Carbon Capture and Sequestration in H.R. 2454 and S. 1733

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November 2, 2009

Congressional Research Service
7-....
www.crs.gov
R40867

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

The carbon capture and sequestration (CCS) provisions in H.R. 2454 and S. 1733 are similar (some sections are identical), and both bills appear to share the goal of fostering the commercial development and deployment of CCS projects as an important component of mitigating greenhouse gas emissions. The bills call for a unified national strategy for addressing the key legal and regulatory barriers to deployment of commercial-scale CCS. A required report detailing a national strategy would identify barriers and gaps that could be addressed using existing federal authority and those that would require legislation, as well as those that would be best addressed at the state, tribal, or regional level. Both bills would also amend the Clean Air Act (CAA) and Safe Drinking Water Act (SDWA) to require that the EPA Administrator establish a coordinated certification and permitting process for geologic sequestration sites, taking into account all relevant statutory authorities. The amended law would require regulation of geologic sequestration wells, and promulgation of regulations to protect human health and the environment by minimizing the risk of atmospheric release of carbon dioxide injected for geologic sequestration.

Both bills contain identical provisions establishing performance standards for CO_2 removal for new coal-fired power plants. Plants covered by this section include those that have a permit issued under the CAA, Title V, to derive at least 30% of their annual heat input from coal, petroleum coke, or any combination of these fuels.

Both bills contain similar provisions that would create a program to accelerate the commercial availability of CO_2 capture and storage technologies and methods by awarding grants, contracts, and financial assistance to electric utilities, academic institutions, and other eligible entities. The bills would allow the establishment of a corporation, by referendum among power industry organizations, that would derive revenue of approximately $1 billion per year via a "wires charge" on electricity delivered from the combustion of fossil fuels. One possible advantage of the program, if enacted, would be the creation of a consistent funding stream—exempt from the annual appropriations process—for development of CCS technology over 10 years.

Both bills would also create a second program that would distribute emission allowances from the cap-and-trade provisions to qualifying electric generating plants and industrial facilities. Although the programs in the two bills are similar in construct and scale, S. 1733 would award allowances to the first 20 gigawatts (Gw) of electricity generation that employs CCS technology via a formula that provides a significant financial incentive, as much as $106 per ton of CO_2 captured for 90% capture efficiency. In contrast, H.R. 2454 would award only the first 6 Gw via the same formula, and then employ a reverse auction scheme to allocate the rest, up to a total of 72 Gw. Thus, S. 1733 allocates allowances to a substantially larger proportion of electricity generating capacity in the first phase of the program, compared to H.R. 2454, at bonus allowance values that could be significantly higher than their average market value.

A chairman's mark to S. 1733, introduced on October 23, 2009, would add an additional incentive for early deployment of CCS by allowing advanced distribution of emission allowances for CCS. In contrast to H.R. 2454 and S. 1733 (as introduced), the chairman's mark would award allowances before the plant has actually captured any CO_2. In contrast, H.R. 2454 and S. 1733 (as introduced) would only distribute emission allowances based on the total tons of CO_2 already captured and sequestered.

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Introduction

This report summarizes and compares provisions for carbon capture and sequestration (CCS) contained in H.R. 2454 and S. 1733, the two leading cap-and-trade bills aimed at reducing U.S. emissions of greenhouse gases. CCS receives considerable attention in both bills because of its potential for substantially reducing carbon dioxide (CO_2) emissions from stationary sources, such as coal-fired power plants, cement plants, and oil refineries, while allowing those industrial sources to continue to operate even in a carbon-constrained environment. The goal of reduced emissions and continued operations is particularly important for the coal industry: coal-fired power plants generate approximately half of all the electricity in the United States, and are responsible for over 40% of U.S. CO_2 emissions from fossil fuels. Many observers consider CCS to be an integral component of a comprehensive strategy to reduce greenhouse gas emissions without creating a near-term disruption of the U.S. energy sector.

Currently, no coal-fired power plants, cement plants, oil refineries, or other large industrial sources of CO_2 in the United States are capturing and sequestering large quantities of CO_2 solely for the purpose of greenhouse gas mitigation. The CCS provisions in H.R. 2454 and S. 1733 are likely intended to spur commercial deployment of CCS at a scale that would greatly surpass the degree of deployment in the absence of additional federal incentives and requirements.[1] Without these incentives, some analyses have projected that low emission allowance prices combined with high costs for installing CCS systems would preclude most additional CCS deployment.[2]

Many questions remain, however, about the possible consequences of accelerated CCS development: financial, legal, regulatory, infrastructure, environmental, and public acceptance.[3] Both bills attempt to some degree to address these questions, largely in parallel and similar fashion, albeit with some important differences. **Table 1** provides a snapshot comparison of the parallel sections in H.R. 2454 and S. 1733, and the body of the report summarizes and discusses each section in sequence.

[1] Current incentives include $3.4 billion in funding for CCS research and development provided in P.L. 111-5, the American Recovery and Reinvestment Act, existing loan guarantees and tax incentives, and the U.S. Department of Energy (DOE) CCS research and development program. For more details on CCS funding, see CRS Report RL33801, *Carbon Capture and Sequestration (CCS)*, by (name redacted).

[2] See, for example, U.S. Environmental Protection Agency, *EPA Analysis of the American Clean Energy and Security Act of 2009: H.R. 2454 in the 111th Congress*, June 23, 2009, appendix, p. 86; or Pew Center on Global Climate Change, *In-Brief, What the Waxman-Markey Bill Does for Coal*, August 2009, fig. 3, at http://www.pewclimate.org/federal/what-waxman-markey-does-for-coal.

[3] For more in-depth discussions of these topics, see CRS Report RL34621, *Capturing CO2 from Coal-Fired Power Plants: Challenges for a Comprehensive Strategy*, by (name redacted) and (name redacted); CRS Report R40103, *Carbon Control in the U.S. Electricity Sector: Key Implementation Uncertainties*, by (name redacted); and CRS Report RL34307, *Regulation of Carbon Dioxide (CO2) Sequestration Pipelines: Jurisdictional Issues*, by (name redacted) and (name redacted).

Table 1. Comparison of Parallel Sections in H.R. 2454 and S. 1733

H.R. 2454	S. 1733	Comments
Title I, Subtitle B	Division A, Title I, Subtitle B	
Sec. 111, National Strategy	Sec. 121, National Strategy	A comprehensive strategy to address key legal, regulatory, and other barriers to CCS.
Sec. 112, Regulations for Geologic Sequestration Sites	Sec. 122, Regulations for Geologic Sequestration Sites	Regulations under the Clean Air Act minimizing the risk of escape of CO_2 to the atmosphere; regulations under the Safe Drinking Water Act for CO_2 geologic sequestration wells.
Sec. 113, Studies and Reports	Sec. 123, Studies and Reports	A study of federal and state environmental laws and state common law applicable to sequestration sites.
Sec. 114, Carbon Capture and Sequestration Demonstration and Early Deployment Program	Sec. 125, Carbon Capture and Sequestration Demonstration and Early Deployment Program	A "wires charge" program that would collect approximately $1 billion annually to foster early deployment of CCS technology.
Sec. 116, Performance Standards for Coal-Fueled Power Plants	Sec. 124, Performance Standards for Coal-Fueled Power Plants	Performance standards under the Clean Air Act for CO_2 removal for new coal-fired power plants.
	Division B, Title I, Subtitle B	
Sec. 115, Commercial Deployment of Carbon Capture and Sequestration Technologies	Sec. 111, Disposition of Allowances for Global Warming Pollution Reduction Program	A program for distributing emission allowances to spur the commercial development of CCS technology.

Source: CRS.

Overview of Key Similarities and Differences

The CCS provisions in H.R. 2454 and S. 1733 are very similar (some sections are identical), and both bills appear to share the goal of fostering the commercial development and deployment of CCS projects as an important component of mitigating greenhouse gas emissions. S. 1733 even specifies—which H.R. 2454 does not—that Congress finds it is in the public interest to achieve widespread commercial deployment of CCS in the United States and throughout Asia before January 1, 2030.

Both bills would require the Environmental Protection Agency (EPA) to regulate geologic sequestration of CO_2 under both the Safe Drinking Water Act and the Clean Air Act, and would also require that the EPA Administrator establish a coordinated certification and permitting process for geological sequestration sites. Recognizing that these statutes do not provide for comprehensive management of geologic sequestration issues (such as long-term liability and pore space ownership), the House and Senate bills would direct the EPA Administrator to establish a task force to examine broadly the federal and state legal framework for geologic sequestration sites and activities, and to report to Congress within 18 months.

Both bills would create two separate programs that would provide financial incentives to develop and deploy commercial-scale CCS. The "wires charge" program, which is nearly identical in both bills and very similar to H.R. 1689, the Carbon Capture and Storage Early Deployment Act

introduced by Representative Boucher, would create an annual funding stream of approximately $1 billion to be awarded by a private corporation to eligible projects. The allocation of development and deployment grants and contracts would be largely independent of federal control, once the corporation is established, leaving the program to the discretion of the electricity generating industry for the most part.

The second program would distribute emission allowances from the cap-and-trade portions of both bills to qualifying electric generating plants and industrial facilities. Although the programs in the two bills are similar in construct and scale, S. 1733 would award allowances to the first 20 gigawatts (Gw) of electricity generation that employs CCS technology via a formula that provides a significant financial incentive, as much as $106 per ton of CO_2 captured for 90% capture efficiency. In contrast, H.R. 2454 would award only the first 6 Gw via the same formula, and then employ a reverse auction scheme to allocate the rest, up to a total of 72 Gw. Arguably the reverse auction process would provide an allowance price closer to its true market value, and thus reflect how the market values CCS versus other emissions reduction options, such as fuel-switching, offsets, and others.[4] If so, then S. 1733 hedges in favor of CCS as a preferred technology by allocating allowances to a substantially larger proportion of electricity generating capacity in the first phase of the program, at bonus allowance values that could be significantly higher than their average market value.

Both the "wires charge" program and the emission allowance scheme focus on the CO_2 capture stage of CCS and generally presume that the technical and regulatory requirements for the transportation and sequestration stages would be in place by the time capture technology is installed and operational. Three nearly identical sections in H.R. 2454 and S. 1733 attempt to address those requirements, through amendments to the Clean Air Act and Safe Drinking Water Act, as well as through studies and reports to construct a national strategy for CCS and identify gaps and barriers that could require additional legislation. Despite these provisions, it is not yet clear whether all of the challenges to transportation and sequestration aspects of CCS can or will be met in concert with the technological and financial challenges of building capture technology that works at large power plants and other industrial sources of CO_2. The promise of CCS in some part depends on the promulgation of a CCS regulatory structure, a sufficient transportation capacity, resolution of liability concerns about long-term CO_2 storage, and public acceptance of CCS, as well as other requirements prior to or in conjunction with the deployment of capture technology at large commercial facilities. Given these present uncertainties, how well the provisions in H.R. 2454 and S. 1733 would advance widespread deployment of CCS still remains an open question.

[4] What true market value means in this situation is not straightforward; nevertheless, a reverse auction would reflect what buyers would be willing to accept as the price of an emission allowance through a competitive process, reflecting to some degree a market-oriented notion of price.

Summary Comparison of CCS Provisions

National Strategy

H.R. 2454

Title I, § 111, of H.R. 2454 would require the Administrator of the Environmental Protection Agency (EPA) to submit to Congress, within one year of enactment, a report detailing a unified national strategy for addressing the key legal and regulatory barriers to deployment of commercial-scale carbon capture and sequestration. The report is to identify barriers and gaps that could be addressed using existing federal authority and those that would require new federal legislation, as well as barriers and gaps that would be best addressed at the state, tribal, or regional level. Additionally, the report is to include regulatory, legislative, or other recommendations to address the gaps and barriers.

S. 1733

Division A, subsections 121(a) and (b) contain the same provisions as § 111 of H.R. 2454, calling for development of a national strategy and related report to Congress. The Senate bill includes an additional provision, subsection 121(c), which states that Congress finds that it is in the public interest that commercial-scale CCS achieve wide deployment in the United States and throughout Asia before 2030.

Regulations for Geologic Sequestration Sites

H.R. 2454

Section 112 of the House bill would require the EPA Administrator to promulgate regulations to manage the geologic sequestration of CO_2 under both the Clean Air Act (CAA) and the Safe Drinking Water Act (SDWA).

Section 112(a) would amend Title VIII of CAA, adding a new § 813 to require the EPA Administrator to establish a coordinated certification and permitting process for geologic sequestration sites, taking into account all relevant statutory authorities. This provision would direct the Administrator to reduce redundancy with SDWA requirements (including the current rulemaking for geologic sequestration wells) and, to the extent practical, reduce the regulatory burden imposed on certified sequestration entities and implementing authorities.

Within two years of enactment, the Administrator would be required to promulgate CAA regulations to protect human health and the environment by minimizing the risk of atmospheric release of carbon dioxide injected for geologic sequestration. The scope of the regulations would include enhanced oil and gas recovery combined with geologic sequestration. The regulations would have to include a process to obtain certification for geologic sequestration; requirements for monitoring, record keeping, and reporting for injected and escaped emissions (taking into account any requirements under § 713 regarding a greenhouse gas registry); and requirements for public participation.

Section 112(a) further would require that, within two years of promulgation of the regulations and every three years thereafter, the EPA Administrator report to the House Committee on Energy and Commerce and the Senate Committee on Environment and Public Works on geologic sequestration in the United States and elsewhere in North America. The report would include data on injection and any emissions to the atmosphere, an evaluation of active and closed sequestration sites, and an evaluation of the performance of federal environmental regulations and programs for sequestration as well as recommendations for their improvement.

This provision broadens the scope of geologic sequestration regulatory authority beyond protecting ground water under SDWA, to protecting against atmospheric releases of CO_2 under the CAA. Currently, EPA's proposed geologic sequestration rulemaking is limited to establishing requirements related to the protection of underground sources of drinking water under SDWA's underground injection control provisions (42 U.S.C. 300h *et seq.*).[5]

H.R. 2454, § 112(b), would amend SDWA by adding a new § 1421(e) to require regulation of geologic sequestration wells. This subsection would direct the EPA Administrator to promulgate, within one year of enactment, regulations for the development, operation, and closure of CO_2 sequestration wells. The regulations would include financial responsibility requirements for emergency and remedial response, well plugging, site closure, and post-injection care. The Safe Drinking Water Act currently does not include explicit financial responsibility provisions, thus limiting EPA's ability to address this issue in its proposed rule.[6]

The section of SDWA that the bill would amend, § 1421, directs the EPA Administrator to promulgate regulations for state underground injection control programs. Thus, H.R. 2454 envisions that EPA would delegate primary oversight and enforcement authority for geologic sequestration wells to interested and qualified states.

S. 1733

Division A, §122, contains the same provisions.

Studies and Reports

H.R. 2454

Section 113(a) would direct the EPA Administrator to establish, within six months, a task force to conduct a study examining the legal framework for geologic sequestration sites. The bill specifies

[5] EPA has proposed a new class of well, Class VI, within the Underground Injection Control Program for wells used for injection of CO_2 for the purposes of CCS.

[6] U.S. Environmental Protection Agency, "Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells; Proposed Rule," 73 *Federal Register* 43520, July 25, 2008. EPA explains in the discussion of the proposed rule that, that although the SDWA does not have explicit provisions for financial responsibility, "EPA believes that the general authorities provided under the SDWA authority to prevent endangerment of USDWs [underground sources of drinking water] include the authority to set standards for financial responsibility to prevent endangerment of USDWs from improper plugging, remediation, and management of wells after site closure. The SDWA authority does not extend to financial responsibility for activities unrelated to protection of USDWs (e.g., risks to air, ecosystems, or public health unrelated to USDW endangerment). It also does not cover transfer of owner or operator financial responsibility to other entities, or creation of a third party financial mechanism where EPA is the trustee."

a range of experts, public and private sector representatives, and other participants to be included on the task force. The study would evaluate (1) existing federal environmental statutes, state environmental statutes, and state common law that would apply to CO_2 storage sites; (2) existing state and federal laws that apply to harm and damage to public health or the environment at closed sites where CO_2 injection has been used for enhanced oil and gas recovery; (3) the statutory framework, implementation issues, and financial implications for various liability models regarding closed sequestration sites; (4) private sector mechanisms that may be available to manage risks from closed sites; and (5) subsurface mineral rights, water rights, and property rights issues associated with geologic sequestration. EPA would be required to report to Congress within 18 months of enactment.

Section 113(b) would direct the EPA Administrator to establish a task force to conduct a study examining how, and under what circumstances, the environmental statutes for which EPA has responsibility would apply to CO_2 injection and geologic sequestration activities. EPA would be required to report to Congress within 12 months of enactment.

S. 1733

Division A, § 123, contains the same provisions for studies and reports.

Summary of Regulatory and Reporting Requirements

Table 2 identifies the schedules for completing reports and regulations required in the above provisions.

Table 2. Geologic Sequestration Regulatory and Reporting Requirements

(summary of parallel provisions in H.R. 2454 and S. 1733)

Action Item	Description	Deadline
National Strategy: Report to Congress	EPA, in consultation with other federal agencies, must develop unified, comprehensive strategy to address key legal, regulatory, and other barriers to commercial-scale deployment of CCS.	1 year after enactment
Clean Air Act (CAA) Regulations	EPA must promulgate regulations to protect human health and the environment by minimizing the risk of escape to the atmosphere of CO_2 injected for geologic sequestration.	2 years after enactment
Geologic Sequestration Activities: Report to Congress	EPA must deliver to the House Committee on Energy and Commerce and the Senate Committee on Environment and Public Works a report on geologic sequestration in the United States and, as relevant, elsewhere in North America.	2 years after promulgation of CAA regulations (i.e., 4 years from enactment) and every 3 years thereafter

Action Item	Description	Deadline
Safe Drinking Water Act Regulations	EPA must promulgate regulations for CO_2 geologic sequestration wells that include financial responsibility requirements.	1 year after enactment
Study of Legal Framework for Geologic Sequestration Sites: Report to Congress	EPA must establish a task force to conduct a study of federal and state environmental laws and state common law applicable to sequestration sites regarding risk management; federal and state laws that apply to harm and damage to the environment or public health at closed sites; statutory framework and issues for private or public assumption of liabilities and financial responsibilities; and mineral, water, and property rights issues.	18 months after enactment
Environmental Statutes Study: Report to Congress	EPA must conduct a study of how EPA-administered statutes would apply to CO_2 injection and geologic sequestration activities.	1 year after enactment

Source: CRS.

Carbon Capture and Sequestration Demonstration and Early Deployment Program

H.R. 2454

Section 114 of H.R. 2454 allows for the creation of a Carbon Storage Research Corporation that would establish and administer a program to accelerate the commercial availability of CO_2 capture and storage technologies and methods by awarding grants, contracts, and financial assistance to electric utilities, academic institutions, and other eligible entities.[7]

The section would establish the corporation by a referendum among "qualified industry organizations," which would include the Edison Electric Institute, the American Public Power Association, the National Rural Electric Cooperative Association, their successors, or a group of owners or operators of distribution utilities delivering fossil fuel-based electricity who collectively represent at least 20% of the volume of all fossil fuel-based electricity delivered by distribution utilities to U.S. consumers. Voting rights would be based on the quantity of fossil fuel-based electricity delivered to the consumer in the previous year or other representative period. The corporation would be established if persons representing two-thirds of the total quantity of fuel-based electricity delivered to retail consumers vote for approval. However, if 40% or more of state regulatory authorities submit written notices of opposition to the creation of the corporation, it would not be established.

[7] Section 114 is nearly identical to H.R. 1689, the Carbon Capture and Storage Early Deployment Act, introduced by Rep. Boucher on March 24, 2009.

If established, the corporation would award grants, contracts, and assistance to support commercial-scale demonstration of carbon capture or storage technology projects that encompass coal and other fossil fuels, and are suitable for either new or retrofitted plants. The corporation would seek to support at least five commercial-scale demonstration projects over the lifetime of the corporation. Pilot-scale and other small-scale projects would not be eligible under the program.

Under § 114, several entities would be eligible to receive grants, contracts, or assistance from the corporation: distribution utilities, electric utilities and other private entities, academic institutions, national laboratories, federal research agencies, state and tribal research agencies, nonprofit organizations, or a consortium of two or more eligible entities. In addition, § 114 would favor "early movers" by providing, in the form of grants, 50% of the funds raised to electric utilities that had already committed resources to deploy large-scale electricity generation units integrated with CCS. The section would provide grant funds to defray costs already incurred for at least five "early movers."

The corporation would raise funding for its program by collecting an assessment on distribution utilities for all fossil fuel-based electricity delivered to retail customers. The assessments would reflect the relative CO_2 emission rates of different fossil fuels used to generate electricity, as shown in **Table 3**.

Table 3. Rate of Assessment for Coal, Natural Gas, and Oil in H.R. 2454

Fuel Type	Rate of Assessment per kilowatt hour
Coal	$0.00043
Natural Gas	$0.00022
Oil	$0.00032

Source: H.R. 2454.

The corporation would be authorized to adjust the assessments so that they generate not less than $1.0 billion and not more than $1.1 billion per year. The authority to collect assessments would be authorized for a 10-year period, beginning six months after enactment. The corporation would dissolve 15 years after enactment unless extended by Congress. If assessments are collected as specified in the legislation, the corporation would accumulate approximately $10 billion to be awarded over 15 years.

Section 114 allows for cost recovery. The legislation would allow a distribution utility whose transmission, delivery, or sale of electric energy are subject to any form of rate regulation the opportunity to recover the full amount of "the prudently incurred costs" associated with complying with § 114, consistent with state or federal laws.

Section 114 also allows for ratepayer rebates. If the corporation does not disburse or dedicate at least 75% of the funds in a calendar year[8] due to absence of qualified projects or similar circumstances, then the corporation must reimburse the balance to the distribution utilities. In this

[8] Beginning seven or more years after the corporation is established.

case, the regulatory authority that gave its approval for cost recovery could also order rebates to ratepayers from the reimbursed pool of funds.

Section 114 also provides specific provisions for the Electric Reliability Council of Texas (ERCOT), so that the program can work for ERCOT as well as for other regions of the country.

Within five years, the Comptroller General of the United States must prepare an analysis and report to Congress assessing the corporation's activities, including project selection and methods of disbursement of assessed fees, impacts on the prospects for commercialization of carbon capture and storage technologies, and adequacy of funding.

S. 1733

Division A, § 125, of S. 1733 is very similar to § 114 of H.R. 2454 with a few exceptions. Under both bills, the corporation to be established would operate as a division or affiliate of the Electric Power Research Institute (EPRI), and be managed by a board consisting of no more than 15 members drawn from the following groups:

- investor-owned utilities;
- utilities owned by a state agency, municipality, or Indian tribe;
- rural electric cooperatives;
- fossil fuel producers;
- nonprofit environmental organizations;
- independent generators or wholesale power providers; and
- consumer groups.

S. 1733 adds two additional groups to the board that were not included in H.R. 2454: (1) the National Energy Technology Laboratory of the Department of Energy, and (2) the Environmental Protection Agency.

The entities eligible to receive grants, contracts, or assistance under the program are identical for both bills; however, S. 1733 also requires that projects shall meet the eligibility requirements of § 780(b) of the Clean Air Act. Section 780 would be an amendment to Title VII of the Clean Air Act, added under S. 1733, and would provide for the commercial deployment of carbon capture and sequestration technologies.[9] Apart from these relatively minor differences, this "wires charge" program created under S. 1733 and H.R. 2454 would be nearly identical.

One possible advantage of the program, if enacted, would be the creation of a consistent funding stream—exempt from the annual appropriations process—for development of CCS technology over 10 years. In contrast, funding for CCS technology from DOE, which is subject to appropriations, has changed significantly over the past decade or more. It has increased from approximately $1 million in FY1997 to $581 million in FY2009. Further, the American Recovery and Reinvestment Act (ARRA, P.L. 111-5) allocated $3.4 billion to CCS to be committed by the

[9] H.R. 2454 also amends Title VII of the Clean Air Act. See discussion below for a comparison.

end of FY2010, a dramatic increase over current funding levels.[10] Concerns could be raised over the relative effectiveness of a sharp but short-lived increase in funding—provided by ARRA, for example—versus a consistent stream of funding over a longer time period, for the purposes of technology development.

Performance Standards for Coal-Fueled Power Plants

H.R. 2454

Title I, §116, of H.R. 2454 would amend Title VIII of the Clean Air Act by adding performance standards for CO_2 removal for new coal-fired power plants. Plants covered by this section include those that have a permit issued under CAA Title V to derive at least 30% of their annual heat input from coal, petroleum coke, or any combination of these fuels. The performance standards are as follows:

- A covered unit that is "initially permitted" on or after January 1, 2020, shall reduce carbon dioxide emissions by 65%. The 65% reduction would result in a level of emissions roughly equivalent to the CO_2 released by a natural gas-fired plant of modern design (a "combined cycle" plant) using no carbon controls. However, to achieve a 65% reduction (or the 50% reduction for older plants; see immediately below) a coal plant would have to install carbon removal technology.
- A covered unit that is initially permitted after January 1, 2009, and before January 1, 2020, must achieve a 50% reduction in CO_2 emissions by a compliance date that will be determined by future developments. Specifically, the compliance date will be the earliest of (1) four years after the date in which the equivalent of 4 gigawatts (Gw)[11] of generating capacity with commercial CCS technology are operating in the United States and sequestering at least 12 million tons of CO_2 annually (equivalent to roughly eight medium-sized coal plants);[12] or (2) January 1, 2025 (which can be extended by the EPA Administrator by up to 18 months on a case-by-case basis).
- Not later than 2025 and at five-year intervals thereafter, the Administrator is to review the standards for new covered units under this section and shall reduce the maximum CO_2 emission rate for new covered units to a rate that reflects the degree of emission limitation achievable through the application of the best system of emission reduction that the Administrator determines has been adequately demonstrated. The Administrator is also to publish biennial reports on the amount of capacity with commercial CCS technology in the United States.

[10] See CRS Report RL33801, *Carbon Capture and Sequestration (CCS)*, by (name redacted), for more details on CCS funding.

[11] A gigawatt is equivalent to 1,000 megawatts or 1 million kilowatts of generating capacity. By way of comparison, total electric generating capacity in the United States is about 1,000 gigawatts.

[12] This 4 Gw of capacity must include at least 3 Gw of electric generating units, may include up to 1 Gw of industrial applications that are capturing and sequestering at least 3 million tons of CO_2 annually, and must include at least two operating 250 megawatt (Mw) or larger generating units that sequester captured CO_2 in geologic formations other than oil and gas fields.

The use of the term "initially permitted" is important in the implementation of this section. A new power plant that has received a permit that is still subject to administrative or legal review is considered to be "initially permitted." If a proposed new coal plant has been "initially permitted" prior to January 1, 2009, it will not fall under the requirements of this section to eventually install carbon controls.

S. 1733

Division A, Section 124, of S. 1733 contains a nearly identical provision. Probably the most important change relates to units that are initially permitted after January 1, 2009, and before January 1, 2020. In H.R. 2454, this class of plants must achieve a 50% reduction in carbon dioxide emissions by a compliance date that can be triggered by market developments, but normally is no later than January 1, 2025. In S. 1733 this date is January 1, 2020.

As noted above, the compliance deadline date can be earlier than 2020 if certain market developments occur. In H.R. 2454 these criteria include installation of the equivalent of at least 4 Gw of generating capacity with carbon capture and sequestration equipment. In the chairman's mark of S. 1733 this is put at 10 Gw, but the breakdown of the target between power plants and industrial plants still adds to 4 Gw. The chairman's mark also clarifies that in determining whether the target has been met, only the treated capacity of retrofitted power plants should be counted toward the target.

Commercial Deployment of Carbon Capture and Sequestration Technologies

H.R. 2454

Section 115 of H.R. 2454 would amend Title VII of the Clean Air Act (and create § 786) to require that not later than two years after the date of enactment, the EPA Administrator is to promulgate regulations providing for the distribution of emission allowances to support the commercial deployment of carbon capture and sequestration technologies in both electric power generation and industrial operations. Eligibility for emission allowances requires an owner or operator to implement carbon capture and sequestration technology at:

- an electric generating unit that has a nameplate capacity of 200 megawatts or more, and derives at least 50% of its annual fuel input from coal, petroleum coke, or any combination of these two fuels, and which will achieve at least a 50% reduction in carbon dioxide emissions annually produced by the unit; and
- an industrial source that, absent carbon capture and sequestration, would emit more than 50,000 tons per year of CO_2, and upon implementation will achieve at least a 50% reduction in annual CO_2 emissions from an emission point.[13]

[13] During markup of H.R. 2454, an amendment was successfully offered to replace the word "source" with the words "emission point" regarding eligibility for emission allowances at an industrial facility. The change in wording could affect the eligibility for industrial sources that employ CCS technology at some but not all emission points in the facility.

Eligibility for emission allowances requires that the owner or operator geologically sequester captured CO_2 or convert it to a stable form that can be safely and permanently sequestered.

Section 115 would distribute emission allowances to electric generating units in two phases. Phase I applies to the first 6 Gw of electric generating units, measured in cumulative generating capacity of such units. Under Phase I, eligible projects would receive allowances equal to the number of tons of carbon dioxide captured and sequestered, multiplied by a bonus allowance value, divided by the average fair market value of an emission allowance in the prior year.[14] The Administrator would establish a bonus allowance value for each rate of carbon capture and sequestration—compared to how much would otherwise be emitted—from a minimum of $50 per ton for a 50% rate to a maximum of $90 per ton for an 85% rate.[15] This section provides an incentive for "early movers." Under Phase I distribution to electric generating units, the bonus allowance value is increased by $10—of the otherwise applicable bonus value—if the generating unit achieves a 50% capture rate before January 1, 2017.

Allowances would be distributed under Phase II after the 6 Gw threshold is achieved. Phase II would distribute emission allowances by reverse auction. At each reverse auction, the EPA Administrator would select bids from eligible projects—each bid submitted would include the total quantity of CO_2 to be sequestered over 10 years and the desired CO_2 sequestration incentive per ton—and begin with the project proposing the lowest level of CO_2 incentive per ton.[16]

If the Administrator determines that reverse auctions are not efficient or cost-effective for deploying commercial-scale capture and sequestration technologies, the Administrator may prescribe an alternative distribution method. In an alternative distribution method, the Administrator would divide emission allowances into multiple "tranches," each supporting the deployment of a specified quantity of cumulative electric generating capacity utilizing CCS technology. Each tranche would support no more than 6 Gw of electric generating capacity, and would be distributed on a first-come, first-serve basis. For each tranche, the Administrator would establish a sliding scale that would provide higher bonus allowance values for projects achieving higher rates of capture and sequestration. For each successive tranche, the Administrator would establish a bonus allowance value that is lower than the rate established for the previous tranche.

Limitations

Under both Phase I and Phase II, the EPA Administrator would reduce or adjust the bonus allowance values for projects that sequester CO_2 in geological formations for the purposes of enhanced hydrocarbon recovery.[17] By reducing the bonus allowance value for these projects, the

[14] Or, expressed as a formula: Allowances = (# tons of CO_2 captured and sequestered) x (bonus allowance value) / (average fair market value for an allowance in prior calendar year).

[15] For example, if an eligible facility could capture 1 million tons of CO_2 per year at a 85% capture rate, then it could receive 1 million allowances if the fair market value was $90 per ton in the prior year; 2 million allowances if the fair market value was $45 per ton in the prior year; or 6 million allowances if the fair market value was $15 per ton in the prior year.

[16] For example, if two eligible projects submitted bids to sequester 10 million tons of CO_2 over 10 years, and project A proposed a $50 per ton incentive, while project B proposed a $40 per ton incentive, the Administrator would presumably first select project B, if each project was otherwise equally qualified.

[17] Enhanced hydrocarbon recovery, also known as enhanced oil recovery (EOR), is a technique whereby CO_2 in injected into the subsurface to improve the recovery of oil (or gas) that might otherwise not be recoverable using conventional oilfield techniques.

Administrator would take into account the lower net costs for an enhanced hydrocarbon recovery project. The lower net costs would presumably result from income to the project provided via sale of the recovered hydrocarbons.

Section 115 of H.R. 2454 also contains several provisions that limit the number of allowances and the total cumulative electric generating capacity eligible for allowances. Under § 115, no more than 72 Gw of total cumulative generating capacity may receive allowances, including industrial applications measured under an equivalent metric determined by the EPA Administrator. In addition, a qualifying project, either an electricity generating plant or industrial facility, would be eligible to receive allowances only for the first 10 years of operation. H.R. 2454 also limits the total percentage of emission allowances made available under the bill for CCS to 1.75% for years 2014 through 2017, 4.75% for years 2018 through 2019, and 5% for years 2020 through 2050. These annual allocation percentages are established in § 782(f) of the Clean Air Act, as amended by H.R. 2454.

Section 115 would allocate the bulk of emission allowances to electricity generating units and limit the amount of emission allowances available to industrial sources. The Administrator would not distribute more than 15% of the allocated allowances under § 782(f) to eligible industrial sources.[18] The allowances may be distributed to eligible industrial sources using a reverse auction method or an incentive schedule, similar to the Phase II methods described for electric generating units. Industrial facilities are specifically excluded if they produce a liquid transportation fuel from a solid fossil-based feedstock, such as coal.

S. 1733

Under Subtitle B of Division B of S. 1733, § 111 allows for the disposition of emission allowances for the global warming pollution reduction program. Similar to § 115 of H.R. 2454, this section of S. 1733 would amend Title VII of the Clean Air Act and add § 780 (equivalent to § 786 created in H.R. 2454), which would distribute emission allowances to electricity generating plants and industrial facilities to foster the deployment of CCS technologies. The goal, scope, and structure of the program in Division B, § 111, of S. 1733 are very similar to those of the program created under § 115 of H.R. 2454, with several important distinctions.

As with H.R. 2454, S. 1733 would distribute allowances for the first 72 Gw of total cumulative generating capacity to employ CCS, including industrial applications, and would distribute them as a similar percentage of the total pool of available allowances: 1.75% for years 2014 through 2017, 4.75% for years 2018 through 2019, and 5% for years 2020 through 2050.[19] S. 1733 would also distribute allowances in two phases; however, it would distribute allowances to the first 20 Gw of generating capacity in Phase I, instead of 6 Gw as proposed in Phase I of H.R. 2454.

Phase I of S. 1733 would distribute allowances in two 10-Gw tranches according to the same formula[20] described in H.R. 2454:

[18] For example, industrial sources would be eligible to receive 15% of 1.75% of total allowances in years 2014 through 2017, or 0.26% of the total allowances under § 782(f) of the Clean Air Act, as amended by H.R. 2454.

[19] These annual allocation percentages are established in § 721(a) of the Clean Air Act as amended by S. 1733; equivalent to §782(f) of the Clean Air Act as amended by H.R. 2454.

[20] Allowances = (# tons of CO_2 captured and sequestered) x (bonus allowance value) / (average fair market value for an allowance in prior calendar year).

- First tranche—10 Gw for eligible projects achieving 50% or more reduction in CO_2 emissions through the use of CCS technology, with bonus allowance values ranging from $50 per ton for 50% capture to $96 per ton for 90% capture (versus $90 per ton for 85% capture in H.R. 2454).
- Second tranche—10 Gw for eligible projects achieving 50% or more reduction in CO_2 emissions with a maximum bonus allowance value of $85 per ton for 90% capture.

Similar to H.R. 2454, "early mover" projects would receive an additional $10 per ton if they commenced operations by January 1, 2017, which would apply to all 20 Gw of Phase I in S. 1733. In contrast, the "early mover" bonus would apply to only 6 Gw in H.R. 2454.

As in H.R. 2454, allowances would be distributed under Phase II by reverse auction. In S. 1733, similar to H.R. 2454, the EPA Administrator may establish reverse auctions for no more than five different project categories, defined based on (1) coal type, (2) capture technology, (3) geological formation type, (4) new versus retrofit, and (5) other factors or any combination of categories 1-4. In S. 1733, the Administrator would establish a separate reverse auction, to be held annually, for projects at industrial sources. Industrial sources would not be allowed to participate in other auctions. A requirement to segregate industrial sources from electricity generating sources is not specified in H.R. 2454.

In parallel to H.R. 2454, the Administrator may prescribe an alternative distribution method under S. 1733 if it is determined that reverse auctions are not efficient or cost-effective. Under both H.R. 2454 and S. 1733, the Administrator would divide the emission allowances into a series of multiple tranches, each supporting the deployment of a specific quantity of cumulative electricity generating capacity. Under S. 1733, each tranche would support 10 Gw of generation capacity. In contrast, under H.R. 2454 each tranche would support 6 Gw.

Limitations

As with H.R. 2454, no more than 15% of the total emission allowances allocated for CCS in S. 1733 would be distributed to eligible industrial sources in any vintage year. In addition, S. 1733 prohibits the distribution of allowances to industrial sources under the first tranche of Phase 1 (i.e., the first 10 gigawatts of generating capacity), but does allow industrial projects to receive allowances under the second tranche of Phase I and thereafter. Under H.R. 2454, projects at industrial sources would be eligible to receive allowances in Phase II, after the allowances for the first 6 gigawatts of generating capacity have been distributed.

S. 1733 also contains a provision for *certification* of qualifying projects that is not included in H.R. 2454. Under S. 1733, qualifying projects that are eligible to receive allowances under either Phase I (the first 20 Gw) or the alternative distribution method of Phase II may request a certification from the EPA Administrator that the project is eligible to receive emission allowances. A project that successfully bids under the reverse auction method of Phase II does not have an option; it would be required to request a certification from the Administrator. The process of obtaining a certification is apparently a more formal requirement for eligibility that leads to a *reservation* of a portion of emission allowances allocated for the deployment of CCS technology.

In addition to applying for a certification, a qualifying project would need to document several items in order for the Administrator to make a determination of eligibility:

- technical information regarding CCS technology to be used, coal type, geological formation type, and other relevant design criteria;
- the annual CO_2 reductions projected for the first 10 years of commercial operation; and
- a demonstration by the owner and operator that they are committed to constructing and operating the project along a timeline of reasonable capture and sequestration milestones.

In addition to documenting this information, the qualifying project must demonstrate its commitment to the project by taking at least one of three *qualifying actions*:

- execution of a commitment by lenders or other appropriate entities to finance the project;
- commitment of the owner or operator to execute a surety bond; or
- an authorization by a state regulatory authority to allow cost recovery from the retail customers for the costs of the project.

For projects that elect not to request certification (Phase I or alternative distribution projects under Phase II are not required to, although they may), the Administrator would make a separate determination of whether the project satisfies eligibility requirements. That determination would occur at a time when the emission allowances are actually distributed. As with H.R. 2454, emission allowances under S. 1733 would be distributed on an annual basis, based on the total tons of CO_2 the project actually captures and sequesters in each of the first 10 years of operation. Although emission allowances may be *reserved* in advance, based on the issuance of a certification or other determination of eligibility, they would not be actually *distributed* until after the CO_2 has been already captured and sequestered.

Chairman's Mark

On October 23, 2009, Senator Boxer released the chairman's mark to S. 1733, which contained a new provision to the emission allowance distribution program for CCS.[21] The new provision would allow for advanced distribution of allowances under Phase I of the program, thus providing an opportunity for fossil fuel fired electricity plants and industrial facilities to receive allowances before the plants have actually captured and sequestered any CO_2. This approach differs from the allowance distribution scheme in H.R. 2454 and S. 1733 (as introduced), which would distribute emission allowances based on the total tons of CO_2 actually captured and sequestered. Similar to H.R. 2454 and S. 1733 (as introduced), the chairman's mark would require that plants have at least a 50% capture rate before they would qualify for allowances.

Under the new provision, 70% of the number of emission allowances reserved under the first tranche of Phase I would be eligible for advanced distribution, and 50% of the second tranche would also be eligible. The amount of allowances eligible for advanced distribution would total 12 Gw of the 20 Gw of generating capacity, or 60% of the total, available under Phase I of S. 1733. By comparison, H.R. 2454 would provide only half that amount (6 Gw) in total for Phase I,

[21] Available on the Senate Environment and Public Works Committee website at http://epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=ee5c67bb-a5a7-453d-a4e0-4c8f2908c0cf.

and would require that the plants have commenced operations and actually be capturing CO_2 before receiving any allowances. The provision in the chairman's mark of S. 1733 could be seen as an additional incentive to "early movers" to build CCS-ready facilities or retrofit existing plants. The requirements for when to provide the advanced distribution are somewhat vague, however, allowing the EPA Administrator discretion to pick a time prior to the plant's operational phase that would "ensure expeditious deployment" of CCS technology.

Some may view the new provision as providing access to emission allowances before the plant owner or operator has made an iron-clad commitment to building and operating a CCS unit. In part, the chairman's mark addresses that concern by specifying that advanced allowances would be limited to only cover costs for retrofitting an existing plant for CCS and to cover the difference in costs between building a new electric generating unit with CCS versus a new plant without CCS. The bill assigns responsibility for the necessary cost estimates—for both the retrofit and the new plant costs—to the organization requesting the advanced appropriations. The advanced allowances would be distributed using the cost estimates provided by the requesting organization.

In addition, certification would be required for a plant to receive advanced allowances. As one of the criteria for obtaining certification, the chairman's mark adds an additional qualifying action to the list of qualifying actions in S. 1733 that would demonstrate a commitment to construct and operate a CCS project: an authorization from a state legislature to allow cost recovery for the CCS project. Thus, a project could receive authorization either from a state regulatory authority for cost recovery, or from a state legislature, as one necessary step to obtaining certification.

The advanced allowance scheme provides a new incentive for power plants and industrial facilities to make a commitment to building CCS that is not present in H.R. 2454 or in S. 1733 (as introduced). It is likely to accelerate early deployment of CCS by making up to 12 Gw eligible for advanced allowances, compared to H.R. 2454, which provides for only 6 Gw in Phase I. How much more electricity generating capacity will employ CCS as a result of the advanced allowance provision is difficult to predict, and would depend, in part, on other factors such as the ratio of the value of bonus allowances established in legislation versus the market price of allowances. The long-term deployment of CCS would also depend on how well the hoped-for "learning-by-doing" gains in efficiency and knowledge accrue from demonstration projects and the experience gained through early deployment at a commercial scale.

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