solutions

# The **Emerging** International Greenhouse Gas **Market**

*Richard Rosenzweig*
*Matthew Varilek*
NATSOURCE, LLC

*Josef Janssen*
UNIVERSITY OF ST. GALLEN

# The **Emerging** International Greenhouse Gas **Market**

**Prepared for the Pew Center on Global Climate Change**

*by*
*Richard Rosenzweig*
*Matthew Varilek*
*Ben Feldman*
*Radha Kuppalli*
NATSOURCE, LLC

*Josef Janssen*
UNIVERSITY OF ST. GALLEN

*March 2002*

*Contents*

## Foreword *Eileen Claussen, President, Pew Center on Global Climate Change*

As businesses, policy-makers, and other stakeholders around the world have become familiar with greenhouse gas emissions trading, it has emerged as the policy of choice to address climate change. Now—with the recent agreements in Bonn and Marrakech, with new carbon trading systems in Europe, and with private sector interest and activity across many economic sectors both here and abroad—we are beginning to see the outlines of a genuine greenhouse gas market.

In this Pew Center report, authors Richard Rosenzweig, Matthew Varilek, Josef Janssen et al. describe the various public and private programs under which many early trades have occurred, the characteristics of the emerging market including the key features of early transactions, and the potential evolution of the market given the concurrent development of domestic and international climate change policy. Case studies of actual trades between four power companies—TransAlta and HEW, and PG&E and Ontario Power Generation—help illustrate leading companies' motivations for engaging in trading, as well as the challenges they have faced in the absence of clear guidelines in the nascent market.

Despite the impressive interest in greenhouse gas trading, the market that has developed thus far remains fragmented. For example, as originally proposed, the trading regimes put forth by the United Kingdom and the European Union differ in important respects: the former is voluntary and the latter is not; the former covers the full basket of six greenhouse gases while the latter is restricted to carbon dioxide. This results in higher transaction costs just as the market is getting off the ground. The challenge ahead, for business, policy-makers, and others, is to work together to help forge linkages between the emerging regimes, and ultimately to achieve convergence.

I am optimistic that we can meet this challenge. We are beginning to see the first glimmers of interest in the U.S. Congress, although the debate is expected to be long and difficult. Perhaps more encouraging are private sector efforts to build a greenhouse gas trading system, such as the Chicago Climate Exchange. Also, many companies have set up their own internal trading systems to "learn by doing," and have been eager to participate in early trades. The need for certainty, for consistency, and for a level playing field all will work to encourage a merging of regimes. Policy-makers must do their best to ensure that all systems are compatible.

The authors and the Pew Center would like to thank the companies featured in this report for sharing their experiences and perspectives, and acknowledge the members of the Center's Business Environmental Leadership Council, as well as Aldyen Donnelly of GEMCo; Erik Haites of Margaree Consultants; Richard Sandor of Environmental Financial Products, L.L.C.; and Tom Wilson of EPRI for their review and advice on a previous draft of this report.

## Executive Summary

A market for greenhouse gas (GHG) emissions has begun to emerge over the past five years. This market is driven in large part by ongoing negotiations of an international global climate change treaty, which will likely impose limitations on GHG emissions. The market has been shaped by successful emissions trading programs established over the past decade, such as the sulfur dioxide ($SO_2$) trading program incorporated in the U.S. Clean Air Act Amendments (CAAA) of 1990.

This paper describes: (1) programs and initiatives that have provided a framework for early trades and policy development; (2) characteristics of the emerging GHG market and key features of early transactions; (3) potential evolution of the market due to ongoing concurrent domestic and international climate change policy development; and (4) potential scenarios regarding the U.S. response to climate change.

### Origins

Greenhouse gas trading has its origins in the United Nations Framework Convention on Climate Change (UNFCCC). Adopted in Rio de Janeiro, Brazil, in 1992, the UNFCCC established the goal for industrialized countries to return to their 1990 GHG emissions levels by the year 2000 and a long-term objective of stabilizing atmospheric concentrations of greenhouse gases "at a level that would prevent dangerous anthropogenic interference with the climate system." In 1995, the Parties reviewed their progress and concluded that the non-binding goal would not lead to the achievement of the Convention's objective of atmospheric stabilization. In response, Parties agreed to pursue a complementary agreement that would establish quantified emissions limitations and reduction obligations for developed countries. This culminated in the negotiation of the Kyoto Protocol in December of 1997.

The process to develop rules, mechanisms, and institutions necessary to bring the Protocol into force is ongoing, including the seventh Conference of Parties (COP-7), held in Marrakech, Morocco, during November of 2001. Though significant progress was achieved there and in previous negotiations, the Protocol has not yet entered into force, and few national governments have imposed limitations on domestic GHG emissions or established trading rules. Thus, the GHG market is evolving under a loosely constructed, ad hoc framework. To date, it has evolved from a variety of mostly project-based emissions trading programs, which have been voluntary in nature and which collectively serve as precursors to formal GHG regulation. More recently, the United Kingdom and Denmark have developed national regulatory programs.

## Project-Based Programs

The UNFCCC allows industrialized countries to meet their emissions reduction commitments "jointly with other Parties" through a form of project-based emissions trading. This program became known as Joint Implementation (JI). Subsequent programs have provided practical experience with key aspects of project-based emissions trading. These programs and initiatives include the U.S. government's Initiative on Joint Implementation (USIJI); the pilot phase of international project-based emissions trading known as Activities Implemented Jointly (AIJ); Ontario, Canada's multi-stakeholder Pilot Emissions Reduction Trading program (PERT); Oregon's Climate Trust; the Dutch government's Emission Reduction Unit Procurement Tender (ERUPT); and the World Bank's Prototype Carbon Fund (PCF), among others.

Each of these programs is governed by a unique set of rules. However, they exhibit some common elements that constitute a *de facto* (though non-binding) set of minimum quality criteria that govern the creation of credible emissions reductions. These common elements include: (1) establishment of a credible counterfactual emissions baseline; (2) proof of environmental additionality; (3) evidence that the reductions are surplus to existing regulatory requirements; (4) proof of permanence or durability of the reductions; (5) demonstration that the emissions-reducing project will not cause emissions to increase beyond the project's boundaries (referred to as "leakage"); (6) establishment of credible monitoring and verification procedures; and (7) proof of ownership of the reductions.

## Market Characteristics

Even though few sources of GHG emissions presently confront binding emissions limitations, a growing number of companies and governments have begun to purchase reductions generated in most part by the programs described above. Few trades of GHG emissions to date have involved an exchange of emissions permits such as "allowances" or "credits," since these terms refer to government-issued commodities that only exist within the context of formal trading systems. Most GHG trades have taken place under a voluntary ad hoc framework involving a commodity defined by the trade's participants and known commonly as verified emissions reductions (VERs). These carry only the possibility, but not a guarantee, that governments will allow them to be applied against future emissions reduction requirements.

The authors estimate that approximately 65 GHG trades for quantities above 1,000 metric tons of carbon dioxide equivalent ($CO_2e$)[1] have occurred worldwide since 1996. This figure includes trades of reductions as well as financial derivatives based on reductions. However, the figure probably understates actual market activity because not all trades are made public, and internal corporate trades and small trades are excluded. It is important to note also that this figure refers to purchases of emissions-related commodities and excludes countless investments in projects that either purposely or incidentally reduce GHG emissions. Prices for VERs have ranged between $.60 and $3.50 per metric ton of $CO_2e$. Some of the price differentials between trades can be explained by differences in the features of the reductions such as their type and vintage, geographical location, and the rigor of the monitoring and verification

procedures. Other factors that affect reductions' commercial value include contractual liability provisions, seller creditworthiness, and demonstration of host country approval of the emissions-reducing project.

Two case studies provide a detailed look at actual GHG trades in this market, illustrating some of the challenges and benefits of early GHG trading as described by market participants. The first case study reviews a purchase of VERs by TransAlta, a Canadian electric utility, from HEW, a German utility. HEW generated reductions by displacing some of its fossil fuel-based generation with electricity generated by wind. The second case study examines a purchase of VERs by Ontario Power Generation, a Canadian utility, from US Gen, a subsidiary of the U.S.-based PG&E National Energy Group. US Gen created reductions by capturing and destroying methane produced at a landfill. Both case studies demonstrate that while participants benefited from these early GHG trades, the lack of clear trading rules has increased transaction costs and been a significant impediment to the development of a more robust GHG market.

## National Trading Programs

Several governments have moved forward in designing domestic trading systems while international trading rules remain under development. At the national level, the United Kingdom and Denmark have each established domestic emissions trading programs. Some trading in these programs has already begun. The European Union (EU) and other countries are in various stages of domestic policy development. At the sub-national level, the state of Massachusetts, for example, will require reductions of carbon dioxide ($CO_2$) emissions from power plants and will allow sources to use trading as a means of compliance.

The development of these and other trading programs demonstrates that emissions trading has gained acceptance as a preferred policy instrument in the world's efforts to reduce GHG emissions. These programs will boost GHG trading activity and motivate more rapid emissions abatement than if governments had waited for the international community to conclude negotiation of the Kyoto Protocol. Already, the initiation of these programs is producing a shift in the commodity that market participants prefer to trade. Some buyers' interest is starting to shift away from VERs, whose eligibility for use as a hedge against binding emissions limitations is uncertain. Interest is beginning to shift towards government-issued permits created by the programs, which are by definition eligible for use against an emissions limitation in their jurisdiction of origin. Permits also stand a superior chance of being transferable into foreign jurisdictions for purposes of compliance.

Significant benefits have and will result from the current development of domestic trading systems. However, some adverse impacts have also resulted from the concurrent development of international and domestic climate change policy. Emissions trading systems currently in operation or under development exhibit unique features that may render them incompatible with each other. For example, the Danish and United Kingdom (UK) systems allow for trading of different gases, cover different economic sectors, and utilize different mixes of allowance and credit-based trading. To date, they have not ldeveloped rules governing interchange and mutual recognition of their tradable units with each other, which could impede or preclude beneficial cross-border transactions. There are also significant differ-

ences between each of these systems and the one being developed in the European Union. Already, the European Commission has warned that the differences in the UK and the EU systems "could create market distortions in the future."[2] Had the treaty been concluded more rapidly, the international framework would have made it easier for Parties to conform their systems leading to increased trading.

Several private-sector and nongovernmental organizations (NGOs) also have developed initiatives to help build the market and to create and take advantage of trading opportunities. They include the Partnership for Climate Action (PCA), the Emissions Market Development Group (EMDG), and the Chicago Climate Exchange (CCX).

## Future Outlook

Recent international agreements negotiated at Bonn and Marrakech resolve many details concerning implementation of the Kyoto Protocol, providing greater clarity to Parties developing domestic trading programs. These agreements will increase the likelihood that future domestic climate change policy measures will be consistent with the rules of the Protocol. However, several issues still must be resolved, and, although likely, the treaty's entry into force is not yet assured. Thus, in the near future, international and domestic GHG policy will continue to develop concurrently, with the risk that incompatibilities between regional, national, and sub-national climate change policies will lead to market fragmentation and sub-optimal economic and environmental outcomes. Such fragmentation does not mean that market participants will not trade across systems. Indeed, market participants will likely devise methods of trading across jurisdictions. However, devising such structures and mechanisms will increase costs.

Prospects for a well-functioning international GHG market have greatly improved as a result of the agreements reached in international climate change negotiations during 2001. However, significant barriers remain, including the unwillingness of the United States, the world's largest emitter, to ratify the Kyoto Protocol. A qualitative analysis of several scenarios related to the United States' future climate policy response reveals that, while in the near term the lack of an emissions constraint may provide an advantage to U.S. firms against foreign competitors confronting such constraints, continued policy uncertainty may be detrimental in the longer term.

In order for the market to achieve its intended environmental and economic results, much work remains to be done. The international community must make an ultimate decision on the legal nature of Parties' compliance obligations with the Kyoto Protocol's provisions and must resolve several other key issues. Institutions governing the treaty's mechanisms must move forward expeditiously to implement the details of the Protocol. Such action will provide Parties with clear policy guidance allowing them to conform their domestic programs to international rules and to enjoy the full economic and environmental benefits of GHG emissions trading.

## I. Introduction[3]

*Emissions trading has emerged as a key environmental policy instrument over the past decade.* The flexibility inherent in market mechanisms such as emissions trading has proven to lower the cost of achieving environmental objectives. The acid rain program of the 1990 CAAA, which authorized trading of $SO_2$ allowances to reduce precursors of acid deposition in the United States, has provided the most compelling empirical evidence to date of the environmental and economic benefits of emissions trading.

The results of the U.S. acid rain program, other smaller-scale experiments, and a body of economic literature served as a catalyst for the inclusion of emissions trading provisions in the Kyoto Protocol. These provisions are designed to reduce the cost of Parties' compliance with potential national emissions limitations. Despite great progress in the international climate change negotiations during 2001, rules governing these and others of the treaty's provisions have not yet been finalized. As a result, the final form of a potential regulated international GHG trading system remains uncertain. Nevertheless, an ad hoc GHG market has already begun to take shape and continues to evolve in response to new policy developments at the international, regional, national, and sub-national levels.

This paper begins by describing the origins of the GHG market and highlighting commonalities and differences among programs that have provided the architecture for pre-compliance GHG emissions trading in the absence of a binding international climate change treaty. The second section of the paper reviews and analyzes known GHG trades from 1996 to the present. This section also describes market participants' motivations and key features of early trades. The last section of the paper describes regional, national, and sub-national GHG trading systems under development and analyzes the impacts of the parallel evolution of domestic and international climate change policy. It then briefly analyzes several possible scenarios regarding the U.S. response to climate change and the consequences of this response for the GHG market, the environment, and the competitiveness of U.S. and non-U.S. firms.

***Box 1***

## Definitions

The paper refers to several types of trading programs and tradable instruments. They are defined below in order to clarify their usage in the paper.

### Trading Programs

- In a **cap-and-trade system** (i.e., allowance-based trading) the maximum level of emissions that can be released from sources is set by the control authority. This level is the cap. All sources are required to have permits (i.e., allowances) to emit. Each permit specifies exactly how much the source is allowed to emit. The permits are freely transferable; they can be bought or sold. The control authority issues exactly the number of permits needed to produce the desired emission level.[4] The largest example of this kind of system, and the most comprehensive trading program to date, is the U.S. acid rain program, in which allowances of $SO_2$ can be traded to comply with an emissions cap.

- Under a **baseline-and-credit system** (i.e., credit- or project-based trading) each participant is provided a baseline against which its performance is measured. If an action is taken to reduce emissions, the difference between the baseline and the actual emissions can be credited and traded.[5] The baseline established for crediting purposes can be fixed, based upon an absolute level of emissions; or dynamic, decreasing or increasing over time. The key distinction between a cap-and-trade system and a baseline-and-credit system is that in the former, regulated sources' emissions are required to achieve an emissions cap, which is a fixed quantity. Such a limit is not necessarily imposed in a baseline-and-credit system. The Clean Development Mechanism, for example, would operate as a baseline-and-credit system.

### Tradable Commodities

- An **allowance** is a government-sanctioned right to emit under a cap-and-trade system.

- A **credit** is a government-recognized right to emit under a baseline-and-credit system.

- A **permit** refers to both allowances and credits. Permits are issued by governments, authorizing a specific quantity of emissions.

- Permits are referred to as **compliance tools** in this paper. Permits are distinct from verified emissions reductions, the commodity most commonly transacted in today's market.

- **Verified Emissions Reductions (VERs)** are created, in the absence of government rules, by project-based activities that are defined by the buyer and seller and verified by a third party.

## II. Origins of Greenhouse Gas Trading

*The development of an international GHG trading system drew from a body of economic literature on the benefits of emissions trading, the Clean Air Act Amendments of 1990, and other more limited experiments with emissions markets.* This section provides an overview of the key policies and programs that have fostered the development of the GHG market.

### A. U.S. Clean Air Act Amendments of 1990

*The Clean Air Act and its amendments include several emissions trading provisions designed to minimize the cost of achieving air quality objectives.* These programs have demonstrated that allowing emissions sources to determine how best to comply with reduction requirements achieves environmental objectives at a lower cost than other regulatory approaches. $SO_2$ allowance trading under Title IV of the 1990 CAAA has been the most notable emissions trading success to date. It has achieved greater environmental benefits than required by law at a lower cost than had been estimated prior to the program's implementation.[6]

The program imposed a cap on $SO_2$ emissions from power plants. The level of allowable emissions was reduced in two phases. Sources could comply by installing technology, switching to fuels lower in sulfur content, purchasing allowances from other sources in the program, or engaging in other activities that would reduce $SO_2$ emissions.

### B. The United Nations Framework Convention on Climate Change

*Article 4(2)(a) of the United Nations Framework Convention on Climate Change (UNFCCC) includes a provision that allows Parties to achieve their commitments to reduce emissions "jointly with other Parties" through Joint Implementation (JI) activities.*[7] The UNFCCC JI provision seeks to encourage Annex I (developed) countries to participate in cooperative projects to reduce emissions of greenhouse gases in developing countries and countries with economies in transition while encouraging sustainable

development and the transfer of technology, capital, and services. The host country and investor would negotiate ownership of the reductions generated by such projects.

The JI provision of the UNFCCC represents a precursor to GHG emissions trading and, more specifically, to the two project-based mechanisms in the Kyoto Protocol. The JI provision under Article 6 of the Kyoto Protocol authorizes countries in Annex B of the Protocol (developed countries and countries with economies in transition) to engage in climate change mitigation projects to generate emissions reduction units (ERUs)[8] to meet their commitments. The Clean Development Mechanism (CDM), established by Article 12 of the Kyoto Protocol, allows developed countries to generate certified emissions reductions (CERs) by engaging in climate change mitigation projects in developing countries.[9]

## C. Project-Based Programs

*The current market in GHG emissions has evolved in concert with a series of project-based programs designed to gain experience and harness the power of markets to address the climate change issue cost-effectively.* Over time, these programs have evolved from pilot initiatives designed to provide practical experience for market participants and governments into mechanisms for achieving voluntary commitments, hedging risk, and complying with binding emissions limits. Each of these programs is governed by a unique set of rules. However, they exhibit some common elements that constitute a *de facto* (though non-binding) set of minimum quality criteria that govern the creation of credible emissions reductions. These programs and initiatives include the U.S. government's Initiative on Joint Implementation (USIJI); the pilot phase of international project-based emissions trading known as Activities Implemented Jointly (AIJ); Ontario, Canada's multi-stakeholder Pilot Emissions Reduction Trading program (PERT); Oregon's Climate Trust; the Dutch government's Emission Reduction Unit Procurement Tender (ERUPT); and the World Bank's Prototype Carbon Fund (PCF). See Appendix I for brief descriptions of these key programs.

### *Common Features of Project-Based Systems*

The following rules and procedures are common elements of project-based systems described in Appendix I. They provide a framework for buyers and sellers to engage in transactions.

- ***Baseline*** "Without project" emissions performance scenario (either static or dynamic).[10] Many

programs measure emissions reductions by comparing "with project" emissions performance against a credible counterfactual baseline.

- ***Environmental Additionality*** Linked closely to the preceding concept, environmental additionality requires that the emissions reductions achieved by the project would not have occurred in the absence of the project.

- ***Surplus*** Proof that emissions reductions were not a result of activities undertaken to comply with existing regulations. This criterion is directly linked to the establishment of baselines. To be credible, baselines should incorporate existing and planned regulatory requirements that have a direct or indirect impact on GHG emissions.

- ***Permanence*** Demonstration that the project's emissions reductions from sources or removals by sequestration will be durable over time.

- ***Leakage*** Evidence that the emissions reductions achieved at the project site do not lead to increases in emissions outside the boundaries of the project (i.e., emissions "leakage"), or that the calculation of claimed emissions reductions quantifies and accounts for leakage.

- ***Monitoring and Verification*** Opinion from a qualified third party that the proposed method for calculating emissions performance can be or has been audited to provide a credible quantitative assessment of actual project performance.

- ***Ownership*** Clear demonstration that the project proponent has a legitimate claim to ownership of reductions generated by the project and that other potential claimants are identified.

These attributes have also been used by market participants and service providers to evaluate project performance in jurisdictions where no particular project-based program has been formally adopted.

### *Differences in Project-Based Systems*

It is important to note that, despite their similarities, project-based programs also have significant differences that lead to different project approval and crediting outcomes within different programs.

***Baselines*** Various programs recognize different types of reference scenarios against which to measure the emissions reductions achieved by project. The use of different baselines creates divergent

quantification outcomes. For example, The Climate Trust requires the use of a dynamic baseline in which emissions are calculated against an emissions rate per unit of output instead of historical mass emissions (i.e., a static baseline). Another type of dynamic baseline is a technology benchmark, where the baseline emissions rate is reduced as technological performance improves. In the first dynamic baseline case, used by The Climate Trust, the project operator has certainty about what quantity of reductions will be achieved at any level of output. In the second technology-based case, project investors face greater uncertainty because the actual emissions rate against which reductions are credited is subject to change over time based upon the regulators' decisions regarding technological advances. In the USIJI program, several baseline techniques have been accepted. While this paper's purpose is not to critique the merits of different baseline approaches, it is important to note that the different approaches lead to different crediting levels.

***Additionality*** The Climate Trust, for example, adopts a stringent "financial" form of additionality, requiring demonstration that the project would not occur in the absence of revenues generated by the sale of offsets. The PCF, on the other hand, applies environmental additionality, but does not require that projects' economic viability depend on revenue from the sale of emissions reductions.

***Surplus*** PERT, for example, has accepted landfill gas (methane) emissions reductions from large U.S. landfills as surplus, even though the landfills are subject to regulations requiring the combustion of landfill gas as a means to control emissions of non-methane volatile organic compounds (VOCs). This acceptance was based on legal opinions provided to PERT which concluded that the destruction of methane from the landfill is surplus to regulation because the regulation addresses only non-methane VOCs. The PCF, on the other hand, will stop accepting reductions from a similar project in Latvia if it accedes to the European Union and becomes subject to similar landfill gas capture and flare requirements.

## D. Corporate Emissions Trading Systems

*In addition to formal project-based systems, individual companies have developed internal trading programs to achieve specified voluntary reduction commitments.* BP and Shell have pioneered these internal systems. Although designed differently, the BP and Shell systems have provided these firms with practical GHG-trading experience and have significantly advanced the dialogue on the benefits of emissions trading. Brief descriptions of these programs are provided in Appendix II.

## III. Market Characteristics

*Based upon the emissions reductions generated from the programs described above, a market for GHG reductions has been emerging since the mid-1990s.* Participants in this emerging market perceive several benefits from early GHG trading, but challenges associated with trading in the absence of clear rules have limited the growth of the market. This section of the paper explains why a market for GHG emissions is emerging and identifies elements of trades, trends in these elements, and the role of market service providers.

### A. Trader Motivations

*Among the policy instruments available to reduce GHG emissions, trading has emerged in recent years as particularly attractive to the business community.* Though few GHG-emitting companies currently face binding emissions limits, public concern and the potentially large future cost of complying with such limits have persuaded many business leaders of the need to take action while minimizing costs. In traditional emissions markets, establishment of formal programs by governments has preceded trading. Section 1 of this paper identifies a variety of pilot emissions trading programs that have provided a loose policy framework for early GHG transactions prior to the establishment of trading rules. Buyers' and sellers' motivations for participating in the nascent GHG market are discussed below.

#### *Buyers*

***Demonstrating Leadership*** Buyers believe that providing financial support for emissions-reducing activities within this emerging policy framework demonstrates leadership on an issue of public concern.

***Complying With Voluntary Corporate Commitments*** Several companies have made voluntary commitments to reduce their GHG emissions and have utilized the market as one policy instrument to achieve these commitments. Emissions reductions need not bear any government endorsement to contribute toward achievement of companies' voluntary emissions targets.

***Hedging Risk*** Many companies and governments believe that, despite present regulatory uncertainty, binding limitations will be imposed on GHG emissions in the future. To begin hedging risk associated with these potentially costly restrictions, some buyers participate in the market believing that current reductions are relatively inexpensive compared to likely future prices in a regulated emissions trading system. Thus, they purchase reductions hoping that governments will allow them to be used for compliance with future government emissions reduction requirements.

***Learning-by-Doing*** Few companies possess extensive experience with emissions trading. For buyers—as well as sellers—who have not previously participated in an emissions trading program, early GHG trading provides opportunities for learning-by-doing. For example, until they prepare to engage in a trade, few companies will have conducted an analysis of internal emissions abatement options to determine at what market price they ought to be a buyer or a seller of permits. Other educational aspects of trading include exploration of how to gain approval for emissions transactions through internal risk management procedures, how to contract for emissions reductions, and how to reflect the value of GHG assets and liabilities on company balance sheets.

***Informing Public Policy*** Practical experience accumulated through transactions can also help to inform public policy. Knowledge developed in the course of negotiating and implementing transactions helps to improve the design of trading programs under development. Firms that have engaged in transactions have a unique insight on trading that provides them with additional credibility when participating in the ongoing climate change policy development process.

Buyers in the market have included large oil and gas companies, electric utilities, and industrial firms that emit a significant volume of greenhouse gases and that anticipate future emissions limits. In particular, Canadian companies that have committed to achieve voluntary emissions reduction targets, such as Ontario Power Generation, TransAlta, Epcor, and Suncor, have purchased significant quantities of reductions to meet their commitments.[11] Additionally, the creation of Canadian exploratory trading programs such as PERT and the GHG Emission Reduction Trading Pilot (GERT) has familiarized Canadian companies with the concept of emissions trading. Similarly, the familiarity of U.S. companies with trading through participation in other emissions commodity markets may have facilitated their involvement in the GHG market.

A few European companies have participated in the GHG market, but not as many as one might expect given the European Union's support for binding emissions constraints. In light of European governments' leadership in pushing forward an international climate change treaty and the European Union's development of a trading program for its 15 member states, more European companies are likely to trade in the future.

Japanese companies, though cautious in the market's early stages, have recently demonstrated a growing interest in trading.

*Sellers*

Like buyers of GHG emissions reductions, sellers are interested in demonstrating leadership on the climate change issue, learning by doing, informing public policy, and shaping future trading rules.

Sellers are also motivated by the opportunity to generate a revenue stream from emissions reductions, a commodity that previously carried no value. In the future, project sponsors may also be able to lower their borrowing costs by improving the creditworthiness of projects through the additional revenue stream derived from GHG sales. These benefits can help to improve overall returns from emissions-reducing projects.

Early GHG sellers do not fit a common profile. They have ranged in size from large multinational energy companies with investment-grade credit ratings to small local landfill operators with no credit rating. In many cases, buyers have sought to acquire reductions generated within their home country. As a result, sellers have been particularly successful in countries with active buyers, such as Canada and the United States. As European demand for GHG reductions grows commensurate with its development of climate change policy, it is anticipated that additional supply will also be generated there.

## B. Key Attributes of Trades

*In the absence of government trading rules, GHG market participants have to define numerous attributes of their trades.* Each transaction is tailored to meet the needs of the individual participants in the trade. However, participants can rely to some extent on the procedures established by the project-based programs described in Appendix I. This section identifies key attributes of GHG trades and highlights some trends in those attributes that have emerged since the first GHG transactions in 1996-1997.

### *Emissions Commodity*

***Verified Emissions Reductions*** Few GHG trades have involved permits, since this term refers to government-issued environmental commodities such as allowances and credits. Rather, most GHG trades have involved verified emissions reductions (VERs). They are quantified reductions that bear most or all of the characteristics described in the discussion on common elements of trading systems in Section 1. Other buyer and seller requirements may also be incorporated into VER transactions.[12] Buyers hope that governments will allow some or all of their VERs to be applied against an emissions limit, should one ultimately be adopted.

***Emissions Reductions*** Emissions reductions (ERs) are the same as VERs except that they do not require third-party verification. However, verification adds credibility to reductions and presumably increases their likelihood of being recognized under future emissions trading rules. Thus, to hedge risk, ERs tend to be a less desirable commodity and are traded less frequently than VERs.

***Compliance Tools*** At the time of this writing, only the United Kingdom and Denmark have established formal emissions trading programs as a component of domestic climate change policies. The units traded within these systems can be utilized for compliance with domestic emissions limitations.

### *Units and Gases*

Almost all GHG trades of all commodity types are denominated in metric tons of $CO_2e$. Most, if not all, trades have involved reductions of $CO_2$ or methane since these gases are relatively easy to monitor and are significant contributors to climate change.

### *Vintage*

The year in which reductions are generated, or their vintage, is a key determinant of whether they will be eligible for recognition under future trading rules. Consequently, vintage has been a key feature of GHG trades. For example, reductions undertaken prior to 1990 hold no commercial value since 1990 is most frequently used as the base year for measuring emissions performance. By contrast, reductions that will be generated from 2008-2012 tend to be desirable because those years constitute the first commitment period specified in the Kyoto Protocol. It is assumed that if other eligibility criteria are met, reductions generated during those years will earn recognition as credits that could be used to

meet Parties' emissions-reduction requirements. Reductions generated during the period 2000-2008 are also valuable because, among other reasons, national governments may establish pre-Kyoto domestic trading systems and because certified emissions reductions generated in developing countries under the CDM during this period may be used for compliance in the first commitment period of the Kyoto Protocol. (See also *Price* below).

Reductions generated between 1990 and 2000 are somewhat less desirable, though not entirely without value, since some may be usable in domestic programs that precede an international agreement, or for achieving voluntary targets.

### *Geographic Location*

Like vintage, the geographic location of emissions-reducing projects will be a key element in determining their creditability. Moreover, unlike some other project attributes such as baseline and monitoring methodologies for which future rules are difficult to predict, location (linked with vintage) is an attribute for which policy is already clear enough to influence the value of reductions in the market.

At a general level, the first key distinction in geography is between developing and developed countries. Reductions achieved through emissions-reducing activities in non-Annex B countries between 2000 and 2008 are desirable because, under Article 12.10 of the Kyoto Protocol, they can be used for compliance in the first commitment period (2008-2012) if they meet specified criteria. In developed countries, it is presumed that only those reductions that will be generated during the first commitment period would be eligible for crediting under international trading rules and thus will hold similar commercial value. Reductions generated in developed countries prior to the first commitment period and after the baseline year 1990 are less valuable.

Canada has been a particularly common location among developed countries for emissions-reducing projects. Canadian companies have been among the most active buyers in the market, and they tend to have a preference for purchasing at least some of their reductions from local projects. Other reductions involved in early transactions have been or will be generated by a variety of projects mainly in Europe and the United States.

Only a handful of projects located in developing countries have resulted in successful emissions transactions. This is a result of several factors. First, projects located in developing countries have greater

perceived project risks, in addition to the policy risks inherent in GHG projects prior to the establishment of crediting rules. Also, few developing countries have established adequate institutions to review project proposals and to grant necessary host country approvals.

### *Ownership*

Government trading rules would presumably designate the entity that is entitled to claim ownership of project-generated emissions reductions. In the absence of such rules, it is essential for potential sellers to prove their ownership of the reductions that they would transfer to a buyer.

For many projects, ownership is not in question. These include, for example, efficiency upgrades at a manufacturing facility or fuel-switching at a power plant. However, for some project types, particularly those such as renewable energy and demand-side management projects that offset or displace fossil-fuel emissions, demonstrating ownership can be challenging and has been a barrier to more frequent sales from such projects. Ownership of the reductions is potentially open to dispute because the reductions do not occur on the site of the project, but rather on the site of a fossil-fueled facility whose power was displaced. These are known as indirect emissions reductions because the reductions occur at facilities other than the one where the project has been undertaken. The possibility that the direct source of emissions would claim title to the same reductions claimed by the project developer creates potential controversy that buyers prefer to avoid.

### *Tradable Instrument*

In most transactions, GHG market participants agree to exchange one of the emissions commodities described above. However, the authors estimate that between 25 and 50 percent of transactions to date have involved an exchange of financial derivatives such as "call options" based on VERs or other emissions commodities.

A buyer of a call option, which is simply a contract specifying certain responsibilities, acquires from a seller the right, but not the obligation, to purchase a fixed quantity of emissions at a fixed price (i.e., the "strike price") on or before a fixed date in the future (i.e., the "expiration date").[13] The buyer pays the seller of the call option to accept the corresponding responsibility to sell emissions reductions according to the agreed terms, if requested. The amount paid for the option is called the "premium."

Sellers are entitled to keep the premium even if the buyer fails to exercise the option. Call options offer buyers a relatively inexpensive way to hedge their exposure to future compliance costs.

Other derivatives include "put options," "collars," and "swaps." A put option entitles the buyer of the option the right to sell a commodity (from which the option is derived) at the strike price on or before the expiration date. The seller of the option is required to purchase the commodity at the agreed price if the buyer exercises the option. The premium is paid by the buyer to the seller at the time the initial transaction is closed.

Collars, or "fences," involve two transactions in which one party buys a call and sells a put (usually with different strike prices and the same expiration date), and the counterparty sells a call and buys a put. By setting a price floor and ceiling, each position will provide protection against market movement. Swaps are transactions in which one type of commodity is exchanged for another, rather than for cash. In emissions trading, there often are tax benefits to swaps as some tax authorities consider them to be nontaxable "like-kind exchanges."

Forward stream transactions are also possible. In this sort of transaction, a buyer acquires promised reductions of consecutive vintages. For example, a buyer might acquire rights to 10,000 tons per year during 2005-2007. In some instances, payment for such streams is provided "on delivery," meaning once rights to the reductions have been transferred to the buyer. In other instances, buyers pay now for reductions to be delivered later. This allows project developers to finance a portion of their emissions reducing projects at the present time by generating immediate revenue through the sale of future emissions reductions. However, it should be noted that seller creditworthiness and liability become important issues in any forward transaction where revenue is paid prior to receipt of the commodity in question. (These issues are discussed below.)

### *Reduction Activity*

***Nuclear Power*** It is possible that some activities that reduce GHG emissions will not be eligible to earn GHG credits. For example, governments may be reluctant to grant credits for reductions generated by nuclear power generation. (The Parties at COP 6-bis[14] in Bonn and at COP-7 in Marrakech agreed that they should "refrain from using" ERUs and CERs "generated from nuclear facilities" to meet their commitments under the Kyoto Protocol for the first commitment period.[15])

***Sequestration*** At the inception of the GHG market, sequestration projects were popular among buyers. Offsets from such projects were perceived as cheap to generate on a per-ton basis, and they provided an economic rationale for protecting forests, which provide additional environmental benefits. Over the past several years, uncertainty regarding sequestration's future treatment in an international agreement has diminished the commercial value of sequestration activities. However, the inclusion in the Bonn agreement and the Marrakech accords of rules regarding the acceptability of sequestration activities will likely revive these projects' attractiveness.

***Renewable Energy and Demand-Side Management*** As indicated above, sales of reductions generated by renewable energy and demand-side management projects sometimes face ownership concerns because the reductions are indirect, meaning that they result from displacement of emissions somewhere other than the project site itself. Multiple potential claimants, such as the owner of the emitting source, technology vendors, and the entity installing the technology, might attempt to claim ownership of these reductions. In addition, quantification of these reductions can be difficult because it requires access to data on emissions resulting from generation of grid-supplied electricity, such as the emissions characteristics of the electric generating units being displaced by the renewable energy or demand-side management investments. Determining displaced emissions from such activities is particularly difficult in increasingly interconnected and restructured electricity markets that are not controlled by a single dispatch authority. Even with access to these data, potential sellers must choose whether to calculate their offset claims through comparison to a grid's annual average emissions rate per unit of energy, or to a baseline that accounts for seasonal and/or intra-day variations in emissions. Governments have not indicated what degree of detail will be adequate for certification, or if such indirect reductions can even be credited.

***Fuel Switching, Production Energy Efficiency, and Fugitive Gas Capture*** Switching to less carbon-intensive fuels, improving the efficiency of production processes, and capturing fugitive gases from landfills, pipelines, mines, and other sources have been popular activities because they generate real, easily quantified emissions reductions as compared to other activities. Many, if not the majority, of transactions in the last two years have been generated by these activities.

### *Liability Provisions*

In a market fraught with many uncertainties, buyers have regarded it as particularly important to specify in contracts what recourse they would have if sellers fail to fulfill their obligations. Should the

seller's project fail to generate the specified number of purchased reductions, or should the reductions be ineligible for crediting in future programs, buyers would prefer that the seller commit to deliver alternative reductions that could be used for compliance. However, few if any sellers have been willing to undertake such a strong commitment since they would be exposed to the variable and potentially high cost of producing or acquiring approved compliance tools in the market. Instead, sellers typically agree that they may supply alternative reductions or may instead return some, or all, of the sale proceeds to the buyer, possibly with a specified financial penalty. Sellers may be able to claim a higher price per metric ton of reduction in return for accepting greater liability.

### *Seller Creditworthiness*

In transactions involving future delivery of emissions reductions, the creditworthiness of the seller has played an important role in negotiations by serving as a proxy for the sellers' ability to perform its contractual obligations. Buyers are more willing to purchase future reductions from a financially sound seller than from a smaller, less viable company. This is because a company with good credit will typically have an easier time mobilizing the resources necessary to fulfill its contractual obligations in case reductions generated by its own projects are fewer than expected, or if they fail to meet certification requirements. Many buyers in the market to date have chosen only to transact with companies of investment grade rating (~BBB) or higher.

In some cases, strong seller creditworthiness has diminished the importance of other reduction qualities such as the accuracy of the baseline, adequacy of monitoring, and demonstration of ownership. Buyers presume that if they acquire reductions for which any of these qualities are shown in the future to be inadequate, a creditworthy seller will have little difficulty acquiring substitute reductions of adequate quality.

Creditworthiness is relatively unimportant for transactions involving VERs for immediate settlement. Since the VERs would carry no guarantee of future creditability, the seller would have fulfilled its contractual obligations once the VERs are generated, verified, and delivered. In these cases there is little need for strong creditworthiness as protection against nonperformance.

### *Baselines and Monitoring*

Buyers prefer reductions measured against a well-documented, reproducible baseline, supported by a clearly documented audit trail, and monitored with an accurate, robust methodology. However, as

indicated above, from a market perspective, the importance of these attributes is often superseded by that of creditworthiness, since this is the means by which buyers ascertain sellers' ability to fulfill contractual commitments. These commitments usually include an obligation to deliver a specified quantity of reductions that meet future certification criteria, including baseline and monitoring methodologies, whatever these may eventually be. So the particular methodologies adopted by sellers at the time of sale are less significant than their commitment to adhere to future methodologies.

### *Host Country Approval*

Under future rules governing project approvals and emissions trading across national borders, the consent of both participating countries will be a prerequisite for official recognition of projects or individual trades. Buyers seeking to prepare for the onset of binding emissions limits have sought to obtain host country approval for trades, when possible. Most project-based systems require such approval.

Host country support has been particularly important for CDM-style projects due to the varying levels of support among developing-country governments for emissions trading and project-based investments. Because few developing country governments have yet established a CDM office with authority to approve or reject projects, acquiring explicit CDM host country approval has been difficult. For buyers motivated by voluntary commitments rather than future compliance, host country approval is unnecessary. However, host country approval will be required under the Kyoto Protocol, should it enter into force.

### *Volume*

According to the authors' research, approximately 65 significant GHG transactions have occurred worldwide since 1996, resulting in the exchange of between 50 and 70 million metric tons of $CO_2e$. However, for several reasons this figure probably understates the actual level of market activity. First, this figure reflects a fairly narrow definition of "trades" that excludes strategic investments that produce emissions reductions but which may not be intended for immediate transfer to another party. Also, some companies choose not to publicize their trades, so these are not reported. Additionally, this figure excludes trades within BP's and Shell's internal trading systems. Small trades involving less than 1,000 metric tons of $CO_2e$ are also excluded.

*Price*

***Verified Emissions Reductions*** VERs have traded for between $.60 and $3.50 per metric ton of $CO_2e$ since the market's first trades in 1996-1997 (see Table 1). Fluctuations in price over time are more likely attributable to differences in the features of individual transactions than to fundamental changes in supply and demand for a given commodity.

Within the category of VERs, prices are segmented by location and vintage since these are key determinants of whether reductions will be eligible for credit or usable for compliance in the future. As indicated above, developed country reductions generated during 2008-2012 and developing country reductions generated after 2000 are both expected to be eligible for credit under the Kyoto Protocol, should it enter into force. Market prices for these commodities reflect this expectation, ranging from $1.65 to $3.00 per metric ton of $CO_2e$. Developed country reductions generated prior to the first Kyoto commitment period and after 1990 have ranged from $.60 to $1.50 per metric ton of $CO_2e$. The authors are not aware of any transactions for developing country reductions generated prior to 2000.

***Emissions Reductions*** Compared to VERs, relatively few ERs have been traded. Buyers probably prefer VERs because they anticipate that verification will be required in order to earn government-recognized permits in the future. Despite this lesser demand for ERs, they are not necessarily cheaper than VERs. Although such reductions incur no verification costs, other required qualities may raise their costs to parity with VERs. For example, ERs purchased by The Climate Trust must be "financially additional," meaning that their projects would not have been financially feasible but for the revenues generated by sale of the GHG emissions reductions. (While project developers pay $0.85 per ton of $CO_2$ to The Climate Trust, The Climate Trust may pay more on a per ton basis to the sponsor of the $CO_2$ mitigation project.) This requirement narrows the pool of potential sellers and, in so doing, excludes some that might have offered cheap reductions.

***Compliance Tools*** In September 2001, DuPont and the Marubeni Corporation conducted the first trade to take place within a formal government program. Dupont sold 10,000 2002-vintage UK allowances to Marubeni on a forward basis. More recently, several transactions have occurred in the Danish system. In one of these, Entergy, a U.S.-based electric utility, purchased 10,000 metric tons of $CO_2$ from Elsam, a Danish utility.[16]

As potential market participants grow more comfortable with the UK and Danish programs, trades of compliance tools will become more common. Prices paid for compliance tools will be higher than those paid for VERs and ERs because they can be utilized for compliance with a government emissions limitation. Other bids to buy and offers to sell in domestic allowance markets suggest that prices for compliance tools will be several dollars higher than those for other commodities currently being transacted in the pre-compliance market. For example, early indications in the UK market suggest a mid-market price of approximately $7 per metric ton of $CO_2e$. Prices in the Danish market will be capped by a noncompliance penalty of approximately $5 per metric ton of $CO_2$ of excess emissions, with current bids and offers suggesting a price of about $3 to $4. Dutch ERUs must be considered VERs at this time; however, they would become compliance tools if they met JI criteria under Kyoto Protocol rules, should the Protocol enter into force. Prices of the contracted reductions from the first round of the Dutch ERUPT program are higher than other VERs because they have already received government approval. The prices are also higher because of unique contracting and procurement procedures.

***Table 1***

**Greenhouse Gas Prices** by Commodity Type, Vintage

| Commodity Type | Vintage Year | Price per ton $CO_2e$ (US$) |
|---|---|---|
| **VERs (historic prices)** | | |
| Annex B VERs | 1991-2007 | $.60-$1.50 |
| Annex B VERs | 2008-2012 | $1.65-$3.00 |
| CDM VERs | 2000-2001 | $1.15-$3.50 |
| Dutch ERUs | 2008-2012 | $4.40-$7.99 |
| **Compliance Tools** | | |
| Danish allowances | 2001 | $2.86-$4.17 |
| Danish allowances – Bid/Offer | 2002 | $2.14-$3.60 |
| UK allowances – Bid/Offer | 2002 | $5.76-$9.36 |

NOTE: Table updated January 22, 2002.

## C. Roles of Service Providers

*In addition to buyers and sellers, other entities such as brokers and auditors have played important roles in the emerging GHG market.*

### *Brokers*

Brokers maintain contacts with a broad range of market participants in order to match suitable buyers and sellers, or "counterparties." They seek to reduce transaction costs by eliminating search costs for participants to seek out counterparties directly. Beyond this traditional brokerage function, GHG brokers have played an important role in the pre-compliance market by generating new supply and demand and in educating potential market participants about the costs, benefits, and mechanics of trading. Other functions brokers play in the emerging GHG market include:

- ***Price Discovery:*** By facilitating transactions, brokers find and publicize the price at which transactions occur. In the emerging GHG market, this price is dependent on the commercial terms and size of the transaction. Price discovery is not as simple as reporting the price of a standardized commodity.

- ***Develop Transaction Structures:*** Brokers help counterparties by developing unique transaction structures that meet the individual needs of buyer and sellers.

A sample term sheet for an offer of GHG reductions is located in Appendix III.

### *Project Development Consultants*

The role of project development consultants is similar to that of brokers, but is focused more on the supply side of the market. These consultants assist developers of GHG-reducing projects to undertake steps such as quantification and monitoring that may lead to a successful sale of reductions. They may also help to market the reductions once they have been prepared for sale.

### *Auditors*

Engineering, accounting, certification, and consulting firms as well as environmental NGOs that provide validation (ex ante audit) and verification (ex post audit) services provide assurance that the emissions reductions meet a minimum quality standard. So far, providing this assurance has involved activities such as: (1) analyzing the plausibility of baseline assumptions; (2) ensuring the accuracy of data used to calculate baselines and actual emissions; (3) ensuring the accuracy of emissions reduction calculations; (4) ascertaining the adequacy of monitoring methodologies; and (5) assessing ancillary project benefits. However, the standards used to conduct these analyses have, to date, been determined mainly by the service providers themselves, along with the demands of buyers. Both draw on criteria of existing project-based programs.

Several NGOs and companies are currently leading projects to develop more rigorous and uniform reporting standards by which to perform verification.[17] For the most part, governments have not yet specified standards for conducting verification of reported emissions reductions. The Dutch ERUPT program and World Bank's PCF are exceptions, as they have issued specific verification criteria and recommended several firms that are qualified to assess projects' adherence to those criteria.

### *Financial Institutions*

Financial institutions like banks and insurance companies perform basic functions such as financing and risk management. Products and services provided by these institutions may include project financing, classical insurance solutions, alternative risk transfer, derivatives, carbon investment funds, corporate equity analysis, and financial advisory services.[18] Several European financial institutions are already designing new financial products and services targeted at the needs of corporate clients that wish to take advantage of GHG emissions trading and project-based mechanisms.

Specifically, carbon investment funds are promising instruments for diversifying risks associated with investments in GHG abatement projects that aim to generate marketable emissions reductions and permits.[19] In contrast, at present there is limited scope for managing specific GHG market risks through classical insurance mechanisms due to the fact that many risks are political in nature and therefore difficult to insure.[20] In conventional project financing, it may be beneficial for both the project sponsor and the lender to take advantage of GHG emissions trading, JI, and the CDM when structuring new energy projects.[21]

## D. Case Studies

*The following case studies help to illustrate the conclusions summarized above by describing the terms of real GHG trades, motivations of participants, challenges encountered, and lessons learned.* The case studies demonstrate exactly how and why a GHG emissions trading market is emerging. They also demonstrate the challenges of trading in the absence of clear rules. This situation has made it difficult to consummate trades, increased transaction costs, and inhibited the development of a more robust market.

### *TransAlta – HEW: A Hint of Things to Come*

TransAlta, Canada's largest non-regulated electricity generation company and second-largest single GHG emitter, plans to reduce net emissions of greenhouse gases from its Canadian operations to zero by 2024.[22] However, it did not commit to eliminate fossil fuels from its generation portfolio. Rather, the company has sought to demonstrate that, through a combination of efficiency improvements, technology development, and emissions offset trading, this aggressive target could be met without large increases in the price of electricity.[23] In pursuing its target, TransAlta has established a reputation as one of the most active participants in the emerging market for GHG reductions. While playing this pioneering role, the company has been involved in a number of "firsts," including its purchase of reductions from a German utility, Hamburgische Electricitäts-Werke AG (HEW). This is thought to be the world's first trans-Atlantic GHG trade.

By 1999, TransAlta had already engaged in a handful of GHG emissions purchases, both on its own and as a member of the Greenhouse Emissions Management Consortium (GEMCo), a not-for-profit Canadian corporation formed by companies seeking to "demonstrate industry leadership in developing voluntary and market-based approaches to GHG emissions management."[24] Having purchased most of its reductions from projects located in North America, TransAlta decided to engage in a more challenging trade for reductions generated by a project in Europe.

At roughly the same time, Dr. Helmuth Groscurth, head of the Energy Concept Future group at HEW, the municipal utility of Hamburg, Germany, attended a conference in Stuttgart where he heard a presentation about the emergence of the market for GHG emissions reductions. Afterwards, Dr. Groscurth approached the emissions broker who had delivered the presentation to inquire whether HEW's planned

installation of wind turbines near Hamburg might be capable of generating marketable GHG reductions. Recognizing that such reductions might meet TransAlta's needs, the broker soon initiated negotiations between the two parties that culminated with the public announcement of a successful transaction in June 2000.[25] The trade took three months to complete. It did not receive formal recognition from Canadian provincial and federal governments.

TransAlta agreed to purchase a total of 24,000 metric tons of $CO_2e$ verified emissions reductions (3,000 metric tons per year generated from 2000 through 2007). HEW would generate the reductions by displacing its own fossil-fueled generation with wind power during periods of high demand. The electricity generated by wind would allow HEW to maintain the same average level of output with reduced emissions. The companies agreed that a German standards company, TUV Management Service GmbH, would be engaged at the seller's expense to verify that the reductions had been generated as promised. HEW's first verification and monitoring report, which covers reductions generated during the year 2000, includes a description of the project's baseline and monitoring methodologies. It will be supplemented annually with an appendix containing new data for calculating the previous year's reductions. The report for 2000 has been approved by TUV.

Both companies agreed that the price of reductions was not a critical issue in their negotiations.[26] This agreement reflects the fact that both parties were motivated primarily by the desire to demonstrate publicly the viability of emissions trading and to gain experience with trading. According to Bob Page, TransAlta's vice-president of sustainable development, the deal was "part of TransAlta's ongoing commitment to reduce our net GHG emissions and lead the way in proving that market-based mechanisms such as offsets and emissions reduction trading really work."[27] Given the relatively small volume of the transaction, the amount of money involved was considered to be of secondary importance. In fact, Dr. Groscurth stated that the costs associated with completing the transaction, including fees for lawyers involved in drafting a contract and technical experts that assembled relevant data and calculated the reductions, exceeded the revenue that HEW received from the sale. Dr. Groscurth explained that these costs were particularly high since it was the company's first trade, but noted that the resulting experience has substantially reduced the costs of subsequent transactions.

For HEW, the most costly aspects of completing the trade were also the most challenging. Though there was support for the concept of emissions trading throughout the company, lawyers took significant time to ensure that the contract consummating the transaction provided HEW with adequate protection against any unforeseen outcomes. HEW also had to develop an adequate baseline methodology to calculate the project's reductions. The company had several options from which to select. In the absence of any government rules on this matter, the buyer and the verifier acted as the ultimate arbiters of the baseline's adequacy.

In TransAlta's view, one of the key factors that made the deal possible was the fact that HEW owned not only the new wind assets but also the fossil fuel units whose emissions would be displaced. According to Paul Godman, manager of sales and marketing in Transalta's GHG offset management operation, the company had reservations about purchasing reductions from renewable energy projects in which the owner of the project did not also own the fossil units, as the ownership and quantification of such reductions are often difficult to determine.[28] Mr. Godman added that HEW's strong financial standing provided assurance that it would be capable of fulfilling its obligations in the trade, which extend several years into the future.

Both companies agreed that their positive experience encouraged them to engage in other trades. After completing its sale to TransAlta, HEW purchased reductions in order to gain experience on the "buy-side" of a transaction. TransAlta has also been both a seller and a buyer and is expanding its GHG trading operation even further to develop partnerships with companies that may seek to benefit from its expertise in the market. Through its new Carbon Market Initiative, TransAlta will offer to sell a portion of reductions in its existing portfolio, which have already been subjected to the company's internal quality assessment procedures. With these and other GHG trading initiatives, both companies hope to take advantage of growing opportunities in the emerging GHG market.

### *PG&E—Ontario Power Generation: The Value of Third-Party Review Processes*

Participation in the GHG market has been mostly voluntary to date. It is clear that market participants perceive some benefits from engaging in pre-compliance transactions. However, in the absence of clear rules governing trading, one should not overlook the practical challenges of realizing these benefits. Completing a pre-compliance GHG trade requires market participants to negotiate

not only the traditional commercial conditions of any emissions transaction, such as price, quantity, and vintage, but also a host of other issues that would not arise in a market created through formal government rules. As the following trade between Ontario Power Generation (OPG), also a member of GEMCo, and US Gen New England (US Gen), a subsidiary of the U.S.-based PG&E National Energy Group, illustrates, resolving these issues often requires a significant investment of time and effort.

OPG, a major Ontario-based electricity generator, has been a pioneer in the area of emissions trading and is one of the most active buyers and sellers in the current GHG market. OPG met its voluntary year-2000 target to stabilize net GHG emissions at 1990 levels by taking actions to improve internal energy efficiency, expanding green power initiatives, and offsetting a significant share of its GHG emissions through the purchase of $CO_2e$ emissions reduction credits from North American and international sources.[29] According to Dave Coates, who manages OPG's GHG emissions portfolio, much of the company's activity in the GHG market has been driven by this commitment.

OPG has successfully completed trades both with and without the assistance of emissions brokers. The trade described in this case study was completed with the services of an emissions broker. In 1999, through a broker, US Gen offered to sell OPG up to one million metric tons of $CO_2e$ emissions reductions generated by capturing and destroying methane that would otherwise be emitted from the Johnston Landfill in Rhode Island from 1998-2000.[30]

US Gen's offer appeared to meet OPG's criteria for emissions reductions. To help ensure that purchased emissions reduction credits are recognized against OPG's voluntary commitment, OPG has committed to have all of its purchases scrutinized by Ontario's PERT program (described in Appendix I). OPG sees this verification as a vital aspect of ensuring a transparent and publicly available record of all discussions relating to the creation of emissions reduction credits. Following PERT's quality assessment, the credits are registered with PERT. OPG annually reports its GHG emissions to Canada's Climate Change Voluntary Challenge and Registry (VCR) Inc. In 2001, the credits used to meet OPG's 2000 target were transferred to the VCR for retirement.

Dan Chartier, emissions marketing manager at PG&E (who negotiated the trade on US Gen's behalf), indicated that his company's main interests in conducting a GHG trade were to gain practical experience with trading and to generate revenue. PG&E has been an active participant in other emissions markets in the United States, but recognized that GHG trading would involve a unique set of challenges. In particular, navigating the PERT process turned out to be more troublesome and required more time than PG&E had expected. According to Mr. Chartier, the absence of formal operating procedures and timelines for decision-making in the PERT process caused delays. Participants in the evaluation process were free to bring up any issue relating to the PERT mandatory criteria that reductions be real, quantifiable, verifiable, surplus, and unique. However, at that time there were no formal procedures governing time limits for decision-making and no final arbiter to determine if a seller had met specific criteria.

Following the PERT process and the negotiation of the contract, the trade was eventually consummated in April 2000, roughly a year after the transaction was initiated. Both companies expressed satisfaction with completion of the trade. However, their experience demonstrates that, without clearly defined rules, the costs of conducting GHG emissions transactions may be high even in instances where the reductions themselves are attractively priced and technically credible.

The following table presents examples of actual transactions and emissions-reducing activities in the GHG market.

***Table 2***

## Examples of Actual Transactions, Projects, and Participants in the Greenhouse Gas Market

| Reduction Activity | Buyer (Buyer Country) | Seller (Project Developer or Host Country) | Date | Total Quantity (metric tons $CO_2e$) |
|---|---|---|---|---|
| **Agriculture** | Industrial consortium (Canada) | Insurance company (United States) | 1999 | 2,300,000 |
| | Electric utility (Australia) | State agency (Australia) | 1998 | 198,018 |
| **Energy Efficiency** | National government (Netherlands) | Electric utility (Romania) | 2001 | 1,536,140 |
| | Electric utility (Canada) | Hospital network (Canada) | 1999 | 34,437 |
| | Electric utility (Canada) | Electric utility (United States) | 1998 | 10,000,000 |
| | Environmental student group (United States) | Energy company (North America) | 1998 | 10,000 (Other reduction activities were included in the transaction.) |
| **Fuel Switching** | Electric utility (Canada) | Electric utility (Finland) | 2000 | 50,000 |
| **Fugitive Gas Capture and/or Use** | Energy company (North America) | Energy company (Asia) | 2001 | 460,000 |
| | Energy company (North America) | Energy company (North America) | 2000 | 650,000 |
| | Electric utility developer (United States) | Landfill gas sequestration project (Canada) | 2000 | 309,664 |
| | Electric utility (Canada) | Landfill gas sequestration project developer (United States) | 1999 | 2,500,000 |
| | Energy company (North America) | Energy company (North America) | 1999 | 260,000 |
| | Energy company (North America) | Energy company (North America) | 1999 | 250,000 |
| | Electric utility (Canada) | Electric utility (Canada) | 1999 | 80,894 |
| | Industrial consortium developer (Canada) | Landfill gas sequestration project (Canada) | 1998 | 210,000 |
| | Electric utility (Canada) | Heavy equipment manufacturer (Canada) | N/A | 367,500 |
| **Renewable Energy** | National government (Netherlands) | Electric utility (Romania) | 2001 | 612,631 |
| | National government (Netherlands) | Electric utility (Poland) | 2001 | 583,500 |
| | Manufacturing conglomerate (Japan) | Electric utility (Australia) | 2001 | 2,000 |
| | National government (Canada) | Electric utility (Canada) | 2000 | 31,104 |
| | Electric utility (Canada) | Electric utility (Germany) | 2000 | 24,000 |
| | Electric utility (Canada) | Pulp and paper company (United States) | 1999 | 89,912 |
| | Electric utility (Canada) | Renewable energy developers (United States) | 1999 | 75,000 |
| | Electric utility (Canada) | Electric utility (Canada) | 1999 | 20,000 |
| | Industrial consortium (Canada) | Insurance company (United States) | 1999 | 2,300,000 |

NOTE: Table based on Natsource research. The table presents examples of actual transactions. The names of participants involved in the trades are confidential and are withheld here. Reported volumes include transactions for emissions reductions as well as options for future purchases of emissions reductions. For further discussion of this distinction, see Section 2.B of this paper.

## IV. Future Outlook

*This section assesses the future direction of the GHG market.* It begins by considering the role of an international climate change treaty in facilitating the development of domestic policy and the GHG market. It then briefly describes a state-level system in the United States, two national-level trading systems being developed in Europe, and a supranational program being developed by the European Union, assessing how concurrent international, national, and sub-national policymaking will affect the continued evolution of the GHG market in the near-term. Next, it examines private-sector and nongovernmental efforts designed to gain experience with trading in the context of continuing policy and regulatory uncertainty. Building on recent progress in international negotiations, the section also suggests the actions necessary to create a more robust market in the longer term. Finally, it returns to the issue of an international agreement by considering possible scenarios for U.S. participation in an international system and the implications of U.S. participation for U.S. and non-U.S. firms, the economy, and the environment.

### A. Role of an International Agreement

*Most countries have supported a multilateral response to global climate change for more than a decade.* This is in recognition of the global nature of the problem and of the fact that unilateral adoption of national emissions limits could threaten economic competitiveness. Efforts to develop a multilateral response began in the late 1980s with preparations for a framework convention on climate change. Adopted at Rio de Janeiro in 1992, the UNFCCC established a non-binding goal for industrialized countries of returning to 1990 GHG emissions levels by the year 2000 and an objective for the world to stabilize atmospheric concentrations of greenhouse gases at a level that would prevent dangerous anthropogenic interference with the climate system. A 1995 review of Parties' progress concluded that the UNFCCC's nonbinding emissions target would not lead to achievement of the Convention's objectives. In response, Parties agreed to pursue a complementary agreement that would establish quantified emissions limitations and reduction objectives for developed countries. This culmi-

nated in the negotiation of the Kyoto Protocol in December 1997. The process to develop rules, mechanisms, and institutions to bring the Protocol into force has continued through the present, including recent negotiations in Marrakech, Morocco, in November 2001.

The Kyoto Protocol does not specify the policies and measures individual countries should implement to achieve their emissions limitation. Rather, it provides Parties the flexibility to comply with their commitments in the way they deem most appropriate to their national circumstances and policy traditions. Parties will undoubtedly implement a mix of policy instruments to achieve their commitments, including taxes, standards and regulatory measures, and voluntary agreements with industry. Many countries will also establish domestic trading systems in order to reduce the costs of achieving their emissions limitation incorporated in the Protocol. Compliance at the lowest possible cost would be realized by harmonizing domestic trading systems in order to facilitate international trades.

Several Parties have initiated their policy development processes prior to the completion of the Protocol. Their task in developing a domestic system and potentially harmonizing it with other systems has been complicated by the lack of a clear international policy framework. As a result, the programs becoming operational have important differences. Whereas some of these differences are inevitable due to each government's policymaking traditions and national circumstances, they could have been minimized if greater clarity existed at the international level. This would have fostered the development of compatible domestic systems and a market that achieves the Protocol's economic and environmental objectives at the lowest possible cost.

Disputes over the Kyoto Protocol in recent years have cast doubt on when it or another agreement would enter into force. This has significantly diminished the plausibility of the scenario described above. However, the progress made at COP-6bis and COP-7 has greatly increased the potential of achieving a clear and binding international policy framework over the longer term.

## B. Trading Programs Under Development

*In spite of the uncertainty that has characterized international climate change negotiations, several governments have initiated the development of domestic GHG emissions trading systems.*[31] This section provides brief descriptions of a sub-national system being developed in the United States and national and regional trading

programs being developed in Europe. It illustrates that, in the absence of a binding international treaty with clear rules to which domestic systems could conform, trading rules in evolving domestic systems differ substantially. Detailed descriptions of the Massachusetts, Danish, and UK programs are provided in Appendix IV.

### *Massachusetts*

Massachusetts recently became the first U.S. state to impose $CO_2$ emissions limits on existing fossil-fired power plants, which have historically been subject to less stringent emissions reduction requirements than new plants under the Clean Air Act. The new law imposes limits on four kinds of air emissions ($SO_2$, $NO_X$, mercury, and $CO_2$) from six power plants in the state. The $CO_2$ reduction requirement can be met either through internal actions, such as repowering from coal to natural gas, or through the purchase of offsets from emissions reduction projects. Specific rules for crediting offsets have not yet been developed, but the state has indicated that offsets will have to be real, surplus, verifiable, permanent, and enforceable in order to be creditable against the emissions reduction requirement.

### *Denmark*

In 1999, Denmark introduced $CO_2$ emissions trading under the $CO_2$ Quota Act, which imposed a first-of-its-kind cap on power-sector $CO_2$ emissions. It established a total emissions quota for electricity producers of 23 million metric tons of $CO_2$ in 2000. The cap will be reduced by 1 million metric tons per year through 2003, when it will reach a target level of 20 million metric tons. In order to engage in transactions, market participants must notify the Danish Energy Agency (DEA) whenever they wish to transfer allowances to another participant. If an electricity producer's annual emissions exceed its holding of allowances, it is subject to a penalty of 40 Danish kroner (about U.S.$5-6) per metric ton of excess emissions. The revenue derived from penalties for noncompliance is directed toward energy-saving projects. The government set a relatively low penalty so as not to disadvantage its power sector against neighboring countries, which have not imposed similar emissions reduction requirements on their electricity producers.

### *United Kingdom*

The United Kingdom was the first industrialized country to develop a broad-based GHG emissions trading program. The UK government published the final framework for its national trading program on

August 14, 2001. While the trading program officially begins in April 2002, forward transactions of permits have already taken place. UK entities may participate in the voluntary trading program through four paths:

(1) by signing a climate change agreement with the government, which could lead to an 80 percent discount for companies subject to a domestic energy tax known as the climate change levy (CCL);

(2) through direct entry, giving companies access to financial incentives;

(3) by generating project credits through emissions reduction activities that could be sold into the trading system; and

(4) through purely voluntary participation in the system.

The first compliance period for companies participating via direct entry will run from January 1, 2002, to December 31, 2002, with subsequent year-long compliance periods starting January 1, 2003, and running through 2006. The first two-year compliance period for companies entering via agreements began on January 1, 2002.

The UK system is complex, with distinct absolute (sources agreeing to emissions caps in exchange for the discount on the CCL) and unit (sources agreeing to rate-based emissions limitations in exchange for the discount on the CCL) sectors. The unit sector has limited ability to trade with the absolute sector, which could reduce market liquidity.

*European Union*

In preparation for ratification of the Kyoto Protocol and to ensure the compatibility of member states' domestic trading programs, on October 23, 2001, the European Commission issued a proposal for a directive that would establish a mandatory EU-wide $CO_2$ emissions trading system.[32] The directive proposes two phases for the program: a preliminary phase from 2005 to 2007 for member states to gain experience with trading, and a 2008-2012 phase mirroring the first commitment period of the Kyoto Protocol.

The EU trading program would initially cover only $CO_2$ emissions, which account for approximately 80 percent of the European Union's total 1999 GHG emissions. The Commission may consider the coverage of other greenhouse gases, as monitoring issues are resolved. The emitting sectors covered by the program include energy combustion installations with a rated thermal input exceeding 20 MW, oil

refineries, coke ovens, metal production and processing, and producers of cement, glass, ceramics, and paper products. These sectors account for approximately 46 percent of projected $CO_2$ emissions in the European Union in 2010, and include 4,000 to 5,000 installations. Inclusion of additional sectors and activities in the program may also be considered at a later date. The directive sets forth monitoring, reporting, tracking, and verification criteria for $CO_2$ emissions that member states would have to meet.

In the initial three years of the program, the EU directive would mandate that member states allocate allowances to affected sources on a grandfathered basis (i.e., based on historical emissions). By June 30, 2006, the Commission will review experiences with the initial allocation method and attempt to establish a harmonized allocation for the first Kyoto commitment period and beyond. In the 2005-2007 period, member states must ensure that their national allocation plans conform to (i.e., enable compliance with) the EU allocation.

The proposed EU directive would allow for unrestricted banking of allowances from one year to the next during the 2005-2007 phase and within the subsequent five-year compliance period. Member states decide whether to allow for banking between the period ending in 2007 and beginning in 2008. The proposal requires that they allow for banking from one five-year period to the next after the first five-year period.

The financial penalty for noncompliance during the 2005-2007 period would be the higher of 50 per excess ton or twice the average price during a predetermined period. For the 2008-2012 compliance period, the penalty would increase to the higher of 100 per excess ton or twice the average market price. In both compliance periods, the operator of the noncompliant installation would still be obligated after payment of the penalty to surrender an amount of allowances in the following year equal to the amount of its emissions overage.

In order to enter into force, the proposed directive must first be approved by member states' environment ministers in the European Council and then by the European Parliament. If the Parliament and Council approve the proposal, it must then be considered and approved by each of the member states' governments and implemented through national legislation.

It is unclear how the already existing UK and Danish programs would be integrated into the EU system. It appears that many elements of the Danish system, which has been approved by the European

Commission, are likely to be compatible with the EU system. However, the compliance provisions appear to be in conflict with the system envisioned by the European Union. Since it will end in 2003, it could be redesigned in a manner consistent with the EU system. By contrast, there appear to be greater tensions between the European Union and United Kingdom on the matter of compatibility. The UK system diverges from the EU system in several important ways, such as sectors and gases covered. Significantly, participation in the UK program is voluntary, while it would be mandatory in the EU program. At COP-7, the EU Environment Commissioner Margot Wallström stated, "By 2005 they (the United Kingdom) will have to adapt to our EU-wide system."[33] On November 28, 2001, an official from the European Commission warned that the incompatibility of the systems "could create market distortions in the future" and that the UK system would require modification to ensure a smooth transition to the EU program.[34]

## C. Impacts of Concurrent Policy and Market Development

*This section describes how the preceding policy developments at the domestic and international levels may influence GHG trading in the near future.*

### *Emissions Commodity Shift: From Voluntary to Compliance Instruments*

VERs, the most commonly traded emissions commodity to date, are of limited value for companies attempting to hedge their risk from a potential future emissions limit. This is because VERs have been created in the absence of government trading rules and carry the risk that governments will not recognize them for compliance with future domestic emissions reduction requirements.

As the domestic and EU trading systems described above become operational, market participants will no longer have to define a commodity in each transaction by developing their own monitoring requirements, baseline methodologies, allowable activities types, or other characteristics of emissions reductions. Government rules will provide a framework for these activities. As a result, market participants will be able to acquire or transfer government-issued permits that conform to specific rules.

In jurisdictions that have imposed binding emissions restrictions and developed domestic trading programs, increasing numbers of buyers will elect to acquire permits rather than VERs because the former are by definition recognized for compliance with emissions reduction requirements. Firms in countries without emissions limits may also create demand for permits. Compared to VERs, permits created in

a formal program stand a higher probability of being transferable to other jurisdictions' future trading programs. Thus, foreign companies may acquire permits as a tool for risk management. For example, a German company anticipating a binding emissions limitation might purchase UK allowances in hopes that they will be recognized for compliance under a future German or pan-European trading system. Even if foreign permits ultimately cannot be used for compliance by a buyer, the acquiring party will be able to liquidate the permits within their jurisdiction of origin, so long as sources in that jurisdiction continue to face binding emissions restrictions (and assuming that the permits do not expire). Nevertheless, some buyers will continue to purchase VERs for compliance with voluntary commitments and to the extent that the lower price of VERs compensates for their less-assured status with regard to future government recognition.

### *Fragmentation*

As the previous descriptions of emerging trading systems illustrate, in the absence of a clear international trading architecture, governments that have proceeded to develop trading programs have adopted unique programmatic elements. Differences among these elements may give rise to incompatibilities in the near-term that will likely inhibit some economically beneficial cross-border transactions. For example, the UK and Danish programs cover different gases and sectors and utilize a variety of allowance-based and credit-based approaches, posing barriers to trade between firms in these countries.

Many of the provisions in the UK program also differ from those in the European Union's draft directive. If these differences are not ultimately harmonized, GHG trading may occur mostly within several fragmented markets, each with its own unique commodity, instead of in a single international market for a homogenous GHG emissions commodity. Table 3 highlights the major design elements of these systems and also identifies the differences in design that could adversely affect market development.

*Table 3*

## Comparison of United Kingdom, Danish, and European Union Emissions Trading Programs

| | United Kingdom | Denmark | European Union |
|---|---|---|---|
| **Mandatory vs. voluntary** | Voluntary with financial incentive payments or climate change levy discounts | Mandatory | Mandatory |
| **Compliance periods** | Direct participants: 2002-2006; Agreement participants: 2002-2010 | 2001-2003 | 2005-2007, 2008-2012 |
| **Gases** | Firms choose coverage: all six GHGs or $CO_2$ only | $CO_2$ | Initially only $CO_2$ |
| **Sectors** | Industrial sectors; electricity sector excluded | Electricity generation only | Industrial sectors and energy sector; chemical sector excluded |
| **Allocation approach** | Direct participants: grandfathering; Agreement participants: free allocations for excess reductions beyond target after compliance is demonstrated | Grandfathering | 2005-2007: grandfathering; 2008-2012: to be determined |
| **Absolute vs. relative targets** | Direct participants: absolute; Agreement participants: relative or absolute | Absolute | Absolute (allows for conversion of relative to absolute) |
| **Domestic project credits** | Projects in UK are allowable except in domestic sector; sequestration not eligible although it may come under review | None | None initially, inclusion to be determined in Commission report by June 30, 2006 |
| **International project credits** | None initially, will consider CDM inclusion to a certain percentage when CDM rules are finalized | None initially, will issue guidelines on JI and CDM inclusion when international rules are finalized | None initially, inclusion to be determined in Commission report by June 30, 2006 |
| **Banking** | Unlimited within compliance period | Participants may bank difference between emissions and saving limit. Savings limit: 90 percent of 2001 allocation, 95 percent of 2002 allocation, 100 percent of 2003 allocation | Unlimited banking in 2005-2007 and 2008-2012; countries may allow banking of 2005-2007 allowances into 2008-2012 period |
| **Financial penalty** | Direct participants: noncompliance means ineligible for annual financial incentive payment; Agreement participants: not eligible for climate change levy discount for year of noncompliance | 40 Danish Kroner/ton initially (US $5-6) | 2005-2007: 50/ton or 2 times average allowance price; 2008-2012: 100/ton or 2 times average allowance price |
| **Environmental penalty** | Direct participants: for each ton of overage, 1.1 to 2 allowances deducted from next year; Agreement participants: none | None | For each ton of overage, one allowance deducted from next period |
| **Financial incentives** | $309 million over 5 years for direct participants; climate change levy 80 percent discount for agreement participants | None | None envisioned; incentives at national level could be considered impermissible "State Aid" |
| **Safety valve (price cap)** | None | None, but low penalty acts as allowance price ceiling | None (but considered in September 2001 proposal) |

To take advantage of cost-saving opportunities for international trade, countries seeking to trade with each other must, at a minimum, establish rules of interchange and mutual recognition of their tradable units. This has not yet occurred between the two existing national trading systems. If ratification of the Protocol takes more time—delaying its entry into force and implementation by the Parties—and if concurrent policy-making continues, less international trading will result than if an international system had provided policy guidance to those developing domestic systems. The consequence of this reduction in trading will be increased compliance costs and potentially less investment in emissions reduction activities.

Countries may ultimately decide to amend their systems to ensure compatibility if cost-minimization is a primary objective. However, such changes would affect the positions of firms that participated in the lengthy policy development processes leading to the existing national system and presumably understood their positions within that system vis-à-vis their competitors' positions. Thus, in addition to being time-consuming, revising a system would be undesirable for some because it changes the "rules of the game," and potentially the competitive positions of affected sources.

The recent international agreements reached at Bonn and Marrakech clarify numerous details concerning implementation of the Kyoto Protocol, and reduce much of the uncertainty that has surrounded international climate change and domestic policy development during the past few years. In particular, the agreements resolved long-running debates on issues such as the imposition of a quantitative limit on the use of the mechanisms for compliance, fungibility of various international GHG units, banking rules, mechanisms governing the potential overselling of Assigned Amount Units (AAUs) (see note 8), and the treatment of sinks. Parties also determined the makeup of a CDM Executive Board, agreed to establish a JI Supervisory Committee, and partially resolved some outstanding issues related to the Protocol's compliance regime. These agreements will likely facilitate more rapid development of an international GHG market by providing clearer guidance to Parties seeking to develop domestic trading programs that will be consistent with international rules and with other domestic systems.

While the magnitude of the achievements at Bonn and Marrakech should not be understated, it cannot be assumed that the development of a seamless international GHG market is an inevitable outcome. Some key elements of the Protocol remain unresolved and require further negotiation. Some remaining issues to be addressed include the legal nature of the compliance program and operational

rules to govern the project-based mechanisms, which are to be agreed upon by the CDM Executive Board and JI Supervisory Committee. Thus, at least in the near future, international and domestic GHG policy will continue to develop concurrently, with the risk that incompatibilities between international, regional, national, and sub-national climate change policies will lead to market fragmentation and sub-optimal economic and environmental outcomes.

It is important to note that incompatibilities and fragmentation will not necessarily prevent international trades from occurring. Experience from analogous emissions markets in the United States suggests that market participants will develop transactional structures enabling them to trade across diverse systems if it is in their interest to do so. However, these trades will involve higher costs relative to those that would occur within more compatible systems.

The impacts of fragmentation on the performance of environmental commodity markets are illustrated by two emissions trading programs in the United States. The first is permanent offset trading of criteria pollutant emissions permits in the United States, authorized by Title I of the Clean Air Act. Under the new source review provisions of Title I, new or significantly modified sources of emissions located in areas that fail to meet national ambient air quality standards must acquire emissions offsets generated by shutdowns or emissions reductions from other existing sources. While the air quality standards that states must meet are established in accordance with federal law, states are provided the authority to regulate permanent offset trading.

States have developed different rules to supervise permanent offset trading. Because of these differences, little cross-border trading has occurred. This is the case even within shared airsheds that would lend themselves to regional trading with no loss of environmental quality. The result is that trading benefits are reduced as new sources are forced to acquire more costly offsets generated within their own state instead of seeking out cheaper offsets within the same airshed in neighboring states. Even where differences in trading rules do not prevent cross-border trades from occurring, those differences introduce additional complexity and increase transaction costs. Differences in national trading systems are likely to yield similar outcomes in GHG markets for the foreseeable future.

The $NO_X$ Ozone Transport Commission (OTC) Budget Program provides another example of the impact of differences in state trading rules. This program is also authorized by Title I of the Clean Air

Act. While the program is generally regarded as a success for having achieved significant reductions of $NO_X$ emissions at low cost, some additional cost savings are lost because of differences in the way individual states implement certain provisions of the program.[35] For example, each state in the program is allowed to choose the method and schedule by which $NO_x$ allowances are allocated to its affected sources. While most states allocate allowances once for the entire four years of the program, a few states such as Massachusetts allocate on an annual basis. This requires some sellers to resort to "allocation-contingent" offers, meaning that the number of allowances that they would sell to a buyer is dependent on the number of allowances they receive. Potential buyers are forced to consider the risks that their counterparty might not receive its anticipated allocation or otherwise default on its obligations. This complicates comparison of competing sell offers, and occasionally obstructs trades.

## D. Additional Greenhouse Gas Trading Initiatives

*This section briefly describes the efforts of private-sector and nongovernmental market participants to create a GHG trading system.*

***Partnership for Climate Action*** In October 2000, the Partnership for Climate Action (PCA) was announced just prior to COP-6. It is a joint effort between the NGO Environmental Defense and Alcan, BP, DuPont, Ontario Power Generation, Pechiney, Shell, and Suncor. More recently, Entergy joined the PCA, and PEMEX has engaged in a bilateral project with Environmental Defense to manage its emissions. Each company in the PCA has committed to make GHG emissions reductions, demonstrate excellence in emissions trading, and report on their progress. With their aggregate emissions exceeding 360 million metric tons of $CO_2e$ in 1990, the group would be the 15th largest emitter in the world if it were a country. The companies have pledged reductions of over 80 million metric tons of $CO_2e$, or more than 20 percent. Individual reduction targets vary, based on each company's ability to reduce emissions. While other significant NGO efforts have been developed to engage the private sector on the climate change issue, the PCA is unique in that member companies have to accept absolute emissions reduction targets and report annually on their progress.

***Emissions Market Development Group*** Announced at COP-6 in The Hague during November 2000, the Emissions Market Development Group (EMDG) is a joint project launched by Arthur Andersen, Credit Lyonnais, Natsource, and Swiss Re in conjunction with a number of other participating companies. It is focused on

creating a "carbon repository" where firms would be able to deposit reductions they have achieved, and enhance their ability to trade the reductions in advance of the emergence of fully developed national systems.

The repository would subject reductions to a review process that values their viability for future compliance in a given country. The repository would evaluate the risks associated with reductions, their owners, and country of origin, and assign proper "exchange rates" in proportion to those risks. The repository would then issue the depositor an amount of tradable common carbon credits (CCCs) that reflect that risk-adjusted exchange rate. These CCCs would be redeemable at a future date for compliance permits in a given jurisdiction. The CCCs would be fully tradable in advance of many national systems, enabling players in the market to better manage their GHG risks. By creating a product that is more clearly defined and adjusted for risks, EMDG hopes to increase liquidity in the early trading market.

At COP-7 in Marrakech, EMDG announced that it had completed a feasibility study on its concept. While most elements of the study remain confidential to EMDG and its participants, it found that the core concepts are technically feasible, but that success hinges on further developments in market conditions. Importantly, the lack of insurance products for guaranteeing reductions for compliance is an obstacle to the creation of such an entity. Insurers believe that insurance products will become available in the near future as national GHG trading programs become operational and as market pricing information for permits becomes available. As the market matures, EMDG plans to develop some components needed by the repository, most notably a "carbon rating engine" that could assess projects' carbon value in a routine, automated way. EMDG also plans to develop a pilot portfolio of reductions that could be rated by this engine and then freely traded.

***Chicago Climate Exchange*** In June 2001, 33 companies with assets in the midwestern United States announced the formation of the Chicago Climate Exchange (CCX). Led by Environmental Financial Products and the Kellogg Graduate School of Management at Northwestern University, under a grant from the Joyce Foundation, the group will explore the potential for a regional GHG trading exchange in order to achieve a specified level of emissions reductions. The companies have indicated in letters to the CCX that they will consider trading on the exchange if effective rules are designed. The CCX has proposed that participating companies voluntarily commit to emissions reductions and trading in all six greenhouse gases. Participants would commit to reducing their GHG emissions by 2 percent below 1999 levels during 2002 and reduce them by 1 percent annually thereafter. Credits would be given for domestic and international

emissions offset projects. The CCX hopes to have the exchange up and running by the third quarter of 2002 for participants in seven states: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. In 2003, the CCX aims to have commitments and trading among participants in the entire United States, Mexico and Canada, and to expand the exchange to include international participants in 2004.

## E. Potential U.S. Development of a Parallel Trading System and/or Participation in an International Agreement

*The United States' stance on the Kyoto Protocol makes its entry into force challenging, although it appears more likely following the successful international negotiations of 2001.*[36] The recent political agreements reached among 180 countries in Bonn and Marrakech on key features of the treaty revived the nearly stalled process of advancing ratification of the Protocol. The negotiations were also notable in that the United States acted only as an observer, having already expressed its opposition to the treaty.

In addition to making it more difficult to achieve the entry-into-force threshold incorporated in the Kyoto Protocol, the U.S. position raises questions about: (1) the levels of trading that will occur; (2) the environmental and economic impacts of the agreement; and (3) impacts on U.S. and non-U.S. firms.

The following section identifies and analyzes some general scenarios regarding U.S. efforts to develop a parallel system to reduce greenhouse gases and its potential participation in international efforts to address climate change. For purposes of simplicity, only a few broad scenarios and their possible impacts are presented here. Also, the authors assume for each of the following scenarios that the Kyoto Protocol will enter into force, in keeping with the stated intentions of the Parties to the Bonn and Marrakech agreements.

### *Scenario 1: The United States Does Not Participate in the Kyoto Protocol and Does Not Develop a Domestic Greenhouse Gas Reduction Program*

In this scenario, the Protocol enters into force without U.S. participation. Parties that choose to develop domestic trading programs as an element of their domestic climate change policy will benefit from international trading rules, allowing them eventually to harmonize their systems more closely, should they choose to do so.

If the United States does not participate in international GHG markets, it is likely that compliance

costs would be far less than had been estimated by most prior analyses of the Kyoto Protocol. Lower costs would result because the largest projected buyer, the United States, would not be a market participant. Additionally, the overall volume of trading would decline without the United States. In the absence of ratifying governments imposing a constraint on use of trading for purposes of compliance with commitments, Annex B Parties would likely be able to achieve a larger share of their compliance requirements by purchasing AAUs without undertaking significant additional abatement. Consequently, the aggregateemissions abatement achieved by the Kyoto Protocol would also be diminished relative to its original formulation.[37]

It is possible that sellers will bank a portion of their AAUs for future domestic use in anticipation of increased economic activity (which may increase GHG emissions) or as an attempt to increase the market price of permits. This possibility has grown more likely as a result of Russia's supplementary allocation of tons for its sinks at COP-7, which will increase its permit supply in the first commitment period. New analysis has recently been conducted attempting to quantify the impacts of such market behavior.[38] This paper does not review the new analysis in depth or render judgment about governments' ability to engage in such strategic behavior. However, if banking does occur in countries with surplus permits, market prices would increase.

Almost all of the analyses of the Protocol without U.S. involvement arrive at similar conclusions: prices for permits and additional GHG abatement would fall. The fall in prices could be mitigated to some degree if potential sellers bank some proportion of their permits for future compliance or in attempt to raise prices.

***Private Sector Impacts*** In this scenario, U.S.-based multinational companies with operations in other Annex B countries (predominantly energy-intensive manufacturing companies with GHG liabilities) may not enjoy the benefit of incorporating U.S. reduction opportunities into their corporate compliance strategies. Several such firms have found that cost-effective reduction opportunities exist in their U.S. operations. However, it is unlikely that reductions achieved in the United States could be used under the Protocol either to minimize their internal compliance costs by utilizing U.S. reductions in corporate reduction strategies or to generate revenue by selling those reductions to other companies.

If the United States remains outside the Protocol and does not develop a domestic GHG program, U.S.-based companies that participate in international markets, particularly those sensitive to energy

costs, might be at a competitive advantage, as they would not incur the costs associated with an emissions constraint. The magnitude of this advantage would depend upon the cost of compliance for those firms that do face an emissions constraint.

It is possible that there will be political ramifications for U.S. firms that benefit from remaining outside the Protocol. Regulated firms in other Annex B countries would likely lobby their governments to level the commercial playing field, which could entail political and trade consequences for the U.S. government and U.S. companies. In addition, U.S. companies would continue to operate under the specter of some future unspecified GHG constraint. Continuation of current policy uncertainty over the long term could increase future compliance costs by forcing firms to make complex decisions about potential capital investments without understanding future climate change policy and potential emissions reduction requirements.

### *Scenario 2: The United States Does Not Participate in the Kyoto Protocol but Develops a Parallel Domestic Greenhouse Gas Program*

It is difficult to predict if or when the United States will require firms to control their GHG emissions. However, in recent months several members of the U.S. Congress have introduced legislation that would, among other things, require electric utilities to reduce their GHG emissions as a component of legislation that also requires reductions in conventional air pollutants. It is not clear if or when such legislation will become law. Nevertheless, it is an important signal that momentum on the climate change issue may be shifting in the United States. Additionally, the Bush Administration proposed that the United States develop a domestic climate change program while remaining outside the Kyoto Protocol.

***Private Sector Impacts*** The U.S. power sector has relatively few low-cost options available to reduce emissions from its own assets, due in part to the long life of its facilities. Near-term emissions limits could cause premature retirement of existing capital stock, increasing the cost of electricity as new plants would have to be financed to replace high-emitting plants. Accordingly, the industry has generally been among the strongest advocates of the elements of flexibility built into the Kyoto Protocol, such as the incorporation of all six greenhouse gases into reduction targets, multi-year commitment periods, sequestration, project-based mechanisms, and international trading.

If the United States does not participate in an international agreement and develops a parallel domestic system instead, many dynamics will affect the ability of power companies and other firms to

gain access to the elements of flexibility built into the Protocol. For example, U.S. legislation might easily incorporate rules allowing firms to buy AAUs under Article 17 and other Kyoto Protocol units, or instruments created by other domestic and regional systems, for purposes of compliance with a domestic emissions limit. However, it is not clear that the Kyoto Protocol would allow purchases of AAUs by Parties outside of the Protocol. Article 17 of the Kyoto Protocol only authorizes trading among Annex B Parties.[39] Additionally, countries with domestic systems in place may attempt to take action to limit U.S. access to their compliance tools. Such purchases also raise important environmental issues that would have to be addressed, such as double counting of reductions.

There is a strong possibility that potential U.S. buyers would devise mechanisms and structures to gain access to international and other countries' domestic GHG instruments for compliance with a U.S. domestic program. They could seek to develop corporate subsidiaries for this purpose and locate them in Annex B countries or utilize market intermediaries. However, gaining access through such structures would increase costs.

The resolution of these issues will be complex and take time. This paper does not take a position on the likely outcomes of these upcoming debates. The outcomes will be driven by technical, legal, and economic issues, which are outside the scope of this analysis, while others will be driven by Parties' political considerations. It is important that such political considerations be taken into account. Recently, Michael Meacher, the UK environmental minister suggested that "U.S. multinationals will want to have a place in emissions trading to which they do not have access unless the U.S. is a member of the Protocol."[40] While Mr. Meacher does not speak for U.S. firms, it is important to note that senior political officials are beginning to think about these issues.

Gaining access to reductions generated by projects in developing countries is likely to be far less complicated for U.S. firms. Developing countries might be quite willing to sell to the United States, creating a system parallel to the CDM. Since developing countries do not have national emissions reduction obligations, such sales would not directly affect the integrity of the Kyoto Protocol's Annex B emissions caps. Allowing sales to the United States would also increase overall demand for reductions generated in developing countries, possibly increasing prices paid to sellers in those countries. Authorizing the transfer of such reductions would require provisions in U.S. law addressing such issues as their creation and transfer for compliance. However, the transaction costs involved in project-based

trading may not provide the same cost-saving opportunities as allowance-based trading. For these reasons, if U.S. domestic legislation eventually moves forward but the United States remains outside the Kyoto Protocol, utilities could be adversely affected by the increased costs associated with exclusion from some trading opportunities and with development of complex mechanisms to overcome trading barriers.

### *Scenario 3: The United States Becomes a Party to the Kyoto Protocol after It Enters into Force*

Under this scenario, the United States could have a domestic program in place as described in Scenario 2, or it may not have developed such a program. If the United States had a program in place, it would likely require revisions to conform to international rules after it ratified the Kyoto Protocol. If the program were limited to a few sectors, an economy-wide domestic program or additional compliance measures would have to be developed in order to achieve compliance with international obligations. If a system were not in place, the United States would have to develop domestic implementing legislation to achieve its international obligations.

By delaying its participation in the Kyoto Protocol, the United States might have greater latitude to shape its terms for participation, perhaps negotiating a more permissive emissions target, for example. However, the rules and institutions governing the mechanisms would have been developed without U.S. participation, reducing the likelihood that they would be favorable to U.S. interests. In addition, if the United States becomes a Party following the first commitment period of the treaty, it is likely that compliance costs would increase for all Parties because the United States could significantly drive up demand for permits. The resulting increase in prices would be dependent on such dynamics as the level of emissions limitation agreed to by the United States, the availability of sequestration, and technological improvement. Recent studies by Richels and Manne, which assume U.S. participation in 2020, provide quantitative analyses of this scenario's impact on the price of AAUs.[41]

During the period in which the United States remained outside the agreement, competing firms in other Annex B countries would likely have gained significant experience in the international GHG market. Major emitting firms have and will continue to develop significant internal infrastructure to manage GHG emissions, likely involving diverse business units and assets. Creating such an infrastructure cannot be accomplished without significant investment in a variety of intellectual, technical, and market

resources over a lengthy period of time. Key tasks involved in developing optimal compliance strategies include understanding current emissions, projecting future emissions growth, assessing internal costs of abatement, comparing these prices to external market prices, and evaluating and implementing less GHG-intensive technologies, practices, and processes. Firms in Annex B countries and major multinational companies will develop years of experience in the GHG market and will necessarily build this infrastructure. While multinational firms facing emissions restrictions in other countries may be prepared to transfer such expertise to the United States when GHG emissions limits come into effect, U.S. firms will nevertheless have less experience than their competitors. As a result, U.S. firms would likely be disadvantaged for a period of time when competing against those that already understand the rules of the game. In addition, firms that have participated in a carbon-constrained world will likely have developed new emissions-reducing practices and technologies.

Under this scenario, U.S. firms also could continue to be affected by existing policy uncertainty, facing the difficulty of making significant capital investments without knowing what regulatory requirements they may face in the future.

*Box 2*

## Scenarios for United States Climate Change Policy and Potential Impacts if Kyoto Protocol Enters into Force

### Scenario 1: United States Does Not Participate in the Kyoto Protocol and Does Not Develop a Domestic GHG Reduction Program

- Multinational firms that have U.S. assets and are located in Annex B Parties have potentially limited options. U.S. reductions are of potentially limited value in carbon management strategy.
- U.S. firms have some competitive advantage in international markets; advantage will depend upon compliance costs for Annex B Parties.
- Compliance costs are reduced for Parties unless Parties with surplus AAUs bank them for future use or in an attempt to drive up prices.
- Less GHG abatement.
- U.S. firms face uncertainty regarding climate change policy with potentially adverse impacts.

### Scenario 2: United States Does Not Participate in the Kyoto Protocol But Develops a Parallel Domestic GHG Reduction Program

- Multinational firms that have U.S. assets and are located in Annex B Parties have potentially limited options. U.S. reductions are of potentially limited value in carbon management strategy.
- There will be potential obstacles to U.S. firms gaining access to Annex B trading market or other foreign, domestic, or regional compliance instruments. Access likely to come at some cost.
- Project-based trading will likely be available. Increased demand for CDM-like projects.
- Costs of domestic compliance may be higher.
- Key environmental issues need to be addressed.

### Scenario 3: United States Becomes a Party to the Kyoto Protocol After It Enters into Force

- After joining the Kyoto Protocol, the United States must develop a domestic GHG reduction program to comply with international obligations.
- If the United States already has developed a domestic GHG reduction program prior to joining the Kyoto Protocol, it must conform the domestic program to international rules. If program is not in place, domestic implementing legislation will be required.
- Non-U.S. firms will have an advantage due to their early market experience in the international system.
- United States must live with existing rules of the international system.
- Compliance costs likely to increase for Parties as United States drives up demand for reductions. Increase in costs depends on stringency of U.S. reduction target.

## V. Conclusions

*During the brief history of emissions trading programs, trading has typically proceeded after government requirements to reduce emissions were imposed and trading rules were developed.* However, the existing emissions trading programs developed to date have not been designed to address an environmental challenge as scientifically, economically, and politically complex as global climate change. Owing in large part to this complexity, the development of comprehensive policy responses to climate change has not kept pace with the rate at which public concern over the issue has grown.

Motivated by a variety of factors including the desire to address this critical environmental challenge, respond to public concern, and shape policy, some companies and governments have already begun exploring the challenges and benefits of GHG trading prior to the existence of a formal regulatory framework. As the review of the current market in Section 2 demonstrates, this has created a unique situation in which policy development and trading is proceeding concurrently rather than sequentially, with each influencing the other. Market participants attempt to conform their trades to emerging policy, and policy-makers seek to develop trading programs in light of accumulating experience from market participants. The authors believe that this trend will continue.

Despite continuing political uncertainty surrounding the climate change issue, increased scientific understanding of climate change and growing public concern will drive more governments and businesses to seek effective ways to address this issue. The diplomatic breakthroughs achieved in Bonn and Marrakech and the recent development of a few domestic systems support the view that policy makers can overcome their differences and implement policy responses.

As environmental policy stakeholders have grown more familiar with emissions trading, it has become the policy measure of choice to address climate change. This is evidenced by the development of GHG emissions trading programs outside the United States, where most practical emissions trading experience resides. The initiation of programs in the United Kingdom and Denmark, for example, will

undoubtedly lead to increased trading in the near term. The EU directive will likely inspire more action by EU member states and greater harmonization among their national programs. These systems will facilitate increased trading activity and motivate investment in activities that reduce GHG emissions.

Existing domestic trading systems were developed without the benefit of clear international rules. The result is that these systems, such as those of the United Kingdom and Denmark, differ in key areas. These differences create potential impediments to cross-border trades. The UK system, and to a lesser degree, the Danish system have some important differences with the trading system currently being designed by the European Union. If domestic permits are to be transacted across national jurisdictions for the purpose of compliance, rules must be devised to allow for their interchange and fungibility. The existing systems may have to be amended to conform to EU rules and eventually, those embodied in the text of the Kyoto Protocol. In the absence of such harmonization, market participants will devise strategies to gain access to foreign GHG commodities. However, this will be a more expensive solution than if programs were initially compatible.

This suggests that at least in the near term, national and sub-national GHG markets may be fragmented, resulting in sub-optimal economic and environmental outcomes. The progress achieved in 2001 at COP-6bis and COP-7 increases the potential that a robust market will develop in the long-term. However, several key issues related to the Protocol that will affect market performance still must be addressed. For example, Parties still must address the binding nature of the Protocol's non-compliance provisions. Institutions governing the mechanisms must move forward expeditiously and Parties must harmonize their domestic systems with each other. Therefore, while the potential for harmonization with its resultant benefits is higher than it has been at any point in the past, more work needs to be done to effectuate a smoothly functioning international GHG market.

## Appendix I: Descriptions of Project-Based Programs

### U.S. Initiative on Joint Implementation

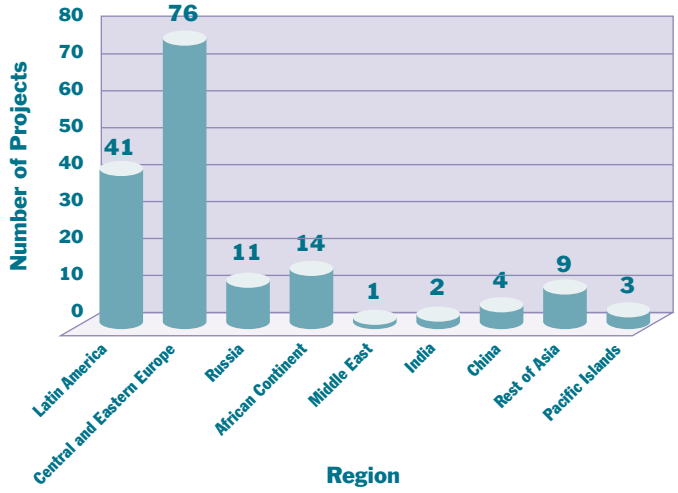
The United States was the first to initiate a JI pilot program. The USIJI was initiated under the 1993 U.S. Climate Change Action Plan (CCAP) as a pilot project to gain experience with GHG reduction projects in both developing and developed countries.[42] Its main objectives were to demonstrate the viability of project-based emissions trading (though no formal credits were granted) and to gain practical experience. USIJI differs from JI under the Kyoto Protocol. While JI under the Kyoto Protocol authorizes emissions reduction projects between Annex B countries and authorized legal entities, USIJI allowed for GHG reduction projects in both developing and developed countries. To date, the USIJI has approved 50 projects in 26 countries.[43] The projects received USIJI approval from the inception of the program in 1994 until the last round of project approvals in October 2000. The location and activity type of the USIJI projects are described in Figures 1 and 2.

### Activities Implemented Jointly Pilot Phase

The AIJ program was initiated at the first Conference of the Parties (COP-1) to the UNFCCC held in Berlin in March and April of 1995.[44] The purpose of this program was to gain practical experience with JI- and CDM-like projects.[45] The pilot phase was supposed to remain in effect until 2000. An agreement reached at COP-7 in Marrakech continues the pilot phase. To date, approximately 155 AIJ projects have been undertaken in 41 countries.[46] These projects are described in Figures 1 and 2. Approximately 80 percent of all projects have involved renewable energy and energy efficiency. Project developers have claimed significant emissions reductions from these projects, though they are not required to seek verification by a third party. Nevertheless, experience generated by USIJI has helped to refine methodologies for quantifying emissions reductions from sources and removals by sequestration.

***Figure 1***

**Regional Location of USIJI and AIJ Projects**[47]



## Pilot Emissions Reduction Trading Project

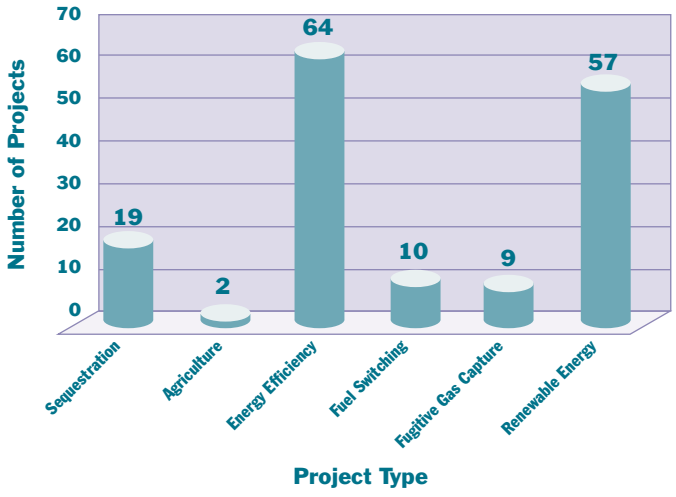
The Ontario, Canada, PERT project is a joint industry and government initiative to explore and promote emissions trading as a tool to reduce emissions of nitrogen oxides ($NO_X$) and volatile organic compounds (VOCs), and since 1997, $SO_2$ and GHG emissions. The PERT program is representative of pilot programs that have been developed to foster voluntary reduction activities and facilitate learning-by-doing. To date, PERT has evaluated scores of projects leading to the registration of 14.6 million metric tons of reductions of $CO_2e$ (including $CO_2$, methane, and nitrous oxide ($N_2O$)) in the PERT registry.[48]

## The Climate Trust (Oregon)

The state of Oregon requires new power plants to offset a portion of their projected $CO_2$ emissions as a condition of obtaining an operating permit.[49] The state requires power plant developers to offset emissions that exceed a specified rate of output (i.e., 17 percent below the most efficient combined cycle natural gas generation technology). To comply with the law, established in 1997, plant developers may choose to acquire qualifying offsets (the project path) in the market that achieve specified criteria or to pay $0.85[50] per metric ton of $CO_2$ (the monetary path) to The Climate Trust,[51] a state-sanctioned nonprofit entity charged with securing offsets. To date, all developers have utilized the monetary path for compliance.[52] The Climate Trust will fund five projects from its first million dollars in offset payments and is currently seeking to spend $5.5 million derived from its second round of offset payments. Table 4 summarizes four of the five projects that were procured in the first round. The fifth is a sequestration project in Ecuador whose features will be announced in early 2002. These projects anticipate avoiding, sequestering, or offsetting a total of 764,300 metric tons of $CO_2$ over the next 100 years.[53]

***Figure 2***

**USIJI and AIJ Projects by Activity**




A second round of contracts totaling $5.5 million will be awarded by The Climate Trust and Seattle City Light (Seattle, Washington) in 2002. The funds for this round are derived from payments to offset $CO_2$ emissions from Calpine's 450-megawatt Hermiston Power Project and Avista Corporation's 260-megawatt Coyote Springs Unit 2 power plant, both located in eastern Oregon.[54] Although all projects funded by The Climate Trust thus far have been located in the Pacific Northwest, The Climate Trust will consider offsets generated anywhere in the world.

*Table 4*

**Projects Funded** by Climate Trust First Tender[55]

| Supplier | Volume (metric tons $CO_2$) of offsets | Project Description |
|---|---|---|
| **Lummi Indian Tribe** | At least 350,000 over 100 years | Preserve 1,654 acres of old-growth Pacific silver fir forest as a carbon "sink" by protecting it from industrial logging cycles. |
| **Portland Office of Transportation** | 70,000 over 10 years | Internet service called CarpoolMatchNW.org that links carpoolers in a region stretching from Salem, Oregon, to Vancouver, Washington, thus reducing emissions from fuel combustion. |
| **Klickitat County Public Utility District No. 1.** | 342,000 over 30 years | Cleaning and removal of $CO_2$ from gases released by Roosevelt Regional Landfill located in south-central Washington. Cleaned gas will fuel electric generation, offsetting higher-emitting grid-generated electricity. |
| **Bonneville Power Administration** | 23,178 over 10 years | Purchase and retirement of 36,500 MWh of Bonneville Environmental Foundation Green Tags; $CO_2$ offsets are being separated from other environmental attributes embedded in tags and transferred to The Climate Trust. |

## Emission Reduction Unit Procurement Tender

The ERUPT was issued by the Dutch Ministry of Economic Affairs (MEA) in 2000. It is designed to assist the Netherlands in achieving its national emissions limit under the Kyoto Protocol through the purchase of ERUs generated from projects in Annex B countries. ERUPT projects must adhere to criteria issued by the MEA's implementing agency, Senter, which are based on potential rules for JI as outlined in Article 6 of the Kyoto Protocol.[56] The Netherlands has indicated that it aims to achieve up to half of its emissions reduction obligations through flexible mechanisms such as JI.[57]

Purchases from five projects in the first round of ERUPT involved a total of 4.2 million metric tons of $CO_2e$ reductions, valued at total of $31 million. These projects are described in Table 5. The government has also issued two additional tenders: (1) a second round of ERUPT, and (2) a CERUPT (Certified Emission

*Table 5*

**ERUPT** Projects

| Supplier | Volume (metric tons $CO_2e$) | Price (US$/ERU) | Country | Project Title |
|---|---|---|---|---|
| **NV Nuon** | 1,536,140 | 7.99 | Romania | Municipal Cogeneration Targoviste |
| **NV Nuon** | 924,590 | 7.99 | Romania | Municipal Cogeneration Cluj-Napoca |
| **BTG Biomass Technology Group BV** | 522,320 | 7.92 | Czech Republic | Biomass Energy Portfolio |
| **United Power Co. (joint venture of SC Hidroelectrica SA and Harza Engineering Co. LP)** | 612,631 | 4.40 | Romania | Surduc – Nehoiaşu Hydro Plant |
| **Nuon International Projects BV** | 583,500 | 7.92 | Poland | Skrobotowo Windpark |

Reduction Unit Procurement Tender), which is designed to allow the government to purchase reductions generated from CDM-like projects. CERUPT aims to generate 3 million metric tons of $CO_2e$ at anticipated prices of $2-$5 per metric ton of $CO_2e$. ERUPT is among the most formal programs to date because it contracts for ERUs, which will become a compliance unit if the Kyoto Protocol enters into force.

## Prototype Carbon Fund

The World Bank established the PCF in 1999 to acquire high-quality project-generated emissions eductions that would potentially be eligible for international recognition under rules governing JI and the CDM. Private firms and governments invested a total of $180 million in the fund. Some believe that the World Bank's international prominence and the PCF's explicit commitment to purchase only reductions of the highest quality have made PCF procedures a *de facto* standard for project evaluation in the absence of government crediting rules. To date, the PCF has purchased reductions from three projects, which are briefly described in Table 6.[58] Private-sector and government participants involved in the PCF are listed in Table 7.

***Table 6***

**Emissions Reduction Projects Funded by the PCF**

| Project Name | Cost of Reductions | Amount of Reductions | Project Description |
|---|---|---|---|
| **Liepaja Solid Waste Management Project (Latvia)** | N/A | 255,000 million metric tons of carbon over 20-year project lifetime | Capture of methane gas from landfill, which will be used for electricity generation |
| **West Nile Electricity Project (Uganda)** | Up to US$3.9 million | 2 million metric tons of $CO_2$ over 20-year project lifetime | Construction of two small hydropower stations, efficient diesel backup facilities, and rehabilitation of mini-grid in region |
| **Chacabuquito Hydro Project (Chile)** | At least US$3.5 million | N/A | Run-of-the-river power plant of 25 MW capacity that utilizes waters of Aconagua River |

***Table 7***

**Private sector and Government Participants in the PCF**

| Countries | Companies | | |
|---|---|---|---|
| **Canada** | BP-Amoco | Gaz de France | RWE |
| **Finland** | Chubu Electric Power Co. | Kyushu Electric Power Co. | Shikoku Power Co. |
| **Japan** | Chugoku Electric Power Co. | Mitsubishi Corp. | Statoil |
| **Netherlands** | Deutsche Bank | Mitsui | Tohoku Electric Power Co. |
| **Norway** | Electrabel | Norsk Hydro | Tokyo Electric Power Co. |
| **Sweden** | Fortum | Rabo Bank | |

## Appendix II: Descriptions of Corporate Emissions Trading Systems

### BP

In 1998, BP voluntarily committed to reduce its GHG emissions 10 percent below 1990 levels by 2010. An internal cap-and-trade system was one of the policy instruments used to achieve its corporate target. After a year of collaborative design work with the NGO Environmental Defense, BP launched a pilot phase in 1999 involving 12 of its business units located in several countries. It was the first major corporation to develop an internal GHG trading system. By 2000, after the acquisition of Amoco, Burmah Castol, and Arco, the trading system was expanded to include BP operations worldwide. In 2000, 2.7 million metric tons of $CO_2e$ were traded at an average price of $7.60 per metric ton.[59]

### Shell

Shell announced its internal cap-and-trade program in 1998 as part of a corporate commitment to reduce GHG emissions 10 percent below 1990 levels by 2002 and to exceed Kyoto Protocol emissions reduction targets through 2010. In January 2000, it instituted its Shell Tradable Emission Permit System (STEPS) program. Approximately 20 units in the company's chemicals, refining, and exploration and production businesses located in Europe, the United States, Australia, and Canada are required to participate in the program. These assets account for approximately 30 percent of corporate emissions. The company establishes caps for business units in developed countries (Annex B), but also allows business units in developing countries (non-Annex B) to generate project-based reductions and sell them into the system. This mechanism is modeled after the CDM.

Although designed differently, the BP and Shell systems have provided these firms with practical GHG-trading experience and have significantly advanced the dialogue on the benefits of emissions trading.

## Appendix III: Sample Term Sheet Offering Greenhouse Gas Reductions

Offer to Sell Carbon Dioxide Equivalent Verified Emission Reductions
*Proprietary and Confidential*

### TRADE DESCRIPTION

Our client wishes to sell a forward stream of 600,000 metric tons of carbon dioxide equivalent ($CO_2e$) verified emission reductions (VERs).

### PRINCIPAL TERMS

***Units*** All prices are given in USD and VER volumes in metric tons of $CO_2e$.

***Volume*** As outlined below, 100,000 metric tons $CO_2e$ VERs per year. Total = 600,000 metric tons.

***Vintage*** The vintage year shall be defined as the period from January 1st to December 31st of specified year.

***VER source*** The $CO_2e$ VERs shall be generated from power plant efficiency upgrades at one of Seller's North American coal-fired electricity generating stations. The power plant upgrade(s) will involve upgrading to more efficient steam turbines and improved steam path (via improved heat exchange), which will improve the fuel efficiency of the power plant. The equipment upgrade will occur no later than the 2nd quarter of 2001.

***Contract*** This transaction is contingent upon signature of a mutually acceptable contract. Upon confirmation of agreement to the terms outlined in this term sheet, Buyer and Seller will have 90 days to finalize and sign a mutually acceptable contract. This period may be extended only by the mutual agreement of both Buyer and Seller. If no contract has been signed within this 90-day period then the transaction is void.

***Down Payment*** Down-payment price per metric ton of $CO_2e$ VER as outlined in Schedule 1 below. Immediate payment of USD 187,500 to be paid within 15 business days to Seller upon execution of a mutually acceptable contract. The upfront payment is determined by summing 10 percent value of each vintage year total price per metric ton multiplied by the total volume of metric tons.

***Balance price and payment*** The balance price represents the remaining 90 percent of the total price per metric ton of $CO_2e$ VER. The balance payment for subsequent years will be made against delivery of the VERs according to the forward schedule below. Upon confirmation that title to the $CO_2e$ VERs has been transferred, Buyer shall forward payment for that vintage year, by wire transfer, to Seller no later than February 15th of the subsequent vintage year.

***Delivery*** Delivery of all rights and title to the $CO_2e$ VERs will be made to Buyer, accompanied by a verification report, on or before the delivery date specified in Schedule 1. The verification report will confirm that the VERs are generated according to the Quality Criteria stated below.

| Vintage | Volume (metric tons $CO_2e$ VERs) | Total Price | Down Payment Price | (USD/metric ton $CO_2e$ VER) | Delivery Date | Balance Settlement Date |
|---|---|---|---|---|---|---|
| 2002 | 100,000 | 2.50 | 0.250 | 2.25 in 2003 USD | Jan 31, 2003 | Feb 15, 2003 |
| 2003 | 100,000 | 2.75 | 0.275 | 2.475 in 2004 USD | Jan 31, 2004 | Feb 15, 2004 |
| 2004 | 100,000 | 3.00 | 0.300 | 2.70 in 2005 USD | Jan 31, 2005 | Feb 15, 2005 |
| 2005 | 100,000 | 3.25 | 0.325 | 2.925 in 2006 USD | Jan 31, 2006 | Feb 15, 2006 |
| 2006 | 100,000 | 3.50 | 0.350 | 3.15 in 2007 USD | Jan 31, 2007 | Feb 15, 2007 |
| 2007 | 100,000 | 3.75 | 0.375 | 3.375 in 2008 USD | Jan 31, 2008 | Feb 15, 2008 |
| Total | 600,000 | 1,875,000 future USD | $187,000 | 1,687,500 in future USD | | |

## QUALITY CRITERIA FOR ESTABLISHING $CO_2e$ VERS

Seller warrants to Buyer that the $CO_2e$ VERs shall meet the following criteria:

- ***Real***: a reduction of actual $CO_2e$ emissions resulting from specific and identifiable actions.
- ***Quantified:*** by transparent and replicable calculation methodology. All necessary data will be available to be verified and audited by an independent third party.
- ***Verified:*** Verification Report will be prepared for each vintage year by independent third party selected by Seller, with costs to be borne by Seller.
- ***Surplus:*** Seller warrants that VERs are in excess of any VERs that are required by existing regulatory requirements at the date of project initiation.
- ***Ownership:*** Seller warrants its ownership of the VERs in written contract with Buyer.

## SALE CONDITIONS

- ***Verification Report:*** The Emission Reduction Verification Report shall be sufficiently comprehensive so as to demonstrate that the $CO_2e$ VERs meet the Quality Criteria outlined above.
- ***Title:*** Title to the subject $CO_2e$ VERs will be assignable at the discretion of the Buyer.
- ***Performance Warranty:*** Volume of the $CO_2e$ VERs estimated is believed to be conservative based on engineer's modeling. If Seller fails to deliver VERs in accordance with the above volume and/or criteria in any given vintage year, Buyer's sole remedy shall be the recovery from Seller down payment funds received, plus interest thereon at 3 percent pro-rated per metric ton of undelivered VER.
- ***Project Category:*** The VERs will be selected from a portfolio from either one facility or a combination of North American facilities at the time of delivery.

## COUNTER-PARTY DESCRIPTION

- Seller is a well-regarded investment grade rated Canadian company in the Energy Sector.
- If necessary, Buyer and Seller shall have a minimum of fifteen (15) business days after term sheet execution to assess their respective credit ratings and ensure credit is compliant with Buyer's and Seller's requirements.

## COMMISSION

- Upon execution and delivery of a mutually agreeable written contract between counterparties, a negotiated brokerage fee is due to broker by both buyer and seller. Broker acts solely as agent in the introduction of trading counterparties. Broker is not responsible for, and is not a substitute for, your determination as to the merits of the provisions and contingencies of the transaction. Broker does not hold itself responsible for the financial condition and/or performance of either counterparty in this transaction.

## CONFIDENTIALITY

All parties to this contract must mutually agree in writing as to the timing, content, and all factors relating to any public announcements regarding this transaction.

## Appendix IV: Descriptions of Emissions Trading Systems in Massachusetts, Denmark, and the United Kingdom

### Massachusetts

Massachusetts recently became the first U.S. state to impose $CO_2$ emissions limits on old fossil-fired power plants, which have historically been subject to less stringent standards than new plants under the Clean Air Act. The April 2001 law imposes limits on four kinds of air emissions ($SO_2$, $NO_X$, mercury, and $CO_2$) from six power plants in the state.

The six plants will be required to reduce their $CO_2$ emissions by 10 percent from their 1997-1999 average emissions baseline. They must then achieve an emissions rate of 1,800 lbs./MWh.[60] The affected units must meet the emissions cap by October 1, 2004, and the output-based limit by October 1, 2006. Facilities that comply through repowering are granted two additional years for compliance. This requirement can be met either through internal actions such as repowering from coal to natural gas, or through the purchase of offsets from emissions reduction projects. So far the government has issued only principles to govern the use of offsets for compliance. Specific rules for crediting of offsets have not yet been developed. At a minimum, those seeking to invest in offsite emissions reduction or sequestration projects must demonstrate to the satisfaction of the Massachusetts Department of Environmental Protection that the reductions are real, surplus, verifiable, permanent, and enforceable.

These requirements must be met before any claimed reduction generated by offsite projects can be applied toward the reduction requirement. The issues of additionality (both financial and regulatory) are still under consideration as the state establishes rules governing the use of $CO_2$ offsets for compliance.

The Massachusetts law is notable in that it was signed by a Republican governor in the aftermath of President Bush's decision not to develop a national program addressing $CO_2$ from power plants and his announcement of the United States' withdrawal from efforts to implement the Kyoto Protocol. In passing the law, the Massachusetts Legislature and Governor were responding to political pressure from environmental groups that rallied local concerns about the impacts of emissions from older coal-fired power plants. The state's inclusion of provisions for emissions trading is intended to strike a balance between environmental and economic objectives.

## Denmark

In 1999, Denmark introduced $CO_2$ emissions trading under the $CO_2$ Quota Act, which imposed a first-of-its-kind cap on power sector $CO_2$ emissions.[61] It established a total emissions quota for electricity producers at 23 million metric tons of $CO_2$ in 2000. The cap will be reduced by 1 million metric tons per year through 2003, at which time the target level of 20 million metric tons is to be reached. The system covers all electricity producers operating in Denmark except producers relying entirely on renewable energy generation and those emitting less than 100,000 metric tons of $CO_2$ per year. Only the largest eight producers receive emissions allowances. $CO_2$ emissions from the small producers, which amount to 1.9 million metric tons, are accounted for in the distribution of allowances to ensure that the sum of emissions allowances plus the contribution from small producers does not exceed the total national quota.

Market participants must notify the Danish Energy Agency (DEA) whenever they wish to transfer allowances to another participant. Each year until 2003, each participant may bank the difference between its individual emissions level and its "savings limit." The savings limit for each participant is set by the government at 90 percent of the participant's allocation in 2001, 95 percent in 2002, and 100 percent in 2003. In 2001, because each participant's emissions level exceeded its savings limit, no participant banked allowances into 2002.

Emissions monitoring is based on fuel consumption data from each electricity- and heat-producing plant in Denmark. To calculate $CO_2$ emissions, fuel consumption is multiplied by a standard emissions factor for $CO_2$ content. If a power producer can substantiate that the actual $CO_2$ factor for the fuel used is different, this $CO_2$ factor will be used. $CO_2$ emissions are reported annually to the DEA.

If an electricity producer's annual emissions exceed its holding of allowances, it is subject to a penalty of 40 Danish kroner (about U.S.$5-6) per metric ton of excess. The government set a relatively low financial penalty in order not to place its power sector at a disadvantage vis-à-vis competitors in neighboring countries, which do not presently face similar requirements. The penalty could be increased if neighboring countries develop similar programs. The revenue from penalties is directed toward energy-saving projects.

Allowances are grandfathered to affected sources based on historical emissions during the 1994-1998 time period. Special provisions were made for combined heat and power (CHP) plants because in Denmark a large proportion (approximately 50 percent) of electricity is produced as CHP, which has already contributed to substantial $CO_2$ reductions. A two-step approach was chosen in which emissions allowances for CHP electricity are allocated before those for other electricity producers. Thus, CHP producers are protected from further reduction requirements in recognition of their previous efforts.

## United Kingdom

On August 14, 2001, the UK government published the final framework for a national GHG trading program. The trading program begins in April 2002.[62] Although Denmark has developed a trading program that covers power-sector emissions, the United Kingdom is the first industrialized country to develop a broad-based GHG trading program that covers most of industry and all greenhouse gases.

The UK trading program will be voluntary and open to all UK organizations. There are four paths by which companies may participate in the program:

- ***Climate Change Agreement (CCA).*** Since April 2001, many companies have been subject to a new tax on industrial and commercial energy consumption, known as the climate change levy (CCL). Companies can obtain up to an 80 percent discount on their CCL liability by entering into a negotiated agreement with the government. Under this agreement, companies have to improve their energy efficiency or reduce emissions below a historic baseline to meet agreed biennial targets from 2002 through 2010. Companies may choose to adopt absolute emissions targets ("absolute sector" participants) or relative targets that are expressed in terms of energy consumed or emissions per unit of output ("unit sector" participants). Most companies have opted for output-based targets.

- ***Direct Entry.*** The government allocated £215 ($309) million over five years of the program (2002-2006), equivalent to £30 million per year after taxes, in order to encourage companies that are not subject to the CCL to take on voluntary targets. These funds will be distributed via an auction in which eligible companies will offer the government a quantity of absolute emissions reductions against a 1998-2000 baseline in return for a portion of the available monies. Successful companies will then have to deliver these emissions reductions in five equal annual amounts in order to receive their incentive payments.

- ***Project Credits.*** Any organization will be able to undertake emissions reduction projects and sell the resulting credits into the program, provided that the project's reductions are additional to emissions reductions that would have been delivered under business-as-usual conditions or other reduction obligations. Each project will have to be assessed by the government on a case-by-case basis. Rules governing this "project" sector have not yet been established.

- ***Purely Voluntary.*** Any other organizations wishing to participate can simply open an account in the registry to buy and sell allowances without having taken on a reduction target. This may include, for example, entities that do not generate emissions but nevertheless wish to engage in trading.

The UK government has negotiated 43 climate change agreements with various sectors, involving more than 4,000 companies. As of February 2002, 46 companies had registered to participate via direct entry, although it is uncertain at the time of this writing if all will participate in the auction.

Trading rules differ according to the means by which companies enter the program. Companies participating via direct entry will operate under a cap-and-trade system. They will receive their allocation in April of each compliance period. These allowances will be tradable but companies will have to hold enough allowances to meet their target in order to receive their incentive payment. In contrast, companies entering via negotiated agreements will operate under a "baseline and credit" system and will receive permits only upon demonstrating that their verified reductions exceed their agreed targets. Permits issued to each type of participant will be tradable (with some restrictions).

UK emissions permits will be denominated in metric tons of $CO_2e$ to allow for conversion between emissions of different greenhouse gases. Each permit will exist only in electronic form and will have a unique serial number to allow for tracking. Permits not used for compliance in a given year may be carried forward or "banked" through 2007. The government may impose limitations on banking permits into 2008. Companies may choose to monitor only $CO_2$ or all six greenhouse gases covered by the Kyoto Protocol. This means that if a company chooses to include any non-$CO_2$ greenhouse gas in its commitment, it must include all six greenhouse gases.

Baseline and monitoring provisions differ according to the means by which companies enter the trading program. For companies participating via direct entry, baselines will be based on their average emissions during 1998-2000. The government will later issue protocols that describe exactly how to monitor emissions from various processes. Once companies have identified and calculated their baseline emissions, they must employ an accredited verifier to review their annual emissions performance. Companies entering the trading program via negotiated agreements with the government are subject to emissions reporting requirements to demonstrate that they have achieved the agreed-upon targets and will only be required to have their emissions data verified by an accredited verifier if they wish to sell permits in the trading program. Companies with output-based targets must also employ an accredited verifier to review their emissions and output data.

Projects can also generate tradable credits. Projects located in the United Kingdom will be allowable in any sector except the residential sector, but cannot cover emissions that are already subject to targets under the program. For the time being, sequestration projects are not eligible; however, the government will continue to review the criteria under which sequestration projects could be made eligible. UK companies may also be able to meet their domestic obligations through international trading and emissions reductions generated abroad once internationally recognized rules for crediting reductions from such projects have been established. It is likely that the number of these reductions that can be used toward compliance will be restricted. Prior to 2008, allowances from other national trading systems will only be admissible for UK compliance if formal recognition has been established between the United Kingdom's and the foreign country's government.

The first compliance period for companies participating via direct entry will run from January 1, 2002, to December 31, 2002, with subsequent year-long compliance periods starting January 1, 2003, and running through 2006. The first two-year compliance period for companies entering via agreements will run from January 1, 2002.

The government will maintain a registry containing the official record of participants' permit holdings. This record will be compared against companies' actual emissions at the end of the compliance period to ensure that they have complied with their emissions targets. A transaction log describing companies' permit transfers over the previous compliance period will be made public after the reconciliation period ends. The government has reserved the right to record and publish price information in aggregated form.

A gateway mechanism has been created to prevent net transfers of permits from the unit sector to the absolute sector in order to maintain environmental integrity. The registry will display in real time when the gateway is open, allowing transfers between the sectors. Only when there has been a net flow into the unit sector will any unit sector participant be able to transfer allowances to the absolute sector. Thus, the gateway would only open in the event that a company in the absolute sector sold permits to a company in the unit sector.

If a company that participates via direct entry exceeds its holdings of valid allowances, the government will suspend payments of its incentive money and reduce its allowance allocation for the next compliance period. A company failing to meet its overall emissions reduction target in the period 2002 to 2006 or withdrawing early from the scheme will have to return the entire financial incentive plus interest. These penalties will come into effect when allowances are first allocated in April of 2002. The government is also considering introducing legislation establishing additional financial penalties for noncompliance by these participants. However, this legislation will not be in place by the time the program starts in 2002. If a company entering via an agreement does not meet its target, the government may cancel the 80 percent CCL discount. This compliance penalty is already in effect.

Treatment of electricity generators, which produce a significant share of national emissions, is still a contentious issue. Generators are not subject to the climate change levy and are therefore not covered by CCAs. In addition, power and heat generators are excluded from the financial incentive program (except where the electricity and heat are generated and used onsite). There may be some scope for generators to gain allowances through participation in energy-saving projects. They can also participate by opening a trading account.

## Endnotes

1. Carbon dioxide equivalent ($CO_2e$) is a measure used to compare the global warming potentials of various greenhouse gases. Global warming potential is an expression of the warming impact of a gas over a given period—usually 100 years—as compared to carbon dioxide. For example, one metric ton of methane is assumed to exert the same impact on the climate system as 21 metric tons of carbon dioxide over 100 years. For more information on global warming potential of greenhouse gases, see research conducted by the Intergovernmental Panel on Climate Change, available at www.ipcc.ch.

2. "European Union Blasts Voluntary GHG Trading." *Air Daily.* November 29, 2001.

3. The findings in this paper are based upon the authors' experience in emissions trading. Richard Rosenzweig is a managing director at Natsource LLC, an international institutional energy and environmental brokerage that facilitates physical and derivatives transactions of electricity, coal, natural gas, emissions permits, emissions reductions, and renewable energy certificates. Matthew Varilek is an emissions markets analyst at Natsource. Josef Janssen is an economist and head of emissions trading and climate policy at the Institute for Economy and the Environment at the University of St. Gallen, Switzerland.

4. Tietenberg, Tom. *Environmental and Natural Resource Economics.* 1996. New York: Harper Collins, 337.

5. Intergovernmental Panel on Climate Change. "Climate Change 2001: Mitigation." Section 10.4.4. www.ipcc.ch/pub/tar/wg3/441.htm.

6. See Ellerman, A., R. Schmalensee, P. Joskow, J. Montero, and E. Bailey. 1997. "Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance." MIT Center for Energy and Environmental Policy Research; and Environmental Defense. September 2000. *From Obstacles to Opportunity: How Acid Rain Emissions Trading Is Delivering Cleaner Air.* Washington, DC: Environmental Defense.

7. See the United Nations Framework Convention on Climate Change, Article 4(2)(a), June 1992. Available at www.unfccc.org/resource/conv/index.html.

8. The four compliance units authorized by the Kyoto Protocol are emission reduction units (ERUs), certified emission reduction units (CERs), assigned amount units (AAUs), and removal units (RMUs). ERUs are generated under Article 6 of the Kyoto Protocol. ERUs would be subtracted from the host country's national emissions cap and added to that of the investor country. CERs are generated under Article 12 of the Kyoto Protocol. These credits would be added to the national emissions cap of the investor country. Annex B of the Kyoto Protocol lists permissible emissions or "assigned amounts" for countries taking on GHG reduction targets, expressed as a percentage of 1990 base year emissions. For compliance and trading purposes, Annex B Parties will denominate their assigned amounts in terms of AAUs, each equal to one metric ton of $CO_2e$. The notion of RMUs was created at COP-7. RMUs represent carbon sequestered through domestic sinks activities that can be used toward an Annex B country's commitment within the compliance period that the reductions are generated. RMUs will not be bankable for future compliance, thus restricting their life on the emissions market.

9. For a description of JI and CDM, see Nordhaus, Robert R., Kyle W. Danish, Richard H. Rosenzweig, and Brit Speyer Fleming. 2000. "International Emissions Trading Rules as a Compliance Tool: What Is Necessary, Effective, and Workable?" *Environmental Law Reporter*: 10837.

10. Static baselines are fixed at a permanent level, such as an entity or project's physical emissions in a given year. Dynamic baselines are emissions baselines that are linked to particular variables and may be revised upward and downward depending on project or entity characteristics such as output levels, growth rates, efficiency rates, and peer group benchmarks.

11. See case study on Ontario Power Generation and TransAlta later in this section.

12. See Section 1 above and Appendix I for definitions used in individual programs and common program elements.

13. American-style options allow the buyer to exercise an option at any time prior to the expiration date. European-style options allow the buyer to exercise an option only on the expiration date.

14. COP-6bis is the second half of the sixth Conference of Parties that started in The Hague. It took place from July 16 – July 27, 2001, in Bonn, Germany. This decision was sustained at COP-7.

15. See "The Marrakesh Accords and the Marrakesh Declaration" at www.unfccc.int/cop7/documents/accords_draft.pdf; and *Review of the Implementation of Commitments and of other Provisions of the Convention.* FCCC/CP/2001/L.7. July 24, 2001. www.unfccc.int/resource/docs/cop6secpart/l07.pdf.

16. Press release (Entergy, Elsam, and Natsource): "U.S. Utility and Danish Electricity Supplier Conduct First Trade in Danish Greenhouse Gas Allowances." December 6, 2001.

17. One of the most prominent efforts has been the GHG Protocol convened by the World Resources Institute and the World Business Council on Sustainable Development. See www.ghgprotocol.org.

18. Janssen, Josef. 2000. "Implementing the Kyoto Mechanisms: Potential Contributions by Banks and Insurance Companies." *Geneva Papers on Risk and Insurance—Issues and Practice* 24(5): 602-618.

19. Janssen, Josef. 2001. "Risk Management of Joint Implementation and Clean Development Mechanism Projects through Carbon Investment Funds." In *Instruments for Climate Policy: Limited versus Unlimited Flexibility?* Albrecht, J., M. De Clercq, and T. Verbeke, eds. Edward Elgar: Cheltenham; and Janssen, Josef. 2001. *Risk Management of Investments in Joint Implementation and Clean Development Mechanism Projects.* Ph.D. Thesis at the University of St. Gallen, Switzerland.

20. Janssen, Josef. *Risk Management of Investments in Joint Implementation and Clean Development Mechanism Projects.* Ph.D. Thesis at the University of St. Gallen, Switzerland.

21. This conclusion is derived from a pilot project conducted by the German bank LBBW in cooperation with a corporate client and the University of St. Gallen.

22. TransAlta, "TransAlta Unveils Proposal to Reduce Net Greenhouse Gas Emissions to Zero." Press Release, updated June 24, 2001. www.transalta.com.

23. TransAlta. 2000. "Beyond Kyoto: TransAlta's Blueprint for Sustainable Thermal Power Generation." www.transalta.com.

24. GEMCo. 2000. "An Introduction to GEMCo." www.gemco.org.

25. TransAlta. 2000. "TA Completes World's First Trans-Atlantic Emissions Reduction Trade." www.transalta.com.

26. Though the companies involved have chosen not to make public the exact price at which the trade occurred, they indicated that it is consistent with the range of VER prices provided in this paper.

27. TransAlta. 2000. "TA Completes World's First Trans-Atlantic Emissions Reduction Trade." www.transalta.com.

28. See discussion in Section 2.B of this paper regarding the challenges in transacting reductions derived by investing in renewable energy and demand-side management projects. For a more extensive analysis, see Cogen, J., and M. Varilek. 2000. "Promoting Renewable Energy and Demand Side Management Through Emissions Trading Program Design." Paper presented to U.S. Department of Energy workshop. October 11-13, 2000. Washington, D.C. www.rand.org/scitech/stpi/Evision/Supplement/cogen.pdf.

29. Ontario Power Generation. 2000. "Ontario Power Generation Greenhouse Gas Action Plan – 2000." www.opg.com/envComm/E_GasRep2001.pdf. The emissions reduction credits purchased included 2.3 million metric tons of $CO_2$ from internal energy efficiency savings.

30. PERT Registry. 2000. Credit Creation Protocol, "US Gen New England, Inc., Carbon Dioxide Emission Reductions from Johnston Landfill, Methane Capture." www.pert.org/Doc/app/JohnstonProtocol4-24-00.doc.

31. Hasselknippe, H. and G. Høibye. 2000. "Meeting the Kyoto Protocol Commitments, Summary – Domestic Emissions Trading Schemes." Confederation of Norwegian Business and Industry.

32. European Commission. October 23, 2001. "Proposal for a Directive of the European Parliament and of the Council establishing a framework for greenhouse gas emissions trading within the European Community and amending Council Directive 96/61/EC." Brussels. europa.eu.int/comm/environment/climat/com/01581_en.pdf.

33. Jones, Matthew. "UK Emissions Trading to Go Ahead Despite EU Concerns." Reuters. November 22, 2001. See also "European Union Blasts Voluntary GHG Trading." *Air Daily*. November 29, 2001; and "EU Tells UK to Amend Its Emissions Trading Scheme." *AFX*. November 8, 2001.

34. "European Union Blasts Voluntary GHG Trading." *Air Daily*. November 29, 2001.

35. Varilek, M. 2000. "What Kyoto Can Learn from the $NO_X$ Market." *Environmental Finance*. July-August: 20.

36. Article 25.1 of the Kyoto Protocol establishes the requirement that 55 Parties representing 55 percent of Annex B 1990 $CO_2$ emissions ratify the treaty in order for it to become binding international law.

37. Several analyses of the Kyoto Protocol have recently been conducted regarding the impact of the treaty with and without U.S. involvement. See Holtsmark, Bjart, and Catherine Hagem. June 2001. "From Small to Insignificant: Climate Impact of the Kyoto Protocol with and without U.S." Oslo: Center for International Climate and Environment Research. www.cicero.uio.no/media/1315.pdf; Nordhaus, William D. "Global Warming Economics." 2001. *Science*. Vol. 294, November 9: 1283; Manne, Alan S., and Richard G. Richels. "U.S. Rejection of the Kyoto Protocol: The Impact on Compliance Costs and $CO_2$ Emissions." 2001. Washington, D.C.: AEI-Brookings Joint Center for Regulatory Studies. October; Baron, Richard, and Martina Bosi. 2001. "Kyoto without the U.S.: Market and Policy Implications." (DRAFT) Paris: International Energy Agency; and Böhringer, Christoph. 2001. "Climate Politics from Kyoto to Bonn: From Little to Nothing?" Mannheim: Centre for European Economic Research.

38. See Manne and Richels. 2001. "U.S. Rejection of the Kyoto Protocol."

39. This legal analysis is from Robert Nordhaus and Kyle Danish, attorneys at Van Ness Feldman, August 2001 memorandum to Natsource.

40. Buchan, David. "Compromise Reached on Global Warming Treaty." 2001. *Financial Times*. November 10.

41. See Manne and Richels. 2001. "U.S. Rejection of the Kyoto Protocol."

42. William Jefferson Clinton and Albert Gore, Jr. October 1993. The Climate Change Action Plan. www.gcrio.org/USCCAP/toc.html.

43. Project descriptions can be found at the USIJI website at www.gcrio.org/usiji/projects/CurrentProjs.html and at the AIJ website at www.unfccc.int/program/aij/. These projects utilize a variety of technologies to reduce emissions, including "wind, geothermal, hydroelectric, and solar energy; coal to natural gas fuel switching; methane gas capture; biomass waste-to-energy generation; forest conservation; reforestation and sustainable land management; reduced impact logging; and energy-efficiency improvements to district heating systems and private residences." USIJI Fact Sheet, March 1999, www.gcrio.org/usiji/about/Ji_fact.pdf. Some projects have particularly large emissions reductions. For example, in Argentina, combined-cycle technology at the CAPEX power plant will result in a reduction of over 20 million metric tons of $CO_2e$. The recent Bioko Island project was implemented by CMS Energy, an electric utility and natural gas company based in the United States. Over a 30-year period, the company will reduce 71 million metric tons of carbon by eliminating the flaring of natural gas at its operations near Malabo, the capital of Equatorial Guinea.

44. The pilot program was established by decision 5/CP.1 of FCC/CP/1995/7/Add.1, the Report of the Conference of the Parties on Its First Session, held at Berlin from 28 March to 7 April 1995, *Part Two: Action Taken by the Conference of the Parties at Its First Session, Addendum*.

45. See Schwarze, R. 2000. "Activities Implemented Jointly: Another Look at the Facts." *Ecological Economics*. 32: 255-267; and Dixon, R., ed. 1999. *The U.N. Framework Convention on Climate Change Activities Implemented Jointly (AIJ) Pilot: Experiences and Lessons Learned*. Kluwer: Dordrecht.

46. The Secretariat of the UNFCCC maintains a list of AIJ projects at www.unfccc.de/program/aij/aijproj.html.

47. Many USIJI projects are also AIJ projects. The projects are distributed over 14 countries in Latin America, 10 in Central and Eastern Europe, 10 on the African continent, five in Asia (besides China and India), and two in the Pacific Islands. Twenty-one projects are located in Estonia. Twenty-five projects are located in Latvia.

48. See Pilot Emission Reduction Trading Project (PERT), "PERT ERC Creations." 2001. www.pert.org/Doc/Reviews2.xls; and PERT, "Draft Rules for Emission Reduction Trading in Ontario," www.pert.org/pdf/Draft%20Rules.pdf.

49. This law originated from Oregon House Bill 3283 introduced in the 69th Oregon Legislative Assembly (1997, Regular Session). The rules for the Oregon $CO_2$ standard are in Oregon Administrative Rules, Chapter 345, Division 24.

50. The price was raised to $0.85 per ton (from $0.58 per ton) in September 2001. The information provided in this project summary is based upon the $0.58 per ton price.

51. The Climate Trust was formerly known as the Oregon Climate Trust.

52. Though the Oregon law allows project developers to meet their offset requirements by paying the fixed fee of $0.85 per metric ton, it does not require The Climate Trust to secure offsets at that price. In fact, The Climate Trust has paid an average of $1.50 per metric ton of $CO_2$ for offsets. Consequently, power plant developers' payments to The Climate Trust have not offset the total quantity of emissions for which they made a payment. Once an applicant pays The Climate Trust, liability for producing the offsets shifts from the plant developer to The Climate Trust. This has led power plant developers to rely on The Climate Trust as a fixed-cost, guaranteed means of compliance. (Information about the average price paid per ton was garnered from phone conversation with The Climate Trust. Confidentiality agreements prohibit the release of the prices paid for $CO_2$ offsets in individual projects.)

53. The Oregon law only allows $CO_2$ reductions to be used to meet the offset requirement.

54. "Over $5.5 Million to Be Awarded to Counter Climate Change," The Climate Trust Press Release, January 30, 2001. See www.climatetrust.org.

55. "The Climate Trust Awards Landmark Contract with the Lummi Indian Tribe for Storing Atmospheric Carbon," The Climate Trust Press Release, May 15, 2001; "The Climate Trust Awards Funds for Web-Based Carpool Matching," The Climate Trust Press Release, May 8, 2001; "The Climate Trust Awards Funds to Innovative Landfill Gas Project to Offset Global Warming Pollution," The Climate Trust Press Release, July 16, 2001; and "Innovating Financing of Wind Power to Cut Carbon Dioxide Levels," The Climate Trust Press Release, September 5, 2001. See www.climatetrust.org.

56. Senter can only anticipate the rules governing JI, since the Kyoto Protocol has not been finalized.

57. See Senter web site at www.senter.nl/erupt.

58. Project-related documents can be found at the PCF Document Library, www.prototypecarbonfund.org.

59. "Greenhouse Gas Emissions Trading in BP." May 2001. www.bp.com/downloads/340/ghg_emissions_trading_in_bp_may2001.pdf.

60. Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, Air Program Planning Unit. "310 CMR 7.29 Emissions Standards for Power Plants." See www.state.ma.us/dep/bwp/daqc/files/regs/729final.doc.

61. Act no. 376 of June 2,1999, Folketinget (Danish Parliament), Section 5, Subsection 4.

62. See UK Emissions Trading Scheme, www.defra.gov.uk/environment/climatechange/trading/index.htm.

This report describes the emerging emissions trading market, including key features of early transactions as well as the market's potential evolution under domestic and international climate change policy. The Pew Center on Global Climate Change was established by the Pew Charitable Trusts to bring a new cooperative approach and critical scientific, economic, and technological expertise to the global climate change debate. We intend to inform this debate through wide-ranging analyses that will add new facts and perspectives in four areas: policy (domestic and international), economics, environment, and solutions.

**Pew Center on Global Climate Change**
**2101 Wilson Boulevard**
**Suite 550**
**Arlington, VA 22201**
**Phone (703) 516-4146**
**www.pewclimate.org**