Emissions Trading: EU ETS, US Voluntary Market &
Carbon Credit Projects as Offsets

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I. Executive Summary

This paper examines the Kyoto Protocol-based European Union Emissions Trading Scheme (EU ETS), the current US voluntary carbon market, and the role of carbon credit projects as offsets within emissions trading programs. The paper will discuss existing state/regional policies aimed at addressing climate change domestically, structures of potential federal regulation, and the potentially complicated interrelations between domestic and international trading programs. The objectives of this paper are to ascertain the risk factors associated with a carbon credit generating renewable energy projects that have the greatest impact on the rate of return for an investor, and to identify factors of trading programs that have been or will be particularly successful, as well as factors that have/will lead to inefficiencies when implemented in the trading market. The methods used will include a quantitative analysis of a carbon credit generating project, as well as a qualitative policy discussion of the existing and proposed emissions trading

program designs. This method will attempt to analyze the impact of different risk factors (i.e. project timing risk, credit delivery risk, and price risk) on the rate of return of investment in a hypothetical carbon credit project. The results of this paper will include a written discussion of the design and implementation of distinct trading schemes and quantitative output will include sensitivity tables relating to the carbon credit project valuation model.

II. Introduction

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty meant to address climate change by setting targets to limit or reduce six greenhouse gas emissions, including carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, HFCs, and PFCs. Climate change or global warming refers to the compounding effect that anthropogenic greenhouse gas emissions have had on a natural atmospheric warming phenomenon called the greenhouse effect. The Intergovernmental Panel on Climate Change (IPCC) attributes the warming trend of the last 50 years to human activities, such as the burning of fossil fuels, increased greenhouse gas emissions from electricity generation and manufacturing, agriculture, and deforestation to name a few. The negative effects of global warming include, but are not limited to, sea level rise, temperature increases, melting glaciers, increased extreme weather, destabilization of ocean currents/thermohaline circulation (i.e. Gulf Stream),

decreased agricultural productivity, more rapid proliferation of disease, and decrease of global biodiversity[1].

The First World Climate Conference took place in 1979 and the IPCC was established in 1988. In June1992, the Convention is presented for signature at the Earth Summit in Rio de Janeiro. The terms of the Kyoto Protocol were negotiated over seven Conference of Parties (COP), the first COP was held in Berlin in 1995. The Kyoto Protocol was adopted in 1997 at COP3 in Japan[2]. In November 1998, US Vice President Albert Arnold Gore, Jr. signed the Kyoto Protocol but the treaty was never presented to Senate for ratification because of the Byrd-Hagel resolution; passed 95-0 this resolution prevents the US from adopting any climate policy that would result in serious harm to the domestic economy (Senate Resolution 98). Negotiations broke down at COP6 in The Hague and resumed again at Bonn. The Kyoto Protocol requires a combined global emissions reduction of 5% below 1990 levels by 2008-2012. The Protocol came into effect February 16, 2005 after it was ratified by Russia to meet the requirement of ratification by 55 countries accounting for at least 55% of emissions from industrialized nations (i.e. "Annex I" countries). A last minute agreement to extend the treaty emissions reductions beyond the 2012 deadline was reached among the Kyoto signatories at the first Meeting of the Parties (MOP) in Montreal, Canada. The most recent MOP held in Bali this past December did not result in any firm political decisions for what will be done post-2012. However, over-the-counter trading of post-2012 carbon credits in the

[1] McCarthy, J., O. Canziani, N. Leary, D. Dokken, and K. White (2001). "Climate Change 2001: Impacts, Adaptation, and Vulnerability." Published for the Intergovernmental Panel on Climate Change by Cambridge University Press.
[2] UNFCCC Timeline (2005). United Nations Framework Convention on Climate Change Timeline accessed on December 5, 2007 at http://unfccc.int/2860.php

EU suggest that the utilities and financial community expect some type of regulation to exist post-2012.

1. EU ETS

The EU ETS began trading in 2005 and is the European Union's solution to achieving their Kyoto targets. The system was initially modeled after the US Acid Rain trading program, developed and regulated by the Environmental Protection Agency. The EU ETS is regulated by the European Commission and industries that fall under their prevue include, power generation, iron and steel, glass, cement, and, most recently, aviation. The right to pollute, or permit, is measured as one ton of CO2 equivalent and traded over several exchanges, including the ECX, EEX, and Nordpool. Permits, or European Union Allowances (EUAs), were allocated according to each country's National Allocation Plan (NAP). Phase I refers to the period from 2005-2007 and Phase II is the period from 2008-2012. The current cost for the right to pollute one ton of CO2e in the EU is approximately €21. Meaning, for every ton of carbon that a power producer emits during the course of generating electricity, they are required to surrender an EUA that was either allocated to them or purchased on the spot market. The EU ETS incorporates the ability to utilize the Kyoto Protocol "flexible mechanisms" as offsets or reductions equivalent to an EUA. The Kyoto flexible mechanisms include the Clean Development Mechanism (CDM) and Joint Implementation (JI). CDM and JI are essentially equivalent with the exception that a CDM project is located in an Annex II country which is exempt from Kyoto targets, while a JI project is located in an Annex I country that has ratified Kyoto. CDM and JI allow a country that is subject to Kyoto targets to meet their reductions, in part, by purchasing emission reduction credits from

renewable energy projects abroad. Projects are accredited under CDM/JI if they cause a reduction in emissions (i.e. a new hydroelectric plant displaces thermal production), contribute to sustainable development in their host country, and are "additional." Additionality has proved to be a controversial requirement. It is meant to ensure that credits are not awarded to projects that would have existed in a business-as-usual scenario. The project should essentially be proven otherwise uneconomical without the sale of the carbon credits.

2. US Voluntary Market

In contrast, the US has effectively abstained from Kyoto Protocol negotiations and declined to ratify the treaty citing the absence of participation of developing countries and negative economic impacts to the US As an alternative to the Kyoto Protocol, President Bush signed the Asia-Pacific Partnership on Clean Development and Climate, which allows participant countries, including Japan and Australia, to set their own goals for reducing greenhouse gas emissions but retains no enforcement mechanism[3]. A viable voluntary market currently exists in the US and is associated largely with the Chicago Climate Exchange (CCX). The CCX is a legally binding, voluntary US greenhouse gas emissions trading system that launched their trading platform in 2003. More than 120 companies have joined CCX, which requires a commitment to reduce aggregate emissions by 6% by 2010. CCX reported 11,850,300 tons of CO2 traded in 1H07 and the 2008 Carbon Financial Instrument (CFI) contract, representing 100 metric tons of CO2e, currently trades at $4.45 per ton[4].

[3] BBC (2005). "US Agrees Climate Deal with Asia." BBC News published on July 28, 2005. Accessed on December 10, 2007 at www.news.bbc.co.uk
[4] Chicago Climate Exchange website: www.chicagoclimatex.com

Participation in even the voluntary market requires the carbon reduction credits be real, measurable, permanent, independently verified, unique, and additional. Within the voluntary markets, carbon credits are referred to as Verified Emission Reductions (VERs). While the voluntary market is not driven by compliance there is still a value proposition associated with participation including, differentiation of company or product as environmentally responsible, potential "early action" credit if mandatory regulation is imposed, increased learning and awareness of carbon project process will be extremely valuable if transition to mandatory program is required. It should be noted that there are many proposals in the House and Senate to address climate change and the general consensus is that whoever comes into power in the next election will adopt carbon regulation in some form. A more in-depth discourse of the different policy proposals may be found in the Discussion section of this paper.

The lack of global/national criteria standardization for VERs has led to criticism of the quality of credits in the voluntary markets. In fact, the *Financial Times*, *New York Times*, *Guardian*, and *Business Week* have all conducted investigations into potentially fraudulent or non-additional VERs. Many organizations have attempted to develop a VER standard but no one standard has been universally adopted. Some proposed standards are as strict as CDM requirements, while others are significantly less stringent. Forestry projects are a rarity under CDM/JI but a significant portion of the current voluntary project landscape. A sampling of some of the existing standards:

Standard Name	Sponsors	Project Types	Additionality Requirements
Voluntary Offset Standards (VOS)	Euro. Carbon Investor Services (ECIS)	Any except nuclear, HFC-23, large hydro	Same as CDM
Voluntary Carbon Standard (VCS)	IETA, Climate Group, World Economic Forum	List of 15 categories; LULUCF; others	Steering Committee to specify
Gold Standard	Gold Standard Foundation	Renewable energy, energy efficiency	Same as CDM
CCX	Chicago Climate Exchange	Agriculture, forestry, waste mgmt, renewable	Specifies its own
Green-e	Center for Resource Solutions	Not specified	Allows benchmark test (top 10% efficient tech.)
ISO14064	International Standards Organisation	Any	Specifies its own
VER+	TÜV SÜD	Any except nuclear, large hydro	Same as CDM
CCBA	Climate, Community, Biodiversity Alliance	Land use	Specifies its own
Climate Cool certification	Climate Neutral Network	Efficiency, methane, renewables, other	Specifies its own
GE/AES GHG Services Standard	GE Energy Financial Services & AES Corp.	Coal mine methane, landfill methane; others	Specifies its own
Duke Standard	Duke University & Environmental Defense	Agricultural land use	Specifies its own

** Excludes any non-international standard that applies to a geographical region outside the US*

Carbon credit registries exist in an effort to avoid double-counting or the re-use of credits from the same source. As is the case with VER standards, there is no universal VER registry. The existence of multiple, disconnected registries mean that it is possible for the same carbon credit to be double-counted or listed multiple times on different registries. This possibility threatens the credibility of the voluntary market and makes auditing difficult to accomplish. A list and description of several of the US registries:

Registry	Description
The Climate Registry	Incorporated in Mar-07, the Climate Registry is a non-profit created to measure, track, verify, and report GHG emissions; 30 member states
Environmental Resources Trust (ERT) Registry	The ERT registry provides third-party validation and verification services; ERT credit standards vary on a case-by-case basis
Chicago Climate Exchange Registry	CCX developed their own registry to track their internal carbon credits, known as Carbon Financial Instruments (CFIs)
CarbonNeutral Company Registry	Founded in 1997, the CarbonNeutral Co. developed an offset project registry for VERs and CERs; associated with the VCS
California Climate Action Registry	Established by California law, CCAR is a non-profit registry to establish GHG emission baselines and promote early action
BlueRegistry	TÜV SÜD, a credit verifier, developed this registry to track their VERs; they intend the registry will eventually track CCX CFIs and VCUs also
US DOE 1605 (b) Registry	The Department of Energy's Voluntary GHG Reporting Program was first created by the Energy Policy Act of 1992 and revised in Apr-07
Bank of New York Global Registrar	Created in conjunction with the Voluntary Carbon Standard (VCS) to track Voluntary Carbon Units (VCUs); assigns unique serial number

Source information: State of the Voluntary Carbon Markets 2007 Report, July 17, 2007.

Investment banks and private investment firms have recently announced investments in US carbon project development firms to capitalize on opportunities in North America and the voluntary market. For example, Morgan Stanley made a 38% equity investment in Miami-based carbon project developer MGM International in January 2007, Credit Suisse made a strategic investment of €44M in EcoSecurities in June 2007, and Camco International & Tudor Investment announced launch of equity joint venture to finance VER generating projects in North America in July 2007. Renewable energy Venture Capital firm, Nth Power, continues to invest in TerraPass a US-based carbon project developer.

III. Objectives

The first objective of this paper is to identify the risk factors associated with a carbon credit generating renewable energy project that have the greatest impact on the rate of return for an investor. This is relevant due to the large growth associated with regulatory and voluntary carbon markets and the potential to utilize credits from renewable energy projects as offsets which may be surrendered in place of a pollution permit allocated or auctioned by the governing agency. The second objective is to identify a few factors of existing and proposed trading programs that have been or will be particularly successful, as well as factors that have/will lead to inefficiencies when implemented in the trading market. For example, the delayed launch of the registry platform (ITL) in the EU ETS resulted in a disconnect between the actual allowance (EUA) and the Kyoto Protocol Clean Development Mechanism credit (CER). While CERs should theoretically trade one-for-one against EUAs, CERs have recently traded at a discount as much as 67% compared to EUAs. This inefficiency may be the result of program design and should be examined and considered when developing future emissions trading programs.

IV. Methods

Oil prices closed above $100 per barrel for the first time this February[5]. As a result, natural gas is gaining favor abroad as a transportation fuel. Given that news groups and political debates have recently focused in on the issue of climate change, this trend is potentially alarming for European power producers who were previously able to

[5] Shenk, M. (2008). "Crude Oil Rises to a Record $100.10 on OPEC Production Outlook." Bloomberg News published on February 19, 2008. Accessed at www.bloomberg.com

simply "fuel switch" from dirty coal to clean natural gas when the price of carbon permits justified the use of the comparatively more expensive fuel source. Considering the current state/regional climate change policies that domestic utilities face, and the threat of future federal regulation, US power generators are keeping a close eye on Europe and how those utilities are handling this dilemma. One avenue the Europeans have pursued is to invest in renewable energy projects abroad that will generate carbon credits, or to simply purchase the credits resulting from these projects without initial investment. As such, it is very useful to understand how these carbon credit projects are developed and structured, and most importantly, to understand the associated risks. In an attempt to examine this matter, a model was created for the purposes of this paper to analyze a hypothetical renewable power project and identify which risk factors have the greatest impact on the rate of return for a project investor (i.e. a bank or utility).

Offsets in the form of carbon credits are generated by renewable energy projects. This paper will examine a hypothetical 5 megawatt (MW) run-of-river hydroelectric project in Chile, similar to actual projects that have been approved by the CDM Executive Board. The purpose of this examination is to determine the impact of several factors on the internal rate of return (IRR) for the project investor. The analysis will attempt to identify which factors have the greatest impact on profitability. The model assumes an efficiency factor of 60%[6], which may be impacted by rainfall at variance with the project developers expectation. The efficiency factor is what most significantly impacts the delivery risk or risk that the project developer will be unable to deliver the estimated credits due to reduced power generation from either too much or too little rainfall. Further, the model assumes that sovereign risk will not materially impact the

[6] 60% is an average efficiency factor for a run-of-river hydroelectric plant of this size, location, and scale.

project based upon Chile's credit rating of A+ established by Standard & Poor's[7]. The model assumes a project start date of June 2008, based on the project developer's assumptions. The model assumes a 10% commission rate[8] for the agency hired to coordinate the accreditation process. This process usually includes filing the appropriate documentation with the CDM Executive Board, dealing with the project verification agency, and identifying the credit purchaser. Finally, the model assumes a range of CER prices for the periods 2008-2012 and post-2012; these ranges are susceptible to political risk that the European Union decides to further limit the usage of CERs as exchangeable permits for EUAs. The 2008-2012 CER price range is determined by the current price and based on historical volatility. The post-2012 CER price range is posted at a significant discount to account for the fact that CERs may not be accepted post-2012 and to incorporate the high uncertainty associated with the post-2012 Kyoto negotiations.

V. Results

1. Offset Project Return Analysis

Below are the sensitivity tables resulting from the above described model and assumption variations. The first table is the base case, the second illustrates the impact of removing the accreditation commission, the third shows the impact of decreasing the plant capacity factor by 10%, and the fourth illustrates the impact of delaying the date the plant comes online by one year. It is evident from these tables that the factors which most impact the IRR of the project for the investor is the price volatility of CERs and the

[7] Bloomberg (2007). "Chile's Rating Raised to A+ by S&P on Copper Windfall." Published on December 18, 2007. Accessed at www.bloomberg.com

[8] 10% is the current standard market rate for South American carbon credit projects of this size.

start date (i.e. date the hydroelectric plant actually comes online and begins producing power and carbon credits).

a. Sensitivity Tables

2008 - 2018 IRR

Post 2012 Price \ 2008 - 2012 CER Price	26.1%	€ 10	€ 11	€ 12	€ 13	€ 14
	€ 0	12.1%	15.8%	19.4%	22.8%	26.1%
	€ 2	16.3%	19.4%	22.4%	25.4%	28.3%
	€ 4	19.5%	22.3%	25.0%	27.7%	30.4%
	€ 6	22.1%	24.6%	27.1%	29.6%	32.1%
	€ 8	24.3%	26.6%	29.0%	31.3%	33.7%
	€ 10	26.2%	28.4%	30.6%	32.8%	35.1%

Other Assumptions: 10.0% Project Developer Commission
65.0% Capacity Factor
Jul-08 Start Date

2008 - 2018 IRR

Post 2012 Price \ 2008 - 2012 CER Price	30.1%	€ 10	€ 11	€ 12	€ 13	€ 14
	€ 0	16.3%	20.2%	24.0%	27.6%	31.0%
	€ 2	20.1%	23.4%	26.7%	29.9%	33.1%
	€ 4	23.2%	26.1%	29.1%	32.0%	34.9%
	€ 6	25.6%	28.3%	31.1%	33.8%	36.6%
	€ 8	27.7%	30.3%	32.8%	35.4%	38.0%
	€ 10	29.6%	32.0%	34.4%	36.9%	39.4%

Other Assumptions: **0.0% Project Developer Commission**
65.0% Capacity Factor
Jul-08 Start Date

2008 - 2018 IRR

Post 2012 Price \ 2008 - 2012 CER Price	21.7%	€ 10	€ 11	€ 12	€ 13	€ 14
	€ 0	7.6%	11.1%	14.4%	17.6%	20.7%
	€ 2	12.2%	15.0%	17.7%	20.5%	23.2%
	€ 4	15.6%	18.1%	20.5%	23.0%	25.4%
	€ 6	18.4%	20.6%	22.8%	25.1%	27.3%
	€ 8	20.6%	22.7%	24.8%	26.9%	29.0%
	€ 10	22.6%	24.5%	26.5%	28.5%	30.5%

Other Assumptions: 10.0% Project Developer Commission
55.0% Capacity Factor
Jul-08 Start Date

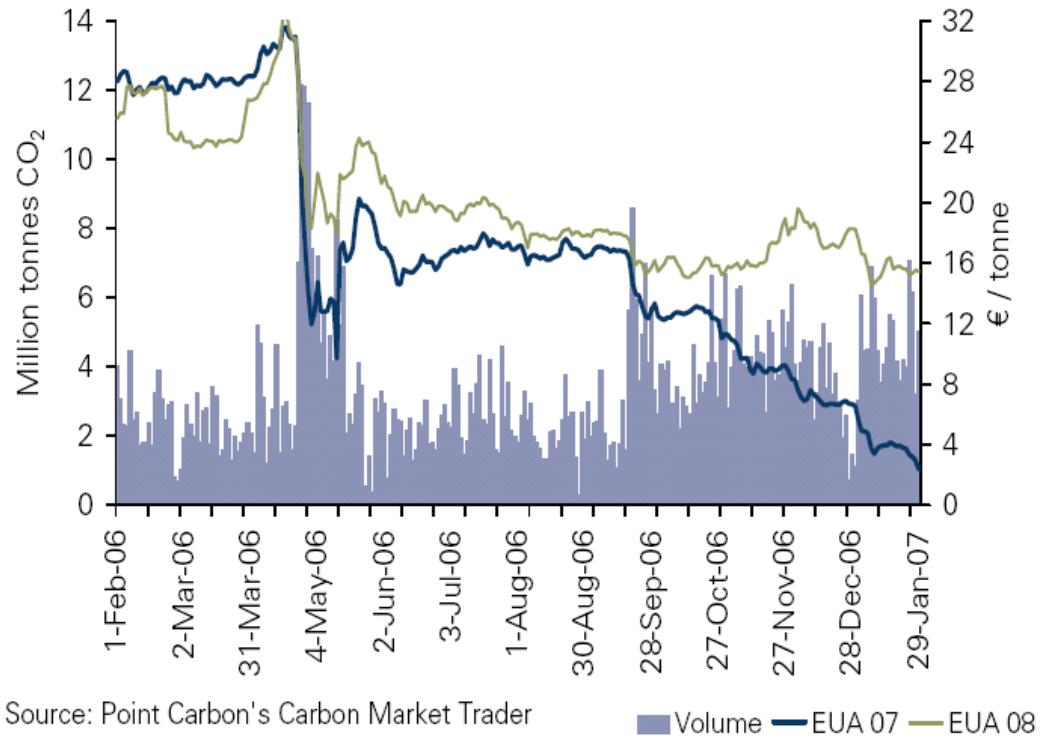
2008 - 2018 IRR

Post 2012 Price \ 2008 - 2012 CER Price	17.9%	€ 10	€ 11	€ 12	€ 13	€ 14
	€ 0	2.8%	5.5%	8.1%	10.6%	12.9%
	€ 2	9.0%	10.9%	12.9%	14.8%	16.7%
	€ 4	13.1%	14.8%	16.4%	18.1%	19.7%
	€ 6	16.2%	17.7%	19.2%	20.6%	22.1%
	€ 8	18.8%	20.1%	21.4%	22.8%	24.1%
	€ 10	20.9%	22.1%	23.4%	24.7%	25.9%

Other Assumptions: 10.0% Project Developer Commission
65.0% Capacity Factor
Jul-09 Start Date

2. EU ETS

Phase I of the EU ETS was considered a learning period for the program and there were several issues that threatened the success and future of the program. The data gathered to determine the initial cap, and subsequent NAPs, was incomplete and not reliable. Worse, the European Commission relied heavily on industrials to provide the data, which created an inherent conflict of interest for the industrials had every incentive to overestimate their historical emission rates. What became, in hindsight, an obvious result was that the scheme was overallocated in Phase I and there was not the required shortage of permits to create a healthy trading market. Further, verification information was accidentally released on the European Commission website in May 2006 and this error led to a crisis of confidence and a crash in the price of vintage 2007 carbon.



3. United States

The US has four policy options to achieve CO2 emission reductions. First, the US may push forward based on the premise of the Asia-Pacific Partnership which encourages voluntary measures. Second, the US may attempt to implement a national carbon tax. Though efficient and comparatively easy to design and implement, a carbon tax is a political non-starter in the US. The Detroit automotive industry lobbyist have been able to successfully block an increase in CAFE (Corporate Average Fuel Efficiency) standards and would fight even harder against either an upstream carbon fuel tax or a downstream carbon emissions tax. Third, the US may utilize the traditional EPA command-and-control policy tool to set a carbon emissions cap and require each power plant to operate under the specified cap. The EPA administration had previously determined that carbon dioxide is not a pollutant and therefore not subject to Clean Air Act regulation[9]. However, this ruling was called into question by a 2007 Supreme Court decision, *Massachusetts v. EPA*[10]. Command-and-control, while effective, results in potentially enormous economic inefficiencies. Command-and-control inefficiencies occur because the regulation offers no flexibility and requires each power plant to reduce emissions to meet a specific target. If we imagine instead that there is a bubble over all the power plants in the nation and allow the reductions to take place at the plants that have the lowest abatement costs we achieve the same emissions reductions at a fraction of the cost[11]. If primarily concerned about the economic impacts of emission reductions

[9] Bornstein, S. (2003). "Bush Administration: Carbon Dioxide Not a Pollutant." Published by the Knight Ridder News Service on August 29, 2003.
[10] Environmental Defense (2007). "Court Rules 5-4 in Massachusetts versus EPA." Published on April 3, 2007. Accessed at www.environmentaldefense.org
[11] Stavins, R.N. (1998). "What Can We Learn from the Grand Policy Experiment? Lesson from SO2 Allowance Trading." Journal of Economic Perspectives, 12(3):69-88.

a command-and-control approach is likely the least attractive option. Fourth, the US may utilize cap-and-trade approach to curbing greenhouse gas emissions, which is the approach used to tackle the issue of acid rain. In 1995, the US Environmental Protection Agency (EPA) introduced a national SO2 emissions trading program to reduce acid rain, which has been considered an environmental and economic success. The program applies only to power generators and combines a cap-and-trade program with a reduction credit system[12]. Both SO2 and CO2 lend themselves to trading regimes because the cost of reducing emissions varies widely among sources allowing for potential gains from trade, especially relative to command-and-control policies. The acid rain program is unlike a carbon trading program in that technology existed that made it relatively easy to retrofit old plants to remove SO2. Currently, there is no economically efficient technology that would allow the same retrofit for CO2. Localized "hot spots" were an issue with SO2 because the sulfur, once emitted, had a tendency to remain in the same general region. Hot spots are not an issue for carbon, which disburses throughout the atmosphere regardless of its source location.

Historically, in the US market-based pollution reduction policies have taken the form of emission trading programs as opposed to emission taxes. This outcome is the result of several factors including the fact that policymakers have found that policies that are very transparent, or have highly visible costs, are not generally received well by the public[13]. The costs associated with an emissions tax are very visible to industry, while the costs of an emissions trading program are less easily quantified. The perception of

[12] Ellerman, A. D., P.L. Joskow and D. Harrison (2003). "Emissions Trading in the US: Experience, Lessons and Considerations for Greenhouse Gases." Pew Center on Global Climate Change, Arlington, VA.

[13] Stavins, R.N. (1998). "What Can We Learn from the Grand Policy Experiment? Lesson from SO2 Allowance Trading." Journal of Economic Perspectives, 12(3):69-88.

control over one's fate may also be a factor in the historical preference for trading versus taxes. Electricity generators may feel they have an advantage when they are able to strategize in the case of permit trading, as opposed to pollution taxes where they have no ability to influence the process.

In the absence of a national carbon emissions policy, state governments are moving forward on their own to reduce greenhouse gas emissions and to pressure the federal government into passing national regulatory legislation[14]. Following the formation of the Regional Greenhouse Gas Initiative (RGGI), California, Washington, and Oregon announced they would follow suit and explore cooperative strategies to address global warming[15]. While some may argue that any action is better than no action, in the case of CO2 regulation there may be negative consequences for states that take matters into their own hands. Should a national policy take effect several years down the line the progressive states may find themselves at a disadvantage to those states who did nothing. If the federal policy should take on a decidedly different appearance or structure from the state program there could be costs associated with restructuring to match the national standard. Allocation of allowances may also be an issue if allowances are allocated based on recent emission tonnage. The progressive states who have already substantially reduced emissions will receive a disproportionately low allocation of pollution permits.

One of the most contentious issues relating to proposed US regulations centers around the initial allocation of allowances. Historically, trading programs have utilized

[14] Lee, J. (2003). "The Warming is Global But the Legislating, in the US, Is All Local." New York Times, October 29, 2003.
[15] Kruger, J. (2005). "From SO2 to Greenhouse Gases: Trends and Events Shaping Future Emissions Trading Programs in the United States." Discussion Paper 05-20; Resources for the Future, Washington, DC.

what is known as the "grandfathering" method, which allocates pollution permits based on past emissions. In other words, those who polluted the most in the past receive the most permits for the future. Another free-of-charge allocation method requires continuously updating the distribution based on recent or current year data. Finally, there is the auction method by which the program facilitators may simply auction the permits to the highest bidder[16]. Each of these methods has its benefits and drawbacks, as well as winners and losers. The grandfather method discourages new firms from entering the market, while the auction method may put existing utilities out of business. Additionally, pollution allowances could be allocated using a hybrid system incorporating both "grandfathered" and auctioned permits. Grandfathering at least a portion of the permits would be a requirement for political feasibility as, "Typically, it is the allocation methodology that creates the most political controversy"[17]. However, grandfathered permits tend to prevent new market entrants and "new source bias could retard the introduction of new facilities and new technologies by reducing the cost advantage of building new facilities which embody the latest innovations"[18]. A hybrid system would be politically feasible because a portion of the permits would be given freely to existing electric utilities, while also allowing new market entries and technological innovations by setting aside a portion of the permits for free market auction.

The initial allocation of allowances may also have an impact on the extent to which emissions "leakage" is a problem. Emissions leakage occurs when participating

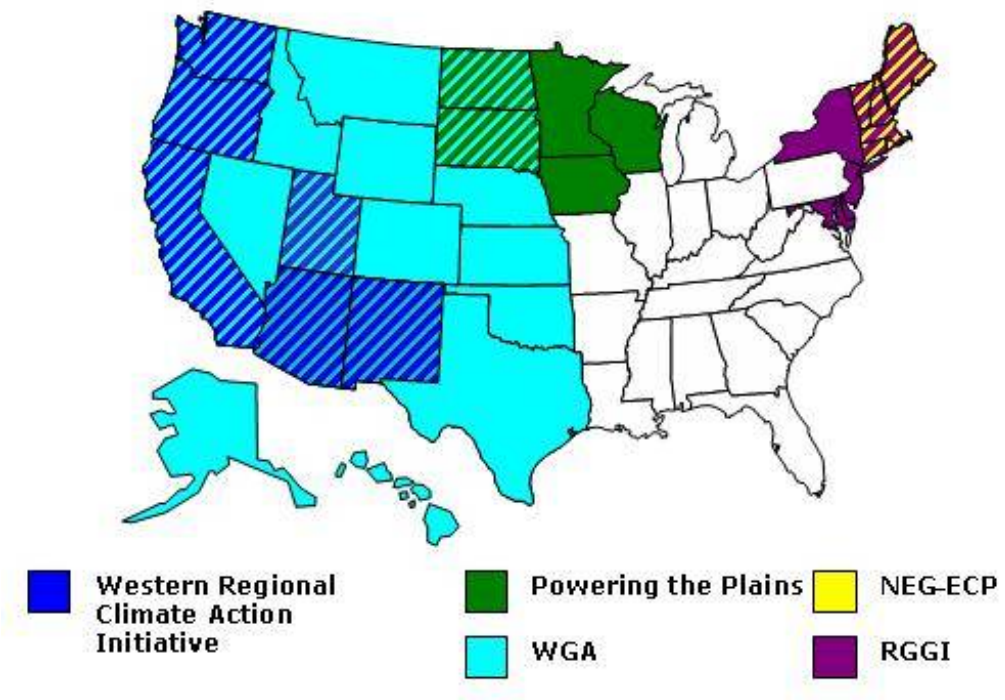
[16] Burtraw, D., D. Kahn and K.L. Palmer (2005). "Allocation of CO2 Emission Allowances in the Regional Greenhouse Gas Cap-and-Trade Program." Discussion Paper 05-25; Resources for the Future, Washington, DC.
[17] Profeta, T. (2005). "Design Principles of a Cap and Trade System for Greenhouse Gases." Policy paper published by the Nicholas Institute for Policy Solutions.
[18] Teitenberg, T.H. (1990). "Economic Instruments for Environmental Regulation." Oxford Review of Economic Policy, 6(1):17-23.

states may draw electricity from non-participants[19]. Leakage is of great concern for global greenhouse gas policies, such as the Kyoto Protocol, because of the fear that firms will relocate carbon-intensive manufacturing facilities to non-participant countries.

VI. Discussion

This section will examine the existing state and regional programs in the US and describe, compare, and contrast the various federal proposals currently in play.

1. US State/Regional Initiatives



Source: Pew Center on Climate Change

Though not a Kyoto participant, the US is acting on the state and regional level to address climate change. For example, twenty-eight states have developed climate action plans, twelve states have set statewide emission reduction targets, twenty-two states and

[19] Aldy, J., S. Barrett and R.N. Stavins (2003). "Thirteen Plus One: A Comparison of Global Climate Policy Architectures." Working Paper RPP-2003-04. Cambridge, MA: Center for Business and Government, John F. Kennedy School of Government.

DC have mandated utilities generate a certain portion of their electricity from renewable sources in a practice known as Renewable Portfolio Standards (RPS), thirteen states have or are in the process of adopting GHG performance standards for vehicles, and twenty-five states have public benefit funds to support renewable energy projects and energy efficiency measures. Several of the larger, regional programs and initiatives are described in the following table:

Initiative	Initial Date	Participants	Description
NE Governors–Eastern Canadian Premiers (NEG-ECP) Climate Change Action Plan	2001	CT, RI, MA, VT, NH, ME; NB, NF&L, NS, PEI, QC	US-Canadian program with target of 1990 emission levels by 2010; long-term reduction target of 75-85% in GHG emissions from 2001 levels
Powering the Plains	2005	IA, MN, ND, SD, WI & Manitoba	Members include states, industry, agriculture, and renewable energy advocates; developing an energy strategy and demonstration projects
Regional Greenhouse Gas Initiative	2003	CT, DE, MA, ME, MD, NH, NJ, NY, RI, VT	Power sector only; CO2e capped at ~121M tons annually through 2015; reduce emissions over 4 years to achieve a 10% reduction by 2019
Southwest Climate Change Initiative	2006	AZ, NM	States will collaborate through respective Climate Change Advisory Groups to identify options for reducing GHG emissions and increasing efficiency
Western Govs' Assoc. Clean & Diversified Energy Initiative	2004	CA, NM, ND, UT, WY	Goal of 30,000 MW of clean energy by 2015 and 20% improvement in energy efficiency by 2020
Western Regional Climate Action Initiative	2007	AZ, CA, NM, OR, UT, WA	Jointly set a regional emissions target by Sep-07; by Aug-08 establish a market-based system to meet target

Sources: Pew Center on Climate Change, www.rggi.org, California Public Utility Commission.

Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) is a regional cap-and-trade program meant to control and reduce CO2 emissions from power generation plants in the Northeast. There are currently seven states participating in RGGI including Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont. In addition,

the District of Columbia , Maryland, Massachusetts, Pennsylvania, Rhode Island, the Eastern Canadian Provinces, and New Brunswick are considered "observers" who may become participants in future years or negotiation phases. In the spring of 2003, New York Governor Pataki reached out to eleven states asking for cooperation in a regional cap-and-trade scheme. By the summer of 2003 the first working group, comprised of both the environmental and energy commissioners from each state, had drafted an action plan. Initially, RGGI will apply only to power plants but the hope is that the program will be expanded to other CO2 sources and eventually to other greenhouse gases. The final RGGI model rule has been adopted by the staff working group. Currently, each state will have to have the model rule approved by the state legislature for program to officially launch in January 2009[20]. Emissions leakage is large a potential obstacle for RGGI because participating states, such as New Jersey, may find that it is more economically efficient to buy their electricity from a non-participant state, such as Pennsylvania, who is on the same electricity grid but is not operating under the carbon cap. Should Pennsylvania increase its electricity generation to meet demand in New Jersey overall domestic carbon emissions would actually increase because Pennsylvania generates its electricity by burning the high carbon content coal that is abundant in the state. Leakage could negate the overall reductions achieved by the program. In June 2007, PJM[21] approved a 250 mile, 765-kV transmission line from West Virginia to Maryland increasing leakage concerns. Unfortunately, attempting to prevent import would violate the Dormant Commerce Clause and be seen as interfering with the interstate power market, technically constitutionally illegal.

[20] RGGI (2007). Regional Greenhouse Gas Initiative. Accessed at www.rggi.org
[21] PJM: the agency governing the Pennsylvania, Maryland, Jersey electricity grid.

The model rule with relation to offsets is explicit. Offset sources will initially be allowed to cover up to 3.3% of their emissions using offsets. However, if prices rise to greater than $7 per ton, RGGI states will be allowed to cover up to 5% of their emissions with offsets. If prices rise to greater than $10 per ton, RGGI states will be allowed to cover up to 10% of their emissions with offsets. RGGI model rule allows for the usage of offset projects outside the U.S. (i.e. CDM). Thus far, at least 6 RGGI states have included 100% auctioning in their rulemaking, which represents 132 million tons of the 188 million ton cap for 2009.

State	Budget (MT)	100% Auction?
Connecticut	10.7	Yes
Delaware	7.6	TBD
Maine	6.0	Yes
Maryland	37.6	No
Massachusetts	26.7	Yes
New Hampshire	8.6	TBD
New Jersey	22.9	Yes
New York	64.3	Yes
Rhode Island	2.7	TBD
Vermont	1.2	Yes
Total	**188.3**	**131.8**

Source: PIRA, May 2007.

California AB32

Also known as the California Global Warming Solutions Act of 2006, AB32 legislation establishes the California Air Resources Board (CARB) as the party responsible for monitoring and reducing GHG emissions. CARB is required to establish emissions cap for 2020 based on 1990 levels by January 2008, develop a plan to achieve reductions via regulation, market based system, or other by January 2009 and adopt

regulations by January 2011 that feasibly and cost-effectively achieve required emission reductions. AB32 also authorizes the Governor to invoke a safety valve (i.e. price cap) in the event of catastrophic events for up to one year. Recently, the Market Advisory Board submitted cap-and-trade recommendations to CARB, promoting a first-seller approach (over load-based cap), and opposing a safety valve.

2. US Proposed Federal Policies

As mentioned previously in this paper, it is widely predicted that the US will see some form of federal carbon regulation in the coming decade. Below is a summary table of the proposed policies currently under advisement:

Name	Sponsors	Targets Summary	Additional Info
Climate Stewardship & Innovation Act	Senators McCain and Lieberman	1990 levels by 2020; 60% below 1990 by 2050	Economy-wide; upstream for transport, downstream for utilities
Global Warming Pollution Reduction Act	Senators Sanders and Leahy	1990 level in 2020; 80% below 1990 level in 2050	Economy-wide
Electric Utility Cap-and-Trade Act	Senators Feinstein and Carper	1.5% per year reduction starting in 2020	Electricity sector, downstream
Climate Stewardship Act	House Reps Olver and Gilchrest	Current levels through 2019; 70% below 1990 levels by 2050	Economy-wide; early action credits limited to 20% of cap
Global Warming Reduction Act	Senators Kerry and Snowe	1990 levels by 2020; 62% below 1990 by 2050	Economy-wide
Safe Climate Act	Rep. Waxman	1990 levels by 2020; 80% below 1990 by 2050	Renewable energy quota and efficiency targets
Clean Air Planning Act	Senator Carper	25% below 1990 CO2 levels in 2050	Power only; SO2, NOx, Mercury & CO2 only
Clean Air Climate Change Act	Senators Lieberman and Alexander	~17% below 1990 levels from 2025 onward	Power only; SO2, NOx, Mercury & CO2 only
Clean Power Act	Senator Sanders	~17% below 1990 levels by 2025	Power only; SO2, NOx, Mercury & CO2 only
Low Carbon Economy Act	Senators Bingaman and Spencer	2006 levels by 2020; 1990 levels by 2030	Economy-wide; upstream for natgas and oil, downstream for coal
America's Climate Security Act	Senators Lieberman and Warner	Current levels by 2012; 70% below current levels by 2050	Power, transportation, and industrial sectors

Source: Point Carbon

Two of the most popular proposed policies include the Low Carbon Economy Act of (LCEA) of 2007 and America's Climate Security Act (ACSA) of 2007.

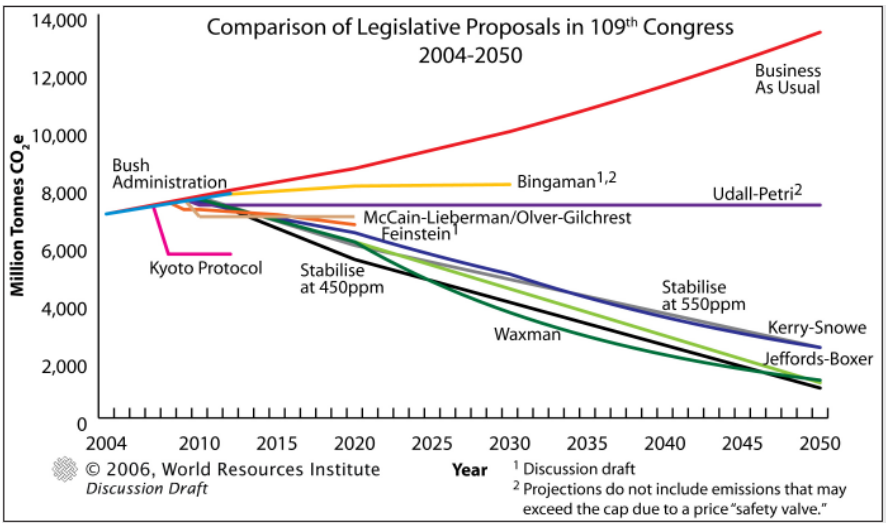
Low Carbon Economy Act of 2007

Introduced in July 2007 by Senators Bingaman and Specter, this program designates trading to begin in 2012. It aims to reduce greenhouse gas emissions to 2006 levels by 2020 and 1990 levels by 2030. It is designed as a cap-and-trade program with a $12 "safety valve." This safety valve can increase 5% above inflation each year after 2012. Opponents to this proposal take issue with the safety price valve and argue that it may be interpreted as a veiled carbon tax. With regard to allocation schemes, this policy would allow 53% free allocation to emitters from 2012-2017 and then free allocation reduced by 2% per year post-2017. Thus 24% permits would be auctioned and the resulting funds used for zero-carbon technology research. The remaining 23% of permits would be set aside for early action reward, carbon capture projects, and agricultural sequestration activities.

America's Climate Security Act of 2007

Introduced August 2, 2007 by Senators Lieberman and Warner, this bill would set the emissions cap to begin in 2012. The regulation would target the electric, transportation, and industrial sectors, which currently represent 80% of US economy. The targets would aim to reduce greenhouse gas emissions to current levels by 2012, 10% below current levels by 2020, and 70% below current levels by 2050. This proposal's alternative to a "safety valve" is that companies would have ability to borrow current vintage permits against future carbon reductions. This legislation would establish the Climate Change Credit Corporation to act as an oversight agency. With regard to

allocation of permits, the proposal would auction 24% of allowances in 2012, increasing to 52% by 2035. With regard to the usage of offsets, the bill allows up to 15% of allowances to be international offset credits, if approved by EPA administrator. The graph below is a visual representation of the stringency of each of the proposed policies:



Source: World Resources Institute

3. Conclusions

The results of the return analysis concluded that project timing and carbon credit price volatility have the greatest impact on investment return for carbon credit generating projects. This information is relevant for carbon project investors who may be unsure how to discount the multitude of project risk factors they must consider when investing. The qualitative analysis indicated that management of market moving data releases are extremely important to emissions markets, as evidenced by the price volatility experienced in Europe during May 2006. The project also illustrates the importance of developing a single standard and registry for voluntary markets to avoid investment in projects that may not meet future standards and the potential for double-counting created by multiple disconnected registries. Overall, greater certainty regarding future legislation and structure is imperative to justify large investments in carbon offset projects.