Order Code RL34436

CRS Report for Congress

The Role of Offsets in a Greenhouse Gas Emissions Cap-and-Trade Program: Potential Benefits and Concerns

Updated June 2, 2008

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Prepared for Members and Committees of Congress

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Summary

If Congress establishes a greenhouse gas (GHG) emissions reduction program (e.g., cap-and-trade system), the treatment of GHG emission offsets would likely be a critical design element. If allowed as part of an emissions program, offsets could provide cost savings and other benefits. However, offsets have generated concern.

An offset is a measurable reduction, avoidance, or sequestration of GHG emissions from a source not covered by an emission reduction program. If allowed — **Table 1** compares offset treatment in proposals from the 110th Congress, including S. 2191, S. 1766, and S. 3036 — offset projects could generate "emission credits," which could be used by a regulated entity (e.g., power plant) to comply with its reduction requirement. Offsets could include various activities:

- agriculture or forestry projects: e.g., conservation tillage or planting trees on previously non-forested lands;
- renewable energy projects: e.g., wind farms;
- energy efficiency projects: e.g., equipment upgrades;
- non-CO_2 emissions reduction projects: e.g., methane from landfills.

Including offsets would likely make an emissions program more cost-effective by (1) providing an incentive for non-regulated sources to generate emission reductions and (2) expanding emission compliance opportunities for regulated entities. Some offset projects may provide other benefits, such as improvements in air or water quality. In addition, the offset market may create new economic opportunities and spur innovation as parties seek new methods of generating offsets.

The main concern with offset projects is whether or not they represent real emission reductions. For offsets to be credible, a ton of CO_2-equivalent emissions from an offset project should equate to a ton reduced from a covered emission source, such as a smokestack or exhaust pipe. This objective presents challenges because many offsets are difficult to measure. If illegitimate offset credits flow into an emissions trading program, the program would fail to reduce GHG emissions. Another concern is whether the inclusion of offsets would send the appropriate price signal to encourage the development of long-term mitigation technologies. Policymakers may consider a balance between price signal and program costs.

If eligible in a U.S. program, international offsets are expected to dominate in early decades because they would likely offer the lowest-cost options. Domestic sectors, such as agriculture and forestry, might benefit if international offsets are excluded. Some object to the use of international offsets due to concerns of fairness: the low-cost options would be unavailable to developing nations if and when they establish GHG emission targets. However, some offset projects may promote sustainable development. On the other hand, international offsets may serve as a disincentive for developing nations to enact laws or regulations controlling GHG emissions because many projects would no longer qualify as offsets.

Contents

List of Figures

List of Tables

The Role of Offsets in a Greenhouse Gas Emissions Cap-and-Trade Program: Potential Benefits and Concerns

Introduction

A variety of efforts to address climate change are currently underway or being developed on the international, national, and sub-national levels (e.g., individual state actions or regional partnerships).[1] These efforts cover a wide spectrum, from climate change research to mandatory greenhouse gas (GHG) emissions reduction programs.[2] In the 110th Congress, Members have introduced a number of proposals that would establish a national GHG emissions reduction regime.

GHG emissions reduction programs, both ongoing and proposed, vary considerably. The primary variables are scope and stringency: which emission sources are covered by the program and how much emission reduction is required.[3] These factors largely determine the impacts of an emissions reduction program, but other design details can have substantive effects.

One such design element is the treatment of offsets. An offset is a measurable reduction, avoidance, or sequestration of GHG emissions from a source *not covered* by an emission reduction program. If a cap-and-trade program includes offsets, regulated entities have the opportunity to purchase them to help meet compliance obligations.[4]

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[1] In 1992, the United States ratified the United Nations Framework Convention on Climate Change (UNFCCC), which called on industrialized countries to initiate GHG reduction. The UNFCCC defines GHGs to include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFC), and perfluorocarbons (PFC).

[2] See CRS Report RL33826, *Climate Change: The Kyoto Protocol, Bali 'Action Plan,' and International Actions*, by Susan R. Fletcher and Larry Parker; CRS Report RL31931, *Climate Change: Federal Laws and Policies Related to Greenhouse Gas Reductions*, by Brent D. Yacobucci and Larry Parker; CRS Report RL33812, *Climate Change: Action by States To Address Greenhouse Gas Emissions,* by Jonathan L. Ramseur.

[3] See CRS Report RL30024, *U.S. Global Climate Change Policy: Evolving Views on Cost, Competitiveness, and Comprehensiveness*, by Larry B. Parker and John E. Blodgett.

[4] In this way, offsets would complement the more traditional emissions trading that can occur between two covered sources. For example, a covered source (e.g., power plant) can make reductions beyond its compliance obligations and then sell these reductions as credits to other covered sources. This type of transaction represents the "trade" component of a cap-and-trade program.

Offsets have generated debate and controversy in climate change policy. If Congress establishes a federal program to manage or reduce GHG emissions, whether and how to address offsets would likely be an important issue. Because most current and proposed programs allow offsets (see **Table 1**), offset projects will probably play some part in an emissions reduction program.

The first section of this report provides an overview of offsets by discussing different types of offset projects and describing how the offsets would likely be used in an emission reduction program. The next section discusses the supply of offsets that might be available in an emission trading program. The subsequent sections examine the potential offset benefits and the potential concerns associated with offsets. The final section offers considerations for Congress. In addition, the report includes a table comparing the role of offsets in selected emission reduction programs: proposals in the 110th Congress, U.S. state initiatives, and international programs.

Offsets: An Overview

Offsets are sometimes described as project-based because they typically involve specific projects or activities whose primary objective is to reduce, avoid, or sequester emissions. Because offset projects can involve different GHGs, they are quantified and described with a standard form of measure: either metric tons of carbon-equivalents (mtC-e) or metric tons of CO_2-equivalents (mtCO_2-e).[5]

To be credible as offsets, the emissions reduced, avoided, or sequestered must be *additional* to business-as-usual (i.e., what would have happened anyway). This concept is often called "additionality." If Congress establishes a GHG emission cap-and-trade program, only sources not covered by the cap could generate offsets.[6] Emission reductions from regulated sources (e.g., coal-fired power plants) would either be required or spurred by the emissions cap.[7] In contrast, if agricultural operations were not covered under an emissions cap, a project that collects methane emissions from a manure digester would likely be an *additional* GHG emission reduction.

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[5] An emissions cap might require only CO_2 emission reductions, but still allow CO_2-e offsets from projects that involve non-CO_2 GHGs.

[6] Although Congress could address GHG emissions with alternative policies — e.g., by enacting a carbon tax or setting emission limits for each source type ("command-and-control) — the option to use offsets is generally discussed in the context of a cap-and-trade regime. Offsets could be a component of a carbon tax framework (e.g., as tax credits), but that discussion is beyond the scope of this report.

[7] For instance, if a covered source reduced its emissions beyond its compliance obligation, the source could sell the reductions as "credits" to other sources subject to the cap. This financial opportunity would create the incentive for sources to find and make reductions beyond their compliance obligations. These type of exchanges represent the foundation of the cap-and-trade system.

If offsets are allowed as a compliance option in an emissions trading program, eligible offset projects could generate "emission credits," which could be sold and then used by a regulated entity to comply with its reduction requirement.[8] This approach is part of the European Union's (EU) Emission Trading Scheme (ETS), which EU members use to help meet their Kyoto Protocol commitments.[9] Under the EU ETS, regulated entities can purchase emission credits that are created from approved offset projects.[10] Regulated entities can then apply the credits towards their individual emission allowance obligations.[11] For example, a regulated entity may consider purchasing offsets if the offsets are less expensive than making direct, onsite emission reductions. Assuming the offset is legitimate — i.e., a ton of carbon reduced, avoided, or sequestered through an offset project equates to a ton reduced at a regulated source — the objective to reduce GHG emissions is met. From a global climate change perspective, it does not matter where or from what source the reduction occurs: the effect on the atmospheric concentration of GHGs would be the same.

Offsets increase emission reduction opportunities. When offsets are not allowed, incentives to reduce emissions or sequester carbon are limited to the covered sources, and there is little motivation to improve mitigation technologies for non-covered sources. Including offsets in a cap-and-trade program would expand these incentives.

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[8] For comparison purposes — e.g., estimating the quantity of offsets and potential offset benefits — this report generally assumes that emission sources and sequestration activities will either not be regulated in any fashion or they will qualify as offsets. However, there are alternative means of addressing emission sources and sinks that are often considered good candidates for offsets. See the Text Box on p. 8: Policy Alternatives to Offsets.

[9] For more information, see CRS Report RL34150, *Climate Change: The EU Emissions Trading Scheme (ETS) Gets Ready for Kyoto*, by Larry Parker.

[10] The credits are called "certified emission reductions" (CERs) or "emission reduction units" (ERUs), depending on whether they originate from the Clean Development Mechanism (CDM) or from Joint Implementation projects, respectively. The CDM is the Kyoto Protocol compliance mechanism, which has been used widely in the EU-ETS, that allows for developing nations to generate offsets and sell them to regulated sources in developed nations. The CDM was established by Article 12 of the Kyoto Protocol. For more information on the Kyoto Protocol's "flexible mechanisms," see [http://unfccc.int/kyoto_protocol/mechanisms/items/1673.php].

[11] Although the credits are equivalent to allowances in environmental and economic terms, they are not interchangeable. For more on the EU ETS, see CRS Report RL33581, *Climate Change: The European Union's Emissions Trading System (EU-ETS)*, by Larry Parker.

Voluntary Offsets

Although this report focuses on the use of offsets in a mandatory GHG emissions reduction program, offsets are generating interest and debate in other contexts. In the United States and around the world, a growing number of businesses, interest groups, and individuals are purchasing offsets and claiming that all or part of their GHG-emitting activities (e.g., travel or specific events) are "carbon neutral." The motivation for these purchases can vary. Some businesses may be seeking to enhance their public image; others may hope to take credit for the offsets in a future GHG reduction program. The exchanges represent a voluntary market for offsets because there is no requirement for the parties to curtail their emissions.

At least 30 companies and organizations sell offsets to individuals or groups in the voluntary carbon market. The quality of the offsets vary considerably, largely because there are no commonly accepted standards. Some offset sellers offer offsets that comply with the more explicit standards of the Kyoto Protocol's Clean Development Mechanism. Other sellers offer offsets that meet the seller's self-established guidelines, which may be considered proprietary information, and thus not publicly available.

Due to the lack of common standards, some observers have referred to the market as the "wild west." This should not suggest that all offsets are low quality, but that the consumer must adopt a buyer-beware mentality when purchasing offsets. For more information, see CRS Report RL34241, *Voluntary Carbon Offsets: Overview and Assessment*, by Jonathan L. Ramseur.

Offset Types and Examples

Offsets could potentially be generated from an activity that emits GHGs or that would remove or sequester GHGs from the atmosphere. This section discusses offsets in four categories. Each category is discussed below with project examples for each group.

Some of the categories and examples listed below may be limited by location. If a U.S. law or regulation (other than an emissions cap) governs a specific emission source (e.g., methane from coal mines), that source's emission reductions would not qualify as domestic offsets, unless the reductions made went further than the regulations required.[12] For example, if the source is required by law or regulation to reduce methane emissions by 50%, reductions up to this threshold would *not* qualify as offsets, but reductions in excess of 50% might qualify as offsets. As more nations establish mandatory caps or require specific technological controls or practices at emission sources, the universe of potential offsets would shrink.

[12] If the source was subject to an emissions cap, reductions beyond compliance obligations would be sold directly as emission credits.

Biological Sequestration. Trees, plants, and soils sequester carbon, removing it from the earth's atmosphere. Biological sequestration projects generally involve activities that either increase existing sequestration; or maintain the existing sequestration on land that might otherwise be disturbed and release some or all of the sequestered carbon. This offset category includes sequestration that results from agriculture and forestry activities, and is sometimes referred to as land use, land use change and forestry (LULUCF) projects. Example of these projects include:

- planting trees on previously non-forested land (i.e., afforestation);
- planting trees on formerly forested land (i.e., reforestation);
- limiting deforestation by purchasing forested property and preserving the forests with legal and enforcement mechanisms;
- setting aside croplands from agricultural production to rebuild carbon in the soil and vegetation; and
- promoting practices that reduce soil disruption: e.g., conservation tillage and erosion control.[13]

Compared to the other offset categories discussed here, biological sequestration projects, particularly forestry projects, offer the most potential in terms of volume. However, this category is arguably the most controversial because several integrity issues are typically (or perceived to be) associated with biological sequestration projects. These issues are discussed in more detail in later sections of this report.

Renewable Energy Projects. Historically, renewable energy — e.g., wind, solar, biomass — has been a more expensive source of energy than fossil fuels.[14] A renewable energy offset project could provide the financial support to make renewable energy sources more economically competitive with fossil fuels. Renewable energy sources generate fewer GHG emissions than fossil fuels, particularly coal. Wind and solar energy produce zero direct emissions. Use of renewable sources would avoid emissions that would have been generated by fossil fuel combustion. These avoided emissions could be sold as offsets. Potential renewable energy offset projects may include:[15]

- constructing wind farms to generate electricity;
- adding solar panels;
- retrofitting boilers to accommodate biomass fuels;
- installing methane digesters at livestock operations.[16]

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[13] For more information on agricultural activities, see CRS Report RL33898, *Climate Change: The Role of the U.S. Agriculture Sector*, by Renee Johnson.

[14] This comparison does not account for the externalities associated with fossil fuel combustion: air pollution, environmental degradation, health problems linked to emissions, etc.

[15] In addition, some may argue that nuclear energy could be considered a renewable energy. This debate is beyond the scope of this report.

[16] The digesters capture the methane, which can be used for energy purposes.

Domestic renewable energy projects are not likely to qualify as offsets in a national emissions reduction program. In a carbon-constrained context, project developers would be hard-pressed to demonstrate that a renewable energy project would not have happened anyway. In an "economy-wide" cap-and-trade emissions program, energy sector emissions would likely be capped.[17] The cap would make fossil fuels more expensive and renewable energy sources more attractive. In fact, none of the congressional proposals (see **Table 1**) that allow offsets specifically allow the use of renewable energy offsets. However, renewable energy projects may still create credible offsets in nations without GHG emission controls on their energy sectors.

Energy Efficiency. A more energy efficient product or system requires less energy to generate the same output. Improvements in energy efficiency generally require a financial investment in a new product or system. These capital investments likely pay off in the long run, but the payback period may be too long or capital financing may be constrained, particularly for small businesses or in developing nations. Examples of possible energy efficiency offset projects include:

- Upgrading to more efficient machines or appliances;
- Supporting construction of more energy efficient buildings;
- Replacing incandescent light bulbs with fluorescent bulbs.

Similar to renewable energy offsets, domestic energy efficiency offset projects would likely face substantial hurdles in proving their additionality in a carbon-constrained regime. As the price of carbon increases and raises energy prices — both outcomes expected with an emissions cap — the incentive to reduce energy use through energy efficiency improvements will increase.

Offset ownership is another potential challenge regarding some energy efficiency offsets. Energy efficiency improvements may occur at a different location than the actual reduction in emissions. For example, a business that runs its operations with purchased electricity will use less electricity if energy efficiency improvements are made, but the actual emission reductions will be seen at a power plant. Thus, the reductions may be counted twice: first as an energy efficiency offset and second as a direct reduction at the power plant. One way to address this potential dilemma is to restrict energy efficiency projects to only those that reduce or avoid *on-site* combustion of fossil fuels. This approach is used in the few congressional proposals that specifically allow energy efficiency offsets.

As with renewable energy projects, there could be energy efficiency projects in nations that do not limit GHG emissions.

Non-CO_2 Emissions Reduction. Multiple sources emit non-CO_2 greenhouse gases. These emissions are often not controlled through law or regulation. These sources — primarily, agricultural, industrial, and waste management facilities — emit GHGs as by-products during normal operations. In

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[17] See CRS Report RL33846, *Greenhouse Gas Reduction: Cap-and-Trade Bills in the 110th Congress,* by Larry Parker and Brent D. Yacobucci.

many cases, the individual sources emit relatively small volumes of gases. However, there are a large number of individual sources worldwide, and many of the gases emitted have greater global warming potential (GWP) than carbon dioxide.[18] Offset projects in this category would generally provide funding for emission control technology to reduce these GHG emissions. Examples of emission reduction opportunities include the following:

- Methane (CH_4) emissions from landfills, livestock operations, or coal mines (GWP = 25)
- Nitrous oxide (N_2O) emissions from agricultural operations or specific industrial processes (GWP = 298)
- Hydrofluorocarbon (HFC) emissions from specific industrial processes, such as HFC-23 emissions from production of a refrigerant gas (GWP of = 14,800)
- Sulfur hexafluoride (SF_6) from specific industrial activities, such as manufacturing of semiconductors (GWP = 22,800)

This offset category is broad, as it involves many different industrial activities. As such, some offset types in this category are generally considered high quality, and others that have generated controversy. For example, methane reduction from landfills or coal mines has a reputation as a high quality offset. These projects are relatively easy to measure and verify, and in many cases would likely not occur if not for the financing provided by an offset market. Therefore, the challenge of proving additionality is easier to overcome.

Offsets involving abatement of HFC-23 emissions from production of a common refrigerant[19] have spurred controversy. Of the offset types certified through the Kyoto Protocol's Clean Development Mechanism (CDM), HFC-23 offsets represent the greatest percentage: 50% of the certified emission reductions (CERs) have come from HFC-23 abatement projects.[20] Controversy has arisen because the production facilities can potentially earn more money from the offsets (destroying HFC-23 emissions) than from selling the primary material.[21] This creates a perverse incentive to produce artificially high amounts of product to generate a more lucrative by-product.

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[18] GWP is an index of how much a GHG may contribute to global warming over a period of time, typically 100 years. GWPs are used to compare gases to carbon dioxide, which has a GWP of 1. For example, methane's GWP is 25, and is thus 25 times more potent a GHG than CO_2. The GWPs listed in this report are from: Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis* (2007), p. 212.

[19] Chlorodifluoromethane, referred to as HCFC-22.

[20] Of the CERs expected to be issued by 2012, the percentage drops to 22% (still the highest percentage by offset type). See the United Nations Environment Programme (UNEP), CDM Pipeline data, at [http://cdmpipeline.org/index.htm].

[21] This calculus depends on the market price for offsets. See Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, Working Paper #56, Stanford Center for Environmental Science and Policy (2006).

Policy Alternatives to Offsets

Policymakers have alternative methods of addressing the emission sources and sinks that are often considered to be candidates for offsets. Some of these options are discussed below.

Emissions Cap. Congress could expand the scope of the emissions cap to include emission sources that were previously excluded. The rationale for initially excluding these sources is that they are large in number, and they individually generate a relatively small quantity of emissions. Therefore, an offset program is arguably a more cost-effective means of achieving reductions from these sources. However, including certain sources, while excluding others, may raise issues of fairness. For example, some may question why specific sources are capped, while other sources can generate financial gain through the offset market. This discussion is beyond the scope of this report.

Emissions Standards. Instead of allowing offsets from non-capped sources, Congress could establish sector-specific emission performance standards or technological requirements. This approach is sometimes described as "command-and-control." Such a policy could be applied to both emission sources and sequestration activities. If Congress sets a baseline requirement, reductions or sequestration beyond the minimum requirement could qualify as offsets.

Set-Aside Allowances. One possible design element of an emission control program is for policymakers to allot a specific percentage of emission allowances from the overall emissions cap to non-regulated entities (i.e., parties not subject to the emissions cap). These allowances are often described as set-asides. In a carbon-constrained context, the set-aside allowances are essentially currency because they could be sold to regulated facilities to help meet compliance obligations. Set-asides can be allocated to parties to promote various objectives, including support for activities that reduce, avoid, or sequester emissions. The allowances may also be distributed for other purposes, such as transition assistance to specific economic sectors or financial support to low-income households. These groups may pay proportionately higher costs in an emission reduction regime.

Although both set-aside allowances and offsets would address emissions in sectors not subject to the cap, their impacts on regulated sources would differ substantially. Set-aside allowances are within the emissions cap. Offsets represent compliance options from sources outside of the cap. Neither offsets nor set-asides would alter the GHG reduction goal of the program: the cap would remain the same. However, offsets would increase the emission reduction opportunities available to regulated sources; set-aside allowances would not.

Potential Supply of Offsets

The potential supply of offsets available for an emissions trading program would be determined by many variables. The first potentially limiting factor would be the design of the system. The wider the scope of the cap-and-trade program, the smaller the offset universe. In addition, policymakers may choose to restrict the types and locations (domestic versus international) of offsets eligible for use by a regulated entity (see **Table 1**).

Within these programmatic boundaries, the supply of offsets available would be primarily dependent on the price of carbon and the advancement of techniques to reduce or sequester emissions. In a cap-and-trade program, the carbon price would be the market price of a tradeable emission allowance.[22] The supply of offsets would fluctuate as the allowance price changes. If the allowance price is relatively low — i.e., $1 to $5/mt$CO_2$-e — only the "low-hanging fruit" projects would be financially viable. If the allowance price is higher, more offset projects would become economically competitive.

A 2005 EPA study estimated the potential of the U.S. agriculture and forestry sectors to reduce, avoid, or sequester GHG emissions (referred to in the study as "mitigation potential").[23] The study evaluated the effects of different carbon prices on this potential.[24] The study found that in the year 2015 the mitigation potential (or offset supply) from these sectors would vary widely, depending on the price of carbon (**Figure 1**).[25] If the price were $1/mt$CO_2$-e, these sectors would potentially generate 121 million mtCO_2-e of offsets; if the price rose to $50/mt$CO_2$-e, almost 1,500 million mtCO_2-e of offsets would potentially be available. To put these numbers in context, the United States is projected to generate approximately 7,736 million mtCO_2-e in 2015.[26] These results are included in this report to indicate the

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[22] The allowance price would be influenced by several factors. The central factor would be the structure of the emission reduction program, particularly the program's scope (which sources are covered) and stringency (the amount and timing of required emission reductions).

[23] U.S. Environmental Protection Agency (EPA), *Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture* (2005).

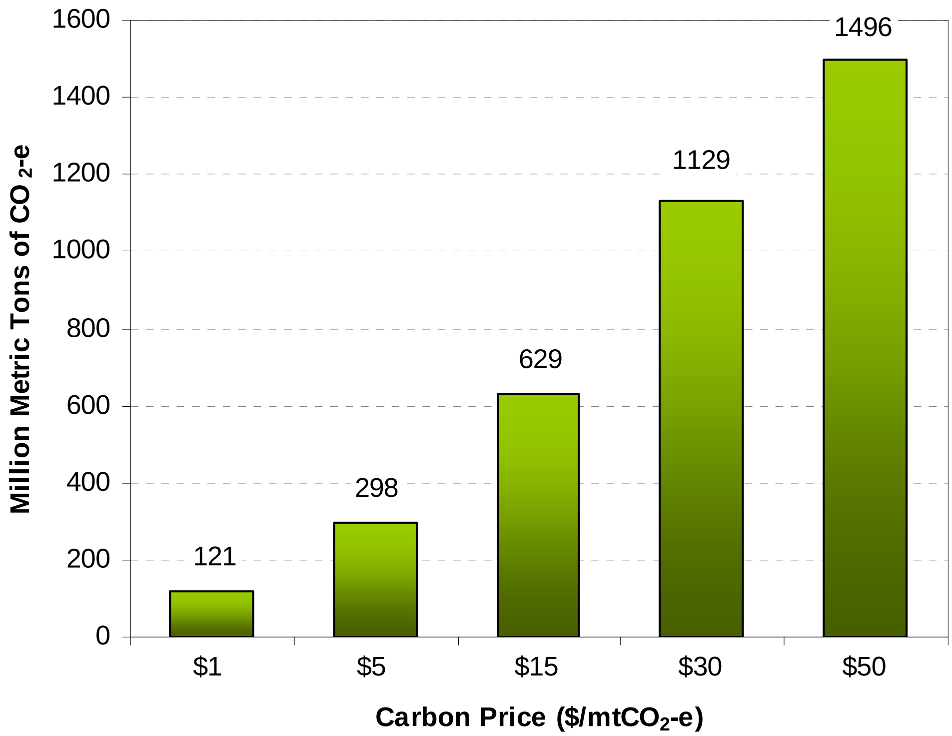
[24] Although the study did not address different means of implementing the price structure, one mechanism would be to allow parties to generate offsets and sell the offsets to regulated entities for compliance purposes.

[25] The mitigation options in these sectors included afforestation, forest management, soil sequestration, fossil fuel reduction/avoidance from crop production, agriculture-related methane and nitrous oxide mitigation, and biofuel production.

[26] This figure reflects *net* GHG emissions, thus includes emission sinks (e.g., land-based activities). The figure is derived from a linear extrapolation of projections for 2012 and 2020. See U.S. Department of State, *Fourth Climate Action Report to the UN Framework Convention on Climate Change*, Table 5-2 (2007).

relative differences in mitigation potential at different carbon price levels. Note that EPA's estimate differs from other prepared estimates.[27]

Figure 1. Estimated Annual Supply of Offsets from U.S. Agriculture and Forestry Sectors at Different Carbon Prices (in 2015)



Source: Prepared by the Congressional Research Service (CRS) with data from EPA, *Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture* (2005).

Figure 2 shows an estimate of the domestic supply of offsets from methane and nitrous oxide reduction projects, including methane reduction from natural gas and oil systems, landfills, and agriculture; and nitrous oxide reduction from agriculture. As with the biological sequestration offsets, more methane/nitrous oxide reduction projects become economically viable as the price of carbon increases. The estimated supply of these offset types is considerably less than the potential supply of biological sequestration offsets.

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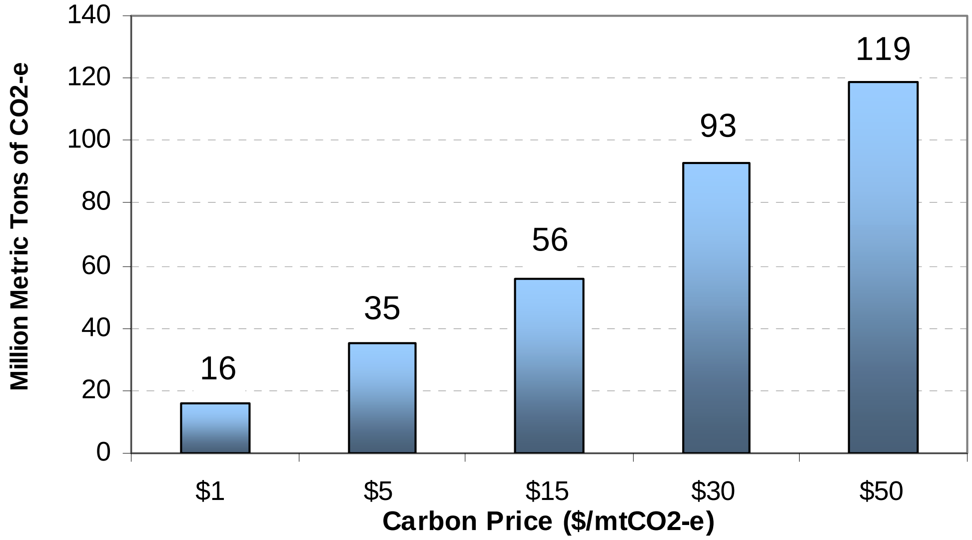
[27] For example, a 2007 EIA study estimated that in 2015 at a carbon price of \$15/mtCO_2-e, 122 million mtCO_2-e (compared to EPA's estimated 629 million mtCO_2-e) would be available as offsets. U.S. Energy Information Administration (EIA), *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007* (2007).

Figure 2. Estimated Annual Supply of Offsets from U.S. Methane and Nitrous Oxide Reduction Projects at Different Carbon Prices (in 2015)



Source: Prepared by CRS with data from EIA, *Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007* (2007).

Note: The data in Figures 1 and 2 were generated from different government agencies. A comparison of the absolute values in the two figures is problematic. The values in Figures 1 and 2 are provided to demonstrate the *relative* differences of potential offset supply as the allowance price increases. In addition, the figures indicate the *relative* difference in offset supply between biological sequestration offsets (Figure 1) and methane and nitrous oxide reduction projects (Figure 2).

It may be instructive to consider the potential supply of offsets in the context of a federal cap-and-trade program. For example, in 2015, S. 2191 (Lieberman/Warner) would distribute 5,456 million emission allowances: each allowance equals 1 mtCO_2-e. Regulated entities would be permitted to use eligible offsets, including domestic agriculture and forestry projects, to meet up to 15% of their allowance submission (see **Table 1**). If all covered entities chose this compliance option, the maximum amount of offsets that could be submitted would be 818 million mtCO_2-e (15% of 5,456). Depending on the price of carbon, this amount of offsets may not be available from suppliers.

The price of carbon is not the only factor that would influence the amount of offsets available in an emissions reduction program. An EPA study stated that "[o]ther nonprice factors, such as social acceptance, tend to inhibit mitigation option installation in many sectors."[28] This has been observed in the forestry sector, which was initially expected to play a much larger role in the CDM. An IPCC report stated that although the forestry sector can make a "very significant contribution to a low-cost mitigation portfolio ... this opportunity is being lost in the current institutional

[28] EPA, *Global Mitigation of Non-CO_2 Greenhouse Gases*, p. 1-23 (2006).

context and lack of political will to implement and has resulted in only a small portion of this potential being realized at present." [29]

Two factors that may limit or slow offset implementation are information dissemination and transaction costs (discussed in a subsequent section). Many of the emission abatement and sequestration opportunities, particularly in the agricultural sectors, may be widely dispersed and under the control of relatively small operations (e.g., family farms). Similarly, many of the agriculture and forestry offset projects would likely present technical challenges, particularly emission measurement and project verification. To generate offsets at these locations, parties would need to know that opportunities exist and are financially viable (based on the carbon price). In addition, the smaller operations would likely need technical support in order to initiate, measure, and verify the projects.

Potential Benefits of Offsets

The inclusion of offsets in a cap-and-trade program could potentially provide multiple benefits. Perhaps the primary benefit would be improved cost-effectiveness. The ability to generate offsets, which could be sold as emission credits, would provide an incentive for non-regulated sources to reduce, avoid, or sequester emissions. The inclusion of offsets could expand emission mitigation opportunities, likely reducing compliance costs for regulated entities. Many offset projects have the potential to offer environmental benefits, as well. Developing countries, in particular, may gain if the United States includes international offsets in a GHG emission program. In addition, the offset market may create new economic opportunities and spur innovation as parties seek new methods of generating offsets. These issues are discussed below in greater detail.

Cost-Effectiveness

A central argument in support of offsets is that their use makes an emissions reduction program more cost-effective. A wide range of activities could be undertaken that would generate offsets. Many of these individual activities would likely generate a relatively small quantity of offsets (in terms of tons), but in the aggregate, their climate change mitigation potential is substantial. Arguably, direct regulation of these sources — either through a cap-and-trade program or regulatory command-and-control provisions[30] — may not be cost-effective because of the administrative burden.

By allowing these sources to generate offsets and sell the offsets (as emission credits) to regulated entities, several benefits are achieved. First, emissions are

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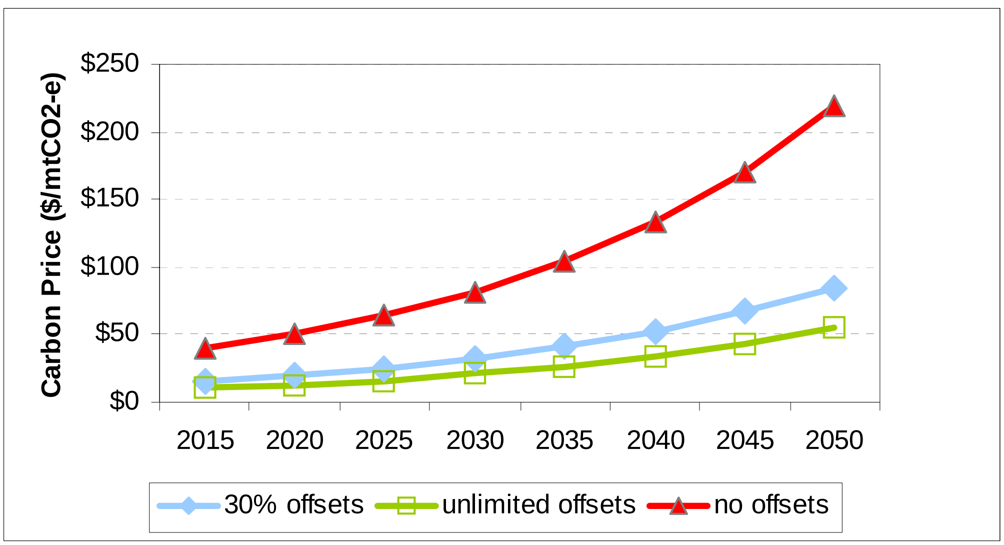
[29] Intergovernmental Panel on Climate Change, *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report*, p. 543 (2007).

[30] A command-and-control program may require, for example, that certain technologies be installed to control emissions from landfills or animal waste, or that specific practices (e.g., conservation tillage) be performed in agricultural operations.

reduced, avoided, and/or sequestered at sources that may not have otherwise occurred.[31] Second, the offsets generated increase the compliance options for regulated entities: covered facilities can either make direct, onsite reductions or purchase emission credits generated from offsets. The increased reduction opportunities provided by offsets are expected to lower the cost of compliance. This impact ultimately affects consumers because they are expected to bear the majority of an emission program's costs.

A 2007 EPA study analyzed the economic impacts of the Climate Stewardship and Innovation Act of 2007 (S. 280), a cap-and-trade proposal that would allow regulated sources to use domestic and international offsets to satisfy up to 30% of their allowance submission.[32] As with other economic models of climate change regulation, the modelers necessarily make many assumptions. Thus, the relative differences between different scenarios is perhaps more useful than the absolute estimates. EPA's study demonstrated a dramatic difference between the offset scenarios. The study found that if offsets are not allowed the price of carbon would be substantially higher (266% higher in 2015) than if offsets could be used (**Figure 3**). A 2008 EPA study that analyzed different offset scenarios under the framework of the Climate Security Act of 2008 (S. 2191) found similar results.[33]

Figure 3. Effect of Three Offset Scenarios on Carbon Price Under Framework of S. 280



Source: Prepared by CRS with data from EPA, *EPA Analysis of The Climate Stewardship and Innovation Act of 2007* (2007).

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[31] If they would have occurred, they would not be additional (to business-as-usual), and thus, not qualify as offsets.

[32] EPA, *EPA Analysis of The Climate Stewardship and Innovation Act of 2007* (2007).

[33] EPA, *EPA Analysis of the Lieberman-Warner Climate Security Act of 2008, S. 2191 in the 110th Congress* (2008).

Under different emission program proposals, the relative gap between carbon prices may not be as striking. Compared to some congressional proposals, S. 280 allows for more flexibility of offset use, particularly international offsets.[34] The study found that international offsets would play a large role, especially in the beginning decades of the program, because there are generally more low-cost offset opportunities in other nations (**Figure 4**). In later years (as the carbon price rises), domestic offset types, particularly forestry-related offsets, play a larger role.

Potential Co-Benefits

Offset projects may produce benefits that are not directly related to climate change. For example, many of the offset projects that promote carbon sequestration in soil (e.g., conservation tillage) improve soil structure and help prevent erosion.[35] Erosion control may reduce water pollution from nonpoint sources,[36] a leading source of water pollution in U.S. waterbodies.[37]

Depending on a project's specific design and how it is implemented, other agriculture and forestry offset projects could potentially yield positive environmental benefits. However, there is some concern that certain projects may produce undesirable impacts, such as depleted soil quality, increased water use, or loss of biodiversity.[38] Many agriculture and forestry offset projects would likely involve land use changes, such as converting farmlands to forests or biofuel production.[39] Determining whether the change imparts net benefits may be a complex evaluation, depending upon, among other things, the current and proposed species of plants and/or trees. Policymakers would likely encounter projects that offer trade-offs: for example, they offset GHG emissions, while imposing an unwanted outcome, such as increased water use, reducing availability downstream.[40] EPA found that the more

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[34] Section 145 allows covered entities to satisfy 30% of its total allowance submission requirement with international credits obtained from offset projects.

[35] Intergovernmental Panel on Climate Change, *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report* (2007), p. 526.

[36] Nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water. See EPA's Nonpoint Source Pollution website, at [http://www.epa.gov/owow/nps/qa.html].

[37] See CRS Report RL33800, *Water Quality Issues in the 110th Congress: Oversight and Implementation*, by Claudia Copeland.

[38] Intergovernmental Panel on Climate Change, *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report* (2007), pp. 529-530.

[39] In fact, these activities are often categorized, particularly in international contexts, as land use, land use changes, and forestry (LULUCF) projects.

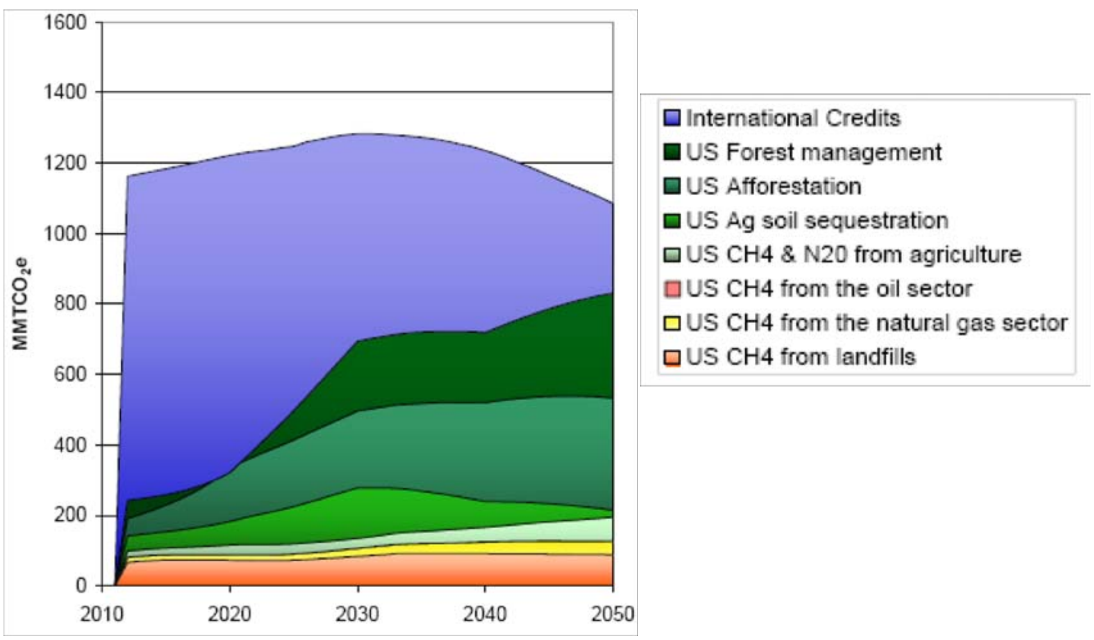
[40] For example, certain evergreen plantations (tree farms) generally have higher water use than the land they replace. Intergovernmental Panel on Climate Change, *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report* (2007), p. 530.

aggressive offset opportunities — afforestation and biofuels production — are more likely to present the most distinct trade-offs.[41]

Potential Benefits to Developing Nations

Most observers would agree that developing nations are unlikely to limit and reduce GHG emissions on a schedule on par with developed nations. With less-regulated emission sources, the universe of eligible offset opportunities would be much larger in developing nations. When EPA estimated offset sources under proposed emission reduction programs (S. 280 and S. 2191), international sources accounted for the vast majority of offsets in the early decades (**Figure 4**).[42] Offset types, such as renewable energy and/or energy efficiency projects, which could face substantial hurdles to qualify as offsets in the United States, would be eligible offsets from developing nations. These types of projects would likely provide environmental benefits beyond GHG emission reduction — improvements in local air quality — by displacing or avoiding combustion of fossil fuels.

Figure 4. Estimated Contribution from Offsets by Type Under S. 280



Source: EPA, *EPA Analysis of The Climate Stewardship and Innovation Act of 2007* (2007).

Note: CH4 is methane; N20 is nitrous oxide.

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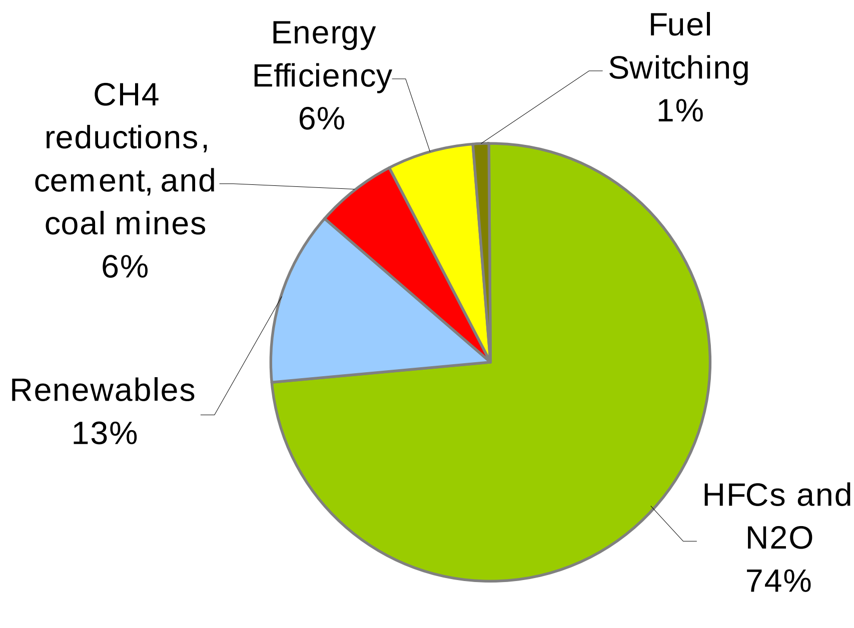
[41] EPA, *Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture* (2005), p. 8-8.

[42] EPA's analyses indicate that international offsets would play a larger role under S. 280 than S. 2191. This is likely due to the different limitations posed by the two proposals. S. 280 would allow regulated entities to use approximately twice the amount of international offsets as S. 2191 (see **Table 1**).

Offset projects in developing nations have the potential to promote sustainable development, such as creation of an energy infrastructure that is less carbon-intensive and more energy efficient. In fact, this was one of the objectives in establishing the Clean Development Mechanism (CDM). Whether this objective is being met is a subject of debate. However, recent projections suggest that offset activities that promote sustainable development will account for a larger percentage of emissions credits in the coming years.

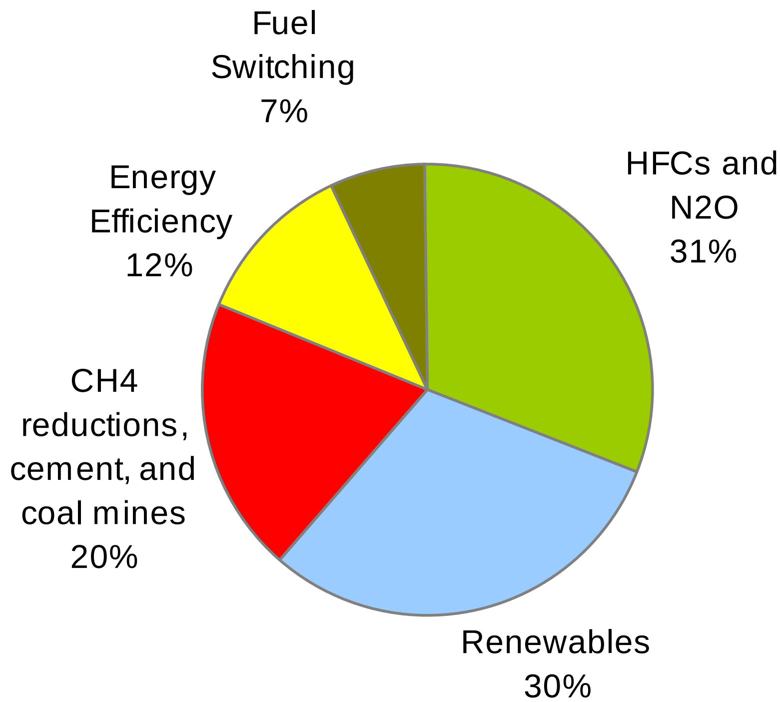
In general, renewable energy and energy efficiency projects contribute more to sustainable development than the offset projects that have dominated the CDM so far (**Figure 5**). As a comparison between **Figures 5** and **6** indicates, the proportion of renewable energy and energy efficiency projects in the CDM is expected to more than double by 2012. This projected shift would likely improve support for sustainable development objectives. However, offset projects — primarily, HFC and N_2O reduction from industrial activities — that provide few sustainable development benefits are still expected to account for approximately 50% of emission credits issued.

Figure 5. CERs Issued by Offset Type (as of February 2008)



Source: Prepared by CRS with data from United Nations Environment Programme, Capacity Development for the Clean Development Mechanism ("CDM Pipeline"), at [http://cd4cdm.org/index.htm].

Figure 6. Projected CERs Issued by 2012



Source: Prepared by CRS with data from United Nations Environment Programme, Capacity Development for the Clean Development Mechanism ("CDM Pipeline"), at [http://cd4cdm.org/index.htm].

Note: Forestry projects are expected to account for 0.3%; transportation projects 0.1%.

Other Potential Domestic Benefits

A federal cap-and-trade emission program that allows offsets as a compliance option may provide economic benefits to particular sectors of the U.S. economy. However, there may be trade-offs, depending on which types of offsets are eligible and whether or not international offsets are allowed. If international offset projects are included in the program, some U.S. business sectors may benefit from the transfer of technology and/or services to support projects in other nations. If international offsets, generally the lowest-cost options, are excluded, the offset projects from the domestic agriculture and forestry sectors would likely gain a greater share of the offsets market, thus generating business opportunities in these sectors.[43]

Another potential benefit that is often highlighted is the ability of an offset market to encourage innovation. As the carbon price provides an incentive for regulated entities to find onsite emission reductions (e.g., through efficiency

[43] As discussed above, the inclusion of international offsets would lower the emission allowance price, which would benefit regulated entities and ultimately consumers.

improvements or development of new technologies), the offset market may spur parties to find new ways to reduce, avoid, or sequester emissions from non-regulated sources. However, there is some concern that the drive to find creative offset methods may encourage offset projects that yield unknown, unintended, and possibly harmful, environmental effects. A frequently cited example in this regard is ocean fertilization, which seeks to stimulate phytoplankton growth (and ultimately improve CO_2 sequestration) by releasing iron into certain parts of the surface ocean. [44]

Potential Concerns

Although offsets have the potential to provide benefits under an emissions trading program, several issues associated with offsets have generated concern and some controversy. Perhaps the primary concern regarding offsets is their integrity. To be credible, an offset should equate to an emission reduction from a direct emission source, such as a smokestack or exhaust pipe. This issue is critical, if offsets are to be used in an emissions trading program. However, implementing this objective would likely present challenges. This and other concerns are discussed below.

Supplementarity

Supplementarity refers to the idea that the role of offsets in an emission reduction program should be secondary to reduction efforts at regulated emission sources. The term comes from the text of the Kyoto Protocol, which states that emissions credits (or offsets) must be "*supplemental* to domestic actions for the purpose of meeting quantified emission limitations and reduction commitments...." (Article 17, emphasis added).

Integrity Concerns

If offsets are to be included in an emissions trading program, offset integrity — i.e., whether or not the offsets represent real emission reductions — is critical. Several issues need to be addressed when evaluating offsets. Some of these issues may present implementation challenges, which if not overcome, could damage the integrity of the offset. These issues are discussed below.

Additionality. Additionality means that the offset project represents an activity that is beyond what would have occurred under a business-as-usual scenario. In other words, would the emission reductions or sequestration have happened anyway? Additionality is generally considered to be the most significant factor that determines the integrity of the offset. In the context of an emissions control program, a test of additionality would examine whether the offset project would have gone forward in the absence of the program. An additionality determination would likely consider the following questions:

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[44] See Ken O. Buesseler, et al.,"Ocean Iron Fertilization — Moving Forward in a Sea of Uncertainty," *Science* Vol. 319 (2008), 162.

- Does the activity represent a common practice or conforms to an industry standard?
- Is the offset project required under other federal, state, or local laws?
- Would the project generate financial gain (e.g., be profitable) due to revenues from outside the offset market?[45]

Offset credits allow regulated entities to generate GHG emissions above individual compliance obligations. If project developers are able to generate emission credits for projects that would have occurred regardless (i.e., in the absence of the trading program), the influx of these credits into the program would undermine the emissions cap and the value of other, legitimate offset projects.

Additionality is at the crux of an offset's integrity, but applying the additionality criterion may present practical challenges. For instance, it may be impossible to accurately determine "what would have happened anyway" for some projects. Assessing a project's additionality may involve some degree of subjectivity, which may lead to inconsistent additionality determinations.

Measurement. Reliable GHG emissions data are a keystone component of any climate change program. If Congress allows offsets as a compliance option, offset data (emissions reduced, avoided, or sequestered) should arguably be as reliable as data from regulated sources. From a practical standpoint, however, achieving this objective may be difficult.

It is generally much simpler to measure and quantify an emission reduction from a direct source than from an offset project. Indeed, the more difficult measurement may be the main reason such reductions are not required by a control program. Regulated sources determine their compliance by comparing actual GHG emissions data against their allowed emissions.[46] In contrast, project developers determine offset emission data by comparing the expected reduced, avoided, or sequestered GHG emissions against a projected, business-as-usual scenario (sometimes referred to as a counter-factual scenario).

To accomplish this task, offset project managers must establish an emissions baseline: an estimate of the "business-as-usual" scenario or the emissions that would have occurred without the project. If project managers inaccurately estimate the baseline, the offsets sold may not match the actual reductions achieved. For example, an overestimated baseline would generate an artificially high amount of offsets. Baseline estimation may present technical challenges. In addition, project developers have a financial incentive to err on the high side of the baseline determination because the higher the projected baseline, the more offsets generated. Requiring third-party verification (as some proposals do) would potentially address this specific concern.

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[45] See, World Resources Institute, *The Greenhouse Gas Protocol for Project Accounting* (2005), at [http://www.ghgprotocol.org].

[46] The emissions data may not be a direct measurement, but an estimate calculated by using related data, such as fuel consumption.

Biological sequestration offset projects may present particular challenges in terms of measurement. The carbon cycle in trees and soils is only partially understood.[47] Variations exist across tree species, ages, soil conditions, geographic locations, and management practices.[48] Estimates of carbon uptake and storage are frequently considered imprecise or unreliable. Further, changes in vegetation cover may have non-emission effects on climate, such as how much of the Sun's energy is reflected or absorbed by the Earth. A recent study in the *Proceedings of the National Academy of Sciences* stated, "Latitude-specific deforestation experiments indicate that afforestation projects in the tropics would be clearly beneficial in mitigating global-scale warming, but would be counterproductive if implemented at high latitudes and would offer only marginal benefits in temperate regions."[49]

Double-Counting. To be credible, when an offset is sold, it should be retired and not sold again or counted in other contexts. However, opportunities for double-counting exist. For example, a regulated entity may purchase offsets generated through the development of a wind farm in a nation that has not established GHG emissions targets. The U.S. buyer would count the offsets, which may have been purchased to negate increased, onsite emissions at the regulated source. In addition, the nation, in which the wind farm is located, would likely see an emissions reduction due to the wind farm. If this decrease is reflected in the nation's GHG emissions inventory, the offset project (wind farm) might replace other reduction activities that the nation might have taken to meet its target.

Some may argue that double-counting is less of a problem if the offset project occurs in a nation with only a voluntary target (as opposed to a nation subject the Kyoto Protocol). However, the impact would be the same if the nation eventually establishes a mandatory target and takes credit for the earlier reductions associated with the offset project. By taking credit for an earlier reduction, the nation might need to make fewer reductions to be in compliance with the new mandatory program.

A tracking system could help avoid such double-counting.[50] Most would agree that a domestic tracking system would be simpler to establish and monitor than a system that follows international offset trading. The latter would require, at a minimum, cooperation with the nations hosting the offset projects.

Permanence. With some offset projects there may be a concern that the emission offsets will be subsequently negated by human activity (e.g., change in land use) or a natural occurrence (e.g., forest fire, disease, or pestilence). This issue is most pertinent to biological sequestration projects, specifically forestry activities. Although many observers expected forestry offsets to play a large role in the CDM,

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[47] See CRS Report RL34059, *The Carbon Cycle: Implications for Climate Change and Congress*, by Peter Folger.

[48] See CRS Report RL31432, *Carbon Sequestration in Forests*, by Ross W. Gorte.

[49] Govindasamy Bala, et al., "Combined climate and carbon-cycle effects of large-scale deforestation," *Proceedings of the National Academy of Sciences*, Vol. 104 (2007): 6550-6555.

[50] See Anja Kollmuss, "Carbon Offsets 101," *World Watch* (2007).

this has not been observed in practice. This result is partially due to concerns of offset permanence in developing nations.[51]

Offset buyers need some assurance that the land set aside for forests (and carbon sequestration) will not be used for a conflicting purpose (e.g., logging or urban development) in the future. Although natural events (fires or pests) are hard to control, human activity can be constrained through legal documents, such as land easements. In addition, an offset could come with a guarantee that it would be replaced if the initial reduction is temporary. Permanence may be more difficult to monitor at international projects.

Leakage. In the context of climate change policy, GHG emissions leakage generally refers to a situation in which an emissions decrease from a regulated (i.e., capped) source leads to an emissions increase from an unregulated source. EPA states that leakage "occurs when economic activity is shifted as a result of the emission control regulation and, as a result, emission abatement achieved in one location that is subject to emission control regulation is [diminished] by increased emissions in unregulated locations."[52]

Leakage scenarios may involve emission sources from the same economic sector, but located in different countries. Many voice concern that if the United States were to cap emissions from specific domestic industries (e.g., cement, paper), these industries would relocate to nations without emission caps and increase activity (and thus emissions) to compensate for the decreased productivity in the United States. Thus, global net emissions would not decrease, and affected domestic industries would likely see employment losses.

In the context of offsets, leakage may occur in an analogous fashion. The opportunity for leakage exists when an offset project decreases the supply of a good in one location, leading to greater production of the good somewhere else. Compared to other offset types, forestry projects, particularly those that sequester carbon by curbing logging, likely present the greatest risk of leakage.[53] For example, an offset project that restricts timber harvesting at a specific site may boost logging at an alternative location, thus reducing the effectiveness of the offset project.[54] Preventing or accounting for leakage from these projects poses a challenge.

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[51] Frank Lecocq and Philippe Ambrosi, "The Clean Development Mechanism: History, Status, and Prospects," *Review of Environmental Economics and Policy* (Winter 2007), pp. 134-151.

[52] See Environmental Protection Agency (EPA), Office of Air and Radiation, *Tools of the Trade: A Guide To Designing and Operating a Cap and Trade Program For Pollution Control* (2003), Glossary.

[53] Nicholas Institute for Environmental Policy Solutions, *Harnessing Farms and Forests in the Low-Carbon Economy: How to Create, Measure, and Verify Greenhouse Gas Offsets*, Zach Wiley and Bill Chameides, eds. (2007), pp. 18-19.

[54] Similarly, forest sequestration projects could shift demand to substitute products (e.g., steel or aluminum studs to replace wood studs in homebuilding) whose production requires more energy, and thus releases more carbon. See CRS Report RL31432, *Carbon Sequestration in Forests,* by Ross Gorte.

Delay of Technology Development

As discussed above, the inclusion of offsets would likely lower the overall cost of compliance. Although many consider this a desired outcome, some contend that the price of carbon needs to reach levels high enough to promote the long-term technological changes needed to mitigate climate change.

> Offsets also can delay key industries' investments in transformative technologies that are necessary to meet the declining cap. For instance, unlimited availability of offsets could lead utilities to build high-emitting coal plants instead of investing in efficiency, renewables, or plants equipped with carbon capture and storage.[55]

Transaction Costs

Transaction costs generally refer to the costs associated with an exchange of goods or services. In an offset market, transaction costs may encompass the following:

- searching for offset opportunities;
- studying and/or measuring offset projects;
- negotiating contracts;
- monitoring and verifying reduced, avoided, or sequestered emissions;
- seeking regulatory approval;
- obtaining insurance to cover risk of reversal (i.e., non-permanence).[56]

Depending on the price of carbon in the offset market, transaction costs may represent a substantial percentage of the value of the offset. Several studies have examined offset projects in an effort to estimate transaction costs. Generally, the studies' results include a transaction cost range that varies by offset type and project size. For example, a study by the Lawrence Berkeley National Laboratory (LBL) found a transaction cost range of \$0.03/mtCO_2-e to \$4.05/mtCO_2-e.[57] Overall, the various studies found that smaller offset projects (measured by tons of CO_2-e) may be at a disadvantage because they would likely face proportionately higher transaction costs: the LBL study found that the mean transaction cost for small projects was \$2.00/mtCO_2-e, but only \$0.35/mtCO_2-e for the largest projects.

The transaction costs may hinder innovation by serving as an obstacle to small, but promising offset projects. However, transaction costs are inherent in an

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[55] Testimony of David Hawkins, Climate Center, Natural Resources Defense Council, before the Senate Committee on Environment and Public Works, November 13, 2007, at [http://docs.nrdc.org/globalwarming/glo_07111301A.pdf]

[56] These are the costs assessed in the following study: Camille Antinori and Jayant Sathaye, *Assessing Transaction Costs of Project-Based Greenhouse Gas Emissions Trading* (2007), Ernest Orlando Lawrence Berkeley Laboratory.

[57] Ibid.

emissions program that requires project developments to meet certain provisions — additionality, measurement, verification, monitoring — to maintain the integrity of the offset allowed as compliance alternatives.

Concerns in Developing Nations

Some argue that offset use, particularly unlimited access to international offset opportunities, raises questions of fairness. Most of the world's GHG emissions (especially on a per capita basis) are generated in the developed nations, while most of the lower-cost offset opportunities are in developing nations. Many observers expect the developing nations to establish mandatory GHG reduction programs several years (if not decades) after developed nations' emission programs are underway. The developed nations are likely to initiate the lower-cost projects and retire the offsets, thus removing the "low-hanging fruit." If and when the developing nations subsequently establish GHG emission caps, the lower-cost compliance alternatives would not be available to them.[58] Some have described this as a form of environmental colonialism.[59]

Another concern is that international offsets may serve as a disincentive for developing nations to enact laws or regulations limiting GHG emissions. For instance, if a developing nation established emission caps or crafted regulations for particular emissions sources, reductions from these sources would no longer qualify as offsets. Developing nations may be hesitant to forego the funding provided by offset projects.

Considerations for Congress

From a climate change perspective, the location of an emission activity does not matter: a ton of CO_2 (or its equivalent in another GHG) reduced in the United States and a ton sequestered in another nation would have the same result on the atmospheric concentration of GHGs. Moreover, unlike many air pollutants — e.g., acid rain precursors sulfur dioxide and nitrogen oxide, particulate matter, and mercury — a localized increase or decrease of CO_2 emissions does not directly impart corresponding local or regional consequences. This attribute of CO_2 emissions, the primary GHG, allows for offset opportunities.[60]

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[58] See e.g., David M. Driesen, 1998, "Free Lunch or Cheap Fix?: The Emissions Trading Idea and the Climate Change Convention," *Boston College Environmental Affairs Law Review* 26:1-87; see also Emily Richman, 2003, "Emissions Trading and the Development Critique: Exposing the Threat to Developing Countries," *New York University School of Law Journal of International Law and Politics* 36:133-176.

[59] See e.g., Ross Gelbspan, "Toward A Global Energy Transition," *Foreign Policy In Focus* (2004).

[60] This attribute also creates critical challenges for policymakers. For instance, if one nation invests in emission reductions, any resulting benefits (e.g., decreased atmospheric GHG concentration) would be shared by all nations, including those that continue to increase their

(continued...)

If allowed as part of an emissions reduction program, offsets have the potential to provide various benefits. The ability to generate offsets may

- provide an incentive for non-regulated sources to reduce, avoid, or sequester emissions (where these actions would not have occurred if not for the offset program);
- expand emission mitigation opportunities, thus reducing compliance costs for regulated entities;
- offer environmental co-benefits for certain projects;
- support sustainable development in developing nations; and
- create new economic opportunities and spur parties to seek new methods of generating offsets.

The main concern with offset projects is whether or not they produce their stated emission reductions. To be credible, an offset ton should equate to a ton reduced from a direct emission source, such as a smokestack or exhaust pipe. If offset projects generate emission credits for activities that would have occurred anyway (i.e., in the absence of the emission trading program), these credits would not satisfy the principle of additionality. For many offset projects, determining additionality will likely pose a challenge. Other offset implementation issues — baseline estimation, permanence, accounting, monitoring — may present difficulties as well. If illegitimate offset credits flow into the trading program, the cap would effectively expand and credible emissions reductions would be undermined. The program would fail to meets its ultimate objective: overall GHG emissions reductions.

Offset projects vary by the quantity of emission credits they could generate and the implementation complexity they present. For instance, domestic landfill methane projects are comparatively simple to measure and verify, but offer a relatively small quantity of offsets. In contrast, biological sequestration activities, particularly forestry projects, offer the most offset-generating potential, but many of these projects pose multiple implementation challenges. This may create a tension for policymakers, who might want to include the offset projects that provide the most emission reduction opportunities, while minimizing the use of offset projects that pose more implementation complications. Addressing these challenges may require independent auditing and/or an appreciable level of oversight and administrative support from government agencies. A report from the National Commission on Energy Policy stated, "Proposals that expect to achieve significant (> 10 percent) compliance through offsets in the near term will be obligated to create a substantial enforcement bureaucracy or risk an influx of illegitimate credits."[61]

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[60] (...continued)
emissions. This dynamic has led some to refer to climate change as the "ultimate global commons pollution problem" because it discourages unilateral emission reduction. See Henry Lee, 2001, "U.S. Climate Policy: Factors and Constraints," in *Climate Change: Science, Strategies, & Solutions* (Eileen Clausen, editor).

[61] National Commission on Energy Policy, 2007, *Energy Policy Recommendations to the President and the 110th Congress*.

If concerns of legitimacy can be resolved, the next question for policymakers may be whether the potential benefits provided by offsets would outweigh any potential harm. One debate may involve whether including offsets would send the appropriate price signal to encourage the development and deployment of new technologies, such as carbon capture and storage. Policymakers may consider striking a balance between sending a strong price signal and reducing the costs of the emissions reduction program.

Another debate may focus on the possible effects of offsets in the developing world (assuming international offsets are allowed in a federal program). On one hand, many of the offset projects may offer significant benefits — more efficient energy infrastructure, improved air quality — to local communities. On the other hand, some maintain that if developed nations use all of the low-cost offsets in developing nations, the developing nations will face higher compliance costs *if and when* they establish GHG emission reduction requirements. Moreover, there is some concern that international offsets may serve as a disincentive for developing nations to enact laws or regulations limiting GHG emissions because they would lose funding from the offset market.

Whether to include international offsets in a federal program raises other considerations as well. The ability to use international offsets for compliance purposes would substantially expand emission reduction opportunities, compared to only allowing domestic offsets. The more emission mitigation opportunities available, the lower the carbon price. This highlights the debate over the balance between overall program costs and price signal for technological development.

If eligible in a U.S. program, international offsets from countries without binding reduction targets are likely to dominate in early decades because of their comparatively lower costs. Certain domestic economic sectors, primarily agriculture and forestry (if eligible as offsets), would benefit if international offsets are excluded. However, the inclusion of international offsets may benefit other U.S. economic sectors through the transfer of technology and services to support the projects. Moreover, as noted above, the more offset opportunities, the lower the overall costs of the cap-and-trade program.

Table 1. Comparison of Offset Treatment in Cap-and-Trade Proposals in the 110th Congress

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
S. 280 (Lieberman)	Specifically allows for agricultural and conservation practices; reforestation; forest preservation; directs EPA to determine other offset types	Up to 30% of allowances can come from domestic or international offsets; if offsets account for 15% of allowances, at least 1.5% must come from agricultural sequestration	Domestic or international projects accepted	Directs the EPA Administrator, in coordination with the Secretaries of Commerce, Energy, and Agriculture, to set standards
S. 309 (Sanders)	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill Directs EPA to implement emissions reduction program; directs Secretary of Agriculture, in coordination with EPA, to develop standards for biological sequestration
S. 317 (Feinstein) (Covers utilities)	No specific prohibitions; specifically allows biological sequestration, including agricultural and forestry activities, and emission reductions from various industrial operations;[a] EPA may allow further types at its discretion	A regulated source can use domestic offsets to cover 100% of its allowances; up to 25% of allowances (50% for new sources) can come from eligible international offsets; this limit increases to 50% if allowance prices reach a level that would cause "significant harm" to the economy (as determined by EPA and Secretary of Treasury)	Domestic and international projects allowed	Directs Secretary of Agriculture, in coordination with EPA, to develop standards for biological sequestration offsets; directs EPA to craft standards for other project types

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
S. 485 (Kerry)	Offsets are not included in the bill;	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill Directs Secretary of Agriculture, in coordination with EPA, to develop standards for biological sequestration
S. 1168 (Alexander) (CO_2 reduction from utilities)	Five offset types allowed: 1) landfill methane reduction 2) sulfur hexafluoride (SF_6) reductions from industrial activities 3) afforestation projects 4) energy efficiency projects yielding reductions or avoidance of CO_2 from natural gas, oil or propane combustion 5) avoided methane from manure management practices	No quantity limitations	Any U.S. state that has signed memorandum of understanding (MOU) with EPA	Legislation includes specific standards[b] for the five offset types allowed; directs EPA to develop standards for other potential project types, including agricultural offsets
S. 1177 (Carper) (CO_2 reduction from utilities)	Identifies 11 eligible types, including agricultural and forestry management practices; authorizes EPA to develop standards for additional types	No limits; directs EPA to develop regulations regarding use of offsets	Directs EPA to develop standards for domestic and international locations	Directs EPA to develop regulations and coordinate with Department of Agriculture regarding biological sequestration offset standards

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
S. 1201 (Sanders) (CO_2 reduction from utilities)	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill Directs EPA to implement emissions reduction program; directs Secretary of Agriculture, in coordination with EPA, to develop standards for biological sequestration
S. 1554 (Collins) (CO_2 reduction from utilities)	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill	Offsets are not included in the bill Directs EPA, in coordination with Department of Agriculture, to help develop procedures for verifying biological sequestration projects
S. 1766 (Bingaman)	Four specific project types shall have streamlined standards: (1) landfill methane; (2) animal waste or municipal wastewater methane; (3) sulfur hexafluoride reductions from transformers; and (4) coal mine methane; the President may add further types	Unlimited use of domestic offsets with identified standards; international offsets limited to 10% of a regulated entity's emissions target	Domestic and international	Directs the President to develop offset verification system; directs Secretary of Agriculture to establish agricultural sequestration standards

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
S. 2191 (Lieberman) Reported by the Senate Committee on Environment and Public Works May 20, 2008	Specifically allows certain agricultural and forestry-related offsets: agricultural land management practices; afforestation; reforestation; forest management; manure management; other offset types may be later allowed by EPA through regulations	Domestic offsets can satisfy 15% of allowance submission In addition, "international emission allowances obtained on a foreign GHG emissions trading market" can satisfy 15% of submission[c]	Domestic Indirect access to international offsets through purchase of international "emission allowances"[c]	Directs the EPA, in consultation with Secretary of Agriculture, to develop regulations to implement offset program; requires offset project developers to submit a petition to EPA and receive approval of project; offset projects must then be reviewed by an accredited third-party, who submits report to EPA for approval; reversal certifications must be submitted annually to EPA
S. 3036 (Boxer)	Same as S. 2191	Same as S. 2191	Same as S. 2191	Same as S. 2191
H.R. 620 (Olver)	Specifically allows for agricultural and conservation practices; reforestation; forest preservation; no limits on other types	Up to 15% of allowances can come from domestic and/or international offsets; if offsets account for 15% of allowances, at least 1.5% must come from agricultural sequestration[d]	Domestic or international	Directs EPA — in coordination with the Secretaries of Commerce, Energy, and Agriculture — to develop verification methods and standards
H.R. 1590 (Waxman)	Offsets are not specifically addressed in the bill	Offsets are not specifically addressed in the bill	Offsets are not specifically addressed in the bill	Offsets are not specifically addressed in the bill; EPA is to ensure that allowances are accurately tracked, reported, and verified

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
H.R. 4226 (Gilchrest)	Specifically allows biological sequestration, which can include agricultural and conservation practices; reforestation; forest preservation; production of cellulosic biomass crops; and other methods determined by EPA; allows for use of other offset projects if approved and added to national registry; no restrictions on international offset types that are approved on case-by-case basis	Alternative compliance mechanisms, which can include domestic and international offsets, can account for up to 15% of allowance submission; if these alternatives account for 15% of allowances, at least 1.5% must come from registered sequestration in agricultural soils	Domestic or international	Directs EPA, in coordination with the Secretaries of Agriculture, Energy, and Commerce, to issue regulations that establish comprehensive measurement and verification methods Directs the EPA to develop program for reviewing international offset projects

a. These projects would become ineligible if subsequent legislation required emissions reductions from these sectors (S. 317 only covers power plants).

b. Offset standards similar to those required by the Regional Greenhouse Gas Initiative (RGGI), a partnership of 10 states from the Northeast and Mid-Atlantic regions. Unlike RGGI standards, S. 1168 does not require third-party verification for offset projects.

c. The proposal does not define "international emission allowance." EPA is directed to develop regulations concerning their use.

d. The legislation states that if an entity uses offsets to satisfy 15% of its allowances, "it shall satisfy up to 1.5 percent of its total allowance submission [with agricultural sequestration offsets]...." (Section 144(b)). This language is arguably unclear as to whether it limits ("up to") agricultural sequestration offsets to only 1.5% or requires that (at least) 1.5% of offsets come from agricultural sequestration activities.

Table 2. Comparison of Offset Treatment in GHG Emissions Reduction Initiatives in the U.S. States

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
Regional GHG Initiative (RGGI) (CO_2 reduction from utilities)	Five offset project types allowed:[a] 1) landfill methane reduction 2) Sulfur hexafluoride (SF_6) reductions from industrial activity 3) Afforestation projects 4) Energy efficiency projects yielding reductions or avoidance of CO_2 from natural gas, oil or propane combustion 5) Avoided methane from manure management practices	RGGI was designed to require that 50% of emission reductions come from regulated sources; offsets can be used to achieve the remaining 50% of required reductions;[b] to apply this objective, offsets are limited to 3.3% of a source's emissions; the limit increases to 5% if the market price of an allowance exceeds $7 (in 2005 dollars, adjusted annually); if price exceeds $10 (in 2005 dollars, adjusted annually), the limit increases to 10%[c]	1) RGGI states; 2) non-RGGI states that have their own GHG reduction program or have signed a memorandum of understanding (MOU) with a RGGI state; 3) international projects (e.g., CDM certified emission credits) allowed if carbon price exceeds $10	Standards Approach: each project must meet general standards and standards specific to the project type; each project must be certified by a third-party
California's Statewide Emission Program[d]	Not specified in statute; details deferred to California Air Resources Board; The Market Advisory Committee (MAC)[e] recommended starting with a small number of project types, such as those allowed under RGGI	Not specified in statute; details deferred to California Air Resources Board Most members of the MAC rejected quantity limitations	Not specified in statute; details deferred to California Air Resources Board Most MAC members rejected geographic limitations	Not specified in statute; details deferred to California Air Resources Board MAC recommended adopting a standards-based approach

Note: Other states have recently enacted legislation to reduce GHG emissions, and a number of states have signed regional agreements that call for GHG reduction. However, these programs are relatively new, and the design details (in particular, offset treatment) have not yet been officially specified. Thus, they are not listed in the above table. For more information, on these programs, see CRS Report RL33812, *Climate Change: Action by States To Address Greenhouse Gas Emissions*, by Jonathan L. Ramseur.

a. More projects may be added in the future.

b. See RGGI Staff Working Group, *Analysis Supporting Offsets Limit Recommendation*, at [http://www.rggi.org/documents.htm].

c. The RGGI Memorandum of Understanding describes this increase in the use of offsets as a "safety-valve." Unlike a traditional safety-valve, the cap would be maintained because additional allowances cannot be purchased at a threshold price. The RGGI "safety-valve" would effectively allow regulated parties to meet the majority (at the 5% limit) or possibly all (at the 10% limit) of their reduction requirements through offsets: the RGGI cap is projected to require regulated sources to reduce their annual emissions by about 7% on average (based on RGGI Offsets Limits Analysis data at [http://www.rggi.org/documents.htm].) The cost protection provided by RGGI's safety-valve will depend on the offset market. For example, if the supply of acceptable RGGI offsets cannot meet demands, the offset price may increase such that the safety-valve is negated. An assessment of offset supply and demand conducted by RGGI officials suggests that this outcome seems unlikely (*Evaluation of Offsets Supply and Potential Demand*, at [http://www.rggi.org/documents.htm].)

d. California Governor Schwarzenegger signed "The Global Warming Solutions Act" (AB32) into law September 27, 2006. AB32 creates a mandatory GHG emissions target: return to 1990 levels by 2020. The statute authorizes, but does not require, the use of market-based mechanisms. The California Air Resources Board (CARB) is responsible for crafting most of the logistical details, including offsets. For more information on AB32 see CRS Report RL33962, *Greenhouse Gas Reductions: California Action and the Regional Greenhouse Gas Initiative*, by Jonathan L. Ramseur.

e. The MAC recommendations are included in the table for comparison purposes because the regulations are being developed. Per California Executive Order S-20-06, the Market Advisory Committee was formed to develop recommendations regarding design details for a market-based emissions reduction program. The Committee includes national and international experts with backgrounds in economics, environmental policy, regulatory affairs, and energy technologies. See Market Advisory Committee, 2007, *Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California*.

Table 3. Comparison of Offset Treatment in International Emissions Trading Programs

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
Kyoto Protocol	**Clean Development Mechanism (CDM) projects**: projects judged individually; wide range of types have been accepted; prohibits use of reductions generated from nuclear facilities;[a] land use, land use changes, and forestry (LULUCF) offset projects limited to reforestation and afforestation[b] **Joint Implementation (JI) projects**: may allow a broader array of project types than the CDM, and would include revegetation, forest management, cropland management and grazing land management; JI projects may be limited by a host country's emission control regulations	**CDM and JI**: "Supplementarity" constraint: offsets must be "*supplemental* to domestic action and that domestic action shall thus constitute a significant element of the effort made by each Party..." (emphasis added);[c] but no specific quantity limitations **CDM**: Reforestation and afforestation projects limited to 1% of party's baseline emissions	**CDM projects**: developed nations finance projects in developing nations **JI projects**: developed nations finance projects in other developed nations; both nations must be parties to the Kyoto Protocol	Case-by-case approval process, which includes test of "additionality":[d] **CDM:** each project must have letter of approval from both buyer and seller's governments; must be evaluated and approved by an Executive Board (EB);[e] independent third party (accredited by EB) determines the certified emissions reductions (CERs) **JI**: Track 1 - eligible host country may approve projects and assign emission reduction units (ERUs); Track 2 - Joint Implementation Supervisory Committee (JISC)[f] approves project and assigns ERUs

GHG Reduction Program	Offset Types Allowed or Prohibited	Offset Quantity Limitation	Acceptable Locations of Offset Projects	System of Verifying Integrity of Offsets
European Union's Emissions Trading System	Kyoto Protocol limitations listed above; Additional limitations: regulated sources cannot use offsets from land use, land use changes, and forestry (LULUCF) projects;[g] offsets from hydroelectric power projects must satisfy certain conditions	**First phase (2005-2007)**: no limits for offsets from CDM, but no JI projects; **Second phase (2008-2012)** EU members set own limits for offsets from CDM or JI projects, but limit must fall within range set by the European Commission (EC):[h] at minimum EU states must allow regulated sources to use offsets to cover 10% of their allowances; at a maximum, offsets can cover up to 50% of the reductions required by cap (in some EU states this equates to 20% of allowances)[i]	CDM projects: developing nations JI projects: other EU nations Domestic offset projects (DOPs) not allowed[j]	CDM/JI offsets follow Kyoto Protocol verification process (described above)

a. UNFCCC, 2001, Conference of the Parties, Sixth Session, Decision Five.

b. UNFCCC, 2001, Conference of the Parties, Seventh Session ("Marrakesh Accords"), Decision 11. Afforestation involves planting trees on previously non-forested land; reforestation involves planting trees on formerly forested land.

c. UNFCCC, 2006, *Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005,* Decision 2/CMP1.

d. "Additionality" is a critical component of the environmental integrity of an offset. The concept refers to whether the offset project would have gone forward on its own merits (e.g., financial benefits) without the support of an offset market or the impetus to comply with a legal requirement. In other words, would the offset project have happened anyway? If the project would have occurred, the project is not additional, and should not qualify as an offset.

e. The EB is composed of 10 members from parties to the Kyoto Protocol; the members' terms are limited.

f. The JISC is composed of 10 members from parties to the Kyoto Protocol; the members' terms are limited.

g. Although private parties subject to the ETS cap cannot purchase LULUCF offsets, EU governments can purchase eligible LULUCF offsets — i.e., from afforestation or reforestation projects — up to 1% of their state's base year (1990) emissions each year (See European Union Directive 2004/101/EC (October 27, 2004); Kyoto Protocol, Decision 17/CP.7 (November 2001)). The World Bank reported that global transactions of LULUCF offsets have only accounted for 6% of this allowable limit.

h. European Commission Communication (COM/2006/725), November 29, 2006.

i. If EU state governments purchase offsets (e.g., to sell as allowances for new sources), these offsets will reduce the percentage of offsets that can be used as allowances by affected sources within that state.

j. This issue has received interest in recent months, and some EU members support including domestic offset projects. See European Climate Change Programme Working Group, 2007, Report of the First Meeting (March 8-9, 2007).