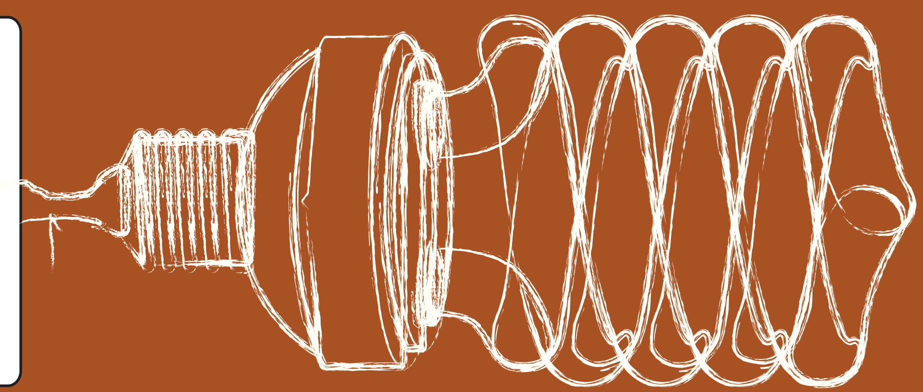
The Potential for **Energy Savings Certificates (ESC)** as a Major Tool in Greenhouse Gas Reduction Programs



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THE POTENTIAL FOR ENERGY SAVINGS CERTIFICATES (ESC)[1] AS A MAJOR TOOL IN GREENHOUSE GAS REDUCTION PROGRAMS

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EXECUTIVE SUMMARY

Energy Saving Certificate (ESC) is an instrument issued by an authorized body guaranteeing that a specified amount of energy savings has been achieved. Each certificate is a unique and traceable commodity carrying a property right over a certain amount of additional energy savings and guaranteeing that the benefit of these savings has not been accounted for elsewhere. The ESC represents the environmental and social attributes associated with the energy saved, just as a renewable energy certificate (REC) represents the environmental and social benefits associated with generating electricity from renewable energy.

Energy Efficiency Portfolio Standard (EEPS)* is a program that sets a specific target for energy savings to encourage more efficient generation, transmission, and use of electricity and natural gas. These targets may be achieved through a market-based trading system. EEPS programs often include a list of eligible energy saving measures that can be used to meet the savings target and may carry a fine or other penalty for non-compliance.

* These programs are also referred to as Energy Efficiency Resource Standards (EERS).

James Hansen, Director of the Goddard Institute on Space Studies and one of the foremost experts on climate change, has said that man has just 10 years to reduce greenhouse gas (GHG) emissions before global warming reaches what he calls a tipping point and becomes unstoppable.[3] Energy efficiency is a critical means to meeting a variety of policy goals - from increasing energy security to improving the standard of living of the poor to decreasing the human impact on the environment. Moreover, many

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[1] In Europe, Energy Savings Certificates are also referred to as "White Tags." However, because the term "White Tag" is trademarked in the United States, only the term ESC is used in this paper.
[2] Consultant to the Center for Resource Solutions
[3] CBS News, "Rewriting the Science: Scientist Says Politicians Edit Global Warming Research," produced by Catherine Herrick and Bill Owens, and aired March 19, 2006.

scientists and policymakers think that the best short-term strategy for making significant and rapid GHG reductions is to launch a massive program in support of energy efficiency.[4] Although energy efficiency has been a top agenda item for energy regulators and policy decision-makers for decades, it has not fully met its promise to deliver the level of reductions that experts believe could be realized.

Unfortunately, GHG cap and trade programs by themselves do not generally stimulate either energy efficiency or renewable energy for several reasons. For example, there is the widely held view that energy efficiency measures are unreliable, unpredictable, and unenforceable. One solution for overcoming some of these problems is to institute strong energy efficiency measurement and verification methodologies along with a credible tracking system that guards against double counting and identifies measures that meet additionality criteria.[5] Energy savings certificates (ESC) may be the necessary tool to make this link. ESCs may be particularly useful to attract investment in hard-to-reach sectors (such as rental buildings, and weatherization in low-income communities) as well as to attract investment in energy efficiency measures with long paybacks that have been slow to enter into the market.

In considering energy savings certificates, there are four primary ways that ESCs might be included as part of a GHG reduction program:

- As a method for verifying compliance with an energy savings target (such as an Energy Efficiency Portfolio Standard (EEPS) program);
- As a trading device (allowing ESCs to be bought, sold or traded) for parties required to meet an energy savings or GHG obligation;
- As a mechanism to demonstrate eligibility for tax incentives, subsidies or carbon offset programs; and

[4] "Energy End-Use Efficiency," Amory Lovins, InterAcademy Council, September 19, 2005. In this white paper presented to the InterAcademy Council (Amsterdam), a consortium of 90 national academies of science, Lovins' summarizes knowledge gained in the past three decades about using energy far more efficiently. Among the surprising insights: "very large energy savings can often cost less than small or no savings." This paper is available online at: http://www.rmi.org/sitepages/pid171.php#EnergyEff.
[5] Additionality is a criterion applied to GHG projects stipulating that project-based GHG reductions may only be quantified if the project or project activity "would not have happened anyway" (i.e., the project would not have happened under business as usual).

- Incorporating all of the above, wherever ESCs can be created and traded within a larger allowance, certificate or project credit trading regime where the ESC benefits are equal to or exceed their incremental costs.

Energy savings targets can be included as part of a GHG cap and trade program or as a supplement to such a program. When used as a supplement, energy savings targets can be part of a separate parallel program (e.g., energy efficiency portfolio standards) as they are in Europe and Australia, or incorporated as a distinct target within a renewable portfolio standard (RPS) as is the case, for example, in Connecticut. Moreover, energy efficiency savings that meet additionality standards and have not been claimed elsewhere could be sold/traded in the voluntary GHG emissions market.

However, because the use of energy savings certificates, especially in Europe, is most closely associated with control strategies requiring compliance with energy efficiency targets or meeting energy efficiency portfolio standards, this paper particularly looks at the ESC and EEPS programs.

Some of the major barriers to utilizing energy savings certificates include the problem of transaction costs. Instituting a rigorous system of energy savings evaluation, measurement and verification (EM&V) introduces additional costs, while at the same time, there are also benefits associated with greater certainty of the energy savings results that give these programs greater credibility. Though reporting and accounting costs can be perceived as a significant issue, one means of reducing them is to piggy-back on the automated computer systems currently in use for electric generation information, such as renewable energy certificate (REC) tracking systems or Generation Information Systems (GIS).[6] Since the incremental cost of adding additional fields to these tracking systems is relatively low, this could help lower accounting and reporting costs.

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[6] For example: the New England Generation Information Service (NE/GIS); PJM Generation Attribute Tracking System (PJM GATS): Midwest Renewable Energy Tracking System (M-RETS); Electric Reliability Council of Texas tracking system (ERCOT); and the Western Renewable Energy Generation Information System (WREGIS).

Because of the transaction costs associated with more rigorous EM&V, our investigation finds energy savings certificates might be most beneficially used for:

- Programs that require high levels of credibility such as:
    - Efficiency or GHG reduction targets that include significant penalties for non-compliance;
    - Programs where significant amounts of money are at stake such as, tax credits for capital intensive efficiency measures, carbon credits or GHG taxes;
- National or large regional programs where the use of ESCs for compliance purposes would significantly offset the administrative costs that would otherwise be required;
- Large, market-based programs that focus on the use of a trading scheme as a key compliance tool;
- Efficiency programs where the primary goal is obtaining as much energy savings as possible as rapidly as possible—including market transformation programs where the ultimate goal is to have everyone energy efficient;
- Measures with high initial costs such as new motors, processes and newer process technologies in the commercial and industrial sector, or whole building improvements, such as weatherization for low income ratepayers, or improvements for rental property, where third parties might be enticed into providing investment capital in exchange for the ESCs that might be produced.

A potentially significant negative aspect to ESCs is that they make energy savings a marketable commodity (rather than a public service or public good). As a commodity, the dictates of the market will tend to direct investment towards energy savings measures with the lowest cost, thereby deterring investments in projects that may have greater up-front costs, or longer payback periods, but would achieve potentially greater or broader energy savings.[7] These issues can be addressed through the careful design of an ESC program somewhat similar to the UK program that is reviewed in the full paper.

Our research and analysis found that the design of an effective energy efficiency program that uses ESCs must have the following elements:

- **Transparent rules and procedures:**
  In developing their rules and procedures, including any subsequent modifications or revisions, each of the ESC schemes that we examined made a concerted effort to make relevant materials available, usually via the Internet, and provided a process for the general public to review and comment. Based on public comments, drafts were reviewed and revised prior to issue. In addition, the results of audits and other program findings were also made available to the public.
- **Little or no proprietary information is withheld from the public:**
  We are not aware of any concerns over the release of proprietary information.
- **A measurement and evaluation system that ensures real, measurable, verifiable, and additional energy savings:**
  All ESC schemes that we reviewed provided a flexible approach for calculating energy savings for groups of measures (e.g., deemed/stipulated savings, or energy monitoring – Italy provides a good example). These approaches are based on international methods that have been tested in the field for over twenty-five years.
- **Independent third-party auditing for verification and compliance**:
  All ESC schemes that we reviewed included a third-party verification system to ensure credibility and accountability. For example, the Independent Pricing and Regulatory Tribunal of New South Wales conducts audits for verification and compliance.
- **A process for issuing and tracking certificates that avoids double counting:**

[7] One example is a home weatherization program for low-income households. Though no one has yet tried using ESCs as a way of attracting financing for these types of challenging applications, the authors believe this could be a very creative and fruitful use of ESCs.

All the ESC schemes that we reviewed included a process for issuing and tracking certificates. For example, the regulators in Great Britain and Italy -- along with the market operator -- are responsible for issuing and tracking the ESCs.

- **A system for detecting and penalizing noncompliance:**
  All ESC schemes that we reviewed incorporated penalties for noncompliance in their programs. For example, France and New South Wales had fixed penalties while the penalties in Italy and Great Britain varied depending on the circumstances.

With these elements in place, we believe that an energy efficiency program using ESCs can efficiently and effectively operate in the voluntary or mandatory market for energy savings, assist with integrated energy resources planning, and be included in a program to reduce GHG emissions.

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I. INTRODUCTION AND BACKGROUND

It is imperative that we take immediate action to mitigate climate change. The Stern report, released on October 30, 2006 by the government of the United Kingdom (UK), states that if climate change is allowed to continue unmitigated, the related costs could devour as much as 20 percent of the world's gross domestic product.[8] Success in slowing carbon emissions could bring great savings to the world economy, possibly in the range of $2.5 trillion a year.[9]

More recently, the Intergovernmental Panel on Climate Change (IPCC), an international body headed by the United Nation Environment Programme and the World Meteorological Organization, issued its assessment confirming the scientific basis for the reality of global climate change. Among its most important findings, the IPCC assessment noted that the negative impacts of the current rate of global warming will intensify and accelerate throughout this century, and that it is critical that actions now be undertaken to mitigate climate change's negative consequences to ecosystems, habitat and population.[10] James Hansen, Director of NASA's Goddard Institute on Space Studies and one of the foremost experts on climate change, is more direct, saying man has just 10 years to reduce greenhouse gases (GHG) before global warming reaches what he calls a tipping point and becomes unstoppable.[11]

Corporate and citizen awareness of climate change in the United States has reached an all time high. In the absence of clear federal policies, local and state governments and Fortune 500 corporations now lead in promoting energy efficiency, greater use of clean and renewable energy

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[8] Sir Nicholas Stern, Stern Review on the Economics of Climate Change, HM Treasury, (London, October 30, 2006), http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

[9] Heather Timmons, Britain Warns of High Costs of Global Warming, (New York Times, October 31, 2006) at: http://www.nytimes.com/2006/10/31/world/europe/31britain.html?ref=world

[10] The Intergovernmental Panel on Climate Change, Fourth Assessment Report: The Physical Science Basis: Summary for Policymakers, Paris, 2007; Elizabeth Rosenthal and Andrew Revkin, Science Panel says Global Warming is 'Unequivocal,' (New York Times, February 3, 2007), p.1.

[11] CBS News, Rewriting the Science: Scientist Says Politicians Edit Global Warming Research, Produced by Catherine Herrick and Bill Owens, aired March 19, 2006, http://www.cbsnews.com/stories/2006/03/17/60minutes/main1415985.shtml

sources and other GHG emissions reduction strategies. An increasing number of businesses and institutions are voluntarily reducing or offsetting their GHG emissions footprint[12] and a dozen or more states are considering market-based "cap-and-trade" programs[13] as a means to implement GHG emissions reductions.

In general, GHG cap and trade programs by themselves do not achieve either greater savings from energy efficiency or increased generation for renewable energy sources. This is, in part, the result of a flawed design of such programs: emissions targets and allowances are aimed predominantly at large emitters, and, as a result, renewable energy projects, for example, do not qualify for allowances or contribute to reducing the overall emissions cap.[14] A recent European Commission paper says that "the EU ETS [European Union's Emission Trading Scheme] by itself is insufficient to stimulate end-use energy efficiency and significant amounts of renewable energy deployment… Under these circumstances one may wish to seek *additional means* to get more energy savings." [15]

Reductions in energy consumption and emissions achieved by energy efficiency should be considered an important element of energy management and resource planning. Effective energy efficiency programs can meet a wide variety of policy goals including increasing energy system reliability, reducing energy use and lowering consumers' electric bills, and lessening negative impacts on the environment. In the United States, energy efficiency has traditionally been a mandate that states place upon utilities and that are paid for by ratepayers and consumers.

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[12] Case studies on innovative waste reduction activities that reduce global climate change are found at the U.S. Environmental Protection Agency's Waste Wise, Climate Change Case Studies, (October 2004), at: http://www.epa.gov/wastewise/climate/pubs.htm . The following 'Waste Wise' partners are featured: Target Corporation, Eastman Kodak Company, Xerox Corporation, Pepco, Springs Industries, and Crown Holdings.

[13] Such programs consist of GHG emissions being capped at or near current levels and reduced over time. In the case of the Northeast Regional Greenhouse Gas Initiative (RGGI), emissions allowances are issued to the large emitters (i.e., utilities and industrial users). Allowances can be traded. Caps are reduced over time and financial penalties result from non-compliance. Details on RGGI are available at: http://www.rggi.org.

[14] During RGGI's stakeholder process, the Center for Resource Solutions (CRS) raised the issue of this design flaw. When renewables projects were left out of the allocation plan, CRS recommended that state policymakers consider allowing renewables projects to contribute to emissions reductions by reducing the overall cap—effectively "taking it off the top." RGGI Initiative, op. cit.

[15] Paolo Bertoldi and Silvia Rezessy, Tradable Certificates for Energy Savings, European Commission, Ispra, Italy (2006), pp.21-22.

Although energy efficiency has been promoted by energy regulators and policy decision-makers for some time, it has yet to fully meet its promise and achieve the expected level of energy reductions. There are several reasons for this. First, there is the widely held view that energy efficiency measures are unreliable, unpredictable, and unenforceable, and, therefore, energy efficiency cannot be relied upon as a utility system resource.[16] This mistaken view has been around for a long time despite contrary findings by industry analysts. In fact, energy efficiency programs are sufficiently reliable, predictable, and enforceable to allow demand-side management to be incorporated as a utility system resource.[17]

A second reason is that investing in energy savings is often seen as less attractive than investing in supply-side technologies. In part, this is due to the fact that energy efficiency measures often focus on facilities and systems already in place and do not involve major new construction or installation projects. For example, boiler insulation or installing more efficient lighting are nearly invisible improvements when compared to investing in a new wind farm or arrays of photovoltaic roof panels.

Further, because energy savings opportunities are so diverse and often found in small increments, there has not been an efficient mechanism for aggregating the savings. Lastly, a financial tool to support the widespread selling and trading of energy savings in the marketplace is not yet available. In order to capture the large-scale carbon reduction savings associated with a major push toward energy efficiency as a key GHG mitigation strategy, these misconceptions and barriers would need to be overcome.

In the past few years, however, important changes have taken place that signal opportunities for more widespread commitment to energy efficiency strategies: (1) The creation and rapid growth

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[16] E. Vine, M. Kushler, and D. York, Myth #10: Energy Efficiency Measures are Not Reliable, Predictable, or Enforceable, Energy and American Society: Fourteen Myths, edited by B. K. Sovacool and M. A. Brown, Springer Press, NY. (2007, pp. 265-287**).** Other misconceptions that affect the support of energy efficiency are also discussed in this volume.
[17] Ibid.

of the renewable energy certificates (RECs) market in North America quantifying the benefits associated with renewable energy;[18] (2) the creation and implementation of tracking systems to issue and track RECs;[19] (3) improved methods for measuring and verifying energy savings; (4) the development in Europe of the concept and a market for "white certificates" or energy savings certificates (see below); and (5) the increased awareness in the United States of the threat of climate change, and the growing interest on the part of local and state governments, businesses, institutions and private citizens in taking early actions to reduce GHG emissions, including individual GHG footprints.[20]

An Energy Savings Certificate (ESC) is an instrument issued by an authorized body guaranteeing that a specified amount of energy savings has been achieved.[21] Each certificate is a unique and traceable commodity carrying a property right over a certain amount of additional energy savings and guaranteeing that the benefit of these savings has not been accounted for elsewhere.

Countries implementing, or considering the implementation of ESCs, are in fact aiming to meet the requirements of the Kyoto Protocol, [22] and many scientists and policymakers think that the best short-term strategy for making significant and rapid GHG reductions is to launch a massive

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[18] There is currently a voluntary market for renewable energy, which represented approximately 12 million MWhs of RECs sold in the U.S. in 2005. This has been a very robust market that has increased exponentially every year since it first began in 2001/2 when approximately 180,000 MWh of RECs were sold. At that time, the majority of the purchases were from residential customers. In 2006, the majority of the purchases were from non-residential customers. For more information, see Green-e Verification Reports for 2002 through 2005, Center for Resource Solutions, San Francisco, CA at: www.resource-solutions.org/index.htm .

[19] Meredith Wingate, Design Guide for Renewable Energy Certificate Tracking Systems, National Wind Coordinating Committee, Green Markets and Credit Trading Work Group, (June 2004).

[20] For example, California climate change policy and programs are listed at: http://www.climatechange.ca.gov/policies/index.html. One example of an effort to offset individuals' GHG emissions is TerraPass, which states on its website that it: "helps individuals easily and affordably balance the environmental impact of their driving, flying and home energy use by purchasing carbon offsets." See http://www.terrapass.com.

[21] The following terms are used interchangeably: white tags, white certificates, energy efficiency certificates, and energy savings certificates. To be consistent, the term energy savings certificates, or ESC, is used throughout this paper.

[22] Amory Lovins, Energy End-Use Efficiency, presentation to InterAcademy Council, September 19, 2005. In this white paper presented to the InterAcademy Council (Amsterdam), a consortium of 90 national academies of science, Lovins summarizes knowledge gained in the past three decades about using energy far more efficiently. Among the surprising insights: "very large energy savings can often cost less than small or no savings." This paper is available online at: http://www.rmi.org/sitepages/pid171.php#EnergyEff.

program in support of energy efficiency. One approach is to institute strong energy efficiency measurement and verification methodologies along with a credible tracking system that guards against double counting and identifies measures that meet additionality criteria.[23] ESCs may be a necessary tool in order to make this link.

Under a scheme that uses ESCs, energy suppliers have to save a given quantity of energy, or, if they are short of their target, to buy ESCs from other suppliers. Likewise, suppliers who have achieved greater energy savings than required are allowed to sell 'surplus' ESCs to those who are short of their target. Generally, energy savings are obtained from consumers' dwellings or facilities. Suppliers typically use three approaches to generate ESCs: (1) fund energy savings programs directed at their customers, (2) contract with appliance retailers who increase their sales of energy efficiency goods in exchange for funding from the energy supplier, and/or (3) use programs conducted by energy service companies (ESCOs).

Among the rationales put forward in support of the use of ESCs and other market-based instruments are: (1) they can provide a rigorous framework for claiming energy efficiency savings; (2) they act as a credible trading tool that can equalize the marginal costs spent on complying with an energy-savings (or GHG reduction) target; (3) under certain circumstances, an ESC scheme creates incentives for and improves the performance of energy savings programs;[24] and (4) ESCs may be particularly useful for attracting investment in hard-to-reach sectors, such as rental buildings and low-income communities, as well as to attract investment in energy efficiency measures with long paybacks that have been slow to enter into the market.

Since obligated parties have different marginal costs of compliance associated with energy savings or GHG reduction targets, and provided that transaction costs are not excessive to undermine the potential benefits of the scheme, equalizing marginal costs through trading is expected to be beneficial:

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[23] Additionality is a criterion applied to GHG projects stipulating that project-based GHG reductions may only be quantified if the project or project activity "would not have happened anyway" (i.e., the project would not have happened under business as usual).
[24] Wingate, Design Guide*,* p.35.

> Apart from complying with this requirement and often being more acceptable than, for instance, taxation, market-oriented schemes are likely to change mindsets. Harnessing market forces to deliver energy savings may thus focus the attention of businesses on the economic benefits of demand-side energy efficiency and energy services and hence stimulate both investments and the ESCO [Energy Services Company] industry." [25]

We have found that a significant barrier to the use of ESCs is the problem of transaction costs. For example, instituting a rigorous system of energy savings measurement, evaluation and verification introduces additional costs on the system's participants. However, these costs are necessary, since the greater certainty of the energy savings results provided by ESCs increases a program's credibility and trust. Therefore, for financial incentive programs and for programs with targets set by regulation with financial penalties for non-compliance, the benefits from ESCs can exceed any incremental transaction costs. Moreover, any incremental costs will be further offset by the added market flexibility afforded by ESCs and by providing a market instrument that guards against double counting/selling of the energy savings.

A potentially significant negative aspect to ESCs is that they make energy savings a marketable commodity, rather than a public service or public good. As a commodity, the dictates of the market will tend to direct investment towards energy savings measures with the lowest cost, thereby deterring investments in projects that may have greater up-front costs, or longer payback periods, but would achieve potentially greater or broader energy savings.[26] These issues can be addressed through the careful design of an ESC program.

To sum up, ESCs are a subset of market-based policy instruments that are favored for their economic efficiency and competition benefits, for improving credibility of energy savings measurement and verification, for providing positive incentives for cost reduction, and for continuous improvement and ability to minimize costs of compliance with policy targets—the market is left free to identify the least-cost options.

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25 Ibid

[26] One example is a home weatherization program for low-income households.

In considering ESCs, there are four primary ways that energy savings certificates might be included as part of a GHG reduction program:

- As a method for verifying compliance with an energy savings target (such as an EEPS program);
- As a trading device (allowing ESCs to be bought, sold or traded) for parties required to meet an energy savings or GHG obligation;
- As a mechanism to demonstrate eligibility for tax incentives, subsidies or carbon offset programs; and
- Incorporating all of the above, wherever ESCs can be created and traded within a larger allowance, certificate or project credit trading regime where the ESC benefits are equal to or exceed their incremental costs.

Energy savings targets can be included as part of a GHG cap and trade program or as a supplement to such a program. When used as a supplement, energy savings targets can be part of a separate parallel program (e.g., Energy Efficiency Portfolio Standard) as they are in Europe and Australia, or incorporated as a distinct target within a renewable portfolio standard (RPS) as is the case, for example, in Connecticut. Moreover, energy efficiency savings that meet additionality standards and have not been claimed elsewhere could be sold/traded in the voluntary GHG emissions market.

However, because the use of ESCs, especially in Europe, is most closely associated with control strategies requiring compliance with energy efficiency targets or meeting energy efficiency portfolio standards (EEPS), this paper will particularly look at the ESC and EEPS programs.[27]

Following this introduction, the whitepaper is organized as follows:

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[27] An Energy Efficiency Portfolio Standard (EEPS) is a program that sets a specific target for energy savings to encourage more efficient generation, transmission, and use of electricity and natural gas. These targets may be achieved through a market-based trading system. EEPS programs often include a list of eligible energy savings measures that can be used to meet the savings target and may carry a fine or other penalty for non-compliance. EEPS programs are also referred to as Energy Efficiency Resource Standards (EERS).

- Section II reviews the experience and current status of ESC and EEPS programs in Europe, New South Wales, and the United States.
- Section III explores measurement and verification issues addressed in the ESC schemes in Europe and New South Wales.
- Section IV examines the experience with renewable energy certificate (REC) reporting, tracking, and accounting systems to see if there are experiences that might be transferred to ESCs.
- Section V evaluates the potential opportunities for complementary demand-reduction technologies, such as solar water heating, geothermal heat pumps, district heating, combined heat and power, and renewable thermal power (i.e., waste heat at biomass facilities), to be incorporated into a comprehensive GHG emissions reduction strategy.
- Section VI discusses the policy opportunities for using ESCs in the United States to encourage energy savings at local, state and national levels.
- Section VII summarizes the barriers and issues identified in the earlier chapters, with a particular focus on transaction costs, evaluation, measurement and verification (EM&V) costs, cream skimming, emissions trading, energy savings targets, integrating RECs and ESCs, ownership of ESCs, and double counting/selling.
- Section VIII and Section IX are the concluding sections. Here, we discuss significant issues and barriers to ESC schemes and lay out a roadmap for overcoming these problems. We include a list of principles for governing ESCs, strategies for balancing and reducing transaction costs, and we present suggestions for integrating ESCs into GHG reduction programs.

II. ENERGY SAVINGS CERTIFICATES

Energy savings certificates are a tool that can be used with a variety of programs. In conducting our review, we have identified the following features as fundamental to the use of ESCs as a program tool:

1) The rules and procedures for issuing ESCs must be transparent with relevant information made publicly available while discouraging gaming and fraudulent claims.
2) Programs that use ESCs must be as inclusive as possible (e.g., allow for broad participation) and support environmental justice.
3) Programs that use ESCs must be designed in a manner that does not exacerbate lost opportunities (e.g., neglecting energy-efficient new construction), undermine special needs (e.g., avoiding investment in low-income households), or make it more difficult to justify longer payback energy efficiency investments (e.g., whole house retrofits).
4) Technical provisions must ensure real, measurable, verifiable and beyond business-as-usual (i.e., additional) energy savings.
5) A mechanism for the independent verification of the savings must be built into the system.

However, despite their usefulness, ESCs are not in wide use. New South Wales (Australia) instituted the first program in 2003, and, since then, programs have been started in a few European countries: first in Italy, followed by Great Britain, and most recently in France. In this section, we discuss in some detail the experiences to date of these countries implementing their ESC strategies.

The European Context

The European Commission (EC) has been very active in promoting energy efficiency in Europe. In 2005, it published the "Green Paper on Energy Efficiency" that stated that by 2020 the

European Union could save at least 20 percent of its energy consumption in a cost-effective manner, listing several options to meet this goal.[28] And in 2006, the Commission issued its "Directive on Energy End-Use Efficiency and Energy Services" promoting energy efficiency and the market for energy services.[29]

As part of the discussion leading up to the Directive on Energy End-Use Efficiency, non-governmental organizations (NGOs) argued that "white tags are a good scheme and should be supported and further implemented at the EU level." [30] The EC staff agreed and recommended that the "implementation or extension of white tag schemes should be done carefully and consistently with existing measures, bringing added value and not duplicating." [31] As a result, the Directive stated that at the end of the third year of its implementation, the Commission will discuss the opportunity to introduce a white certificate system at the European level. The Directive is expected to enter into force in 2008. [32]

As a result, Italy, followed by Great Britain and France, has introduced ESCs to promote energy efficiency investments as a cornerstone of a sustainable energy policy.[33] The programs are just beginning, so only very preliminary results are available.

In Europe, the demand for ESCs has been driven by establishing compulsory national energy savings targets[34] aimed at increasing national and European energy security, meeting GHG emissions reduction targets set forth in the 1997 Kyoto Protocol, and reducing the burden on the poor.

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[28] European Commission, Green Paper on Energy Efficiency: Doing More with Less, (Brussels, June 2005).
[29] European Commission, Directive 2006/32/EC of the European Parliament and of the Council on Energy End-Use Efficiency and Energy Services and Repealing Council Directive 93/76/EEC, (Brussels, April 5, 2006).
[30] European Commission, Report on the Analysis of the Debate of the Green Paper on Energy Efficiency, Staff Working Document, (Brussels, 2006).
[31] Ibid.
[32] European Commission, Green Paper on Energy Efficiency: Doing More with Less, (Brussels June 2005).
[33] In the Flemish region of Belgium, there are savings obligations imposed on electricity distributors without the certificate trading option. Denmark and the Netherlands are discussing the possibility of an ESC trading system.
[34] Measured in tons of oil equivalent saved [toe]. A toe is the energy content of one ton of oil.

Italy

Italy currently has the only fully-fledged tradable, ESC system in the world. [35]
It has established a goal of reducing its energy intensity (energy use per gross domestic product) by 2 percent per year until 2015, and then scaling up to 2.5 percent per year until 2030.[36]

In 2001, the Italian Ministry of Industry established an obligation for gas and electric distribution companies with more than 100,000 customers in 2001 to achieve specific annual energy savings targets during a five-year period from 2005-2009. Italy's Regulatory Authority for Electricity and Gas (AEEG) designed the program, and the Italian scheme for ESCs became operational in January 2005.

In the Italian Scheme, the energy savings targets increase in stringency each year over the 2005-2009 period. The mechanism is planned to deliver energy savings equivalent to 5.8 million toe (Mtoe) in the five-year target period. Total electricity savings could amount to nearly 14 TWh, while natural gas savings could total about 3.3 billion cubic meters. Italian targets are just for savings achieved each year, and do not include expected savings in the future.

The program allows energy service companies (ESCOs) to also earn credits and sell them to distribution companies in order for the latter to meet their targets. Distribution companies can reduce energy use in several ways: (1) implement energy efficiency programs for their own customers or for customers of other distributors; (2) jointly operate programs with ESCOs, product manufacturers, installers, or financial institutions; or (3) buy ESCs from third parties.

Projects in all end-use sectors are eligible. At least 50 percent of the target set for each single year needs to be achieved by reduction in the electricity and gas use supplied to electricity and

[35] For more information on the Italian Scheme, see: P. Bertoldi, Energy service companies and white certificates: The use of market forces to unlock investments in energy efficiency, presented at the International Energy Efficiency Conference, (London, Nov. 2, 2005); and other sources cited in the text and in the References: Bertoldi and Rezessy (2004, 2006), Bertoldi et al. (2005), International Energy Agency (2006), Malaman and Pavan (2002), Pavan (2002, 2004, 2006b), and Rezessay et al. (2006)..
[36] In Italy, as in other countries, reductions in energy intensities are seen as one metric for reducing GHG emissions.

gas users. This stipulation is commonly referred to as the "50 percent constraint." The remaining target share can be achieved by primary energy savings in all of the other end-use sectors.

The trading of certificates represents the market-based component of Italy's energy efficiency efforts. As discussed earlier, the certificate is a market instrument that carries a property right over a certain amount of saved energy and ensures that the benefits of these savings have not been accounted for elsewhere. While the energy savings targets are annual targets, under Italy's trading system, ESCs are valid for up to 5 years.[37] If the obligated parties fall short of their targets, they must pay a penalty for non-compliance. However, the penalty only avoids one year of non-compliance, not the full five years for which measures must be maintained. Therefore, in some cases, the shortfall must be made up in subsequent years.

Based on the results of previous measurements, calculations and evaluation studies, specific demand savings values are recognized for specific energy-saving measures and are accepted as "deemed savings" values. Deemed savings measures are being steadily added to the Italian program. In other cases, savings can be estimated using engineering approaches developed by the regulators. This allows for new project ideas to be developed and submitted to regulators for a pre-implementation "qualitative check," but final savings estimates must be submitted and approved following project implementation.

To illustrate the Italian Scheme, we list some of the eligible measures developed by the Government, including measures for which deemed savings values were set by the regulator:

- Electric motors and their applications
- Lighting systems
- Reduction of stand-by power[38]
- Reduction of electricity consumption in thermal uses

[37] The Italian targets assume that measures will be in place for five years and imply an obligation to maintain the measures for at least five years.
[38] A surprisingly large number of electrical products -- from air conditioners to VCRs -- cannot be switched off completely without being unplugged. These products draw power 24 hours a day, often without the knowledge of the consumer. We call this power consumption "standby power." For more information, see http://standby.lbl.gov.

- Reduction of air conditioning electricity consumption
- Promotion of high efficiency electric appliances in offices and homes
- Substitution of electricity to other energy sources with reduction of primary energy consumption
- Heating/cooling and heat recovery in buildings supplied with non-renewable fuels
- Development of renewable energy sources at users' premises
- Promotion of electric and natural gas vehicles
- Campaigns for education, information, and promotion of energy efficiency

Only investments in energy efficiency technologies, which are referred to as "hard measures," are included in Italy's system. "Soft measures," such as behavioral changes, are not eligible. Public information campaigns are eligible only if they are connected to specific hard measures.

While the maximum lifetime of most eligible projects is 5 years, for the following measures, the lifetime is extended to 8 years since they are very likely to stay in place for that length of time:

- Thermal insulation of buildings
- Control of radiation entering through windows during the summer
- Bio-climatic architecture
- Passive cooling
- Solar water heating

Additionality is a key issue in the Italian ESC program. Only savings that are achieved over and above market trends and legislative requirements are counted against the Italian targets. We discuss additionality in more detail in Section IV.

As stated above, the Regulator (AEEG) implements the trading scheme. Certificates can be issued only after authorization by the Regulator. One ESC is equivalent to 1 toe, and can be banked within the 5-year compliance period. ESCs can be traded bilaterally, or through an organized, official market managed by the Electricity Market Operator (GME) according to rules and criteria approved by AEEG. The GME issues and registers ESCs upon specific request by AEEG, organizes market sessions, and registers bilateral over-the-counter (OTC) contracts in a Registry. Once they have been entered in the Registry, the ESCs are available for trading. ESCs are issued to all distributors and their controlled companies, and to energy service providers, including ESCOs.

Provided that all legal and technical requirements are met, any interested party can participate in the spot market and have an account in the Registry to record certificates bought and sold. Each party must pay an annual fee that covers the costs borne by the Electricity Market Operator to administer the Registry, and for the market sessions where trading of ESCs occurs. There is a basic fee plus a variable charge for each certificate transaction, including those of bilateral contracts. Market sessions are held at least once a month during the year, and at least once a week in the four months prior to the annual compliance check. Market rules include procedures to ensure the integrity of the market to both sellers and buyers—each participant is allowed to sell only the certificates that are registered on their account, and certificates are transferred from the seller's account to the buyer's account only upon payment of the total value of the transaction. Aggregate data on the ESC trading scheme are published once a year in the Regulator's Annual Report.

In the Italian scheme, there are three types of ESCs differentiated in terms of: (1) electricity savings, (2) natural gas savings, and (3) reductions in fossil fuels due to fuel switching, but only if combined with energy efficiency improvements. Banking of certificates is allowed throughout the 2005-2009 period, and certificates issued in any of these five years can be used to meet the targets set for the period. Energy savings achieved by "early actions" from projects developed in 2001-2004, the four years prior to the implementation of scheme, are considered to be market eligible, subject to the Regulating Authority's approval. There are no restrictions on banking. However, because of concerns about long-term compliance borrowing of ESCs is not allowed.

Monthly trading sessions started in 2005, and the first weekly trading sessions were held in March 2006 and continued until the end of May; the first compliance check was made in early June. Trading was found to be at a level significantly more than the annual target (approximately 1 million toe, or 86 MWh). However, while OTC trades were strong, marketplace trading was lower than expected with only a few thousand certificates exchanged during the sessions.[39]

Because the obligated distributors had, on average, fewer certificates than they needed to meet their obligation, there was a larger share of trading during the second week of May, prior to the first compliance check. This also reflected the prevailing strategy of obligated distributors who have tended to rely on the market to buy certificates from third parties instead of developing their own energy efficiency projects. At the first weekly trading session in March 2006, the price for ESCs started out at 80 Euros/certificate (105 USD/certificate, or approximately $0.01/kWh); the most recent numbers have averaged 80-85 Euros/certificate. The compliance check with the 2005 targets was made by the Regulator in early June 2006, as required, and found that the national target was met, including the 50 percent constraint, and banked certificates owned were in excess of the first year's target. [40]

Since January 1, 2005, AEEG has received more than 350 requests for the verification and certification of energy savings, drawn from 1,100 energy saving projects. The energy efficiency projects are expected to save, at least, 155,000 toe: 97,854 toe for electricity distributors, and 58,057 toe for natural gas distributors. Looking more closely, about 40 percent of the projects submitted to the AEEG were performed by electricity and gas distributors, usually in conjunction with third parties (e.g., equipment manufacturers, installers, and ESCOs), while the other 60 percent of the projects were performed directly by ESCOs accredited by the Regulatory Authority. This distribution reveals the potential for market and OTC trading, both prior to the first compliance check and in years following.

[39] Personal communication with Marcella Pavan, Dec. 4, 2006.
[40] Ibid.

The Regulator authorized the Electricity Market Operator to issue certificates equal in volume to the certified energy savings. In June 2006, the AEEG completed its evaluation and certification of ESCs, amounting to a total savings of about 280,000 toes.[41] About 75 percent used default savings estimates (otherwise known as deemed or stipulated savings) established by the Regulatory Authority, 21 percent used engineering estimates with some metering, and only 4 percent used monitored savings. Popular measures in the first year included cogeneration, district heating improvements, and public lighting projects.

The Italian approach reflected the importance of having reliable but simplified energy savings calculation techniques and verification rules for starting and promoting the development of the scheme.

Table 1 shows energy savings achieved from the following accredited systems/end uses:

Table 1: Percent of Savings by Sector in Italy

System providing savings	**Percent of energy savings (%)**
Generation and distribution systems for various energy carriers (e.g., systems for natural gas decompression, cogeneration, district heating)	29
Household electricity consumption (e.g., lighting systems, electric water heaters, small PV systems, white goods, heating pumps, air conditioning systems)	28
Heating energy consumption in households and the commercial sector (e.g., boilers and water heaters, wall insulation and double glazing, solar systems for heating water)	20
Public lighting (e.g., street lighting)	19
Industrial energy consumption (e.g., high efficiency industrial motors, variable speed drives)	5

Because the AEEG found that with the overall energy savings target for Italy's electricity distribution sector and its natural gas sector were achieved, a surplus of ESCs could be "banked" for the following years. The largest part of these savings came from "early actions" (the crediting of energy efficiency measures that were installed prior to the start of the program – from as early

[41] Ibid.

as 2001). It is important to reiterate, that because the crediting lifetime for the majority of eligible projects is limited to 5 years, a very large amount of energy savings certificates will be released in the first few years of Italy's program. Therefore, as it proceeds, the program's increasing stringency of its targets will produce an increasing need for new certificates. This, in turn, will require more new eligible energy efficiency projects in order to obtain sufficient savings to meet the future targets.

Great Britain

In Great Britain, the Energy Efficiency Commitment (EEC) is similar to a scheme for ESCs, [42] and is broadly similar to the later phases of the Energy Efficiency Standards of Performance that existed in Great Britain from 1994 to 2002. [43] And, although ESC trading is not allowed in a fully realized form, Britain's' EEC serves as a good framework for examining energy savings certificates.

The EEC currently runs in 3-year cycles from 2002 to 2011, and there is now a policy commitment to extend some form of obligation on suppliers to 2020[44]. In 2001, the "Energy Efficiency Commitment" was developed by the government and passed by Parliament, requiring electricity and gas suppliers achieve targets for energy efficiency. The program is administered by the Office of Gas and Electric Markets (Ofgem – the regulator of gas and electricity markets in Great Britain), and the rules were developed by the Department for Environment, Food, and Rural Affairs (DEFRA).

Under the program, specific demand savings values are recognized for many specific energy-saving measures, based on the results of previous measurements, calculations, and evaluation

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[42] For more information on Great Britain, see: Bertoldi, (2005), and other materials cited in the text and in the References: Bertoldi and Rezessy (2004, 2006), Bertoldi et al. (2005), Costyn (2002), IEA (2006), Ofgem (2004, 2005, 2006), and Rezessy et al. (2006).
[43] Personal communication with Nick Eyre, Feb. 6, 2007.
[44] Ibid.

studies. Moreover, one-half of the savings must be achieved from projects focusing on homes inhabited by low- and moderate-income families.

Electricity and gas suppliers, which are primarily deregulated entities that compete against each other to provide services to end-use customers, operate different energy-saving programs. The suppliers operate these programs both directly and by contracting with third parties and they then track the measures installed and the savings achieved. Because energy savings can be achieved in homes served by other suppliers, many suppliers have contracted with housing agencies, appliance and boiler manufacturers, distributors and vendors, and other third parties to deliver energy savings. Electricity and gas suppliers are required to report their energy savings results to Ofgem on a quarterly basis using the standardized spreadsheet Ofgem developed. Ofgem periodically audits supplier processes and hires firms to inspect a sample of homes and verify measures are being installed as claimed.

Although EEC regulations do not provide for certificate trading, there is some flexibility. With written agreement from the regulator, suppliers may trade among themselves energy savings achieved from approved measures, or obligations. Spot trading however, is not permitted.

In addition, should the linkage between excess energy savings and carbon savings be formalized, British energy suppliers could conceivably trade achieved energy savings into the small and voluntary British national emission trading scheme, or into the European Union's Emissions Trading Scheme (EU ETS), which is mandatory for large emitters in the European Union. However, as of now, the linking of carbon savings to these emission trading schemes has yet to be formalized. Moreover, this issue may be moot; because the value of energy savings to the suppliers is greater in the EEC than in either emissions trading scheme, all suppliers have chosen to carry over savings between cycles.

The first cycle (EEC-1, 2002-2004) required all gas and electricity suppliers with 15,000 or more domestic customers to deliver a certain quantity of "fuel standardized energy benefits" by assisting their customers to undertake energy-efficiency measures in their homes. Energy savings targets are expressed in fuel-standardized terawatt hours (TWh), with the number of kWh multiplied by an appropriate adjusting factor: [45]

Coal	by 0.56
Electricity	by 0.8
Gas	by 0.35
LPG[46]	by 0.43
Oil	by 0.46

Under the ECC, projects related to electricity, gas, coal, oil, and LPG are allowed. In the first cycle, the overall savings target required that, when compared to 2002 levels, savings equal to 63 fuel-standardized TWh[47] must be achieved by March 2005. The target represented the cumulative energy savings over the lifetime of the measures discounted at 6 percent., and is equivalent to an annual average 1 percent reduction in carbon emissions from all households. As noted above, the suppliers were required to target at least 50 percent of their energy savings efforts to low- and moderate-income households.[48] This "priority group" is about 7.7 million households, and includes pensioners aged 60 or over, occupants of social housing, recipients of disability benefits, or households receiving benefits with children under the age of 16. The remaining 50 percent of households are higher income consumers, and a portion of their bills contributes to paying some of the costs of the energy efficiency measures.

As system administrator in the British system, Ofgem is responsible for setting each supplier's individual targets based on its individual market shares; overseeing suppliers' activity; managing

[45] The weighting is essentially a carbon weighting of different energy sources. Until 2006, the primary legislation did not allow targets to be set in terms of carbon, hence, this system of "fuel-weighted energy savings." Ibid.
[46] LPG stands for Liquefied Petroleum Gas and is a mixture of hydrocarbon gases used as a fuel in heating appliances and vehicles.
[47] This equals approximately, 62 billion kWh. Energy savings are discounted over the lifetime of the measure and then standardized according to the carbon content of the fuel saved.
[48] Defined as families receiving low income benefits or tax credits.

the project evaluation and approval processes; verifying savings; managing data; and, reporting progress.

To be eligible for the regulation scheme, all energy efficiency measures must be approved by Ofgem. The regulator has defined a number of standard energy efficiency measures that can be accepted for fulfilling the obligation, for example:

- Insulation of attics, walls, and water heaters
- High efficiency hot water tanks
- Window glazing
- Lighting measures
- Heating measures: boilers, heating controls, solar water heating, heat recovery ventilation, ground source heat pumps
- Energy efficient appliances
- Combined heat and power
- Fuel switching

It is possible for a supplier to use a newer and/or more innovative scheme that is not contained in the list of standard measures, but to do so requires independent verification.

The energy savings achieved by the above standard measures are stipulated in a Technical Guidance Manual (see below). New and innovative measures that are not contained in the list of standard measures are still possible but require independent verification. The total energy savings projected over the lifetime of the energy efficiency measure are discounted and credited for the commitment period (e.g., savings expected over a measure with a 20-year lifetime are credited upfront over a 3-year commitment period).[49] This allows transaction costs to be minimized, since nobody has to track the savings from every measure over its whole lifetime. This also provides maximum support to longer lifetime measures. In other words, if only three years of the 20 years of savings were credited, there would be no incentive for (or interest in) including longer lifetime measures.

[49] Discounting means that expected savings in future years are discounted back to the date of installation.

Ofgem produced a Technical Guidance Manual for EEC-1 that provided information on the factors that needed to be accounted for in quantifying energy savings from particular measures, and guidelines on the best practices to follow. Information is provided for each energy efficiency measure on the basis of the annual energy savings figures, the lifetime of the measure over which the energy savings can be claimed, and the technical standards for the delivery or installation of the measure.[50]

The first commitment period covered Spring 2002 to Spring 2005, and required achieving energy savings of 63 TWh (billion kWh).[51] Twelve suppliers were given savings targets, and with the exception of two suppliers who stopped installing measures due to administrative problems, the suppliers met their EEC targets.[52] While committed suppliers were allowed to trade commitments, no trades occurred. Finally, the requirement that 50 percent of the target savings efforts be focused at Priority Group households was achieved. Over the first commitment period, achieved energy savings totaled 87 TWh, exceeding the goal by 40 percent. Of this total, nearly one-half (40 TWh) was achieved in the third year of the program.

Looking at the 87 TWh of savings achieved in ECC-1, the largest share of savings (56 percent) came from building insulation measures. There were numerous opportunities for such measures, and they were found to be the most cost-effective of all approved measures. [53] Installation of compact florescent lights (CFLs) accounted for a quarter of the savings achieved, followed by efficient appliances (11 percent), and heating measures (9 percent). And, with the installation of almost 40 million CFLs, CFLs were by far the largest number of projects undertaken in the first commitment period. Overall, energy savings were achieved at an average cost of about 0.7 pence per electrical kWh saved, which is less than 1.5 U.S. cents/kWh.

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[50] Office of Gas and Electricity Markets, Energy Efficiency Commitment 2002-2005: Technical Guidance Manual, Issue 3, (London, 2004).
[51] These figures are for lifetime energy savings for measures installed over the first commitment period.
[52] Because the two companies had ceased energy trading, no penalty was imposed on them.
[53] There are about 9 million uninsulated walls: most homes built in the period 1930-1979 were constructed in this way. Earlier homes tended to have solid walls, and more recently built homes have insulated walls. Eyre, (2007).

Because of the larger than expected savings in the first commitment period, higher goals were established for the second commitment period (EEC-2). For this period, a goal of 130 TWh was set, which was roughly double the target set for EEC-1. Importantly, in this commitment period, the threshold for obligation increased from 15,000 domestic customers to 50,000 domestic customers. This second period also included updated lists of measures and deemed savings values. The goal for the 2005-8 period was to achieve approximately a 2 percent reduction in annual UK residential energy use, which amounted to savings of nearly 0.7 percent per year. However, due to carryover savings from the first commitment period,[54] about 25 percent of the 2005-8 target was actually achieved before the beginning of the new commitment period.

The evaluation of the first year of EEC-2 found that the suppliers achieved 60 percent of their overall target. While roughly 46 percent of overall savings was saved in the Priority Group, a considerable amount of these savings were from energy savings carried over from EEC-1. Excluding the energy savings that were carried over, only 40 percent of the suppliers' activity were in the Priority Group. More savings occurred in the Non-Priority Group than the Priority Group because the former paid some of the costs of the measures, thus making it cheaper for the suppliers.

Due to changes in the building codes, sales of efficient appliances, and operating experience with CFLs, and adjustments in the calculation procedures, insulation measures were expected to be even more important in the second commitment period, while efficient boilers, appliances, and CFLs were expected to account for a smaller portion of total savings. And, as expected, supplier activity targeting the Priority Group has promoted insulation measures. While a wider range of allowable measures was delivered to the Non-priority Group, the majority were also insulation measures. Consequently, roughly 80 percent of the total energy savings achieved to date have come from the installation of insulation measures. However, other measures have been widely

[54] Suppliers, who over-achieved their savings target in the first commitment period were allowed to transfer these savings to the second commitment period.

and effectively promoted: roughly 15 million additional CFLs were distributed in the first year of the EEC-2.

To date, there has been little interest in trading because energy savings can only be traded once the supplier's own energy savings target has been achieved. As noted earlier, rather than trading, suppliers who exceeded their EEC-1 target have chosen to carry their savings over to EEC-2.

Work has just started on setting an appropriate goal for the Energy Efficiency Commitment 2008-2011 period. Since large commercial and industrial customers are covered by other programs related to the UK's commitments under the Kyoto Protocol to reduce GHG emissions, there is some discussion of expanding the EEC program to include small commercial customers.

France[55]

France has established the most recent ESC scheme. In July 2005, the French legislature passed a new energy law that included energy savings targets.[56] The total energy savings target for the first three years is 54 TWh in final energy, cumulative over the life of the energy efficiency actions and discounted at a rate of 4 percent. These savings must be achieved in the three-year period July 2006 – June 2009, and within this period there are no interim, annual deadlines; the targets will be verified only at the end of the period. Overall, the expected cost of action is estimated to be less than 20 Euro (26 USD) per MWh. The Ministry of Industry is responsible for establishing the scheme, allocating savings targets, administering the scheme, and issuing certificates. Certificates are issued and are valid for the July 1, 2006 to June 30, 2008 period; certificates also remain valid for four years after the current period.

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[55] For more information on the French scheme, see: Bertoldi, (2005), and other sources cited in text and in References: Bertoldi and Rezessy (2004, 2006), Bertoldi et al. (2005), IEA (2006), Karl (2004), Lefebvre (2006), Rezessy et al. (2006), and Urvoas (2007).
[56] European Council for an Energy Efficient Economy (ECEEE), French Law to Drive Down Energy Consumption, (May 31, 2006), available at: http://www.eceee.org/news/news_2006/2006_05_31/

Energy savings targets are set for suppliers of electricity, natural gas, domestic fuel, and heating and cooling for stationary applications, but not for suppliers of fuel for transport. Energy savings targets are shared among suppliers with annual sales beyond a fixed threshold. Small electricity, natural gas, and heating and cooling suppliers of less than 400 GWH in annual energy sales are exempted.

A target of 54 billion kWh (54 TWh) of electricity or the equivalent for other fuels, was established for lifetime savings for measures implemented in 2006-2008, discounted at the rate of 4 percent per year. There are no annual targets – just a single, overall average three-year target, which for 2006-2008 is on the order of 0.15 percent of French energy use.

The obligated actors received targets in proportion to their market sales in the residential and commercial sectors and their threshold depends on the kind of supplied energy:

- For suppliers of electricity, natural gas, heating or cooling, the threshold is 0.4 TWh/year
- For suppliers of LPG, the threshold is 0.1 TWh/year
- For suppliers of domestic fuel, there is no threshold

The Industry Ministry proposed the following breakdown by energy supply sectors:

- 57% for electricity supply
- 26% for gas supply
- 1% for heating and cooling supply
- 13% for domestic fuel suppliers
- 3% for LPG

Suppliers can either motivate customers to take energy efficiency actions, implement energy efficiency actions themselves, or buy ESCs from third parties for the amount of savings needed. As was explained earlier, ESCs are tradable certificates, specified in terms of cumulative kWh achieved. The savings must be additional to the business-as-usual case.

In the French scheme, there is a focus on standardized actions, and standardized projects with stipulated energy savings are encouraged. Custom measures can also be implemented and savings are assessed on a case-by-case basis.

The French Agency for Environment and Energy Management (ADEME), and an industry group, the technical Environment and Energy Association (ATEE), are responsible for defining standardized actions. The Ministry of Industry then validates these actions and issues a decree to make them a French regulation. A list of standardized actions has been defined and includes residential/commercial measures, industrial measures, and transport measures. It is important to note that while transport fuel suppliers do not have obligations, transport energy savings are able to earn certificates. Among the eligible technologies are:

- Energy efficient lighting, appliances, boilers, and motors
- Insulation of attics, walls, and water heaters
- Double glazing of windows
- Heating controls
- Variable speed motors
- Wood-fired heating systems for homes, district heating, or industry

Actions conducted to meet the obligation must be additional relative to the supplier's usual activity. The French scheme excludes plants that are under the European Union's Emission Trading Scheme (EU ETS), fuel substitution between fossil fuels, and energy savings resulting only from measures implemented to comply with current legislation.

Projects must be of a size where the achieved savings are above 1 GWh over the lifetime of a project. It is possible to pool savings from similar actions in order to reach the required threshold. The parties that are permitted to trade ESCs include all energy suppliers: electricity, gas, domestic fuels, cooling, and heating, as well as any economic actor who can implement energy efficiency projects and get certificates.

Certificates are delivered after the programs are carried out and prior to the realization of energy savings. Certification of projects implemented by bodies that do not have savings obligations is allowed. If an obligated supplier cannot submit a sufficient number of certificates to meet its obligations, it must pay a penalty price of 2 Euro cents per kWh (about 2.4 U.S. cents per kWh) of the total shortfall. French regulators plan to encourage a market in certificates by publishing a list of the prices of certificate sales, and possibly also publishing a list of certificate sellers.

The French scheme has only been implemented recently, so there is little direct program experience by which to evaluate its effectiveness. Decrees were adopted in May 2006, to be applied starting on July 1, 2006, and energy savings projects that are implemented after January 1, 2006 are eligible.

New South Wales

On January 1, 2003, the first scheme in the world with an ESC trading element went into effect when New South Wales (NSW), the most populated state in Australia, put in place its Greenhouse Gas Abatement Scheme [GGAS]. [57] The GGAS was extended on January 1, 2005, to become a joint scheme with the Australian Capital Territory. [58]

The New South Wales ESC scheme differs from those in Europe, most notably Italy's. Under the 2003 GGAS framework, electricity retailers and other parties are required to meet mandatory targets for reducing GHG emissions from the electricity they use or supply. A statewide benchmark for reducing GHG emissions was set at 7.27 tons of CO_{2e} per capita by 2007, about 5 percent below the target level of per capita emissions in the Kyoto Protocol baseline year of

[57] For more information on New South Wales' ESC program, see: I. MacGill, H. Outhred, and K. Nolles, Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry, Energy Policy 34, (2006), pp. 11-25, and other sources cited in the text and in References: Bertoldi and Rezessy (2006), Crossley (2005), International Energy Agency (2006), Independent Pricing and Regulatory Tribunal (2006), and Sniffin (2006).

[58] While there are some slight differences in the implementation of the GGAS in the Australian Capital Territory, the programs are essentially the same.

1989/1990.[59] To ensure continual progress towards the 2007 end target, the GGAS included progressively tighter annual reduction targets, from a target of 8.65 tons per capita in 2003 and leading to the final benchmark of 7.27 tons per capita in 2007, a level that was to be maintained until at least 2012. Recently, the GGAS was extended until December 31, 2021, and the per capita target will remain at 7.27 tons, until a final decision is reached on whether Australia adopts a national cap and trade style emissions trading scheme. [60]

The parties required under the GGAS to meet targets for GHG emissions are called "benchmark participants." Each year, based on their contribution to the supply of electricity in New South Wales, the required level of reductions of GHG emissions is established for each benchmark participant. For example, if an electricity retailer sells 5 percent of total electricity sales in NSW, it is responsible for meeting 5 percent of the required reduction applied to the NSW electricity sector's total benchmark. In addition, there is a non-compliance penalty of AUD 11.50 (8.9 USD) per ton of emissions above the target levels. [61]

Benchmark participants include the following:

- Electricity retailers
- Electricity customers taking supply directly from the Australian National Electricity Market
- Electricity generators with contracts to supply electricity directly to customers
- Other parties who consume large volumes of electricity in New South Wales and who elect to participate directly in the scheme

[59] While Australia signed both the original United Nations Framework Convention on Climate Change (UNFCCC) and the subsequent Kyoto Protocol, to date the Protocol itself has not been officially ratified. Australia is listed as an Annex I party, or a developed country with GHG emissions reduction targets based on 1989-1990 base levels, see: UNFCCC, Kyoto Protocol: Parties, Australia. 2007. http://maindb.unfccc.int/public/country.pl?country=AU
[60] Private communication with Margaret Sniffin, (Jan. 23, 2007).
[61] Until 2009, these penalties are subject to adjustments based on the Consumer Price Index [CPI]. Starting in 2010, the penalty will be increased by one dollar each year for four years, and continue to be adjusted by the movement of the CPI. A more complete discussion is found in: NSW Greenhouse Gas Abatement Scheme, Issue 2, (2006).

In addition, organizations carrying out State "significant developments"[62] and large customers[63] can elect to manage their own GHG benchmarks. These entities are called "elective benchmark participants," and having nominated which of their sites are parts of the scheme, they must meet the benchmark reduction targets for those sites.

Under the GGAS, tradable NSW Greenhouse Abatement Certificates (NGACs) can be used by participants to meet their CO_2 reduction targets. A NGAC represents the abatement of one ton of CO_2, and is a transferable certificate that can be purchased by a benchmark participant and then surrendered when compliance reports are filed. Abatement certificates are created by parties carrying out GHG abatement projects accredited and pre-approved by the independent economic regulator for New South Wales, the Independent Pricing and Regulatory Tribunal of NSW [IPART]. [64]

In the Scheme, NGACs can be created through the following measures: a) Low-emission generation of electricity (including cogeneration), or improvements in emission intensity of existing generation activities; b) Demand-side abatement (DSA); c) Carbon sequestration in forests; and, d) Reduction of on-site GHG emissions in industry that are not directly related to electricity consumption. Since energy efficiency is a focus of this report, we further explain the five main classes of DSA measures that are allowed in the NSW scheme: (1) energy efficiency projects that modify existing energy consuming equipment, processes, or systems, or which modify energy usage; (2) energy efficiency projects that replace existing energy consuming equipment: (3) energy efficiency projects that install new energy efficiency equipment that replace similar equipment; (4) fuel switching projects, where the substitution results in reduced GHG emissions; and (5) on-site electricity generation that replaces supply from the grid, where the substitution results in reduced GHG emissions.

[62] So far, no organizations conducting State significant developments are elective benchmark participants.
[63] A large customer is defined as a customer other than a retail supplier that, on its own or together with other related entities, has an electricity load within NSW of over 100 GWh per year at one site or multiple sites owned or occupied by the customer, as long as one of the sites uses over 50 GWh per year.
[64] In addition to accrediting abatement projects, IPART is responsible for overall administration of the GGAS, including conducting audits for verification and compliance, and managing the GGAS Registry.

All of the projects for creating emission reductions have to be additional as compared with a "before" baseline and, therefore, require the establishment of business-as-usual baselines. This definition of additionality is different than the criteria used for the Clean Development Mechanism in the Kyoto Protocol, where the project would not have been implemented in the normal course of business in the absence of the GGAS.

Based on the scale and complexity of the project, audits may be required at the accreditation or pre-approval stage, and after energy savings are realized. As of 2006, over 150 auditors from 14 audit firms have been trained by the Scheme Administrator. [65]

The right to create and sell NGACs rests with the party liable to pay for the energy consumed at the site where a NGAC project is implemented. To illustrate with the earlier example of the electricity retailer, the retailer may then transfer the right to create and trade NGACs to other electricity retailers, other benchmark participants, and all end use sectors. This ability to assign to third parties the right to create NGACs also creates the opportunity for firms providing energy management services (e.g., ESCOs) to offer the creation of NGACs as an additional value-added service.

NGACs can be freely traded between benchmark participants; banks, traders, and corporations can also participate in the trading system.[66] All buying and selling of NGACs is done in the open market with ownership transfers performed through the GGAS Registry. Certificates and trades are recorded in the Registry that is maintained by a private sector contractor; the Registry is not a trading platform and trading is done outside of the Registry. Purchasers can self-register on the Registry and then buy NGACs. However, under this scheme, projects cannot create both NGACs and renewable energy certificates. And although some brokers are operating, most trades are bilateral. The government is not involved in trading.

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[65] Crossley (2007), McGill, et al, Design Lessons (2006), NSW Greenhouse Gas Abatement Scheme, (2006).
[66] The scheme also allows some large electricity customers to claim credit for reducing on-site GHG emissions from non-electricity related industrial processes at sites that they own and control. These large users can create Large User Abatement Certificates for these activities, but these certificates cannot be traded.

As of the end of 2006, 188 projects were accredited: 97 generation, 82 demand-side abatement, 5 carbon sequestration (forestry) and 4 large users (non-electricity abatement). This represented a steady increase since the end of 2005 when 146 projects were accredited.

Looking specifically at DSA projects in 2006, 36 were in the residential sector, 28 were in the commercial sector, 14 were in the industrial sector, and 5 were on-site generation projects.[67] In particular, the number of DSA projects accredited in the residential sector significantly increased from 11 in 2005 to 36 in 2006, an increase that is also reflected in the large proportion of certificates being registered from this sector (98 percent of all DSA certificates). However, accredited parties have until June 30, 2007 to register certificates for 2006 abatement, and to date no certificates have been created from the industrial and commercial sectors, and only 1.8 percent have been registered from on-site generation.

Benchmark Statements were due by March 18, 2007 for the 2006 compliance year. It is expected that for 2006, all participants will comply with the Scheme and there were will be more certificates created than required to meet the obligations of the Benchmark Participants. The number of NGACs surrendered and accepted in 2006 is projected to increase by 25 percent compared to 2005. [68] As certificates are bankable, these are available to meet compliance regulations in future years.

As noted above, NGACs are traded on the open market. The current price is 11-15 AUD (8.6 USD-11.6 USD) per ton of emissions, a price that is effectively capped by a penalty of 11.5 AUD per ton of emissions. The funds generated by the penalties may be used to provide additional revenue for abatement projects.

The primary market for NGACs has been electricity retailers, where over 32 million certificates have been created to date. The surrender obligation for 2006 is estimated to be approximately 10

[67] IPART (2006); Sniffin, (2007),
[68] Ibid.

million certificates, effectively offsetting a portion of the GHG emissions associated with their electricity purchases.[69] Energy efficiency generated 5.9 million NGACs in 2006 as compared to 1.5 million in 2005, 742,233 in 2004 and 345,141 in 2003.[70] There has been a strong growth in residential energy efficiency projects, particularly giveaways of CFLs and low-flow showerheads.[71] However, while large companies are rolling out more energy efficiency projects,[72] projects in commercial buildings represent less than 2 percent of NGACs created to date.[73]

While energy efficiency is recognized as the lowest cost GHG abatement option, because they result in small amounts of reductions, occur across many sites, involve multiple activities, and often involve behavioral change that cannot be easily quantified and claimed as NGACs, transaction costs have been perceived as a major barrier to the development of small-scale energy efficiency projects, Other inhibiting factors include: applicants must pay a fee of 500 AUD (389 USD) per project for accreditation, need a good record keeping system, may pay for audits (the average cost of an audit is about 10,500 AUD (8,167 USD), and incur ongoing compliance costs.

In 2005, 95 percent of projects using deemed factors under the Default Abatement Factors method. However, 2006 saw a dramatic increase in energy efficiency NGACs, increasing from less than 5 percent of total certificates in 2005 more than 27 percent in 2006.[74] Moreover, the Administrator of the GGAS is trying to minimize the transaction costs and the administrative burden, by combining small projects with similar geographic locations, technology types, calculation methods, etc.

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[69] Sniffin, (2007).
[70] IPART, (2006); Sniffin, (2007).
[71] To account for the possibility that some households will not install these products, or will delay the installation of these products, an Installation Discount Factor (IDF) is applied that discounts the amount of NGACs that can be earned from these products. Initially, the IDF was 0.8 for products that were given away, meaning that 80 percent of the calculated abatement delivered by these products was recognized by the regulator. However, effective August 25, 2006, the IDF was changed to 0.4, so that it may no longer be cost effective to provide these products free of charge to customers.
[72] Sniffin, (2006).
[73] Sniffin, (2007).
[74] IPART, (2006); Sniffin (2007).

Today, in NSW, third parties are now seeing the benefits in bundling projects, and there is increasing interest from non-liable parties in buying NGACs. NGACs are now recognized as evidence of verified and legitimate sources of GHG abatement,. NGACs are increasingly being used outside of the GGAS, as for example, to provide GHG emission offsets for events or products, to channel environmental funds to GHG abatement, and for use in other emissions reductions schemes that allow project-based offsets.

Comparison of Countries

Table 2 summarizes the key features of the New South Wales and the three European ESC systems in place.

Table 2: Features of White Certificate Systems in Europe and New South Wales

	Italy	France	Great Britain (EEC-2, 2005-2008)	New South Wales
Description	Sets specific energy savings goals that must be achieved each year	Sets specific energy savings goals that must be achieved over a 3-year period	Sets specific energy savings goals for each 3-year period	Sets specific GHG emission reduction goals that must be achieved each year
Unit of target	Toe, annual	TWh[75]	TWh fuel weighted energy benefits	Ton of $CO_{2e.}$
Duration of current phase	2005-2009	2006-2008	2005-2008	2003-2020
Targets	230 PJ[76] total	194 PJ total (54 billion kWh (or equivalent) discounted lifetime savings)	468 PJ total (130 billion kWh lifetime savings)	No energy targets; 5% below per capita CO_2 emissions
% of Annual Demand	0.5%	1%	1%	N/A
Sector coverage for eligible projects	All consumers	All consumers	Residential customers only	All consumers
Restrictions on compliance	50% from reduction in own energy sector (electricity and gas)	None	50% from priority group (low income consumers on social benefits)	None

75 1 TWh (terawatt hour) is 10^9 kWh, or one million MWh.
76 1 PJ (petajoule) = 10^{15} J (Joules); since 1 kWh = 3.6 10^6 J, 1 PJ = 2.78 10^8 kWh

Obligated parties and thresholds	Electricity and gas distributors above 100,000 customers served	Retail electricity, gas, LPG, heat, cold and heating fuel suppliers above energy sales of 0.4 TWh/year	Retail electricity and gas suppliers above 50,000 residential customers served	Electricity retailers; electricity customers taking supply directly from the grid; electricity generators with contracts to supply electricity directly to customers; other parties who use lots of electricity in New South Wales and who elect to participate directly in the scheme
Trading	Certificates are traded; spot market; OTC trading	Certificates are traded; only bilateral exchanges allowed	No certificates; obligations can be traded; savings can be traded after own obligation met; no spot market; one-way trade in national emission trading scheme	Certificates are traded; only bilateral exchanges allowed
Institutional structure	Energy regulator (AEEG) plus electricity market operator (GME)	Ministry of Industry and French Agency for Energy Management (ADEME)	Energy regulator (OFGEM)	Energy regulator (IPART)
Measurement & Evaluation	Three M&V approaches: (1) deemed savings; (2) engineering with field measurement; and (3) energy monitoring (direct measurement).	Ex-ante energy savings based on standardized engineering estimates.	Ex-ante energy savings based on standardized engineering estimates. Monitoring only affects energy savings accredited in future schemes.	Emission reductions estimated using: (1) project impact assessment method; (2) metered baseline method; (3) default abatement factors method; or (4) generation emissions method

Penalty	Fixed by the Regulator, taking into account the actual possibility to meet the target (i.e., number of certificates issued as compared to the annual target), the magnitude of the noncompliance, and the state of affairs of the non-compliance party.	0.02 Euro (0.025 USD)/kWh	No specific guidance on how penalty would be calculated; the penalty can be up to 10% of the supplier's turnover	AUD 11.50 (8.9 USD) per ton of emissions above the targets

Among the key differences among the four countries are:

- Between the Great Britain and Italian approaches, Britain allows for trading of individual obligations, while the Italian scheme only allows for trading of savings achieved through ESCs.
- The Italian model does not account for comfort taking, the so-called "rebound effects",[77] but Great Britain does.
- Great Britain calculates savings with reference to what annual savings will be by 2010 (i.e., savings in future years are discounted and calculated for each commitment period) , whereas Italy uses a five-year time scale (i.e., any savings beyond five years are excluded).
- New South Wales includes ESC trading as part of its overall GHG emission reductions scheme; in the European ESC trading schemes, GHG emissions reductions are considered one of the benefits of achieving energy savings.

Recently, there have been other European ESC-related activities:

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[77] Energy efficiency does not always result in energy savings because of the "rebound" effect (also referred to as "snapback" or "take back"). For example, some occupants of buildings might raise their thermostat settings for winter heating due to lowered incremental energy costs resulting from improved insulation. There is some debate in the literature regarding whether snapback is a significant factor for many efficiency measures. See Edward Vine and Jayant Sathaye, Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines, Lawrence Berkeley National Laboratory, Berkeley, CA, LBN-40316, 1997.

IEA/DSM Task XIV

The International Energy Agency (IEA)'s Implementing Agreement on Demand-Side Management Technologies and Program, recently supported "Task XIV", a project on market mechanisms for ESC trading. The objectives of the Task were: (1) to assess the experience of existing ESC schemes and their effectiveness in reducing energy consumption and CO_2 emissions, (2) to detail ESC implementation problems, and (3) to evaluate how ESCs could interact with other environmental benefits schemes. The Task started in June 2004 and published its final report in June 2006.[78]

The EuroWhiteCert Project

The EuroWhiteCert Project was established in April 2005, to support the conceptual and technical development of tradable ESCs. The project involves a critical evaluation of the experience with already established European ESC schemes. In addition, the project hopes to explore the practical implementation of an ESC scheme by developing a uniform measurement and verification methodology, certifying existing projects, and identifying a set of alternative market participants. The measurement and verification methodology will be tested by verifying, certifying and compiling a database of recent energy efficiency and renewable energy projects in different European Union Member States, and in different sectors, as well as in terms of competing technologies, to ensure that it is applicable in each of the member states, and within the framework of a European certification scheme.

The EuroWhiteCert Project is expected to last until April 2007. In 2006, they published two papers: "White Certificates: Concept and Market Experiences," and "Interaction and Integration of White Certificates with Other Policy Instruments: Recommendations and Guidelines for Decision Makers."[79]

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[78] International Energy Agency, (2006).
[79] These papers are available at: http://www.ewc.polimi.it/

III. ENERGY EFFICIENCY RESOURCE STANDARDS IN THE U.S.

Although no energy savings certificate programs comparable to those in New South Wales or Europe have been implemented in the United States, several states are promote energy efficiency by developing Energy Efficiency Portfolio Standards (EEPS). In this section, we examine various state efforts to develop EEPS[80] and consider whether the successful implementation of EEPS could motivate states to create energy savings certificates.

There are clearly considerable similarities between an EEPS and the Renewable Portfolio Standard (RPS) many states are adopting. The marked exception is that the EEPS pertains to a required level of efficiency savings, while the RPS' requires a level of renewable energy purchases. It is important to note, however, that because of these similarities, some states are combining a EEPS and a RPS into a comprehensive energy policy. Connecticut recently provided for energy savings certificates to be used in conjunction with its RPS, and indications are that other states may be moving in that direction. [81]

An EEPS consists of targets for energy savings directed at electricity and/or gas utilities; often providing flexibility to achieve the target through market-based systems. With trading, a utility that saves more than its target can sell savings credits to utilities that fall short of their savings targets. Such systems permit the market to find the least-cost savings.

All EEPS include provisions requiring the utilities or other program operators to provide energy savings improvements for the end-users. The utility and/or program operator must document the operation and performance of these programs. Some EEPS also include distribution system efficiency improvements, combined heat and power (CHP) systems, and other high-efficiency

[80] EEPS are also referred to as Energy Efficiency Resource Standards (EERS).
[81] S. Nadel, Energy Efficiency Resource Standards: Experience and Recommendations, American Council for an Energy Efficient Economy, (Washington, DC, 2006), and sources cited in text.

distributed generation systems. EEPSs are typically implemented at the state level, but they can be implemented over local or regional areas.

Today, EEPS-like energy savings programs are currently in operation in eight states: California, Colorado, Connecticut, Hawaii, Nevada, Pennsylvania, Texas, and Vermont. And, at least two other states, Illinois [82] and New Jersey, are working to plan their own programs. Beginning with Connecticut, we briefly summarize the eight states whose different EEPS programs are now underway.

Connecticut

Connecticut adopted its RPS in 1998. In 2005, state energy policy was amended to require energy efficiency by commercial and industrial consumers, including CHP plants; energy efficiency requirements for residential customers were not included. Under the 2005 legislation, electricity suppliers in Connecticut were required by January 1, 2007 to demonstrate that 1 percent of the electricity they supply was from energy efficiency and CHP, a requirement that increases by 1 percent annually, to 4 percent by January 1, 2010. As a result, the utilities would need to seek additional energy savings, either by expanding existing programs, or utilizing the State's market-trading system to purchase verified energy savings achieved by third parties, such as ESCOs, or buying energy savings certificates directly from the state.

In 2004, Connecticut's energy savings were equal to about 1 percent of electricity sales by the covered utilities, and of these savings, approximately 64 percent were from the commercial and industrial sectors. Connecticut expects that the expanded 2005 energy efficiency requirements will increase total energy savings relative to current efforts by almost 0.4 percent of annual sales annually in subsequent years.

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[82] The Illinois Commerce Commission (ICC) opened a rulemaking in the summer of 2006 (Docket 06-0388) to implement the Energy Efficiency Performance Standard. However, the ICC subsequently suspended any action until it could clarify whether the ICC if fact had the necessary regulatory authority. The issue is now awaiting action by the State legislature legislation to resolve the matter. Personal communication with D. Baker (Nov. 6, 2006).

California

California has a long history of promoting energy efficiency. In 2005, the California Public Utilities Commission adopted regulations setting electricity and natural gas savings targets for each of California's investor-owned utilities (IOU) for the period 2006 through 2008. These regulations required the IOU's to achieve combined energy savings totaling 23,183 GWh of electricity and 444 million therms of natural gas by 2013. In order to meet these goals, California's utilities needed to significantly expand their existing energy savings programs. In 2002, IOU energy efficiency programs saved 1,104 GWh per year. However, to reach the target for 2013, the IOUs will need to obtain an additional 2,318 GWh in energy savings each year or more than doubling the amount of savings. In 2004, the IOUs began to expand their efficiency programs in anticipation of the 2005 regulations, increasing their electricity savings by over 60 percent from 2002, to some 1,869 GWh. But even with this impressive accomplishment, the IOUs still need to increase annual electricity savings by about one-third relative to their 2004 efforts in order to meet the required 2013 savings targets. Moreover, the energy savings programs for natural gas will need to increase even more rapidly, needing to double by 2008 and more than triple by 2013.

Colorado

Colorado's largest utility, the investor-owned Public Service of Colorado (also known as Xcel Colorado) is required to meet energy savings goals as part of a settlement agreement approved by the Colorado Public Service Commission in December 2004 to resolve litigation over its proposed new coal-fired power plant. Under the settlement, Xcel Colorado agreed to use its best efforts to acquire an average of 40 MW in demand reduction and 100 GWh of energy savings from energy efficiency programs each year from January 1, 2006 to December 1, 2013. Based on Xcel Colorado's 2004 sales, the annual savings goals amount to about 0.38 percent sales.

If the terms of the settlement are met, by January 1, 2014, Xcel Colorado will have achieved a cumulative total of 320 MW of total demand reduction and 800 GWh of annual electricity savings. Implementation of the settlement by Xcel Colorado began January 1, 2006, and results to-date are not yet available.

Hawaii

In 2001, Hawaii enacted its RPS that was later amended in 2004 to require renewable resources to provide 8 percent of electric sales in 2005, with the requirement increasing to 20 percent in 2020. These amendments also modified the RPS to include energy efficiency as a qualified source of renewable energy. The RPS places no cap on energy efficiency savings, nor mandates a set-aside for renewable energy savings. Energy from CHP plants is also included. Hawaii's two major utilities must evaluate savings from their efficiency programs, and submit a report annually to the Hawaii Public Utilities Commission for review. In 2004, renewable energy and energy efficiency resources accounted for about 11.2 percent of electricity sales; of this 11.2 percent, renewables made up a little more than two-thirds, and the remainder came from energy efficiency efforts.

Nevada

In 2001, Nevada adopted its RPS, requiring that by 2013, 15 percent of the electricity sold to Colorado's consumers be generated from renewable resources. In 2005, the RPS was amended to increase the portfolio requirement to 20 percent of electricity sales by 2015, with provisions allowing each utility to use energy efficiency programs to obtain up to 25 percent of the new RPS requirements. Furthermore, the RPS requires each utility to obtain at least 50 percent of the energy efficiency savings from the residential sector.

Utilities may operate energy efficiency programs themselves and/or purchase energy savings credits from third parties. Each utility uses measurement and verification protocols to validate their reported savings. The Nevada Public Utilities Commission then reviews these renewable energy and energy efficiency credit submissions; no savings credits are approved until the submissions are verified.

Extra credits may be rolled over to future years. And, if a utility does not meet its portfolio goals, it is subject to fines and administrative sanctions.[83] The utilities publicly announced their intention to achieve the maximum energy efficiency savings allowed under the law. In order to reach this goal, the utilities are expected to file a formal request to the Nevada Public Utilities Commission to approve a significant increase in energy efficiency funding for 2007-2009. .

Pennsylvania

In 2004, the Pennsylvania legislature adopted the "Alternative Energy Portfolio Standards Act:" under which renewable energy must increase to account for 8 percent of the power sold in the state by 2019 (after 15 years of implementation). Annual targets are set for intervening years. Savings from energy efficiency along with hydropower, waste coal generation, and generation from municipal solid waste (landfill methane) are included as Tier 2 "advanced energy resources." Starting in 2006, the percentage of electricity generation from Tier 2 resources must increase over time—4.2 percent of electricity sold in 2006, 6.2 percent in 2011, 8.2 percent in 2016, and 10 percent in 2021.

For energy efficiency savings, there are two categories of savings estimates: (1) deemed savings[84] and (2) metered savings. For the deemed savings approach, the Pennsylvania Public Utility Commission developed a Technical Reference Manual that includes algorithms for calculating savings from residential heating, ventilation, and air conditioning (HVAC), lighting and appliance measures and commercial and industrial HVAC, motor, and lighting measures.

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[83] The Nevada Public Utilities Commission can waive fines and sanctions based on a determination that there was insufficient renewable energy or energy efficiency resources available for purchase.

[84] This savings methodology is used for projects for which expected savings are reasonably well understood and, as a result, direct measurements would not be cost effective. Issues of measurement and verification are discussed in detail in Section IV.

Texas

In enacting its electricity restructuring law in 1999, Texas became the first state to establish a requirement that the state's electric utilities offset a portion of their demand growth through end-use energy efficiency programs. This 1999 legislation introduced retail competition in the sale of electricity and directed the Public Utility Commission of Texas (PUCT) to establish energy-efficiency programs to meet a specific demand-reduction goal. Under these regulations, and subsequent 2001 legislation, beginning in 2003, Texas' electric IOUs were required to implement energy efficiency programs that represented 10 percent of their demand growth. Energy savings goals are specified in peak kW and are based on a rolling baseline, defined as the average load growth over the previous five years.[85] .

Allowable energy efficiency programs fall into two main classes: standard offer and market transformation. Standard offer programs are offered by private energy efficiency service providers selected by customers. The utilities provide specified payments per unit of energy and demand savings to the service provider. Market transformation programs seek to overcome market barriers and promote long-term changes in markets for energy efficiency measures. Specific programs are developed by utilities and their shareholders in a collaborative process and then approved by the PUCT.

The energy efficiency programs are funded through public benefit funds generated by utility transmission and distribution rates. In 2004, the public benefit funds totaled about $85 million statewide. Energy and demand savings are determined through a mixture of deemed savings estimates previously approved by the PUCT and in-field measurements in accordance with the IPMVP, the International Performance Measurement and Verification Protocol [86]

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[85] Public Utility Commission of Texas, Report to the 79th Texas Legislature, Scope of Competition in Electric Markets in Texas, Austin, TX, (2005).

[86] The International Performance Measurement and Verification Protocol, or IPMVP, was developed by the U.S. Department of Energy and is currently managed by the Efficiency Valuation Organization, a non-profit organization dedicated to energy efficiency measurement and verification. See: www.evo-world.org

In Texas, there currently are eight programs in operation, and the utilities are generally exceeding the requirement that 10 percent of load growth come from energy efficiency. In 2003, the specified goal was 135 MW, but utility energy efficiency programs reduced demand by 151 MW, exceeding the goal by 11 percent, and reduced overall electricity use by 370,000 MWh. In 2004, the specified goal was 147 MW, but utility energy efficiency programs exceed the goal by 30 percent, reducing demand by 192 MW. And in 2005, the specified goal was 142 MW, but utility energy efficiency programs reduced overall demand by 181 MW, exceeding the goal by 27 percent, as well as reducing electricity use by 500,000 MWh. [87]

The apparent success of Texas' energy efficiency program was recently established in an independent audit of program operations in 2003 and 2004. The audit not only confirmed the reported savings, but found additional savings. The verified adjusted energy savings showed that statewide, peak demand reductions exceeded the statewide goals by approximately 14 percent in 2003 and by 34 percent in 2004.[88]

Vermont

The Vermont program is different than the other states in this section in that the energy efficiency goals were established by a competitively awarded contract and not directly by legislation or regulation. Nevertheless, the program functions the same as an EEPS and serves as a useful example.

In 1999, the Vermont Public Service Board (PSB) transferred operations of Vermont's energy efficiency programs from the utilities to a single, statewide "energy efficiency utility" operating under the name Efficiency Vermont (EV). EV is financed by a public benefit fund established by the legislature, and it is administered by the PSB. Efficiency Vermont is run by a contractor, selected through a competitive bid process.

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[87] Public Utility Commission of Texas, Report to the Texas Commission on Environmental Quality, Emission Reduction Incentive Grants, Austin, TX, (2005).
[88] Summit Blue Consulting, LLC, et al., Report to Public Utility Commission of Texas: Independent Audit of Texas Energy Efficiency Programs in 2003 and 2004, Austin, TX, (2006).

The selected contractor enters into a performance-based contract with PSB that includes specific energy (kWh) and peak demand (kW) savings targets and the mechanism for how the savings will be counted. The contractor is required to submit a report annually to the PSB detailing the estimated savings claimed for installed measures tracked and documented by its data tracking system.

The contract contains holdback provisions limiting compensation received by the contractor, pending confirmation that contractual goals for savings and other performance indicators have been achieved. A review of the claimed savings is carried out by PSB, who makes any necessary adjustments before issuing a final ruling on the amount of savings achieved. An independent review is conducted on verifying savings.

Efficiency Vermont began operations in 2000, and in 2004 the program achieved 205 MWh of annual savings and 26 MW of summer peak demand reduction, results that take into account savings obtained in 2004 from measures installed in previous years. A new contract was awarded for the 2006-2008 period, with an annual savings goal of over 1 percent of electricity sales each year. Verified savings to date have been exceeding the specified goals.

The key features of EEPS policies in the U.S. are summarized in Table 3:

Table 3: Summary of EEPS Policies in the U.S.

State	EEPS Description	Applies to	Savings Target	Timeframe	Measurement and Evaluation
California	Sets specific energy and demand savings goals	IOUs	Savings goals set for each program year from 2004 to 2013. The savings target for program year is: 23, 183 GWh, 4,885 MW peak, and 444 MMtherms	2004-2013 Annual MWh, MW, and therm savings adopted for each of these years	M&E protocols established, based on IMPVP

Colorado	Settlement agreement: sets specific targets that utility company will make "best effort" to achieve	Public Service of Colorado	320 MW and 800 GWh (40 MW and 100 GWh each year)	2006-2013	Assumptions about free riders and spillover are made by utility and contractors; a third-party independent evaluator conducts field surveys and adjusts savings at the end of the DSM commitment period.
Connecticut	RPS includes energy efficiency at commercial and financial facilities, and also includes CHP and load management programs	IOUs	Savings goals get for each program year: 1% for 2007, 2% for 2008, 3% for 2009, and 4% for 2010 and thereafter	2007-2010 and thereafter	Estimated savings are based on deemed (stipulated) savings. Impact evaluations later verify and true-up savings.
Hawaii	RPS includes energy efficiency	IOUs	20% of kWh sales (overall RPS target, EE portion not specified)	2020	Not available.
Nevada	RPS includes energy efficiency	IOUs	Energy efficiency can meet up to 25% of the energy provider's portfolio standard, Combined EE/RE standard is: 6% for 2005-6, 9% for 2007-8, 12% for 2009-10, 15% for 2011-12, 18% for 2013-14, and 20% for 2015 and thereafter	2005-2015 and thereafter	A third-party independent evaluator conducts field studies and adjusts Nevada Power's gross savings estimates. Will now be looking at free riders and reporting net savings.
Pennsylvania	Alternative energy portfolio standard includes energy efficiency	IOUs	Tier 2 goals (including EE): 4.2% for years 1-4, 6.2% for years 5-9, 8.2% for years 10-14, and 10% for years 15 and thereafter	Years 1-15 and thereafter	Savings estimates are based on (1) deemed savings or (2) metered savings
Texas	Sets goals as percentage of forecast load growth	IOUs	10%	2004 and thereafter	Savings estimates are based on (1) deemed savings or (2) in-field measurements based on IPMVP

Vermont	Sets energy and demand goals for overall PBF program	Program administrator	87,766 MWh for 2000-2, 119,490 MWh for 2003-5, 204,000 MWh for 2006-8	2000-8	Savings are deemed (estimated) and reviewed by PUC. Adjustments are made based on evaluation results; custom calculations done for custom measures. Independent evaluations verify savings every 3 years.

Other ESC Experiences in the United States

GS Energy's Sterling Planet group is a private for-profit company pioneering the U.S. market for ESC, and already has trademarked the term "White Tags" for their product. Sterling Planet is focusing on four areas of renewable energy and energy efficiency, including market-based approaches; (1) Green Tags; (2) Green Power; (3) Green Buildings; and (4) White Tags.

As reported recently in TreeHugger Online*:*

> …Sterling has a 'nationwide plan' that allows consumers in any state to invest in energy efficiency, and Sterling is also targeting businesses and organizations, with trading and banking going both ways. They hope to bring together White Tag buyers and sellers; buyers will include electric utilities in mandated markets with portfolio standards and corporations or institutions in voluntary markets that are looking to meet greenhouse gas emission goals. Sellers will include those who have taken concrete, effective measures to reduce their energy use and have contracted with Sterling Planet to measure, monetize and certify the White Tags that result. [89]

The Sterling Planet group is using computer-based "state-of-the-art technology with advanced mathematical techniques and neural network algorithms to establish with greater than 99.9% accuracy, scalable and cost-effective processes for measurement, verification and certification of

[89] "An alternative to Green Tags—Sterling Planet's 'White Tags,'" TreeHugger Online, (May, 2006), available at: http://www.treehugger.com/files/2006/05/an_alternative.php

White Tags."[90] Their neuronetwork-based model, which we refer to as the Sterling Model, is based on three components: billing data, weather data, and verification data.[91]

Here is an example to illustrate how the model is used[92]:
If 100 high efficiency air conditioners are going to be installed in 100 buildings, the following activities are conducted:

1. Baseline data on each building are collected: historical energy use (in this case, billing data) and weather data.
2. After the high efficiency air conditioners are installed, a verification check is made to make sure the air conditioners were actually installed.
3. More recent billing and weather data are collected to calculate current energy use in buildings.
4. Savings are calculated by taking the differences in energy use (before and after the installation of high efficiency air conditioners): baseline energy use extrapolated over time minus current energy use.
5. If changes in occupancy are known to have occurred, additional data may be collected on previous and current occupancy use, and the energy saving results are normalized for occupancy.

Sterling Planet's Experience to Date

At present, the Sterling Model is currently under review by the Pacific Northwest National Laboratory and Georgia Tech.[93] After these reviews, Sterling plans to give the Sterling Model to certification bodies for approval, and if approved, Sterling will give the model to customers for free.[94]

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[90] http://www.sterlingplanet.com and http://www.gs-energy.com/carbon.php
[91] Personal communication with Paul McGregor, (Nov. 27, 2006).
[92] Presently the Sterling Model is applicable only to commercial and industrial customers.
[93] McGregor, (2006).
[94] Connecticut's ESC market "opened" at the beginning of 2007.

IV. MEASUREMENT AND VERIFICATION (M&V) ISSUES

Because the two are inextricably linked and are a major source of debate, baseline and additionality criteria are two issues of particular importance in evaluating energy savings. Determining additionality requires a baseline for the calculation of energy saved. In order to calculate energy savings, one needs to estimate the baseline energy use for a particular facility (i.e., its forecasted energy use). Moreover, many schemes require that the energy savings (or emission reductions) are additional to what would have occurred without a program (or ESC); in particular, additionality is an important requirement in the Kyoto Protocol's Clean Development Mechanism (CDM). However, determining additionality is inherently problematic because it requires resolving a counter-factual question: What would have happened in the absence of the specific project? [95] Additionality and baselines vary by ESC system. Most use criteria similar to the CDM, in which the project would not have been implemented in the normal course of business in the absence of the ESC program.

We examine in more detail how measurement and verification and baseline and additionality are addressed in the four countries with experience with ESCs: Italy, Great Britain, France, and New South Wales.

Italy

The Italian ESC system uses one or more of the following certification approaches:

(1) Deemed savings approach: A deemed savings approach is used for projects for which expected savings are reasonably well understood and, as a result, direct measurements would not be cost effective. This approach is totally a priori, i.e., no on-site measurement of energy

[95] Similar challenges are faced in evaluating GHG emissions from project-based mechanisms, such as the Joint Implementation and Clean Development Mechanisms in the Kyoto Protocol, and also in evaluating utility programs in the U.S.

consumption is necessary. For each project, a specific amount of saved energy is specified ex-ante for each measure. The savings are stipulated on the basis of technical analysis, as well as some simplifying assumptions (e.g., hours of use). In this approach, field measurements are not required and, for adjusting energy savings, a default factor is used for free riders (customers who would have installed an energy efficiency measure without the program) and for the persistence of energy savings (how long the energy savings will last).[96] Pre-approval is not required for projects under this approach.

(2) Engineering approach, with some field measurement: used for large-scale projects where energy savings are understood but vary by key parameters (e.g., hours of use). In this case, direct measurement of hours of use are required and then used with engineering calculations (e.g., expected energy use per device). For adjusting energy savings, a default factor is used for free riders but the persistence of savings is measured directly.

(3) Energy monitoring: energy savings are quantified via a comparison of measured consumption before and after the project, taking into account changes in other factors, such as weather and occupancy levels. This approach is used for those efficiency measures that are less predictable due to variation in key parameters (e.g., changes in weather and hours of occupancy). For adjusting energy savings, a default factor is used for free riders but the persistence of savings is measured directly.

For all of the approaches, the baseline is the average technology sold at the national level to produce the same level of energy service. If differences exist between various areas of the country, local averages are used. In contrast, the determination of additionality varies by each approach. For example, when using and the deemed savings or engineering approach, additionality is addressed after choosing the baseline reference technology (i.e., measures are additional if they go beyond the average technology sold at the national level). However, for

[96] Given that the crediting lifetime in the Italian scheme is 5 years for the majority of the energy savings measures, the persistence of savings over time is assumed to be equal to 100 percent; savings in subsequent years are estimated using a default persistence factor.

those projects using energy monitoring, the project developers have to demonstrate additionality in their proposal, which then must be approved by the Regulatory Agency before it can actually be applied. Most importantly, in the Italian ESC system, in order for savings to be considered additional, they must exceed market trends and those legislatively required.

In June 2006, eligible operators were able to submit requests electronically (through the AEEG website) for the verification and certification of attained savings for the following measures that use the deemed savings approach:

- Replacement of incandescent lamps with CFLs
- Replacement of residential electric water heaters with electronic ignition gas heaters
- Installation of more efficient residential gas fired boilers
- Installation of more efficient residential gas water heaters
- Replacement of single-pane with dual-pane windows
- Wall and roofing insulation
- Installation of high efficiency electric motors in industrial applications
- Installation of high efficiency refrigerators and freezers
- Installation of high efficiency washing machines and dishwasher facilities
- Installation of low flow showerheads in homes, hotels and recreation facilities
- Installation of faucet aerators in homes
- Installation of air source heat pumps in new or renovated residential buildings
- Installation of air conditioners with cooling capacity below 12 kW
- Installation of variable speed drives for pumping systems below 22 kW
- Installation of power regulators in public lighting systems
- Replacement of mercury vapor lamps with high pressure sodium lamps
- Use of photovoltaic generators below 20 kW
- Use of solar water heaters
- Energy recovery from natural gas decompression

Engineering estimates have been developed for the following measures that use the engineering approach:

- Energy recovery from natural gas decompression
- Variable speed drives on large hydraulic systems
- Combined heat and power
- District heating

For those monitoring energy use, monitoring plans are required. They must be submitted to the Regulator for pre-approval, and must conform to pre-determined criteria (e.g., sample size requirements).

Using predetermined formats, project developers submit their reported savings to the Regulator, who then verifies the actual energy savings realized by each project. The verification process includes random on-site inspections of the projects sites by the Regulator, as well as on-site audits of project-related documentation.

Most of the projects submitted to date have used the deemed savings and the engineering approach. In all cases, ex-post verification and certification of actual energy savings achieved is conducted on a yearly basis.

Great Britain

In Great Britain, the savings of a project are calculated and pre-approved when the project is submitted, based on a standardized estimate that takes into consideration the technology used, weighted for fuel type, and discounted (using a discount factor of 3.5 percent) over the lifetime of the measure. As noted previously, certificates are awarded only once, for the estimated lifetime energy savings of an individual project, and not for the energy savings achieved within the current compliance period. Monitoring results only affect the energy savings accredited in future schemes.

Suppliers are accredited with energy savings for their schemes on an ex-ante basis, with accreditation based largely on findings from the monitoring of a sampling of projects conducted in earlier EEC rounds. The methodology for determining the energy savings attributed to measures was, based on recognized sources, such as the Building Research Establishment (BRE) and the Energy Saving Trust.

The Department for Environment, Food and Rural Affairs (DEFRA) requires all suppliers to demonstrate additionality; the method chosen is based on a specific different technology. For example, for CFLs for the priority group, all CFLs are defined as additional, because of the high cost of the CFL and the low income of the consumer.

For projects which rely on other government funding, then the achieved savings are adjusted based on the levels of other funding sources. The decision to allow 100 percent credit for non-government funding was a deliberate policy choice to ensure that other sources of funding are maximized.[97]

Ofgem audits suppliers' processes on a periodic basis, by hiring outside firms to inspect a sample of homes to make sure measures are installed as claimed. Two rounds of audits have been conducted to date: the summer of 2003, and in early 2005, and confirmed that the suppliers were implementing their schemes as proposed, and that they had the correct procedures in place to report their schemes accurately.

Concerns have been expressed over the possibility that energy suppliers could falsely claim the total energy savings towards their EEC target by counting savings from other, current partnership projects and not from additional projects as is required. These concerns were due in part to the limited ex-post verification of the energy savings carried out by the Government. However, although actual energy savings achieved from the different measures were not monitored on a

[97] Eyre, (2007)

before-and-after basis, the National Audit Office (in a report published in July 2004) found that "in administering the EEC, Ofgem has established robust arrangements for checking suppliers' schemes and obtaining reliable data." [98]

France

As of the end of 2006, 94 standardized savings actions had been defined, and standardized methodologies set up for estimating savings for these actions. These methodologies are based on "fast and straightforward user-friendly procedures" that are based on technical evaluations obtained by pilot projects and/or mathematical models.

Energy projects must be additional to business as usual. The criteria for additionality depend on the implementer of the particular energy savings project(s):

- For an obligated implementer or public municipality, any eligible energy savings activity is considered additional
- For eligible but non-obligated implementers, an eligible action is additional if the action implemented is not related to its main activity. This criterion therefore excludes all implementers whose core business is related to energy efficiency.

Additionality is determined based on the focus of the eligible actions: for example, for commercial new construction, additionality is based on the French building code for commercial construction, although no standardized saving action had been adopted for new buildings by the end of 2006. For insulation and energy systems such as boilers or electric heaters, the baseline is based on the existing stock of building or equipment. And for other products, such as electrical appliances, or installation of CFLs, the baseline is based on current sales, such as the average power of incandescent lamps installed in households, the estimated percentage of CFLs sold to replace incandescent lamps, and the annual consumption of equipment (refrigerators, freezers, etc.) based on a representative sample.

[98] Ofgem, (2004)

New South Wales

In New South Wales, there are three methods for calculating emission reductions from energy efficiency projects:

> The Default Abatement Factors Method specifies "default abatement factors," which are deemed or stipulated factors for certain common equipment and installations, such as CFLs, refrigerators, washing machines, motors, and the replacement of electric hot water systems with gas.
>
> The Metered Baseline Method is typically used in energy performance contracts. In this method, energy savings are calculated by conducting metering before and after the contractor's installation of an energy efficiency measure. Depending on the extent of variation in the baseline, the energy savings are then normalized, by using such factors as weather or occupancy.
>
> The Project Impact Assessment Method relies on engineering data to calculate energy savings. This method is used when the energy reductions are small compared to electricity consumption at the site, baseline energy consumption data for the site are unavailable (e.g., new construction), or the unexplained variation in the baseline is high.

Under the GGAS to date, 33 projects have used the Project Impact Assessment Method, 11 have used the Default Abatement Factors Method, and 3 have used the Metered Baseline Method. [99]

New South Wales uses different criteria for determining additionality than in the CDM. In New South Wales, all of the projects for creating emission reductions have to be additional to a

[99] Sniffin, (2006).

business-as-usual baseline. [100] This type of additionality is different than the criteria used for the CDM, where as was discussed earlier, the project would not have been implemented in the normal course of business in the absence of the GGAS.

[100] Crossley (2007); MacGill, Outhred, and Nolles, (2006)

V. REPORTING, TRACKING AND ACCOUNTING

Because of the similarities of market-based instruments for energy efficiency and renewables, it is useful to look at the experience with REC reporting, tracking and accounting systems to identify lessons that might be transferred to ESC systems.

REC Systems

From our investigation of REC systems, we identified four primary issues that are relevant to a discussion of ESCs: (1) establishing the property rights to the tradable certificate or instrument; (2) avoiding double counting/selling; (3) proving compliance with specific programs; and (4) integrating voluntary and compliance markets. Upon closer examination, we believe that these issues can be effectively addressed with the use of electronic tracking systems.

Both the European and US/Canada/Mexico REC systems use software similar to that used in electronic banking and transfer systems. These tracking systems are policy and technology neutral; they are an accounting system that establishes and follows the property rights to the RECs, tracks their transfer from the generator's account—where they are first issued to other accounts that have purchased the certificates, until claims are made and the certificates are "retired."[101] Since a specific REC may only be deposited into one account at any point in time, these tracking systems not only establish property rights, but also protect against double counting within their jurisdiction.

In these systems, a REC is issued every time a participating generator generates one MWh of power verified and reported by the control area operator. That certificate is issued, given a unique serial number, and deposited into the generator's account where it is held until it is either

[101] Once 'retired,' the REC with that unique serial number may not be re-circulated into the system for any future use. It is 'frozen' in a retirement account.

transferred to another account or retired. These tracking systems are only accounting systems; they are not involved in the financial transactions and do not serve as trading platforms.

Each certificate is accompanied by an electronic database with the following information:

- Technology/fuel type
- Project size
- Geographic location of project
- Owner of project
- Date of first operation of project
- Date of creation of the certificate and
- May also include associated emission data and eligibility of RECs from this project for particular programs.

Because there are major economies of scale associated with designing and operating a tracking system, most electronic systems cover broad geographic areas. As a result, there may be a number of different renewable energy programs in different states within a geographic area that all use the same tracking system. In such cases, although the eligibility and resource requirements for each REC program may vary widely, the database that accompanies each certificate allows program administrators and consumers to decide for themselves which certificates meet their personal, business, regulatory or program needs.

Moreover, for the most part, renewable energy tracking systems have the capacity and functionality to accommodate other data fields and other types of certificates besides those for renewable energy.

From when the European RECS tracking system first began operation in 2001, through September 2006, Europe's certification and tracking system issued approximately 157 million

MWh of RECs; some 60 million MWh were issued in 2005 alone.[102] In the U.S., approximately 37 million MWh of RECs were issued in 2005.[103]

Brief history of REC Systems

In 2001, the Renewable Energy Certificate System in Europe (RECS) was formed as a membership organization of companies with renewable energy obligations under the European Union who wanted to develop a model electronic system for issuing certificates, and reporting, tracking, and accounting for the attributes from renewable generation. The RECS tracking system is very active today. In addition to issuing and tracking RECs, it also issues certificates for co-generation and CHP systems.

In the United States, the first issuing and tracking systems were developed in conjunction with state RPS programs. In 2002, the Electric Reliability Council of Texas (ERCOT) established a generation information system to issue, track, and report on certificates used to administer the Renewable Energy Credit Program, an element of Texas' RPS policy. A short time later, the New England Power Pool (NEPOOL) instituted a similar reporting, tracking, and accounting system for all types of generation located in the New England region the New England Generation Information System, or NE/GIS.

Since then, several other tracking systems that have been implemented, or are under development, elsewhere in the United States: the Generation Attribute Tracking System (PJM/GATS), which is operational in Pennsylvania, New Jersey and Maryland; the Midwest Renewable Energy Tracking System (MRETS), which will cover Minnesota, Iowa, North and South Dakota, Wisconsin, Illinois and Manitoba; and the Western Renewable Energy Generation

[102] From the Association of Issuing Bodies (AIB) homepage: http://www.aib-net.org
[103] This total includes the number of 'eligible' renewable energy certificates issued by operational tracking systems, plus the number of voluntary RECs certified by Green-e. Data are from a combination of NREL and CRS data reports, although the number is probably an underestimate, since it may not fully reflect RECs issued for RPS compliance in states without tracking systems.

Information System (WREGIS), which will include eleven western states, the Canadian provinces of British Columbia and Alberta, and northern Baja, in Mexico.

Both MRETS and WREGIS are expected to become operational later in 2007. Of particular interest is that in addition to providing RPS-related compliance services, both systems were also developed with the voluntary renewable energy market in mind; under MRETS and WREGIS, certificates for both voluntary and mandatory renewable energy programs can be issued, tracked, and retired by the same tracking systems. [104]

PJM/GATS is run by a for-profit company under state regulatory oversight, while the other tracking systems are operated as a governmental (MRETS) or a quasi-governmental (ERCOT, WREGIS, NE/GIS) entity. In either case, "static" data, including the type of system, its size, date of first operation, etc., may be verified by either a governmental agency, such as the state's energy office, or as in Canada by an independent company—TerraChoice. "Dynamic data," notably plant energy output, are primarily collected directly from generation facility meters. Before being input into the information system, these data are verified by the operator of the transmission control area where the project is located.

Energy Savings Certificates

Since ESCs schemes are relatively new, the reporting, tracking, and accounting have generally been undertaken by the Agency responsible for the design of the program. Under this tracking method, which is used in the existing ESC systems as well as in most of the U.S. energy efficiency programs, the role of the regulator is to "accredit" by issuing the licenses to third parties and then auditing their performance. Because this type of approach has some aspects of self-regulation, it carries a higher amount of risk for policy makers. However, this approach can potentially reduce the overall cost of compliance and implementation—a major concern for ESC schemes. In the final analysis, then, who issues the certificates is not as important as ensuring

[104] Center for Resource Solutions, Green-e Verification Reports for 2002 through 2005, at: www.resource-solutions.org/index.htm.

the certificates themselves are based on verified data that are readily available either from the energy regulator, as in Italy, or from a certified verifier as is the case with other registry schemes.

To illustrate, we review the operation of tracking systems in Great Britain, Italy, and Connecticut.

Great Britain

In discussing Great Britain's ECC regime earlier, we noted that electricity and gas suppliers are required to report their achieved energy savings results to Ofgem on a quarterly basis, using a standardized spreadsheet developed by Ofgem. This information is used to compile Ofgem's quarterly EC Update report.

Once a project has been completed, Ofgem then confirms the exact types and numbers of measures that were installed, and also examines the results of the supplier's monitoring of the quality of installations and customer satisfaction, along with evidence from the relevant project partners (e.g., retailers and social housing providers). And additional procedures are in place to monitor each supplier's delivery of required energy efficiency services, and to oversee their progress against its target.

Italy

As mentioned previously, an important element in the Italian ESC scheme is that while the Regulator (AEEG) is responsible for overall implementation, the marketplace is organized and its operation is managed by the Electricity Market Operator (GME) according to rules and criteria approved by AEEG. The GME issues and registers ESCs upon specific request by AEEG, organizes market sessions, and registers bilateral over-the-counter (OTC) contracts in a Registry. Once registered, the ESCs are then available for trading. The ESCs are issued to all distributors and their controlled companies and to ESCOs. ESCs are tradable via bilateral OTC contracts, or on a spot market organized and administered according to rules set out jointly by the Regulator and the Electricity Market Operator.

Connecticut

Under the Connecticut RPS program, which begin earlier in 2007, a set of eligible Class III measures (such as energy efficiency, CHP, and demand response) are listed in the Department of Public Utility Control (DPUC)'s Technical Reference Manual along with their deemed values. The DPUC reviews and approves the savings and passes this information to the NE/GIS, which issues certificates for the savings and places them in the account of the entity that paid for the savings. From that point on, these certificates are treated the same as RECs and are used to show compliance with the state's RPS program. If the utility paid for the measures, then the certificates are issued to the utility's account. If not, then the utility must buy them from whoever produced the savings and transfer the certificates into the utility account. Connecticut uses an electronic tracking system for tracking, reporting and accounting for energy savings as well as electricity generation. The program officially began in January 2007.

Combining Renewable Energy and Energy Efficiency Issuing and Accounting Tasks

As we've indicated, we believe that it is entirely feasible for the same accounting systems used to track renewable energy to be used for energy efficiency savings as well. [105] Once an ESC is issued, an ESC would have approximately the same functionality needs as a REC. And, to the extent that the same system was used for both 'white' ESCs and 'green' renewable certificates, little, if any, additional infrastructure investment would be required, thus lowering the cost of using these electronic tracking systems for ESCs, and quite possibly lowering the overall transactional costs for all participants.

[105] The European RECS tracking system was asked recently by the European Commission to consider issuing and tracking ESCs.

Moreover, the fact that the existing tracking systems could serve both mandatory state programs and voluntary markets provides additional justification for considering trading ESCs in both markets. Clearly it is very important to recognize that to meet the requirements of a future federal energy policy aimed at reducing GHG emissions, these same systems could be linked as a national Energy Efficiency Resource Standard into one harmonized national certificate tracking network.

A fundamental issue associated with using an electronic tracking system for ESCs is the measurement and verification (M&V) of the savings: Who validates the calculations/measurements and who enters the information into the system? In the case of renewable energy, M&V issues are very straight forward since the data come directly from electronic meters and are verified by the control area operator, who is already verifying them for transmission purposes. In the case of RECs, because the data are obtained directly, the transaction costs are very low, and the reliability of the data is high.

In the case of ESCs, however, the energy savings data for the same volume of energy as produced by renewable electricity are quite diffuse and would need to come from many more sources. This extensive data collection means increased transaction costs. Moreover, additional transaction costs result from converting this information into credible certificates: because there is no automatic system for recording energy savings, this information must be entered manually, necessitating additional individual project and data review. How much this additional effort adds to the cost of ESCs will depend on the efficiency of the M&V programs and processes.

Some of the European literature expresses concern about trading ESCs for special purpose programs.[106] For example, the UK program requires 50 percent of the energy savings to come from low-income households. Should ESCs become a fungible and interchangeable commodity, then specific program goals could be subverted because of buying ESCs from sectors other than those intended.

106 International Energy Agency, (2006).

However, the issue of maintaining the goals of special purpose programs can be accommodated through a REC-type tracking system. Just as the database associated with RECs issued by renewable tracking systems is able to differentiate according to the source/type etc. of generation, it is also possible to do the same thing with ESCs for special purpose programs, by "red flagging" certain types of certificates to indicate that they can only be used for specific programs.

Double Counting/Selling

Double counting or double selling occurs when the same savings from the same activity are sold or traded simultaneously to two separate entities. Or, the same savings are claimed as credit for two different programs when the program rules do not allow such double counting. Double counting is a concern for renewable energy as well as for energy savings.

The use of ESCs and a network of tracking systems with clear and compatible protocols for issuing certificates and verifying static data can, at least minimize, if not completely eliminate double counting. These types of tracking system and networks issue certificates with unique serial numbers, and ownership of the certificates is established by having these certificates deposited in an owner's account—the same certificate cannot be held in two different accounts at the same time. Programs that use these systems to confirm compliance with particular targets usually require that the certificates used for compliance purposes be retired (put into a retirement account from which they may not be withdrawn again and used by anyone), and that a report be submitted from the system administrator to the regulating authority indicating the number and type of certificates retired in that participant's account.

VI. POTENTIAL TECHNICAL OPPORTUNITIES FOR ESCS

The use of RECs is established in the United States. Here, RECs are most commonly issued for the output from electric generating facilities. And while several of the tracking systems, including WREGIS and MRETS, are designed to issue certificates for behind-the-meter generation and thermal projects, most have not as yet developed the necessary protocols to do so.

There are similar measurement and verification issues with ESCs, as with behind the meter activities and thermal technologies. Each ESC is often diffuse and relatively small in size, requiring aggregation in order to reduce the transaction costs from measurement and verification.

The behind-the-meter and thermal technologies most likely to take advantage of ESCs include:

- Behind-the-meter renewable electricity generation (PV, wind, small biomass)
- Solar water heating
- Geothermal and air source heat pumps
- Renewable thermal power (waste heat at biomass facilities)
- "Smart Communities," where the entire community is designed in a manner that reduces all types of energy inputs, including electricity, natural gas, and heating and transportation fuels.
- Cogeneration and CHP

Because they reduce the customer's need for externally produced electricity, natural gas, or other fuels, these other activities serve as demand-reduction strategies. However, these activities are often not recognized as viable policy options, because proponents of renewable energy programs argue that they are not supply resources, or are designed only as a source for bulk power, while those favoring demand-side reduction programs believe these technologies represent the supply side and should be covered by renewable programs.

In Europe, however, many of these activities are included within energy savings programs. In Italy, for example, cogeneration, district heating and other thermal renewable energy applications, passive cooling, solar water heating, behind-the-meter renewable energy generation, and the promotion of electric and natural gas vehicles are listed as eligible projects. In addition, Great Britain's ECC includes solar water heating and CHP, and it now appears that France will include district heating and thermal renewable energy applications in their new ESC program.

To the extent that there is a desire to encourage greater use of these technologies and applications, there is no apparent reason that ESCs could not be used along with more traditional energy efficiency measures to meet such needs in a properly designed REC program that makes certain that the energy savings may be eligible for certificates from either the ESC or REC program, but not from both.

In considering these technology applications, one key issue stems from the fact that some of these measures save thermal energy, gaseous or liquid fuels, and not electricity; therefore, all the energy savings produced must then be standardized into one value to allow for issuing compatible certificates. In Italy, this is accomplished by converting all savings into tons of oil equivalent (toe). In Great Britain and France, all savings are converted to terawatt hours (TWh). Combining multi-energy sectors simply requires an additional calculation to bring all of the sources under the same unit of measure.

Similarly, in order to use RECs in GHG reduction programs, the RECs, which are measured in MWh, have to be converted to pounds of carbon (or carbon equivalent – CO2e) avoided. There has been a lot of research and debate concerning the proper methodology for doing this conversion. But whatever methodology is finally adopted, to the extent that ESCs might also be used as proof of GHG reductions or traded as offsets, the same methodology for converting a MWh of power generation would need to be applied to the savings from electricity. A different conversion factor would need to be used for natural gas or other fuel savings. Having a mixture of sectors represented by one energy unit could require going back to the database to convert everything into pounds of CO_2e. However, if an electronic tracking system is used for issuing, tracking and accounting for the certificates, an algorithm can be built into the software that can automatically convert the savings to pounds of CO_2e.

VII. POTENTIAL POLICY OPPORTUNITIES FOR ESCS IN THE UNITED STATES

For GHG reduction purposes, energy efficiency can either be an integrated part of a GHG cap and trade program or it can be handled through a separate but parallel energy savings program. Examples of the second approach are RPS (with energy efficiency targets) or EEPS programs, and utility and state energy efficiency programs (without hard targets[107]) that supplement a GHG cap and trade program that does not integrate energy efficiency. In addition, a national voluntary market for GHG reductions is gearing up that can supplement GHG reductions resulting from cap and trade programs. To the extent that such savings are real, measurable, verified and additional to business as usual, GHG reductions from energy efficiency measures could participate in this voluntary market. The issuing, use and tracking of real, measurable, verified and additional energy savings in the form of ESCs provides an opportunity for energy efficiency savings to be eligible and credible within a voluntary GHG market.

Under these approaches, the eight state programs described in this paper, as well as any other RPS programs that contemplate adding energy savings to their requirements, offer opportunities for incorporating ESCs as a market-based and credible accounting instrument. EEPS programs that may be proposed by other states or the Federal government could also provide ESC opportunities.[108]

Similarly, a state[109] and/or a federal GHG reduction program could consider including the use of energy savings as a GHG reduction strategy. While it may be some time before either becomes law, there are indications that the newly elected Congress may seek to pass legislation for a

[107] Programs with "hard targets" are ones that have specific penalties for not meeting the target (e.g. a fine). Significant financial penalties justify the incremental transactional costs of ESCs that might be associated with more rigorous measurement and verification requirements.
[108] A recent report on ESCs indicates that either a separate or combined portfolio approach will work, the decision depending upon state-specific considerations and politics; Nadel, (2006).
[109] Several state and regional bodies are moving in this area, notably —RGGI [the Regional Greenhouse Gas Initiative, a coalition of states in the northeast and mid-Atlantic region], California, Washington, Oregon, and New Mexico.

national EEPS and a national GHG reduction program. Tradable ESCs can be included in any reduction program containing market-based mechanisms. [110]

Regarding the design of a basic electricity or gas GHG cap and trade program, if the system is facility-based, where emitting facilities are capped and receive a share of the allowances, then energy efficiency measures would not be eligible to receive GHG benefits except where they are performed directly at the capped facility. However, under a load-based cap and trade program, energy efficiency has the potential to become an important GHG reduction tool, especially if there are "set asides" [111]and targets for energy efficiency, and the program can be designed in a manner that provides GHG benefits for "additional" efficiency measures.

Moreover, the use of ESCs would encourage energy efficiency programs that promote the aggregation of energy efficiency savings, either by government or by the private market. And to the extent that a robust market for tradable ESCs (or verified GHG reductions from ESCs) develops, the revenue from the sale of the credits could be used to offset program costs. In addition, such markets could be expanded to include real and verified energy efficiency benefits from certified green buildings and energy-efficient communities.

A supplemental voluntary market for ESCs could be created, similar to a currently functioning voluntary market for renewable energy.[112] Significantly, the market for RECs has prompted construction of new renewable energy facilities separate from any need to comply with mandates and other related renewable energy policies. It is estimated that more than 2,500 MW of new

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[110] Bertoldi and Rezessy, "Tradable certificates for energy efficiency," (2004), p. 32.

[111] A set aside is a pool of allowances that is used to award energy-efficiency and renewable-energy projects that reduce or displace electricity generation.

[112] There is currently a voluntary market for renewable energy, which represented approximately 12 million MWhs of RECs sold in the U.S. in 2005. This has been a very robust market that has increased exponentially every year since it first began in 2001/2 when approximately 180,000 MWh of RECs were sold. At that time, the majority of the purchases was from residential customers. In 2006, the majority of the purchases were from non-residential customers. For more information, see "Green-e Verification Reports for 2002 through 2005," by the Center for Resource Solutions, San Francisco, CA (www.resource-solutions.org/index.htm).

renewables have been brought on-line as a result of this voluntary REC market.[113] It is possible there would be a similar response to a robust ESC market. Moreover, in an ESC market, it would be possible for independent energy efficiency providers to compete in producing energy efficiency savings. By expanding the market beyond established utility energy efficiency programs and providers, the costs of energy savings programs and of the resulting credits could be reduced.[114]

Any ESC market would, however, need to be designed to be compatible with utility energy efficiency programs and also ensure it does not introduce any unintended consequences that would change the outcome from what was intended or expected. In such a trading system, the energy savings are verified, and the credits are determined and then awarded by the program administrator.[115] Suppliers could buy and sell ESCs, as could other entities that aggregate end-users (e.g., communities, non-profit organizations, etc.). The size of the credit is very important: it should be large enough to attract the interest of serious market participants, but small enough that potential participants are not excluded. And, as has been discussed earlier, in an ESC market it is important that associated transaction costs are kept to a minimum so that the system's benefits outweigh the costs of implementation and administration.

[113] This information came from NREL voluntary markets web site: http://www.eere.energy.gov/greenpower/resources/tables/new_gp_cap.shtm

[114] Nadel, op. cit. p.32.

[115] This could be done by state utility regulatory commissions, US Department of Energy (DOE), or the US Environmental Protection Agency (EPA).

VIII. ISSUES & BARRIERS

Here and in the following section, we describe the issues and challenges to establishing an ESC scheme as an effective and efficient method of using energy efficiency as a means for reducing GHG emissions. Because an ESC program is essentially a policy tool and not a formal policy, it is unlikely that a stand-alone ESC program will be implemented. Rather, development and implementation of an ESC program will likely be combined with either an energy efficiency portfolio standard (EEPS) or some other type of required energy efficiency target, or within an overall GHG reduction program.

There are a number of activities that need to be addressed in designing and implementing an ESC program, including:

- Program administration
- Program marketing
- Monitoring and evaluating projects (e.g., the issue of additionality)
- Setting energy savings targets
- Setting baselines
- Choosing reference technologies
- Establishing a process for issuing and tracking certificates
- Verifying the data that is the basis for issuing certificates
- Certifying certificates
- Establishing a trading system for certificates (if trading is allowed)
- Detecting noncompliance

Most of these activities are not specific to using ESCs, but are necessary in any regulated energy efficiency program, including when energy efficiency is incorporated into an overall GHG reduction effort. However, several activities are specific to the use of ESCs: (1) establishing a trading system; (2) verifying the data that are the basis for issuing certificates; and (3) certifying certificates.

In addition, there are several significant design and implementation issues associated with the above activities that we discuss in the following pages:

- Transaction costs
- Evaluation, measurement, and verification costs
- Eligible projects and cream skimming[116]
- ESCs and emissions trading
- Savings targets
- Integrating RECS and ESCs
- Ownership of ESCs
- Double counting/selling

Transaction costs

As noted earlier, a basic concern and possible barrier to the development of an ESC program will be transaction costs. Transaction costs may be high in ESC programs because: (1) the number of different activities that need to be conducted: (2) the number of potential participants in the residential, commercial, and industrial sectors that in turn leads to multiple interactions; and (3) the need for rigorous and systematic evaluation, measurement, and verification (EM&V) to maintain credibility. Further, among the factors influencing the administrative burden and the associated transaction costs are the number of regulated sources, the availability of data, and the level of reporting and monitoring needed. The result, therefore, is high transaction costs that negatively affect participation in an ESC program.

However, transaction costs can be reduced by: (1) bundling or aggregating energy efficiency projects, instead of a number of small, individual projects[117]; (2) using sampling in evaluating

[116] Cream skimming refers to the targeting of the most cost-effective energy efficiency measures with short payback times (also known as low hanging fruit), while excluding other cost-effective measures but with longer payback times.

projects, instead of evaluating every project; and (3) using deemed (stipulated) energy savings or engineering-based calculations, instead of monitoring or using field data. Moreover, as the participants become more experienced with the program requirements, transaction costs should correspondingly decrease over time.

Evaluation, Measurement and Verification Costs

As stated at the outset, the main focus of this research project is to assess how using ESCs can expand the use of energy efficiency as a method of reducing GHG emissions. And in order to evaluate the efficacy of energy efficiency as a resource that can reduce GHG emissions, as well as helping to meet other important economic, environmental, and energy system goals, reliable EM&V is essential to ensure the credibility, transparency, and consistency of ESC programs.

To reduce their EM&V costs, California, Pennsylvania, and Texas have developed protocols. And with these protocols as models, other states can quickly institute their own EM&V systems and reduce their transaction costs. In addition, a tiered approach, such as the white certificate scheme used in the Italian ESC system, is a good mechanism for reducing the EM&V costs for certain energy efficiency measures, such as using the deemed savings approach to reduce costs for energy suppliers and provide certainty to investors through the ex-ante evaluation of the energy efficiency projects.[118]

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[117] For example, a city could be a community aggregator by targeting energy efficiency improvements across hundreds or thousands of households. At such a large scale, the cost of financing and management would be less than if this was done by each household making their own investments.

[118] One possible pitfall of relying on deemed savings is that if only standardized EM&V methodologies are used, then more complex system-wide energy efficiency measures, such as whole building retrofits, will not receive attention due to the need for more complex EM&V systems. Here, ESCs will need to be integrated with other policy instruments, including public benefit funds and state tax credits, that promote new and emerging technologies and system-wide measures.

Eligible Projects and Cream Skimming

As is the case other energy efficiency programs, it is expected that most projects and measures in ESC programs will be highly cost effective, having relatively high benefits at low costs—so-called "low hanging fruit." But, is "cream skimming," where the first entrants are able to implement projects that are the most highly cost effective, good or bad? If the intent is to maximize energy savings, then cream skimming is an appropriate strategy, because you could obtain large quantities of relatively inexpensive energy savings in a short amount of time, with a quick payback. Here, the reliance is on already mature and competitive, or almost competitive, short term energy efficient technologies. However, from the perspective of greenhouse gas reduction programs, mature and competitive short-term energy-efficient technologies may not be considered additional and as such offer no benefits. In addition, such choices will mean "lost opportunities" for obtaining significant energy savings through energy efficiency measures, such as new construction, retrofits of whole buildings and other measures having long payback periods. Therefore, if ESCs are tied to energy savings goals, which are then tied to energy savings potential, then it is better for programs to use ESCs for long-payback measures.

Another issue that stems from cream skimming is the increased presence of "free riders." This might not be of great concern when considering how best to transform the energy market, because having free riders aids in promoting increased use of energy efficiency strategies. Still, it is important to determine whether the energy savings and emission reductions projects can be shown to be additional to any that would otherwise occur**; i**f strict additionality criteria are developed, the issue of free riders may be mitigated. Therefore, in evaluating the criteria for selecting projects to include in an effective ESC program, one needs to ask the following questions: Should all projects be eligible or only those that involve readily accepted technologies, or only those projects that can demonstrate additionality? Should incentives be provided for projects with long paybacks and are less likely to be developed?

ESCs and Emissions Trading

It is important to consider whether there should be direct linkages between ESCs and GHG emissions trading schemes. Projects that generate additional energy savings achieve reductions in CO_2 emissions.[119]

In Europe, ESCs and the EU's Emission Trading System (EU ETS) have been introduced in the energy sector in parallel. However, the existing ESC schemes and the EU ETS have significantly different characteristics and design features (e.g., obligated parties, covered sectors, measures, and methodologies for crediting towards energy targets). These differences present challenges for developing a common European carbon trading system incorporating ESCs.

While there is no emissions trading currently underway in the U.S., it appears that we are getting closer in establishing such markets. One might well argue that it is best to wait until these schemes are in place, and then integrate ESCs. But that begs the question of what would be the added value of ESCs? And regardless of any mandatory market system for reducing GHG emissions, voluntary markets will continue to play an important role in reducing emissions. Further, while some may continue to insist that it is best to wait until more practical experience has been accumulated about existing ESCs, there is no denying the benefits of learning by doing.

It is still unclear how much energy efficiency will be promoted by only the current approaches to emissions trading. Conceptually, ESCs can obtain more energy savings and quite possibly more cost-effective carbon reductions, particularly from sectors not currently covered by existing cap-and-trade systems, as is the case in the EU ETS, where households are not participants. The incremental cost for adding ESCs to trading schemes could be quite low, since these trading schemes will already have EM&V protocols.

Nevertheless, there are a number of practical and technical reasons to remain cautious in moving forward with efforts at integration. An integrated scheme may become too complex in

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[119] GHG reductions can be calculated from energy savings by various methodologies, including the use of average emission factors. E. Vine and J. Sathaye, Guidelines for the Monitoring, Evaluation, Reporting, Verification, Certification of Energy-Efficiency Projects for Climate Change Mitigation, Lawrence Berkeley National Laboratory, Publication: LBNL-41543, Berkeley, CA, (1999).

administrative and technical terms, making it difficult to manage and vulnerable to misreporting and other flaws, such as double counting. If not properly designed, integration may even undermine the overall effectiveness of the two schemes (for example, if the issuance of credits under the two schemes is affected by double counting).

Measuring and verifying the savings to certify the results remains a significant challenge. So, it is encouraging to point out that work in the U.S., Europe, and the CDM continues to make progress in answering the challenges and in the development of EM&V protocols for energy efficiency projects.

Savings Targets

Based on a study of the U.S. experience with energy efficiency resource standards (EERS), the authors recommended that future EERS savings targets be set at 0.8 percent per year of total retail sales. [120] Under routine conditions, savings at that level are at the upper end of historical experience. But in the present era of higher energy prices, and with new policy innovations such as "trading" for energy efficiency credits, such savings would seem to be realistically available. While those states just beginning to establish significant energy efficiency program may now lack the infrastructure and expertise comparable to states with established regimes, they potentially can achieve greater total energy savings from energy efficiency programs because they likely have many more "untapped" opportunities. For states without much experience with energy efficiency programs, they might initially establish more modest targets than the recommended 8 percent per year, but they could presumably increase their targets to higher levels within a reasonably short period. A five-year target of 5 percent is well within what

[120] M. Kushler, S. Nadel, and D. York. Energy Efficiency Resource Standards: The Next Great Leap Forward?, Proceedings of the 2006 Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, DC. (2006), 5.206-5.216.

leading states have achieved, and it is still below what numerous studies have shown is the total cost-effective potential for energy efficiency.[121]

Integrating RECs and ESCs

Historically, renewables and energy efficiency have been addressed as distinct policy issues. The use of ESCs could be important to developing a more productive integration of energy efficiency and renewable energy policies and programs. As was noted earlier, RECs and ESCs are essentially compatible, and the same accounting and tracking systems and can be used for both, thereby reducing overall transaction costs for both schemes. In addition, the use of tradable certificates in both renewables and energy efficiency has the potential to create synergies that increase the opportunities for combined renewables and efficiency programs. Such combined programs could be very beneficial in making the electricity sector cleaner and more environmentally sustainable.

There are some technologies that could fall under either energy efficiency or renewable energy, such as solar water heating, on-site generation, and geothermal heat pumps (see Section VI). Therefore, programs should be explicitly designed to ensure that the savings from these measures do not fall through the cracks because each program might conclude that the other program is more appropriate for the crediting of savings. Proper design is also important to eliminate double counting.

Here the issue is not which side of the ledger the savings should be counted, but that the savings are counted accurately and consistently. As an example, solar water heating should not receive energy savings certificates in one state and renewable energy certificates in another when both states (or both programs) are participating in the same national program. Nor should such technologies be restricted from being included in either set of programs. Clearly, adjustments

[121] S. Nadel. The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies, Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy-Efficient Economy, Washington, DC (2004).

will be needed in order to integrate programs and their eligible technologies under a common certificate issuing, tracking and verification system.

RPS Programs

There are issues associated with including energy efficiency measures as eligible within a RPS as opposed to establishing a separate EERS. We have found that such questions stem more from political expediency than public policy.

Since the first state enacted a RPS in late 1990s, the concept has become well understood, to the point where a state's consideration of adopting an RPS no longer creates insurmountable problems or entrenched opposition. Currently, there are more than 22 states with RPS laws, and other states are moving to adopt their own.

On the other hand, energy efficiency portfolio standards, or other state programs that set specific energy efficiency targets, are a fairly new policy concept. Today, only four states—California, Colorado, Texas and Vermont—have separate, independent efficiency standards. Four other states—Connecticut, Hawaii, Nevada and Pennsylvania, have energy efficiency targets as part of their renewable or alternative energy portfolio standard.

One of the issues raised in having both efficiency and renewables in the same program is that depending upon the situation, without separate targets, there could be less interest in continuing to investigate newer, experimental technologies.[122] Worse, proponents of renewables could wind up opposing energy efficiency and vice versa, which would be counter-productive given the need for both approaches, particularly to meet the challenge of global warming. Such conflict can be avoided by recognizing that both energy efficiency and renewable energy technologies/measures can benefit from using many of the same implementation tools, such as

[122] For example, in an area where energy efficiency has been very successful but renewables are lagging due to siting issues, allowing either to be used to reach a common target could remove the pressure for resolving the renewable siting problems, so renewables are never developed.

tradable certificates and certificate tracking systems, as well as sharing some common administrative functions.

In the final analysis, efficiency and renewables programs, whether in the same policy program or separate, should be understood as being compatible with individual energy savings targets and synergistic implementation approaches. The decision to integrate them into a comprehensive energy savings and emissions reduction strategy rests, not on structural issues, but on the particular focus and circumstances of individual states.

Ownership of ESCs

Another issue that will need to be settled is who owns the property rights to an ESC. Is it the person or company that provided the funding for the energy savings measure? Is it the person or company that installed the measure? If public benefit monies are used, how would that affect ESC ownership? If the energy savings measures were created under contracts that were silent with regard to ESC ownership, then how should ownership be established?

In approaching questions of property rights, it is important to recognize that similar issues have arisen in the renewable energy/RECs area, and have been settled for the most part through appropriate contract language and some regulatory rulings. For example, in January 2007 the California Public Utilities Commission ruled in Decision 07-01-018 that they would allow renewable distributed generation system owners to retain 100% of their renewable energy credits), and that utilities would not be able to count the output of renewable distributed generation facilities that have received ratepayer incentives toward the utility's renewable portfolio standard obligations. One might expect a similar decision favoring consumers (rather than utilities) when deciding on the ownership of carbon credits when public benefit funds are involved. The most difficult ownership issues are those associated with power purchase contracts entered into before the existence of RECs, and as a result, the contract is silent on the REC ownership issue.

In comparison, issues of ownership of ESCs raise additional questions. Who is responsible for EM&V? How is EM&V to be funded? Who is liable if the energy savings are not realized? Here, as experience with REC systems has demonstrated, the best solution to resolve these concerns is with explicit contract language that establishes the eligible source to making energy savings claims, and identifies who has the legal rights to any energy savings certificates, whether they exist at the time of contract signing or if they are created in the future. Further, should the existing contract be silent on energy savings certificates, but such certificates are expected to become a factor sometime during the life of the contract, the contract should include provisions for subsequent revision that allows for the clarifications of ownership of any ESCs at that time.

The general rule for RECs is that they "follow the money"—whoever made the primary investment in the renewables project receives the RECs and can then sell them, trade them, or deed them over to another party as they choose. Problems can occur where there is a split in the financing, such as if the RECs are from renewables funded with both public and private capital. In such cases, because of measurement and verification issues and transactions costs, absent specific contract or regulatory language (see California decision above), questions of ownership are generally resolved in favor of the party that invested the largest share of the money.

Double Counting/Selling

As discussed earlier, double counting/selling is one of the most challenging issues to an effective and efficient market for renewable or energy savings certificates. As broadly defined, double counting is the sale or use of the same certificate or attributes derived from one unit of renewable electricity or energy savings by more than one person or entity at the same time. Table 4 below provides examples of various types of double counting. While it is possible to verify energy savings or renewable energy production through the use of attestations and auditing of the contract path or chain of custody of such attributes, this approach breaks down, or becomes prohibitively expensive, for large volume markets (markets with many players and many transactions). Furthermore, as programs are developed that use ESCs, additional rules on potential double counting or double use situations will be needed to provide consistency with best practices that have been applied to RECs and other business transactions.

A contract between buying and selling parties that explicitly identifies the ownership of the various energy attributes reduces misunderstandings and inadvertent double selling/double counting. And, as was discussed earlier in the paper, one of the main reasons for using electronic accounting and tracking systems is to guard against double counting/selling. In issuing of certificates with unique serial numbers that can then be tracked electronically, such tracking systems are able to eliminate the problem of double counting/selling within their particular geographic service area. However, with national programs or national markets, it may be necessary to work with a number of different tracking systems. One effort now underway is with the North American Association of Issuing Bodies (NAAIB) that facilitates the coordination between the different tracking systems to ensure double counting/selling does not occur between one tracking system and another.

Table 4. Summary of Recommendations and Examples of Double Counting/Selling[123]

Double Counting/Selling				
	Double Sale	Partial Double Sale	Double Claiming	Double Use
Definition	Certificate is sold to more than one party	Portion of a certificate is sold to more than one party	More than one party is claiming ownership of a single certificate or portion of a certificate	One party is using the same certificate for more than one purpose or two parties own a single certificate sequentially and each use it, one after the other
Number of Parties Involved	2	2	2	1 or 2
Best Practice Recommendation	Should be prohibited in all cases	Should be prohibited in all cases	Should be prohibited in all cases	Regulators should develop explicit language to prevent circumstances of double use that are not intended.
Other Comments	Usually deliberate and fraudulent	May occur inadvertently due to customer confusion about what is included in product	Usually a result of unclear contracts or lack of understanding of TRCs	May be acceptable in some cases, depending on the legislative intent.
REC Example	A RE generator sells a single REC to two parties: a utility buying MWhs with the TRCs included in the contract, and a REC marketer.	A RE marketer sells a REC to a green power customer while simultaneously selling the CO_2 benefit to a private company so it can make greenhouse gas claims.	RE generator sells its RECs to a marketer and the electricity to a utility. The utility claims the electricity purchased is renewable on its disclosure label.	A utility uses a single REC to meet both an RPS requirement and to meet retail green marketing claims, as reflected on its disclosure label.
ESC Example	A company that has been issued ESC for their energy savings (or has bought such ESCs) sells a single ESC to two parties: a utility meeting its energy efficiency mandate and the ESC is included in a contract with an ESC marketer.	An ESC marketer retires an ESC to meet an efficiency target and sells the CO_2 benefit to another party that wants to use greenhouse gas claims.	A company receives ESC for their energy efficiency improvements and claims the benefits on their greenhouse gas registry. Then they sell the ESCs to another party that claims a reduction in their greenhouse gas footprint	A company receives ESCs for efficiency measures needed to gain the highest LEEDS level and also uses them to lower their greenhouse gas footprint.

[123] The RECs portion of this table is taken from: Jan Hamrin and Meredith Wingate, Regulator's Handbook on Tradable Renewable Certificates; Center for Resource Solutions, San Francisco, CA, (May 2003).

IX. ROADMAP FOR OVERCOMING ISSUES AND BARRIERS

As discussed above, we have identified four primary ways where there could be benefit in using energy savings certificates:

- As a method for verifying compliance with an energy savings target (such as an EEPS program);
- As a trading device (allowing ESCs to be bought, sold or traded) for parties required to meet an energy savings or GHG obligation;
- As a mechanism to demonstrate eligibility for tax incentives, subsidies or carbon offset programs; and
- Incorporating all of the above, wherever ESCs can be created and traded within a larger allowance, certificate or project credit trading regime where the ESC benefits are equal to or exceed their incremental costs.

In light of these four potentially beneficial uses for ESCs, we present our conclusions concerning their potential to be a major element within an energy efficiency performance standard as a GHG reduction strategy.

We begin by reiterating some of the major barriers to utilizing ESCs. First, as we have stressed, is the problem of transaction costs. We have pointed out that instituting a rigorous system of energy savings EM&V introduces additional costs, while at the same time, there are also benefits associated with greater certainty of the energy savings results that give these programs greater credibility.

Reporting and accounting costs can be perceived as a significant issue. However, as discussed previously, one means of reducing reporting and accounting costs is to piggy-back on the automated computer systems currently in use for electric generation information, such as REC tracking systems or Generation Information Systems (GIS). Since the incremental cost of adding additional fields to these tracking systems is relatively low, this could help lower accounting and reporting costs.

In almost all cases, state energy regulatory authorities have primary control over how these tracking systems are used. To then incorporate the issuing and tracking of ESCs into these systems would require:

- Agreement by the appropriate decision-makers, probably utility regulators and possibly environmental regulators;
- A discussion with the system operators to determine the systems' capacity to handle these activities;
- Development of any new system specifications, if necessary to accommodate ESCs;[124]
- Determination of the size of the ESCs that will be issued and the unit of measurement to be used;
- If appropriate, the identification of any conversion factors needed to convert to the common unit of measurement and to convert to CO2e;
- Development of the list of acceptable energy efficiency measures, or include all measures identified by participating programs;
- Development of EM&V protocols, as necessary, for each of the types of mechanisms;
- Determination of what static data are required (e.g. type of mechanism, geographic location, etc.) and how and by whom these data would be verified, such as by the regulator on a spot-check basis, or by third-party certifiers for each project; and
- Determination of how and by whom the energy savings data will be entered into the system.

In this regard, as mentioned earlier, a new non-profit organization is being formed, the North American Association of Issuing Bodies (NAAIB). NAIB will be a forum for the coordination and cooperation of existing and emerging systems issuing, tracking or registering electric generation or energy savings certificates, or related environmental attributes in North America. One of the goals of this new organization is to discuss common

[124] The Center for Resource Solutions has considerable experience in work with all of these systems. And in their opinion, very little, if any, changes to these systems would be necessary.

issues and resolve common problems. The NAAIB is expected to be launched in the summer of 2007, and if successful, it could act as a "one-stop shop" for developing common protocols and procedures for incorporating ESCs into existing and emerging tracking systems.

The other major task associated with reducing transaction costs is to streamline the EM&V processes without sacrificing credibility. Possible options to address this include the following:

- Use protocols established by other organizations (e.g., California's EM&V protocols[125]);
- Focus on those energy efficiency measures with energy savings that are relatively easy to calculate (e.g., deemed/stipulated savings) in the first phase of a program (followed by the inclusion of measures that require more intensive measurement and evaluation in the second phase of a program);
- Ensure rigorous and credible measurement and evaluation, so that later verification can be conducted more quickly and less expensively;
- Develop an infrastructure of trained measurement and evaluation professionals (upfront costs of training will reduce total program costs in the long run);
- Allow measurement and evaluation of "bundled projects," as long as the projects are similar in nature, scale, and geography; and
- Allow performance benchmarks for determining additionality, instead of a project-by-project analysis of additionality.

One of the overriding challenges to the question of reducing transaction costs is balancing costs with social justice—in other words, allowing everyone to participate compared to allowing only large customers and large firms to participate. The British ESC program, for example, is designed so that only residential customers can participate; however, because they target only to this specific sector, they expect to have high

[125] California Public Utilities Commission, California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals., San Francisco, CA (2006).

transactional costs. If, however, it is possible to reduce some of the transactional costs, this could make ESCs more attractive in all kinds of venues.

This presents the challenge of ameliorating the negative aspect of ESCs that is the result of making energy savings a commodity. As a commodity, the market will drive investment toward the least-cost energy savings mechanisms, possibly limiting (if not eliminating) investment in measures that would obtain considerable energy savings, but have high initial costs and longer payback times. If not carefully managed, this could undermine specific programs, such as weatherization for low-income households and increase the number of "missed opportunities" to achieve energy savings.

Therefore, at the core of any efforts to balance costs with social justice, is the need to determine what ESCs deliver that is worth extra transactional costs, and in what ways can they be used so not to cause perverse and unintended results.

To help reduce the transaction costs associated with more rigorous EM&V, our investigation finds ESCs might be most beneficially used for:

- Programs that require high levels of credibility such as:
    - Efficiency or GHG reduction targets that include significant penalties for non-compliance;
    - Programs where significant amounts of money are at stake such as, tax credits for capital intensive efficiency measures, carbon credits or GHG taxes;
- National or large regional programs where the use of ESCs for compliance purposes would significantly offset the administrative costs that would otherwise be required;
- Large, market-based programs that focus on the use of a trading scheme as a key compliance tool;
- Efficiency programs where the primary goal is obtaining as much energy savings as possible as rapidly as possible—including market transformation programs where the ultimate goal is to have everyone energy efficient;

- Measures with high initial costs such as new motors, processes and newer process technologies in the commercial and industrial sector, or whole building improvements, such as weatherization for low income ratepayers, or improvements for rental property, where third parties might be enticed into providing investment capital in exchange for the ESCs that might be produced.

We have also identified the following programs where the use of ESC schemes would be less attractive:

- Energy efficiency measures and programs that could be considered "business as usual" and not "additional" for the purpose of GHG reduction;
- Existing state and utility energy efficiency programs that do not justify the additional transactional costs and where the programs are operating efficiently as they are;
- Smaller energy efficiency programs where the transactional costs cannot be justified;
- Special purpose programs that are targeted toward "lost opportunities" (such as whole building retrofits, new construction and time-critical renovation or equipment replacement), or aimed at special subgroups, such as low-income housing, rental housing, etc., unless the program is specifically designed to use ESCs as an incentive to attract financing.

Based on our findings, the following governing principles are suggested to guide the development of sound ESC programs:

1. The rules and procedures for issuing ESCs should be transparent and make relevant information publicly available and discourage any gaming or fraudulent claims;
2. Programs that use ESCs should be as inclusive as possible, and allow for broad participation and support social and environmental justice;
3. Programs that use ESCs should be designed in a manner that does not exacerbate lost opportunities, undermine special needs, or make it more difficult to justify longer payback energy efficiency investments;

4. Technical provisions should ensure real, measurable, and verifiable energy savings that are beyond what can be considered business-as-usual; and
5. A mechanism for independent verification of the savings must be built into the system.

Incorporating ESCs into Greenhouse Gas Reduction Programs

There are two fundamental issues associated with incorporating ESCs into GHG reduction programs. One is how the basic cap and trade system is designed and how energy efficiency is included. The second issue is "additionality."

Regarding the design of a basic electricity or gas GHG cap and trade program, if the system is facility-based, where emitting facilities are capped and receive a share of the allowances, then energy efficiency measures would not be eligible to receive GHG benefits except where they are performed directly at the capped facility. However, under a load-based cap and trade program, energy efficiency has the potential to become an important GHG reduction tool, especially if there are "set asides" [126]and targets for energy efficiency, and the program can be designed in a manner that provides GHG benefits for "additional" efficiency measures.

When a program has as one of its primary goals the reduction of GHG emissions, then additionality will be the critical screening tool. As discussed earlier, additionality criteria have been used in conjunction with GHG reduction programs to show that a project or saving was undertaken because of a particular program and would not have happened otherwise. Several tests for additionality have been developed for the CDM and which could be applied in other GHG reduction programs. For example, one measure of additionality is "financial additionality," where the project could not have been financed without the revenue from selling carbon credits.

[126] A set aside is a pool of allowances that is used to award energy-efficiency and renewable-energy projects that reduce or displace electricity generation.

Though many energy efficiency measures are cost effective today, it is always important to minimize costs while maintaining the quality and integrity of a program. Therefore, for GHG reduction programs that are trying to minimize costs related to determining additionality, one could develop an initial list of eligible energy efficiency measures that would be considered additional without too much paperwork--such as, whole building improvements, measures with long-paybacks, and investments with split incentives (e.g. improvements on leased or rented property).

An issue related to additionality is how to integrate new energy efficiency GHG programs with existing utility energy efficiency programs, many of which are mandated by government. As with renewables, ESCs can be used for either government mandated programs or in voluntary markets, but not for both. And, as local governments, states, regions and possibly the Federal government design GHG cap and trade programs, these programs, and how the program's baseline is calculated, will further define what is additional.

Finally, because ESCs (and RECs) have transaction cost associated with them and have been denominated in fairly large units (e.g. MWh, TWh and Tonnes of CO_2), ESCs may not be appropriate for use in GHG reduction programs with measures that individually yield small savings. An exception would be for a program specifically designed to aggregate or bundle many small energy savings into a credible, easily verified savings pool, as long as all the projects are similar in nature, scale, and geography.

Roadmap for Effective ESC Programs

In conclusion, our research and analysis found that designing an effective energy efficiency program that uses ESCs must have the following elements:

- **Transparent rules and procedures:**
  In developing their rules and procedures, including any subsequent modifications or revisions, each of the ESC schemes that we examined made a concerted effort to make relevant materials available, usually via the Internet, and provided a process for the general public to review and comment. Based on public comments, drafts were reviewed and revised prior to issue. In addition, the results of audits and other program findings were also made available to the public.
- **Little or no proprietary information is withheld from the public:**
  We are not aware of any concerns over the release of proprietary information.
- **A measurement and evaluation system that ensures real, measurable, verifiable, and additional energy savings:**
  All ESC schemes that we reviewed provided a flexible approach for calculating energy savings for groups of measures (e.g., deemed/stipulated savings, or energy monitoring – Italy provides a good example). These approaches are based on international methods that have been tested in the field for over twenty-five years.
- **Independent third-party auditing for verification and compliance**:
  All ESC schemes that we reviewed included a third-party verification system to ensure credibility and accountability. For example, the Independent Pricing and Regulatory Tribunal of New South Wales conducts audits for verification and compliance.
- **A process for issuing and tracking certificates that avoids double counting:**
  All the ESC schemes that we reviewed included a process for issuing and tracking certificates. For example, the regulators in Great Britain and Italy -- along with the market operator -- are responsible for issuing and tracking the ESCs.
- **A system for detecting and penalizing noncompliance:**

All ESC schemes that we reviewed incorporated penalties for noncompliance in their programs. For example, France and New South Wales had fixed penalties while the penalties in Italy and Great Britain varied depending on the circumstances.

With these elements in place, we believe that an energy efficiency program using ESCs can efficiently and effectively operate in the voluntary or mandatory market for energy savings, assist with integrated energy resources planning, and be included in a program to reduce GHG emissions.

GLOSSARY

ADEME	French Agency for Energy Management
AEEG	Italy's Regulatory Authority for Electricity and Gas
ATEE	French Environment and Energy Association
BRE	Building Research Establishment
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
CHP	Combined Heat and Power
CRS	Center for Renewable Solutions
DEFRA	Department for Environment, Food, and Rural Affairs
DPUC	Department of Public Utility Control
DSA	Demand Side Abatement
EC	European Commission
EEC	Energy Efficiency Commitment
EEPS	Energy Efficiency Performance Standard
EERS	Energy Efficiency Resource Standard
EM&V	Evaluation, Measurement and Verification
ERCOT	Electric Reliability Council of Texas
ESC	Energy Saving Certificate
ESCO	Energy Saving (Service) Company
ETS	Emissions Trading Scheme
EU	European Union
EV	Efficiency Vermont
GGAS	Greenhouse Gas Abatement Scheme
GHG	Greenhouse Gas
GIS	Generation Information System
GME	Italy's Electricity Market Operator
HVAC	Heating, Ventilation, and Air Conditioning
ICC	Illinois Commerce Commission
IDF	Installation Discount Factor

IOU	Investor Owned Utility
IPART	Independent Pricing and Regulatory Tribunal of NSW
IPCC	International Panel on Climate Change
IPMVP	International Performance Measurement and Verification Protocol
LPG	Liquefied Petroleum Gas
M&V	Measurement and Verification
MRETS	Midwest Renewable Energy Tracking System
NAAIB	North American Association of Issuing Bodies
NE/GIS	New England/Generation Information System
NEPOOL	New England Power Pool
NGAC	NSW Greenhouse Abatement Certificate
NREL	National Renewable Energy Laboratory
NSW	New South Wales
Ofgem	Office of Gas and Electric Markets
OTC	Over The Counter
PJM/GATS	Generation Attribute Tracking System (in Pennsylvania, New Jersey and Maryland)
PSB	Public Service Board
PUC	Public Utilities Commission
PUCT	Public Utilities Commission of Texas
REC	Renewable Energy Credit
RECS	Renewable Energy Certificate System
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewables Portfolio Standard
TOE	Ton of Oil Equivalent
WREGIS	Western Renewable Energy Generation Information System

REFERENCES

Baker, D., Personal communication with David Baker, Nov. 6, 2006.

Bertoldi, P., Energy service companies and white certificates: The use of market forces to unlock investments in energy efficiency, presentation at the International Energy Efficiency Conference, London, Nov. 2, 2005.

Bertoldi, P. and S. Rezessy, Tradable certificates for energy efficiency: The dawn of a new trend in energy policy, *Proceedings of the 2004 Summer Study on Energy Efficiency In Buildings*, American Council for an Energy Efficient Economy, Washington, D.C., 2004.

Bertoldi, P. and S. Rezessy, Tradable Certificates for Energy Savings (White Certificates): Theory and Practice, European Commission, Joint Research Centre, Ispra, Italy, 2006.

Bertoldi, P., S. Rezessy, O. Langniss, and M. Voogt, White, green and brown certificates: How to make the most of them, Proceedings of the 2005 ECEEE Summer Study, European Council for an Energy Efficient Economy, Paris. 2005.

California Public Utilities Commission. California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals. California Public Utilities Commission, San Francisco, CA, 2006.

CBS News, "Rewriting the Science: Scientist Says Politicians Edit Global Warming Research," produced by Catherine Herrick and Bill Owens, aired March 19, 2006, available at: http://www.cbsnews.com/stories/2006/03/17/60minutes/main1415985.shtml

Center for Resource Solutions, Green-e Verification Reports for 2002 through 2005, San Francisco, CA, 2005, available at: www.resource-solutions.org/index.htm, or: http://www.green-e.org/getcert_re_veri.shtml

Costyn, J., Certificate trading for the UK's energy efficiency commitment, presentation at the Workshop on Energy Efficiency Certificate Trading, Milan, April 17, 2002.

Crossley, D., The White Certificate Scheme in New South Wales, Australia, presentation at the IEA Demand Side Management Program Task 14 Workshop on White Certificates, Paris, April 14, 2005.

Crossley, D., Personal communication with David Crossley, Nov. 23, 2006.

Crossley, D., Personal communication with David Crossley, Jan. 11, 2007.

European Commission, Green Paper on Energy Efficiency. Doing More with Less. European Commission, Brussels, final, June 22. 2005.

European Commission, Directive 2006/32/EC of the European Parliament and of the Council of April 5, 2006, on Energy End-Use Efficiency and Energy Services and Repealing Council Directive 93/76/EEC. European Commission, Brussels, April 5, 2006.

European Commission, Report on the Analysis of the Debate of the Green Paper on Energy Efficiency, Commission Staff Working Document, European Commission, Brussels, 2006.

European Council for an Energy Efficient Economy, French Law to Drive Down Energy Consumption, May 31, 2006, available at: http://www.eceee.org/news/news_2006/2006_05_31/

EuroWhiteCert Project, White Certificates: Concept and Market Experiences, 2006 available at: http://www.ewc.polimi.it/

EuroWhiteCert Project, White Certificates: Concept and Market Experiences, 2006 available at: http://www.ewc.polimi.it/

Eyre, N., Personal communication with Nick Eyre, Feb. 6, 2007.

Hamrin, J. and M. Wingate, Regulator's Handbook on Tradable Renewable Certificates, Center for Resource Solutions, San Francisco, CA, May 2003.

Independent Pricing and Regulatory Tribunal, Report to Minister, Compliance and Operation of the NSW Greenhouse Gas Abatement Scheme during 2005, Sydney, New South Wales, 2006.

Intergovernmental Panel on Climate Change, Fourth Assessment Report: The Physical Science Basis: Summary for Policymakers, Paris, 2007.

International Energy Agency/Implementing Agreement on Demand-Side Management Technologies and Programs, Task XIV: Market Mechanisms for White Certificates Trading, Final Report, 2006, available at: http://dsm.iea.org/NewDSM/library.asp

Karl, U., White certificates as an element of climate policy in France, presentation at the Workshop on Crucial Issues in Carbon Trading, Karlsruhe, March 5, 2004.

Kushler, M., S. Nadel, and D. York, Energy efficiency resource standards: The next great leap forward? Proceedings of the 2006 Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, DC., 2006. 5.206 - 5.216.

Langniss, O. and B. Praetorius, How much market do market-based instruments create? An analysis for the case of 'white certificates, Proceedings of the 2003 ECEEE Summer Study, European Council for an Energy Efficient Economy, Paris, 2003.

Lefebvre, H., The French Energy Law and White Certificates System, presentation at the Workshop on the Implementation of EU ESD, Berlin, Jan. 31, 2006.

Lovins, A., Energy End-Use Efficiency, presentation at the InterAcademy Council, September 19, 2005, available at http://www.rmi.org/sitepages/pid171.php#EnergyEff

MacGill, I., H. Outhred, and K. Nolles, Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry, Energy Policy, 2006, 34: 11-25.

Malaman, R. and M. Pavan, Energy efficiency certificate trading: Food for thought from a recently launched Italian scheme, presentation at the Workshop on Energy Efficiency Certificate Trading, Milan, April 17, 2002.

McGregor, P., Personal communication with Paul McGregor, Nov. 27, 2006.

Nadel, S., The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies, Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, D.C., 2004.

Nadel, S., Energy Efficiency Resource Standards: Experience and Recommendations, American Council for an Energy Efficient Economy, Washington, DC, 2006.

New South Wales, AU, NSW Greenhouse Gas Abatement Scheme, GGAS Newsletter, Issue 2, 2006, available at http://www.greenhousegas.nsw.gov.au.

Northeast Energy Efficiency Partnerships, Inc, Need for and Approaches to Developing Common Protocols to Measure, Verify and Report Energy Efficiency Savings in the Northeast, Lexington, MA, 2006.

Office of Gas and Electricity Markets, Energy Efficiency Commitment 2002-2005: Technical Guidance Manual Issue 3, Ofgem, London, 2004.

Office of Gas and Electricity Markets, A Review of the Energy Efficiency Commitment 2002-2005, Ofgem, London, 2005.

Office of Gas and Electricity Markets, A Review of the First Year of the Energy Efficiency Commitment 2005-2008, Ofgem, London, 2006.

Pavan, M., Personal communication with Marcella Pavan, Dec. 4, 2006.

Pavan, M.. New Trends in Energy Regulation: The Integration of Command and Control Approaches, Tariff Regulation and Artificial Markets for Demand-Side Resources, Proceedings of the 2006 International Association of Energy Economists (IAEE) Conference, Potsdam, Germany, 2006.

Pavan, M., The Italian White Certificates System: Measurement and Verification Protocols, presentation at the EU and ECEEE Expert Seminar on Measurement and Verification in the European Commission's Proposal for a Directive on Energy Efficiency and Energy Services, Bruxelles, Sept. 21, 2004.

Pavan, M., What's up in Italy? Market liberalization, tariff regulation and incentives to promote energy efficiency in end-use sectors, Proceedings of the 2002 Summer Study on Energy Efficiency In Buildings, American Council for an Energy Efficient Economy, Washington, DC, 2002

Public Utility Commission of Texas, Report to the 79th Texas Legislature, Scope of Competition in Electric Markets in Texas, Austin, TX, 2005.

Public Utility Commission of Texas, Report to the Texas Commission on Environmental Quality: Emission Reduction Incentive Grants, Austin, TX. 2005.

Revkin, Andrew, and Rosenthal, Elizabeth, Science Panel says Global Warming is 'Unequivocal,' New York Times, February 3, 2007, p.1.

Rezessy, S., P. Bertoldi, and M. Pavan Assessment of White Certificate Schemes and their Integration into the Carbon Markets, Proceedings of the 2006 Summer Study on Energy Efficiency In Buildings, American Council for an Energy Efficient Economy, Washington, DC, 2006.

Ruggieri, G., Options for the Integration of Energy End-use Efficiency and Energy Services into Green Power Products and Labels, report prepared as part of the EIE Project "Clean Energy Network for Europe (CLEAN-E), eERG, end-use Efficiency Research Group, Dipartimento di Energetica, Politecnico de Milano, 2006.

Schiller, S., C. Schroeder, J. Mapes, et al., Ratepayer Funds for Performance-Contracting---Three Approaches to Measurement and Verification and Market Outreach, in Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy-Efficient Economy., Washington, D.C, 2002.

Sniffin, M., New South Wales Greenhouse Gas Abatement Scheme: Demand Side Abatement – What's Happening and Lessons Learned, 2006, available at www.greenhousegas.nsw.gov.au

Sniffin, M., Personal communication with Margaret Sniffin, Jan. 23, 2007.

Sovacool, B.K. and M. A. Brown, eds., Energy and American Society: Fourteen Myths, Springer Press, NY, 2007.

Stern, Sir Nicholas, Stern Review on the Economics of Climate Change, HM Treasury, London, October 30, 2006, available at: http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

Summit Blue Consulting, LLC, Quantec, LLC, Teton Energy Partners, and Fox, Smolen & Associates, Independent Audit of Texas Energy Efficiency Programs in 2003 and 2004, Public Utility Commission of Texas, Austin, TX, 2006.

Timmons, H., Britain Warns of High Costs of Global Warming, New York Times October 31, 2006, available at http://www.nytimes.com/2006/10/31/world/europe/31britain.html?ref=world

Treehugger Online, An alternative to Green Tags—Sterling Planet's 'White Tags' November 2006, available at: http://www.treehugger.com/files/2006/05/an_alternative.php

United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Parties, Australia, 2007; available at . http://maindb.unfccc.int/public/country.pl?country=AU

U.S. Environmental Protection Agency, Waste Wise, Climate Change Case Studies, Washington, DC, October 2004, available at: http://www.epa.gov/wastewise/climate/pubs.htm .

Urvoas, L., Personal communication with Louis-Jacques Urvoas, Jan. 29, 2007.

Vine, E. and J. Sathaye, The Monitoring, Evaluation, Reporting, and Verification, of Climate Change Mitigation Projects: Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines, Lawrence Berkeley National Laboratory, Berkeley, CA, LBN-40316, 1997.

Vine, E. and J. Sathaye, Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Energy-Efficiency Projects for Climate Change Mitigation, Lawrence Berkeley National Laboratory, Berkeley, CA, LBNL-41543 1999.

Vine, E., M. Kushler, and D. York, "Myth #10: Energy Efficiency Measures are Not Reliable, Predictable, or Enforceable," Energy and American Society: Fourteen Myths, edited by B. K. Sovacool and M. A. Brown, Springer Press, NY. 2007.

Wingate, M., Design Guide for Renewable Energy Certificate Tracking Systems, National Wind Coordinating Committee, Green Markets and Credit Trading Work Group, Center for Resource Solutions, San Francisco, CA, June 2004.