Giving Credit Where Credit is Due:
Energy Efficiency in CO_2 Emissions Trading

David Nemtzow, Nemtzow & Associates
Omar Siddiqui, Electric Power Research Institute

ABSTRACT

The more efficient use of electricity is widely considered to be a major and low cost means of lessening greenhouse gas (GHG) emissions and mitigating global climate change. Not surprisingly, increasing responses to climate change – including CO_2 cap-and-trade and offset schemes[1] – are placing greater emphasis on utility energy efficiency and demand-side management activities.[2] This paper provides an overview and exploration of methods to account for CO_2 emissions reductions specifically associated with implementation of energy efficiency (EE) programs into GHG cap-and-trade programs and offset schemes.[3] It is intended to assist electric utilities, policymakers and others interested in incorporating EE projects into evolving CO_2 offset schemes to better understand key methodological, analytic and policy issues. The paper focuses on how to understand, account for, quantify, verify, and optimize how a given level of electricity savings may both reduce CO_2 emissions and potentially be granted credits for such CO_2 savings that may be traded in cap-and-trade regimes. The paper evaluates the analytical methodologies for crediting EE with CO_2 offsets applied by various emissions trading schemes. In addition, the paper assesses that rationale used by certain emissions trading schemes to disallow EE as an eligible project category for CO_2 offsets. In particular, the paper discusses key analytical barriers to the inclusion of EE as an eligible category for CO_2 offsets and approaches to overcoming those barriers.

Energy Efficiency's Role in Mitigating Climate Change

The more efficient use of electricity is a major and often low-to-no cost means of reducing carbon dioxide emissions and mitigating global climate change. Energy efficiency (EE) can be deployed faster and at lower cost than supply-side options such as new central power stations.[4] Moreover, as EPRI has recently concluded, "the impact of EE on CO_2 emissions includes not only the load that it directly reduces, but also the new generation that it defers, buying time for incrementally cleaner and more efficient generation to come on-line."

EPRI's Prism Analysis (see Figure 1), for example, has determined that electric sector EE has the potential to reduce annual growth in electricity consumption through 2030 from the 1.05 percent forecasted in the Energy Information Administration's Annual Energy Outlook for 2008

---

[1] Offsets are emissions reductions or sequestration that is achieved outside of a party's internal operations which are intended to be used to offset a regulated party's mandatory targets or goals. Energy efficiency offsets are offsets that are generated by creating energy efficiency among parties other than the regulated entity.

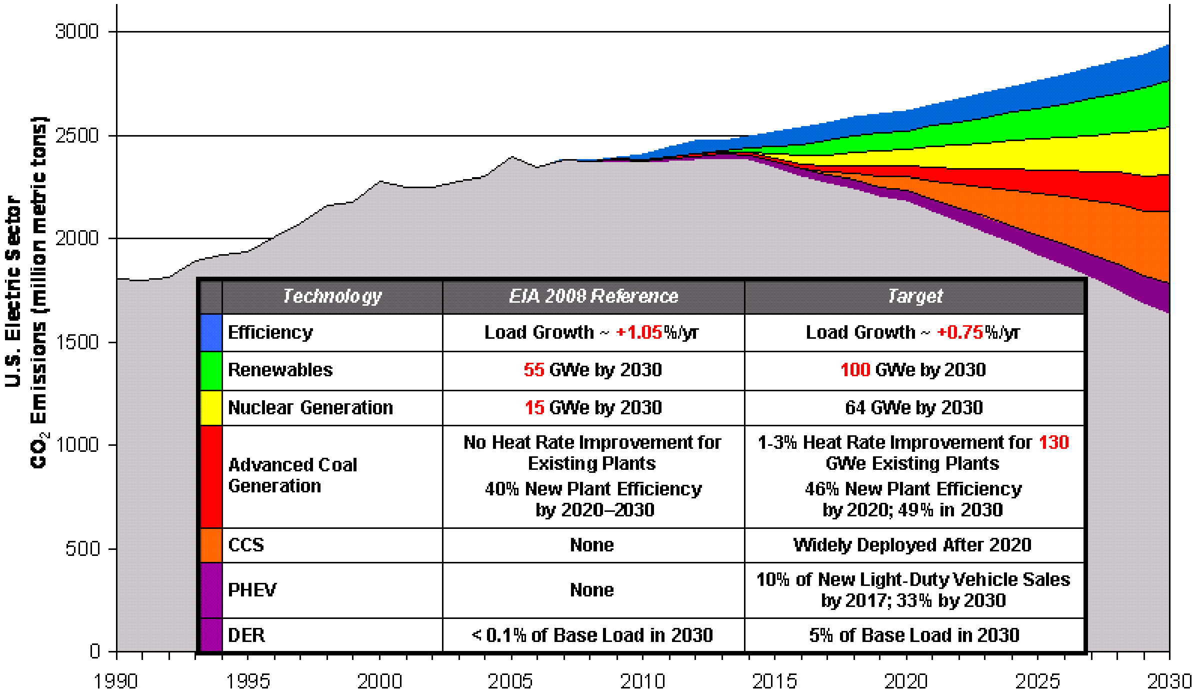
[2] This paper typically uses the term Energy Efficiency and focuses on demand-side electricity efficiency (while considering other DSM, such as demand response, advanced metering infrastructure and load management). Supply-side energy efficiency has a major role to play in mitigating CO_2 emissions but is not examined in this paper.

[3] The following terms are used interchangeably following the terms "cap-and-trade" and "offsets": system, program, regime, scheme.

[4] "The Power to Reduce CO_2 Emissions: The Full Portfolio", EPRI Discussion Paper, August 2007.

to 0.75 percent, thereby reducing CO_2 emissions by approximately 200 million tonnes/year by 2030. This potential reduction in CO_2 emissions from EE is on par with projected contributions from renewables, nuclear, and advanced coal generation, under assumptions of greater R&D investment in these supply-side technologies. Furthermore, the EPRI Prism analysis shows that EE, in contrast to supply-side options, is the most readily available and deployable lever for utility sector CO_2 reductions available today, and is projected to remain the largest contributor to CO_2 reductions through 2020. Not surprisingly, responses to climate change – including the evolution of GHG emissions cap-and-trade programs and offset schemes – are increasingly emphasizing EE, and electric utility EE and DSM activities in particular.

Figure 1. Energy Efficiency as Part of Full Portfolio Approach to Mitigating CO_2 Emissions in the U.S. Electric Sector



	Technology	EIA 2008 Reference	Target
🟦	Efficiency	Load Growth ~ +1.05%/yr	Load Growth ~ +0.75%/yr
🟩	Renewables	55 GWe by 2030	100 GWe by 2030
🟨	Nuclear Generation	15 GWe by 2030	64 GWe by 2030
🟥	Advanced Coal Generation	No Heat Rate Improvement for Existing Plants 40% New Plant Efficiency by 2020–2030	1-3% Heat Rate Improvement for 130 GWe Existing Plants 46% New Plant Efficiency by 2020; 49% in 2030
🟧	CCS	None	Widely Deployed After 2020
🟪	PHEV	None	10% of New Light-Duty Vehicle Sales by 2017; 33% by 2030
🟪	DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

Source: EPRI PRISM Analysis, 2008

The emergence of cap-and-trade, offset and emissions trading systems (whether within or outside of the Kyoto framework) as means of mitigating CO_2 emissions has very important implications for EE's role in climate change. The nature and design of these capping and/or trading schemes will greatly affect the size, cost and nature of EE's contribution to mitigation in three very different ways. One, the non-EE specific aspects of the overall system design will have a significant impact on EE; these include the stringency of the overall cap, which economic sectors are regulated, and which economic entities are "first regulated." Two, the establishment of "energy efficiency offsets" – a mechanism that allows regulated parties to get credit toward their caps by lessening other parties' emissions through energy efficiency – can provide an important opportunity for energy efficiency. Three, other aspects of a cap-and-trade system may be added to specifically assist energy efficiency, such as dedicating a share of the revenue generated by cap-and-trade for EE programs.

It is the second approach – establishing EE offset systems – that is the subject of this paper. This may be an important new opportunity to electric utilities, which have long played a leading role in promoting and delivering on the large potential of EE and are in a very strong position to deliver qualifying EE that can be used to offset their own emissions, or sold to others who need the offsets. Establishing EE offsets requires understanding the strengths and limitations both of EE and of cap-and-trade systems – and then designing an EE offsets system that accurately, reliably and persuasively accounts for emissions reductions resulting from EE. This is neither a straightforward nor a simple task which is why – even though energy efficiency's fundamental role in reducing GHG emissions is universally accepted – to date most emission trading schemes have not created EE offset systems. Several existing and emerging emissions trading systems, however, do include EE offsets, as do comparable regulatory programs, and consideration of EE's role in cap-and-trade regimes continues to grow.

Energy Efficiency's Role in Emissions Trading

Why Energy Efficiency?

Energy efficiency can and should play a major role in combating climate change, and including EE offsets can facilitate that role and increase EE's impact. As is well documented, EE has a very large, cost-effective and reliable potential to mitigate CO_2 emissions in the US and globally. Furthermore, there is an important, albeit less clear, role for Demand Response, load management and advanced metering infrastructure; although they typically reduce CO_2 emissions they may have no or even a negative impact, furthermore, their positive potential is not well known, or even doubted, discouraging many policymakers from investing the effort to include them in emissions trading.[5] EE's extensive low, no or negative cost potential means that including it in a cap-and-trade program can substantially reduce the cost of compliance. A recent study by McKinsey depicts a host of EE categories, such as efficient lighting and building shell improvements, as CO_2 abatement strategies with net *negative cost*, i.e. where lifetime energy savings outweigh capital and O&M costs.[6] Where other mechanisms are unavailable to achieve EE, offset programs present an essential approach to economic efficiency.

In short, EE is good for mitigating climate change, and mitigating climate change is good for EE.

Why Energy Efficiency Offsets?

The establishment of an EE offsets system (or any other type of offsets for that matter, such as planting trees or reducing methane leakage from natural gas pipes) introduces additional flexibility into a GHG cap-and-trade regime, thereby increasing compliance options, lowering overall compliance costs and lessening backlash against stringent caps. Allowing offsets is predicated on the logic that if a regulated party prefers to lessen other parties' emissions and not just its own it should be allowed to do so. For a regulated party such as an electric utility such a preference may come from the fact that it is cheaper to reduce others' emissions than one's own, or any number of other reasons, including specialized expertise, community/government rela-

---

[5] See for example "The Green Effect: How demand response programs contribute to energy efficiency and environmental quality" David Nemtzow, Dan Delurey and Chris King in Public Utilities Fortnightly, March 2007.

[6] McKinsey & Co. and The Conference Board. "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" U.S. Greenhouse Gas Abatement Mapping Initiative – Executive Report. December 2007.

tions, non-GHG benefits (e.g., load management), and/or a desire to have the flexibility to leave generators and/or operations untouched.

Emissions trading allows a more market-oriented and dynamic approach to EE and may produce unexpected, high-performance solutions. For example, the emergence of mass distribution of CFLs and high-efficiency showerheads – displacing far more carbon-intensive alternatives – in New South Wales, Australia (NSW) since 2005 was entirely unexpected at the time the NSW Greenhouse Gas Reduction Scheme (GGAS) was established, and would not likely have arisen absent the offsets program.

There may also be a lack of other mechanisms and/or funding to achieve cost-effective EE. There are a great many EE opportunities for which no current or planned development programs exists, and for which no funding has been allocated. For example, given that non-Annex I (developing) countries have no obligations under the Kyoto Protocol, funding parties in Annex I (industrialized) countries would otherwise have no incentive to devote resources to delivering on the low-cost EE opportunities available there except for the offsets allowed by the Kyoto Protocol's Clean Development Mechanism (CDM).

Downsides to EE Offsets

Despite EE's potentially positive role in CO_2 cap-and-trade systems, there are several reasons to not establish special EE offset provisions – particularly the risk of "double-counting" – and, in fact, most cap-and-trade systems to date do not allow EE offsets, including the largest trading scheme in the world, the European Union's Emissions Trading Scheme (ETS). The reasons for this include the following.

Double counting. By their very nature, cap-and-trade systems implicitly encourage energy efficiency as a response given that emissions are capped on an absolute basis, not on a per kWh or per BTU basis. If an electric utility is cap-and-trade regulated and it is able to get its customers to adopt energy efficiency, power consumption and generation and attendant carbon emissions would decline, and the utility will be that much closer to meeting its obligations. Therefore, allowing EE to be used as an offset creates the possibility of "double-counting": the successful energy efficiency would reduce emissions and thus count toward a given target; allowing it to be quantified and used as an offset could be double-counting.

There are two ways to eliminate double-counting. One is to deduct the quantity of the EE offsets out of the total allowed cap, while perhaps limiting the number of total EE offsets that will be allowed. This was the approach taken by Congress when it established the EE reserve in the federal acid rain cap-and-trade. The other is to limit the qualifying offsets only to energy efficiency measures outside the boundaries – sectoral or jurisdictionally – of the GHG regime. (This in turn raises its own concerns including maintaining the quality and integrity of the offset and ensuring that the offset does not simultaneously count toward another jurisdiction's GHG regulations, thereby creating an new case of double-counting.)

Also important are the rhetorical responses to concerns about double-counting, which include the argument that energy efficiency is "more equal than other" emissions strategies – because of its numerous ancillary benefits – and therefore it should receive this additional incentive. Secondly, although cap-and-trade schemes do incent efficiency, they may not do so to a strong enough degree to be meaningful; this depends upon the architecture of the cap-and-trade, for example if power generators are regulated instead of electric utility companies there will be virtually no incentive for them to promote end-use efficiency. In fact, the architects of two key EE offset programs in cap-and-trade regimes – that in the federal acid rain program and in the GGAS scheme – were fully cognizant of the risk of double-counting and successfully pursued it nonetheless because of EE's importance to them.

Developing EE Offsets is a "distraction" from the challenging task of establishing cap-and-trade. Establishing a trading system is challenging enough; including EE offsets creates additional complexity and effort. The challenge of meaningfully and effectively combining negawatts and megawatts in utility programs is longstanding – extending that challenge to emissions trading requires additional policymaker and program management resources, which may be scarce.

Developing EE Offsets is a "distraction" from the challenging task of promoting and EE. It is not certain that EE offset schemes (or cap-and-trade regulations for that matter) will yield significant investment in EE. EE's disperse nature can result in transaction and administrative costs of participating in an offset program that easily overwhelm the financial benefits, which are in turn usually thinly spread among many parties. Accordingly, maximizing EE's role in mitigating climate change may be more suitable through means other than establishing an EE offset program.[7] This can be done in conjunction with trading schemes – for example by dedicating to EE a share of the revenue generated by a trading systems[8] – or completely distinct from them, such as by adopting appliance standards, Energy Efficiency Resource Standards and/or conducting utility-administered DSM activities. Although this consideration – EE's tough sledding within emissions trading – is compelling to many, it is not so much an argument against establishing EE offsets as a reason for EE supporters to be unenthusiastic about EE offsets.

Analytic and accounting challenges for consistency with emission caps. At a minimum, including EE offsets in emissions trading programs requires establishing analytic methods and accounting mechanisms to accurately estimate the GHG mitigation impact of EE activities and to properly credit them in an emissions trading system. As discussed below, this is a complex and not always straightforward exercise, in large part due to the dynamic nature of integrated electrical grids. While those who argue against the development of EE offsets cite legitimate concerns regarding the effort and difficulty in "getting it right", the enormous near and long-term potential of EE in mitigating climate change dictates that any cap-and-trade regime that excludes it runs the risk being inappropriately focused away from this very large and inexpensive resource. The experience with EE offsets to date in emissions trading and related activities show that adequately workable and accurate offset systems can be developed. Furthermore, there are mechanisms available to lessen any risk of getting the methodology "wrong" for EE (or any other offsets for that matter), such as capping the quantity of credits that may be obtained from EE offsets, as the northeastern U.S. states' Regional Greenhouse Gas Initiative (RGGI) does.

---

[7] "Comments of the American Council for an Energy-Efficient Economy and the Alliance to Save Energy on the Regional Greenhouse Gas Initiative Draft Model Rule", May 22, 2006.

[8] For example, ACEEE and the Alliance to Save Energy, ibid., have recommended that "At least 50% of the financial proceeds of public-benefit allowance sales be dedicated to energy efficiency."

Design Elements for an EE Offsets System

The creation of EE offsets from electric utility DSM programs to mitigate CO_2 emissions in a cap-and-trade scheme can be disaggregated into five key steps:

(1) Electric utility's projects, programs, policies, and/or expenditures are undertaken to →
(2) Deploy EE measures and behaviors among end users that →
(3) Save electric energy (both MWh and MW) that →
(4) Avoid CO_2 emissions that would have occurred, which in certain jurisdictions may be granted →
(5) Credits or offsets in GHG/CO_2 cap-and-trading/offset schemes.

Designing energy efficiency offset programs primarily requires attention on the focus on how Steps 3 and 4 become Step 5, namely how to understand, account for, quantify, and operationalize the appropriate CO_2 allowances from electricity saved by efficiency. Doing so entails consideration of a range of issues and program elements which will benefit from analytic and modeling work and from extensive experiences over the past three decades, including:

- The evaluation, measurement and verification (EM&V) protocols around utility energy efficiency, demand response and other demand-side management programs[9];
- Formal EE goals-setting and risk-reward mechanisms that demand rigorously quantified energy efficiency results[10];
- Energy Efficiency Resource Standards, such as has been adopted in several states and passed the U.S. House of Representatives in 2007[11];
- The energy efficiency set aside in the federal NOx budget program and the EE offset in the federal Acid Rain cap-and-trade program[12]; and
- The existing CO_2 cap-and-trade regimes that provide for offsets, particularly those that have EE offsets, such as NSW GGAS.

A discussion of the issues and options of key design elements of EE offsets systems follows. Several of the issues relate to the complex and sometimes subjective offsets accounting that requires estimation of key baselines, leakage and additionality**.**

---

[9] The literature on utility DSM EM&V is enormous; see for example "Model Energy Efficiency Program Impact Evaluation Guide: a Resource of the National Action Plan for Energy Efficiency" November 2007, prepared by Steve Schiller for the USEPA/DOE National Action Plan for Energy Efficiency, www.epa.gov/cleanrgy/documents/evaluation_guide.pdf. Extensive information is also available at the CALifornia Measurement Advisory Council (CALMAC) web site, http://www.calmac.org/.

[10] See for example, the CPUC Risk-Reward Mechanism Proposed Decision (scheduled for consideration and likely adoption September 20, 2007), which establishes shareholder returns and penalties based upon the achievement or failure to achieve previously established energy efficiency goals.

[11] See for example, "Energy Efficiency and Resource Standards: Experience and Recommendations" Steven Nadel, ACEEE, February 2006 at http://www.aceee.org/pubs/e063.htm. The EERS that passed the U.S. House is a partial voluntary substitute for Renewable Portfolio Standards; Section 9611 "Federal Renewable Portfolio Standard" of H.R. 3221 "Renewable Energy and Energy Conservation Tax Act of 2007".

[12] Known as the "Markey Amendment" to the Clean Air Act Amendments of 1990. 40 CFR 73.26. www.epa.gov/airmarkets/progsregs/arp/conserve.html

Calculating Emissions Mitigation: Average versus Marginal Emissions

Perhaps the most analytically difficult aspect of designing an EE offset regime is adopting a methodology to determine the quantity of emissions that are avoided as a result of the EE.[13] At the heart of the challenge is the inescapable counter-factual reality: it is impossible to measure and compare CO_2 emissions in two worlds – the world in which the EE project existed, and the world in which it didn't. As a result, it is necessary to estimate those different worlds under certain assumptions – within the constraints of the available data, time and budget.

Key is appreciating that implementing EE (or any other change to an electric system's supply or demand mix) makes changes at the margin of operation, not "in the middle" and hence it affects marginal emissions, not system average emissions. Determining what is at the margin has several aspects:

- Electric systems' dispatch order, fuel mix and unit performance vary on a real-time basis over the course of the day and year and across years, as does a system's emissions profile;
- The energy-saving performance of EE measures may also vary on a time-dependent basis;[14] and
- Combining the above two factors means that mitigation from EE measures will vary considerably in the course of the day and year and over time.

One key consideration is defining the margin with respect to the generating fleet, since nearly all electric utility systems are integrated with neighboring companies. There are several logical choices, but some are limited by the availability of usable data. Defining the system at the ISO level and calculating marginal dispatch accordingly is a reasonable approach. Utility load dispatch models exist that can adjust for demand-side impacts, such as EE measures with specified load shapes, to produce a reasonable proxy for marginal emissions. [15]

This capability suggests that marginal analysis of CO_2 impact at the end use level, where a load shape can be defined, is possible.

Calculating Emissions Mitigation: Historic, Current and Future

It is more difficult to do such a marginal analysis for future activities than for past activities. In fact it becomes increasingly complex in situations where there is sufficient EE (as well as demand response and load management) to defer or avoid new generation, as it requires hypothesizing which new generating resources would have been built had the EE activities not occurred.

---

[13] This job is even more difficult for demand response activities since they are more likely to change the running order of the generating system.

[14] For example, replacing an incandescent traffic signal with an LED one will yield a flat "load curve" for the savings. On the other hand replacing an air conditioner with a more efficient one equipped with advanced sensors, controls and/or thermal storage will change the load profile of the cooling.

[15] Among others, Electricité de France has analyzed the link between its generation composition and end use loads to develop carbon intensities of end uses on a grams of CO_2 per kWh basis.

To account for this factor, an EE offset scheme can use a "build margin" to represent the emissions factor of avoided new generating units in addition to an "operating margin", which reflects reductions in the baseline performance of the fleet of existing generators. Accordingly, the emissions mitigation calculations should be calculated based upon a weighted average of the operating margin and the build margin, remaining cognizant of assumptions about the need for new generation and the time frame of the analysis.

Calculating Emissions Mitigation: Precision versus Simplicity

As in other areas of regulation and program management, there is a trade off between calculating precise results and finding an easy and affordable approach.

The simplest approach is to use a single system-wide "displaced emissions rate" or other similar fixed co-efficient derived from an emissions database. By contrast, a complete hourly dispatch or production cost model can simulate and compare the CO_2 emissions from different assumptions of demand levels, timing and even location. The former is less accurate and likely to use historic, average data. The latter is much more subtle, rigorous and accurate – some models (such as EPRI's GHG-CAM simulation model) incorporate avoided T&D losses, retail electricity prices (and expected annual growth in these prices), and the avoided cost of power generation, and allows the use of either average or marginal avoided CO_2 emissions in the regional grid. But production modeling is labor-intensive and opaque to those who do not have full access to the model, its assumptions and algorithms, which can lead to controversy due to the often contentious and high-stakes nature of climate change mitigation and of power planning.

There are also various "medium effort" techniques that are in use. One technique is to use an emissions databases or a semi-dynamic simulation of a system's dispatch via a production model to posit a "proxy" plant at the margin and then use the proxy plant's emissions performance to estimate avoided emissions. Better yet – but still not nearly as fine-tuned as using an hourly dispatch simulation – is using a few proxy plants to reflect daily or seasonal load curves and then matching the time-sensitive performance of the EE measures against the emissions from those plants.[16] Additionally, all of the above approaches run the risk of inadequately considering, or even neglecting, the adoption of new technologies.

Handling Additionality

"Additionality" is the degree to which GHG benefits attributed to an emission mitigation project resulted from a project and would not have occurred even without the intervention. Closely related to additionality is the phenomenon of "free ridership", in which a party participates in a project and is awarded incentives for actions that would have been undertaken (in whole or in part; sooner or later) *even without* the presence of the project or any incentives. Conversely, the counter-phenomenon of "spillover" (also known as "free drivers") is also observed, in which a party is impelled by a project to perform an action (either directly called for by the project or a related action) for which it *does not receive* an incentive payment – likely because the party was not aware of or eligible for the incentive but performed the action nonetheless, perhaps because they had learned that a competitor or friend had performed the action.

---

[16] A useful discussion of the medium-effort approaches can be found in "Model Energy Efficiency Program Impact Evaluation Guide", op.cit.

Additionality is, of course, an important and long-standing issue for many governmental and utility activities, including demand-side management. It is impossible, of course, to prove that a given action was additional because it is impossible to precisely compare behavior in a world with the EE intervention to a world without the intervention. Different approaches can be taken to address additionality and to minimize its likelihood.

Additionality for activities that are well known and replicable, such as an inefficient appliance replacement programs, can be handled by determining a numerical co-efficient and using it to discount the results of the program. For example, for California's energy efficiency programs this is known as a "net-to-gross" ratio which is a number up to 1.0 that represents the best estimate of what share of an EE administrator's program results should be credited to that administrator, rather than assumed to have occurred anyway; a net-to-gross of 1.0 represents the conclusion that all of the results of a program is additional, while a net-to-gross of 0.7 signifies that 70 percent of the results are due to the program, while the remaining 30 percent would have happened anyway.[17] The NSW GGAS uses a different approach, discounting program activities by an "Installation Discount Factor" to reflect the fact that not all of a given measure will actually be installed.[18] Furthermore, EE offset schemes may also simply declare in their regulations that qualifying activities must be "additional." Such a declaration may be done only for appearances' sake, but it may be done to provide the scheme administrator the authority to disregard activities the administrator believes are not additional.

Certainly the desire to optimally deploy EE and/or GHG resources demands a careful consideration of additionality in order to minimize the less-necessary interventions. However, it should be kept in mind that for an issue that is as compelling as is global climate change, energy users will be educated and encouraged to take efficiency and other mitigating steps by a very wide variety of sources and not just by utility-sponsored programs. Thus, none of these steps do, or can, provide complete assurance with respect to additionality and the understandable desire to be assured of additionality should be resisted.

Consideration of Leakage and Secondary Effects

Because no emissions trading scheme has a global impact or is truly economy-wide, there is a risk that something might occur outside the boundary (territorial or sectoral) of the regulated system that is related to an emissions-mitigating activity and reduces its environmental effect. This is of particular concern with state-based regimes where there is a multi-state power grid, as in those cases a regulated party may inadvertently or deliberately shift its emissions from the regulated jurisdiction to a neighboring, non-regulating, one. Such "leakage" is a concern with or without the adoption of EE offsets. But it can be important if EE activities change the dispatch of powerplants in the grid and result in increases in CO_2 emissions outside the regulatory regime, in a GHG version of "whack a mole", or in another unanticipated secondary manner due to the integration of the power grid and the indirect nature of EE on power emissions levels.

Although the term "leakage" is typically used regarding a *negative* secondary impact of EE, there are usually *positive* secondary impacts of EE that should be properly credited if possible in an EE offset scheme including:

---

[17] A listing of the official California net-to-gross ratios can be found on the Database for Energy Efficient Resources (DEER) at http://eega.cpuc.ca.gov/deer/Ntg.asp.

[18] "Greenhouse Gas Benchmark Rule (Demand Side Abatement) No. 3 of 2003", NSW Government, 25 August 2006, Table 1.

- Reduction in air conditioning load due to the deployment of efficient lighting and equipment,
- Transmission and distribution line losses, particularly during times of peak demand when T&D runs less efficiently,
- Reduction in demand that allows reduced use or even avoidance of marginal generating units – which often will have a high heat rate and poor emissions profile.

In either case, negative or positive, leakage and other secondary impacts can be thought of as costs and benefits that are difficult – perhaps too difficult – to measure or even estimate. As such the only "solution" to leakage is to robustly and comprehensively estimate a measure's impact on marginal CO_2 emissions, both within and beyond the strict borders of the cap-and-trade scheme.

Determining Eligibility

EE offset schemes handle eligibility in several ways:

Eligible measures. EE offset schemes typically define what measures are eligible to reduce future confusion and error. Programs may provide definitions of eligibility and/or a list of eligible measures for clarification. For example, the Regional Greenhouse Gas Initiative (RGGI) Model Rule includes several pages of definitions and examples of qualifying CO_2 Emission Offset Projects. The eligibility for certain EE measures, e.g. installing efficient lighting or replacing old appliances, is straightforward. Additionally, EE offsets may be allowed for fuel-switching to a less carbon-intensive fuel; no or low-carbon onsite power generation that replaces supply from the grid; and/or lessening emissions through energy efficiency for non-electric end uses.

Eligible parties. EE offset systems may choose to limit which parties are eligible for initially earning credits from EE offsets. For example, NSW GGAS limits the earning of credits from Demand-Side Abatement to the end-use customer or other party "liable to pay for the energy consumed by End-User Equipment"; GGAS does expressly allow the end-use customer to assign rights to a "nominated party" such as program implementers.

Location of activity. Schemes need to decide whether extra-jurisdictional EE measures are eligible. Doing so allows for additional opportunities, which may well be lower cost and/or more plentiful than EE opportunities within the regulating jurisdiction. However, two factors argue very strongly against allowing extra-jurisdictional EE: one, it is very difficult to monitor, measure and verify and therefore more likely to be non-additional, if not at least partially fraudulent; and two, the jurisdiction in which the EE activity takes place may have its own GHG regime that is incompatible with that of the regulated party.

Ineligibility. Offset systems often define what is ineligible to send a clear message to potential participants. Examples include measures that are earning credits in a renewable portfolio standard, have been funded in large part by government funds, are not readily quantified or expected to have sufficient permanence, or are completely informational in nature and impossible to quantify may be declared ineligible for earning offsets.

Facilitating Aggregation

The disperse nature of energy efficiency makes it perennially challenging to capture – very large in aggregate but often quite small for an individual party in a given period – a characteristic that is brought to the fore in EE offsets programs as they require new transactional costs (such as filing fees and the time and expense to prepare applications, maintain auditable records and legally clarify allowance ownership) that can swamp the financial value of the EE. Two important methods to reduce this problem involve aggregating the benefits, across parties and/or across time. The former can be done by allowing the "bundling" of projects from a single party into a single application; in fact the administrator of the EE offset program may choose to expedite filings that are pre-bundled, such as if they are part of an Energy Performance Contract. The latter is done by allowing the EE-generated allowances to be calculated and collected at the time of initial installation, based upon engineering estimates of the lifetime of the EE measure, rather than require the party to annually apply for allowances. In all cases, this problem is lessened if EE offset programs allow full fungibility both of EE-generated offsets and of the rights and responsibilities of the various program participants.

Conclusion

Energy efficiency offsets are likely to remain part of the debate on GHG cap-and-trade regimes because they provide the potential for large amounts of low-cost and flexible CO_2 mitigation. Before an EE offset scheme should be designed and adopted, two threshold questions must be addressed: one, are the administrative and transactional costs of such an approach too great to warrant the effort necessary to implement an EE offsets scheme and, two, are there more effective ways to optimize EE's role in mitigating CO_2 emissions that should be pursued first, or even in lieu of EE offsets. In developing an EE offset scheme a few caveats should be kept at the forefront. One, EE's dispersed nature demands that an emphasis be placed on facilitating aggregation and minimizing transaction costs. Two, our quarter century-plus of experience evaluating, measuring and verifying DSM and modeling utility grid performance provides an excellent understanding of several key design concerns (including end user behavior, additionality, and consumption and emissions profiles over time); however, it is not now nor ever will be perfect – and the bright spotlight of tradable credits will bring to the fore long-standing debates about measurement and quantification. In this regard, technological developments in advanced metering infrastructure (and perhaps other smart grid technologies) offer the potential to enhance the measurement and verification capability of EE programs, which could in turn raise the confidence that utilities and policymakers might place in program-induced energy savings. Three, the most vexing issue for EE offsets in a cap-and-trade scheme is that of double-counting which has solutions (i.e. deducting the quantity of the EE offsets out of the total allowed cap) that are analytically sound but politically challenging.

Going forward, the electric power industry and emissions trading systems would benefit from the development of a modeling framework that could account for the design elements identified in this paper to produce a quantitative relationship between EE activities and CO_2 impact. To provide a level of rigor necessary to pass muster with emissions trading regimes, such a framework would need to: (a) provide a credible basis for deemed energy savings of EE measures, that may include enhanced techniques for measurement and verification, (b) develop marginal CO_2 offsets as a function of EE deployment and generation mix, at (c) an appopriate level of system aggregation to best handle leakage and other secondary impacts (e.g. ISO-level).

References

American Council for an Energy-Efficient Economy and Alliance to Save Energy. "Comments of The American Council for an Energy-Efficient Economy and The Alliance to Save Energy on the Regional Greenhouse Gas Initiative Draft Model Rule." May 22, 2006.

California Measurement Advisory Council (CALMAC). http://www.calmac.org/

Chicago Climate Exchange (CCX). "Energy Efficiency and Fuel Switching Emission Offsets" www.chicagoclimatex.com/

Clean Air Act Amendments of 1990. 0 CFR 73.26. www.epa.gov/airmarkets/progsregs/arp/conserve.html

Database for Energy Efficient Resources (DEER). http://eega.cpuc.ca.gov/deer/Ntg.asp

Electric Power Research Institute. "The Power to Reduce CO_2 Emissions: The Full Portfolio, EPRI Discussion Paper" August 2007.

Government of New South Wales (Australia). "Greenhouse Gas Benchmark Rule (Demand Side Abatement) No. 3 of 2003." August 25, 2006.

H.R. 3221 "Renewable Energy and Energy Conservation Tax Act of 2007". Section 9611 "Federal Renewable Portfolio Standard".

IPART "Fact Sheet on NGACs from DSA"; GGAS Annual Report 2006, Section 4.3.

Nadel, Steven. "Energy Efficiency and Resource Standards: Experience and Recommendations" American Council for an Energy-Efficient Economy. February 2006. http://www.aceee.org/pubs/e063.htm.

Nemtzow, David, Dan Delurey, and Chris King. "The Green Effect: How Demand Response Programs Contribute to Energy Efficiency and Environmental Quality." Public Utilities Fortnightly, March 2007.

Stavins, Robert N., Judson Jaffe and Todd Schatzki. "Too Good to Be True? An Examination of Three Economic Assessments of California Climate Change Policy" January 2007.

United Nations Clean Development Mechanism. http://cdm.unfccc.int/

United States Environmental Protection Agency. "Cap and Trade: Essentials" http://www.epa.gov/airmarkets/cap-trade/index.html