The Impact of Climate Change on the Conduct of Evaluation: The Establishment of New Evaluation Guidelines

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ABSTRACT

In this paper, we present an overview of guidelines recently developed for the monitoring, evaluation, reporting, verification, and certification (MERVC) of energy-efficiency projects for climate change mitigation, on behalf of the U.S. Environmental Protection Agency (EPA) (Vine and Sathaye 1999). These guidelines address several key issues, including methods for estimating gross and net energy savings and greenhouse gas (GHG) emission reductions.

Introduction

The reliability and credibility of energy savings needs to be assessed for climate change projects. Implementation of MERVC guidelines is intended to: (1) increase the reliability of data for estimating GHG benefits; (2) provide real-time data so that programs and plans can be revised mid-course; (3) introduce consistency and transparency across project types and reporters; (4) enhance the credibility of the projects with stakeholders; (5) reduce costs by providing an international, industry consensus approach and methodologies; and (6) reduce financing costs by providing project MERVC standardization, thereby allowing project bundling and pooled project financing.

These guidelines cover the following concepts: (1) methods for evaluating energy savings; (2) key issues influencing the establishment of a credible baseline (free riders) and the calculation of gross energy savings (positive project spillover and market transformation); (3) a process for verifying and certifying project impacts; (4) the importance and value of evaluating environmental and socioeconomic; (5) reporting forms for estimation of gross and net energy savings and emission reductions, for monitoring and evaluation of these savings, and for verification; and (6) quality assurance guidelines. In this paper, we focus on items (1) through (4).

The Kyoto Protocol

More than 176 countries have become Parties to the U.N. Framework Convention on Climate Change (FCCC). The Parties to the FCCC adopted the Kyoto Protocol for continuing the implementation of the FCCC in December 1997. The Protocol requires developed countries to reduce their aggregate emissions by at least 5.2% below 1990 levels by the 2008-2012 time period. The Kyoto Protocol includes two project-based mechanisms for activities across countries: (1) Article 6 allows for joint implementation projects between Annex I countries: i.e., project-level trading of emissions reductions ("transferable emission reduction units") can occur among countries with GHG emission reduction commitments under the Protocol; and (2) Article 12 provides for a "Clean Development Mechanism" (CDM) that allows legal entities in the developed world to enter into cooperative projects to reduce emissions in the developing world for the benefit of both parties; legal entities in non-Annex I countries can also develop projects on their own.

These mechanisms allow developed countries to use certified emissions reductions from project activities in developing countries to contribute to their compliance with GHG targets. Projects undertaken by developed countries will not only reduce GHG emissions or sequester carbon, but may also result in non-GHG benefits and costs (i.e., other environmental and socioeconomic benefits and costs). As countries start to respond to the mandate of the Kyoto Protocol, developers of energy-efficiency projects will be asked to demonstrate how their project will reduce GHG emissions. The MERVC guidelines will help to ensure that the energy savings and emission reductions associated with these savings are "real" and measurable.

The strictness of MERVC guidelines needs to be carefully considered. Strict guidelines may easily lead to burdensome and complex procedures, thereby increasing the costs and reducing the cost-effectiveness of a project. If the guidelines for international verification are "loose", however, then project sponsors might be more able to manipulate the "measured" emission reductions, e.g., inflating the net emission reductions from the project. This paper lays out the key issues involved in MERVC and our proposed solutions to these issues.

Monitoring and Evaluation of Energy Use and GHG Emissions

In Figure 1, we present an overview of an approach developed by Lawrence Berkeley National Laboratory (LBNL) for evaluating changes in energy use and emissions. During the monitoring and evaluation stage, gross energy savings are first measured, using one of the options provided in the U.S. Department of Energy's (DOE) International Performance Measurement and Verification Protocol (IPMVP). Energy savings include the savings from positive project spillover and market transformation. The savings estimates are reviewed through the use of quality assurance guidelines. The baseline that was first estimated in the project development stage is re-estimated, accounting for free riders. The net change in energy use is equal to the gross change in energy use minus the re-estimated baseline (see below). Net carbon emissions are then calculated, using either default emission factors or emissions based on generation data.[1]

The data collection methods used in monitoring and evaluation include engineering calculations, surveys, modeling, end-use metering, on-site audits and inspections, and collection of utility bill data. Most monitoring and evaluation activities focus on the collection of measured data; if measured data are not collected, then one may rely on engineering calculations and "stipulated" (or default) savings (as described in EPA's Conservation Verification Protocols and in DOE's IPMVP). Data analysis methods include engineering methods, basic statistical models, multivariate statistical models (including multiple regression models and conditional demand models), and integrative methods.

The selection of evaluation methods should take into account project characteristics and the kind of load and schedule for the load before the retrofit. The load can be constant, variable, or variable but predictable, and the schedule can either be known (timed on/off schedule) or unknown/variable. The monitoring approach can be selected according to the type of load and schedule.

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[1] We are only examining CO_2 impacts.

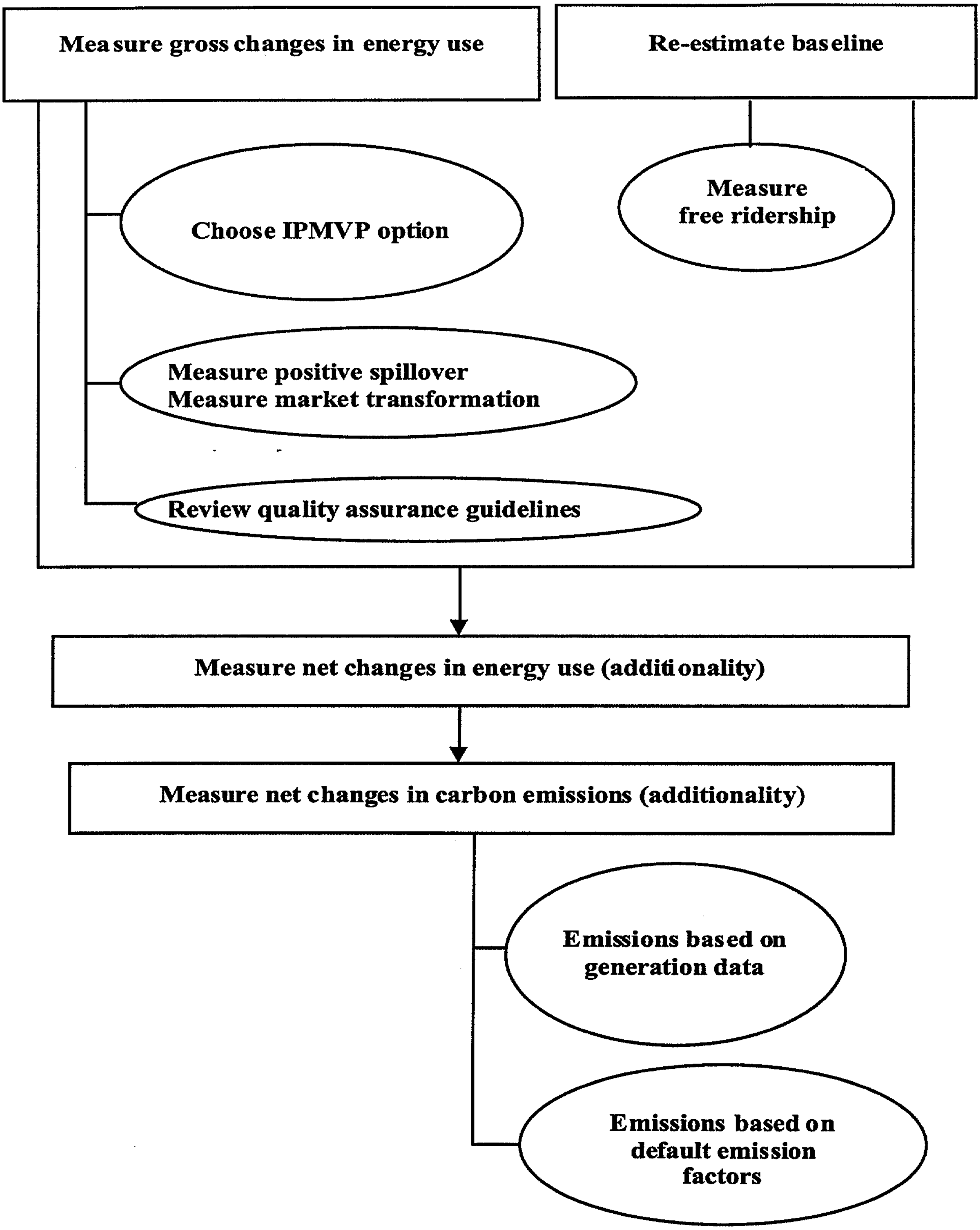

Fig. 1. Evaluation Overview

The applications of these methods are not mutually exclusive; each approach has different advantages and disadvantages (see Vine and Sathaye 1999), and there are few instances where an evaluation method is not amenable to most energy-efficiency measures. Using more than one method can be informative. Employing multiple approaches, perhaps even conducting different analyses in parallel, and integrating the results, will lead to a robust evaluation. Such an approach builds upon the strengths and overcomes the weaknesses of individual approaches. Also, each approach may be best used at different stages of the project life cycle and for different measures or projects.

The data collection and analysis methods vary in cost, precision, simplicity, technical expertise required, and uncertainty. Tradeoffs will need to be made for choosing the appropriate methods: e.g., level of accuracy and cost of data collection. There is no one approach that is "best" in all circumstances (either for all project types, evaluation issues, or all stages of a particular project).

Some of the methods may be more applicable to the monitoring and evaluation of a particular project (e.g., a retrofit of a large commercial building), rather than the monitoring and evaluation of a program that involves many projects at multiple facilities (sites). If the focus is on one building, then some of the methods contained in this paper will not be utilized (e.g., basic statistical models, multivariate statistical models, and some integrative methods). Since most readers of this paper are familiar with these data collection and analysis methods, we focus on critical issues that need to be addressed during the evaluation of these projects.

Application of IPMVP Approach

Although not targeted to carbon emissions, we believe that the U.S. Department of Energy's (DOE) International Performance Measurement and Verification Protocol (IPMVP) is the preferred approach for monitoring and evaluating energy-efficiency projects for individual buildings and for groups of buildings, since the IPMVP covers many of the issues discussed in these guidelines as well as offering several measurement and verification methods for user flexibility (USDOE 1997).[1]

A key element of the IPMVP is the definition of two measurement and verification (M&V) components: (1) verifying proper installation and the energy-efficiency measure's potential to generate savings; and (2) measuring (or estimating) actual savings. The first component assumes the following: (a) the baseline conditions were accurately defined and (b) the proper equipment/systems were installed, were performing to specification, and had the potential to generate the predicted savings. The general approach to verifying baseline and post-installation conditions involves inspections, spot measurement tests, or commissioning activities.

The IPMVP was built around a common structure of four M&V options (Options A, B, C, and D) (Table 1). The purpose of providing several M&V options is to allow the user flexibility in the cost and method of assessing savings. The options differ in their approach to the level and duration of the verification measurements. None of the options are necessarily more expensive or more accurate than the others. Each has advantages and disadvantages based on site specific factors and the needs and expectations of the customer. Project evaluators should use one of these options for reporting on measured energy savings.

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[1] The IPMVP is primarily targeted to the monitoring and evaluation of an individual building, in contrast to other protocols (e.g., CPUC 1998) that are aimed at the monitoring and evaluation of programs (involving multiple sites). The protocol can be downloaded via the World Wide Web: http://www.ipmvp.org.

Table 1. Overview of IPMVP's M&V Options

M&V Options[1]	How Savings Are Calculated [reference to LBNL's MERVC methods]	Initial Cost[2,3]	Annual Operating Cost[4]
Option A: ▪ Focuses on physical inspection of equipment to determine whether installation and operation are to specification. Performance factors are either stipulated (based on standards or nameplate data) or measured. ▪ Key performance factors (e.g., lighting wattage or "motor" efficiency) are measured on a snapshot or short-term basis. ▪ Operational factors (e.g., lighting operating hours or motor runtime) are stipulated based on analysis of historical data or spot/short-term measurements.	Engineering calculations or computer simulations based on metered data and stipulated operational data. [Engineering methods] [Short-term monitoring]	0.5 to 3%	0.1 to 0.5%
Option B: ▪ Intended for individual energy conservation measures (ECMs) (retrofit isolation) with a variable load profile. ▪ Both performance and operational factors are measured on a short-term continuous basis taken throughout the term of the contract at the equipment or system level.	Engineering calculations after performing a statistical analysis of metered data. [Engineering methods] [End-use metering]	2 to 8%	0.5 to 3%
Option C: ▪ Intended for whole-building M&V where energy systems are interactive (e.g., efficient lighting system reduces cooling loads) rendering measurement of individual ECMs inaccurate. ▪ Performance factors are determined at the whole-building or facility level with continuous measurements. ▪ Operational factors are derived from hourly measurements and/or historical utility meter (electricity or gas) or sub-metered data.	Engineering calculations based on a statistical analysis of whole-building data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis. [Basic statistical models] [Multivariate statistical models]	0.5 to 3% (utility bill analysis) 2 to 8% (hourly data)	0.5 to 3%
Option D: ▪ Typically employed for verification of saving in new construction and in comprehensive retrofits involving multiple measures at a single facility where pre-retrofit data may not exist. ▪ In new construction, performance and operational factors are modeled based on design specification of new, existing and/or code complying components and/or systems. ▪ Measurements should be used to confirm simulation inputs and calibrate the models.	Calibrated energy simulation/ modeling of facility components and/or the whole facility; calibrated with utility bills and/or end-use metering data collected after project completion. [Engineering methods] [Integrative methods]	2 to 8%	0.5 to 3%

<u>Source</u>: Adapted from USDOE (1997) and based on personal communication from Greg Kats, USDOE, Dec. 18, 1998.

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[1] It is assumed that the cost of minimum M&V, in projects not following IPMVP, involves an initial cost of 0.5%, and an annual operating cost of 0.1% to 0.2%, of the project cost. The costs in this table are uncertain and should be used for general guidance; developers need to estimate costs based on real projects.

[2] The initial M&V cost includes installation and commissioning of meters.

[3] In new construction, this is the % of the difference in cost between baseline equipment and upgraded/more efficient equipment

[4] Annual operating cost includes reporting, data logger and meter maintenance cost over the period of the contract

Establishing the Monitoring Domain

The domain that needs to be monitored is typically larger than the geographic and temporal boundaries of the project. To compare GHG reductions across projects, a monitoring domain needs to be defined. Consideration of the domain needs to address the following issues: (1) the temporal and geographic extent of a project's direct impacts; and (2) coverage of positive project spillover and market transformation.

The first monitoring domain issue concerns the appropriate geographic boundary for evaluating and reporting impacts. For example, an energy project might have local (project-specific) impacts that are directly related to the project in question, or the project might have more widespread (e.g., regional) impacts (leading to positive project spillover and market transformation). Thus, one must decide the appropriate geographic boundary for evaluating impacts. Also, energy projects may impact energy supply and demand at the point of production, transmission, or end use. The MERVC of such impacts will become more complex and difficult as one attempts to monitor how emission reductions are linked between energy end users and energy producers (e.g., tracking the emissions impact of 1,000 kWh saved by a household in a utility's generation system). The second issue concerns coverage of positive project spillover, as discussed in the next section.

Positive Project Spillover

For most projects, the number of eligible nonparticipants is far greater than the number of participants. Thus, when measuring energy savings, it is possible that the actual reductions in energy use are greater than measured because of changes in participant behavior not directly related to the project, as well as to changes in the behavior of other individuals not participating in the project (i.e., nonparticipants). These secondary impacts stemming from an energy-efficiency project are commonly referred to as "positive project spillover".[1] Positive project spillover may be regarded as an unintended consequence of an energy-efficiency project; however, as noted below, increasing positive project spillover may also be perceived as a strategic mechanism for reducing GHG emissions.

The methods for estimating positive project spillover are similar to those used for free ridership (see below). Explicit estimates can be obtained by asking participants and nonparticipants survey questions, and discrete choice models can be used. Participant and nonparticipant spillover effects can be included in savings estimates in billing analyses, similar to how gross savings are calculated.

Market Transformation

Project spillover is related to the more general concept of "market transformation," defined as: "the reduction in market barriers due to a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced or changed" (Eto, Prahl and Schlegel.

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[1] Spillover effects can occur through a variety of channels including: (1) an individual hearing about a project measure from a participant and deciding to pursue it on his or her own ("free drivers"); (2) project participants that undertake additional, but unaided, energy-efficiency actions based on positive experience with the project; (3) manufacturers changing the efficiency of their products, or retailers and wholesalers changing the composition of their inventories to reflect the demand for more efficient goods created through the project; (4) governments adopting new building codes or appliance standards because of improvements to appliances resulting from one or more energy efficiency projects; or, (5) technology transfer efforts by project participants which help reduce market barriers throughout a region or country.

1996). In contrast to project spillover, increasing market transformation is expected to be a strategic mechanism (i.e., an intended consequence) for reducing GHG emissions for the following reasons:

- To increase the effectiveness of energy-efficiency projects: e.g., by examining market structures more closely, looking for ways to intervene in markets more broadly, and investigating alternative points of intervention.
- To reduce reliance on incentive mechanisms: e.g., by strategic interventions in the market place with other market actors.
- To take advantage of regional and national efforts and markets.
- To increase focus on key market barriers other than cost.
- To create permanent changes in the market.

Market transformation has emerged as a central policy objective for future publicly funded energy-efficiency projects in the United States and in projects funded by the Global Environment Facility. Most evaluations of market transformation projects focus on market effects (e.g., Eto. Prahl and Schlegel 1996; Schlegel, Prahl and Raab 1997): the effects of energy-efficiency projects on the structure of the market or the behavior of market actors that lead to increases in the adoption of energy-efficient products, services, or practices. In order to claim that a market has been transformed, project evaluators need to demonstrate the following (Schlegel, Prahl and Raab 1997):

- There has been a change in the market that resulted in increases in the adoption and penetration of energy-efficient technologies or practices.
- That this change was due at least partially to a project (or program or initiative), based both on data and a logical explanation of the program's strategic intervention and influence.
- That this change is lasting, or at least that it will last after the project is scaled back or discontinued.

The first two conditions are needed to demonstrate market effects, while all three are needed to demonstrate market transformation. The third condition is related to the permanence/lastingness of market effects: if the changes are not lasting, then market transformation has not occurred. Because fundamental changes in the structure and functioning of markets may occur only slowly, evaluators should focus their efforts on the first two conditions, rather than waiting to prove that the effects will last.

To implement an evaluation system focused on market effects, one needs to carefully describe the scope of the market, the indicators of success, the intended indices of market effects and reductions in market barriers, and the methods used to evaluate market effects and reductions in market barriers (Schlegel, Prahl and Raab 1997). Evaluation activities will include one or more of the following: (1) measuring the market baseline; (2) tracking attitudes and values; (3) tracking sales; (4) modeling of market processes; and (5) assessing the persistence of market changes. These evaluation activities will use one or more of the following data collection and analysis methods: (1) surveys of customers, manufacturers, contractors, vendors, retailers, government organizations, energy providers, etc.; (2) analytical and econometric studies of measure cost data, stocking patterns, sales data, and billing data; and (3) process evaluations.

Re-estimating the Baseline

For joint implementation (Article 6) and Clean Development Mechanism (Article 12) projects implemented under the Kyoto Protocol, the emissions reductions from each project activity must be "additional to any that would otherwise occur," also referred to as "additionality criteria" (Articles 6.1b and 12.5c). Determining additionality requires a baseline for the calculation of energy saved, i.e., a description of what would have happened to energy use had the project not been implemented (see Violette, Ragland and Stern 1998). Additionality and baselines are inextricably linked and are a major source of debate. Determining additionality is inherently problematic because it requires resolving a counter-factual question: What would have happened in the absence of the specific project?

Because investors and hosts of energy-efficiency projects have the same interest in an energy-efficiency project (i.e., they want to get maximum energy savings from the project), they are likely to overstate the energy saved (e.g., by overstating business-as-usual energy use). Cheating may be widespread if there is no strong monitoring and verification of the projects. Even if projects are well monitored, it is still possible that the real amount of energy saved is less than estimated values. Hence, there is a critical need for the establishment of realistic and credible baselines and the evaluation of such baselines based on measured data ("re-estimated baseline"). The re-estimated baseline should describe the existing technology or practices at the facility or site. Ideally, energy use should be measured for at least a full year before the date of the initiation of the retrofit project and for each year after the initiation of the project during the lifetime of the project. However, if the loads and operating conditions are constant over time, one-time spot measurement may be sufficient to estimate equipment performance and efficiency. The re-estimation of baselines needs to account for free riders and may rely on comparison groups.

Free riders. In energy-efficiency projects, it is possible that the reductions in energy use are undertaken by participants who would have installed the same measures if there had been no project. These participants are called "free riders." The savings associated with free riders are not truly "additional" to what would occur otherwise. Free ridership should be predicted, if possible, during the estimation of the baseline.

Free ridership can be evaluated either explicitly or implicitly. The most common method of developing explicit estimates of free ridership is to ask participants what they would have done in the absence of the project (also referred to as "but for the project" discussions). Based on answers to carefully designed survey questions, participants are classified as free riders (yes or no) or assigned a free ridership score. Project free ridership is then estimated as the proportion of participants who are classed as free riders. Two problems arise in using this approach: (1) very inaccurate levels of free ridership may be estimated, due to questionnaire wording; and (2) there is no estimate of the level of inaccuracy, for adjusting confidence levels.

Another method of developing explicit estimates of free ridership is to use discrete choice models to estimate the effect of the program on customers' tendency to implement measures. The discrete choice is the customer's yes/no decision whether to implement a measure. The discrete choice model is estimated to determine the effect of various characteristics, including project participation, on the tendency to implement the measures.

A method for calculating implicit estimates of free ridership is to develop an estimate of savings using billing analysis (as described above) that may capture this effect, but does not isolate it from other impacts. Rather than taking simple differences between participants and a comparison group, however, regression models are used to control for factors that contribute to differences between the two groups (assuming that customers who choose to participate in projects are different from those who do not participate). The savings determined from the regression represent the savings associated with participation, over and above the change that would be expected for these customers due to other factors, including free ridership.

The U.S. Environmental Protection Agency's Conservation Verification Protocols reward more rigorous methods of verifying free riders by allowing a higher share of the savings to qualify for tradable SO_2 allowances. Three options are available for verifying free riders: (1) default "net-to-gross" factors for converting calculated "gross energy savings" to "net energy savings;"[1] (2) project-estimated net-to-gross factors, based on measurement and evaluation activities (e.g., market research, surveys, and inspections of nonparticipants); or (3) if a developer does not do any monitoring nor provide documentation and the default net-to-gross factors are not used, then the net energy savings of a measure will be 50% of the first-year savings (USEPA 1995 and 1996).

Comparison groups. For re-estimating the baseline, comparison groups can be used to capture time trends in consumption that are unrelated to project participation. For example, if the comparison groups' utility bills show an average reduction in energy use of 5% between the pre- and post-periods, and the participants' bills show a reduction of 15%, then it may be reasonable to assume that the estimated project impacts will be 15% minus the 5% general trend for an estimated 10% reduction in use being attributed to the project.

Calculating Net GHG Emissions

Once the net energy savings have been calculated (i.e., measured energy use minus re-estimated baseline energy use), net GHG emissions reductions can be calculated in one of two ways: (1) if emissions reductions are based on fuel-use or electricity-use data, then default emissions factors can be used, based on utility or nonutility estimates[2]; or (2) emissions factors can be based on generation data specific to the situation of the project (e.g., linking a particular project on an hourly or daily basis to the marginal unit it is affecting). In both methods, emissions factors translate consumption of energy into GHG emission levels (e.g., tons of a particular GHG per kWh saved). In contrast to default emission factors (method #1), the advantage of using the calculated factors (method #2) is that they can be specifically tailored to match the energy efficiency characteristics of the activities being implemented by time of day or season of the year. For example, if an energy-efficiency project affects energy demand at night, then baseload plants and emissions will probably be affected. Since different fuels are typically used for baseload and peak capacity plants, then emission reductions will also differ.

The calculations become more complex (but more realistic) if one decides to use the emission rate of the marginal generating plant (multiplied by the energy saved) for each hour of the year, rather than the average emission rate for the entire system (i.e., total emissions divided by total sales) (Swisher 1997). For the more detailed analysis, one must analyze the utility's existing expansion plan

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[1] The "net-to-gross" factor is defined as net savings divided by gross savings. The gross savings are the savings directly attributed to the project and include the savings from all measures and from all participants; net savings are gross savings that are "adjusted" for free riders and positive project spillover. Multiplying the gross savings by the net-to-gross factor yields net savings.

[2] The emission factors represent the basic conversion between energy consumption and generation of greenhouse gases. These factors are usually expressed in mass of emitted gas per unit of energy input (g/GJ) or sometimes in mass of gas per mass of fuel (g/kg or g/t).

to determine the generating resources that would be replaced by saved electricity, and the emissions from these electricity-supply resources. Thus, one would establish a baseline (current power expansion plan, power dispatch, peak load/base load, etc.), select a monitoring domain, conduct monitoring option, measure direct emission reductions (e.g., reductions occurring at the neighboring power plant to lower demand), measure indirect emissions (e.g., modification in the power system due to lower output at the neighboring plant), and calculate net carbon reductions.

One would have to determine if the planned energy-efficiency measures would reduce peak demand sufficiently and with enough reliability to defer or obviate planned capacity expansion. If so, the deferred or replaced source would be the marginal expansion resource to be used as a baseline. This type of analysis may result in more accurate estimates of GHG reductions, but this method will be more costly and require expertise in utility system modeling. In addition, this type of analysis is becoming more difficult in those regions where the utility industry is being restructured: e.g., the supply of energy may come from multiple energy suppliers, either within or outside the utility service area.

The decision on which methodology to use will depend on project size (e.g., kWh, kW, carbon credits requested, project expenditures) or relative project size (e.g., MW/utility service MW). It is up to the evaluator to decide on the best method for the project. Certain thresholds may need to be developed. If a project is of a certain relative magnitude (e.g., a project is 50 MW and the utility's service area is 400 MW), the evaluator should probably select the second method above.

Environmental and Socioeconomic Impacts

The Kyoto Protocol exhorts developed countries, in fulfilling their obligations, to minimize negative social, environmental and economic impacts, particularly on developing countries (Articles 2.3 and 3.14). Furthermore, one of the primary goals of the Clean Development Mechanism is sustainable development. At this time, it is unclear what indicators of sustainable development need to be addressed in the evaluation of energy-efficiency projects. Once there is an understanding of this, then MERVC guidelines for those indicators may need to be designed. At a minimum, energy-efficiency projects should meet current country guidelines for non-Clean Development Mechanism projects.

LBNL's MERVC guidelines for energy-efficiency projects include environmental and socioeconomic impacts for two additional reasons. First, the persistence of GHG reductions and the sustainability of energy-efficiency projects depend on individuals and local organizations that help support a project during its lifetime. Focusing only on GHG impacts would present a misleading picture of what is needed in making a project successful or making its GHG benefits sustainable. Second, a diverse group of stakeholders (e.g., government officials, project managers, non-profit organizations, community groups, project participants, and international policymakers) are interested in, or involved in, energy-efficiency projects and are concerned about their multiple impacts.

Energy-efficiency projects have widespread and diverse environmental and socioeconomic impacts that go beyond GHG impacts (e.g., see Table 2. Direct and indirect project impacts need to be examined, as well as "avoided negative environmental and socioeconomic impacts" (e.g., the deferral of the construction of a new power plant, or the preservation of an archaeological site). Both gross and net impacts need to be evaluated.

Table 2. Potential Environmental and Socioeconomic Impacts

Environmental Impacts	Socioeconomic Impacts
Dams and reservoirs	Cultural properties (archeological sites, historic monuments, and historic settlements)
Effluents from power plants	Distribution of income and wealth
Hazardous and toxic materials	Employment rights
Indoor air quality	Gender equity
Industrial hazards	Induced development and other sociocultural aspects
Insurance claims	Long-term income opportunities for local populations
Occupational health and safety	Public participation and capacity building
Water quality	Quality of life (local and regional)
Wildlife and habitat protection or enhancement	

Source: Adapted from World Bank (1989) and EcoSecurities (1998).

In examining socioeconomic impacts, evaluators need to ask the following questions: who the key stakeholders are, what project impacts are likely and upon what groups, what key social issues are likely to affect project performance, what the relevant social boundaries and project delivery mechanisms are, and what social conflicts exist and how they can be resolved. To address these questions, evaluators could conduct informal sessions with representatives of affected groups and relevant non-governmental organizations.

Evaluators need to collect some minimal information on potential impacts via surveys or interviews with key stakeholders. The evaluator should also check to see: (1) whether any existing laws require these impacts to be examined, (2) if any proposed mitigation efforts were implemented, and (3) whether expected positive benefits ever materialized. Evaluators may want to conduct some short-term monitoring to provide conservative estimates of environmental and socioeconomic impacts. The extent and quality of available data, key data gaps, and uncertainties associated with estimates should be identified and estimated.

Concluding Remarks

MERVC guidelines are needed for energy-efficiency projects in order to accurately determine the net GHG, and other, benefits and costs, and to ensure that the global climate is protected and that country obligations are met. The next phase of this work will be to develop a procedural handbook providing information on how one can complete the monitoring, evaluation and verification forms referred to in this paper. We then plan to test the usefulness of these handbooks in the real world.

Acknowledgments

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