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The Global Carbon Emissions Markets:
Managing Risk, Overcoming Complexity and Capturing Opportunities

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Abstract

The following paper examines the large and growing markets which exist for carbon emission-related transactions in Europe, the US and other regions. A range of companies will participate in these markets, with effective management of carbon-related activities becoming material to overall company performance. As markets and regulations mature, company focus will shift from inventorying the amount of carbon emissions and meeting regulatory reporting requirements, to understanding the relative cost or value of compliance activities, and managing risk and return.

Increased market size, degree of standardization, liquidity and risk and will drive leading companies to adopt a systematic approach to managing carbon-related activities. This systematic approach will include enabling technology which will likely be an extension of functionality already associated with certain energy trading and risk management systems. In addition to carbon emissions, market participants may also need to systematically manage their participation in related markets developing for renewable energy and energy efficiency.

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Table of Contents

Introduction

Greenhouse Gases (GHG) such as carbon dioxide (CO2) have been identified as major contributors to global warming. Environmental and political pressures have driven efforts to address global warming, as well as somewhat related concerns around energy security. As a result, markets have emerged around certain aspects of carbon emissions, renewable energy and energy efficiency.

The overall "carbon trading market" in 2008 was estimated to total over $120 billion in transactions covering more than 4.2 billion metric tonnes of CO2 equivalent. This represented a doubling in market size by value from 2007 levels and a somewhat lower increase in terms of market tonnage. It appears that market growth is again strong in 2009, although weakening prices have kept value growth below tonnage growth. Analysts project that the global carbon trading market could reach one to three trillion dollars by 2020, although these projections assume U.S. legislative action.

It is important to consider a few key points when looking at carbon markets: first, carbon trading is still an emerging market, so views expressed will represent a point of time; late Summer 2009 for this Whitepaper. Second, only a handful of analysts cover the market, and the high level of non-exchange based trades (e.g., over-the-the counter, bi-lateral) result in a range of market size estimates. Third, the "market" is highly fragmented, with one analyst indicating that there are really over forty carbon markets. Finally, carbon trading is an acronym-rich environment; we apologize ahead of time for the number of acronyms identified, but thought that a basic familiarity with many of them would be useful.

Carbon Trading

Carbon trading generally refers to the trading of a permit of some type to emit a certain amount of GHG, usually measured in metric tonnes of CO2 equivalent (tCO2e). Different types of GHG have different multipliers, depending on their relative "Global Warming Potential". Multipliers range from "one" for CO2 up to 23,900 for Sulphur Hexafluoride. Some carbon markets deal only with CO2, while others include all types of GHG.

Under cap-and-trade programs, certain GHG producers must measure the amount of GHG they emit and obtain permits (e.g., allowances or credits) equivalent to that amount. Programs vary as to which GHG producers are covered, and which entity is responsible for obtaining permits; this often changes over time. It is critical to understand how permits are created, allocated, transacted and monitored. Another important point is who receives the proceeds from these transactions.

Although there may be over forty carbon markets, there are only three principal regimes: the Kyoto Mandatory (or Regulated) Regime, the Non-Kyoto Mandatory Regime and Voluntary Regimes. Permits are created through one of several different mechanisms under these regimes.

The UN Framework on Climate Change (UNFCCC) encouraged industrialized nations to stabilize GHG emissions. The Kyoto Protocol, which was adopted in December 1997 and went into force in February 2005, created legally binding obligations for 38 industrialized countries (the "Annex B Parties") to reduce GHG emissions to around 5% below 1990 levels during a compliance period running from 2008 to 2012. The Marrakech Accords in 2001 defined key rules and principals. Several mechanisms were designed to facilitate trade in carbon reductions, but they were supposed to be "supplemental to domestic action". As a result, the following units or credits are commonly seen in carbon markets:

- **Assigned Amount Units (AAUs)** are given to governments, but may be reallocated to industry sectors and companies, or sold to other governments. They represent allowances for the GHG that an Annex B country is permitted to emit over the 2008-2012 commitment period. The estimated market for AAU trades in 2008 was around $200 million.
- **Certified Emission Reduction (CER)** credits are established under the Kyoto Clean Development Mechanism (CDM). They are project-based credits created by verified emission reductions in eligible sectors in uncapped developing countries. The global market for CERs is large, with the primary market in 2008 estimated at $6-9 billion, and the secondary market at $15-26 billion. China generates over half of all CERs.
- **Emission Reduction Units (ERUs)** are created under the Joint Implementation (JI) mechanism through private project investment between two Annex B countries. To avoid double counting, an AAU must be converted to create an ERU. Estimates for the 2008 market for ERU trades vary widely, but were typically in the $1-2 billion range.
- **Removal Units (RMUs)** are based on land use, land use change and forestry (LULUCF) activities such as reforestation and not tilling land. They can be created under the CDM or JI mechanisms and are mostly seen in voluntary markets.

Country-based registry systems track, record and are used to settle emission-related transactions. The UN Climate Change Secretariat in Bonn, Germany keeps the International Transaction Log (ITL) and verifies transactions. As of December 2008, 34 country registries are linked to the ITL.

Kyoto is important to understand, because the emission levels it sets help drive cap-and-trade levels under programs such as the European Union Emission Trading Scheme (EU ETS) as well as the type of carbon instruments being transacted, especially CER credits where standardization has been critical for market liquidity. Not all Kyoto instruments are allowed in all programs. For example, the EU ETS Phase I did not allow the use of ERUs, and Phase II still does not allow the use of RMUs.

The 5.2% overall Kyoto emission reduction target was quickly achieved after 1990 because of economic collapse in former Eastern Bloc countries and associated GHG emission reductions of around 40%. Excess AAUs from former Eastern Bloc countries due to this collapse are often referred to as "hot air", with pressure on some governments to avoid them. ERUs created by projects in these countries are also sometimes questioned. Although the overall target was met, countries must still meet their individual Kyoto obligations.

Looking ahead, some market uncertainty exists because a new international framework needs to be negotiated and ratified by the end of the first commitment period in 2012. An important step should be the Copenhagen UNFCCC Conference of Parties (COP) in December 2009, which will work on a successor to the Kyoto Protocol.

European Carbon Markets

Several carbon emission control and trading concepts were tested by the UK Emission Trading Scheme (UK ETS) which ran from 2002 through to the end of 2006. During this period, the European Union Emissions Trading Scheme (EU ETS) was also established, with approval in 2003 for a first compliance period starting 2005.

The EU ETS was developed separately from the Kyoto Protocol, but a "Linking Directive" later allowed certain Kyoto Mechanisms for compliance, most notably the CDM to enable use of Kyoto CER credits for compliance. Countries set individual emission caps through Member State National Allocation Plans (MSNAPs) approved by the EU Commission based on a set of criteria, including whether totals were consistent with Kyoto targets. Disagreements over MSNAPs can end up in EU courts, as seen with countries such as the Czech Republic, Estonia, Italy and Poland in 2009.

The EU ETS is being implemented through a series of phases:

- **EU ETS Phase I (2005-2007)** was a "large test" covering five sectors, over 10,000 installations and around half of all EU emissions. Excessive allowances were given away for free, resulting in windfall profits for the power industry, and a subsequent price drop due to oversupply.
- **EU ETS Phase II (2008-2012)** was broadened to cover more sectors, with fewer free allocations and provisions for more international offsets
- **EU ETS Phase III (2013-2020)** should require 100% auctioning of allowances except for special exceptions. Legal requirements for a proposed 20% reduction goal by 2020 may move from Member States to the EU level and eliminate national allocation plans. Use of certain types of emission credits and units may still be limited

The trading unit created for the EU ETS is the European Union Allowance (EUA). EUAs and CERs are traded over-the-counter (OTC), on exchanges, or through bilateral arrangements. According to one analyst, around 40% of EUAs and 15-20% of secondary CERs were handled on exchanges in 2008. The European Climate Exchange (ECX) is the European market leader. Other exchanges include: BlueNext, the European Energy Exchange (EEX), Nord Pool and greenmarket. In 2009, views on counterparty risk led to more brokered OTC volume being cleared on exchanges.

The European carbon market is large. EUA sales in 2008 were estimated at $90-95 billion for around three billion tonnes of CO2; the EU also accounts for a significant amount of the $21-35 billion primary and secondary market for CERs.

North American Mandatory Carbon Markets

North America is a currently a mix of regulated, "mandatory-voluntary" and voluntary markets. Regulated markets include participants covered by the Alberta Specified Gas Emitters Regulation (SGER) as well as the U.S. Regional Greenhouse Gas Initiative (RGGI); mandatory-voluntary markets include members of the Chicago Climate Exchange (CCX); and voluntary markets include participants in programs such as the US EPA Climate Leaders program, and companies who decide to voluntarily reduce their carbon emissions for other reasons.

The first mandatory North American carbon market opened July 2007 in Alberta under the SGER. It required around 100 facilities to reduce emission intensity rather than absolute emissions. Compliance options included: reducing emissions, purchasing Emission Performance Credits, purchasing Alberta-generated qualified offsets called "Alberta-based offset credits" or Verified Emissions

Reductions or Removals (VERRs), or paying a $15 per tonne penalty to the Climate Change and Emissions Management Fund. The 2008 SGER carbon trading market was estimated at around $30 million for over 3 million tonnes of credits, primarily VERRs.

RGGI is the first mandatory U.S. GHG cap-and-trade program. It was created through the joint efforts of ten Northeast and Mid-Atlantic states, with other states such as Florida considering joining. It covers 225 power plants, with emission levels set by carbon budgets in each state based on the RGGI Model Rule and linked through allowance reciprocity. All allowances are auctioned, with states getting the proceeds to fund green projects. Emissions are to be stabilized between 2009 and 2014, then reduced 10% below 2009 levels by 2018. Approved offsets developed within member states may be used to meet a small percentage of requirements. Studies show RGGI will probably be over-allocated until 2014.

The first RGGI compliance period started January 2009, but two auctions were conducted in 2008 and generated over $100 million in revenue for 44 million tonnes. Estimated 2009 market size is over $350 million for around 130 million tons. RGGI futures trade on the Chicago Climate Futures Exchange (CCFE) and the NYMEX green exchange. Credits issued before 2012 will probably be fungible under proposed US cap-and-trade legislation, although there may be pricing issues.

North American "Mandatory-Voluntary" and Voluntary Carbon Markets

CCX operates a voluntary legally binding cap & trade system for all six GHG though emission reduction agreements in place with over 400 members representing 15% of US stationary emission sources; this is roughly one-quarter of the emissions covered by the EU ETS. Carbon Financial Instruments (CFIs) cover both allowances and offsets, with offsets based on Intergovernmental Panel on Climate Change (IPCC) approved mitigation actions and verified by independent entities. Corporate officers must sign emissions attestations for compliance. In 2008, CFIs worth over $300 million and representing almost 70 million tonnes were traded.

Voluntary markets include Verified or Voluntary Emission Reductions (VERs) that do not comply with the Kyoto Protocol, but are verified by independent agents and may eventually become CERs or ERUs. Growth of the voluntary market is supported by several leading standards and registries. Market size is unclear, although one analyst conservatively estimated the 2008 market at around $400 million for over 50 million tonnes. New Energy Finance has identified around 3,000 entities trading voluntary carbon offsets.

The largest voluntary program is the U.S. EPA Climate Leaders program where companies conduct a corporate-wide GHG inventory, set 5-10 year reduction goals, and report progress annually to the EPA. It was launched in 2002 with 11 charter members, and had 284 companies as of mid-2009 representing over 8% of total annual U.S. GHG emissions. Some companies participate in both the CCX and the EPA Climate Leaders program.

Voluntary efforts are supported by a range of standard-setting organizations led by the Voluntary Carbon Standard (VCS) with around half of the market, and followed by the Gold Standard, Climate Action Reserve Protocol and the American Carbon Registry Standard, each with around 10% of the market. Carbon credit prices vary somewhat by standard because of real or perceived differences in credit characteristics and risk.

Potential Future North American Markets

Several U.S. states and Canadian provinces have emission targets, and may also be members of one of the two large regional initiatives outside of RGGI: the Western Regional Climate Action Initiative (WCI) and the Midwest Regional Greenhouse Gas Reduction Accord (MRGGRA). The three regional initiatives are looking at ways to link to form a larger integrated market.

California passed AB 32, the California Global Warming Solutions Act of 2006, requiring a reduction of GHG emissions to 1990 levels by 2020, or an estimated 25-30% reduction from business as usual. The California Air Resources Board manages the program, with most enforcement starting in 2012. California also linked with WCI as one of 7-state and 4-provincial members,

WCI is developing a phased cap-and-trade approach to reduce all GHG emissions 15% below 2005 levels by 2020, with Phase 1 (2012-2014) covering electricity generation and large industrial facilities and Phase 2 (2015-2020) adding transportation, residential, commercial and industrial fuels. A key feature of both the California and WCI approaches is identification of a Point of Regulation (PoR) for compliance. Instead of the actual emitter, the PoR may be the fuel supplier. This approach was carried over into proposed U.S. Federal legislation.

The MRGGRA was agreed to in late-2007, and covers 6-states and 1-province. Advisory Group recommendations were presented in mid-2009 stating a preference for a cap-and-trade program at the federal level, rather than a regional program. As a result, activities have slowed awaiting potential federal legislation.

Canada looked at an intensity-based cap-and-trade in the 2007 "Turning the Corner" document, but now appears to be looking at program consistent with US Federal proposals. The threat of an election in late-2009 could further delay Canadian plans.

Other Carbon Markets

In Australia, the mandatory New South Wales Greenhouse Gas Reduction Scheme (GGAS) started in January 2003 using New South Wales GHG Abatement Credits (NGACs). Over the past few years, analysts estimate this market at $150-225 million per year for 20-30 million tonnes.

Australians are negotiating on the Carbon Pollution Reduction Scheme (CPRS) originally set to start in 2010 using Australian Emissions Units (AEUs) covering all six GHG and all sectors except agriculture and other land use. Draft legislation allowed use of CER credits and ERUs, with expectations that they would be used to meet around half of Australia's carbon emission goals. In August 2009, CPRS was defeated in parliament with a rematch planned for later in the year. Negotiations are complicated by the possibility of a second defeat leading to a new election

Discussions continue on amending New Zealand's existing carbon trading scheme, with amended legislation expected in the next few months. The Labour government set up an ETS in 2008, but it was put on hold by the National Party when it came to power. Considerations include how to link with international markets, as well as treatment of the important forest industry.

The DPJ replaced the LDP in Japan, and announced a mandatory carbon trading scheme to be introduced by the fiscal year starting April 2011. It will provide a 25% reduction from 1990 emission levels by 2020. This compares to an earlier goal set by the LDP which was equivalent to around an 8% reduction. Plans are still at a fairly early stage, with significant political and industry resistance. A trial voluntary carbon trading market was launched in October 2008, with mixed results through mid-2009. At the same time, Japan as a Kyoto signatory continues to purchase carbon credits internationally to help meet its commitments.

Even India is considering a cap-and-trade market as part of its proposed national energy efficiency plan, with a preliminary outline that mirrors several characteristics of the EU ETS. Analysts place

the potential annual market size at around $15 billion. Although the Indian government provided early approval of the plan as a signal to the upcoming Copenhagen talks, significant work still needs to be done to initiate and implement the plan.

US Federal Initiatives

US national GHG emission policy as currently embodied in the American Clean Energy and Security Act of 2009 (ACESA) and being considered by the Senate could have a large impact on carbon markets. Views are mixed on what might be passed and the timing of various requirements. ACESA calls for market rules to be in place by 2013, with over 80% of US GHG covered by 2016.

The proposed cap-and-trade framework is similar to what is seen in other markets, although refined product supplier obligations follow the California PoR model where suppliers are responsible for their own emissions as well as for end-use (e.g., transport sector) emissions. ACESCA calls for most emission credits to be given away for several years rather than auctioned, similar to Phase 1 of the EU ETS. The major exception is for refiners who were only allocated around 2% of all credits while being responsible for over 40% of all emissions.

Provision has been made for a significant level of allowable carbon emission offsets, possibly up to 2 billion tonnes if enough are available. It is also likely that mandatory regional and voluntary markets established before a certain date will have some ability to "grandfather" into the new national market.

Due to recent problems with financial markets, ACESA as well as the proposed OTC Derivatives Act of 2009 favor exchange traded carbon emissions over OTC transactions. The Senate is also considering limiting banks from participating in carbon market derivatives and securitization, potentially reducing market liquidity and development. Although ACESA points to FERC for monitoring carbon emission markets, the CFTC is pushing for a lead role in market oversight.

Other pending issues include the US EPA's move to regulate GHG under The Clean Air Act. This requires "best available control technologies" for entities emitting 250 tons or more per year. The legislative approach has a 25,000 ton threshold, and there will likely be challenges to the legal authority for EPA attempts to raise the threshold.

With successful US national legislation covering carbon emissions, some analysts estimate the potential US market size for carbon trading by 2020 at $1 trillion. However, there is some strong resistance to proposed legislation, and legislators are also focusing their efforts in other areas (e.g., health care reform) Near-term business activities by carbon market participants should probably focus on business risks and opportunities presented by existing regional markets, state initiatives and EPA mandates.

Carbon Market Participants

A range of entities participate in carbon emission markets. Due to their emission profiles and the typical evolution of market design, early direct participants are usually power generators. Most indirect market participants such as financial institutions are the same as those seen in electricity trading.

Companies active in industrial sectors such as steel, cement, glass, pulp & paper, and refining are often included as direct participants in subsequent phases of market development, with sources of distributed emissions such as transportation typically left for final stages of market development. Indirect participants at the "industrial sector" stage tend to include those seen in gas and liquids trading.

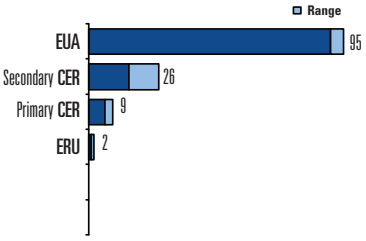
Consumer products and other large "public relations intensive" companies also often participate to a varying extent in voluntary carbon markets, usually due to the perceived marketing or brand value of participation.

Financial institutions such as banks, traders and hedge funds participate along various parts of the carbon emissions transaction lifecycle in order to profit from activities such as market creation, market operation, risk management, advisory services, trading, direct investment or speculation. As indirect participants, they often join to leverage or augment their existing activities in electricity, gas or liquids trading. In several cases they have directly invested in offset project developers.

A fairly large set of service providers are also important market participants and key enablers for market development. Critical entities include several rule-making bodies, a fairly large number of carbon emission registries, less than a dozen exchanges, and an even shorter list of technology providers to the exchanges. Traditional service providers seen in all markets are also present, such as legal, accounting and consulting firms. Some specialist firms participate, including companies that provide offset monitoring and verification services.

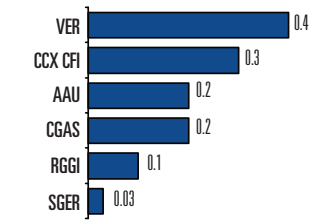
Finally a group of investors in carbon emission-related projects such as carbon offset developers are active, with another layer of entities sometimes serving to market or aggregate projects. It is not unusual to see carbon-emission project developers being closely aligned to other market participants such as financial institutions, electric utilities and industrial companies.

Estimated Carbon Emission Markets – 2008 ($ Billion)



Source: New Carbon Finance; Point Carbon, IETS, Published Information

Estimated Carbon Emission Markets – 2008 ($ Billion)



Source: New Carbon Finance; Point Carbon, IETS, Published Information

Business Requirements: Measuring and Reporting Carbon Emissions

An early business requirement for direct carbon market participants is to meet internal and external carbon inventory and reporting requirements. In most cases, this has been handled through fairly simple spreadsheet or database applications with somewhat manual reporting processes. This has worked fairly well during a period where the focus has been on utility-related emissions with over half of the companies reporting having ten or fewer installations. This approach will come under pressure as more locations are required to provide more information. Industry analysts suggest that only 10-20% of all relevant companies have installed specific applications to track and report information related to carbon emissions.

Companies which have installed software often use applications adapted from the Environmental, Health and Safety (EH&S) compliance reporting market, although some applications have their roots in areas such as business intelligence, data management, generation optimization and supply chain management. A few companies have developed and implemented custom energy and GHG inventory systems.

As companies move from measuring and reporting direct carbon emissions from large facilities to a broader definition of their "carbon footprint", the complexity of required systems increases. A carbon footprint typically extends to inbound and outbound supply chain estimates, as well as carbon generated by services such as employee travel. New required system functionality includes direct and indirect GHG inventories, integrated field emission measurements, emission calculation engines, emission factor and methodology updates, integration with general ledger and travel reservation systems, multi-regime reporting, identification of emission reduction projects, and verification of reductions or credits. Emission information is collected, calculated, aggregated, stored, reported, compared to permitted levels, and may trigger a workflow if problems exist.

GHG measurement and reporting requirements have typically been driven by regulations and shaped by the needs of various registries and their associated standards. These requirements are fairly stable in Europe, with information feeding into national registries which in turn feed into higher level registries. For example, each country under the EU ETS has its own registry linked to the Community Independent Transaction Log (CITL). With the start of the Kyoto compliance period in 2008, connections were switched from CITL to the UN ITL. The UN ITL was also linked

to the EU emission trading registry to allow direct transfers and reduce delivery risk for CERs into the EU ETS.

Business Requirements: Carbon Emission Reporting and Compliance

A key market shift is the increased attention being paid to compliance and regulatory risk associated with carbon emission reporting. Several countries plan to increase the level and frequency of reporting requirements starting in 2010, stressing and possibly overwhelming spreadsheet-based approaches. For example, under the UK Carbon Reduction Commitment it will be mandatory for around 5,000 companies by April 2010 to increase the frequency of emissions-related data gathering or face penalties. Canada is also trying to implement standard emissions reporting, with a June 2010 deadline for large emitters over 50,000 tonnes per year to report 2009 GHG emissions. Some U.S. states have mandatory reporting requirements.

The biggest inventory and reporting changes will probably come from the U.S. where the EPA has proposed a comprehensive GHG emissions registry covering fossil fuel suppliers, automakers and companies emitting 25,000 or more tonnes per year. This system would cover 13,000 facilities emitting 85-90% of all US GHG emissions. EPA's May 2009 budget included $17 million to develop the registry plus $2 million for other related work. The EPA plan calls for reporting requirements to go into effect in 2010, with annual reports submitted in 2011 for 2010. Estimated private sector compliance cost is $160 million for the first year, and $127 million on average for following years.

Investor pressure is also driving changes in inventory reporting and required compliance. The US 2009 proxy season had a record 68 climate-related shareholder resolutions filed. Actions taken as a result included agreements by: Chevron to develop a business plan to track performance against annual GHG reduction targets for operations as well as for products sold; IDACORP to adopt GHG reduction targets; and NV Energy to expand disclosure of its strategy to address climate change.

At the highest level, there is an increasing need to be able to assure the Board and investors that proper controls are in place for carbon-related assets and liabilities, and that a strategy is in place to address GHG management. As an example of possible risks, the New York Attorney General in late-2008 reached settlements with coal-fired power producers Dynegy and Xcel Energy on potential violations of New York State securities laws from failure to disclose risks faced due to climate change and potential regulation. The companies agreed to include detailed disclosures for the next four years in their Form 10-K filings regarding "material financial risks associated with the regulation of GHG emissions in relation to climate change". Among many required disclosures were an emissions management report, strategies to reduce risk, and estimated compliance costs. One company fell under New York regulatory scrutiny due to being listed on the NYSE rather than having a local physical presence.

A common feature of existing systems measuring and reporting carbon emissions is that they tend to focus on volumetric (i.e., tonnes of emissions) and a certain base level of compliance reporting. This required base level of compliance reporting is, in some cases, increasing dramatically. At the same time, the emerging need to develop a carbon management strategy is pushing some companies to more sophisticated, transactional, systems with the ability to manage and optimize carbon emission-related activities.

Business Requirements: Managing and Optimizing Carbon Emission Reductions

Approaches for managing and optimizing carbon emissions typically focus on associated cost, value and risk, and often require both organizational redesign and new technology-enabled processes. A key change is the increased attention paid to financial aspects of emission positions, including risk adjusted valuations. A related area is bringing current and potential carbon related costs into planning and investment processes.

The cost of carbon emissions will need to be determined and integrated into financial planning and budgeting processes. As an example, National Grid stated that they started integrating carbon accounting into core financial processes in 2009. According to Deloitte, information will be required to support financial statements in at least five major areas: accounting for carbon regulatory obligations, accounting for held emissions rights and offsets, accounting for forward contracts, issues of impairment for emissions credits, and regulatory treatment for the recovery of the cost of emissions credits. Another key consideration is whether emission credits are counted under an inventory model or an intangible model similar to goodwill or intellectual property.

In theory, any investment where some form of energy is involved will require analysis of costs or values associated with carbon emissions. The cost of carbon emissions will need to be included in financial modeling for investment decisions. In early 2008, several leading financial institutions released "The Carbon Principles" establishing guidelines and "enhanced diligence" requirements for power plant investment decisions that consider "the value of avoided CO2 emissions". This explicitly recognizes that capital investments made today will probably operate under long-term carbon constraints.

Carbon credits may also need to be included as part of investment packages. A California logging project was recently stopped by lawsuits demanding carbon offsets or other mitigation. Renewable investments should be more attractive with associated carbon credits, although a recent proposal by a California municipal utility suggests that the current value of carbon credits does not come near the required subsidy level to make solar power investments attractive.

Due to variations between different carbon instruments and markets, and the potential differential impact of regulatory change, enhanced risk evaluation and monitoring capabilities will be required. This may include evaluating and monitoring "sub-prime carbon" created through project bundling and splitting of risk components (i.e., securitization) such as occurred in late-2008 when Credit Suisse bundled carbon credits from 25 offset projects at different stages of UN approval sourced from three countries and five project developers, then split them into three packages with different levels of risk.

Overall, emissions management should become an integrated part of energy trading and risk management (ETRM) in meeting or supporting the needs outlined. A well-designed platform should be able to handle different emission allowance and credit configurations, much like the power market where each regional market has different characteristics and requirements. A list of potential functionality includes: demand forecasting and sensitivity analysis; valuation and other carbon data modeling, including mark-to-market (MtM) and risk analytics; decision support for optimization; contract administration and credit portfolio management; trade capture, including unique attributes (e.g., program, phase, vintage, registry); deal confirmation; provisions for automatic emission measurement feeds; inventory and position management, including open positions and options; emission allowance portfolio management, with carbon credit vintage and expiration information; a single point to manage changes in market rules; settlements; inventory and trade accounting; and the ability to support reporting and regulatory compliance.

The "spreadsheet approach" and most existing applications can not meet these emerging requirements. Carbon emission-related complexity, values and risks are becoming high enough to justify enhancing existing ETRM systems to provide some or all of this new functionality. If markets continue to expand as expected, "greenfield" implementations of new ETRM systems may even become justified.

Trading Renewable Energy in North America

Markets for Renewable Energy Certificates (RECs) are very similar in many respects to carbon emission markets. A REC represents the renewable characteristics of a specified output of energy, such as one megawatt hour, and is usually traded separately from the actual power produced. RECs are almost exclusively related to power generation, acquisition or sales. They exist in a mix of country, regional and state markets, with a range of jurisdictional characteristics.

In the US, RECs are used to satisfy requirements for some state Renewable Portfolio Standards, (RPS) a regulatory policy enforced at the state level which requires renewable energy to be included in generation or sales portfolios. As of August 2009, 29 states and the District of Columbia have an RPS, while another five states have renewable portfolio goals. While most RPS states support some form of REC trading, four states as of the end of 2008 did not allow unbundled RECS.

RECs often vary between states in terms of characteristics such as classes, tiers and vintages. Roughly one-third of all state RPSs include multipliers for factors such as state of origin and type of generation. Certain states have "carve-outs" where certificates exist for specific types of renewable energy. As of mid-2009, fourteen states had solar carve-outs or related mechanisms which may give rise to Solar Renewable Energy Certificates (SRECs). To further complicate the situation, allowable renewable energy sources sometimes vary by state.

Many RECs are transacted bi-laterally through Requests for Proposals (RFPs), with some handled by state-level systems. The US is also covered by several regional tracking systems, typically built around a transmission organization, that track a variety of characteristics associated with generation and imported power. The earliest system came on-line in 2001 for ERCOT, followed by the NEPOOL Generation Information System (GIS) in 2002, the PJM Generation Attribute Tracking System (GATS) in 2005, the WECC Western Renewable Energy Generation Information System (WREGIS) in 2007 and three other regional systems in 2007-2008. Systems can typically handle REC creation, posting, inventorying, transactions, accounting and reporting.

In early 2009, the Chicago Climate Futures Exchange (CCFE) launched compliance REC future contracts for New Jersey, Connecticut and Massachusetts, as well as Voluntary REC Futures.

The proposed ACESA includes a U.S. National RPS for all investor-owned utilities starting at 6% in 2012 and increasing to 20% in 2020. Of the 20%, at least 15% must come from renewables and up to 5% from energy efficiency. If some form of this National RPS is passed, it should drive development of a consistent and fairly large US REC trading market. However, development of underlying renewables production will still be strongly influenced by the cost of renewables, the availability of relatively high subsidies or incentives, and transmission capacity for market access.

Trading Renewable Energy in Europe

While Europe currently leads North America in trading carbon emissions, its markets for RECs are, at best, equivalent to the fragmented North American markets. The EC published a white paper in 1997 setting a 2010 renewable target of 12%. Targets have changed over time, with a directive adopted in December 2008 targeting an increase in renewables from the current 8.5% of EU energy mix to 20% by 2020. Differentiated 2020 targets were set for each Member State, with National Renewable Energy Action Plans due by mid-2010.

Only a few countries such as Belgium, Italy, Sweden and the UK have mandatory renewable targets with associated REC schemes. Cross-border trading in the mandatory market is currently complicated and seldom occurs. Europe has historically relied heavily on subsidies such as feed-in-tariffs (FITs) and other fiscal incentives rather than RECs to encourage renewables. A proposed EU-wide REC-style trading approach based on Guarantees of Origin (GOs) was rejected in 2008, as was the option for "virtual" imports based on renewable energy investments in outside countries.

A significant amount of REC trading is on a voluntary basis, especially under a system created by RECS International and administered by the Association of Issuing Bodies (AIB). At the end of 2008, RECS International had 235 members across 24 countries. It works through country-specific markets which are currently dominated by hydropower exported from Norway and Sweden, with windpower a distant second. In 2008, around 184 TWh of renewable certificates were generated.

Other Renewable Energy Trading

Australia established a Mandatory Renewable Energy Target (MRET) in 2001 through the "Renewable Energy (Electricity) Act 2000" which led to a robust market for RECs. Australian RECs are created on the REC Registry and validated by the Office of the Renewable Energy Regulator. Market liquidity and prices are established by a range of participants. Legislation was passed in August 2009 to implement an expanded national Renewable Energy Target (RET).

Japan has had an RPS in place since 2002. Instead of REC trading, Japan has used feed-in-tariffs to encourage solar investment, and is considering expanding FITs to other renewable energy sources by 2011. A new goal of 10% renewables by 2020 is being discussed.

Trading Energy Efficiency

White Certificates, which are also known as Energy Savings Certificates (ESCs), Energy Efficiency Credits (EECs) and White Tags, are created through energy reduction. Only some are tradable, and markets are even more limited than those for emissions and renewables. In some cases, efficiency goals are becoming part of an RPS or are being converted to carbon reduction targets.

In the US, Energy Efficiency Portfolio Standards were completed for over twenty states by the end of 2008. Trading is primarily a mix of utility-related mandatory and voluntary activities, and may be captured under RPS-related REC trading. Connecticut's white tag trading program, established in 2007, is one of the more active and classifies energy efficiency as "Class III Renewable Energy Credits"; this is a good illustration of the overlap with renewable energy markets. Other examples include Pennsylvania through "Tier II Alternative Energy Credits"; New Jersey and Nevada through "Portfolio Energy Credits"; and Sterling Planet with its "US Voluntary White Tags".

In Europe, the EU "Directive on Energy End-Use Efficiency and Energy Services" mentions White Certificates, but leaves options for future use open. The EC through the EuroWhiteCert (EWC) Project is reviewing the potential for a Europe-wide White Certificate scheme. Italy is a leader in OTC trading of energy efficiency improvements through mandates placed on energy and gas distribution companies. France and the UK have targets primarily set through electricity and gas suppliers, but there is little trading of certificates, partly due to market design and the certification process. Countries such as Bulgaria, Denmark, Hungary, the Netherlands, Poland and Romania are investigating the possible use of White Certificates. In other non-European countries such as Australia, limited trading currently exists in Energy Efficiency-related instruments.

System Requirements for Renewable and Efficiency Trading

Energy trading and risk management systems upgraded to enable companies to inventory, ensure compliance, manage and optimize carbon emissions should also be able to handle requirements for activities associated with renewable energy and energy efficiency. The systematic approach ETRM systems provide for capturing, inventorying, analyzing and reporting characteristics, values and risks of varying positions and trading instruments allows them to cover a wide range of complex yet related markets.

Conclusion

Markets associated with carbon emissions and related areas such as renewable energy and energy efficiency will continue to develop and converge, although they will contain distinct localized or regional characteristics for the foreseeable future. The growing size and liquidity of markets, greater materiality to individual companies, and pressure from regulators and investors will shift the focus of market participants from monitoring physical volumes toward investing in integrated capabilities through energy trading and risk management systems to meet increasing compliance requirements, optimize costs or potential value and manage risks.

About the Author

Mr. Gallup has over 25 years of experience as a consultant or executive with companies in most energy-related industries, including: power, renewables, electric & gas distribution, oilfield services, energy retailing, gas transmission, oil & gas exploration, coal & other mining, refining, energy trading & marketing, chemicals production & marketing, pulp & paper, telecommunications, waste management and metals recycling. In addition to the US, he has worked in Australia, Brazil, Canada, China, France, India, Jamaica, Mexico, Norway, Turkey and the UK.

Currently working as an independent consult for several utility and energy-related companies, Mike has previously held various positions with firms such as: Ernst & Young, Deloitte Consulting, a major Indian Service Provider, CRA International, McKinsey & Company, PSEG, FMC and Elders Resources. He has helped companies in a broad range or areas, including: strategy, new business development, planning & budgeting, business & technology architecture, risk management, compliance, cost reduction and profitability improvement.

Mr. Gallup holds a BS with distinction in Chemical Engineering from Cornell University and an MBA with distinction from Harvard Business School.

About Allegro's Emissions 8.1

Allegro's Emissions 8.1 component was developed and recently introduced to the market to meet the challenges that arise from mandated requirements and overall management with highly efficient and fully integrated functionality aimed at renewable credits and emissions certificates. Emissions 8.1 provides comparative reporting with the ability to access, manage and match requirements necessary for compliance. This component has the flexibility to capture, trade including unique attributes (e.g., program, phase, vintage, registry);and track emissions certificates with all required attributes to manage the following functions:

- Trade capture of bilaterals, allocations, expire, options, allocated surrender certificates or RECs
- Forecasted and actual emissions and renewable usage
- Physical Inventory
- Position management with comparative reporting against reporting Agencies across the Globe
- Valuation and Mark to Market
- Compliance Reporting

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About Allegro

Allegro is the global leader in energy trading and risk management (ETRM) solutions for producers, refiners, power and gas utilities, commodity traders and commodity consumers. With more than 24 years of steady growth and deep industry knowledge, our enterprise-wide trading and risk management platform drives transparency and efficiency across front, middle, and back offices, while also managing complex logistics associated with physical commodities. Allegro's proven solutions provide traders, risk managers and management with flexible solutions - across all currencies and commodity types - that allow decision makers to hedge and execute with confidence. Allegro is headquartered in Dallas, Texas, and serves customers worldwide with offices in Calgary, Houston, London, Rotterdam, Singapore and Zurich along with a global network of partners.

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