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Valuation of Carbon Valuation of Carbon Capture and Sequestration Under Greenhouse Gas Regulations

Elizabeth L. Aldrich, *Boise State University*

CCS Brief # 4: Valuation of Carbon Capture and Sequestration Under Greenhouse Gas Regulations

Elizabeth Lokey, M.S., Ph.D.
Senior Consultant
Camco International

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Foreword

This paper is the first in a two part series about the role of carbon capture and sequestration (CCS) in greenhouse gas regulations. This paper focuses on the various ways that CCS could be valued in different types of greenhouse gas markets while the second in this series focuses on how CCS could be valued as an offset and fungible in the market.

Abstract

Carbon capture and sequestration (CCS) could play a significant role in reducing greenhouse gas emissions in the future. The price associated with a metric ton of carbon dioxide reduction could help make CCS a more financially-viable technology. However, the value assigned to CCS depends on the type of greenhouse gas regulation chosen, such as a standard, greenhouse gas tax, or cap-and-trade system, and the details of how the market is implemented. This paper will cover ways in which CCS can be incorporated into greenhouse gas regulations and the implications of each of these methods. It will then cover how CCS is treated in current regulations for regulated entities.

I. Background

Global climate change due to increases in greenhouse gas emissions have led many countries to study innovative solutions to reduce these emissions without sacrificing the standard of living that the combustion of fossil fuels and other industries have afforded. One particular mitigation approach for the most ubiquitous greenhouse gas, carbon dioxide (CO2), is direct sequestration: capturing CO2 at its source, transporting it via pipelines, and storing it indefinitely to avoid its release to the atmosphere.[i] Carbon capture and sequestration (CCS) is at a very early stage of deployment, with only four active sites and five proposed sites worldwide as of 2005.[ii] [1] Despite the relatively small market penetration of CCS, it has the potential to play an important role in the portfolio of climate change mitigation technologies, supplementing the carbon emission reductions to be achieved by energy efficiency, conservation, and renewable energy technologies.[2]

The interest in potential opportunities to capture and permanently store CO2 has been dominated by the electric utility sector, but the technology may be equally applicable, if not more so, to other industries with large CO2 emissions, such as natural gas processing facilities, fertilizer plants, and ammonia producers.

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[1] At that time, CO2 was also being sequestered inadvertently at 18 enhanced oil recovery, coalbed recovery, and gas recovery sites, and 43 acid gas (hydrogen sulfide) injection sites. These sites exist because sequestering CO2 helps boost the profits of the industries, but reduction of greenhouse gases and permanent sequestration of the CO2 is not the sole purpose of these facilities. (Sarah Forbes, Kate Robertson, Jette Findsen, & Steve Messner, *International Carbon Capture and Storage Projects Overcoming Legal Barriers,* 24 (DOE/NETL-2006/1236, 2006), *available at* http://www.netl.doe.gov/energy-analyses/pubs/ccsregulatorypaperfinalreport.pdf.)

[2] The term "sequestration" instead of "storage" will be used in this paper since storage implies that the CO2 could one day be retrieved and reused; "sequestration" connotes permanent storage. As CCS is contemplated as a tool to mitigate global warming, there is no thought that the CO2 injected will intentionally be retrieved and used for any purpose.

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CCS has the potential to make a significant contribution to the problem of climate change, and is a common feature in scenarios modeling how emissions may be reduced in the future. Robert Socolow shows that CCS is one of the scalable solutions to the climate dilemma in his famous paper "Solving the Climate Problem" which describes seven key technologies and practices needed to stabilize CO2 emissions at 7 billion metric tons per year and keep climate change impacts as minimal as possible.[iii] A 2008 International Energy Agency report entitled "Carbon Capture and Storage: A Key Abatement Option" shows that CCS could contribute to 10.4 gigametric tons of reductions annually or 19% of the global warming solution.[iv]

However, even if CCS becomes technically feasible, the cost of capture, transport, and injection may be too expensive to compete with other methods of mitigating or avoiding emissions until the cost of CCS falls or the cost of carbon rises. McKinsey and Company estimate the cost of CCS for early commercial scale projects to be €35-50 per metric ton of CO2 sequestered. The range is due to a variety of factors such as which separation technology is used and how far from the site of injection the stack is located.[v] If greenhouse gas legislation is adopted ubiquitously and a price close to the cost of CCS is established for each metric ton of CO2 emitted, then CCS may become more economically viable than it currently is. CCS could be recognized as a way for emitters to reduce their greenhouse gas footprint and/or the CO2 stored could be qualified as an emissions offset and sold to emitting entities as a cost-effective way of reducing their own emissions in place of purchasing permits to pollute, known as emissions allowances.

Despite the enormous potential for CCS to provide a CO2 reductions for large emitters, emerging and existing greenhouse gas regulations are only just beginning to provide incentives to encourage CCS activities. Most emerging programs are likely to count CCS activities by considering them as a reduction in a regulated entity's emissions, while only a few recognize CCS as a valid form of offsets from unregulated emitter activities. The specific way in which CCS is valued in greenhouse gas regulations determines how much these CCS activities will benefit from future greenhouse gas regulations.

II. Incorporation of CCS in Greenhouse Gas Regulations

There are three mechanisms that policy makers can use to control greenhouse gas emissions: an emissions standard, a carbon tax, or cap-and-trade program. Creative hybrids of these regulations have been formulated to avoid some of the downfalls of each system. Outside of these three programs, CCS could be valued as project which reduces greenhouse gas emissions, known as an offset, which could be fungible into any of these three types of greenhouse gas regulations.

a. Emissions Standard

California's Senate Bill 1368, which stipulates that power suppliers produce no more than 1,100 pounds of CO2 per MWh, is an example of specific regulations that set an emissions standard.[vi] If there was no incentive for emitters to go above and beyond this standard, then plants with CCS may, for economic reasons, sequester only the portion of the stack emissions that would allow that facility to meet the standard and vent the remainder. Therefore, it may be essential to offer additional benefits for facilities that go beyond the standard.

Alternatively, a standard could mandate that every new and existing coal-burning power plant or heavy industry with stack emissions separate and sequester its CO2. While this is a possibility, it is not likely to occur since this type of policy solution could be quite costly and impractical. A modification of this type of standard has begun to be implemented in states like Kansas where a bill has been introduced that would require new power plants to capture and store 45% of their CO2 emissions and old power plants to capture and store 20% of their CO2 emissions.[vii] Pennsylvania has also introduced legislation that would require distribution companies to source 3% of their electricity from facilities that have CCS.[viii] The "Clean Coal Portfolio Standard," Senate Bill 1987 in Illinois, requires utilities to source 5% of their electricity from facilities that engage in CCS.[ix]

Another type of standard is a Carbon Emissions Portfolio Standard, which would require that electricity suppliers meet mandates on the acceptable emissions of the product they sell. House Bill 2156 of Washington establishes such a requirement that can be met by sourcing qualifying offsets, electricity from clean sources like facilities that engage in CCS, and making payments into a CO2 mitigation fund.[x] This type of regulation would work in a similar fashion to Renewable Portfolio Standards. No allowances would be issued; instead, states would be responsible for meeting their reduction targets by sourcing electricity from low-carbon facilities or purchasing qualifying offsets. Regional tracking systems could trace offset procurement and sales and ensure that regulated entities were meeting their goals. This solution would avoid some of the complexities inherent in various allocation distribution schemes under a cap-and-trade system and provide a clear incentive for CCS.[xi]

b. Carbon Tax

A carbon tax is a fee emitters must pay for every metric ton of CO2 emitted above a threshold or per metric ton emitted cumulatively. A carbon tax, unlike a cap-and-trade system which will be described later, provides a stable price per metric ton of CO2. This price signal allows emitters to budget how much they will be impacted by regulation. A carbon tax cannot achieve a set amount of emissions that may be deemed permissible by scientists with certainty since economic modeling cannot predict each emitter's internal abatement costs and behavior with total accuracy. Therefore, how much emitters will respond to the tax by reducing emissions is unknown.

A traditional carbon tax system will not provide an environment that allows CCS operators to derive maximum economic benefit because any emitters that are not subject to the carbon tax but have facilities that would be eligible for CCS would not have the incentive to engage in CCS. And, in a carbon tax scheme that sets a permissible amount of emissions for emitters, there is no incentive for CCS operators to sequester more than this permissible amount since they would derive no economic benefit from doing so.

Norway, however, has implemented carbon taxes in ways that avoid some of these problems. Norway's use of carbon taxes for off-shore drilling prompts StatOil in its Sleipner project to inject CO2 produced by its extraction operations that would have been off-gassed or released into the environment. Statoil benefits from CCS activities as it avoids having to pay the Norwegian Discharge Tax of €40 per metric ton of CO2.[xii] Because there is no permissible amount of emissions for off-shore drilling operations, CCS operators in this sector benefit from every metric ton sequestered.

c. Cap-and-Trade

Cap-and-trade schemes involve the setting of a target cap of permissible emissions by a given year in the future. This amount of permissible emissions is based on what scientific studies have shown will allow humanity to live with and adapt to an acceptable amount of the climate change impacts. These schemes usually have caps that are less stringent for interim target dates in the short-term and more stringent in the long-term. Large emitters are usually the first to be regulated, and individual caps for various industrial sectors are set. Emitters that are regulated within each sector are given or purchase individual pollution permits or allowances from the overall cap. Each allowance typically represents the ability to emit one metric ton (metric ton) of CO2 equivalence.[3] These emitters can then buy and sell these allowances to meet their reduction targets, make in-house reductions through measures such as installing more efficient equipment, or purchase qualifying offsets to apply to their CO2 reduction targets. A cap-and-trade scheme allows the market to set the price of CO2; therefore, emitters are subject to the market's volatility. Over time, the number of allowances distributed and decreases to meet the progressively more stringent targets for reductions in greenhouse gases. If emitters exceed their individual caps, they must pay penalties that are designed to be more expensive than simply purchasing allowances or offsets.

The types of emitters that are regulated in cap-and-trade schemes vary. In the U.S.'s Regional Greenhouse Gas Initiative (RGGI) that became operational in January of 2009, only electric power generators with a rated capacity of at least 25 MW are regulated.[xiii] In the European Union's European Trading Scheme (EU ETS), five sectors including power and heat generation, oil refineries, metals, pulp and paper, and other energy intensive industries are covered.[xiv]

Most European countries, Japan, Australia, New Zealand, and emerging U.S. and South Korean greenhouse gas markets favor a cap-and-trade system to control emissions. Cap-and-trade schemes have, on the whole, been more popular for several reasons. The word "tax" tends to create politically negative connotations. Secondly, if a given tax level is found to be too overbearing or ineffective in making CO2 reductions, it can be difficult to adjust the tax level in the short term. A cap-and-trade system, in theory, allows for more flexibility in how regulated entities can meet their reductions since emitters can trade permits and use offsets. This flexibility could allow for the regulated entities to meet their targets more cheaply than if they had to make in-house reductions.

Although cap-and-trade systems can allow for the incorporation of CCS, the incentive for CCS activities is not always as straightforward. The price of CO2 in a cap-and-trade system varies widely since the price is set by market dynamics. In the first European Union Trading Scheme (EU ETS), the spot price of an allowance ranged between €20-25 in October 2005, but then bottomed out at € .10 on June 22, 2007 when it was recognized that the regulated entities had been over-allocated permits. In the second EU ETS, the price was around €20-25 in August of 2008 and then dropped to €8.23 on February 16, 2009 when other markets worldwide sagged. This fluctuating price for CO2 does not provide a constant price signal for CCS developers, who need price stability close to the €35-50 per metric ton estimate of the costs of CCS in order to get loans for the huge capital expenditures necessary for separating and sequestering CO2.[xv]

[3] Metric tons are most often used for accounting in greenhouse gas programs, but the Regional Greenhouse Gas Initiative uses short tones. Also, within all cap-and-trade schemes, all six greenhouse gases are put in terms of CO2 equivalence to allow for one unit of trade.

The complex situations that arise through varying allocation schemes within cap-and-trade systems are described in the following section.

d. Offsets

Offsets are projects that reduce or absorb greenhouse gas emissions that would not have occurred in a business-as-usual situation. The number of tons of reductions that result from these projects can be counted, checked by independent third parties, and sold to entities that must meet compliance obligations under a carbon tax, cap-and-trade, or standard regulation. The money that can be earned through sale of these emission reductions often provides the extra revenue necessary for the project to exist. In this way, the argument can be made that the project would not have occurred in a business-as-usual situation without the benefit of the carbon revenue. Also, any project that is required by a law that is enforced cannot earn carbon revenues under most recognized programs because the project would have been implemented regardless of the carbon revenues available.[xvi]

Offsets could have an important role in promoting CCS projects from industries that are not covered by greenhouse gas regulation. For example, fertilizer, ethanol, and ammonia plants have opportunities to sequester CO2 as they have relatively pure streams of CO2 in their stack emissions, could hook into CO2 pipeline networks, and could sequester emissions. However, these industries may not be covered by greenhouse gas legislation initially or even after the first few phases of new legislation. Which entities are covered depends on the legislation in question. Often a threshold of a given number of greenhouse gas emissions per year is used to determine the regulated versus unregulated sectors. For example, in Alberta, Canada, this threshold is 100,000 metric tons per year.[xvii] Small fertilizer, ethanol, natural gas processing, and ammonia plants that are well under a given market's threshold could be left out of the market indefinitely. CCS could provide an incentive for these types of industries to sequester their CO2 emissions for the benefit of the carbon revenues that could be earned.

CCS could even be considered an offset from all polluting entities, even those under the greenhouse gas regulation. In this instance, emissions would be reported at the site of the stack. Then, the emissions that are sequestered would be eligible for crediting as offsets.

The various permutations and complexities involved in counting CCS as an offset activity are numerous and will be discussed in part II of this paper.

e. Hybrid Approaches

While these three regulatory approaches may seem distinct, they can be combined in order to produce an end result that achieves greenhouse gas reductions and avoids some of the pitfalls of each individual system. One example of a scheme that blends a carbon tax, cap-and-trade system, and offsets is Alberta, Canada's intensity-based reduction scheme. In this system, entities that emit more than 100,000 metric tons of CO2 equivalent per year must reduce the emissions they produce per product by 12% of 2002 levels by 2010. Emitters can meet this target by choosing to pay a carbon tax of $15 Canadian per metric ton of CO2 they emit over the limit, make in-house reductions, or purchase qualifying offsets that count towards their target as metric tons reduced.[xviii] Regulated entities that make more reductions than required by law can sell the excess reductions as Emissions Performance Credits (EPCs). This modified carbon tax scheme would allow for the successful incorporation of CCS in certain sectors since Alberta Environment created a methodology for qualifying offsets and EPCs from the sequestration of CO2 from enhanced oil recovery and natural gas processing.[xix]

III. Inclusion of CCS in Cap-and-Trade Programs

There are many ways in which allowances could be allocated to emitters in different types of cap-and-trade programs. Since allowances are permits to pollute a given amount of CO2, the scheme chosen that dictates how these permits are either freely given or must be purchased has the ability to determine the relative cost impact of the greenhouse market on regulated entities. Each allocation scheme would impact industries differently as they are based on the amount of emissions one had in the past, type of technology one uses, the efficiency of the process, and other factors each a significant impact on regulated entity's greenhouse gas liabilities. The allocation schemes that will be introduced include the following approaches: historical emissions, benchmarking, output-based, input-based, and load-based. The type of allocation scheme selected will determine which of these factors is most important. And, within each of these schemes, revenue is at stake as allowances could be either be given freely or auctioned, which would require each polluter to pay for the right to pollute each metric ton they emit.

a. Auctioning v. Allocating Allowances

Auctioning 100% of the allowances in a market would require new and existing emitters to pay for each metric ton they emit. On the other hand, allocating allowances allows polluters to receive the initial set of allowances they need for free. CCS operators would benefit from not having to buy any allowances in such a scheme. Auction schemes have the potential to generate enormous sums of money. The accumulation of these funds begs the question, what should be done with this money?

Within the RGGI, states are able to choose the portion of the allowances that will be auctioned, and most have chosen close to 100% to be auctioned. The money collected from these auctions is put towards activities that are determined by each state and supports programs that promote energy efficiency and reduce global warming.[xx] In President Barack Obama's 2009 Budget Proposal suggests auctioning 100% of allowances; of the $78.7 billion that would be generated from these allowances in Fiscal Year 2012, $15 billion per year would go to clean energy technologies while the remainder would go towards tax cuts. These tax cuts may help consumers pay the higher costs of good and products that would now cost more due to allowances that regulated entities would have to buy.[xxi]
Often 100% auctioning of allowances is unpopular with emitters and may face too many hurdles to become a political reality for many greenhouse gas markets. Therefore, some greenhouse gas legislation, like the Lieberman-Warner Bill, proposes auctioning a portion of the allowances at the start of the market and increasing the auctioned portion in subsequent years of the market.[xxii]

A hybrid allocation/auctioning scheme could still benefit CCS operators partially, but a system of auctioning 100% of allowances would provide the most straight-forward benefit for CCS operators since in this instance, all power plants, old and new, would be responsible for purchasing allowances for every metric ton of CO2 emitted. CCS plants that could sequester 100% of the CO2 from the stack would benefit from not having to purchase any allowances. With a 100% auction system, there is no need for a technology standard since new power plants would simply purchase allowances based on the CO2 they create, which would be an inherent incentive to use the cleanest technology available. Also, new entrants would not receive allowances from a new entrant reserve. Instead, they would just purchase the number of allowances they need. The allocation schemes described below assume that a portion of, or all, allowances will be given freely. The implications for CCS operators under each scheme will be described.

b. Historical Emissions-based

In cap-and-trade schemes such as the EU- ETS and RGGI, the greenhouse gas allowances, or permits to emit one metric ton of CO2, are distributed to regulated entities based on their historical emissions in a baseline year. In a historical emissions-based or "grandfathering" allocation scheme, each individual facility that emits enough CO2 to qualify as a regulated entity and is included in the market is given allowances based on the emissions the facility had in a historical year or the average of its emissions in several historical years. Then, as the cap is lowered, these facilities must make reductions, purchase allowances, or purchase offsets in order to meet their targets.[xxiii]

Under a federal cap-and-trade scenario where in the initial phases some allowances are given to existing generators for free based on their historical emissions in a "grandfathering" scheme, implementing CCS at existing facilities could be an economically attractive proposition (depending on the value of an allowance) as it would free up allowances that could then be sold to other market participants. In a scheme that only grandfathers allowances, new CCS plants would earn no allowances. This situation may create an incentive for new coal-burning plants to set up operations without CCS and then to convert to CCS to then sell the allowances they were given.

c. Benchmarking

A benchmarking scheme consists of giving allowances to emitters based on a technology benchmark or best available technology standard for each industrial sector. Using the electrical power sector as an example, a set number of allowances for new power-producing entrants are allocated based on a standard that is set at a given MWh produced per unit of CO2 emitted.[4] Existing emitters would get fewer allowances than cover their existing operations if they do not meet this standard. New generators in benchmarking schemes are expected to produce generation at or below the technology standard. If they were able to produce electricity more efficiently and had excess permits, then they would be able to sell these permits.[xxiv]

In the planning of a market that uses a benchmarking scheme, the allowances for existing facilities and new entrants are considered as the overall cap for the sector is set. The allowances for new generators are put in a set-aside pool for future allocation based on projections of future expansion of the industry. In this way, giving allowances to new entrants does not compromise the integrity of the cap and goals of mitigating the impacts of global warming.

[4] Other industrial partners would receive a technology standard that is based on the amount of products that can be produced in a given amount of time. This paper often uses the electrical sector for many of its examples for simplicity.

Both existing facilities that retrofit their operations to incorporate CCS and new CCS facilities would benefit from a benchmarking scheme in that they would earn allowances based on their production output. They would then be able to sell these allowances.

d. Hybrid Grandfathering/Benchmarking

The benchmarking and grandfathering schemes mentioned above usually do not exist in their pure form in emission trading markets. Typically, a hybrid of these two markets is employed in order to provide an equitable system that does not overly penalize existing or new emitters. An example of this hybrid scheme is embodied in the EU ETS and proposed US greenhouse gas legislation. According to the proposed Lieberman-Warner Climate Security Act of 2008, existing emitters would have to purchase 24.5% of their allowances through an auction and receive the remainder of their allowances based on their historical emissions in 2012 when the market would begin.[xxv] Existing and new generators that employ CCS are proposed to receive a benefit in that they will not have to purchase any of their allowances and will earn bonus allowances for each metric ton sequestered, but these emitters must meet a technology standard in order to receive these bonus allowances.[xxvi] Existing power producers that retrofit their facilities must emit no more than 1,200 pounds of CO2 per MWh of electricity produced and a new power producer with CCS must produce one MWh of electricity with less than 800 pounds of CO2. After 2018, new facilities must produce one MWh with 350 pounds of CO2.[xxvii]

In this type of hybrid system, existing plants that converted to use CCS would most likely receive allowances based on the historical emissions of the plant. New CCS operations would receive allowances based on a technology standard, which would provide the CCS operator with allowances they could sell.

e. Output-based

Although allowance allocation for electrical generation is typically done through a historical emissions-based and benchmarking hybrid approach, an output-based approach is an alternative distribution that would allocate allowances based on the MW capacity or MWh generation of an electrical generator and other performance indicators for the remaining capped industries. Connecticut and Massachusetts chose an output-based system of allowance allocation for their NOx Trading Budget. This system would benefit those generators and manufacturers that could produce the most of their product per unit of CO2 emitted. It was initially favored by Canada because of its ability to limit the negative impact on industries that compete in export markets.[xxviii]

For CCS operators, an output-based approach where permits are allocated based on the capacity or product produced from the plant irrespective of the amount of CO2 emitted would not provide operators with any more allowances than their competitors of the same size that were not sequestering would earn. Therefore, there would be no incentive to engage in CCS in this type of system. An output-based scheme would have to be modified to allow for some type of bonus allowance structure, which would provide additional bonus allowances for facilities with CCS, to create an additional incentive for CCS operators. Examples of proposed European and US legislation with bonus allowances are described in a subsequent section.

Another drawback to this allocation scheme is that other emission-free power generators like nuclear and renewable energy generators may claim that they too deserve allowances since energy output is the basis for allocation distribution in this load-based

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approach.[xxix] Giving these generators allowances may skew the market by either overwhelming it with allowances, lowering their value, and making overall reduction of emissions more difficult or restricting the market and making allowances pricier.

f. Input-Based

As an alternative to the output and historical fuel approaches, allowances could be distributed based on the amount of fuel that is used for a facility. This type of allocation is known as input-based since the number of allowances given is based on the fuel input to the system. In an input-based allocation scheme, each individual facility that emits enough CO2 to qualify as a regulated entity and is included in the market must reduce its own emissions by either making on-site efficiency improvements, burning less fossil fuels, or purchasing carbon credits from approved projects to apply towards its reduction targets.[xxx]

CCS operators under an input-based approach would have a relative advantage to their competitors that meet a technology standard but do not sequester their CO2 since CCS operators would earn allowances based on the fuel they use instead of an average of the MWh produced per metric ton of CO2. And, given the fact that plants with CCS are very fuel inefficient because of the energy penalty of between 11 and 40% inflicted by post-combustion separation of the CO2 and sequestration, CCS plants would use more fuel and receive more allowances than their counterparts of equal size.[xxxi] If fuel prices ever dropped below the price of an allowance, there would be an implicit incentive in this system to use fuel inefficiently. Therefore, it is important to complement this system with a technology standard that applies to both CCS and non-CCS operators to avoid the fuel being used inefficiently in order to earn more allowances. The amount of CO2 that would have been released from a CCS facility would be measured to ensure that CCS operators are meeting the standard.

g. Load-based

Yet another allowance distribution option within cap-and-trade markets is a load-based approach which would reward CCS operators. This approach is most applicable for the electrical sector, but may be applied to other sectors that are dominated by large companies that control a variety of individual facilities. In countries or states with unbundled or deregulated electricity markets, this approach would allocate or auction allowances to distributors or load-serving entities (LSE) who sell electricity to the end customer. LSEs would then be responsible for ensuring that the reduction targets were made by sourcing electricity from a variety of generators that when averaged together produce no more emissions than the LSE was allocated or reducing their load and burning less fuel in a way that met the LSE's targets.[xxxii]

In regulated electricity markets, generation companies like Reliant Energy of Texas, which may own several individual generation facilities, would be responsible for sourcing generation that does not exceed the allowances they were given. LSEs and generation companies could be given allowances based on the size of the population they serve and the carbon intensity of the generation in their area.[xxxiii]

This approach allows LSEs and generation companies to meet the reduction targets with flexibility by allowing some older, more polluting generators to continue operating if the

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LSE or generation company has other, cleaner facilities that do not exceed the amount of allowances the company owns. A CCS operation at one facility would make it easier for the company as a whole to meet its cap. In the initial stages of market design, the Regional Greenhouse Gas Initiative (RGGI), Oregon Carbon Allocation Task Force and the California Public Utilities Commission considered this approach.[xxxiv]

Table 1: Summary of Options to Incorporate CCS in Greenhouse Gas Regulation

Greenhouse Gas Control Mechanism	*How it Works*	*Implications for CCS*
Standard	Emitters can emit no more than technology standard or are required to implement CCS	-There is no incentive to sequester below permissible limit -Could lead to costs that are unreasonable for emitters if all required to implement CCS
Carbon Tax	Emitters pay set amount per metric ton of CO2 emitted over limit of permissible emissions	-There is no incentive to sequester below permissible limit -Emitters that do not have to pay tax would have no incentive to sequester
Offsets	CCS creates credits that can be purchased to fulfill reduction targets	-Could allow industries outside of the cap to participate
Auctioning v. Allocating Allowances	Auctioning – allowances are sold to emitters Allocating – allowances are freely given to emitters	-Auctioning 100% of allowances would provide an implicit benefit to CCS operators without requiring bonus allowance allocation for CCS
Cap-and-Trade: Historical Emissions	Allowances given or auctioned to regulated emitters based on emissions from a baseline year or years	-New CCS operators would earn no allowances and would need to earn bonus allowances to have an advantage over non-CCS plants
Cap-and-Trade: Benchmarking	A set number of allowances allocated based on a technology standard	-CCS operators would earn an advantage by being able to sell their unneeded allowances or not having to buy allowances from the market
Cap-and-Trade:	Allowances given or auctioned to regulated	-CCS operators would need to earn bonus allowances to have an advantage over non-

Output-Based	emitters based on their generation or capacity to generate	CCS plants -Nuclear and renewable energy generators may lobby for allowances
Cap-and-Trade: Input-Based	Allowances given or auctioned to regulated emitters based on the amount of fuel they use	-CCS operators benefit as they receive allowances like other emitters based on the fuel they use -May cause CCS to be considered as an offset since allowances only given to those with fuel inputs -Could encourage inefficient use of fuel to generate more credits
Cap-and-Trade: Load-Based	LSEs or companies (instead of individual plants) must fulfill carbon reduction obligations	-CCS is rewarded as it helps the LSE or company meet overall reduction goals

IV. Treatment of CCS in Existing Cap-and-Trade Markets

International examples of how geologically sequestered CO2 is treated within cap-and-trade schemes show recognition of CCS, and some provide provisions which incentivize its development beyond the standard distribution of allowances to emitters with bonus allowances.

The European Union European Trading Scheme allows each country to choose its allocation scheme, but most have chosen the hybrid historical emissions and best available technology approach.[xxxv] The EU is currently in the second phase of its Emissions Trading Scheme, which runs from 2008-12. In this scheme it was proposed that CO2 that is sequestered within EU boundaries be considered "not emitted" from the regulated entity for accounting purposes.[xxxvi] EU regulators may have made this ruling since all allowances will be auctioned in the EU ETS III, which, as described in the previous section, would implicitly reward CCS operators. [xxxvii]

To date, there are no examples of the avoided price of emitting CO2 leading to CCS in the EU ETS I or II because the price of CO2 has been too low to incentivize this expensive activity. The EU has provided a much stronger signal to potential CCS developers for the third phase of the scheme, which runs from 2013-2020. The third phase creates a pool of 300 million allowances which are available to the first 12 facilities which develop large scale CCS capacity.[xxxviii] The precise details as to how this fund will be distributed have yet to be worked out, but it appears likely that facilities, provided they meet certain criteria, will receive a bonus allowance for every metric ton of CO2 stored, in addition to not having to surrender allowances for CO2 which they store. Thus, with many forecasters predicting a CO2 price of €30 ($39 USD) from 2012-2020 and a price in excess of €40 ($52 USD) approaching 2020, facilities which store the gas in a regime with bonus allowances may be receive double or triple the allowance price.[xxxix] Given the Mckinsey and Company cost estimate of €35-50 per metric ton of CO2 sequestered, bonus allowances for CCS, combined with high future predicted carbon prices of €40 ($52 USD), could be a lucrative endeavor.[xl]

Australia has also proposed to follow the EU's lead by proposing in their "Carbon Reduction Scheme Green Paper" to count sequestered tons as a reduction in the amount of CO2 permits that an entity would need to hold.[xli] Thus far, no bonus allowances have been proposed for this scheme.

The proposed Lieberman-Warner Climate Security Act of 2008 and the Dingell Boucher Discussion Draft of October 2008 offer similar support and incentives for CCS as seen in Europe by offering bonus allowances and subsidies for CCS activities. Regulated emitters would benefit not only from the value of the allowance (that does not have to be purchased in an auction or could be sold if given freely) but also earns additional allowances for the CCS activities. Both the Bill and Draft allow facilities to receive the bonus amount for the first 10 years of operation, and facilities must sequester at least 85% of the carbon dioxide.[xlii]

The Lieberman-Warner Bill proposed to offer bonus allowances in terms of the number of extra allowances given for each metric ton sequestered. The bonus allowances from these schemes are carved out of the overall cap and set aside for distribution to these industries. For each metric ton sequestered in 2012, the facility will benefit from not having to purchase the 24.5% of allowances that will be auctioned.[xliii] Then, the facility engaging in CCS will also earn three bonus allowances, each equal to the average allowance price in the previous year. The amount of bonus allowances varies on which draft of the Lieberman-Warner Bill is consulted; the Draft presented to the 2nd Session of the 110th Congress shows bonuses starting at three, rising to four, and ramping down to one by 2030 to reflect the assumed lower cost of CCS implementation as the technology develops. The Bill requires the minimum size of electrical facilities that take advantage of the bonus allowances to be 100 MW. To ensure that large emitters do not earn a windfall in bonus allowances by generating a lot of CO2 and sequestering it, the Bill requires new entrants to meet a technology standard that mandates that no more than 800 pounds of CO2 per MWh before 2018 and 350 pounds of CO2/MWh after 2018 before CCS activities have occurred. It also makes an adjustment to decrease allowances available for plants with more than 350 pounds of CO2/MWh and increase allowances available for plants with less than 350 pounds of CO2/MWh.[xliv]

The more recent Dingell-Boucher Discussion Draft proposes giving bonus allowances for the electrical sector based on a dollar amount. For the first 3 GW of generation with CCS installed, a subsidy of $90 per metric ton sequestered applies. The next 3 GW installed nationwide receive $70 per ton. The remaining installations earn $50 per ton. In contrast to the Lieberman-Warner Bill, which relies on the market to set and maintain a high price for CO2 allowances in order to incentivize CCS by giving a set amount per metric ton of CO2 sequestered, the Dingell Boucher Draft provides more financial assurance for CCS operations. The Dingell-Boucher Draft also has other small differences from the Lieberman-Warner Bill; it promotes only large CCS facilities by requiring the minimum size of plants that can take advantage of the bonus allowances to have a capacity of at least 250 MW. To ensure that dirty coal plants do not capture the bonus allowances, a new entrant minimum of 500 pounds per MWh for new plants and 1200 pounds per MWh for existing generation facilities exists with no sunset clause. For the industrial sectors that

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engage in CCS, the incremental costs of the CCS operations will be covered by the bonus allowances.[xlv]

V. Conclusion

CCS could play multiple roles in future carbon regulation. How CCS is incorporated into these regulations will determine the financial benefit CCS operators are able to earn from operations and the likely speed with which CCS is adopted. While incorporation of CCS into a technology standard is straightforward, there is little incentive for emitters to sequester more than the standard requires. If CCS were simply mandated through a standard for all regulated emitters that could employ it, the cost of implementation would not be contained and could be unreasonable for emitters to pay. More creative standard programs that implement carbon portfolio standards could provide a more economical way for CCS to be involved in the market. CCS in a traditional carbon tax system that does not cover all polluting entities would fail to incentivize some emitters that are not required to pay the tax to sequester the carbon from their operations. Under a cap-and-trade system, entities both under and outside of the cap would be encouraged to sequester emissions, as all metric tons sequestered could have market value if there was an effective mechanism to demonstrate and document the amount sequestered and the market accepted CCS offsets. Hybrid approaches of these markets may prove to be the best alternative as a hybrid system can eliminate some of the pitfalls of each regulatory approach.

Regardless of which approach is chosen, project-based offsets can play a role in providing cost containment for the regulated entities. Allowing for CCS to be counted as a valid form of offsets in greenhouse gas regulation could allow entities that are traditionally left out of the market to have an incentive to engage in CCS.

Of the various regulatory approaches available, cap-and-trade has been favored to this point. However, even within cap-and-trade schemes, there is a wide variance in how much CCS operators would benefit from their activities. In a historical emissions-based cap-and-trade scheme that offers no bonus allowances for CCS, CCS operators at new facilities would earn no allowances and thus, not benefit at all from the market. In a benchmarking scheme, facilities with CCS would be given allowances based on the technology standard and could sell these allowances if they sequestered 100% of their CO2. In an output-based system where generators receive allowances based on their ability to produce a given amount of their product, CCS would benefit, but the market may be overwhelmed by the influx of credits that would be derived from renewable and nuclear generators in this approach. In an input-based system, which gives allowances based on the amount of fuel burnt, CCS operators would benefit from their operations but there would be an inherent incentive to burn more fuel and be inefficient. Alternatively, in a load-based approach, CCS would be effectively incorporated into the market and help load-serving entities and energy portfolio managers of other companies meet their cap. All of these cap-and-trade approaches could involve auctioning, instead of freely allocating, allowances. Full auctioning of allowances would provide the maximum value for CCS operators.

The type of greenhouse gas market and allocation method in a cap-and-trade scheme that is selected will determine how much CCS will benefit from this regulation. Perhaps a hybrid of a carbon tax and cap-and-trade scheme or a hybrid of allocation approaches under a carbon tax, which may include a benchmarking and historical emissions mixed

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with bonus allowances for CCS, would be most advantageous for CCS. If future greenhouse gas regulations follow the EU ETS and proposed US legislation, CCS will derive value from a system of bonus allowances within a cap-and-trade system that allocates and auctions allowances based on historical emissions and uses benchmarking for new entrants.

The issues facing incorporation of CCS into greenhouse gas regulations are myriad and complex, but the alternative of excluding this activity from regulation could cause even more challenging problems to arise as a result of climate change impacts. If stabilization of greenhouse gasses at an acceptable level is to occur by 2050, then experts like the International Energy Agency assume that CCS will be about 20% of the mitigation solution.[xlvi] This situation can only occur if CCS receives some economic benefit from regulations to overcome high implementation costs. Therefore, it is paramount to begin serious consideration of the aforementioned regulatory options and offset protocols to effectively incorporate incentives for CCS development in future regulation.

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