Securing the Link Between Energy Efficiency Savings and Greenhouse Gas Reductions:
How Will Energy Efficiency Evaluation Protocols Measure Up?

Chris Ann Dickerson, Freeman Sullivan & Co., San Francisco, Calif.
Mike McCormick, California Climate Action Registry, Los Angeles Calif.

ABSTRACT

As efforts to mitigate global climate change intensify, opportunities for using energy efficiency as a means for reducing greenhouse gas (GHG) emissions are attracting a great deal of attention. In particular, there is interest in establishing guidelines for verifying emissions reductions for use in emerging GHG markets and/or other institutional mechanisms. This presents several new challenges for practitioners in energy efficiency evaluation and reporting. First, it is necessary to develop methods and protocols to account for and report emissions reductions from energy efficiency programs and/or projects. Second, in order to use these emissions reductions in market-based GHG limitation programs, there must be widespread agreement on measurement standards that characterize, verify and register each unit of GHG reduction. Meeting these challenges will necessitate a new level of collaboration between the energy efficiency evaluation and the GHG accounting fields. This paper is designed to introduce professionals who have been primarily involved with energy efficiency to concepts and current issues in GHG accounting and reporting. It begins by contrasting measurement purposes and perspectives in GHG accounting versus traditional energy efficiency evaluation. Next, we discuss current topics in: 1) GHG accounting and project protocols, and 2) estimating grid-based emissions reductions. We conclude with recommendations for the next steps to develop measurement and certification standards that yield verifiable GHG reductions from energy efficiency to ensure that efficiency can participate in emerging GHG regulatory programs.

Introduction

Growing concern about global climate change has occasioned a wide array of public and private initiatives to limit greenhouse gas (GHG) emissions, most notably the ratification of the Kyoto Protocols by 140 countries and the introduction of the European Union's Emissions Trading Scheme (ETS) earlier this year. Even in the United States, where the federal government has doggedly refused to regulate GHG emissions, concerns about global climate change resulting from human activity have intensified. For example, the governor of California recently proposed a statewide plan to reduce GHGs (Schwarzenegger 2005), a number of cities and counties have begun to establish GHG reduction policies, as have a small, but growing number of private businesses and other entities.

Electricity generation accounts for the largest portion of GHG emissions in the United States − 33 percent (EPA 2005). Thus, programs and projects to reduce energy use through efficiency represent an important opportunity to reduce GHG emissions. A key purpose for using energy efficiency in these initiatives is to generate verifiable emissions reductions, which project developers can turn into tradable units (so-called emission reduction credits) and use within the market-oriented cap-and-trade systems designed to cut GHG emissions (and/or other pollutants). Market-based policy tools such as cap-and-trade programs are an attractive approach since they theoretically minimize the costs to society to reach reductions targets by reducing the marginal costs spent on achieving a capped emissions target. Market based instruments also create incentives to innovate and improve performance, for example, by rewarding development of more efficient technology or production practices.

There are several fundamental measurement issues that must be resolved before GHG reductions from energy efficiency can be used effectively in emerging market and regulatory systems. First, it is necessary to develop methods and protocols to assess the emissions reductions resulting from energy efficiency programs and/or projects. Second, in order for these emissions reductions to serve as verified and/or tradable credits, there must be widespread agreement on measurement standards necessary to characterize, certify and register each unit of GHG reduction. Meeting these challenges will necessitate a new level of collaboration between the energy efficiency evaluation and the GHG accounting fields.

This paper draws on the authors' experience in California where a number of regulatory bodies and private entities are undertaking efforts to develop infrastructure to limit, measure, monitor, register and trade GHG emissions. It is designed to introduce professionals who have been primarily involved with energy efficiency to concepts and current issues in GHG accounting and reporting. It begins by contrasting measurement purposes and perspectives in GHG accounting with energy efficiency evaluation. Next, we discuss current topics in: 1) GHG accounting and project protocols, and 2) estimating grid-based emissions reductions. We conclude with recommendations for the next steps to develop measurement and certification standards that yield tradable GHG reduction credits from energy efficiency to ensure that efficiency can participate soon and meaningfully in emerging GHG trading activities.

Perspectives and Practices in GHG Accounting vs. Energy Efficiency Evaluation

Overarching Goals

Energy efficiency professionals will find several aspects relating to the purposes and procedures of GHG accounting important to understand in order to develop techniques and protocols suited for verifying emissions reductions from energy efficiency. Energy efficiency produces many benefits to society, including lower energy costs as well as reduced air pollution and the GHG emissions that would otherwise result from the burning of fossil fuels to generate power. Though it would seem that energy efficiency measurement and evaluation would share a great deal of conceptual territory with GHG emissions measurement and accounting, this is not the case. In fact, the fields have evolved as rather distinct disciplines with surprisingly little crossover. A recent review of the relationship between air quality regulations and energy efficiency published in 2003 states that:

> One of the key barriers is organizational culture. For example, energy and air quality program personnel represent different 'cultures,' use different 'languages' and frequently have different perspectives on local and global concerns … [E]nergy personnel assume that reductions in energy use reduce or displace new or existing energy production. In their minds these hypothesized reductions or displacements of energy production translate directly into actual emission reductions … Historically, they have not concerned themselves with demonstrating where, when or whether emissions reductions occur at actual, specified emissions sources. In contrast, air quality personnel focus on emissions sources to determine allowable emissions levels and emissions reductions. For them, reducing electricity demand in a non-attainment area does not necessarily translate into an emissions reduction within the airshed (Vine 2003, 333).

Note that this passage discusses air quality measurement of specified air pollution emissions (i.e., criteria pollutants like NOx, SOx, ozone, mercury, etc), which are typically subject regulations in local air basins. GHGs represent a special case of air emissions management and measurement because they have a global rather than localized effect. Regarding criteria pollutants, the U.S. has begun to implement energy efficiency as a means to reduce air pollutants such as NOx. Although these mechanisms are being implemented on a relatively small scale, experiences with these programs will provide lessons that can be used to develop programs and protocols for employing energy efficiency as a means to reduce GHGs (EPA 1999: EPA 2003).

"Inventories" vs. "Evaluations"

Another important concept for energy efficiency evaluators is that a major focus of GHG accounting activities at this time deals with quantifying emissions *production,* yielding an absolute "inventory" of an entity's total emissions profile. (An "entity" is often a business or company, but can also be a municipality or governmental agency, non-governmental organization, school or other type of establishment.) Constructing an output inventory is a distinctly different enterprise than an energy efficiency evaluation, which focuses from the outset on estimating *savings* or *reductions*. Energy professionals should be aware that GHG inventories are quantified and reported *ex post* – after the emissions are produced and within a certain reporting period, usually the previous year. In contrast, energy efficiency evaluation commonly entails forecasting baseline energy use for a specified future period (often the lifetime of a measure) and forecasting the anticipated reduction in energy use from implementing energy efficient measures. Relative to the energy efficiency field, learning and becoming accustomed to techniques involving forecasting future baselines and estimated reductions is a new practice in GHG accounting, so energy efficiency evaluators need to consider how to introduce these procedures and accommodate the methods for GHG reporting where necessary.

GHG Accounting Frameworks

As mentioned above, air emission measurements focus on the time and place of the emission more so than traditional energy efficiency evaluation. Air emissions and GHG accounting frameworks also focus a great deal of attention not only on the source and location of the emissions, but also on legal ownership. This involves setting reporting boundaries for the company such as rules to account for emissions from partially owned entities, and for direct and indirect emissions. (Direct emissions arise from sources owned or controlled by the reporting entity; indirect emissions result from the reporting entity's actions but arise from sources owned or controlled by a separate entity.) The complex rules employed to resolve questions of "ownership" or responsibility are conceptually similar to those applied in financial accounting – hence the term "GHG *accounting*".

It is interesting to note that current energy efficiency evaluation is beginning to focus on the time, place and source of energy production – and therefore the composition of the energy that is replaced by energy efficiency. For example, California has recently adopted a plan to evaluate and report savings from energy efficiency using "time and place differentiated valuation" for marginal costs (CPUC D.05-04-024). The goal of this method is to report the avoided costs of energy more precisely to reflect variation in generation and transmission costs by region, season and time of day. The governing precepts for developing time and place differentiated avoided costs are similar for estimating the emissions reduced from the grid by energy efficiency. This issue will be discussed in a later section.

Measurement Comparability between GHG Reduction Strategies

Developing guidelines to account for emissions *reductions* is a relatively new enterprise for GHG measurement, and one where close partnerships with the energy efficiency evaluation community will prove invaluable. Energy professionals should bear in mind as they begin to crossover into the GHG emissions field that, from a GHG accounting perspective, emissions *reductions* may result from many types of projects – energy efficiency is just one subset of candidate activities. For example, reductions can also result from terrestrial sequestration (e.g., tree planting), substitution of renewable energy for fossil-based fuels, and changes in production or transportation practices to name a few options. Thus, protocols for measuring GHG reductions from energy efficiency must ensure that the reductions are fungible with the other tradable units in cap-and-trade programs.

Current Status of GHG Inventory and GHG Project Reduction Protocols

Regional, national, and global organizations are introducing or considering several initiatives for monitoring, reporting, regulating, taxing, and/or trading GHG emissions. Each of these effors is organized with differences in scope, region, territory, reporting and funding mechanisms and many other complexities of design. Development of acceptable standards for reporting and registering an entity's 1) total emissions inventory, as well as 2) emissions reductions from approved projects are a critical aspect of the regulatory infrastructure necessary to track, trade, and ultimately reduce GHG emissions. One of the most vexing issues at this time for GHG emission management programs is that, in most cases, the exact nature of programs, both nascent and proposed, has yet to be fully articulated, so requirements for measurement and reporting standards remain similarly unknown.

Quantifying and recording current GHG inventories is a pre-condition for successful implementation of any of these mechanisms. Active and vigorous efforts are underway worldwide at this time to refine and codify GHG emissions accounting guidelines, so that entities can report, track and register their current emissions inventories. Although there are a number of emergent reporting organizations, each with somewhat unique goals and purposes, most have adopted reporting guidelines that reflect or build upon basic accounting practices described in *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.* These protocols are designed to follow five principles that support all aspects of GHG accounting and reporting: relevance, completeness, consistency, transparency and accuracy (WRI/WBCSD 2003).

The WRI/WBCSD protocols articulate program-neutral GHG accounting principles. However, to operationalize these guidelines effectively, GHG program administrators add program-specific rules to address issues particular to their circumstances, such as program goals, geographic considerations, or type of sources. Organizations such as the California Climate Action Registry (CCAR) are developing detailed protocols for conducting and certifying entity-wide GHG inventories. Likewise, the Department of Energy's 1605(b) and the U.S Environmental Protection Agency's Climate Leaders program have also developed program specific accounting and reporting rules. The Registry, for example, produced a General Reporting Protocol, in 2002 (updated in 2003), and continues to add industry-specific guidelines, including inventory protocols for the utility/power sector and the forestry industry, both published in 2004 (CCAR 2003, 2004).

Energy efficiency professionals should also bear in mind the distinction between protocols for GHG inventories and protocols for GHG reductions from projects. Even though development of all GHG measurement and reporting infrastructure is in early phases, protocols for *inventories* are more well-developed than those for GHG *reductions*. Observe, for example, that while the WRI/WBCSD protocol for conducting GHG *inventories* was first published in 2001, with a revised edition published in 2003; in contrast the WRI/WCSBD's *Greenhouse Gas Protocol: Project Quantification Standard,* (the

Project Protocol) for quantifying GHG reductions is in draft form at this time (as of mid-2005) (WRI & WCSBD 2003). This indicates that while there are dedicated individuals and organizations currently working to develop institutional infrastructure and guidelines to support GHG reduction projects, further work will be necessary on a variety of fronts. This is an area where expertise from energy efficiency evaluation could prove to be extremely valuable and timely.

Guidelines for Evaluating GHG Reduction Projects

Measuring GHG *reductions* from *projects*, including but not limited to energy efficiency projects, is a new and relatively undeveloped enterprise for most of the GHG accounting industry. There has been a great deal of discussion about how these processes ought to work, but since most of the GHG regulatory and trading structures themselves have yet to be fully designed and implemented, the same is true (even more so) of guidelines for measuring and certifying reductions. Currently, criteria that have been proposed for measuring and certifying emissions reductions from energy efficiency projects are either 1) written in broad terms to encompass a range of different purposes and outcomes, depending on the nature of the proposed program, or 2) in progress but not yet fully established (as in the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism (CDM) and Department of Energy's (DOE) 1605(b) program). This section provides background on fundamental guidelines for measuring GHG reductions, including those from energy efficiency, and a brief review of principles governing GHG project reduction evaluation. We refer to two initiatives to illustrate current guidance on determining emission reductions from energy efficiency: the "Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification (MERVC) of Energy Efficiency Projects for Climate Change Mitigation" are a series of seminal documents published during the 1997-2000 period by Ed Vine and Jayant Sathaye of the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Vine & Sathaye 1997; Vine & Sathaye 1999; Vine & Sathaye 2000), and CDM Approved Methodologies. The primary international effort to establish general guidelines for emission reduction activities is run by WRI.

MERVC

The first influential work on measuring GHG reductions from energy efficiency uses sophisticated techniques for solving a uniquely complicated problem – measuring the effects of something that doesn't happen – energy that is never used and/or emissions that never occur due to the implementation of energy efficiency projects. These techniques rely on the procedures applied in energy efficiency evaluation to provide a useful framework for designing measurement protocols for account for GHG emission reductions. The purpose and scope of the MERVC Guidelines is as follows, which reflect close correspondence between GHG emission reduction procedures and energy efficiency evaluation:

> Implementation of MERVC guidelines is … intended to: (1) increase the reliability of data for estimating GHG benefits; (2) provide real-time data so that mid-course corrections can be made; (3) introduce consistency and transparency across project types and reporters; and (4) enhance the credibility of the projects with stakeholders … Any proposed MERVC guidelines should reflect the following principles: they should be consistent, technically sound, readily verifiable, objective, simple, relevant, transparent, and cost-effective. In practice, tradeoffs will have to be made among some of these criteria: e.g., simplicity versus the technical soundness of a guideline, and high transaction costs and comprehensiveness (Vine & Sathaye 1997, preface).

The MERVC guidelines propose basic protocols for:

1. establishing a credible baseline
2. accounting for impacts outside of project boundaries
3. net GHG reductions and other impacts
4. precision of measurement
5. MERV frequency
6. persistence (sustainability) of savings, emissions reduction, and carbon sequestration
7. reporting by multiple project participants
8. verification of GHG reduction credits
9. uncertainty and risk
10. institutional capacity in conducting MERV; and
11. the cost of MERV.

The Clean Development Mechanism.

The Clean Development Mechanism (CDM), under Article 12 of the Kyoto Protocol, permits non-Annex I countries (developing countries) to undertake emission reduction activities that result in certified GHG emission reductions, which are eligible to be sold to Annex-I countries (countries with emission reduction obligations) for GHG emission compliance purposes. To receive certification, the projects that create emissions reductions have to satisfy certain criteria – establishing a project baseline and demonstrating additionality chief among them (UNFCC 2004). At this time, projects (including but not limited to energy efficiency) to reduce GHGs are being reviewed and approved on a case-by-case basis. To date, the CDM Executive Board has approved three small-scale methodologies evaluate energy efficiency projects, ASM.II.C, ASM.II.D, ASM.II.E (UNFCC 2004). No evaluations to measure emission reductions from these small-scale projects are being conducted as of yet.

GHG Protocol Project Quantification Standard.

The WRI/WCSBD Project Protocol, currently in draft form (due to be published in 2005), provides guidance on measuring emission reductions. The principles are very similar to the MERVC documents.

1. Standardize methodologies and GHG accounting principles to simplify GHG project quantification, while improving quality and credibility;
2. Diminish uncertainty for project developers and decrease transaction costs;
3. Boost investor confidence in GHG projects;
4. Support greater consistency between different projects and GHG trading programs.

The *Project Protocol* defines a "project" as follows:

> A GHG project is a specific project or activity designed to achieve GHG emission reductions, carbon storage, or enhancement of GHG removals from the atmosphere. GHG projects may be stand-alone projects, or specific activities or elements within a larger non-GHG related project. GHG reductions are calculated relative to what the emissions would have been in the absence of the project (this is referred to as the baseline emissions). To achieve a reduction, the project's GHG emissions must be lower (or in the case of removals, higher) than the baseline emissions (WRI 2003, 8)

The GHG Project Protocol specifies the following eight steps for evaluating GHG reductions from a GHG reduction project. These steps mirror similar overall concepts for the impact evaluation of energy efficiency programs, and will seem familiar and sensible to energy efficiency evaluators.

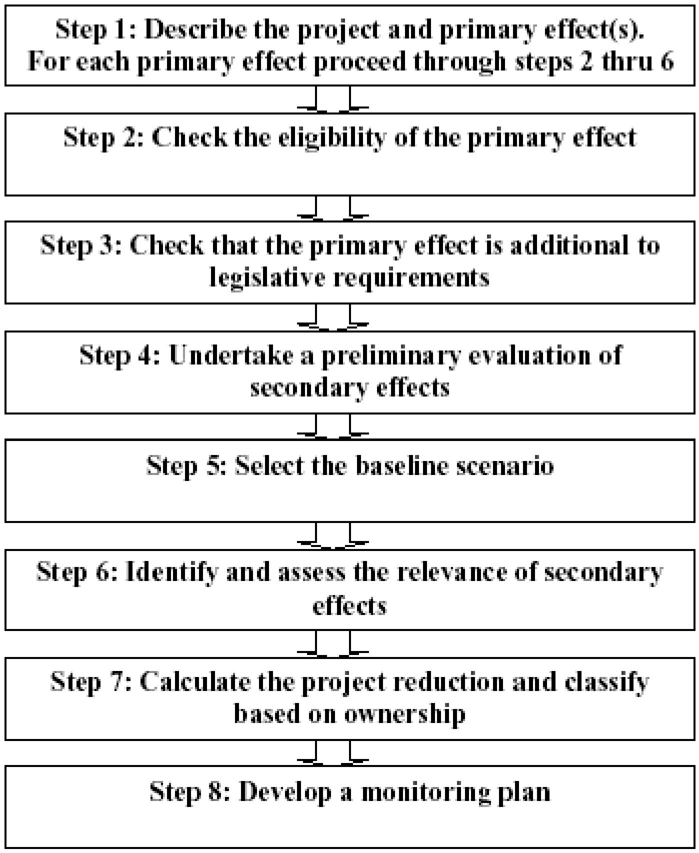

Figure 1: Project Quantification Steps from the WRI/WBCSD Project Protocol

Although the evaluation framework is similar and terminology is similar, there are several key differences between measuring GHG project reductions and traditional energy efficiency evaluation. Energy efficiency evaluators will benefit by a fuller understanding of these issues as they become more active in efforts to use energy efficiency more frequently as a GHG reduction strategy.

Baseline. Establishing a baseline is a complicated endeavor in both energy efficiency and emissions reductions evaluations. The baseline describes a set of conditions that would have occurred in the absence of the project activity, corresponding to the emissions associated with this baseline scenario. In practice, there may be several possible alternatives for what would have happened in the absence of the project activity. The reduction in GHG emissions from each project activity is quantified as the difference between the baseline emissions and the GHG emissions of the project activity, taking into account any relevant secondary effects

Note that from a GHG perspective, both primary or direct effects (roughly equivalent to "participant savings" in energy efficiency parlance) as well as secondary effects ("spillover" and/or "market effects" in energy efficiency) of the project are considered an explicit part of the analysis from the outset. This is somewhat different that traditional energy efficiency evaluation which tends to focus first on direct effects – although ensuring that evaluation accounts for spillover and market effects has become commonplace for energy efficiency evaluation and reporting in some jurisdictions.

Additionality is a criterion for assessing whether a project activity has resulted in GHG reductions or removals beyond, or in addition to, what would have occurred in its absence. This is an important criterion for ensuring the environmental integrity of a project activity. Additionality is an equally important concept in energy efficiency; traditionally the terminology used is "net" savings. From an energy efficiency perspective, net savings, or net-to-gross ratios are discussed in terms of 1) naturally occurring conservation – changes in baseline energy use that would have occurred for both program participants and non-participants in the absence of the program, and, 2) free riders – program participant who would have implemented the program measure or practice in the absence of the program. Distinguishing naturally occurring conservation from free-ridership has always been somewhat difficult, both in terms of measurement and even in terms of clearly defining whether these constitute a single concept or two separate but related concepts. Even the most seasoned evaluators in energy efficiency, when pressed, have difficulty distinguishing the two. However, regulators, evaluators and program implementers agree baselines change over time, typically growing more efficient, and that program-caused impacts must be above the forecast baseline. They also agree that in order to count as program impacts, efficiency savings must be caused by the program. If the program provides incentives, for example, to participants who would have purchased efficient equipment anyway, the effects are not *net* above baseline. Or, to use climate change terminology, do not meet the additionality criterion.

An interesting and potentially important implication of the additionality criterion is that the emissions savings from existing or planned energy efficiency programs that are already justified or funded based on determinations regarding public benefit and/or the avoided cost of generation may not qualify as *additional* savings. This is an issue policymakers may wish to consider as they develop legislation to support energy efficiency in their jurisdictions. For example, the California Public Utilities Commission has recently committed well over a billion dollars for energy efficiency in the next three years – 2006-2008. In GHG frameworks, a criterion for determining additionality involves examining a project proposal through the lens of jurisprudence – projects intended to reduce GHG emissions must be *additional* to any activities already required by law. A strict reading of this additionality criterion could reveal that the emissions reductions from energy efficiency funded through this mandate are ineligible for participation in certification schemes since the reductions are already required by law. This may not be the outcome that policymakers in either GHG or energy efficiency intend, but it represents an area where communication and cooperation between fields will prove valuable.

Characterizing Energy Savings in Terms of GHG Emissions Reductions

Measuring Energy, Demand and Therm Savings

The first step in characterizing emissions savings from energy efficiency is to estimate the energy savings resulting from the program or project in question. The energy efficiency evaluation industry has developed an array of methods and techniques for estimating the energy savings impacts. These methods vary in approach and rigor, following the basic rule of thumb that meticulous and thorough evaluation can produce more precise measurements, at increasingly greater cost. The key to developing well-designed evaluation protocols is to manage these trade-offs and expenditures wisely. It is worthwhile to expend resources on evaluation to provide decision-makers with adequate information for them to make choices about resource allocation, strategies and goals. Evaluation resources should be allocated to the areas where the expenditures can most effectively reduce uncertainty about the underlying savings estimates. Currently, while there are guidelines describing best practices in measurement methods and techniques, decisions regarding the level of rigor required for energy impact evaluations vary between existing energy efficiency jurisdictions. In fact standards often vary between programs within a given jurisdiction (TecMarket Works 2004).

Since there are many methods and techniques for conducting evaluations to choose from, "protocols" or "standards", as described in the previous section, represent agreements among parties regarding the level of measurement rigor required to "certify" a unit of reduction. Typically, in energy efficiency, the energy savings are measured with a pre-specified level of rigor and then expressed in terms of reduced kW, kWh and therms.

Expressing Energy Savings in Terms of Avoided Costs

In almost every instance, decision-makers are interested in knowing the monetary value of the energy savings, so the savings estimates are also expressed in terms of the "avoided costs" of energy – the value of the energy that is never generated or purchased because energy efficiency was implemented instead.

As with guidelines for other aspects of evaluation, the precision with which reported energy savings are translated to avoided costs of energy is a matter of preference and agreement. In practice, generation, transmission and distribution costs vary by location, season and time of day, and other factors. Some jurisdictions are comfortable overlooking these variations and using a systemwide average value to monetize energy savings that occur at any time during the day or year. Others differentiate between avoided costs during several daily "time of use" periods, and often by season as well. Trends toward employing even more sophisticated (and expensive) estimates of avoided costs, for example in California, specify that avoided costs of energy should be measured and reported by region and using 8,760 hour load curves. Transmission and distribution savings also vary according to these dimensions, and can be reported in terms of systemwide averages or using sophisticated time and location differentiated estimates. Thus, the precision of the avoided cost estimate is driven by data availability as well as policy-makers choices regarding the value of information versus resources required for increased reporting precision. As with "protocols" to measure energy savings, "protocols" or "standards" for characterizing the avoided costs of energy represent agreements among parties about the analytic techniques and required to verify the translation of energy savings into avoided costs. Sometimes simplified techniques are adequate; in other instances the parties require more sophisticated estimates.

Expressing Energy Savings in Terms of Avoided Emissions

Procedures for estimating energy savings for purposes of calculating avoided emissions are conceptually identical to those for estimating avoided costs of energy, except that the measured energy savings are translated to avoided emissions. Just as avoided costs vary depending on characteristics of each grid including location, season and time of day, the emissions profile of an electric grid varies according to the generation running through it at any given time. This profile tends to follow certain patterns that vary to reflect the plants – and in particular, the fuels – online producing electricity at any given time. However, emissions profiles do not necessarily correlate with avoided costs. From an avoided cost perspective, electricity tends to have its highest value during peak system use, so technologies that reduce peak demand tend to have higher avoided costs. The same is not necessarily true of emissions profiles. For example, imagine a case where dirtier plants are online during shoulder periods, and cleaner combustion turbines are used to meet peak demand. That would be an instance where technologies that reduce energy use during shoulder hours have a bigger impact on emissions than measures that reduce peak energy use. Energy efficiency evaluators have conducted a great deal of work on avoided costs, but are just beginning to study these questions and their implications for characterizing savings from energy efficiency in terms of reduced or avoided emissions(Erickson et al. 2004; Marnay et al. 2002).

Questions that must be resolved in order to develop "standard" methodologies for estimating grid emissions profiles are essentially identical to questions that must be resolved to estimate avoided costs. First, energy savings are estimated and reported. Then the energy savings are translated into emissions reductions based on a grid profile. The parties must come to agreements about the level of analytic precision they will accept for emissions profiles used to certify reductions. In some cases a single grid-wide average is adequate, but in most cases guidelines for certifying GHG reductions are favoring more sophisticated measurements that reflect locational, seasonal, and daily variations in emissions profiles.

Methods for Calculating Grid-Based Emissions Reductions

Stakeholders working to develop methods for estimating emissions savings resulting from displacing existing generation with renewable generation have already been working on developing methods for characterizing reduced emissions. Methods for estimating emissions reductions from energy efficiency can build on this work. The [Canadian] Commission for Environmental Cooperation recently produced a comprehensive report on the numerous initiatives underway to estimate emissions profiles – and emissions reduction estimation strategies – in a variety of areas and jurisdictions (Tampier 2004).

In part, participants in this industry are still wrestling with basic problems of defining which emissions are avoided (in this case by renewable energy, but the same concept applies to reductions due to efficiency). Energy efficiency evaluators will recognize these topics as identical to concerns about estimating avoided costs. According to the CEC report, there are three basic methods to choose from to estimate avoided emissions:

> 1. Grid average – the average emissions per MWh for the national grid, or a region, are used as a baseline to quantify emission reductions
>
> 2. Operating margin – the marginal generation unit is used to quantify emission reductions. This unit is the plant that comes on the grid last of all plants. Different plants can be on the margin, depending on the time of day and the season. This method requires some more complex modeling to anticipate which plant will be the marginal unit at which point in time. This information is not always available.
>
> 3. Build margin – the emissions from planned generation plants are used to determine emission reductions. The build margin is often a natural gas plant, but can also be a mix of different plants, including coal, nuclear, or large hydro.

The report notes an emerging preference for methods 2 and 3, including strategies to blend them together:

> There is a clear trend away from simplistic methodologies, such as using the grid average, towards using the operating margin, the build margin, or a combination of both (combined margin). However, the methodologies to calculate these margins vary considerably … A range of options are being suggested … complex models are being criticized for being very expensive to implement, requiring large amounts of data, and being less transparent. Simpler models are seen as yielding unrealistic results in some

situations. Some methodologies therefore represent a compromise between a very simple approach and sophisticated modeling (Tampier 2004, 7).

There is no single "correct" approach. In practice the decision about which method to use is discussed by stakeholders and stipulated as a compromise based on many considerations including differing points of view about the proper metric to use, as well as more practical issues like data availability.

A Word on Standardization and Transparency

As discussed throughout this paper, there is a need for cooperation among organizations in setting standards and protocols for measuring emissions reductions from energy efficiency, including protocols and practices for describing grid emissions. Although, perfect agreement on acceptable methods for savings and grid profiles would be convenient, this could be unrealistic. The degree of effort required to develop and maintain this level of coordination would be enormous. And, in fact, it is important for different localities and organizations to have the flexibility of implementing rules designed to achieve their special goals and needs.

What is important, critical in fact, is that program administrators have agreements on terminology for the measurement standards, and transparency regarding calculation methodologies. Taking these steps now will help prevent a situation where too many groups currently developing market and or regulatory systems for GHG reduction spend time carefully crafting rules for measurement guidelines only to discover later that their systems are not compatible. Standardization does *not* mean that all of the organizations have to *use* exactly the same rules – just that there must be agreements on terminology and transparency regarding the meaning of different methods.

Conclusions

The opportunity to use energy efficiency as a means of reducing GHG reductions is an important area of interest for entities engaged in GHG reduction. In order to verify emissions reductions from energy efficiency programs or projects, it is necessary to develop measurement and verification protocols designed to yield fungible, tradable units of emission reduction. Several key challenges must be addressed for these protocol development efforts to yield the best results.

- It is helpful to understand several underlying differences between traditional energy efficiency evaluation and traditional emissions reduction accounting measurement and reporting, in order to facilitate the blending of these two approaches into a new method for calculating emissions reductions from energy efficiency.

- Many organizations, both in the U.S. and other countries, are currently developing mechanisms for certifying, trading, and otherwise accounting for emissions reductions. An important step toward engaging energy efficiency as a means of GHG reduction will be to develop protocols and certification procedures that are accepted by a variety of these mechanisms in order to facilitate accreditation and trading.

- Methods must be developed to characterize energy savings in terms of avoided *emissions* rather than *avoided costs*, the traditional unit of measurement. This does not necessarily entail development of new techniques to measure *energy saving*s from efficiency. Rather, the new challenge is to link measured electric energy savings to a grid emissions profile. Protocols or guidelines must be developed for estimating a grid emissions profile, and then measurements must be made to characterize the affected grids. The approach has many parallels to the application of avoided costs in energy efficiency evaluation.

- Practitioners in energy efficiency evaluation should engage and participate in efforts to develop accounting and reporting protocols for GHG emission reductions from energy efficiency activities. Their experience and expertise would be crucial to establishing measurement and monitoring guidance that is consistent with well-tested and accepted procedures from energy savings analysis. Energy Efficiency professionals should not abstain from the protocol development efforts taking place at the DOE 1605(b), EPA Climate Leaders, California Climate Action Registry, the Efficiency Valuation Organization (EVO) – formerly known as the International Performance Measurement and Verificiation Protocol (IPMVP) – or WRI.

Acknowledgements

The author's would like to thank our International Energy Program Evaluation panel leader, Ed Vine, and our fellow panelists for valuable comments on earlier drafts of this paper. We are grateful for excellent editorial assistance from Josh Bode of Freeman, Sullivan & Co. Any errors, of course, remain our own.

Reference List

California Climate Action Registry (CCAR) 2002. *General Reporting Protocols*. Los Angeles, CA: California Climate Action Registry. Available at www.climateregistry.org

California Public Utilities Commission (CPUC) 2005. *Interim Opinion on E3 Avoided Cost Methodology.* San Francisco, CA: Decision 05-04-0924 before the California Public Utilities Commission

California Public Utilities Commission (CPUC) 2005. *Interim Opinion: Updated Policy Rules for post-2005 energy Efficiency and Threshold Issues Related to Evaluation, Measurement and Verification of Energy Efficiency Programs.* San Francisco, CA: Decision 05-04-051 before the California Public Utilities Commission.

Erickson, J., C, Best, D. Sumi, B. Ward, B. Zent, K. Hausker 2004. *Estimating Seasonal and Peak Environmental Emissions Factors.* Madison, WI: State of Wisconsin, Department of Administration, Division of Energy.

Efficiency Valuation Organization www.evo.org ; International Performance Measurement & Verification Protocol www.ipmvp.org

Marnay, C., D. Fisher, S. Murtishaw, A. Phadke, L. Price, J. Sathaye 2002. *Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector.* Berkeley, CA: Lawrence Berkeley National Laboratory, Energy Analysis Department, Environmental Energy Technologies Division.

Schwarzenegger, A. 2005. Governor of California. *Executive Order S-3-05, June 1, 2005.* Sacramento: California.

Tampier, M 2004. *Discussion Paper on North American and International Initiatives to Quantify Emission Reductions from On-Grid Renewable Electricity Facilities.* Vancouver, BC: Commission for Environmental Cooperation.

TecMarket Works 2004. *The California Evaluation Framework: Prepared for the California Public Utilities Commission and the Project Advisory Group.* Oregon, WI: TecMarket Works. Available at www.calmac.org .

United Nations Framework Convention on Climate Change 2004. *Decision 15/CP7.* Available at http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

U.S. Environmental Protection Agency (EPA) 1999. *Guidance on Establishing an Energy Efficiency and Renewable Energy (EE/RE) Set-Aside in the NOx Budget Trading Program.* Washington, DC: U.S. EPA, Office of Atmospheric Programs, Office of Air and Radiation.

U.S. Environmental Protection Agency (EPA) 2003. *Creating an Energy Efficiency and Renewable Energy Set-Aside in the NOX budget Trading Program: Administrative and Quantitative Elements. Washington, DC: U.S. EPA,* Climate Protection Division, Office of Atmospheric Programs Office of Air and Radiation.

Vine, E. 2003. "Opportunities for Promoting Energy Efficiency in Building as an Air Quality Compliance Approach." *Energy - The International Journal*, 28(4): 319-341.

Vine, E. and J. Sathaye 1997. *Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Energy-Efficiency Projects for Climate Change Mitigation: Review of Existing Protocols and Guidelines.* Washington, DC: US. Environmental Protection Agency, Climate Policy and Program Division (LBNL-40316).

Vine, E. and J. Sathaye 1999. *Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Energy-Efficiency Projects for Climate Change Mitigation*. Washington, DC: US. Environmental Protection Agency, Climate Policy and Program Division (LBNL-41543

Vine, E. and J. Sathaye 2000. *Best Practices Guide: Monitoring, Evaluation, Reporting, Verification, and Certification of Climate Change Mitigation Projects*. Berkeley, CA: Lawrence Berkeley National Laboratory.

World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD). 2003. *The Greenhouse Gas Protocol: Project Quantification Standard (Road Test Draft).* Washington, DC: World Resource Institute.