The Future of Carbon Credits from Fly Ash Substitution Products

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1. Introduction

1.1 Legislative and regulatory background

Mandatory greenhouse gas (ghg) reductions have become one of the most contentious issues of domestic environmental policy at both the state and the federal level. Numerous regulatory initiatives are underway and new legislation continues to be hotly debated. At a state level, the California Air Resources Board (CARB) recently approved regulations for an economy-wide mandatory reduction program.[1] Also in 2010, the Environmental Protection Agency (EPA) issued its mandatory ghg regulations. Early in 2011 the United States House of Representatives, propelled by the newly elected Republican majority,. passed a budget that included defunding EPA from any further work on greenhouse gases, including implementation of the newly-tailored Prevention of Significant Deterioration (PSD) air permitting program.[2]

These bills and regulations are based on the belief that the earth's atmosphere grows warmer over time and that man-made agricultural and industrial processes contribute significantly to the amounts of carbon dioxide and other greenhouse gases that potentially lead to an increase in temperature. Opponents of ghg regulations point to the economic impacts of regulations at a time when most economies are suffering a recession. They also point out researchers' inability to determine how much of the current increase in temperature is part of the natural variability of the earth's atmosphere.

[1] California Air Resources Board approved draft regulations on December 16, 2010 with further changes to be considered at a later date.

[2] House Amendment 466 passed on February 18, 2011 prohibiting the use of funds by EPA "to implement, administer, or enforce any statutory or regulatory requirement pertaining to emissions of greenhouse gases."

At the heart of the debate about ghg regulations lies the so-called "cap and trade" legislation Congress considered, but failed to pass in the 111th Congressional Session.[3] The legislation would have created a mandatory cap and trade allowance program for regulated entities with ghg emissions from industrial sources rather than the traditional command and control regulation for point sources. The proposed legislation also created a carbon offset market to ensure cost-containment of carbon allowance prices.

Despite the lack of federal law, a myriad of activity continues to lend shape and form toward creating a multi-billion dollar US domestic carbon market. These programs incorporate a curious aggregation of mandatory state programs on both East and West coasts and numerous voluntary programs for those willing and able to make carbon reductions either for profit or as a precursor to future mandatory regulations (i.e. pre-compliance entities).

Existing mandatory programs vary not only in geographic location, but also in scope of coverage. California's Assembly Bill 32, The Global Warming Solutions Act, covers the entire state economy. The cap and trade portion of the related regulation phases in various sectors begins in 2012 starting with industrial sources such as electricity generation, petrochemical refining, specialty chemical manufacturing, and other industrial sectors. In contrast, the East Coast's more modest Regional Greenhouse Gas Initiative (RGGI) incorporates only the electricity generation sector.

[3] The American Clean Energy Security Act passed the House of Representatives (219-212) but the Senate did not vote on the legislation.

1.2 Cement Production

Cement production ranked fourth among the U.S. sources of carbon dioxide emissions trailing fossil fuel combustion, non-energy use of fuels, and iron and steel production, including metallurgical coke production.[4] The cement manufacturing industry generates carbon dioxide through the direct combustion of fuel onsite and as a by-product of clinker production when calcium carbonate converts to lime. Indirect emissions also include electricity generation from offsite and transportation emissions. Estimates of the amount of carbon dioxide per ton of cement produced range from 0.71 tons carbon dioxide/ton fly ash in concrete to 1 ton carbon dioxide/ton clinker replaced, depending on assumptions made regarding electricity generation and transportation distances.[5] Multiple options for reducing ghg emissions exist, the most prominent of these being raw material substitution using fly ash.

Fly ash, the fine grained particulate matter generated as a by-product from the combustion of coal, increasingly serves as a substitute material for clinker in cement production. Using fly ash in the production of cement has at least three benefits: 1) extends the useful product life of the concrete, 2) prevents fly ash from consuming increasingly valuable landfill space, 3) reduces energy and water use necessary to

[4] USEPA (2010). "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008." EPA 430-R-10-006 April 2010. Office of Atmospheric Programs. Washington D.C.

[5] US EPA cites 0.71 tons carbon dioxide/ton fly ash in concrete in its Study on Increasing the Usage of Recovered Mineral Components in Federally Funded Involving Procurement of Cement or Concrete to Address the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users. Report to Congress. June 3, 2008. EPA 530-R-08-007. D-20 while industry estimates generally use 1 ton carbon dioxide/ton clinker replaced.

produce concrete, including carbon dioxide, but also reduces nitrogen oxide and sulfur dioxide, precursors to ozone formation and acid rain respectively. As fly ash replacement creates carbon dioxide reductions, certain fly ash projects can create carbon credits under mandatory carbon trading programs, as well as, under certain voluntary carbon trading programs.

In the course of conducting research for this report, the authors note that very few actual fly ash mandatory substitution projects exist which generate carbon credits. Of the nineteen known raw material substitution projects, only one is believed to be within the United States.[6] That is not to say that other projects do not exist within the United States, but rather to say that information about them may not be publically available. As the debate over fly ash continues in the United States, it is critically important that the sustainable and positive attributes of fly ash are championed. EPA's proposal to classify fly ash as a hazardous waste further clouds the positive attributes fly ash can contribute to carbon neutrality. Consequently, the authors seek to expand dialogue on this key topic to recognize the importance of the fly ash resource in a carbon constrained environment. The remainder of this paper examines the fundamental characteristics of the carbon markets and suggests practical steps to overcome obstacles preventing widespread creation of either voluntary or mandatory carbon credits from fly ash .

[6] As of March 2011 the authors located one fly ash project receiving credits in the RGGI program and 18 projects receiving credits in the Clean Development Mechanism program.

2. Monetizing Carbon Reductions

This section details the qualities of carbon credits and provides examples highlighting these principles. We begin by detailing the characteristics of offsets and continue by constructing a fictional, but nonetheless realistic, case study illustrating the process of creating carbon offsets. The third section documents additional requirements stemming from the voluntary nature of carbon offsets. Similarly, a continuation of the case study illustrates the complications stemming from the limited legitimacy of the voluntary markets. The section concludes by reviewing known fly ash projects.

2.1 Characteristics of Offsets

Quality standards for carbon credits require project owners to demonstrate increasingly strict requirements utilizing the following characteristics: real, permanent, quantifiable, verifiable, and additional. In other words, a carbon credit comes from a physical change in operations that cannot be undone overtime that results in a known amount of carbon reductions that can be measured and verified by an independent third-party. At a minimum, projects should be beyond any action required by law or regulation and should demonstrate some type of barrier to implementation such as an uneconomic project, new technology demonstration, or an uncommon practice.

Fly ash substitution projects meet these characteristics as the reduction stems from a physical change in operation that cannot be undone over time in that fly ash cannot be removed from the cement once added to the process. The amount of direct reductions arising from the change in operations due to reductions in fuel combustion for firing the

kiln, processing of raw materials, on-site electricity generation (if applicable), and direct emissions due to calcination of limestone (if present in raw material) can be calculated according to good engineering practices agreed upon by other specialists. Current best practice for counting indirect emissions from fossil fuel combustion in power plants should be estimated using regional averages. However, emission reductions related to the transport of additional additives encounter some difficultly as distances and fuel usages may not be readily available.

2.2 Case Study - Part I

The Reliable Electric Utility Generation Company burns Powder River Basin coal in order to generate electricity for its service area. Fly ash resulting from combustion accumulates and is placed in a landfill outside of Animated Country. Coyote Ash Marketing approaches Reliable about selling its fly ash to a third party and searches for a buyer. Acme concrete company currently manufactures concrete as Animated Country is building a new freeway to Hollywood. Acme has the option of replacing some of the clinker with fly ash and enters into an agreement with Coyote for the fly ash. Coyote hires Roadrunner Transportation Service to move the fly ash from Reliable's generating facility to the Acme facility for use in the manufacturing process.

Once the fly ash replaces clinker in the cement manufacturing process, a reduction in greenhouse gases, namely carbon dioxide related to the use of energy in the facility has occurred. A physical change in operations that cannot be undone over time has occurred. This action, however, in and of itself, does not create a monetizable carbon offset,

although the project has the potential to become a carbon offset if all of the parties involved work together to file the paperwork.

2.3 Additional Requirements for Selling in a Voluntary Market

Carbon offsets generated under mandatory programs typically require less representation to transact in the marketplace as the stamp of approval from a regulatory agency lends the carbon offsets legitimacy in the marketplace. Stated another way, the buyer may have confidence in the value of the carbon offsets based upon the regulatory agency's acceptance and approval of the application package. Voluntary carbon offsets struggle to obtain this same legitimacy.

As a result, more requirements are added onto projects in order to transact in the marketplace. It should be noted that there are more requirements for voluntary credits than for mandatory carbon credits. Factors that should be considered during project development could include regulatory additionality, demonstrating ownership of the credit, accuracy of the submittal and double-counting of credits. In short, the project developer must demonstrate the project is not required by law or regulation and that the seller has the legal right to engage in a transaction. The seller must further represent that the paperwork associated with the project is free of material errors and the environmental characteristics of the project will only be sold once.

2.4 Case Study - Part 2

In addition to creating the Project Design Document detailing the technical characteristics of the carbon reductions, the project proponents must prepare legal contracts detailing how the carbon credits would be distributed between parties and an Affidavit of Title showing ownership would be claimed by only one party. All parties involved agreed to create one and only one set of carbon credits.

2.5 Fly Ash Project Transactions

The sad truth is that not all carbon reductions become carbon credits. In fact, the majority of carbon reductions fail to meet the criteria for becoming a carbon credit. Further, not all carbon credits transact on the open market due to lack of buyer interest because of project type and/or external circumstance. The authors believe that this factor will worsen if the EPA designates fly ash as a hazardous waste.

To date, carbon credit programs have not been designed solely to incentivize reductions of carbon emissions, but rather to reflect specific political agendas. Protocols differ along project types, geographical location, levels of public participation, and definitions of additionality all of which reflect varying beliefs on environmental protection and sustainable development.

Transactions in the marketplace account for the differences in program design through the pricing mechanism. Projects that meet more stringent carbon credit qualifications tend to trade at higher prices than those with less stringent requirements. For example,

gold standard projects with more stringent requirements for additionality and increased public participation yield greater revenue than projects created under the ISO 14064 standard.

Generally speaking, third-party market surveys generally determine that methane-to-energy projects such as landfill gas along with other renewable energy projects and forestry projects dominate the current carbon market transactions. Projects based on industrial equipment upgrades, leak detection and repair, and raw material substitutions may yield meaningful ghg reductions, but have a more difficult time meeting the criteria for becoming carbon credits and rarely transact.

3. Future Outlook for Fly Ash Projects in the Carbon Markets

Entities operating the carbon markets demonstrate varying opinions on granting carbon credits for fly ash substitution. This section provides a brief overview of the main stream programs with an eye towards assessing the ease of creating a carbon credit. The section is organized into mandatory markets versus voluntary markets.

3.1 Mandatory Markets

The United Nations Framework Convention on Climate Change established the oldest of the mandatory carbon credits and one of the most widely accepted protocol databases for carbon reduction projects through its Clean Development Mechanism (CDM). CDM projects may only be located in Third World countries that have ratified the Kyoto Protocol. However, due to the stringency of the methodology creation project, CDM

methodologies may be accepted by other programs. Fly ash projects may be accredited under this protocol under very limited circumstances enforced through stringent project boundaries and additionality requirements.

The Regional Greenhouse Gas Initiative (RGGI) established the oldest US domestic carbon trading program in 2007. Regulated entities under the RGGI program include electric utility boilers. RGGI formally claims five pre-established project types but individual state rules give broad authority to the state environmental agency to approve carbon credit projects. At least one fly ash substitution project received carbon credits under this program.

California's Assembly Bill 32, The Global Warming Solutions Act, like RGGI previously, creates a regional program for carbon credits. The California Air Resources Board (CARB) continues to shape the rules and regulations for the carbon markets and two updates to the draft rule should be finalized in 2011. The current rule provisions allow for four offset project types, with a mechanism for creating future project methodologies, such as fly ash. The rule also potentially allows for connections to other programs most notably the nascent Western Climate Initiative and RGGI.

However, recent draft regulations issued by CARB indicate that reduction projects from sources that are regulated in California will not be allowed to generate offset credits under this program and the cement industry as a whole is included in the program. CARB to date has not specified a timeframe or a mechanism to share credits with RGGI.

EPA's extension of the PSD program to greenhouse gasses also creates opportunities but unanswered questions about the role that fly ash can play in a carbon constrained environment. EPA created the need to offset increases in emissions under certain circumstances through the use of offsets or Emission Reduction Credits (ERCs) as part of the 1977 Clean Air Act. ERCs fundamentally differ from carbon credits/allowances in that companies create ERCs after a reduction in emissions occurs. For example, an electric utility boiler that ceases operations may apply for ERCs the first six months after making a physical change rendering the boiler inoperable (i.e. removing the fuel line.) Regulations typically divide ERCs into three categories - Mobile Source ERCs, shutdown ERCs, and process related ERCs (i.e. everything else).

ERC creation packages typically require the identification of the emission point name (EPN) at which the reduction occurs. It is therefore not clear how reductions that take place across multiple EPNs would be accredited without some clear distinction in the amount of reduction contribution per EPN. Fly ash credits compound this problem as the reduction occurs not only across EPNs, but also across sites.

3.2 Voluntary Markets

In addition to the mandatory markets, a myriad of voluntary markets have emerged both domestically and abroad. Many of the registries arose out of a political purpose, for example to "solve" one or more flaws (both perceived and real) with the United Nations Framework Convention on Climate Change's Clean Development Mechanism or to gain

support for the overall concept of trading carbon credits. Approximately twenty voluntary standards and/or registries compete to approve carbon credits. However, two voluntary markets routinely receive attention from policy makers - the Climate Action Registry and the Voluntary Carbon Standard and these two programs are briefly reviewed below.

The California Climate Action Registry (CCAR) formed in 2001 with a mandate to track emissions inventories for the purposes of determining voluntary reductions in greenhouse gasses, In 2008 CCAR expanded its role incorporating registering voluntary carbon credits. Additionally, CCAR changed names and currently conducts business as the Climate Action Reserve (CAR). CAR currently registers carbon credits from a pre-approved list of methodologies including forestry, livestock and landfill (in both the United States and Mexico), coal mine methane, nitric acid production, organic waste composting, organic waste digestion, and ozone depleting substances (in the United States only). CAR considered fly ash credits in 2008, but rejected the project type based upon multiple factors including difficulty of creating a single performance based standard and the likelihood that at least part of the project would be regulated in the future under a mandatory program.

The Voluntary Carbon Standard (VCS) allows fly ash credits in principle. At the time of writing, no fly ash projects have received approval, although energy efficiency and biomass fuel switching projects within cement production facilities have received approval. VCS accepts all CDM project methodologies Additionally, project proponents

may submit new methodologies for approval to the Voluntary Carbon Standard Association for approval.

4. Recommendations

Carbon credits from fly ash substitution projects face a myriad of socio-political obstacles. One way to lower these objections is to establish a foothold in the voluntary programs, such as the VCS as well as, expanding the number of projects in the mandatory markets.

International markets recognize and welcome the role that fly ash can play in a carbon constrained economy. As focus on fly ash remains high, organizations should develop a road map to get the necessary underpinnings that allow for fly ash to play a pivotal role in both the voluntary and mandatory markets. Given the current configuration of the cap and trade program in California, there may be an opportunity to reduce emissions onsite by replacing clinker with fly ash. This scenario, however, would be site specific and further research with a defined project boundary would be necessary.

In cases where direct penetration of markets may not be forthcoming, e.g., California, an indirect linkage through reciprocity agreements could benefit this industry. That is not to say that fly ash project proponents will be able to eliminate all barriers to implementation as some of the hurdles that project proponents overcome are inherent in the very nature of the carbon project itself. That having been said, a strong focus and push for the inclusion

of fly ash credits must become part and parcel in order to preserve the economic viability of this project type at a critical juncture.