ENERGY EFFICIENCY AND CONSERVATION

BLOCK GRANT (EECBG) PROGRAM

EVALUATION PLAN

APRIL 2011

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1. INTRODUCTION

The U.S. Department of Energy (DOE) is sponsoring a national evaluation to measure the key outcomes achieved by its Energy Efficiency and Conservation Block Grant (EECBG) Program during the 2009 through 2011 program years. The findings from this evaluation will document the Program's principal achievements and provide valuable information for policy makers and program managers to help inform future energy efficiency and renewable energy efforts. This Chapter discusses the key research questions to be addressed by the EECBG study, provides additional background information on the structure and operations of the EECBG Program, and briefly describes the major types of energy efficiency and renewable energy activities supported by the Program.

PURPOSE OF EECBG EVALUATION/BACKGROUND

The upcoming EECBG Program evaluation is designed to serve a twofold purpose. The primary purpose of the evaluation is to accurately quantify the principal outcomes achieved by the Department of Energy's $2.7 billion Formula Grant investment in energy efficiency and renewable energy[1]. The secondary purpose is to determine the most effective types of activities supported by the Program and identify key organizational and operational characteristics related to successful performance.

The EECBG evaluation will be performed by Seller (an independent evaluation contractor) selected through a competitive solicitation process and managed by Oak Ridge National Laboratory (ORNL). Planning for the study has begun and the independent evaluator will be selected in the spring of 2011. It is expected that the study will be completed by the end of the 2012 calendar year.

The following terminology will be used throughout this document and should also be employed by the evaluation contractor when performing the study and documenting its results. "Program" refers to the entire EECBG Program, which consists of all funded activities carried out by grant recipients nationwide. "Broad Program Area" or "program area" refers to a related set of activities performed by multiple grant recipients in different states and locales that have basic similarities in terms of the actions performed and services provided (e.g., energy efficiency retrofits; financial incentives; renewable technologies). "Subareas" refer to identifiable sets of activities within a Broad Program Area that have common characteristics (e.g., the kind of retrofit measure installed or type of financial incentive mechanism employed) that distinguish them from other types of activities within their program area. "Activities" are the basic building blocks of the Program and refer to the specific actions taken by individual grant recipients. Many EECBG-funded activities consist of a single action or project, such as the retrofit of a large government facility or the development of a renewable energy generation facility. Other

[1] This evaluation focuses entirely on the Formula Grant portion of EECBG and not on the competitive awards provided by the Program, which account for a significantly smaller portion of total funding.

activities consist of multiple actions funded by a single grant and performed under a common administrative framework, such as an energy-efficiency loan effort targeted at a particular set of clients. While it is not unusual for evaluators to refer to sets of multiple related actions as a "program," for this study they will be called "activities[2]."

In line with the study objectives presented above, the key research questions to be answered by the EECBG Program Evaluation are:

- What is the total magnitude of energy and cost savings, and other key outcomes, achieved in those Broad Program Areas that cumulatively account for approximately 80% of total Formula Grant expenditures in the 2009 – 2011 program years?
- What is the magnitude of outcomes achieved by each of the most heavily-funded Broad Program Areas within the EECBG portfolio? and
- What are the key factors influencing the magnitude of EECBG outcomes?

It is important to note that preliminary outcome estimates will be provided to DOE on a quarterly basis by grant recipients, as specified in the *DOE Recovery Act Reporting Requirements*. Accordingly, program planners and managers will have access to preliminary outcome data even before the findings from the EECBG evaluation become available.

EECBG PROGRAM STRUCTURE AND OPERATIONS

The EECBG Program, funded for the first time by the American Recovery and Reinvestment Act (Recovery Act) of 2009, represents a Presidential priority to deploy inexpensive, clean, and reliable energy efficiency and renewable energy technologies across the country. The Program, authorized in Title V, Subtitle E of the Energy Independence and Security Act (EISA) and signed into law on December 19, 2007, is modeled after the Community Development Block Grant Program administered by the U.S. Department of Housing and Urban Development (HUD). The Formula component of the EECBG Program provides approximately $2.7 billion in grants to about 2,350 cities, counties, states, territories, and Indian tribes. Grants can be used for energy efficiency and conservation efforts communitywide, as well as renewable energy installations on government buildings. Activities eligible for use of funds include the following:

- Building energy audits and retrofits, including weatherization
- Financial incentives for energy efficiency such as energy savings performance contracting, on-bill financing, and revolving loan funds
- Development of an energy efficiency and conservation strategy
- Installation of distributed energy technologies including combined heat and power and district heating and cooling systems
- Installation of renewable energy technologies on government buildings
- Transportation activities to conserve energy and support renewable fuel infrastructure
- Installation of energy-efficient traffic signals and street lighting

[2] In the State Energy Program evaluation that is currently underway, such sets of related actions are referred to as "programmatic activities."

- Reduction and capture of greenhouse gas emissions generated by landfills or similar waste-related sources
- Material conservation activities including source reduction, recycling, and recycled content procurement efforts
- Building code development, implementation, and inspections
- Any other appropriate activity that meets the purposes of the Program and is approved by DOE

The EECBG Program assists U.S. cities, counties, states, territories, and Indian tribes to develop, promote, implement, and manage energy efficiency and conservation efforts designed to: reduce fossil fuel emissions; reduce the total energy use of the eligible entities; improve energy efficiency in the transportation, building, and other appropriate sectors; and create and retain jobs.

In addition to the Formula-eligible entities mentioned above, stakeholders of the EECBG Formula Program include Congress and organizations representing units of local government such as the National Association of State Energy Officials (NASEO) and the National Association of Counties (NACo).

The EECBG Program is administered through DOE's Office of Weatherization and Intergovernmental Program (OWIP) under the Office of Energy Efficiency and Renewable Energy (EERE). Individual oversight of the approximately 2,350 EECBG recipients is delegated to 59 project officers spread among DOE headquarters in Washington, DC, and field offices in Golden, Colorado; Las Vegas, Nevada; and Oak Ridge, Tennessee. Working in close cooperation with a number of recipients, these project officers maintain awareness of the status of grant execution, identify and mitigate barriers to performance, ensure that recipients meet reporting requirements, and verify compliance with statutory and regulatory requirements for each of their grantees.

BRIEF DESCRIPTION OF EECBG EFFORTS

The EECBG Funding Opportunity Announcement (FOA) outlined 14 eligible types of activities established through EISA. Recipients utilize their own discretion in selecting which combination of activities to pursue, subject to a verification of eligibility by DOE staff. A preliminary examination of the Performance and Accountability for Grants in Energy (PAGE) database, which contains descriptions of the activities performed by EECBG grant recipients, indicates that those efforts often consist of single actions, in contrast to the larger, multiple-action activities more common under DOE's State Energy Program (SEP).

The current distribution of EECBG Formula funding among the 14 Broad Program Areas is shown in Table 1.1. As that table indicates, the six top-funded Broad Program Areas in combination account for over 80% of total EECBG Formula Grant expenditures. Those six broad categories of activities – Energy efficiency retrofits; Financial incentives; Buildings and facilities; Lighting; Onsite renewable technology; and Energy efficiency and conservation strategy – will be the focus of this evaluation. It should be noted that the number of activities

shown in the table do not include numerous activities supported by "subgrants" of EECBG funds provided by the states to local governments too small to receive direct EECBG grants.

Table 1.1. Distribution of EECBG formula grant activities, by Broad Program Area			
Broad Program Area	**Percent of Funding**	**Cumulative Percent of Funding**	**Number of Activities**
Energy Efficiency Retrofits	**36.7%**	**36.7**	**2,416**
Financial Incentives	**18.5%**	**55.1**	**391**
Buildings and Facilities	**9.6%**	**64.7**	**778**
Lighting	**7.0%**	**71.7**	**610**
Onsite Renewable Technology	**6.3%**	**77.9**	**467**
Energy Efficiency and Conservation Strategy	**5.2%**	**83.2**	**786**
Transportation	4.2%	87.4	509
Other	3.6%	91.0	86
Technical Consultant Services	2.4%	93.4	534
Residential and Commercial Buildings and Audits	2.3%	95.7	422
Energy Distribution	1.3%	97.0	79
Material Conservation	1.2%	98.2	158
Reduction/Capture of Methane/Greenhouse Gases	1.1%	99.3	47
Codes and Inspections	0.7%	100.0	111
TOTAL	100.0%	100.0	7,394

2. OVERVIEW OF STUDY DESIGN

The main research questions to be addressed in the EECBG evaluation, the outcome metrics that will be used, and the key elements of the study design are summarized in this chapter.

RESEARCH QUESTIONS

As noted in Chapter 1, the EECBG evaluation is designed to answer three key questions:

- What is the total magnitude of energy and cost savings, and other key outcomes, achieved in those Broad Program Areas that cumulatively account for approximately 80% of total Formula Grant expenditures in the 2009 – 2011 program years?
- What is the magnitude of outcomes achieved by each of the most heavily-funded Broad Program Areas within the EECBG portfolio? and
- What are the key factors influencing the magnitude of EECBG outcomes?

The preceding chapter listed 14 Broad Program Areas into which all EECBG activities can be grouped. This evaluation is designed to estimate key outcomes for the six most heavily-funded of those areas, separately and in combination. The findings will demonstrate what has been accomplished by the major portion of Program funding and will also allow a comparison of the outcomes achieved per dollar of investment by the main program areas.

The final question, regarding the key factors influencing the magnitude of EECBG outcomes, will be answered by identifying specific design, implementation, operational, technical assistance, and market factors that are related to performance. Such information can be useful to policy makers, program managers, and other parties interested in the adoption and effective utilization of energy efficiency and renewable energy technologies.

METRICS

The EECBG evaluation will quantify achievements for three important outcomes: (1) energy and cost savings; (2) gross carbon emission reductions; and (3) direct and indirect job creation. Each is described briefly below.

Energy and Cost Savings

This evaluation will estimate the amount of energy saved by EECBG-funded activities for each of the most heavily-funded Broad Program Areas individually and for those six program areas in combination. Findings will be reported in absolute terms and as a percentage of pre-treatment energy use. Savings estimates will be generated for each major fuel type (electricity, natural gas, fuel oil, propane, gasoline, diesel fuel) and for all fuels combined (using source BTUs as a common measure). The associated cost reduction will also be calculated. Energy and cost

savings should be weather-normalized and estimated for each year over the effective useful life (EUL) of the energy efficiency and renewable energy measures installed.

Gross Carbon Emission Reductions

Annual gross carbon emission reductions resulting from the energy savings discussed above will also be measured. Those emission reductions result from the reduction or avoidance of fossil fuel consumption achieved by EECBG-sponsored energy efficiency and renewable energy activities. Like energy impacts, carbon reductions will be reported for each year over the EUL of the activities studied. Those gross carbon reduction estimates will be reported in metric tons of carbon dioxide (CO_2) for each Broad Program Area individually and for all program areas studied in combination.

Direct and Indirect Job Creation

The third key metric addressed by this study is the net number of jobs created or retained by EECBG-supported activities. This includes jobs that are directly created in the course of implementing energy efficiency and renewable energy activities as well as indirect jobs that are generated as a result of supplying the tools, resources, and support services that enable those efforts. Jobs created by the additional local expenditures enabled by activity-induced reductions in energy cost over the effective useful life of the actions taken will also be documented but, because this is a *net* jobs analysis, the number of jobs lost in the energy production and distribution sectors as a result of the achieved energy savings will also be factored into the analysis.

KEY ELEMENTS OF STUDY DESIGN

Figure 2.1 illustrates the key elements of the EECBG evaluation design. Each of those study components is described briefly below.

The EECBG evaluation will begin with a review of the PAGE data set, which will be provided to the contractor by ORNL, to provide essential information on EECBG activities carried out during the study period in the six most heavily-funded Broad Program Areas, which will be the focus of this study. Key information to be examined includes the number and type of activities performed, the amount of EECBG funding supporting those activities, the amount of funding leveraged from other sources, and key activity characteristics relevant to operation and performance. This information will be augmented, as needed, by information from other sources.

Following the review of PAGE and other sources described above, a final sort of EECBG activities into major program areas and subareas will be performed for the six most heavily-funded Broad Program Areas. This final sort will build on a preliminary sorting exercise carried out by the DOE project officers, using program areas and subareas developed in consultation with ORNL.

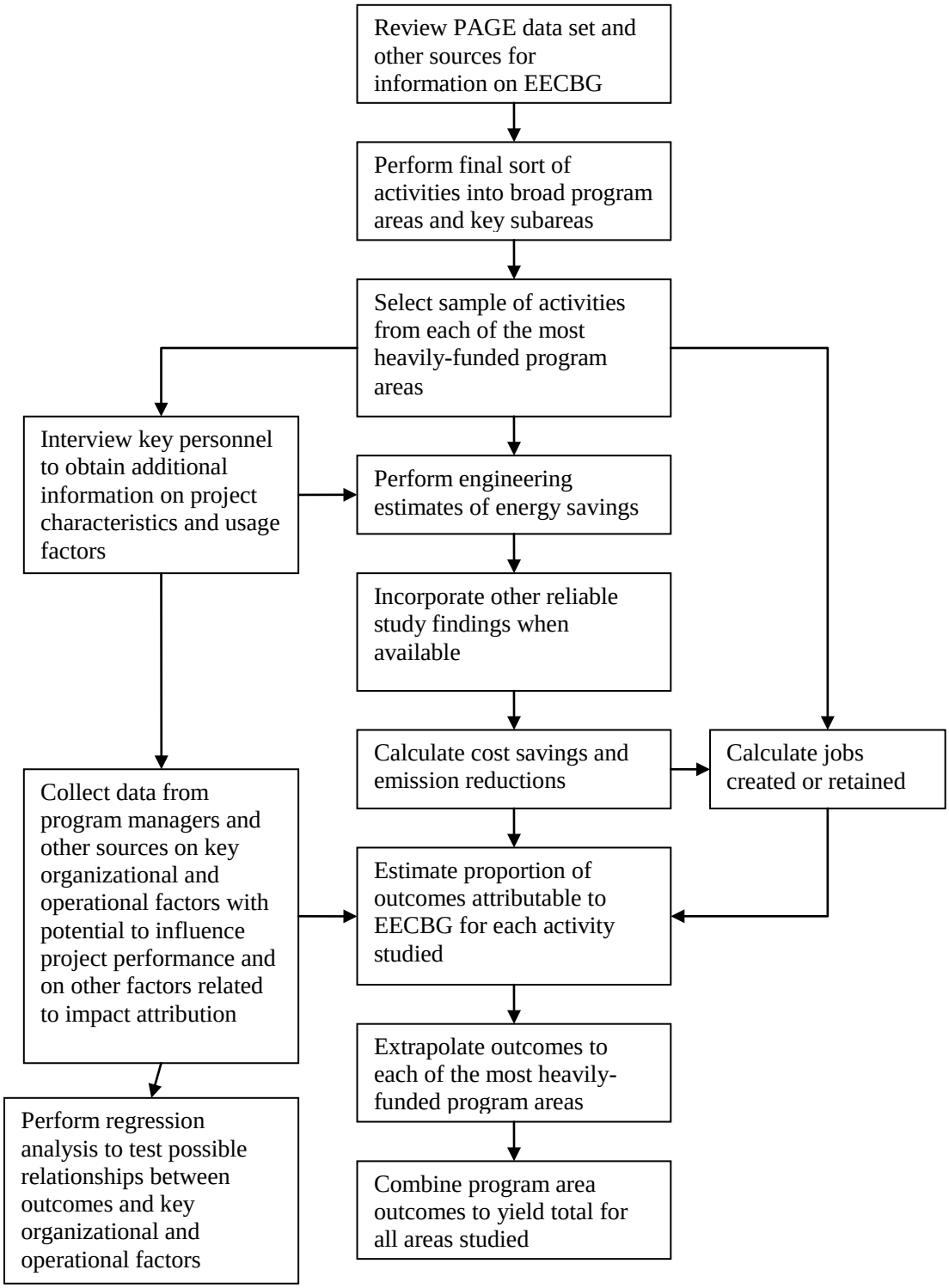

Figure 2.1. Key elements of EECBG evaluation design

The next step in the study will be to select a sample of activities to study from the six most heavily-funded Broad Program Areas, using some form of probability sampling. Each program area will have its own sample, with larger program areas having bigger sample size. The total number of activities selected for study, from all six major program areas combined, will be approximately 350, with the precise number dependent on the distribution of the sample across the various program areas studied and the cost per individual study for the various Broad Program Areas and subareas.

Once the sample has been selected, engineering estimates of energy impacts will be made for each of the sampled activities. This will involve interviewing key personnel to collect additional information on activity characteristics and usage factors that will allow energy consumption to be calculated for pre- and post-activity systems and equipment under the relevant operating conditions. From this, pre- and post-activity energy consumption can be compared and savings calculated. An important advantage of this approach over studies that employ billing analysis is that the study can be completed more quickly (because 12 months of post-treatment billing data are not required) and at substantially lower cost per activity examined. The major disadvantage is that there will be greater uncertainty surrounding the savings estimates for each individual activity studied, but past experience suggests this will be more than offset by the fact that the lower per-unit cost will allow a much larger and more representative sample to be used. However, if sufficient resources were available to study a representative sample of activities using billing analysis or comparable methods, more reliable results could be expected.

At the same time that this study is being carried out, some state and/or local governments are likely to be sponsoring evaluations of their own EECBG activities. To the extent possible, the findings of those efforts should be incorporated into this evaluation, to expand the number of activities that can be examined. Accordingly, ORNL will coordinate with DOE's project officers to identify, for the independent evaluation contractor, where EECBG activities are already being evaluated and avoid duplication of effort. In order for other evaluation results to be used in this study, they must be sufficiently objective and rigorous and focus on the appropriate program areas and subareas.

After energy savings have been estimated, cost savings and gross emission reductions can be calculated based on the magnitude of energy savings, energy prices for the relevant fuels, the mix of affected fuels, supply conditions, and the carbon-emitting characteristics of the fuels involved. The net number of jobs created or retained will be estimated based on activity costs and characteristics and the cost savings achieved by the activities in question.

Because EECBG-funded activities often receive additional support from other sources, an essential component of this evaluation will be to estimate the proportion of outcomes attributable to EECBG itself. The analysis will be guided by attribution assessment questions developed by experts in this field based on state-of-the art behavior change science. It will utilize attribution analysis approaches designed to identify why the EECBG-funded activities in question were implemented and the importance of the EECBG funding in stimulating that to happen.

The outcome estimates described above will be extrapolated to each Broad Program Area studied based on the findings from the individual studies and the amount of funding in each program

area. Those program area outcomes will then be combined to yield a cumulative total, by outcome metric, for all of the Broad Program Areas studied.

At the same time that data are collected from activity managers to be used in the engineering estimates, additional information will be gathered on key organizational and operational factors with the potential to influence performance. To the extent necessary and possible, information will also be gathered on other important factors related to impact attribution. This information will come from activity managers as well as other key parties involved in the activities under study. After all outcome calculations are performed and the relevant information is collected, statistical analysis will be performed to determine whether, and to what extent, the organizational and operational factors examined influence the achievement of key outcomes.

3. CHARACTERIZATION OF EECBG FORMULA GRANT ACTIVITIES

The EECBG evaluation will begin with a review of the PAGE data set and information from other sources, as necessary, to collect essential information on activities carried out during the study period in the most heavily-funded program areas. Then, a final sort of EECBG activities into major program areas and subareas will be performed for those Broad Program Areas that cumulatively account for approximately 80% of total EECBG funding. Each of these key elements, which are essential precursors to the sample selection task described in Chapter 4, is discussed in more detail below.

REVIEW *PAGE* DATA SET AND OTHER SOURCES FOR INFORMATION ON EECBG ACTIVITIES

A review of relevant sections of the PAGE data set will be the first step in understanding the types of activities being implemented by EECBG Formula Grant recipients. As of mid March, 2011, there were 7,394 individual activities listed in the PAGE data set (Table 1.1), with combined funding of just over $2.7 billion. In the six most heavily-funded program areas, 5,448 activities accounting for approximately $2.24 billion in allocations were listed. However, it should be noted that, as mentioned in Chapter 1, those activity numbers do not include numerous activities supported by "subgrants" of EECBG funds that the states pass on to local governments too small to receive direct EECBG grants.

The activities supported by EECBG grants vary widely in scope and cost, ranging from small low-cost equipment upgrades to multimillion dollar activities consisting of a large number of individual actions across multiple local government jurisdictions. A broad range of market sectors are targeted by the various EECBG activities, including agricultural, commercial, industrial, institutional, and residential. However, a very substantial number of activities focus on the local government sector. It will be important for the evaluation contractor to review the PAGE data set carefully to gain an understanding of the activities described in the six Broad Program Areas of interest for this study.

The review of the PAGE data set conducted by the evaluation contractor will examine a number of factors in addition to activity type. These will include the magnitude of EECBG funding, the amount of support provided by other sources, and any other information that might be relevant to activity operations and performance. Information can also be gathered in other ways, such as through interviews with grant recipients, as needed to fully characterize the funded activities.

As of mid-March, 2011, there was significant variation in the completion status of the various EECBG-supported activities as shown in Table 3.1, below. Because a number of EECBG activities are already completed or nearing completion, it will be possible to launch data collection and analysis efforts once a sample is selected and any necessary approvals of data collection instruments are obtained, at least for some of the activities. In fact, it is possible to perform engineering estimates before an activity has reached completion, but the effort under

study must be far enough along so that its essential characteristics and operating environment can be well understood.

Table 3.1. Distribution of EECBG activities, by completion status	
Completion status as of March 18, 2011	**Percent of total EECBG activities**
Completed	20%
80% to 99% complete	9%
60 to 79% complete	5%
40 to 59% complete	8%
20% to 39% complete	12%
1% to 19% complete	18%
0% complete	28%

PERFORM FINAL SORT OF ACTIVITIES INTO BROAD PROGRAM AREAS AND KEY SUBAREAS

The individual activities performed by EECBG grant recipients will be sorted into Broad Program Areas and appropriate subareas so that similar activities are grouped together. This is an essential step in the selection of a sample that is representative of the types of activities supported by EECBG and also allows appropriate impact estimation approaches to be chosen that match the relevant application and use environment.

The DOE project officers charged with providing guidance and oversight to EECBG grant recipients are currently involved in performing the type of sorting exercise described above. The project officers are classifying the activities supported by direct EECBG grants as well as by the subgrants provided by states to their smaller locales. However, it is likely to be more difficult to identify the subgrantees responsible for specific activities than it will be for direct grant recipients.

The Broad Program Areas and subareas used in the DOE project officers' sorting effort were developed by DOE, in consultation with ORNL. The desired outcome of that collaboration is a classification scheme that accurately describes the nature of the various kinds of activities undertaken and also provides a basis for the sample selection process required for this study.

As previously noted, the six Broad Program Areas to be examined in this study are: (1) Energy efficiency retrofits; (2) Financial incentives; (3) Buildings and facilities; (4) Onsite renewable technology; (5) Lighting; and (6) Energy efficiency and conservation strategy. The first four of those broad areas are treated as major categories in DOE's current sorting effort. The subareas associated with each of them are shown in Table 3.2. The other two Broad Program Areas listed above are not called out as separate categories in DOE's sorting effort. Lighting efforts are treated by DOE as subareas of the Retrofits area and another Broad Program Area (New Construction Upgrades) that is not shown in Table 3.2. Energy Efficiency and Conservation Strategy is classified as a subset of a broader area called Studies and Plans (not shown in Table 3.2) and should possibly also include activities from other elements of the Studies and Plans program area, such as Strategic Energy Plans.

Table 3.2. DOE's Preliminary Subareas for Main Program Areas	
Broad Program Area	**Key Subareas**
Retrofits	Boiler
	Building Envelope
	Cool Roofing
	Compressed Air
	Exterior Lighting
	Fans
	HVAC
	Insulation
	Interior Lighting
	Motors
	Process Heat
	Pumps
	Sensors
	Solar Hot Water
	Steam
	Water Heating
	Water Saving
	Other
Financial Incentives	Interest Rate Buy-down
	Loan Loss Reserve
	On Bill Financing
	PACE (Property Assessed Clean Energy)
	Performance Contracting
	Power Purchase Agreement
	Rebates: Appliance
	Rebates: Non-Appliance
	Revolving Loan Fund
	Sub-grant
	Tax Credits
	Other
Buildings	Architecture, Design, and Engineering
	Energy Efficiency Rating and Labeling
	Energy Management Systems
	Measurement and Verification
Renewable Energy	Anaerobic Digestion
	Biomass/Biofuel
	Fuel Cells
	Ground Source Geothermal
	Hydropower
	Solar Photovoltaics
	Solar Thermal
	Wind Power

The projected completion date for the DOE project officers' sorting effort is July, 2011. Once that task has been completed, the independent evaluation team selected to perform the EECBG

evaluation will examine the results and conduct a final sort tailored to the needs of this study. As part of that final sorting effort, the EECBG evaluation team will consider whether any more subareas are needed and, if so, will gather any additional information that is needed for the final sorting exercise. It seems likely that, at the least, additional subareas will be needed to adequately classify the various activities carried out in the broad area of Energy Efficiency and Conservation Strategy.

4. EVALUATION OF SELECTED EECBG ACTIVITIES IN MAIN PROGRAM AREAS

The evaluation of individual EECBG activities will involve several major steps, starting with the selection of a sample of representative activities from the six most heavily-funded program areas. Between them, those six areas account for over 80% of all EECBG Formula Grant funding. Once a sample is chosen, engineering estimates of energy savings will be performed for each selected activity. Based on those savings estimates, cost savings and gross emission reductions will be calculated. The net number of jobs created or retained will also be estimated. Finally, the proportion of outcomes attributable to EECBG (as opposed to other sources of support) will be estimated for each activity studied. Additional detail about each of these steps is provided below.

SELECT SAMPLE OF ACTIVITIES FROM MOST HEAVILY-FUNDED PROGRAM AREAS

This task involves the selection of a sample of EECBG-funded activities that is representative of the various efforts that make up the most heavily-funded program areas. The findings from this sample can be extrapolated to each program area that is examined. It is estimated that roughly 350 individual activities will be examined from the six program areas of interest for this study. The exact sample size will be determined by the distribution of the sample across the various program areas studied and the cost per individual study for each Broad Program Area and subarea.

The study sample will be selected using a nested stratification approach that focuses on the six most heavily-funded Broad Program Areas and a number of key subareas within each of those broad areas. This approach is designed to ensure that the activities selected for study will provide a reliable estimate of EECBG impacts.

Broad Program Areas

As described in the previous Chapter, EECBG Formula Grant activities will be sorted into Broad Program Areas and an appropriate number of subareas. The six Broad Program Areas to be examined in this study represent the first layer of sample stratification. Each of those program areas will be assigned a priority ranking (1-6) based on a number of criteria, which will be finalized during the early stages of the evaluation. At a minimum, those criteria will include the total level of funding for the activities in each program area, the projected level of energy savings for each type of activity, and the number of activities funded within each program area. This will allow the study to focus more evaluation resources on those program areas that have the greatest potential to achieve impacts. It is anticipated that significant overlap will occur between the criteria. In other words, many of the program areas with the most funding and the most activities are also likely to have the highest levels of projected impacts.

Once funding levels, anticipated impacts, and activity counts are identified for each of the Broad Program Areas to be studied, an approach will be developed for assigning a relative priority to

each one. The independent evaluation contractor will work with Oak Ridge National Laboratory to develop a priority assignment algorithm. That algorithm will assign weights to the primary metrics and establish a numeric ranking system that results in an importance score for each broad area of interest.

Each program area in the study will then be assigned a sample quota proportional to its priority ranking. In other words, a program area that is twice as important as another area will receive twice the sampled number of activities. The sample quotas are expected to vary substantially among the program areas. For example, a review of the PAGE data set indicates that the program area labeled Energy Efficiency Retrofits accounts for nearly 37% of all funded EECBG activities while Energy Efficiency and Conservation Strategy accounts for only about 5% of total funding. The sample quotas for the program areas must reflect such differences.

The total number of sample points to be included in this evaluation will be determined after the ranking process, based on the available budget. Because the average cost involved in conducting an engineering estimate will vary by program area, the exact sample size will depend on the rank order assigned to the six Broad Program Areas addressed in this study. As noted earlier, it is expected that approximately 350 activities will be sampled in this study, depending on the results of the prioritization effort and the cost per individual study in the various program areas.

Once some engineering estimates have been completed in the various program areas, the sample distribution can be adjusted to account for the observed variability in energy savings within areas. Larger samples tend to be needed where there is greater variability, while a smaller sample size can result in reliable estimates where outcomes tend to be very similar from activity to activity. This consideration of variability, while important, cannot be addressed in the initial sample allocation process because suitably reliable savings estimates are not expected to be available at that time.

Key Subareas

In the previous Chapter, it was noted that the individual activities within each Broad Program Area will be sorted into relevant subareas so that similar activities are grouped together. Once the sample size for each Broad Program Area has been determined, each of the relevant subareas will be assigned a sample quota based on its percentage of the program area's overall funding. For example, if industrial motor retrofits are found to account for 25% of all retrofit funding, 25% of the activities included in the retrofit sample will be taken from an industrial motor retrofit subarea. Although the sample size for each subarea will be purposefully determined, individual activities will be selected randomly from the set of all activities of that subtype. This means that any individual activity within each subarea has the same probability of being sampled as any other activity of the same type.

A potentially complicating factor in the sample selection process is the previously-noted existence of a substantial number of activities supported by subgrants provided by the states to local governments that are too small to receive direct EECBG grants. While the activities supported by those subgrants will be included in the sorting exercise described in Chapter 3, there could be some difficulty involved in identifying the subgrantees responsible for specific

activities. The evaluation contractor will assess the situation while reviewing the PAGE data set and performing a final classification of activities. In the detailed work plan to be developed to guide this evaluation (see Chapter 7), the evaluation contractor will propose a sampling approach that allows maximum possible consideration of subgrantee activities in proportion to their size and number.

At the time that the sample is selected, additional activities from the various subareas should be chosen in case future additions to the sample are needed. This will allow for substitutions to occur when a selected activity cannot be evaluated due to cancellation, substantial modification, significant delay, lack of cooperation by management, or some other reason. These potential sample replacements should be chosen in proportion to the number of activities in each Broad Program Area and subarea so if one activity is dropped, a replacement from the same subarea can be used.

Once the final sample is identified, the selected activities will be sorted into estimated completion time periods informed by the progress reports that each is required to provide to DOE. Those time periods will include the following:

1. Already completed
2. Projected to be completed by June 30, 2011
3. Projected to be completed between July 1, 2011 and December 31, 2011
4. Projected to be completed between January 1, 2012 and June 30, 2012

The impact assessment efforts will begin with the earliest time period and will not move to a subsequent time period until its activities are substantially completed. All activities do not need to be completed to be assessed, but they do need to be sufficiently far along so that key evaluation assessment information is available to allow reliable ex ante outcomes to be estimated. Activities that are not sufficiently complete to provide adequate data by the end of the study period will be dropped from the sample and replaced with additional sampling points.

The above-described sampling approach ensures that the sample will be representative of the main activities funded, cover the most heavily-funded program areas and subareas, and focus more evaluation resources on the most important program areas and activity types. However, it also means that the uncertainty of outcome estimates for program areas with smaller amounts of funding will be greater than for more heavily-funded areas.

PERFORM ENGINEERING ESTIMATES OF ENERGY SAVINGS FOR SELECTED ACTIVITIES

This evaluation will generate independent engineering estimates of impacts for approximately 350 individual EECBG-funded activities. The evaluation contractor will not rely on impact estimates provided by the grant recipients themselves but rather will independently estimate impacts employing activity-specific technology usage and application information. That information will be obtained from the submitted grant applications and through interviews with activity managers and key stakeholders.

The activity-specific assessments will be conducted by expert evaluation professionals including engineers trained and experienced in the calculation of energy impacts for the types of technologies and activities implemented. Any activities involving behavior change by energy consumers will be assessed by behavioral research professionals who understand cause-and-effect relationships and the environmental conditions that drive behavior modifications leading to energy impacts.

The strength of this approach is that it is based on expert engineering estimates of savings from a representative sample of the activities funded by EECBG grants. The major weakness is that it does not include on-site metering, measurement, verification, or monitoring to confirm the estimates or calibrate the engineering calculations. However, substantial cost savings are realized in this approach, enabling this study to be conducted within the available budget while providing reasonably reliable impact estimates.

Data Collection

The ability to conduct accurate assessments of the impacts of energy efficiency and renewable energy activity is limited by the ability to obtain accurate information about the activities funded. While it is possible to estimate impacts from an examination of an activity description and assume the conditions associated with key impact calculation variables, activity descriptions alone are typically not enough to accurately estimate impacts. In this evaluation, data will be collected not only on an activity's technologies but also on a range of environmental, usage, and application factors related to that activity.

To gather information on the activities under study, the evaluation contractor will review activity descriptions submitted to EERE by the applicants and stored in the PAGE data set. It may also be necessary to review the actual applications submitted if all activity-related information is not available in PAGE. To obtain more detailed information, the analyst will conduct interviews with key personnel, managers, or trade allies associated with the activities being assessed. In some cases, it may be advisable to obtain detailed technology information from manufacturers or suppliers. In other cases, architects, specifiers, and planners may need to be interviewed. At other times, information may have to be gathered from key policy makers and activity managers. The evaluation contractor will coordinate its data collection efforts with those of the upcoming Better Buildings Program evaluation to ensure that, if both studies need information from the same respondent, those inquiries are combined, to the extent possible, so that a single subject does not receive more than one data request.

The interviews described above, and all others mentioned in this chapter, will be guided by surveys and interview protocols developed by the independent evaluation contractor to elicit the information needed. In those cases where identical information has to be collected from 10 or more respondents, approval must be received from the Office of Management and Budget (OMB) before data collection can begin. Accordingly, the initial data collection effort will focus on gathering information from PAGE and other sources that do not require OMB approval.

Information must also be gathered pertaining to the baseline case that would have occurred if the activity had not been implemented. For retrofits, this means that information will be needed on what was in use prior to the retrofit and what (if anything) would have been done if the EECBG funds had not been available. For new construction, it is necessary to collect information on current codes for the relevant jurisdiction and what would have been built without EECBG funds. For behavior change savings, the assessment must focus on the behaviors in effect before the activity was undertaken and assess the degree of change caused by the intervention.

The independent evaluation contractor will be responsible for reviewing the activity-specific information available through the EECBG grant application and structuring the additional data collection efforts required to collect the data necessary to estimate impacts for each activity assessed. The evaluation budget does not allow for on-site inspections or measurements. As a result, the assessment will rely on "desk-evaluations" and use the types of information described above to estimate impacts.

In addition to the data collection efforts described above, the independent evaluation contractor will be expected to help lay the groundwork for the collection of utility bills that could be useful in future program evaluation efforts. Specifically, the evaluation contractor will be required to distribute to all sample subjects a form (previously designed and approved by DOE) authorizing the release of the customer's utility bills. ORNL will provide the form to the contractor. As part of this undertaking, the contractor will ask all recipients of the billing data waiver to return the signed form to either the contractor or ORNL, as determined by ORNL. While the EECBG Evaluation is designed as an engineering-based analysis, the potential availability of utility bills could allow a limited number of individual activities to be studied using billing data analysis *if* the nature of the activity and the facilities involved lend themselves to that approach and the costs are not prohibitive. In such cases, the evaluation contractor could take advantage of the data base of utility contacts being compiled for a current evaluation of DOE's Weatherization Assistance Program. The detailed work plan to be developed by the independent evaluation contractor to guide this evaluation will identify any cases in which such an approach might be appropriate.

Data Analysis

The focus of the energy impact analysis will be on comparing estimated energy consumption before and after the implementation of EECBG activities. This is commonly called an engineering-based pre-post difference estimation process. The analysis efforts will be guided by best practices associated with the field of estimating ex ante energy impacts for energy efficiency and renewable energy initiatives. These best practice approaches include those contained in the New York Technical Reference Manual for energy efficiency programs, the Ohio Technical Reference Manual, and other similar documents. In addition, peer-reviewed deemed-savings databases can also be used for estimating activity-induced energy savings when the activities are adjusted to the *as installed and used* conditions, informed by interviews with key activity managers or other stakeholders. To off-set the lack of on-site metering, monitoring, and verification efforts, the use of technical manuals and deemed-savings databases should be limited to those that are well-documented, have been peer reviewed, and reflect the results of previous evaluation findings.

For activities not covered by current technical manuals or by peer-reviewed deemed-savings databases, estimation algorithms developed by the evaluation contractor and approved by ORNL may be applied. In such cases, the evaluation contractor will develop an estimation algorithm and submit that approach to ORNL for approval or modification.

The analysis for each sampled activity must result in a point estimate of energy savings that reflects the best judgment of the estimation professional for the conditions associated with the effort under study. Where possible, the assessment will report the conditions that most impact the range of expected savings and indicate the assumptions used to reach the point estimate. If an activity selected for analysis consists of a number of individual actions, a single estimate will be made for the entire set. Savings estimates developed by grant recipients will not be adopted because the focus of this analysis is on independently determining activity outcomes.

Effective useful life (EUL) energy impact analyses will be conducted so that the impacts can be reported for each year over the EUL of the activities assessed using typical EULs for the activities implemented, as found in the applied technical reference manuals or the deemed-savings databases used. For activities that do not have an EUL, the evaluation contractor will estimate the EUL and provide a justification for it.

Deliverable

The calculations performed for each activity are a deliverable and must be provided to ORNL in Excel or some other appropriate format. Key data in the calculation documentation must be labeled to allow an independent confirmation of calculation accuracy by a third party.

For renewable energy activities, installed capacity should be measured as well as the amount of energy generated or expected to be generated under the connection, price, and demand conditions for each site assessed. All estimates must be informed by activity-specific information regarding the conditions associated with energy consumption to help ensure the highest levels of estimation accuracy without on-site inspections, metering, or verification efforts.

Total energy impacts will be estimated for each sampled activity. In addition, the evaluation contractor will report energy impacts per EECBG dollar and for each dollar of total activity cost. As discussed in Chapter 5, the outcomes calculated in these individual activity analyses will be rolled up to the subarea, Broad Program Area, and cumulative program area levels.

Other Studies

Findings from other studies of EECBG activities sponsored by individual states and locales will be incorporated into this study to the extent possible. This will have the effect of avoiding duplication of effort and expanding the number of activities that can be examined. As previously noted, any independent evaluation used in this study must meet high standards of objectivity and rigor and address the appropriate program areas and subareas.

CALCULATE COST SAVINGS AND EMISSION REDUCTIONS

The energy cost savings associated with each sampled activity's energy savings will be estimated based on average energy costs for the sectors in which the savings occur. Average energy costs as reported by the Energy Information Administration (EIA) and adjusted for energy and fuels inflation and discount factors can be used for the year in which the savings occur.

This evaluation will also estimate the amount by which carbon emissions are reduced as a result of the energy saved. For electricity savings, the evaluation contractor will estimate gross carbon emission reductions using the most recent regional data from the U.S. Environmental Protection Agency's Emissions and Generation Resource Integrated Database (e-GRID) and a methodology consistent with those used for other EERE programs. For other fuels, the carbon reduction will be estimated by converting the fuel saved to metric tons of CO_2, assuming a complete oxidation reaction. In all cases, gross carbon emission reductions will be reported in metric tons of CO_2.

Deliverable

The assumptions used in the estimation process and the limitations of the findings will be clearly explained in the report documenting study findings.

CALCULATE JOBS CREATED OR RETAINED

In addition to quantifying outcomes for the metrics discussed above, the EECBG evaluation will estimate the net impact on job creation and retention from the broad types of activities addressed in this study. Specifically, this study will address jobs having three distinct origins. They are:

1. The number, type and duration of jobs associated with the manufacture, storage, transportation, and sales of equipment purchased and installed in conjunction with the funded activities;
2. The number, type and duration of jobs associated with the installation of equipment for funded activities; and
3. The number, type and duration of jobs associated with the economic impacts occurring as a result of activity-related energy savings over their effective useful life.

In addition, the number of jobs *lost* in the energy production and distribution sectors as a result of EECBG-induced energy savings will also be factored into the analysis.

The evaluation budget does not allow for a fully-calibrated economic impact analysis, such as a calibrated state- and industry-specific REMI-like modeling assessment. However, an analysis *can* be conducted using industry standard job counts for the types of equipment installed, supplemented with interview data from equipment manufacturers, distributors, wholesalers, retailers, contractors and activity managers when industry-specific job metrics are not available.

The approach used should include an assessment of jobs associated with the various job-creation and job-loss sources listed above. For example, job creation estimates for equipment manufacturing can be estimated from the typical jobs required per unit of production for the technologies installed, supplemented with industry standard job metrics for storage and distribution of those technologies from the point of manufacture to the point of sale. New jobs associated with the installation of the technologies can be derived by using industry standards for the types and size of equipment installed, or from interviews with a sample of contractors installing the kinds of equipment associated with the EECBG funded activities. The jobs created from additional expenditures allowed by annual energy cost savings can be estimated using information from the job impact literature or the results of more rigorous energy impact economic model studies, such as the one conducted for Focus on Energy in Wisconsin. Job losses in the energy industry due to reduced consumption can likewise be taken from the job impact literature or other economic modeling efforts.

ESTIMATE PROPORTION OF OUTCOMES ATTRIBUTABLE TO EECBG FOR EACH ACTIVITY

Because EECBG-funded activities often receive additional support from other sources, an essential component of this evaluation will be to estimate the proportion of outcomes attributable to EECBG itself. Accordingly, an analysis will be conducted for each sampled activity to determine the portion of total outcomes that is attributable to EECBG.

The simplest way to address this issue is to use information on activity funding collected from the PAGE data set and other sources (see Chapter 3) and attribute outcomes to EECBG and any other sources of support based on their relative contribution. However, a more complex – and more defensible – approach will be used in this evaluation.

The analysis performed here will be guided by attribution assessment questions posed to key financial decision makers, activity managers, and other relevant personnel. Those questions will be developed by experts in this field based on state-of-the art behavior change science. It will utilize attribution analysis approaches designed to identify why the EECBG-funded activities in question were implemented and the importance of the EECBG funding in stimulating that to happen. The interviews with key decision makers, activity managers, and other personnel will be conducted by experienced interview professionals. The exact approach to be used in this study will be developed by the independent evaluation contractor in consultation with ORNL.

5. AGGREGATION OF INDIVIDUAL STUDY FINDINGS TO BROAD PROGRAM AREA AND CUMULATIVE LEVELS

Once energy and cost savings, gross emission reductions, and net job creation and retention estimates are developed for each of the individual EECBG activities in the sample, those outcome estimates will be extrapolated to each Broad Program Area addressed in the study and to all of those areas combined, as discussed below.

AGGREGATE FINDINGS FOR EACH BROAD PROGRAM AREA STUDIED

As noted in the previous chapter, a separate sample will be selected for each Broad Program Area addressed in this study, using some form of probability sampling. Accordingly, findings from the individual activity studies can be aggregated to yield a total for each Broad Program Area, using a weighting procedure that accounts for the magnitude of funding for each individual activity, the relevant subareas composed of related activities, and the entire program area made up of its various subareas. The attribution of effects will be determined for each individual activity and then "rolled up" to the subarea and Broad Program Area levels.

The aggregation of findings will begin with the calculation of outcomes per dollar of funding for each activity sampled. As mentioned above, each activity will be weighted based on its relative contribution to overall funding. Outcomes measured for the sample will be extrapolated to each subarea and Broad Program Area to reflect the funding for the sampled activities relative to total funding for each subarea and the entire program area. Confidence intervals surrounding point estimates for each outcome will be determined based on variation within the sample and sample size. A finite population correction factor can be used to reflect the fact that the number and size of EECBG grants are limited and known.

When findings from the individual activity studies are aggregated, the error bounds surrounding the outcome estimates will tend to be narrowest where the samples are largest. Because this study will take the largest samples from the most important program areas, it will tend to yield the most precise findings for those areas that are most important to the overall EECBG portfolio.

CALCULATE CUMULATIVE FINDINGS FOR ALL PROGRAM AREAS STUDIED

As mentioned above, the outcome estimates developed for each Broad Program Area will be extrapolated from individual activity studies to represent accomplishments from *all* EECBG efforts in each program area. Then, the point estimate and error bounds from all Broad Program Areas under study will be summed to produce cumulative estimates for each outcome metric.

6. IDENTIFICATION OF FACTORS INFLUENCING PERFORMANCE

In addition to estimating the outcomes achieved by the most heavily-funded Broad Program Areas, individually and in combination, it is also important to identify key factors influencing the magnitude of those achievements. An understanding of the factors related to successful performance can be helpful to public policy makers, program managers, and other parties interested in the adoption and effective utilization of energy efficiency and renewable energy technologies. The major steps involved in identifying key influences on activity performance are to (1) conduct a literature review to identify possible factors influencing performance; (2) collect data on key organizational and operational factors suggested by the literature review; and (3) perform statistical analysis to test possible relationships between those factors and performance. Each of these three elements is discussed separately below.

CONDUCT LITERATURE REVIEW TO IDENTIFY POSSIBLE FACTORS INFLUENCING PERFORMANCE

The first step in identifying key factors influencing performance will be an examination of past studies exploring the relationships between various organizational and operational factors and the outcomes achieved by energy efficiency and renewable energy activities. A major source of information will be published proceedings from energy efficiency, renewable energy, and evaluation conferences. Two key proceedings that will be examined are those associated with the annual American Council for an Energy-Efficient Economy (ACEEE) Summer Study and the biannual International Energy Program Evaluation Conference (IEPEC). Other proceedings will also be examined, as relevant.

Several major online evaluation databases will also be searched. The best known of these are the California Measurement Advisory Council (CALMAC) Searchable Database, the Consortium for Energy Efficiency (CEE) Market Assessment and Program Evaluation (MAPE) Clearinghouse, and the New York State Energy Research and Development Authority (NYSERDA) library of New York Energy $mart quarterly and annual evaluation reports.

Other reports and journal articles documenting state, utility, and university studies could provide useful information and those will be examined as well.

COLLECT DATA ON KEY ORGANIZATIONAL AND OPERATIONAL FACTORS

Based on the findings from the above-described literature review, a set of relevant possible influences on energy efficiency and renewable energy activity performance will be identified. These could include design, implementation, operational, and market factors as well as technical assistance services provided to activity managers and staff.

The precise nature of the key variables mentioned above will be determined for each sampled activity through the review of activity records and direct interviews with the involved parties.

For activities targeting the residential sector as well as small-scale efforts in the institutional, commercial, and industrial sectors, the necessary data can generally be collected through telephone interviews conducted with activity managers. Because such interviews are already planned in conjunction with the engineering analysis, the extra effort required for this additional component will be minimal. For medium- and large-scale institutional, commercial, and industrial activities, additional interviews with other key participants are likely to be needed. To the extent that some key participants may not be available to be interviewed, non-response bias could be introduced into the study and the analyst should be aware of that and attempt to reduce it to the extent possible.

PERFORM STATISTICAL ANALYSIS TO TEST POSSIBLE RELATIONSHIPS BETWEEN PERFORMANCE AND KEY ORGANIZATIONAL AND OPERATIONAL FACTORS

Once all necessary data on the full set of potential influences on activity performance are collected for each sampled activity, statistical analysis will be performed to test the relationship between those explanatory variables and key outcomes. The two major outcome variables of interest in this analysis will be absolute energy savings and energy savings as a percentage of pre-activity energy use. Key explanatory variables can include: program area; amount of funding; support provided by other sources, time period; the nature of the market involved, type of organization doing the activity; past experience of the responsible organization; energy efficiency and renewable energy history of the jurisdiction where the activity took place; involvement of community groups in implementation; the type and amount of technical assistance received by activity managers and staff; and any other relevant factors suggested by the literature review. The exact analytical approach, or combination of approaches, to be used in this study will be developed by the independent evaluation contractor in consultation with ORNL.

The objective of the statistical analysis will be to identify key factors that are significantly related to activity outcomes. As discussed in Chapter 5, each activity will be weighted to reflect its relative share of overall EECBG funding. Statistical analyses can be performed for each Broad Program Area separately as well as for the combined set of program areas under study.

7. TIMELINE AND DELIVERABLES

The EECBG evaluation project will involve 12 key administrative and research steps, starting with the preparation of this evaluation plan and ending with completion of a final report documenting study findings. In between those start and end points, an independent evaluation contractor will be selected, a detailed work plan will be developed, and a number of critical research tasks will be performed. All 12 steps and the time periods over which they will be performed are shown in Figure 7.1 (below) and beginning with the study initiation meeting step described briefly in the remainder of this Chapter.

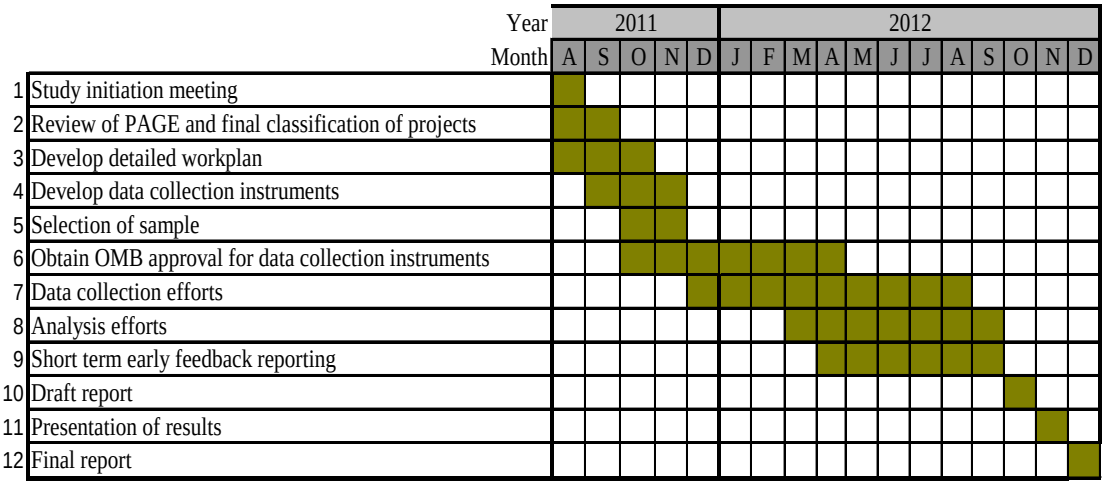

Figure 7.1. Evaluation timeline

Study Initiation Meeting. The study initiation meeting with ORNL, in the presence of DOE, and the winning contractor or contractor team will be held in August, 2011 to kick-off the evaluation. During this meeting, the evaluation plan will be reviewed and discussed to give focus to the study and the research needs, methodologies, and timelines going forward.

Review of PAGE and Final Classification of Activities. In August and September of 2011, the PAGE data set and additional sources, as needed, will be reviewed by the evaluation contractor and a final sort of activities into Broad Program Areas and key subareas will be performed.

Develop Detailed Work Plan. The independent evaluation contractor will develop a detailed work plan to guide the EECBG evaluation between August and October of 2011. The work plan will include a plan for weekly conference calls between ORNL, in the presence of DOE, and the independent evaluation contractor for the purpose of discussing project status and key

methodological issues. Following comments from ORNL on an initial draft, the plan will be finalized.

Develop Data Collection Instruments. From September to November 2011, surveys and interview protocols will be developed to allow the collection of detailed information on EECBG-funded activities, the technologies involved, baseline conditions, and key factors affecting implementation and performance.

Selection of Sample. During October and November, 2011, a sample of EECBG activities covering the six most heavily-funded Broad Program Areas and key subareas will be selected by the evaluation contractor and reviewed and approved by ORNL.

Obtain OMB Approval for Data Collection Instruments. All data collection instruments involving the collection of identical information from 10 or more respondents must receive approval from OMB before they can be deployed. This process is expected to run from October 2011 through April 2012.

Data Collection Efforts. From December, 2011 through August, 2012 the evaluation contractor will collect all data needed to conduct the required analyses. The initial data will be acquired from the PAGE data set and grant applications, with additional information coming from interviews with activity stakeholders and others after OMB approval is received.

Analysis Efforts. The analysis efforts for this evaluation will commence shortly after the start of data collection so that research findings can be developed as the data are collected. The analysis efforts will be staged to assess completed activities and utilize available data first. The analysis effort will take place between March and September, 2012.

Short Term Early Feedback Reporting. EERE has requested that findings from the evaluation be communicated as they are developed. This will be accomplished through the use of early feedback memorandums to be delivered by the evaluation contractor to ORNL and DOE managers as the analysis work moves forward during the April, 2012 to September, 2012 period.

Draft Report. The evaluation contractor will provide a draft report to ORNL in October, 2012. The draft report will include all analytical results and research findings.

Presentation of Results. In November, 2012, the evaluation contractor will provide an on-site presentation of study findings to ORNL, in the presence of DOE, and the Peer Review Panel and obtain comments and suggestions for finalizing the report. At this time, the contractor will also deliver all calculations and supporting documentation used to conduct the analysis and estimate impacts.

Final Report. Following the on-site presentation, the evaluation contractor will produce a final report detailing all evaluation methods and findings. The report will be delivered by the end of the 2012 calendar year and will meet quality and presentation standards provided by ORNL. The contractor will also deliver all data collected during the study.