The Global Carbon Market

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Presentation to:

Commission des transports et de l'environnement
Assemblée Nationale du Québec

February 18, 2003

Recently Point Carbon, a Norwegian firm that analyzes the market for greenhouse gas emissions, reported that 382 transactions involving 394 million tonnes of CO_2 equivalent emissions had occurred from 1996 through 2002. The commitments under the Kyoto Protocol, assuming it enters into force, do not take effect until 2008. Why is there such a large market for greenhouse gas emission reductions so far in advance of a regulatory requirement?

My presentation discusses the development of the global carbon market to-date and anticipates how the market is likely to evolve over the next decade if the Kyoto Protocol enters into force.

Development of the Global Carbon Market

Products and Prices

The carbon market includes numerous "products" consisting of different categories of units, different vintages for a particular category of unit, and different types of transactions.

The main categories of units, all of which permit the release of greenhouse gas emissions to the atmosphere, are:

- Verified emission reductions (VERs) -- emission reductions resulting from voluntary actions to reduce greenhouse gas emissions or increase the carbon stored in sinks that have been verified by an independent third party.
- National compliance units -- allowances or credits that can be used for compliance with a national (or sub-national) obligation to limit greenhouse gas emissions. Allowances and credits are permits issued by the regulator responsible for the program.
- Kyoto compliance units -- units that can be used by a Party to the Kyoto Protocol for compliance with its emissions limitation commitments under the Protocol. This includes assigned amount units (AAUs) and sink enhancement (removal) units (RMUs) issued to Kyoto Parties, emission reduction units (ERUs) for joint implementation (JI) projects, and certified emission reductions (CERs) for clean development mechanism (CDM) projects in developing country Parties.

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Carbon Products and Prices, 2002

Product	Vintage	Source of the Units	Buyers	Price Range (US$/tCO$_2$e)
Verified Emission Reductions (VERs)				
Annex I	1991 - 2007	Voluntary actions to reduce emissions or enhance sinks verified by an independent third party	Companies with self-imposed targets	$0.60 - $1.50
Annex I	2008 - 2012		Companies expecting to face compliance obligations after 2008	$1.66 - $3.00
Non-Annex I	Post 2000			$1.15 - $3.50
National Compliance Units				
Denmark	2001 - 2003	Danish government	8 electricity generators	$2.14 - $4.17
United Kingdom				
Absolute sector	2002 - 2006	UK government	All participants	$5.76 - $9.36[a]
Relative sector	2002 -2010	UK government after independent verification	Participants with relative targets	About $4 to $8
European Union Member States[b]	2005 - 2007 2008 - 2012	National government	Installations subject to trading programs	About $4 $2.00 to $7.50[c]
Kyoto Compliance Units				
CERs	2000 - 2012	CDM Executive Board for projects in Non-Annex B Parties	Annex B governments and companies in Annex B countries that expect to have a compliance obligation post 2008	$3.30 to $5.50[d]
ERUs	2008 - 2012	Annex B governments for projects they host		$3.00 - $8.00[e]
AAUs	2008 - 2012	Annex B governments based on Kyoto targets[f]		$3 to $5[g]

Notes:
a Prices rose steadily during 2002 to over $18 in October, but have since fallen back into this range.
b All countries that are members of the European Union, 25 by 2005, will be required to have an emissions trading program. Non-member countries may negotiate reciprocal agreements with the EU.
c Results of an expert poll on the price of a forward contract in December 2003 for delivery of EU allowances in 2005 -- median $4.00 and range $2.00 to $7.50.
d The Netherlands government requested bids for CERs and announced a maximum prices that range from $3.30 to $5.50 depending upon the type of project.
e The first purchases of ERUs by the Netherlands government had a price range of $4.40 to $8.00. The target price range for the second tender was $3.00 to $5.00 and the average cost of the units purchased was about $4.80.
f Some Annex B countries, including Russia and Ukraine, have commitments under the Kyoto Protocol that exceed their projected emissions. Thus, they are likely to have surplus AAUs even if they implement no emission reduction actions. Such units are commonly called "hot air".
g Slovakia has sold AAUs to a Japanese firm at a price believed to be in the $3 to $5 range.

Source: R. Rosenzweig, M. Varilek, B. Feldman, R. Kuppalli and J. Janssen, *The Emerging International Greenhouse Gas Market*, Pew Center on Global Climate Change, Arlington, Virginia, March 2002, Table 1, p. 18.

Verified emission reductions have existed since the mid-1990s. The market distinguishes between VERs created after 2000 in developing countries and 2008 in Annex I countries since it may be possible to convert them to Kyoto compliance units. That possibility does not exist for earlier VERs. Establishment of the Danish CO_2 trading program in 2001 and the United Kingdom greenhouse gas trading scheme in 2002 created national compliance units for those countries. Kyoto compliance units do not yet exist.

Transactions involving all of these types of units are currently taking place even though the Kyoto compliance units do not yet exist. The basic types of transactions are:

- "Spot" sales, which involve immediate (within days) delivery of the units similar to the purchase of mutual fund units or shares. Spot sales can occur only for units that already exist.
- Forward contracts, which involve delivery of the units on a specified date in the future. The price involves an initial payment, possibly interim payments, and final payment upon delivery.
- Options, which provide the buyer an option to buy the units on a specified date in the future at a specified price.

Forward contracts and options are currently available for all of the products; indeed they are the only contracts currently available for Kyoto compliance units.

The prices specified in forward contracts for Kyoto compliance units during 2002 suggest a price range of US$3 to US$5/tCO_2e for these units. Prices for VERs that might be able to be converted into Kyoto compliance units range from about US$1 to US$3/tCO_2e. This price range represents a premium over VERs that can not be converted into Kyoto units and a substantial discount relative to Kyoto units reflecting the risk that conversion may not be possible. The prices in the Danish and UK markets reflect the circumstances unique to those markets.

Evolution of the Market: 1996 - 2000

According to Point Carbon virtually all transactions from 1996 through 2000 occurred in North America. All of these transactions involved VERs. All of the trading activity was voluntary; the buyers did not face regulatory obligations related to greenhouse gas emissions.

Greenhouse gas trading in Canada occurred through two pilot programs as well as independent trades.

- The Pilot Emission Reduction Trading (PERT) project operated from 1996 through 2001 as a demonstration project for emissions trading of greenhouse gases and other pollutants in Ontario and neighbouring airsheds. Over 60 emission reduction projects were submitted to PERT with greenhouse gas emission reductions exceeding 13 million tonnes of CO_2e. Most of the VERs purchased through PERT were bought by Ontario Power Generation Inc. to meet its voluntary emissions targets.

- The Greenhouse Gas Emission Reduction Trading (GERT) pilot was established to learn about greenhouse gas emission reduction trading through reviews of actual projects. The provinces of Alberta, British Columbia, Quebec, Manitoba, Nova Scotia, and Saskatchewan participated together with the federal government, several industry associations and environmental groups. During its lifetime -- 1998 through 2001 -- GERT reviewed 10 projects with an estimated reduction of over 5 million tonnes of CO_2e. Reductions from five of the projects were purchased by companies and governments.

The Greenhouse Emissions Management Consortium (GEMCo) was founded in 1996 to help companies better understand emissions trading by buying VERs from various types of emission reduction and sink enhancement projects. GEMCo's membership included ATCO Utilities, BC Gas Utility Ltd., BC Hydro, Enbridge Ltd., EPCOR Utilities Inc., NOVA Chemicals Ltd., Nova Scotia Power Inc., Ontario Power Generation Inc., SaskPower, TransAlta Corporation, TransCanada PipeLines Ltd., and Westcoast Energy Inc. Member companies decide how many VERs to purchase from each project based on their own needs and interests. GEMCo attracted considerable attention for the purchase of VERs resulting from increased carbon sequestration in agricultural soil by Iowa farmers. Some GEMCo members, including Ontario Power Generation Inc. and TransAlta Corporation also identified and consummated their own transactions. In addition, Suncor Energy Inc., and possibly a few other companies, purchased VERs on their own without participating in either of the pilot projects or GEMCo.

Canadian companies concerned about climate change purchased VERs for a variety of reasons. The companies wanted to gain experience with emissions trading, test the feasibility of different emission reduction and sequestration actions, meet self-imposed emissions targets, influence government policy relating to climate change and emissions trading, and hedge risks associated with future limits on greenhouse gas emissions.

The VER transactions between 1996 and 2000 involved spot sales, as well as forward contracts and options for reductions achieved prior to 2008 and after 2008. Many of the VERs purchased by Canadian companies came from American sources. The main reason for this was the impression that the American government was more likely to provide "credit for early action" than the Canadian government. In other words, the buyers believed that the American government was more likely to award Kyoto compliance units for future reductions from early emission reduction and sequestration projects than the Canadian government.

Evolution of the Market: 2001 - 2002

Over the past two years several new products -- national compliance units for European trading programs and Kyoto compliance units -- have entered the market. As a result the market has grown in size and geographic scope. Canadian and American trades of VERs declined during 2001 as the pilot projects concluded and during 2002 due to the uncertainty associated with Kyoto ratification and future policies to limit greenhouse gas emissions. Trading activity increased in Denmark and the United Kingdom as they introduced emissions trading programs in 2001 and 2002 respectively. The Netherlands and the World Bank's

Prototype Carbon Fund contracted for delivery of Kyoto compliance units during 2001 and 2002. The total number of trades increased dramatically in 2002 -- exceeding the total for the previous six years combined -- but with most of the increase coming in the United Kingdom.

A trading program covering CO_2 emissions by electricity generators was launched in Denmark in 2001. Trading activity is limited since there are only eight participants (of which two dominate) that are competitors in the electricity market and a sale of allowances is interpreted as an opportunity for a competitor to increase market share. Trades in this market have been mostly spot sales.

The emissions trading program in the United Kingdom is large and complex. It covers over 10,000 establishments in over 40 industries, but excludes electricity generators and oil refineries. The vast majority of the participants are covered by agreements that specify allowable emissions per unit of output. A small minority (about 50) of the participants have agreed to absolute emissions targets. The absolute allowances can be used for compliance by all participants while the per-unit credits can only be used by participants with such targets. Thus the program has two types of compliance units with different prices for spot sales as well as forward contracts and options.

In 2000 the Netherlands government requested bids for ERUs from eastern European countries to help meet its commitment under the Kyoto Protocol. Contracts to purchase four million tonnes of CO_2e from five projects were awarded in 2001. Bids for additional ERUs and for CERs were solicited in late 2001. The purchase of over five million tonnes of ERUs from four projects was announced in late 2002 at an average price of about $4.80/t CO_2e. Negotiations for the purchase of CERs are still underway. These are all forward contracts.

The Prototype Carbon Fund (PCF) established by the World Bank began negotiating contracts for future delivery of ERUs and CERs during the past two years. Over US$100 million has been raised by the PCF to invest in projects that will generate ERUs or CERs. The funds have been invested by several national governments, including Canada, and corporations. Investors get a share of the ERUs and CERs and so get a diversified portfolio of units. Interest has been so high that the World Bank has announced the establishment of two more funds and other organizations have announced the creation of similar funds.

As the likelihood of entry into force of the Kyoto Protocol has increased and forward contracts for Kyoto compliance units have become available the market for VERs has declined, but not disappeared. A few firms, such as Ontario Power Generation Inc., with a self-imposed emissions target for the current year are still buying VERs to help meet their target. A few firms are buying VERs to offset the emissions associated with a product to make it more attractive to consumers. VERs are being purchased to offset the emissions associated with meetings -- Canada offset the emissions associated with the G8 summit. And individuals can buy VERs to offset the emissions of their vehicles or flights.

Future Evolution of the Global Carbon Market

European Trading Programs, 2005

The next major development in the evolution of the global carbon market is likely to be the implementation of emissions trading in the European Union. Late last year the European Parliament and the Council gave initial approval to a Directive that would require each Member State to implement a CO_2 trading program for specified sources beginning in 2005.

The Directive specifies various conditions that the national programs must satisfy, including:

- the gases covered -- CO_2 only initially but with provisions to include other gases;
- the sources covered -- electricity generation and other large fossil fuel users, oil refineries, coke ovens, metal refiners, steel producers , cement plants, lime plants, glass manufacturers, ceramic product producers, and pulp and paper plants that exceed specified threshold sizes;
- allocation of allowances -- free during the 2005-2007 period;
- non-compliance penalty -- €40 plus an allowance for each tonne of excess emissions; and
- unrestricted trade in allowances among participating programs.

Although not yet specified, requirements for monitoring, reporting, verification and registries will be developed.

The Directive allows Member States flexibility in some areas, including:

- the allocation of allowances to participants -- but, the national allocation plan must meet specified criteria, is subject to review by other States and can be rejected by the Commission;
- opt-out for specified facilities -- specified facilities can opt-out of the program for 2005-2007 if they are subject to comparable emission reduction, monitoring, reporting, verification requirements and similar penalties; and
- compliance pools -- groups of participants may be allowed to form pools for compliance purposes with responsibility devolving to the individual facilities if the pool does not comply.

With the expansion of the European Union in 2004, the 25 Member States will be required to have emissions trading programs that comply with the Directive in 2005. The programs are expected to have 4,000 to 5,000 participants and cover about 45% of the European Union's total CO_2 emissions. Point Carbon projects the size of the EU market at about US$8 billion per year in 2007.

Without the Directive, a few of the smaller countries (e.g., Luxembourg and Malta) probably would not be able to use emissions trading because the number of participants would be too small to create a competitive market. Free trade in allowances across programs, as required by the Directive, means that there will be a single European market for allowances. Then the number of participants in a country's trading program is no longer a concern.

Adoption of the Directive would force changes to the existing programs in Denmark and the United Kingdom. The Danish program is scheduled to end on December 31, 2003. If the Danish program is extended it would need to be expanded to cover sources other than electricity generators as required by the Directive. Otherwise the Danish program is reasonably consistent with the requirements of the Directive.

Substantial changes to the United Kingdom program will be required to meet the Directive. Emissions by electricity generators and oil refineries must be covered to comply with the Directive. At present industrial and commercial customers are accountable for the emissions associated with their electricity consumption. To avoid double counting, the targets of existing participants must be revised to exclude the emissions associated with their electricity consumption. With revised targets, many of the sources required to participate in the EU trading program could be allowed to opt-out. Alternatively, they could be removed from the existing program and included in a new program under the Directive. A large majority of the participants in the current program will not be covered by the Directive; a separate program may be maintained for those sources.

Other Developments 2003-2007

Norway has announced that it plans to start an emissions trading program for greenhouse gases in 2005. The proposed design is similar to that of the EU Directive for the sources specified by the Directive. However, the Norwegian design would cover additional gases and a much larger share of its national emissions.

Japan has announced that it plans to experiment with emissions trading beginning in 2003. Details of the Japanese proposal are not yet available.[1] The EU Directive states that agreements should be concluded with other Annex B Parties to the Kyoto Protocol to provide for the mutual recognition of their greenhouse gas allowances. Thus, the Norwegian and Japanese programs could be linked to the EU market.

Massachusetts has implemented a cap on the CO_2 emissions of seven old coal-fired electricity generating stations equal to their average emissions for 1997-99. The stations also will need to reduce their emissions intensity by 10% by 2006 or 2008. Credits purchased from other CO_2 emission reduction programs approved by the regulator can be used to comply with the requirement. New Hampshire has established a target of reducing the CO_2 emissions for the three fossil-fired generating units in the state to 10% below the 1990 level. Credits for CO_2 reductions approved by the regulator can be used to meet the target.[2]

[1] Switzerland has passed a law that would allow emissions trading to meet its fossil fuel related CO_2 emissions targets, but the program could not begin until 2008. Extensive work on emissions trading for greenhouse gases has been undertaken Canada but almost all of this work assumes that the program would not begin until 2008.

[2] The three stations are owned by the same company, so any trading among the three stations will be internal transfers.

Kyoto compliance units will start to become available during this period, probably in 2003. The CDM Executive Board is expected to accredit several "designated operational entities" during the first half of 2003 and they can then review and validate proposed projects. Since some of the projects have already started, the first CERs could be issued soon after the initial projects are registered. Registration of projects will reduce the uncertainties associated with forward contracts and options for CERs. And the supply of CERs will increase over time, improving liquidity in the spot market.

Beginning in 2004 Annex B Parties will be able to establish their initial assigned amount under the Kyoto Protocol. Then they will be able to issue and trade their AAUs. Since an ERU can only replace an AAU, this will allow both AAUs and ERUs to be traded and further improve liquidity in the spot market for Kyoto compliance units.

While the foregoing developments suggest a significant growth in the markets for national compliance units and Kyoto compliance units, there will still be a demand for VERs. Oregon has a requirement that new energy facilities offset a portion of their greenhouse gas emissions. This requirement must be met through new emission reduction or sequestration projects, rather than the purchase of allowances or credits. Washington has implemented a similar requirement through its approvals process for new facilities. Licenses issued for two new coal-fired generating stations in Alberta require the owners to offset CO_2 the emissions in excess of those from a comparable gas-fired combined cycle plant. The detailed rules for meeting this condition are not yet known.

The Chicago Climate Exchange, a voluntary emissions trading program, has announced that it will begin operation in the first quarter of 2003 with at least 14 participants, including Manitoba Hydro. Participants commit to reduce their emissions of greenhouse gases by four percent below the average of their 1998-2001 baseline by 2006.

The current market for VERs to help meet voluntary corporate commitments and to offset the emissions associated with products, or to offset the emissions associated with travel will remain but probably not grow significantly.

Further Evolution - 2008-2012

The start of the Kyoto commitment period should see a further increase in the size of the global carbon market and further consolidation of the different markets.

Canada, possibly Switzerland and perhaps other Annex B Parties will launch domestic emissions trading programs to help meet their Protocol commitments. Beginning in 2008 Member States will be able to unilaterally expand the coverage of their emissions trading programs under the EU Directive. The US market may introduce a national trading program or additional state programs. These developments will expand the carbon market.

It is likely that all of the programs in Annex B countries will allow domestic allowances to be exchanged for Kyoto units. No program has yet developed rules for such exchanges. Unless

a country imposes restrictions on such exchanges, this will tend to equalize the prices of the Kyoto units and the national compliance units. As long as each program allows easy exchange between Kyoto units and national allowances, the prices should converge even though the designs of the domestic trading programs are quite different.

Considerable work on the design of a greenhouse gas emissions trading program for Canada has been undertaken over the past few years by the Domestic Emissions Trading Working Group. Implementation is likely to occur through the negotiation of "covenants" with industry groups. Each covenant is expected to set out emission reduction commitments, monitoring and reporting obligations, provisions for the use of trading for compliance, penalties for non-compliance, and other matters. It is not yet clear whether the relevant provisions of the covenants will be sufficiently uniform to create an efficient emissions trading program. To reward low cost emission reductions it must be possible for sources to sell their surplus credits or allowances easily on the domestic or international market.

Even though a country is not a Party to the Protocol it may choose to allow entities to use Kyoto units for compliance with domestic greenhouse gas emissions limitation obligations. This would be attractive to participants if the cost of Kyoto units was less than the cost of the allowances for the program. Non-Party allowances could not be used for compliance with Kyoto Protocol obligations. A recent bill by Senators McCain and Lieberman provides for the establishment of a greenhouse gas emissions trading program in the United States beginning in 2010 with the use Kyoto units for compliance for up to 15% of total emissions.

Summary

From 1996 through 2000 the carbon market consisted entirely of VERs with spot, forward and option contracts. Most of the trading occurred in North American with Canadian firms accounting for a significant share of the purchases.

National compliance units for Denmark and the United Kingdom were introduced in 2001 and 2002 respectively. Forward contracts for Kyoto compliance units -- AAUs, CERs and ERUs -- were signed for the first time in 2001 and 2002 as well. Since these units can be used for compliance they are preferred to and command higher prices than VERs. The volume of VER trades has declined, but total trading activity has increased substantially, especially in the United Kingdom.

The EU Directive is expected to lead to the next major increase in the size of the carbon market. If adopted it will require all 25 Member States to have CO_2 emissions trading programs in 2005. Other countries, such as Norway and Japan, are also expected to launch trading programs about that time. They may be independent or be linked to the EU programs. This is projected to increase the size of the market from less than a hundred million dollars per year today to several billion dollars per year in 2007.

A growing quantity of Kyoto compliance units will become available over the next five years. This will enable spot sales of those units as well as the current forward and options contracts.

Prices for Kyoto compliance units may differ from those of the domestic trading programs in the EU, Norway, Japan and American states. Since free trade is allowed among EU programs the price should be relatively uniform across those programs and this is likely to be the largest segment of the global market.

With the beginning of the Kyoto commitment period in 2008 more countries will launch emissions trading programs and countries with programs will increase the coverage of their programs. This will expand the market further.

All Annex B countries are expected to allow relatively easy exchange of national units for Kyoto compliance units. If that is the case, prices of national units will tend to converge to the prices of Kyoto compliance units even if domestic programs have different designs. If the United States does not ratify the Protocol but implements a domestic emissions trading program it could allow the use of Kyoto units for compliance. Kyoto units would be used for compliance if the price was lower than that of American allowances. American allowances could not be used for compliance with Kyoto commitments. Thus the price harmonization could extend even to non-Parties.

The price of carbon will fluctuate as does the price of every product. And price differences among products will remain. CERs from reforestation projects, for example, might be discounted relative to the prices of CERs from other projects. The AAUs from a country that may not meet its commitment may command a lower price than those from a country expected to meet its commitment. And the national units of a country that restricts exchanges with Kyoto units may have a different price than the Kyoto units. But these price differences should be smaller than the price range in the market last year -- from less than $1 to over $15.

What will the price be in 2010? Using a discount rate of 10% per year, a price of US$5/t$CO_2$e in 2002 is equivalent to about US$10/t$CO_2$e in 2010. Model results assuming a perfectly competitive market average US$3.25 with a range from $0 to $16.50/t CO_2e in 2010 (in 2010 dollars). Assuming that Russia behaves as a monopolist raises the average price to US$14.50 with a range from $1.50 to $40.00/t$CO_2$e in 2010 (in 2010 dollars). A recent expert poll on the price of allowances in 2008 indicated a median of $8.00/t$CO_2$e with a range of $2.00 to $30.00. Obviously there is a lot of uncertainty about the future price of carbon, but there is a lot of uncertainty about the future price of oil as well.