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ABSTRACT

Since 2005, opportunities have existed worldwide for technology developers to pursue greenhouse gas emission reduction projects under the Kyoto Protocol. The emerging carbon market is slated to expand exponentially as the United States (U.S.) becomes engaged on a federal level. The expected enactment of U.S. Congressional legislation, together with existing greenhouse gas emission cap and trade systems, provides a wealth of additional business opportunities for clean energy technology companies in the carbon credit market. This article offers an overview and analysis of opportunities in the emerging carbon credit market.

INTRODUCTION

Since 2005, opportunities have existed worldwide for technology developers to pursue greenhouse gas emission reduction projects under the Kyoto Protocol. The emerging carbon market is slated to expand exponentially as the United States (U.S.) becomes engaged on a federal level. The expected enactment of U.S. Congressional legislation, together with existing greenhouse gas emission cap and trade systems, provides a wealth of additional business opportunities for clean energy technology companies in the carbon credit market. Given the general acknowledgement that increasing levels of greenhouse gas emissions negatively affect the earth's climate and are expected to cause significant environmental and health problems, countries worldwide are imposing regulations designed to reduce greenhouse gas emissions. The most frequently imposed form of regulation is a cap and trade model. The implementation of a cap and trade regulatory system essentially serves to monetize carbon through the establishment of a system that creates a market, and a minimum value, for documented and verifiable carbon emissions reduction credits. As carbon markets continue to mature and more stringent emissions caps are imposed, clean carbon technologies have emerged as a key factor that enables carbon market participants to profit from carbon credit transactions. These clean energy technologies are the new frontier of the energy market. They enable technology providers, and project owners and developers, to participate in a converging international market that is projected to trade over USD$1 trillion annually. The U.S. is poised to enact Federal legislation imposing limits on greenhouse gas emissions, which will provide incentives for the further development of renewable energy sources. The new developments in the U.S., together with the existing worldwide cap and trade mechanisms under the Kyoto Protocol, make this an ideal time for clean energy technology companies, developers, and investors to enter and profit in the burgeoning worldwide carbon market.

CLIMATE CHANGE: POLITICAL AND ECONOMIC CONSIDERATIONS

Increasingly, climate change issues have become a major focus of U.S. and international political and economic considerations, lifestyle decisions, and public opinion polls. Once relegated almost exclusively to the domain of scientists and environmentalists, the relevance of greenhouse gas emission control now ripples worldwide through the spheres of mass media, finance, and government. As the general populace becomes familiar with the lexicon of climate change issues and recognizes the severe environmental and economic consequences that may occur if greenhouse gas emissions are permitted to continue

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unchecked, governments and non-governmental organizations have mobilized to seek to reverse this trend of rising emissions. Sharpening the focus on controlling greenhouse gas emissions has confirmed that certain regulatory schemes, such as cap and trade programs, may help stem this critical worldwide environmental problem.

Although affected industries might protest regulatory schemes that set demanding compliance levels, cap and trade systems create opportunities for companies and entrepreneurs who engage in developing clean energy technologies[1] and renewable energy projects to generate additional revenue streams—and enhance financing options—by adding a carbon emission reduction component to their projects. Surprisingly, it seems that many technology developers and project owners who stand to benefit from these opportunities are unaware of the potential to derive additional revenues by virtue of the carbon emission reduction features of their technologies. However, with proper planning and execution, a carbon component potentially may be added to many clean energy technology projects.

The spectrum of potentially applicable clean energy technologies is wide: technologies to capture excess heat and gas and transform the excess into electricity; technologies to produce biodiesel from waste oils, waste fats or solid waste; technologies to reduce pipe leaks and increase water pumping efficiency; and technologies to assist in fuel-switching. In fact, some technologies may be utilized in a single project to generate multiple, different streams of revenue. Indeed, opportunities exist for developers to add a carbon credit component to existing technologies, thereby enabling the project owner to reap the financial rewards of a carbon market that has grown from US$60 billion in 2007 to US$200 billion in 2008, and which is projected to reach US$1 trillion if the United States Congress enacts a nationwide cap and trade regulatory system.

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THE ROLE OF CLEAN ENERGY TECHNOLOGY IN CLIMATE CHANGE

Overwhelmingly, studies have demonstrated that increased levels of greenhouse gases, a defined set of gases (including methane, nitrous oxide and, most notably, carbon dioxide) that trap heat and infrared radiation in the earth's atmosphere, negatively affect the earth's climate. In fact, a recent report of the Intergovernmental Panel on Climate Change, a scientific body established by the World Meteorological Organization ("WMO") and the United Nations Environment Programme ("UNEP"), reveals that increases in greenhouse gas concentrations from human activity very likely have caused most of the increases in global average temperatures since the mid-20th Century. Without question, the burning of fossil fuels—coal and gasoline, specifically—and the ensuing release of carbon dioxide is the main source of greenhouse gas emissions due to human activity. In light of these findings, carbon emission reduction has become synonymous with stemming climate change, and implementing effective regulatory control over greenhouse gas emissions has become a priority of leaders worldwide.

Although each regulatory framework differs slightly, typically these regulatory approaches feature mandatory cap and trade systems that commoditize greenhouse gas emissions. Under a mandatory cap and trade program, regulations establish overall air quality goals for specific industries that are greenhouse gas intensive (e.g., energy industries, manufacturing industries, and construction) in a certain geographic area. Sources in those industries (e.g., power plants, waste incineration facilities) receive from the regulatory body, through mechanisms such as auctions, sales or assignments, a certain number of allowances that represent the amount of greenhouse gases that such sources are allowed to emit. Extra allowances are generated from facilities that emit greenhouse gases at a level under their cap; these under-emitting facilities can sell their unused allowances, or credits, on the open market.

Often, the number of allowances distributed under a cap and trade system is not sufficient to cover completely a particular source's emissions, in which case the source has limited alternatives: reduce production or retrofit the facility to meet the cap (a prohibitively costly option that usually is economically impractical) or purchase enough extra allowances to compensate for the source's excess, above-the-cap emissions. Consequently, regulatory frameworks with stringent caps or scarce allowances drive up the demand for, and the value of, credits. Such regulations effectively create a population of purchasers who are unable to adequately reduce their emissions and must purchase credits on the open market. Thus, entities that can generate credits have a readily available pool of purchasers to whom their allowances or credits can be sold. In effect, entities purchasing credits pay a charge for polluting, while sources selling credits are rewarded for having reduced their emissions or provided a technology to help others reduce theirs. In this way, incentives are created for those sources that can reduce emissions most cheaply to do so, achieving the pollution reduction at the lowest possible cost to society.

Under a mandatory cap and trade system, technologies that efficiently and cost-effectively reduce greenhouse gas emissions below capped levels may create revenue streams for an existing pollution source. For example, a cogeneration power plant may create credits by utilizing technology

to capture would-be-wasted thermal energy and converting it to electricity. This capacity could be sold or, potentially, displace electricity that otherwise would be produced by a coal-fired thermal plant. By using the appropriate technology, the power plant could boost its efficiency through cogeneration and, consequently, reduce the amount of coal necessary to produce the same amount of pre-cogeneration electricity. A reduction in the amount of coal means the plant can reduce its overall emissions without using all of its allowances. The plant can then sell its allowances to an over-emitting source.

Typically, a cap and trade regulatory framework will include regulations that establish procedures and mechanisms governing the production of emissions credits, and some regulations even control the price of the credits. Generally, the procedures govern the methodology and framework for developing and operating projects that are specifically designed to reduce greenhouse gas emissions below a certain threshold. The amount of "foregone" emissions (i.e., the difference between the threshold and the actual amount emitted) is translated directly into an amount of carbon emission reduction credits that can be sold to sources that require such credits, or allowances, to fulfill regulatory mandates and continue operating. The emission reduction projects utilize clean energy technologies to achieve sub-threshold levels of greenhouse gas emissions; the more efficient and cost-effective the technology, the more credits a project produces and the more revenue that may be generated for the project owner.

Technology, then, becomes the critical driver for successful emission reduction projects. A power plant that employs cogeneration technology, for example, potentially may derive two revenue streams: the cogeneration of electricity and, because the plant is burning less coal and emitting less greenhouse gases, carbon emission reduction credits that can be sold in the market. Of course, the potential breadth of the second revenue stream depends wholly on the efficiency of the technology used.

CARBON REGULATION AS THE FRAMEWORK FOR CARBON MARKETS

Several regulatory frameworks for the creation and marketing of carbon credits already exist worldwide. Perhaps the most advanced regulatory framework, and also the most fertile ground for deploying carbon emission reducing technologies, is the carbon cap and trade program established under the Kyoto Protocol. In the U.S., a country that trails much of the world in regulatory control of carbon emissions, regional initiatives have begun to gain traction. Also, the consideration of federal legislative initiatives to curb carbon emissions are underway in the U.S. Congress. Thus, as discussed below, technology developers now have additional opportunities to deploy their clean energy technologies in projects throughout the world.

KYOTO PROTOCOL-CLEAN DEVELOPMENT MECHANISM PROJECTS

Drafted initially in 1997, with 183 signatory countries, the Kyoto Protocol came into force in 2005. The Kyoto Protocol categorizes countries as either "developed" or "developing" and caps greenhouse gas emissions in the 38 industrialized countries and the European Union defined as "developed," while allowing emissions reduction projects in "developing" countries. The Kyoto Protocol seeks to reduce the emission of greenhouse gases to an average of approximately 5.2% below 1990 levels over the period of 2008 to 2012. Through a series of flexible mechanisms, however, the Kyoto Protocol allows capped countries to trade emission allowances. By limiting the supply of emission allowances, the Kyoto Protocol imposes a market-determined price on greenhouse gas emissions, which participants can purchase if they exceed their allowances.

> "More recently, private carbon funds—collective investment schemes that receive money from investors and use the money to purchase carbon credits or invest in CDM projects—have entered into the carbon credit market, financing projects with promising technologies and attractive returns on investment."

At the same time, the Kyoto Protocol allows developed countries to seek lower cost carbon emission reductions in non-capped, developing countries. Certain provisions of the Kyoto Protocol permit developing countries to create carbon offset projects that are regulated by a market instrument called the Clean Development Mechanism ("CDM"). The development of such projects is supervised by the CDM Executive Board under the guidance of the Conference of Parties of the United Nations Framework on Climate Change. Project owners who follow the CDM procedures and protocols can implement carbon offset projects that are expected to generate certified carbon emission reductions ("CERs"). Generally referred to as "carbon credits," each CER equals one metric ton of carbon dioxide emissions, and these carbon credits ultimately may be used to fulfill the national compliance obligations of developed countries. Although the value of the market continues to increase, and the CDM Executive Board continues to expand the scope of qualifying projects by approving additional carbon emission reduction methodologies, the successful completion of a CDM project requires patience and a balanced approach to technology, international regulations, and forward-looking contracts.

CDM projects, like the model cap and trade program, serve an existing compliance market that must purchase credits to continue their operations. The challenge of CDM for a

technology developer or project owner is to match the technology with a CDM-approved methodology;[2] demonstrate the project's additionality;[3] obtain validation and registration and then implement the project; verify the project's emission reductions and then sell the resulting certified credits. Although the CDM process has complex regulatory requirements, it rewards innovative technologies that efficiently and cost-effectively reduce carbon emissions.

An ideal CDM project fits a ground-breaking technology into a pre-existing methodology. For example, the CDM recognizes a methodology for methane gas capture and flaring, common at facilities like large municipal waste sites; successful capture and flaring under the methodology results in the creation of credits. The CDM also has approved a methodology that awards credits for displacing carbon-generated power on the electricity grid. For instance, a new method of biogas and anaerobic digestion, which is a biological treatment process to reduce odor, produce energy, and improve the storage and handling characteristics of waste, could be designed to fit into the existing, approved methodology while simultaneously generating two CDM revenue streams: methane capture from anaerobic digestion and the subsequent feeding of that methane to a generator whose electricity would displace "dirty" electricity on a grid. Essentially, the new technology links two CDM methodologies and creates multiple revenue streams for a technology developer and a landfill site operator.

INVESTMENT-DRIVEN INNOVATION

Most successful CDM projects to date have required significant initial capital to perfect or purchase necessary technology, to finance the capital costs of project implementation, and to pay for CDM-associated costs, including registration, validation, and monitoring. CDM project costs can quickly exceed US$10 million, and many project owners simply do not have the resources to execute a project without outside capital, especially in a tight credit market. Initially, project developers seeking outside investment appealed to various national governments that had created funds to purchase carbon credits, aligning the expectations of the CDM process as a way for developed countries to satisfy their compliance obligations with the reality of state-funded CDM projects. More recently, private carbon funds—collective investment schemes that receive money from investors and use the money to purchase carbon credits or invest in CDM projects—have entered into the carbon credit market, financing projects with promising technologies and attractive returns on investment.These carbon funds typically are launched by private financial institutions, development banks, international organizations or government agencies, and the shareholder structures are usually private firms, governments or a mix of both. A recent study by ICF International analyzing the emergence of carbon funds in the carbon credit market notes that the number of exclusively private carbon funds has grown from one in 2003 to more than 30 in 2008, marking the first time that purely private vehicles exceed the number of governmental and multi-shareholder funds.

> "Indeed, the most promising revenue-generating carbon reduction technologies ultimately may involve capturing carbon dioxide and using it to make plastics or chemicals, increasing the efficiency of engines and turbines, or creating feedstock for bio-fuel generation from a wide variety of existing non-carbon related processes."

EUROPEAN UNION EMISSION TRADING SYSTEM

The European Union Emission Trading System ("ETS") is an example of an effective, large-scale regional emissions trading scheme. ETS regulations impose compliance requirements on several thousand European installations, applying a modified cap and trade system. Under the first iteration of the ETS, each country participant distributed allowances freely to its regulated facilities. In turn, each regulated facility was required to measure its carbon emissions on an annual basis and submit to its respective government the number of allowances equal to such facility's carbon emissions. Similar to a model cap and trade program, if a facility had more allowances than necessary, it could sell its allowances on the open market. The ETS has evolved and recent proposed changes to the trading system include auctioning allowances from a central organization (rather than allocating them freely on a country-by-country basis). Moreover, the ETS allows regulated facilities to satisfy their compliance requirements in part by using credits generated through the Kyoto Protocol CDM process thus increasing the market for CDM projects.

EMISSION REDUCTION IN THE UNITED STATES

In the absence of federal legislation mandating carbon emission reduction, state consortiums have been established to fill the national regulatory void. One such initiative is the Regional Greenhouse Gas Initiative ("RGGI"), the first mandatory, market-based effort to reduce greenhouse gas emissions in the U.S. RGGI is comprised of ten states in the Northeast and Mid-Atlantic regions who have committed to a 10% reduction of carbon emissions from the power sector by 2018. Under RGGI regulations, participating states have agreed to a cap and trade system whereby allowances will be auctioned off in phases.[4] The most recent auction of allowances occurred on March 18, 2009 and involved the sale of over 30 million allowances, which raised over US$117 million for the participating states. Notably, the secondary market for these allowances continues to

develop, and a recent "Report on the Secondary Market for RGGI CO_2 Allowances" revealed that the average volume of allowance futures trading reached 330,000 allowances per day in January 2009. Additionally, RGGI allows a polluting source to use offset allowances, including emission credit retirements from mandatory programs outside the United States (e.g., CERs generated from CDM projects under the Kyoto Protocol), to satisfy a limited portion of the source's compliance obligation. Simply, the emissions offset provisions of the RGGI participating states' regulations allow for the award of carbon dioxide offset allowances to projects outside the capped sector (the electric power generation sector) that reduce or sequester emissions of greenhouse gases. The offset allowance projects rely heavily on cutting-edge technologies to make them economically feasible, but, once operational, the carbon offsets have multiple potential buyers to purchase them.

At the federal level, President Obama already has expressed confidence that the United States Congress will pass into law a national cap and trade system. In fact, President Obama recently echoed a campaign promise to set a hard cap on all carbon emissions and achieve an 80% reduction by 2050 by including the foundation of a national cap and trade program in the budget he sent to Congress. President Obama's proposed cap and trade program would require a reduction in greenhouse gas emissions of about 14% by 2020 and 83% by 2050. The Obama Administration also projects the program will generate revenues from the sale of $646 billion worth of emissions permits by 2020. If the Obama Administration's model follows existing regulatory frameworks, the United States' federal cap and trade system likely will include provisions governing carbon offset credits and the trading of allowances and credits on a secondary market, thus creating opportunities for technology developers and project owners to benefit from the addition of this potentially enormous compliance market.

More recently, Democrats in the U.S. Congress have acted, announcing a bill even more aggressive and ambitious than President Obama's plan. The proposed legislation, announced on March 31, 2009, would require a faster carbon emission reduction period than President Obama's plan. Furthermore, the proposed bill would require every region of the country to generate 25% of its electricity from renewable sources by 2025. Legislators and advocates do not unanimously agree on the feasibility of the proposed target, but all stakeholders agree on one critical element: the only way to achieve such an ambitious objective is to develop the technology to drive carbon emission reduction and renewable energy projects.

LESSONS FOR THE U.S. MARKET FROM KYOTO

As an example, early in the CDM process, investors and project developers pursued projects that targeted certain types of greenhouse gases, like perfluorocarbon (HFC23) gases. Initial projects focused predominantly on HFC23 gases because a small amount of HFC23 reduction returned a large volume of credits (e.g., each metric ton of HFC23 is equivalent to 11,700 tons of carbon dioxide). Now, however, having depleted the number of low-risk, high-reward projects, the carbon funds have begun to migrate towards higher risk projects requiring more capital and involving cutting-edge technologies. Experienced investors approach CDM projects the same way the investors approach IPOs or commodities exchanges: as investment risks mount, carbon funds attempt to mitigate risk by getting involved in the CDM process at an early stage, rather than waiting for the CDM project to generate carbon credit revenue streams. The project developers prepare a Project Identification Note or a Project Idea Note ("PIN") that equates to a prospectus or private placement memorandum ("PPM").[5] Although not formally required by either the Kyoto Protocol or the CDM Executive Board, the PIN highlights primary investor concerns by providing information about the project overview and technical description.[6] Project developers also use the PIN to entice investment and to gain local support for the project.

Not surprisingly, the need to fulfill complex CDM requirements often means that the investor possesses most of the negotiating leverage; the project owner cannot build the project without the financier's capital investment. Accordingly, the investor often can specify the type of investment (debt, equity, and/or the carbon credits themselves), the terms of sale, and the risk mitigation techniques. For example, if financing were unavailable for the previously described landfill gas project, the project owner might be required to sell future credits on a forward-looking basis to finance the project. When project owners pre-sell credits in the primary market at an early, pre-generation stage, the purchase price for the credits is expected to be lower than the published secondary market trading value, reflecting the considerable risk assumed by the buyer.

SUMMARY

In the final analysis, technologies that help reduce carbon emissions represent the linchpin of all carbon credit cap and trade systems. The technologies necessary to drive innovation include brand new "linking" technologies (like the biogas and anaerobic digestion technology described above), but they also include improvements to existing technologies whose applications may not be obvious. Indeed, the most promising revenue-generating carbon reduction technologies ultimately may involve capturing carbon dioxide and using it to make plastics or chemicals, increasing the efficiency of engines and turbines, or creating feedstock for bio-fuel generation from a wide variety of existing non-carbon related processes. The most successful projects will, like the early HFC23 projects, continue to utilize low-risk technologies (technologies that already have been proven to work in a particular field or capacity) to generate reliably large numbers of credits. Just as oil companies have spent the last twenty years developing

better drills and more efficient extraction techniques for an oil-starved market, the cap and trade systems functioning currently, and those expected to be implemented in the not-too-distant future, will facilitate the technological developments necessary to meet the needs of the growing carbon compliance market.

It remains difficult to predict which technologies and projects will provide the largest return on investment. At this juncture, before the carbon credit wave fully crests, all owners of carbon-emitting facilities should undertake a critical examination of the precise processes by which their facilities emit carbon to identify potential points of improvement. For technology developers not currently involved in carbon emission reduction projects, the current environment invites a study of how their technologies could be adapted or deployed to take advantage of the opportunities in a rapidly growing worldwide carbon market.

The move toward regulatory convergence worldwide, through the implementation of carbon cap and trade systems as a component of the effort to stem the pervasive impacts of greenhouse gas emissions, will continue to drive the market for clean energy technologies and the carbon emission reduction credits that may be derived from such projects. In turn, this force will help facilitate the availability of the financing needed to fund the development and commercialization of these new technologies because the emerging regulatory-driven markets provide a committed and consistent pipeline of funding for research and development. As long as the specter and implementation of regulations exist, the demand for technology development likely will intensify.

ENDNOTES

1 Although no unified definition of clean energy technology exists, most industry professionals use the term to define (i) technologies that produce energy with little or no harm to the environment or, more broadly, (ii) a diverse range of products, services, and processes that harness renewable materials and energy sources, dramatically reduce the use of non-renewable natural resources, and reduce or eliminate emissions and waste.

2 Each CDM sector has a matching suite of "methodologies" approved by the CDM Executive Board, and these methodologies fall into two groups: baseline methodologies and monitoring methodologies. Baseline methodologies refer to the manner by which a project developer estimates the carbon emissions that would have been created in the most plausible alternative scenario to the implementation of the project. A monitoring methodology, on the other hand, spells out the means to calculate the actual emission reductions from the project and sets forth how project proponents should develop and implement a monitoring plan for a particular project type in order to gather the data required to calculate emission reductions from the project.

3 The key criteria for eligibility as a CDM project is that the emission reductions are "additional" to those reductions that would have occurred in the absence of the project. Project developers must establish a baseline scenario that represents the emissions of greenhouse gases that would occur in the absence of the proposed project activity. The required "additionality" is demonstrated by showing that the project reduces emissions compared to the baseline scenario.

4 Similarly, the Western Climate Initiative ("WCI"), a cross-border collaboration of seven Western states and four Canadian provinces, currently is developing a market-based cap and trade system similar to RGGI. As of April 2009, WCI organizers have scheduled stakeholder meetings and crafted a plan that will enable them to move toward implementing a cap and trade program.

5 If raising funds in the U.S. for a carbon emission reduction project, a prospectus or PPM in compliance with U.S. securities law would re required.

6 Specifically, the PIN usually provides information about: the location and type of the project (including the technology used), the estimated total number of carbon credits produced by the project, the number of years over which the project will generate carbon credits, the financial structure of the project, local cultural and environmental effects and, finally, the estimated sale price of each credit generated.

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