated savings had been 2.918 million MMBtu. Thus in terms of site energy, these 95 projects reported 99.8% of the estimated energy savings. On the basis of source energy, the projects reported saving 5.488 million MMBtu during the previous year, compared with estimated energy savings of 5.479 million MMBtu. On the basis of source energy, the projects reported saving 100.2% of the estimated energy savings.

While the first tier of the evaluation did not attempt to verify the reported cost or energy savings in any way, these results are important because they serve as a first-level measure of the aggregate performance of Super ESPC contracts with respect to their energy use reduction goals and cost savings guarantees. Up to this point, detailed, program-wide information of this nature has not been available.

1 INTRODUCTION

Among the most widely used vehicles to implement energy savings performance contract (ESPC) projects in the federal government are the regional and technology-specific Super ESPCs administered by the U.S. Department of Energy's (DOE's) Federal Energy Management Program (FEMP). Super ESPCs are indefinite-delivery, indefinite-quantity (IDIQ) contracts designed to make ESPCs as practical and cost-effective a tool as possible for agencies to use. These "umbrella" contracts were competitively awarded to energy services companies (ESCOs) who demonstrated their capabilities to provide energy projects to federal customers. The general terms and conditions are established in the IDIQ contracts, and agencies implement projects by awarding delivery orders to the Super ESPC ESCOs. Using IDIQ contracts, agencies can implement Super ESPC projects in far less time than it takes to develop stand-alone ESPC projects. Since 1998, federal agencies have used Super ESPCs to install more than \$900 million worth of energy improvements.

The principal objective of the evaluation being carried out by Oak Ridge National Laboratory (ORNL) for FEMP is to compare predicted and guaranteed Super ESPC cost and energy savings with the savings actually achieved. ESCOs guarantee a certain amount of cost savings to be delivered by their ESPC projects, based on their estimates (or predictions) of energy and cost savings that the project will deliver. Energy savings are not formally guaranteed in the contracts, but they form the basis for the guaranteed cost savings. At least once per year in each ongoing ESPC project, the ESCO carries out a series of activities designed to verify that the installed equipment is operational and that energy and cost savings are being delivered, and to determine whether cost savings guarantees were met for the reporting period. These measurement and verification (M&V) activities are carried out in accordance with an M&V plan that is part of the contract between the agency and ESCO. Hence, the specific activities such as ESCO inspections, measurements and engineering calculations, and witnessing of these activities by agency personnel vary by project. The results of the M&V activities are reported to the agency in the form of an annual M&V report. These annual reports are the primary source of information for the evaluation.

As described more fully in Section 2, the evaluation uses a three-tier, nested design, with increasingly more intensive and rigorous methods being applied to smaller and smaller samples. This interim report presents the results of the first tier of the evaluation, which involved collection and review of the latest available M&V report for each ongoing Super ESPC project. Information was extracted from the reports to develop a database that includes estimated and reported energy savings by fuel type, and estimated, reported and guaranteed cost savings for each energy conservation measure (ECM) in each of the ongoing projects. The database was then used to determine fundamental information about the program such as:

- the ratio of reported to guaranteed cost savings,
- the ratio of reported to estimated cost savings, and

- the ratio of reported to estimated energy savings.

While the first tier of the evaluation does not attempt to verify the reported cost or energy savings in any way, the results are important because they serve as a first-level measure of the aggregate performance of Super ESPC contracts with respect to their energy conservation goals and cost savings guarantees. Up to this point, detailed, program-wide information of this nature has not been available.

2 EVALUATION METHODOLOGY

The evaluation of the Super ESPC program uses a three-tier, nested design (Figure1), with increasingly more intensive and rigorous methods being applied to smaller and smaller samples.

The first tier of the study reviews the latest M&V report for each ongoing Super ESPC project. This includes all active Super ESPC projects for which the relevant improvements were completed and accepted by the government by spring of 2005¹. For each project included in the study population, the energy and cost savings documented by the ESCO in the latest M&V report are recorded. The ESCO-reported savings is compared to the guaranteed cost savings and to the predicted (or “estimated”) energy savings on which those guarantees are based.

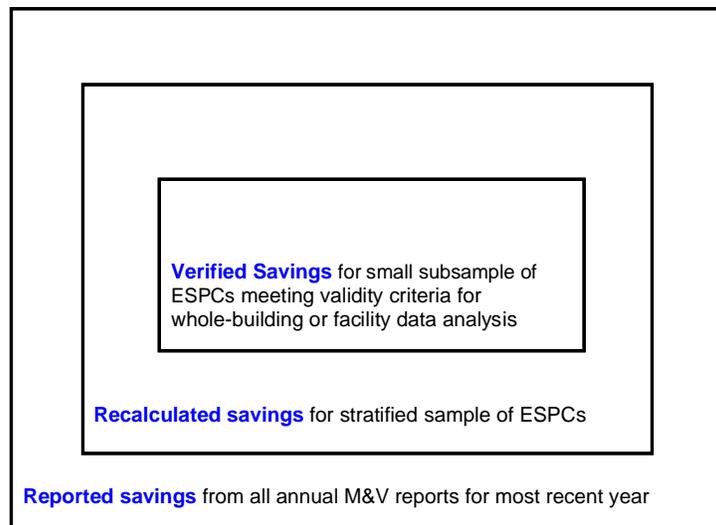


Figure 1: Graphic representation of nested evaluation design.

Tier 2 of the study focuses on a subsample of ongoing Super ESPC projects, stratified by U.S. census region and status with respect to the August 2001 Super ESPC consistency modifications. The regional and technology-specific Super ESPC IDIQ contracts were awarded in a series beginning in 1998, and improvements resulting from lessons learned while establishing the earlier contracts were incorporated into the later Super ESPCs. The modifications made to the Super ESPC IDIQs after August 2001 eliminated the differences between the regional contacts, making them all consistent across the program. The standardization and uniformity of the contracts and project documents, especially the financial schedules, was intended to improve quality assurance and administration of Super ESPC projects.

¹ Spring of 2005 was chosen as the cut-off date because that allows at least one full year of performance, for which an annual M&V report can be produced, before the initiation of data collection for this study.

For the sampled projects, savings for the most recent M&V report are recalculated employing the approach specified in the M&V plan and, to the extent possible, using improved data in place of previously used values for key factors that influence energy consumption and costs. The Tier 2 approach consists of verifying all the math from the earlier calculations, verifying to the extent possible the savings associated with reduced energy-related operations and maintenance (O&M) and repair and replacement (R&R) expenses, substituting measured values for some stipulated values and, where possible, using measured values for key parameters.

The Tier 3 analysis is conducted for a much smaller subsample that meets validity criteria for whole-building or whole-facility data analysis. This effort measures verified energy and cost savings under real-world conditions for a set of three to five Super ESPC projects. Examples of this type of analysis are presented by Shonder and Florita (2003) and Shonder and Hughes (2005).

The findings from each tier are used in conjunction with the findings from the other two tiers to optimize the value of this evaluation. Specifically, the Tier 3 data are used to corroborate the Tier 2 findings and to suggest any necessary refinements to the Tier 2 numbers. This approach of using intensive case studies to corroborate and flesh out the findings from less-intensive studies of larger numbers of subjects is frequently used in the evaluation field (e.g., Berry, Brown, Wright, and White 1991; U.S. Nuclear Regulatory Commission 1996). In turn, the adjustment factors produced through the Tier 2 and 3 analyses are applied to the reported savings documented in Tier 1 to estimate total verified savings from all implemented projects.

A more complete description of the evaluation methodology, including detail on sample selection for the level 2 subsample, is presented by Schweitzer et al. (2006).

3 DATA COLLECTION AND EXTRACTION

As the result of ESPC legislation and guidance from FEMP, Super ESPC projects produce a wealth of documentation throughout their lifetime, including the following.

- Initial proposals
- Final proposals (including M&V plan, DO schedules, etc.)
- Post-Installation M&V reports
- Annual (or more frequent) M&V reports
- Contract modifications (updated DO schedules)

While invaluable for tracking the performance of individual projects and measuring the progress of the program in general, this paper trail creates challenges for recordkeeping.

For Tier 1 of the evaluation, the most important documents were the M&V reports. Since ESPCs are implemented at the site level, site personnel generally receive and review

these reports. Site personnel are best suited to do this because they are most familiar with the performance of the conservation measures themselves and with the ESCO's performance of any required performance-period services during the contract term. Nevertheless, due to the decentralized nature of the process, there has up to this time been no central repository for M&V reports. This has made it difficult for auditors to collect the documentation needed to perform program-wide audits.

A major benefit of this evaluation has been the collection of nearly every M&V report produced to date on each project awarded under the Super ESPC umbrella contracts. In response to a request in April 2006, ESCOs began sending M&V reports to DOE's Golden Field Office. ORNL worked with Golden to keep track of reports received and to determine which ones were still outstanding. Periodic communications between ORNL, Golden, and the ESCOs elicited additional reports.

One problem at the outset is that it was not known exactly how many projects were in the performance period. Through its Federal Energy Project Financing Specialists, Project Facilitators, and core teams at the National Laboratories, DOE is generally aware of the progress of each ESPC project up to the time of contract award. After award, however, DOE's involvement is diminished. Until recently there has been no formal process for agencies to notify DOE of important post-award events such as project acceptance by the government, beginning of performance period, receipt of M&V report, contract modifications, and contract termination.

Thus the first step in the data collection process was to determine exactly how many documents were to be expected. As of April 30, 2006, DOE's list of awarded Super ESPCs (maintained at <http://www1.eere.energy.gov/femp/financing/superespcs.html>) contained 142 projects. The more recently awarded projects were still in construction, or were still in the first year of the performance period, and no M&V report had yet been produced. Some older projects had already completed the performance period or had been terminated for other reasons. Eventually it was determined that 102 projects in all were in the performance period and had produced at least one M&V report by April 30, 2006. This set of 102 projects formed the study population, and their most recent M&V reports provided the data source for the evaluation.

The periods covered by the reports have various start dates depending on when the project's performance period began; however, the average start date is 12/1/2004 and the average end date is 11/30/2005. Thus roughly speaking, the results presented in this report correspond to calendar year 2005. The contract year of the reports ranges from year 1 to year 6, with the distribution of reporting years as presented in Table 1.

Contract year	Number of reports
1	16
2	21
3	22
4	19
5	16
6	8

Concurrently with collection of the M&V reports, information was extracted from the reports to populate a database. This database contains a separate record for each project, and for each project, the following information is included for each ECM:

- The technology category of the ECM (these are specified in schedule B-1, Attachment 3 of the “Attachments to the IDIQ Contract”, linked at http://www1.eere.energy.gov/femp/docs/idiq_06_attachments.doc)
- The M&V method used (FEMP option A, B, C or D)
- Estimated energy savings by fuel type (electricity, natural gas, oil, steam, etc.)
- The units of the estimated energy savings (kWh, therms, MMBtu, etc.)
- Estimated cost savings, divided into savings from reduced energy and utility bills, and savings from reduced O&M and R&R costs
- Reported energy savings by fuel type
- The units of the reported energy savings
- Reported cost savings, divided into energy savings and O&M/R&R savings

The database also includes the guaranteed cost savings for the reporting period. Typically the guaranteed cost savings are not broken down by ECM; instead the ESCO guarantees a dollar amount for the entire project for each contract year.

The quality of the 102 M&V reports examined varied widely, and many were lacking some of the information listed above. For example, some reports were missing the estimated cost savings. In these cases it was sometimes possible to obtain the missing information from the award Delivery Order (DO) schedules (also called H-schedules in some older projects) for the project. These schedules provide a concise listing of the important technical and financial aspects of the project. They are contract documents and are typically included in the Final Proposal, but DOE collects them separately and maintains them in a central database.

In particular, schedule DO-1 provides a listing of estimated and guaranteed savings by contract year. If no modifications have been made to the contract, the estimated and guaranteed savings listed in the M&V report should correspond to the estimated and guaranteed savings listed in the DO schedules for that particular contract year². To fill in missing information, it was assumed that if the guaranteed savings listed in the annual report matched the guaranteed savings listed in the DO-1 schedule for the corresponding contract year, then the estimated savings for the year was as listed in schedule DO-1. Likewise, for reports that did not list guaranteed savings, it was assumed that if the estimated cost savings listed in the M&V report matched the estimated cost savings listed in schedule DO-1 for the corresponding contract year, then the guaranteed cost savings for that year were the guaranteed cost savings listed in schedule DO-1.

² DO schedules list costs and savings by contract year, and M&V reports usually include the contract year in their title, for example, *Fox Army Health Center: Year 3 Measurement and Verification Report, October 1, 2003 – September 30, 2004*.

Other reports were missing information on estimated energy savings. In most cases, the estimated energy savings are a function of the ECMs installed and assumptions made about operating hours, weather, occupancy, and other variables. The estimated energy savings are generally the same for each year of the contract. The estimates are made prior to contract award, and if no modifications are made to the contract, the estimates do not change. The estimates appear on schedule DO-4, and they are used, along with the utility rates and escalation rates specified in the contract, to develop the proposed or estimated cost savings for each year of the contract that are listed in schedule DO-1. In the case of missing information on estimated energy savings, it was assumed that if the estimated cost savings listed in the M&V report matched the estimated cost savings listed in schedule DO-1 for the corresponding contract year, then the estimated energy savings were as listed in schedule DO-4.

Many of the projects were found to have been modified in some way since award. In fact, in about a third of the 102 projects examined, the annual guaranteed cost savings listed in the M&V report were different from the guaranteed savings listed in the DO-1 schedule for the corresponding contract year. In these cases, the figure presented in the M&V report was assumed to be correct, but it would have been preferable to have a contract document to verify the information in the M&V report. Some M&V reports did in fact include copies of the applicable DO schedules as an appendix. Having copies of the DO schedules that apply to each M&V report would increase the amount of information available for the evaluation, since it would allow more of the missing information to be filled in. A letter was sent to the ESCOs by DOE's Golden Field Office in August 2006 requesting copies of the current DO schedules, but by the time this report was prepared, few had been received.

4 REPORTED AND GUARANTEED COST SAVINGS

Although the primary objective of an ESPC project is to reduce energy use, the most important issue contractually is cost savings, which are guaranteed on an annual basis by the ESCO. Reductions in energy use are usually the largest source of the cost savings, but savings can also come from reductions in demand, improved power factor (which sometimes results in lower utility rates), and reductions in water use. Reduced O&M and R&R costs are another major source of savings in ESPC projects.

The first objective of the Tier 1 analysis was to determine the aggregate reported and guaranteed annual cost savings for the Super ESPC program. Altogether it was possible to determine reported and guaranteed cost savings for 100 of the 102 reports received. The total annual guaranteed cost savings for the 100 projects for the periods covered was \$42,894,909, and the total reported cost savings was \$46,354,106. In the aggregate, reported cost savings were 108% of the cost savings guarantees.

In 12 of the 100 projects, the reported annual cost savings was equal to the guaranteed cost savings, suggesting that all of the savings in these projects were stipulated. When these projects are excluded, the total reported cost savings in the other 88 projects was 110% of the total guaranteed cost savings.

Of the 88 non-stipulated projects, 81 reported annual cost savings greater than the guaranteed cost savings. The average amount of the additional cost saving was 12% of the guaranteed cost savings.

Cost savings shortfalls were reported in 7 of the 88 non-stipulated projects. The shortfalls range from 0.7% to 22% of the annual guaranteed savings, with the average amount being 6% of the annual guaranteed cost savings. In six of the seven cases, the shortfall was resolved through a reduced payment to the ESCO. In the remaining case — the one in which the 22% shortfall occurred — the M&V report claims that the shortfall was due to an action on the part of the agency and was not the ESCO's responsibility. Most Super ESPC contracts include a process for dispute resolution, and presumably that process was or is being followed in this case.

It is of interest that for this group of 100 projects, 79.3% of the reported annual cost savings were due to reductions in utility bills, and 20.7% were due to O&M or R&R savings, all of which were stipulated.

For the most part the amounts by which reported cost savings exceeded or fell short of the guarantees were small in relation to the guarantee. This is best seen in a figure, but before presenting it the following description is provided of the way the information is displayed.

Consider a project with annual guaranteed cost savings of \$50,000. Before M&V activities are performed, the only information available is the amount of the savings guarantee for this year. This is represented by the left side of Figure 2. Suppose the M&V activities measure a savings of only \$40,000, meaning there is a savings shortfall of \$10,000. On the right side of Figure 1, the bar from the left side is shifted downward so that a portion of it falls below the horizontal axis. The amount lying below the horizontal axis is the magnitude of the shortfall, shown in red. The amount that remains above the horizontal axis represents the reported savings, shown in yellow. The total height of the bar, red plus yellow, represents the guaranteed savings of \$50,000.

Figure 3 presents another project with a savings guarantee of \$50,000 dollars, but where the M&V activities measure a savings greater than \$50,000. Here the bar from the left side of the figure is moved upward on the right side of the figure. The bar is shifted upward by the amount of the surplus, which is shown in blue. The height of the yellow bar, which represents the guaranteed savings, does not change. The combined height of the yellow and blue bars represents the reported savings.

Using the scheme illustrated in Figures 2 and 3, Figure 4 presents the annual cost savings, along with any additional savings or shortfalls, as reported in the most recent available M&V reports for the 100 Super ESPC projects analyzed. The projects are arranged in descending order of reported annual cost savings.

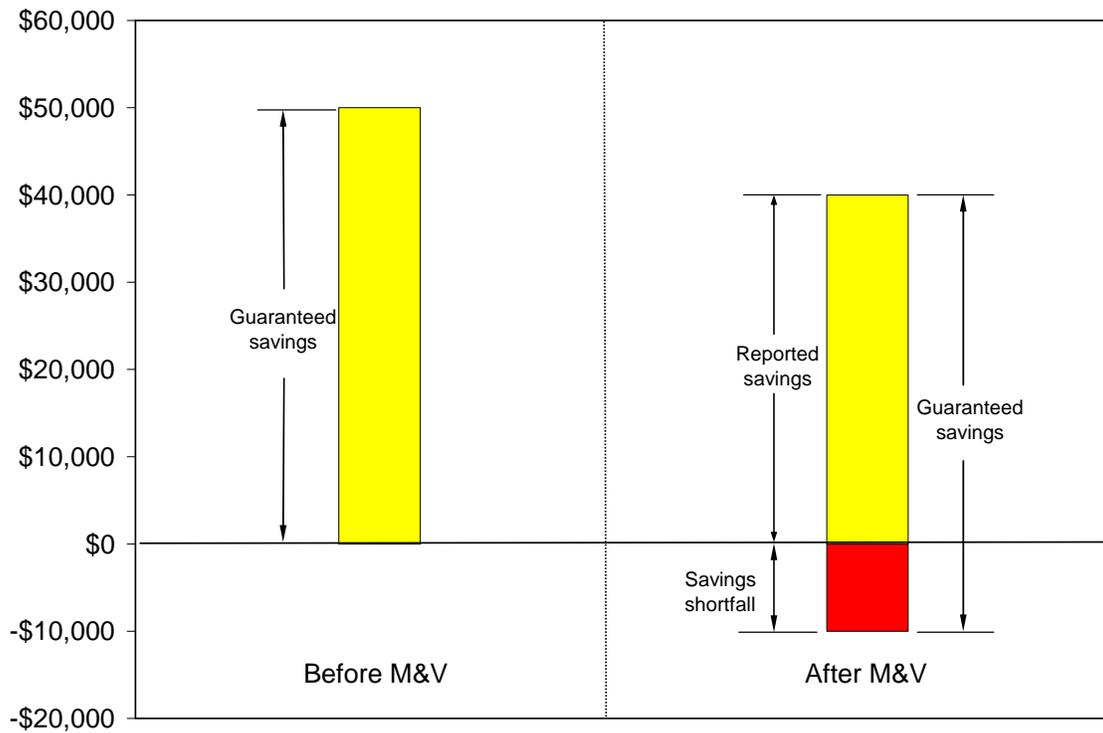


Figure 2: Guaranteed and reported savings for a project with a savings shortfall.

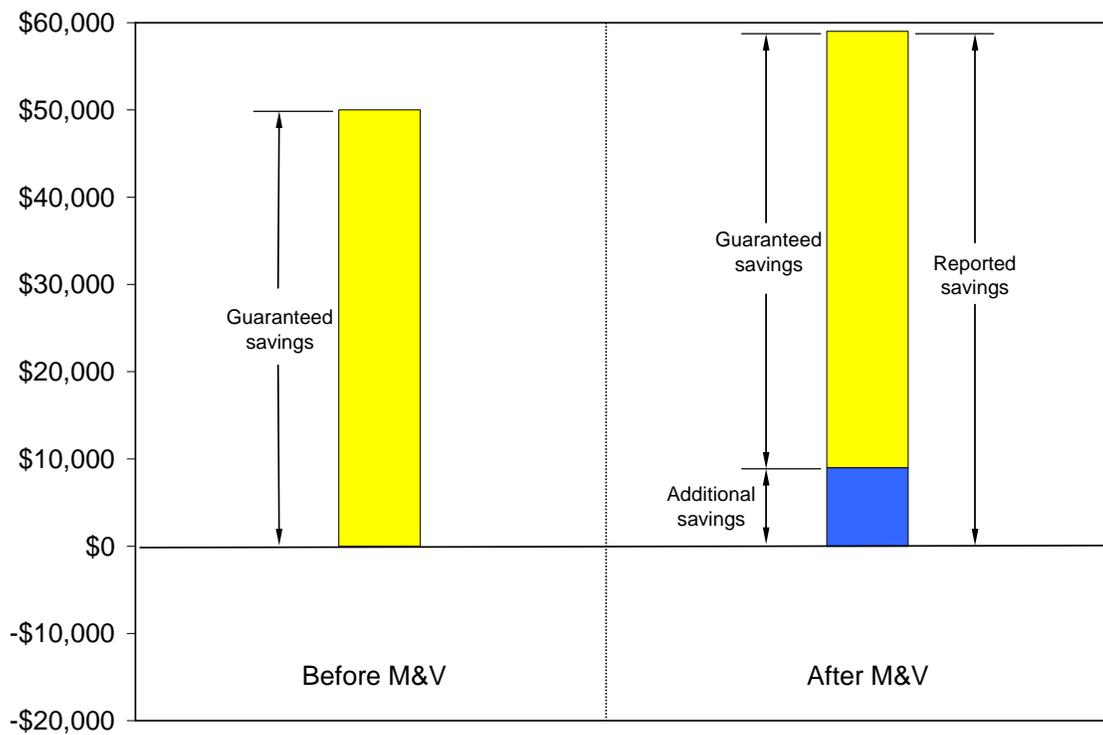


Figure 3: Guaranteed and reported savings for a project in which cost savings exceeds the guarantee.

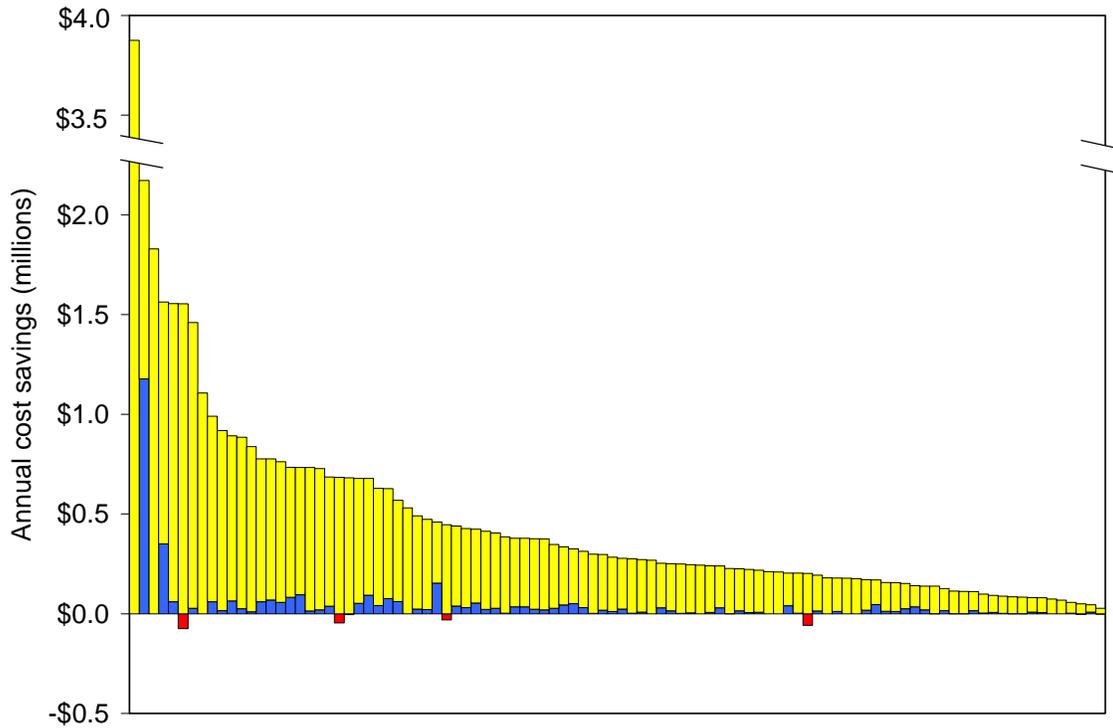


Figure 4: Annual cost savings from 100 ongoing Super ESPC projects. Cost savings above the guarantee are shown in blue, cost savings shortfalls are shown in red. Where no shortfall occurs, the yellow bar is the amount of the guarantee. Where a shortfall occurs, the amount of the guarantee is the sum of the heights of the yellow and red bars.

One fact immediately evident from Figure 4 is the large range in the amount of cost savings delivered by the projects: the largest is reporting more than 100 times the cost savings of the smallest. This means that program averages can be dominated by the performance of a small number of large projects. In fact, the second largest project is seen to be reporting 218% of its guaranteed cost savings. This large savings does affect the program-wide average, but not overwhelmingly. When this project is removed from the data, the ratio of reported to guaranteed savings falls from 108% to 105%.

Figure 5 presents the same information as Figure 4 but in a different way: here the bars represent the percentage of annual guaranteed cost savings reported in the annual M&V reports. The bars are ordered from highest to lowest percentage of annual guaranteed cost savings, which is a different order from that of Figure 4. The message is the same, however: The majority of projects report cost savings greater than the savings guarantee, and only a few projects had cost savings shortfalls.

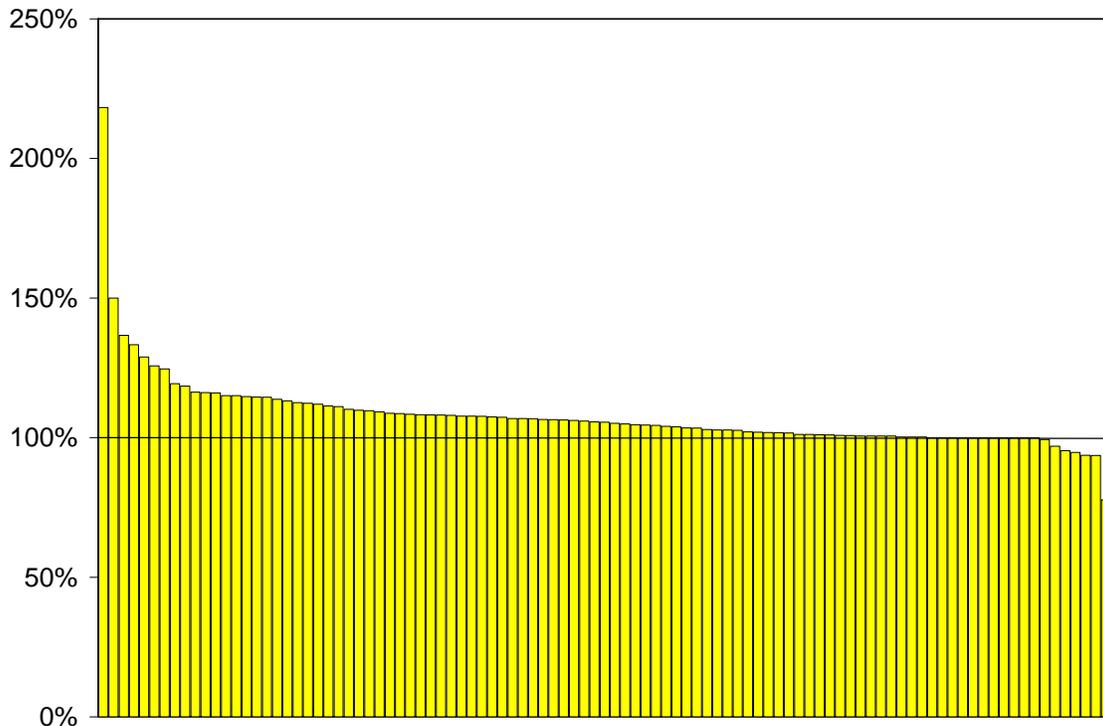


Figure 5: Percentage of guaranteed annual cost savings reported in 100 ongoing Super ESPC projects.

The Tier 2 subsample of projects is stratified by census region (see Figure 6) and by status with respect to the August 2001 consistency modifications. Table 2 presents the proportion of the total guaranteed cost savings in each census region (for example, 44% of the \$42,894,909 in guaranteed annual cost savings identified in the 100 M&V reports occurs in the South). Table 3 shows the percentage of the guaranteed cost savings reported for each region. There are some variations, with projects in the South reporting 111% of the guaranteed cost savings, and projects in the West reporting 105%.

Census Region	Percentage of total guaranteed savings
Northeast	12%
Midwest	12%
South	44%
West	32%

Census Region	Percentage of guaranteed savings reported
Northeast	107%
Midwest	108%
South	111%
West	105%

In all, 33% of guaranteed savings are received from projects awarded before the August 2001 consistency modifications, and 67% were awarded after the modifications. Projects awarded before the modifications reported 105% of their guaranteed savings, and projects awarded after the modifications reported 110% of their guaranteed savings.

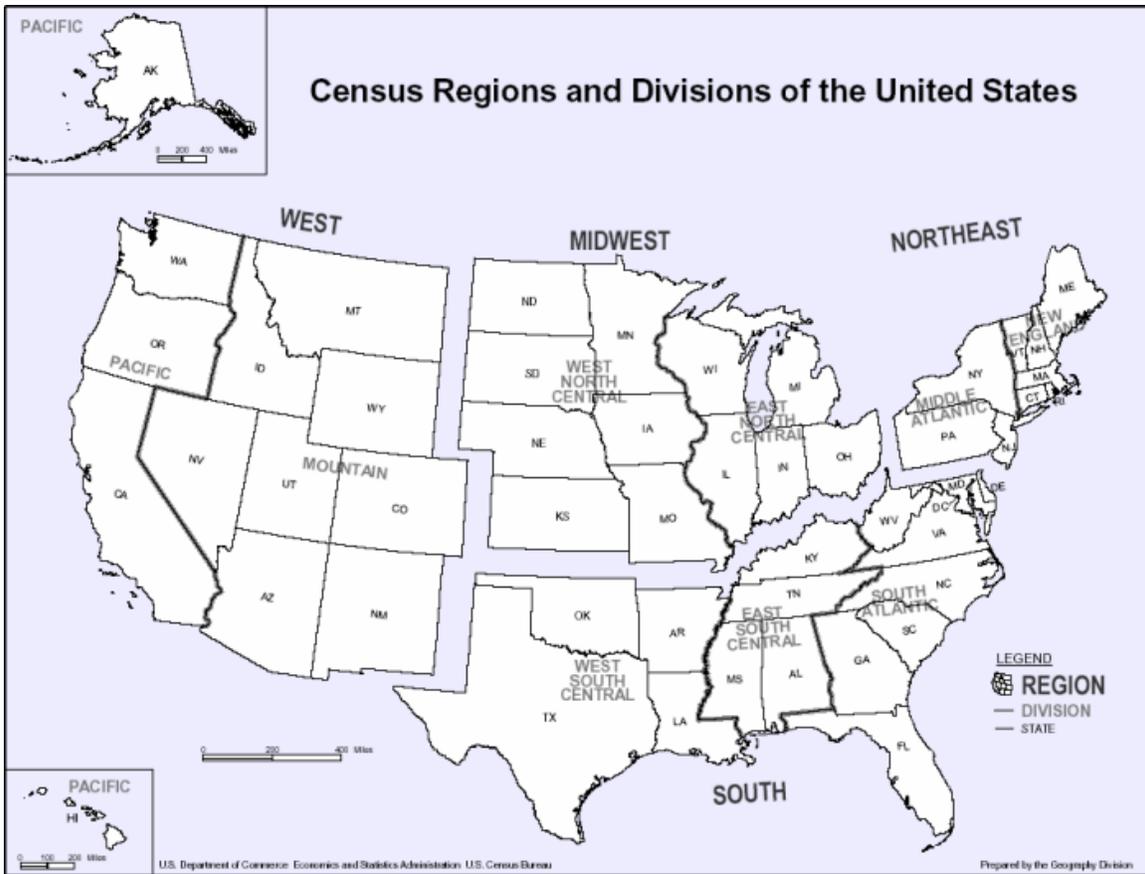


Figure 6: Census regions of the United States.

5 REPORTED AND ESTIMATED COST SAVINGS

ESCOs use engineering models to estimate project energy savings, and then use contract utility rates and escalation rates to estimate cost savings for each year of the contract. These estimated or proposed cost savings are included on schedule DO-1 for each project, and are usually included in the M&V reports. As described in Section 4 above, if estimated cost savings were not provided in the M&V report, it was possible to extract the information from schedule DO-1, *but only if the contract had not been modified since award*. This was because only the award DO schedules were available for all projects. In all, it was only possible to determine estimated and reported cost savings for 91 of the 102 projects.

For these 91 projects, the total estimated cost savings for the periods reported on was \$45,282,944 and the total reported cost savings was \$44,750,719. Thus in the aggregate, reported cost savings were 99% of the estimated cost savings.

The total guaranteed cost savings for the 91 projects was \$41,396,870. Note that the \$44,750,719 in reported savings for this group is 108% of the savings guarantee, the same figure obtained for the larger group of 102 projects.

Dividing the estimated savings by the guaranteed savings, it is seen that on average, ESCOs guarantee about 91% of the savings they estimate for the reporting period.

Figure 7 shows the amount by which the reported savings exceeded or fell short of the estimated savings, in a manner analogous to Figure 4.

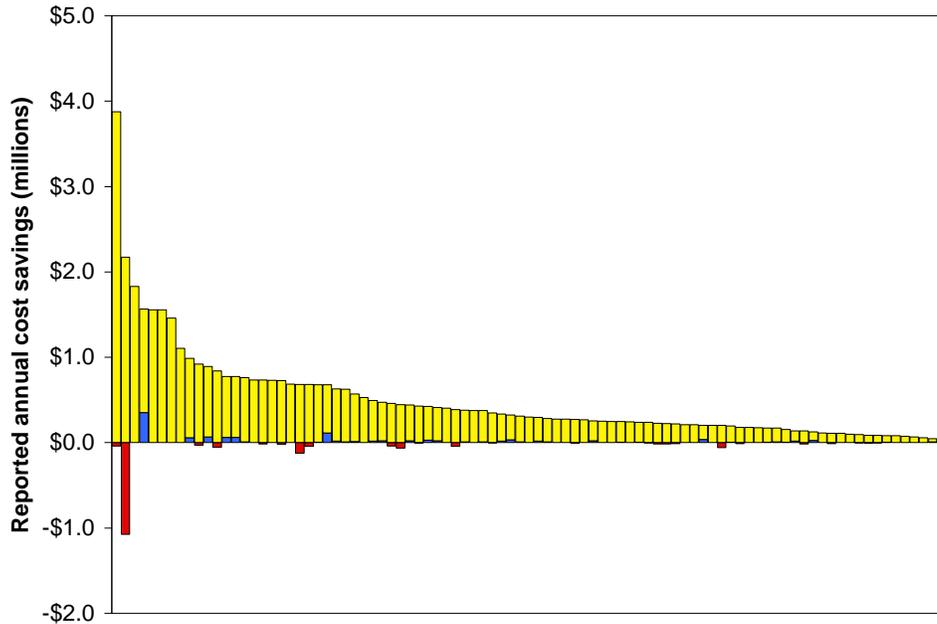


Figure 7: Reported and estimated annual cost savings from 91 Super ESPC projects. Reported cost savings above the estimated amount are shown in blue, and reported savings below the estimated amount are shown in red. Where reported cost savings equals or exceeds the estimated, the height of the yellow bar is equal to the estimated savings. Where reported cost savings is less than the estimated amount, the estimated savings is equal to the height of the yellow and red bars combined.

The height of the blue bars in Figure 7 is the amount by which the reported cost savings exceeded the estimated cost savings, and the height of the red bars is the amount by which the reported cost savings fell short of the estimated savings. The projects are arranged in descending order of reported savings. It is seen that aside from one outlier, the amounts by which reported cost savings exceed or fall short of the estimated savings are small in relation to the estimated savings.

6 REPORTED AND ESTIMATED ENERGY SAVINGS

Annual M&V reports track energy savings as well as cost savings, since one of the primary motivations for implementing Super ESPC projects is to meet energy use reduction goals. Energy savings are not guaranteed, but the ESCO estimates the energy savings that will occur in each reporting period and uses those savings to estimate cost savings and to determine the cost savings that will be guaranteed. The annual M&V report usually presents the energy savings realized during the period, as determined by the methods described in the M&V plan. The reported energy savings are used to determine the reported cost savings.

Some of the M&V reports examined were missing information on energy savings. As with the cost savings, in some cases it was possible to determine the estimated energy savings from the DO schedules. Where this information was missing, if the guaranteed cost savings in the M&V report was equal to the guaranteed savings listed on schedule DO-1 for the corresponding contract year, it was assumed that the estimated energy savings was as listed in schedule DO-4. Furthermore, it was sometimes

possible to determine reported energy savings when this information was missing: If the reported cost savings was equal to the estimated or proposed cost savings listed in schedule DO-1, then it was assumed that the reported energy savings for the period was equal to the estimated cost savings listed in schedule DO-4.

It is customary in the federal government to report energy savings on a site basis, counting electricity savings at 3412 Btu per kWh, and adding in other fuel savings in Btu. This is problematic for ECMs such as combined heat and power plants that offset the purchase of grid electricity through the use of natural gas, because they can increase the amount of site energy used, while reducing the overall amount of energy used at the site and for the power plant to generate the grid electricity used. DOE's guidance on Section 502(e) of Executive Order 13123 was followed in these cases. The guidance credits the site energy use by 8,438 Btu for each kWh of avoided electricity use to account for the reduction in source energy use.

Of the 102 annual M&V reports examined, it was possible to determine the reported and estimated energy savings for the reporting period in 95 cases. On a site energy basis, the proposed or estimated energy savings for the 95 projects was 2,918,137 MMBtu. The reported energy savings was 2,913,235 million Btu, or 99.8% of the estimated savings. Since the total project investment for the 95 projects was \$356,712,495, the reported savings represents 8,167 Btu/year for each dollar invested.

M&V Methods

Most of the M&V reports examined provided information on the M&V method used for each ECM (Option A, B, C, or D). The percentage of the total guaranteed cost savings verified by each M&V option is shown below for 100 ongoing Super ESPC projects.

M&V Option	Percentage of guaranteed cost savings
A	78%
B	15%
C	1%
D	6%

Note that the reported cost savings was 99% of the estimated cost savings, similar to the ratio of reported to estimated energy savings.

Of the 95 projects, 28 reported annual energy savings less than the amount estimated for the period. For these projects, the reported energy savings averages about 94% of the estimated energy savings.

Thirty-nine of the 95 projects reported annual energy savings greater than the amount estimated for the period. On average these projects are reporting just over 100% (100.4%) of the estimated energy savings.

As is true of cost savings, for the most part the amount of energy savings above or below the estimated savings is small compared to the estimated savings. Figure 8 presents reported site energy savings, along with any additional savings or shortfalls, in a manner analogous to Figure 4.

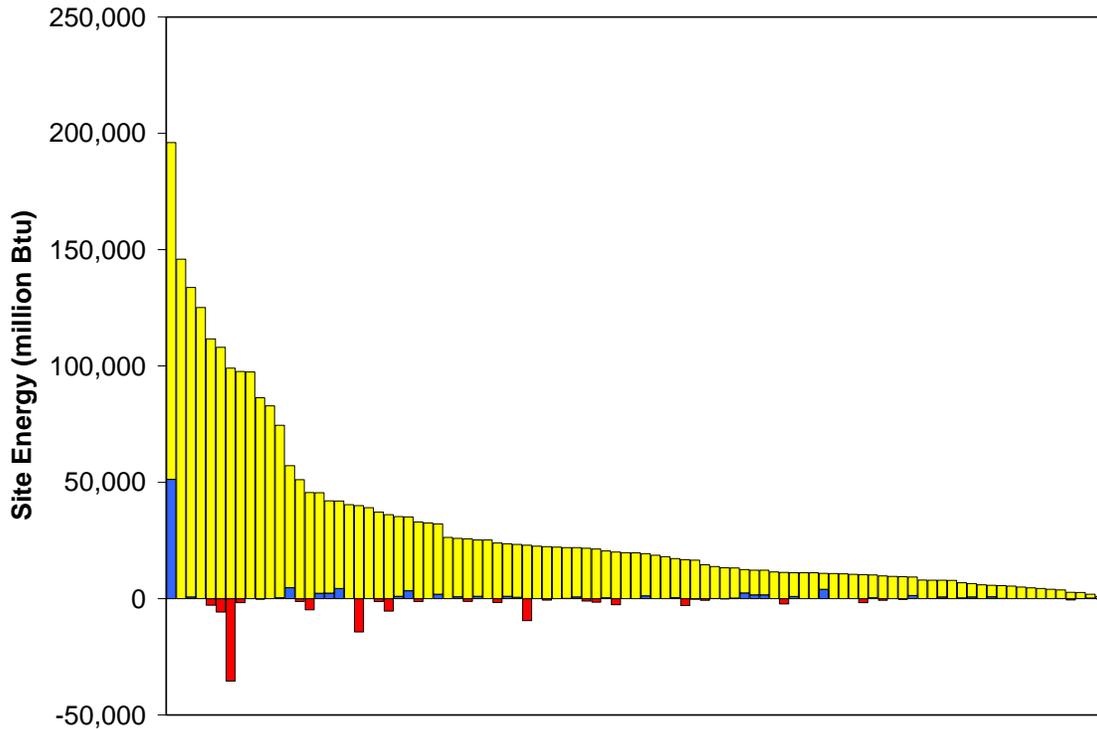


Figure 8: Annual site energy savings from 95 ongoing Super ESPC projects. Reported energy savings greater than the estimated savings are shown in blue, and reported energy savings less than the estimated savings are shown in red. Where no shortfall occurs, the yellow bar is the amount of the guarantee. Where a shortfall occurs, the amount of the guarantee is the sum of the heights of the yellow and red bars.

Table 4 presents the net annual reported and estimated energy savings from the 95 projects by fuel type. “Net” savings means that no corrections were made for projects that increased site energy use while reducing source energy use. These numbers are of interest because they present the direct reductions in utility usage at the project sites. Note that

the ratio of reported to estimated savings varies by fuel type. In the aggregate, the projects report only 98% of the estimated electricity savings, but 113% of the estimated natural gas savings.

Table 4: Aggregate net annual reported and estimated energy savings by fuel type for 95 Super ESPC projects.

	Reported		Estimated		Ratio of reported to estimated
	Savings (MMBtu)	Percentage of total	Savings (MMBtu)	Percentage of total	
Electricity	1,251,679	52.3%	1,275,544	54.9%	0.98
Natural gas	722,756	30.2%	641,798	27.6%	1.13
Fuel oil	116,180	4.9%	102,169	4.4%	1.14
Steam	270,504	11.3%	270,831	11.6%	1.00
Chilled water	8,870	0.4%	2,927	0.1%	3.03
Other	23,019	1.0%	32,059	1.4%	0.72
Total	2,393,008		2,325,328		0.98

Energy savings can also be reported on the basis of source energy, which counts the energy used at the power plant to produce grid electricity. In general, source energy provides a better measure of the environmental impacts of energy efficiency and renewable energy measures than does site energy use. Given the data of Table 3 and an average 28.8% electric conversion efficiency (as specified in DOE’s guidance on Section 502(e) of Executive Order 13123), the reported source energy savings resulting from the 95 projects is 5,488,410 MMBtu, compared with estimated source energy savings of 5,479,748 MMBtu. Thus on a source energy basis, reported energy savings is more than 100% of the estimated energy savings — about 100.2%. Since source energy savings correlate directly with reductions in greenhouse gas emissions, this is a more meaningful comparison, and it shows that on the whole, Super ESPC projects exceed the energy savings estimated for them.

In a similar manner, source energy savings can be calculated for each of the 95 projects. Figure 9 presents the source energy savings for each project, along with any additional savings above or shortfalls below the estimated source energy savings. Again, the amounts by which reported savings exceed the estimated savings are relatively small compared with the estimated savings.

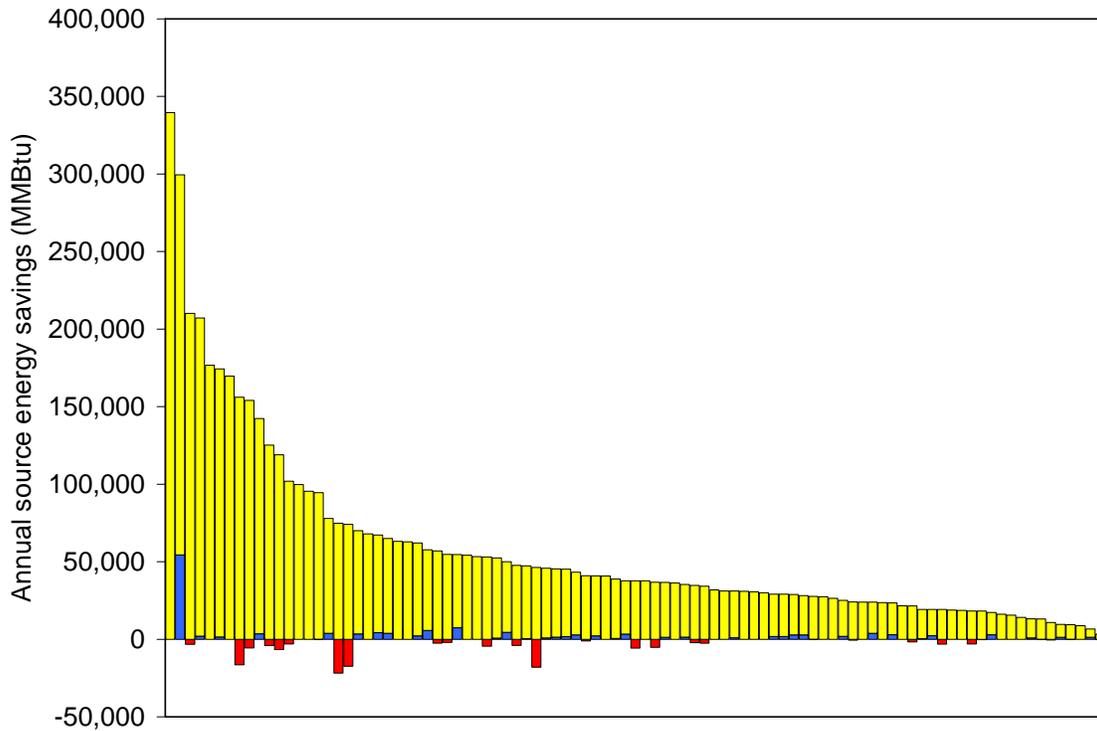


Figure 9: Annual source energy savings from 95 ongoing Super ESPC projects. Reported energy savings greater than the estimated savings are shown in blue, and reported energy savings less than the estimated savings are shown in red. Where no shortfall occurs, the yellow bar is the amount of the guarantee. Where a shortfall occurs, the amount of the guarantee is the sum of the heights of the yellow and red bars.

Table 5 presents information on the source of energy and cost savings by ECM technology category. The table shows, for example, that 22.9% of program-wide site energy savings and 18.5% of program-wide source energy savings are derived from ECMs involving building automation and controls. These ECMs are responsible for 13.0% of program-wide reported cost savings.

Table 5: Percent of program-wide reported site energy savings, reported source energy savings, and reported cost savings delivered by each technology category.

Technology	Site energy savings	Source energy savings	Reported cost savings
Building automation/controls	22.9%	18.5%	13.0%
HVAC	17.4%	12.8%	10.7%
Lighting	16.7%	25.7%	22.6%
CHW/HTHW/Steam Distribution	16.5%	8.3%	6.8%
Distributed Generation	6.6%	4.5%	5.5%
Ground source heat pumps	5.1%	2.9%	4.6%
Chiller plant improvements	4.2%	5.5%	7.2%
Water/Sewer	3.0%	5.5%	4.1%
Motors	2.0%	2.9%	1.8%
Miscellaneous	1.8%	2.2%	6.9%
Renewables	1.0%	1.3%	1.0%
Load shifting	1.0%	0.4%	0.2%
Energy/Utility Distribution System	0.9%	0.5%	1.5%
Envelope improvements	0.4%	0.3%	0.3%
Process Improvements	0.4%	0.6%	1.2%
Boiler plant improvements	0.2%	8.0%	12.1%
Commissioning	0.0%	0.0%	0.0%
Refrigeration	0.0%	0.0%	0.0%

7 CONCLUSIONS AND RECOMMENDATIONS

In Super ESPC projects, ESCOs use engineering formulas and other techniques to estimate the energy savings that will result from the conservation measures installed. Contract energy prices are then used to estimate the cost savings that will result from the estimated energy savings in each year of the contract. Other cost savings, including those that result from O&M or R&R savings, are added in to determine the total estimated annual cost savings. ESCOs then guarantee a percentage of the estimated cost savings. In the M&V report, the ESCO reports both the energy savings and the cost savings that occurred during the reporting period.

Based on an analysis of the most current M&V reports from all ongoing projects that have completed at least one year of performance, aggregate reported savings in the Super ESPC program is about 108% of aggregate guaranteed cost savings. Aggregate reported savings is about 99% of the estimated savings. This means that ESCOs are guaranteeing about 91% of the cost savings they estimate for a given period.

Energy savings can be calculated in terms of site energy use and source energy use. Based on site energy use, the projects analyzed reported 99.8% of the energy savings that had been estimated for the periods reported on. Based on source energy use, the projects reported 100.2% of the estimated savings.

While this stage of the evaluation did not attempt to verify the energy or cost savings in any way, these results do serve as a first-level measure of the overall performance of the Super ESPC program. Based on the information reported, the projects do seem to be meeting their objectives in terms of energy and cost savings.

One concern is that not all of the required information on energy and cost savings could be determined from every M&V report. In some cases it was possible to determine the information based on reference to other documents, but FEMP has developed standards for M&V reports (see for example www1.eere.energy.gov/femp/docs/mv_annual_report.doc), and these are not being followed in every case. This has been noted by others who have examined samples of M&V reports (Nexant, 2002; Nexant 2004).

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