GLOBE ADVISORS
A division of the GLOBE Group

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Primer on **Climate Change & Carbon Trading**

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GLOBE Advisors Primer on

Climate Change & Carbon Trading

2012

Prepared by:

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Forward

For the past 20 years, the GLOBE Group has been an active facilitator of change in the business of the environment. GLOBE provides a suite of essential services that assist both the corporate sector and evolving industries in their collective efforts to mitigate or adapt to the impacts of climate change.

The emerging markets and regulations designed to manage greenhouse gas emissions and to mitigate the impacts of climate change are part of a complex and not easily understood tangle of politics, policy, business interests, self-interests, and environmentalism. There is a need for simplicity and clarity – one of the reasons for this Primer on Climate Change and Carbon Trading, developed by GLOBE Advisors, a division of the GLOBE Foundation.

GLOBE Advisors is an international business consultancy with vast networks and extensive experience in the areas of international project management, partnership development, and market research. We are well positioned to undertake endeavours that further our mandate of developing the business of the environment.

This Primer is an update to GLOBE's 2009 Carbon Report and is designed to provide some background on the current science and policies designed to address climate change. It also serves as an overview to the current status of carbon markets, describing the various players and detailing the schemes designed to facilitate emissions trading.

While the future of carbon markets is uncertain, the wheels are in motion to affect measurable changes that counter the human activities that accelerate climate change.

John D. Wiebe
President and CEO
GLOBE Advisors

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1 Introduction

Climate change is one of the most important global issues of our time, and also one of the most controversial. Amidst the global debate, vital facts on this matter are often lost. Despite extensive coverage on climate change, many still are not clear on its full implications, or are confused by the acronyms, the players involved, and the contradictory studies and reports.

The first major international effort to develop a climate change strategy was the United Nations Framework Convention on Climate Change (UNFCCC), an agreement signed by 189 countries in 1992. The Framework eventually led to the formation of the Kyoto Protocol in 1997. The Kyoto Protocol, which was ratified by 193 parties, established specific targets for emissions reductions for industrialized countries (UN Framework Convention on Climate Change (a), 2011).

One of the main features of the Kyoto Protocol was the establishment of market-based mechanisms to stimulate the development and deployment of technologies that could help reduce carbon-based greenhouse gas (GHG) emissions and conserve energy. In broad terms, countries can meet their emission reduction targets either by lowering their own emissions, by purchasing carbon credits (which are essentially permits to emit GHGs), or by investing in projects that would reduce emissions in other countries.

The ability to earn and to trade carbon credits has given rise to new markets for these instruments. Compliance carbon markets have developed to meet the Kyoto Protocol quotas, the largest of which is the European Union Emissions Trading Scheme (EU ETS). A forerunner for this cap-and-trade system was implemented in the United States in 1990 through the Acid Rain Program that formed part of their Clean Air Act (United States Environmental Protection Agency, 2009). This law in effect put caps on sulphur dioxide (SO_2) emissions and allowed for trading of excess allowances.

Worldwide, it is estimated that the emerging market for carbon credits has now stalled at about $142 billion after years of continuous growth. Experts attribute the lack of growth to a lack of post-2012 regulatory clarity which is when the existing legally-binding Kyoto compliance period ends (Linacre et al., 2011). A smaller but growing voluntary carbon market also exists where institutions and individuals purchase carbon offsets that reduce their GHG emissions.

Reports published in recent years indicated that, as a society, we were beginning to move in the right direction but were failing to reach the carbon intensity reductions needed to limit global warming to two degrees by 2050. New information released in 2011 looks even more troubling, as for the first time in several years, the carbon intensity of the global economy (CO_2 emissions per unit GDP) is actually increasing, and we are now, in fact, moving in the wrong direction (PwC, 2011).

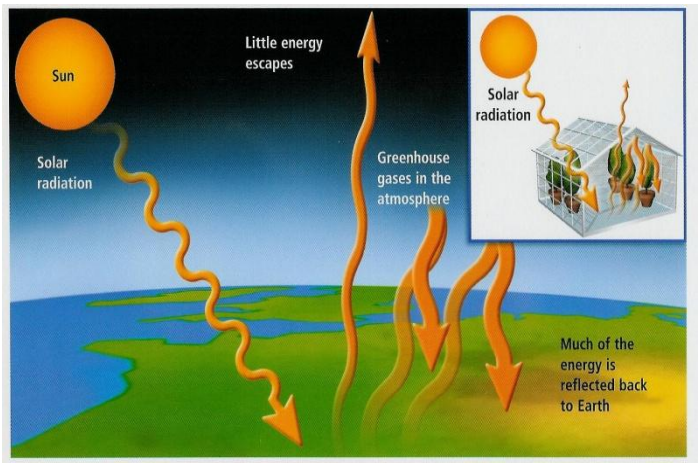
Moving forward, the role of market-based solutions will continue to grow, and this primer provides readers with a current market assessment of existing mechanisms, as well as the planned direction for future initiatives.

2 Background on Climate Change Science

2.1 What are Greenhouse Gases?

Greenhouse gases (GHGs) are gases that exist in the Earth's atmosphere and act as an insulating blanket on the planet by trapping some of the sun's thermal radiation. These gases are one of the primary reasons that life can exist on Earth.

When sunlight reaches the Earth's surface, some of the energy is absorbed and warms the planet while the rest is radiated back to the atmosphere at a longer wavelength than the sunlight (see Figure 1). Some of these longer wavelengths are absorbed by GHGs in the atmosphere before they are lost into space. The absorption of this long-wave radiant energy warms the atmosphere. These GHGs act like a mirror and reflect back to the Earth some of the heat energy which would otherwise have been lost. The reflecting back of heat energy by the atmosphere is called the "greenhouse effect".



Source: Chilton Elementary, 2002

Figure 1: The greenhouse effect results when the Earth's atmosphere traps the sun's energy and warms the surface.

Most GHGs exist naturally, but human activities, primarily the generation of energy through combustion of carbon-based fossil fuels, are pushing atmospheric levels of these substances higher than usual.

Examples of the atmospheric lifetime and Global Warming Potential (GWP) for the six primary anthropogenic GHGs:

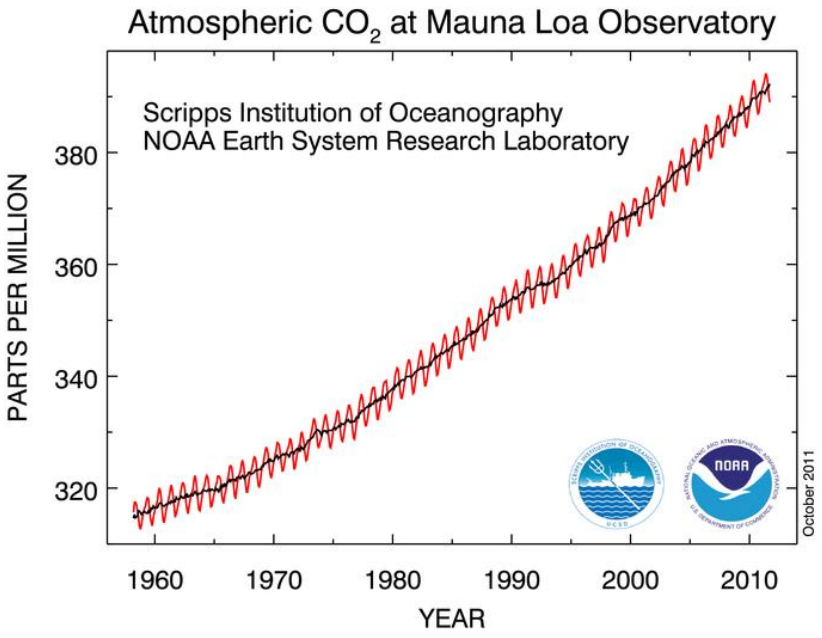
1. **Carbon Dioxide (CO_2)** has a variable atmospheric lifetime and cannot be specified precisely. Recent work indicates that recovery from a large input of atmospheric CO_2 from burning fossil fuels will result in an effective lifetime of tens of thousands of years. CO_2 is defined to have a GWP of 1 over all time periods.
2. **Methane (CH_4)** has an atmospheric lifetime of 12 ± 3 years and a GWP of 62 over 20 years, 23 over 100 years, and 7 over 500 years. The decrease in GWP at longer times is because methane is degraded to water and CO_2 by chemical reactions in the atmosphere.
3. **Nitrous Oxide (N_20)** has an atmospheric lifetime of 120 years and a GWP of 296 over 100 years.
4. **Hydrofluorocarbons (HFCs)** has an atmospheric lifetime of 12.1 years and a GWP of 1,700 over 100 years.
5. **Perfluorocarbons (PFCs)** has an atmospheric lifetime of 50,000 years and a GWP of 5700 over 100 years.
6. **Sulphur Hexafluoride (SF_6)** has an atmospheric lifetime of 3,200 years and a GWP of 22,000 over 100 years.

With the recent increases in agricultural and industrial practices, humans have begun emitting significant amounts of GHGs including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), per-fluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

Carbon dioxide is the largest component of human GHG emissions in terms of volume, and such gases are usually measured in terms of carbon dioxide equivalent (CO_2e), a metric used to compare the contribution to global warming of various GHGs.

For example, the GWP of methane, which is the second most abundant GHG after carbon dioxide accounting for 14% of global emissions, is rated as 25 over 100 years, meaning that an emission of one metric tonne of methane is equal to emissions of 25 tonnes of carbon dioxide in terms of contribution to climate change (Global Methane Initiative, 2011).

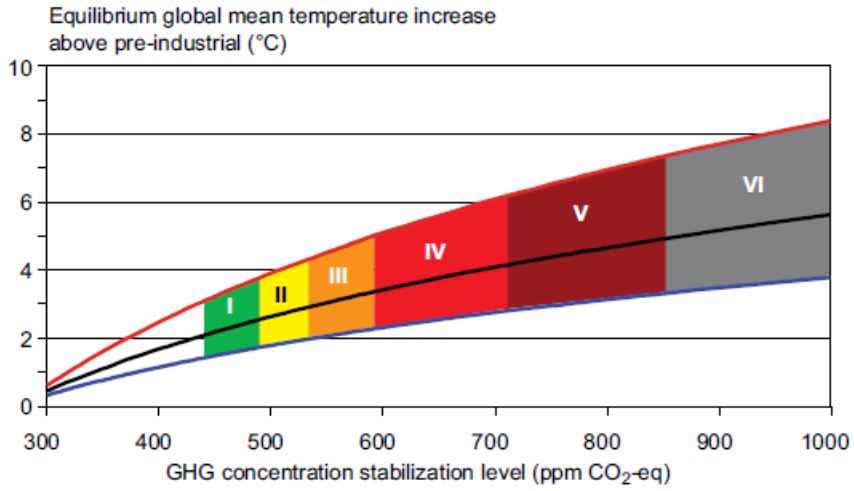
Atmospheric levels of GHGs have increased dramatically since large-scale industrialization began around 150 years ago, from 280 parts per million (ppm) CO_2e to 388 ppm. The increase has been so significant that National Oceanic and Atmospheric Administration (NOAA) reported that atmospheric concentrations of carbon dioxide reached their highest reported levels ever in May 2011 (National Oceanic and Atmospheric Administration (a), 2011). Figure 2 illustrates this rapid and steady increase of CO_2 levels over the last half century.



Source: National Oceanic and Atmospheric Administration (b), 2011

Figure 2: Rapid increase in CO_2 concentrations in the atmosphere since 1960.

The result of rising concentrations of CO_2e in the atmosphere can be linked directly to global mean temperatures. This correlation is illustrated in Figure 3.



Source: IPCC Working Group III Report, "Mitigation of Climate Change", 2007

Figure 3: The effect of greenhouse gas concentrations on temperature.

If the Earth's concentration of CO_2e reaches 600 ppm, the global mean temperature is expected to rise between 2.2 and 5.0 degrees Celsius above the pre-industrial equilibrium. It is possible for the planet to reach this level of CO_2e in the atmosphere by as early as 2020 if concentrations increase to as little as 10% over 2000 levels (Intergovernmental Panel on Climate Change, 2007).

Scientists on the IPCC claim the following:

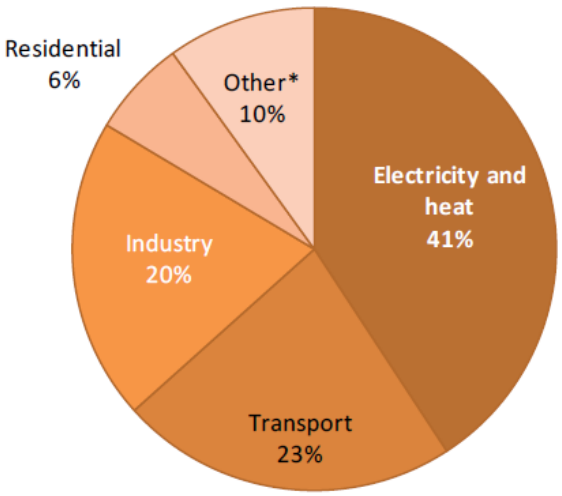
- The world has already warmed by an average 0.7C in the past century. Temperatures in polar-regions have increased the fastest, with 5C rises in some areas;
- Another 1.3 degrees Celsius of warming is inevitable because of GHGs already released into the atmosphere;
- Alpine ski resorts will be left without snow and many rivers will dry up. In Africa, up to 250 million more people will suffer water shortages by 2020;
- Worldwide agriculture could be devastated, especially in parts of Africa and Asia where some crop yields could be halved by 2020;
- Tidal flooding will increase. Global sea levels are rising by 3.1 mm a year and accelerating (mostly due to warm water expansion);
- Emissions of CO_2 - the main GHG - grew by 80% between 1970 and 2004. Its concentration in the atmosphere is the highest it's been for 650,000 years; and
- The amount of CO_2 emitted by humans will rise by up to 90% by 2030 unless action is taken.

2.2 Where do Greenhouse Gases Come From?

Energy used for industrial processes, electrical generation, and transportation, make up the largest components of human-caused (i.e., anthropogenic), GHG emissions, mostly through the extraction and combustion of fossil fuels (see Figure 4 below). Coal, oil, and natural gas are all hydrocarbon-based fuels that emit CO_2 when consumed, and provide the majority of the world's energy supply. The International Energy Agency reported that global primary energy demand rebounded by a remarkable 5% in 2010, pushing CO_2 emissions to a record 30.6 gigatonnes in 2010 and that subsidies that encourage wasteful consumption of fossil fuels jumped to over $400 billion (UN Environment Programme, 2011).

The increase in nitrous oxide (N_2O) concentration is primarily due to agriculture. Deforestation and changes in land use are also major contributors to GHGs, as carbon is released from storage in plants and trees. Landfills are a source of methane as waste decomposes anaerobically.

At present, methane from agriculture related activities accounts for about 50% of the 6,875 million metric tonnes of CO_2e which is released annually into the atmosphere (Global Methane Initiative, 2011).



Source: International Energy Agency (c), 2011

Figure 4: Sources of anthropogenic GHG emissions by sector.

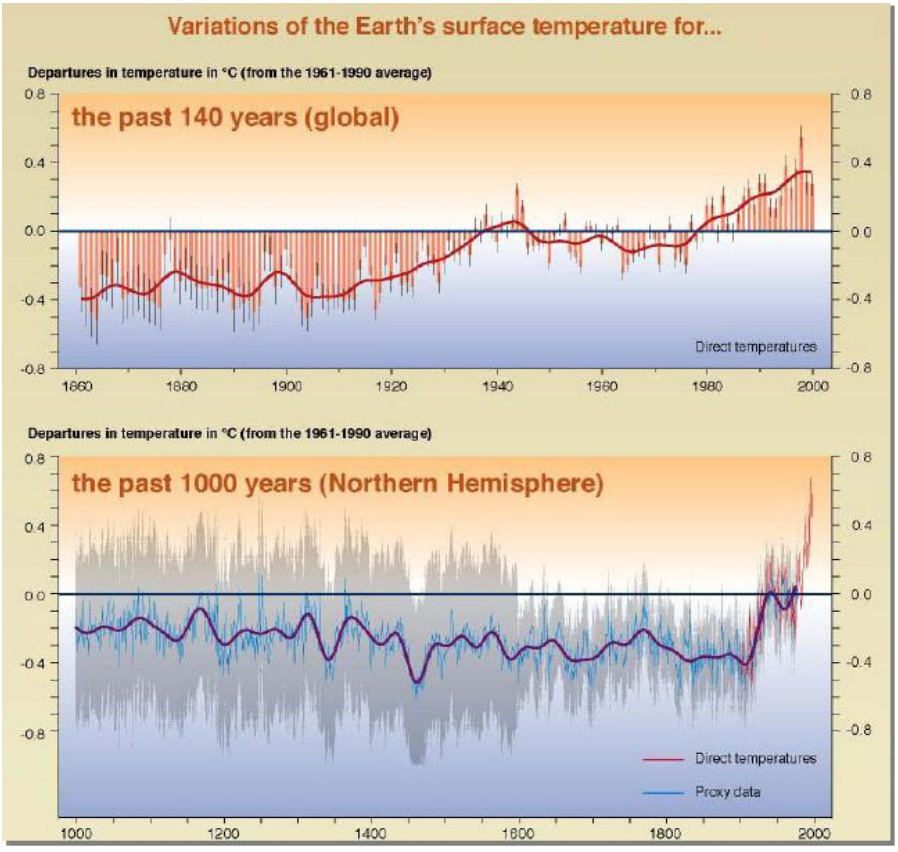
2.3 Global Warming vs. Climate Change

The terms "global warming" and "climate change" are often used interchangeably, as if they represent the same phenomenon. However, there are fundamental differences between the two, as described below.

Global Warming

The Earth's current warming trend is based on both natural warming and cooling cycles that have been happening for eons, as well as human-caused additions to GHGs, which are boosting the atmosphere's ability to trap heat in the biosphere. While GHGs do occur in our atmosphere naturally, humans are causing GHG levels to increase so quickly that it's causing the average global temperature to rise much faster than it would without anthropogenic GHG emissions. When GHG levels rise, the atmosphere warms as more radiation is trapped in the insulating layer.

Scientific research has concluded that human-caused emissions of GHGs are contributing to the more rapid temperature increases experienced as a global average in recent decades (see Figure 5). This phenomenon, which is expected to continue and to accelerate in the coming century, is known broadly as “global warming”.



Source: Intergovernmental Panel on Climate Change, 2007

Figure 5: Variations of Earth’s surface temperature over time.

Global warming is defined as the gradual increase, observed or projected, in global surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions (Intergovernmental Panel on Climate Change, 2007).

The Earth's ecosystems are interconnected and as a result when temperatures rise quickly, the overall systems become unstable. An average global temperature increase of only two to three degrees can be compared to a human suffering from a fever; the systems begin to malfunction and life on the planet has a difficult time adapting (Intergovernmental Panel on Climate Change, 2007).

Climate Change

Climate change on the other hand, is about much more than the Earth's average temperature. It is defined by the UNFCCC, as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

To understand what a changing climate entails, it is helpful to first understand what is comprised in the definition of "climate". Climate is defined by a number of factors including::

- Average regional temperature, as well as day / night temperature patterns, and seasonal temperature patterns;
- Humidity levels;
- Precipitation (average amounts and seasonal patterns);
- Average amount of sunshine and level of cloudiness;
- Air pressure and winds; and
- Storm events (type, average number per year, and seasonal patterns).

While *global warming* and *climate change* are, by definition, different phenomena, they both have human impacts to blame for their existence. The leading scientists within the field have acknowledged that anthropogenic GHG emissions are a primary contributor to the rapid onset of global warming and climate change relative to historic rates (Intergovernmental Panel on Climate Change, 2007).

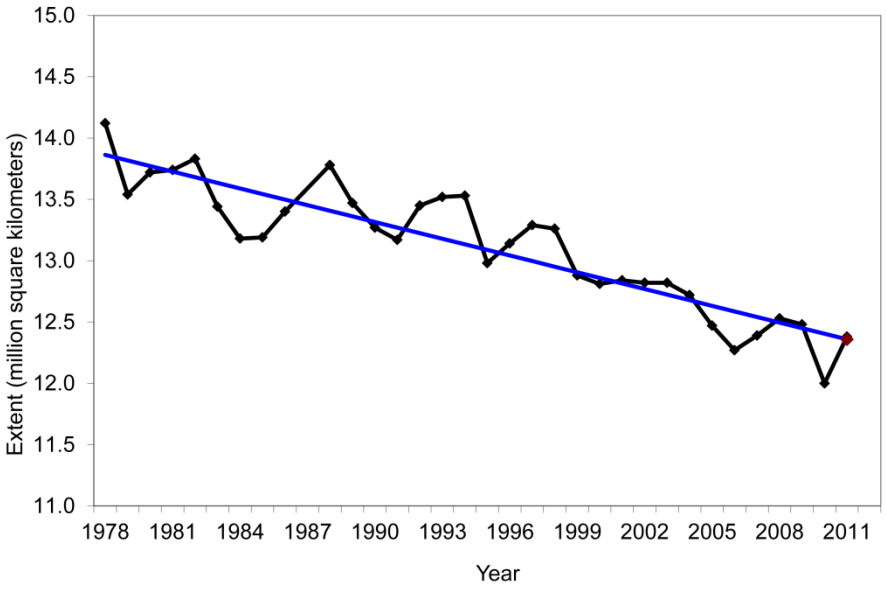
The links between GHG levels, human activities such as the combustion of fossil fuels, and global temperature variability are the core elements of the climate change issue.

2.4 Impacts of Climate Change

The full effects of climate change are uncertain, as it is difficult to predict the level of temperature increase that will actually occur and the impacts that these changes will have on complex natural systems. At the lower level of projected temperature increases, impacts may be minimal, while at the higher end, catastrophic changes could occur that affect all life on the planet.

The Intergovernmental Panel on Climate Change (IPCC), a scientific body set up by the World Meteorological Organization and the United Nations Environment Programme, notes that although a slight increase in temperature may be marginally beneficial to some regions, the net impacts of climate change are likely to be negative for most areas.

Through the melting of Arctic sea ice and the continued retreat of glaciers around the world, global mean sea levels are projected to rise by between 9 and 88 centimeters by 2100 (Intergovernmental Panel on Climate Change, 2007). Figure 6 illustrates the continual decline of sea ice coverage in the Arctic. If ice levels continue to decline, many coastal areas and low-lying island states will be inundated with water, making areas uninhabitable or vulnerable to extreme weather.



Source: National Snow and Ice Data Center, 2012

Figure 6: Average monthly arctic sea ice extent December 1979 to 2011

Coastal erosion, seawater intrusion into groundwater, and ecosystem changes are also predicted. Large-scale desertification could make much of the world's agricultural land unproductive and uninhabitable. It has been predicted that millions of people may be displaced by rising sea levels, flooding, and drought, resulting in major environmental refugee scenarios.

Melting of the Arctic may also free up a polar transportation route that is currently covered in thick sea ice, making the Northwest Passage a viable shipping route for up to 120 days compared to the current 20 to 30 days, predicts the Arctic Climate Impact Assessment (ACIA) (Arctic Climate Impact Assessment, 2008). Melting of permafrost and a northward expansion of woodlands will have an effect on Northern ecosystems, threatening species such as polar bears and caribou that depend on current climate conditions.

Evidence also points to an increase in pests and human diseases with a rise in temperature, though the extent of this has not yet been agreed upon by scientists.

The pine beetle infestation in Western Canada is one example of the possible effects of climate change, as warmer than usual winters have allowed this non-native species to survive, damaging an estimated 17.5 million hectares of forest worth hundreds of millions of dollars.

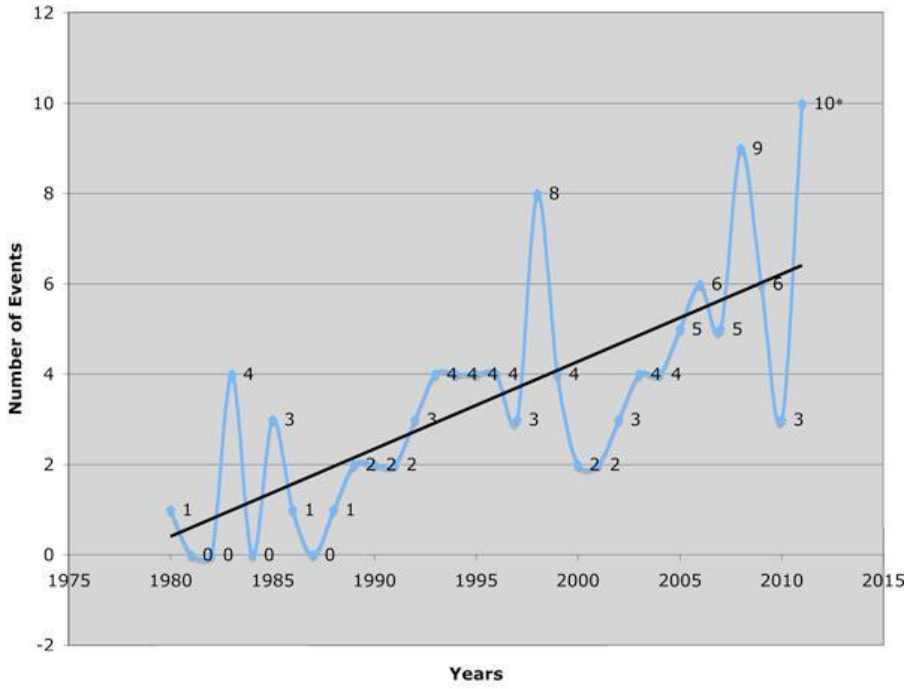
Agricultural productivity in temperate zones may actually improve with small increases in temperature, while larger increases could threaten crops. Biodiversity has already been impacted in many areas as species migrate north to maintain their ideal climate, and birds and flowers respond to spring-type weather earlier in the year.

Marine fisheries may experience positive and negative changes, with possible redistribution of species across regions. More research on this subject is expected with the next IPCC Assessment set for release in 2013 / 2014. Negative impacts are being recorded as major die-offs of coral reefs in tropical waters around the world from temperature stress.

An increase in extreme weather events, such as hurricanes, droughts, and fire, has also been projected. Though a concrete link has yet to be established, scientists have shown that an increase in sea surface temperatures coincides with an increase in the number of intense hurricanes in the Atlantic. More volatile weather patterns are expected in most areas.

Many insurance companies have responded by making climate change a major strategy consideration, offering products that encourage emissions reductions and mitigation strategies to limit losses. Leading companies such as Swiss Re consider climate change to be one of the most pressing business issues of this century (Swiss Re, 2010). Figure 7 illustrates the increase of extreme weather events in the United States with costs of over $ 1billion.

The IPCC predicts that Africa will be the region most affected by climate change, due to both changes in mean temperatures and rainfall, as well as increased variability associated with both. Parts of sub-Saharan Africa – where high vulnerability to weather shocks already exists – are expected to be hit the hardest, with decreases in agricultural productivity between 15% and 35%. Recent volatility in food prices and supplies has illustrated that climate change is an important threat to food security and introduces risk and uncertainty into food systems not only in Africa, but worldwide (Food and Agriculture Organization, 2010).



Source: Scientific American, 2011

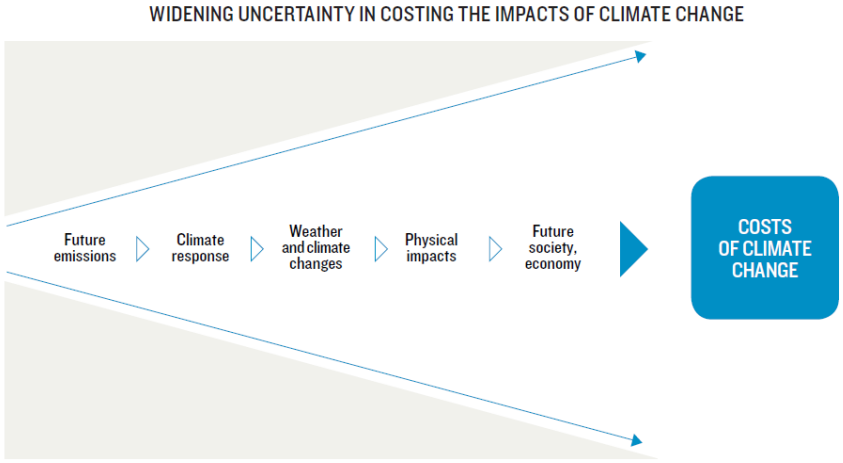
Figure 7: American weather events costing more than US $1 billion between 1980-2010.

Health issues can also be tied to GHG emissions and subsequent climate change. Climate change will increase the likelihood of extreme heat events and contribute to increased urban air pollution, which already accounts for 1.2 million deaths each year (World Health Organization, 2010). An increase in the frequency and duration of natural disasters and corresponding spread of waterborne diseases is also going to be a problem according to the World Health Organization. An analysis released in 2010 found that boosting the European Union's GHG emissions reduction target from 20% to 30% would reap $39 billion a year in health care cost savings by 2020 (Scientific American, 2010).

In terms of predicting the total economic impacts of these global changes, there is again a great deal of uncertainty. Climate change costs in Canada could escalate from roughly $5 billion per year in 2020 to $21 billion and $43 billion a year by the 2050s (National Round Table on the Environment and the Economy, 2011).

On a global level, some models predict losses in the GDP of developing nations of hundreds of billions of dollars per year, while a comprehensive economic review by former World Bank Chief Economist Sir Nicholas Stern estimates that climate change could cost the world economy 5% of its GDP or around $3 trillion per year (Ambrosi, 2008). This cost is equivalent to economic collapses similar to the Great Depression. If wider impacts are taken into account, the projection leaps to 20% of world GDP, enough to cripple the global economy.

In general, the long-term economic impacts are very difficult to quantify, but certainly worst-case scenarios projected in climate models would have catastrophic effects on the livelihoods of billions of people around the world, with corresponding volatility in the global economy. Figure 8 represents the economic uncertainty of climate change which has led to governments, militaries, and many other organizations taking the position that the effects of climate change are simply too enormous to ignore.



Source: National Round Table on the Environment and the Economy, 2011

Figure 8: Economic uncertainty connected with climate change.

As economic uncertainty continues to grow surrounding the costs associated with climate change, initial figures released from Swiss Re's Sigma Team show that with approximately $108 billion in insured catastrophe losses, 2011 ranks as one of the most expensive years for the insurance industry, second only to 2005 ($123 billion) when hurricanes Katrina, Wilma, and Rita alone caused claims of over $100 billion (Swiss Re, 2011).

3 Dealing with a Changing Climate

3.1 Adaptation vs. Mitigation

The question, "what can be done about climate change?" has been widely debated over the last two decades by governments, businesses, and organizations around the world. In broad terms, there are two routes being followed simultaneously: adaptation and mitigation.

Adaptation

Adaptation involves minimizing the negative effects of climate change through precautionary measures. In the short-term, climate change is expected to occur to some degree as global economies continue consuming fossil fuels as a source of energy supply. As a result, adaptive measures may need to be adopted in many regions. These could include the construction of sea barriers, the altering of agricultural methods, the stockpiling of food, and improving protection against pests and diseases. Constructing buildings to withstand extreme weather events and to maintain constant temperatures efficiently are some small adaptive measures that are being undertaken. Conservation efforts that will help northern peoples and animal species cope with melting permafrost are also important aspects of climate change adaptation.

The World Bank concluded that while there are differences across regions and sectors, adapting our infrastructure to climate change would cost between one and two percent of the total cost of providing that infrastructure (World Bank, 2010).

Mitigation

Mitigation involves a large-scale effort to reduce human-caused GHG emissions and other climate changing activities.

Scientific modeling has shown that stabilizing levels of GHGs in the atmosphere could reduce or prevent damaging levels of climate change. Atmospheric levels of GHGs are currently around 388 parts per million (National Oceanic and Atmospheric Administration (a), 2011) compared to a pre-industrial level of 280 ppm. Stabilizing this concentration between 430 ppm and 550 ppm will help to reduce the most serious risks of climate change (Intergovernmental Panel on Climate Change, 2007).

Ways of reducing GHG emissions are constantly evolving and some of the more well-known methods are examined in further detail in the section that follows.

3.2 Methods of Reducing Atmospheric Greenhouse Gases

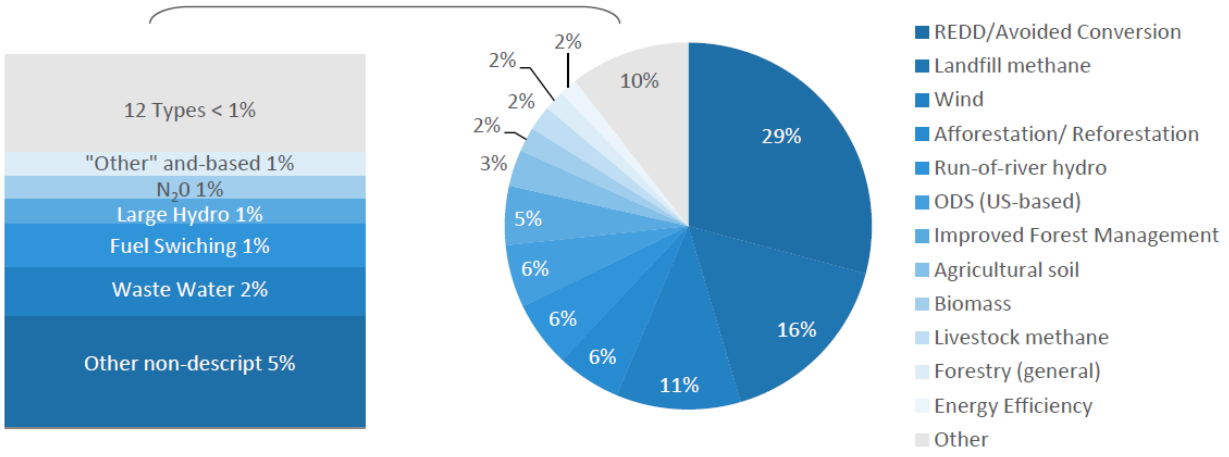
While most GHGs are naturally found in the atmosphere as mentioned previously, the rapid increase in their concentrations in recent years has been a cause of serious alarm. To reduce anthropogenic sources of GHGs emitted by both industrialized and developing nations, several methods are being applied.

The primary methods for reducing atmospheric GHGs include:

1. Application of energy efficient practices and clean technologies;
2. Renewable energy generation;
3. Alternative fuel sources;
4. Emissions capture and storage;
5. Carbon sequestration and land use; and
6. Destruction of industrial pollutants

These reduction methods combined with ever advancing technologies, specialized techniques, and practices have allowed private and public sector players to either reduce their GHG emissions, or develop projects that offset emissions, creating credits that can be sold in the carbon markets.

A survey of the voluntary carbon market by Ecosystem Marketplace and New Carbon Finance revealed that at the moment, the most popular projects for offsetting emissions were found in the areas of Reducing Emissions from Deforestation and Forest Degradation (REDD), methane capture, and renewable energy generation (Peters-Stanley et al. 2011). The actual percentage break down by project type is shown in Figure 9.



Source: Peters-Stanley et al. 2011

Figure 9: Transaction Volume by project type for over-the-counter carbon markets, 2011.

As technologies evolve and practices are applied on wider scales, cost efficiencies are reached, further increasing popularity of these methods. To provide a better understanding of these methods that are the primary areas for carbon offset projects, a brief description of each is provided below.

Energy Efficiency & Clean Technologies

Energy efficiency is perhaps the largest area of opportunity for reducing the expected rise in global GHG emissions. The International Energy Agency (IEA) has shown that improved energy efficiency using today's technologies can reduce expected growth in electricity demand by half, and cut the need for added generation capacity by one-third, even as global energy demand increases by 50%. Sustainable building techniques, efficient lighting and heating technologies, low-energy appliances, and other existing products should not be overlooked for their energy and cost-saving potential.

Renewable Energy Generation

Currently, renewable energy makes up a small percentage of the world's energy supply. According to the IEA, application of these methods for reducing GHG emissions is expected to increase nearly 60% by 2030. Renewable energy coming from sources such as wind, solar, biomass, geothermal, small-scale hydro-electric, and ocean power can provide GHG emission reductions by displacing fossil-fuel usage. In many cases, these emission-free energy sources are a viable alternative. Wind turbines are becoming larger, solar panels more efficient, and the costs for renewable energy in some cases are approaching parity with traditional energy sources – although challenges still remain.

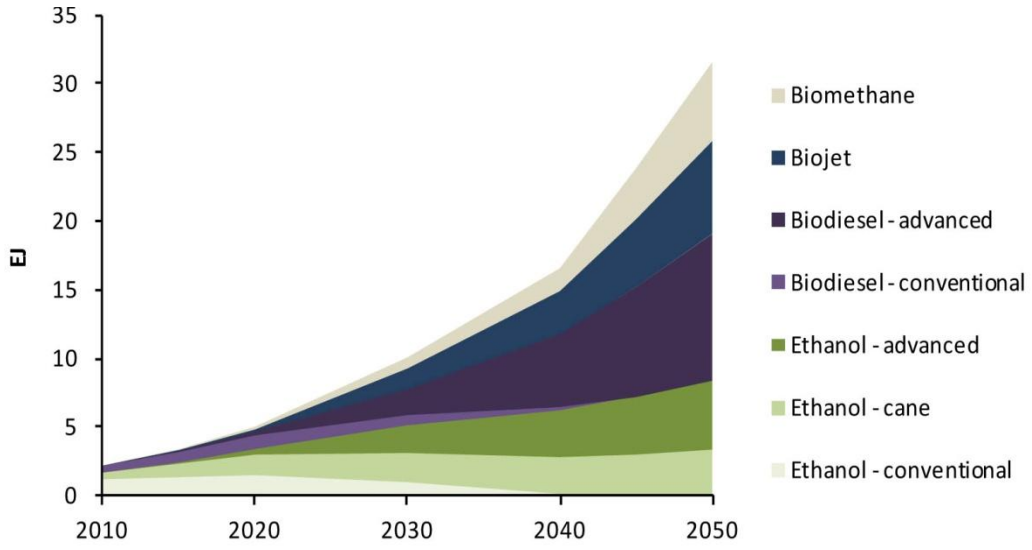
In 2010, almost all major economies had some form of support scheme for renewable electricity; this stands in contrast to the year 2000, when only 16 countries provided targeted support (International Energy Agency (b), 2011). Some countries, including Denmark and Sweden, have already reached impressive renewable energy goals of over 20%, while others have set similar short- and long-term targets. Despite this good news, worldwide renewable electricity generation since 1990 has grown an average of 2.7% per year, which is less than the 3% growth seen for total electricity generation (International Energy Agency (b), 2011). There are also signs that policy support is weakening due to government support for austerity measures.

Alternative Fuel Sources

Bioenergy (i.e., the process of using plants, trees, and other organic matter as fuel for heat, power, and electricity), is also emerging as a major energy sector. Biomass can be converted into fuels such as ethanol and biodiesel, or combusted directly using advanced technologies that reduce air emissions. Bioenergy is considered “carbon neutral” because growing the crops needed to produce fuel offsets the GHG emissions from combustion.

While economic and technical challenges to the wide-scale use of biofuels remain, ethanol markets will continue to grow, and the UN Food and Agriculture Organization (FAO) predicts that bioenergy could provide up to 25% of the world's energy by 2025 (Food and Agriculture Organization, 2009).

The United States leads research and development expenditures for bioenergy, having invested $2.6 billion between 2005 and 2010 (International Energy Agency (b), 2011). Figure 10 illustrates the IEA’s vision roadmap for future supply sources of the world’s biofuel.



Source: International Energy Agency (b), 2011

Figure 10: IEA's biofuel roadmap vision for supply, 2010–50 (in exajoules).

In the transportation industry, biofuels have shown steady growth, but still only represent 3% of global road transport fuel consumption, whereas electric vehicles are poised to take off with major economies having announced targets to reach about 7 million vehicle sales per year by 2020 (International Energy Agency (b), 2011).

Biofuels can be energy intensive to harvest and produce, and as a result, standards are beginning to appear to ensure that the fuels are developed in a manner which provides true GHG reductions through the value chain. One example is the EU's Renewable Energy Directive, which requires that biofuels generate GHG savings of at least 5% compared to fossil fuels (International Energy Agency (b), 2011).

Critics warn that it is vital that the sources of biofuel meet stringent sustainability criteria to ensure that the fuel is generated with a positive social impact and without competing with food or causing negative impacts for biodiversity. To address these concerns, new "advanced" biofuel technologies are gaining in popularity and make use of thermo-chemical and biochemical techniques to derive energy from cellulosic, biosynthetic, and algal fuel sources (International Energy Agency (b), 2011). Commercial airlines are also successfully introducing biofuels from next generation feedstocks to power flights.

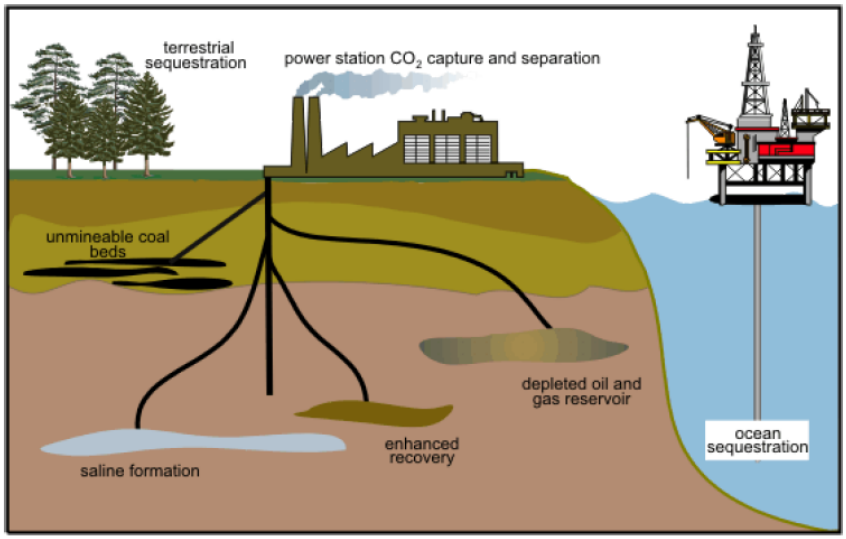
Natural gas and hydrogen are also looked upon as potential source of fuel for a "cleaner" energy future. Natural gas shows potential for reducing emissions from its use in long-haul trucking, for ferry fleets, and for conversions in industrial applications. Hydrogen is used in fuel cells to power buses and cars, and can also be deployed in large-scale power plants. When combusted, its only emission is water vapour. Technical challenges must still be overcome surrounding the production, distribution, and cost of hydrogen technologies, but many believe the "hydrogen economy" is well on its way to becoming a reality.

Carbon Capture & Storage

Although the alternative energy sources listed above are sure to make up a growing component of the worldwide energy mix, most international organizations are projecting that fossil fuels will continue to dominate global energy generation until at least 2050. Faced with that reality, a push to demonstrate the use of "cleaner" fossil fuels is underway.

New technologies are emerging that allow for the gasification of coal to reduce its emissions. One area of particular importance is that of carbon dioxide capture and storage (CCS).

Technologies now exist to capture CO_2 from point sources, and demonstration projects have worked to try and establish the viability of storing the gas for the long-term in geological formations, abandoned oil wells, or in deep sea reservoirs (see Figure 11). While there are over 70 projects currently planned around the world, it is uncertain how many of them will become operational. Some estimates suggest that there may be a need for 100 large-scale CCS projects by 2020 and over 3,000 by 2050 to meet GHG emission reduction targets (International Energy Agency (b), 2011).



Source: United States Department of Energy, 2008

Figure 11: Examples of GHG capture, storage and sequestration.

Currently the world's largest operating CCS project is found in Weyburn, Saskatchewan, where the scientific field study has stored over 13 million tonnes of CO_2 since it was established in 2000 (Canadian Association of Petroleum Producers, 2011). The project uses CO_2 produced from a coal gasification plant in Beulah, North Dakota, and transports it via a 330 kilometer long pipeline for use and storage in the oil fields of Weyburn.

Other offset projects involve the capture and storage or destruction of methane generated from farm animals, landfills, or other industrial wastes. Methane can be destroyed either by combustion (producing $CO_{2)}$, or it can be broken down by aerobic and anaerobic digestion activities. Converting methane to CO_2 reduces the global warming effect of the methane molecules by 96%.

Carbon Sequestration & Land Use

Carbon sequestration is another way of reducing emissions. It occurs when CO_2 in the atmosphere is trapped in a sink. A sink is any natural reservoir that stores carbon. The most commonly thought-of sinks are forests and vegetation, although the oceans are in fact the world's largest sinks. Carbon sequestration is one of the most promising ways for reducing the build-up of GHGs in the atmosphere. In fact, even under the most optimistic scenarios for energy efficiency gains and the greater use of low- or no-carbon fuels, sequestration will likely be essential if the world is to stabilize atmospheric concentrations of GHGs at acceptable levels (International Energy Agency (b), 2011).

The Kyoto Protocol allows for carbon credits to be earned for sequestration projects, such as the planting of trees. Land-use, land-use change and forestry (LULUCF) projects focus on natural carbon sinks such as forests and soil. For example, forestry companies that replant deforested areas could potentially earn offset credits, given that forests absorb CO_2 as they grow. Soil management techniques can preserve or increase the amount of carbon sequestered in the soil with the first project having been validated in late 2010 (Linacre et al., 2011). A key issue in this area is that the projects must represent an actual reduction of GHG emissions compared to "business as usual".

In addition, many developing nations want the opportunity to earn credits by preventing deforestation. Deforestation, particularly in Brazil, Indonesia, and parts of Africa, accounts for about 20% of GHG emissions. Deforestation can be avoided either by paying directly for forest preservation, or by using offset funds to provide substitutes for forest-based products.

To address these issues, outcomes from the UN's sixteenth Conference of the Parties (COP 16) in Mexico led to the creation of the REDD scheme. REDD credits provide carbon offsets for the protection of forests, and provide a mechanism to allow funding from developed nations to assist in the protection of native forests in developing nations. COP 17 in South Africa illustrated continued commitment towards REDD initiatives, but neglected to provide the robust environmental and social safeguards many were calling for (World Resources Institute Insights, 2011).

Destruction of Industrial Pollutants

Industrial pollutants, such as hydro-fluorocarbons (HFCs) and per-fluorocarbons (PFCs) have Global Warming Potentials that are many thousands of times greater than carbon dioxide by volume. Because these pollutants are easily captured and destroyed at their source, they present a vast and low-cost source of carbon offsets. Up until 2011, these gases were a popular source of offsets due to their affordability. As a result of unethical business activities around the production of these substances, however, the EU confirmed in 2011 the ban of Certified Emission Reductions (CERs) from HFC and nitrous oxide (N_2O) adipic acid projects starting in 2013 (Linacre et al., 2011).

4 Policy Approaches to Climate Change Reduction

4.1 United Nations Led Change

In response to the changing environment and the potentially devastating effects of climate change, the world came together to tackle the issues. In 1990, the UN General Assembly decided to start work on a climate change convention.

The UN Conference on Environment and Development, also known as the Rio Earth Summit, was held in Rio de Janeiro, Brazil, in 1992. The conference was attended by 172 governments, with 108 of those countries sending their heads of state. Another 2,400 representatives of non-government organizations (NGOs) also attended, alongside 17,000 people at the parallel NGO Global Forum who had consultative status.

History was made at this conference when the attendees recognized for the first time at an international level that climate change is occurring and that it is largely due to human activities. At the core of international efforts to address climate change, the United Nations Framework Convention on Climate Change (UNFCCC) was launched under the Bali Road Map.

The UNFCCC is an international environmental treaty aimed at stabilizing GHG concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system.

Under the UNFCC, governments are obligated to:

- Gather and share information on greenhouse gas emissions, national policies and best practices
- Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries
- Co-operate in preparing for adaptation to the impacts of climate change.

Countries agreed to the Convention on May 9, 1992, and it entered into force on March 21, 1994. Currently, 194 countries have ratified the treaty (UN Framework Convention on Climate Change (a), 2011).

The Convention requires precise and regularly updated inventories of GHG emissions from industrialized countries. With a few exceptions, the "base year" for tabulating greenhouse GHG was set as 1990.

The treaty as originally framed set no mandatory limits on GHG emissions for individual nations and contained no enforcement provisions; it is therefore considered legally non-binding. Rather, the treaty included provisions for updates (called "protocols") that would set mandatory GHG emission limits. The first addition to the treaty, the Kyoto Protocol, was adopted in 1997.

The Kyoto Protocol

The Kyoto Protocol was agreed to at the UN's third Conference of the Parties (COP 3) in December 11, 1997, in the Japanese city of Kyoto and entered into force on February 16, 2005. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing GHG emissions. These targets amount to an average reduction of 5.2% in GHG emissions against 1990 levels over a five-year period from 2008 to 2012.

Developed countries, also known as Annex I and II countries, are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity. For this reason, the Protocol places a heavier burden on developed nations (UN Framework Convention on Climate Change, 2011).

The Kyoto agreement includes a set of rules for how the parties to the agreement can reach their reduction goals through the trade of GHG quotas – the so-called flexibility mechanisms.

Non-Annex I or II countries (mostly developing countries), do not have binding targets under the Kyoto Protocol, but must ratify the Protocol in order to host emission reduction projects under the flexibility mechanisms.

The Kyoto Flexibility Mechanisms

Under the Treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms. The mechanisms are:

1. **Emissions Trading**, also known as cap-and-trade, involves industrialized countries with obligations under the Kyoto Protocol trading the GHG quotas they have been allocated. For example, if it is less expensive to reduce CO_2 emissions in Finland than in Denmark, Denmark may let Finland reduce emissions on its behalf. The unit for emissions trading was defined as an Assigned Allocation Unit (AAU) and is equivalent to one metric tonne of CO_2e (UN Framework Convention on Climate Change (b), 2011).

2. **Joint Implementation (JI),** which allows a country with GHG emission reduction or limitation commitment under the Kyoto Protocol (Annex I or II countries) to earn Emission Reduction Units (ERUs) from an emission-reduction or removal project in another Annex I or II country. Each ERU is equal to one tonne of CO_2e, which can be counted toward meeting Kyoto targets. For example, if Denmark gets involved in a project at a fertilizer factory in another industrialized country to reduce the factory's nitrous oxide emissions, then Denmark will be able to deduct the savings in emissions from its own climate account. To this point, some have considered the JI never to have reached its potential, in part because one of the largest expected contributors (the United States) never signed onto Kyoto. Even after Kyoto expires in 2012, the JI scheme is expected to be operational for a few more years, as ERUs are valid for a crediting period running from 2008 to 2015 (EuroActiv, 2011).

3. **Clean Development Mechanism (CDM),** works in a similar way to JI projects. The fundamental difference is that CDM projects occur in developing countries with the help of a partner company from an industrialized nation. CDM projects use Certified Emission Reduction (CER) credits that are equal to one metric tonne of CO_2e. These CERs can be traded and sold, and used by industrialized countries to meet part of their emission reduction targets under the Kyoto Protocol.

For both JI and CDM projects, independent bodies must confirm that the projects do in fact lead to genuine GHG emission reductions prior to them being included in their emission accounts. As of November 2011, 3,560 CDM projects were registered around the world with the majority (81.8%) found in Asia and the Pacific region (UN Framework Convention on Climate Change (c), 2011).

JI Projects are found predominantly in countries with economies in transition (EIT) and include the former Soviet Union states. All of these countries (with the exception of Russia, Ukraine, and Croatia) are members of the EU and are therefore part of the EU Emission Trading Scheme (ETS).

Both JI and CDM projects also operate under a different system from cap-and-trade. Known as a baseline-and-credit scheme, this system is based on levels where no specific caps exist. Instead, participants are allowed to emit CO_2 according to a historic or industry-specific baseline level of emissions (Kollmuss et al., 2008).

Beyond Kyoto

Kyoto's first (and only) commitment period expires in 2012. Many experts note that clarity is still urgently needed on the post-2012 international climate change regime and on countries' plans to use market-based mechanisms to meet domestic GHG emission reduction objectives. Expected gross use of Kyoto assets now stands at 1.39 billion tCO_2e over the 2008-2012 commitment period (up 14% from 2010), with approximately 70% of demand coming from the private sector (Linacre et al., 2011). The three Kyoto flexibility mechanisms will be required to meet the demand for Kyoto assets.

Adjusting the approximate 2.4 billion CERs and ERUs contracted (nominal) for risk of under-delivery and accounting for AAU transactions, as well as some secondary transactions by governments, leads to an estimated residual demand of 136 $MtCO_2e$ of Kyoto assets over the next two years – virtually all from European governments (Linacre et al., 2011).

CDM projects contracted in the next few months will be unlikely to deliver large volumes before 2013, and thus governments may have to purchase AAUs to cover their residual Kyoto shortfalls and under-delivery of credits from CDM and JI projects.

Copenhagen, Denmark, hosted the fifteenth Conference of the Parties (COP 15) under the UNFCCC in 2009 with the goal to establish a global climate agreement for the period from 2012 onwards when the Kyoto commitment expires. While the conference resulted in a new political accord struck by world leaders for explicit GHG emission reduction pledges by all the major economies (including China for the first time) and other major developing countries, it fell short of establishing a binding agreement (Pew Center on Global Climate Change (a), 2009).

The 2010 assembly of COP 16 in Cancun, Mexico, also failed to establish international, legally-binding commitments for reducing CO_2 emissions, but did result in a number of positive outcomes for carbon markets and climate finance. Some highlights of COP 16 included:

- Finalizing the establishment of the "Green Climate Fund" to channel up to $100 billion a year by 2020 to help developing countries fight climate change;
- The continuation of the Kyoto mechanisms, including important improvements and reforms to the CDM;
- The inclusion of Reducing Emissions from Deforestation and Forest Degradation (REDD and REDD+); and
- The formal recognition of developing countries' pledges of Nationally Appropriate Mitigation Actions, which are aimed at achieving a deviation in their GHG emissions compared to business-as-usual trends by 2020 (Linacre et al., 2011).

With only one year left in the original Kyoto commitment period, COP 17 in Durban, South Africa, was a critical venue for climate change policy development. By the end of the conference, the following agreements had been reached:

- A core group of developed countries agreed to participate in a second commitment period of the Kyoto Protocol. The new commitment period would start from January 1, 2013, and would extend up to either 2017 or 2020 (to be decided at COP 18 in 2012);
- Countries agreed to include carbon capture and storage (CCS) technology under the CDM;
- Guidelines on technical issues like safeguards and forest reference levels in REDD have been finalized and its now eligible for international financing;
- The $100 billion (by 2020) Green Climate Fund is now operational and the first meeting will be in Switzerland, with South Korea providing start up finance for the fund; and
- Participating countries agreed to work on a new international climate change treaty that would include developed as well developing countries for the first time, including India and China. The countries have agreed to decide on the modalities of this treaty by 2015 and implement it beginning in 2020 (Climate Connect (c), 2011).

While there is still uncertainty about what international agreements will emerge, Section 6 illustrates that there is reason to remain optimistic as several regional initiatives are actively ramping up and expanding just as Kyoto winds down.

4.2 Cap-and-Trade vs. Carbon Tax

Although the Kyoto Protocol has effectively established the ground work for a global emissions reduction framework, there is still debate as to whether cap-and-trade or carbon taxes would be more effective at reducing GHGs.

Both cap-and-trade and a carbon tax have the potential to achieve the same level of increased efficiency by achieving the optimal emissions abatement level at the minimum cost. However, the cost to a corporation may be lower with a cap-and-trade system while a carbon tax can bring in revenue for a government unless it is designed to be revenue neutral.

In both cases, firms have tangible financial incentives for adopting new, cleaner technologies to reduce their emissions. Carbon taxes and auctioned permits can be used to generate revenue for governments to reduce budget deficits, reduce taxes on labour and capital, or invest in carbon reduction initiatives.

Cap-and-Trade

As noted, the cap-and-trade approach uses free-market principles to achieve a reduction in emissions of a particular GHG. A government or regulatory body sets a limit on the total amount of emissions that are allowed depending on the industry, and issues or auctions permits (carbon credits) for that amount. Companies or organizations covered by the cap must only emit according to the permits they possess.

If companies exceed their allowable limits of emissions, they must obtain credits from other companies that have surplus credits, or by investing in projects that offset their emissions (offset projects). Thus, emissions are “capped”, and emitters can “trade” credits until their emissions match the amount of permits they possess.

Suggested Benefits of Cap-and-Trade:

- Provides greater investor certainty by enabling businesses to estimate allowance prices needed for their work;
- Offers greater environmental benefits by placing a fixed cap on emissions; and
- May create a "useful economic shock absorber" because carbon allowance prices could be adjusted according to changing conditions

(Leybovich, 2009)

The carbon credits can either be sold directly or through an intermediary such as a broker, a retailer, or on an open market exchange. In theory, this method allows companies to achieve their maximum allowable output at the lowest cost. On the negative side, critics claim that the cap-and-trade system is complicated, has an unreliable track record, and allows companies to “buy the right to pollute”.

Although it can be argued that purchasing carbon offsets amounts to "buying one's way out", it is clear that most companies will have difficulty eliminating 100% of their emissions. Purchasing carbon credits offers the opportunity for companies to better manage their climate impact.

Also, creating an emissions inventory, which is necessary to determine how many offsets need to be purchased, is an important first step for many companies that can lead to GHG emission reductions at a later date.

Carbon Tax

A carbon tax places a direct tax on GHG emitters, regardless of the source and is considered by many as a more straightforward policy approach.

India and several European countries have imposed energy taxes based partly on carbon content, although none have been able to introduce a uniform carbon tax on all sectors.

Australia has recently finalized the introduction of a national carbon tax starting in 2012 which will evolve into a cap-and-trade system by 2015 (see Section 6.3 for further details on future schemes). Concerns remain about whether a carbon tax would actually reduce emissions or if companies would simply pay the tax and continue to produce the same amount of carbon dioxide.

Several other countries have proposed carbon taxes, including China, South Korea, South Africa, and New Zealand.

Suggested Benefits of a Carbon Tax:

- Will lend predictability to energy markets and avoid price volatility which may discourage investments in low-carbon technologies
- Is transparent and easily understandable, making it more likely to elicit the necessary public support needed for implementation
- Can generate revenues that can be returned to the public through dividends or progressive tax-shifting; and
- Can be implemented with a relatively low opportunity for manipulation by special interests

(Carbon Tax Center, 2011)

In 2008, the Province of British Columbia, Canada, introduced the first broad-based carbon tax in North America. The tax was set up as revenue neutral with tax collections being returned to industry and individuals through income tax cuts.

A report released in January 2008 with respect to Canada reaching deep GHG emissions reductions by 2050 found that either a carbon tax or a market-based system could be effective so long as they were applied broadly and consistently (National Round Table on the Environment and the Economy (NRTEE), 2007).

According to Glen Murray, the former NRTEE Chair, "…putting a price on emissions is the most effective tool to achieve deep GHG reductions over the long-term…An early and clear price signal is needed to influence the investment decisions by industry in the technology and innovation required to achieve deep reductions and also to influence consumer decisions and behaviour."

Whichever approach is applied should be complemented with policies that include regulatory standards, subsidies, and infrastructure investments.

5 Carbon Markets

5.1 Carbon Markets Defined

The "carbon market" is a term used to describe the free market trading of GHG emissions credits with an overall goal of controlling pollution levels. The markets allow companies who emit relatively low levels of GHGs to sell their emission credits or offsets either directly to end-buyers or through an intermediary or exchange. This trading system thus provides economic incentives to reduce GHG emissions.

The carbon markets are made up of either buyers who must purchase carbon credits in order to meet their emission caps, or buyers who are not regulated by law to reduce emissions but choose to do so voluntarily through offsets. Therefore, the carbon markets can be divided into two categories: the compliance carbon market and the voluntary carbon market.

The global carbon market was, until recently, growing year after year at an astonishing rate. After five consecutive years of robust growth, the total value of the global carbon market stalled at $142 billion during 2010 before adding 4% growth in value during 2011 (Linacre et al., 2011), (Reuters (a), 2012).

According to analysts at Bloomberg New Energy Finance the volume of carbon credits and allowances traded worldwide shrank to 6.9 billion tonnes of CO_2e in 2010, from 7.7 billion tonnes in 2009. This drop was a result of a 94% collapse in volumes traded in the US Regional Greenhouse Gas Initiative (RGGI), which accounted for 9% of the global total, as illustrated in Figure 12 (Carbon Finance, 2011). Markets rebounded in 2011 with a 19% increase in volume with 8 billion tonnes of CO2e being traded (Reuters (a), 2012).

	Volume ($MtCO_2e$)		Value (US$ million)	
Markets	**2009**	**2010**	**2009**	**2010**
Voluntary OTC	55	128	354	414
CCX	41	2	50	0.2
Other Exchanges	2	2	12	10
Total Voluntary Markets	**98**	**131**	**415**	**424**
EU ETS	5,510	5,529	105,746	106,024
Primary CDM	135	94	2,858	1,325
Secondary CDM	889	1,005	15,719	15,904
Kyoto [AAU]	135	19	1,429	265
RGGI	768	45	1,890	436
Total Regulated Markets	**7,437**	**6,692**	**127,642**	**123,954**
Total Global Markets	**7,535**	**6,823**	**128,057**	**124,378**

Source: Peters-Stanley et al., 2011

Figure 12: Transaction volumes and values for the global carbon market, 2009 and 2010.

Beyond 2012, although the potential demand for GHG emission reductions could reach 3 billion tonnes or more, the only substantial and unconditional demand to date comes from Europe, estimated at 1.7 billion tonnes. The supply available between 2013 and 2020, through existing projects, is seen as sufficient to fill that demand, leaving little incentive for project developers to invest further and create a future supply of emission reductions (Linacre et al., 2011).

5.2 Compliance Carbon Markets

The compliance, or regulatory, carbon market is made up mostly of countries who have ratified the Kyoto Protocol and are obligated to meet their emission caps for the 2008 to 2012 period. This consists primarily of EU countries that are predominantly net buyers of emission permits. In addition, some US states have formed their own regulated market system.

The total value of the regulated market in 2010 was $123.9 billion with a volume of 6.7 billion metric tonnes of CO_2e (Peters-Stanley et al., 2011).

While the international regulatory environment remains uncertain, national and local initiatives have noticeably picked up and may offer the potential to collectively overcome the international regulatory gap. The most prominent of these initiatives is California's cap-and-trade scheme, which is expected to begin operating in 2013 (see Section 6.3 for more details).

On January 1, 2005, the EU ETS became one of the first legally mandated carbon trading systems, operating as a cap-and-trade system (European Commission Climate Action, 2009). Similar to Kyoto's Assigned Amount Units (AAUs), the EU ETS uses EU Allowance Units (EUAs) as the trading unit, with one EUA being equivalent to one metric tonne of CO_2e.

One external pressure acting on the compliance carbon market is illegal activities. Despite the fact that the EU ETS has been the subject to several criminal controversies (including value-added tax (VAT) fraud, "phishing" scams, and theft) Europe's exchange continued to dominate the market. In 2010, 5.5 billion EUAs were traded for a value of $106 billion, which accounted for 81% of the total carbon market volume and 85% of its value (Peters-Stanley et al., 2011). The EU trading scheme currently operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein, and Norway) and is expected to reduce total emissions by 21% in 2020 compared to 2005 levels (Linacre et al., 2011).

Within the CDM, primary volumes continued to fall in 2010 to 94 million $MtCO_2e$, down 76% from 2008, while secondary trading of Certified Emission Reduction (CER) trading credits rose to 1 billion $MtCO_2e$, up 62% over 2008 (Peters-Stanley et al., 2011).

The price of CERs continued to drop in 2011, hitting an all time low of $9.30/tonne in October, having lost 40% of its value in less than half a year (Reuters (a), 2011). The low prices have reduced the incentive to invest, as has uncertainty over the international climate regime after 2012. The reduced availability of debt finance is also weighing on supply.

Trading of AAUs plummeted from 135 million $MtCO_2e$ in 2009 to 19 million $MtCO_2e$ in 2010 as the number of permits issued continued to be a problematic issue and contributing to high volatility in the price of carbon (Energy & Environmental Management, 2011).

Global transportation is a sector which has until recently been left out of existing compliance carbon markets, but Section 8.1 explores the integration of new efforts underway.

5.3 Voluntary Carbon Markets

Voluntary carbon markets include all carbon offset trades that are not required by regulation. Pre-compliance programs are increasingly important within the voluntary market and might include initiatives established to eventually integrate with regulatory programs, or programs that might become compliance regimes themselves. Such programs may even have elements of law and regulation in them, but they don't completely fit the bill of a compliance scheme (GHG Management Institute, 2011).

The Chicago Climate Exchange (CCX), established in 2003, was the first voluntary but legally binding cap-and-trade system operating in North America and Brazil. In April of 2010, Intercontinental Exchange (ICE) acquired the CCX, which led to the announcement that the cap-and-trade program would conclude at the end of Phase II in December 2010. Even though the ICE will continue to operate the CCX program's project protocols and registry system in 2011–12, this signaled a huge shift in the marketplace (Linacre et al., 2011).

A secondary voluntary mechanism, which is not related to a cap-and-trade system, can be described as over-the-counter (OTC) transactions. The OTC market – which customarily shared almost half of annual volumes with the CCX – transacted 127.9 $MtCO_2e$ in 2010, or 97% of global market share (Peters-Stanley et al., 2011). These carbon credits originate mostly from emission reduction projects and are known as Verified Emission Reductions (VERs) or simply as carbon offsets

Even with the demise of the CCX, 2010 was a record year for activity in the voluntary carbon markets. While volumes in the voluntary space remain much smaller in size compared to compliance markets (i.e., less than 0.3% of the global carbon markets), overall transaction volumes increased 28% between 2009 and 2010 (Linacre et al., 2011). A resurgence in value among purely voluntary standards like the Gold Standard (up 56% to $55 million) and continued interest in "act local" project types, such as bike shares and composting, illustrate ways the market continues to adapt (and grow) around its traditional customer base (Linacre et al., 2011).

Another rapidly expanding part of the pre-compliance and voluntary market is that of REDD in developing countries whose market share has increased by more than 500% since its development in 2009 (Linacre et al., 2011).

Reasons a company might take part in the voluntary carbon market could include its commitment to reducing GHG emissions as well as an opportunity to market its position as environmentally conscientious. Many buyers also choose to purchase carbon credits voluntarily from compliance markets like the EU ETS or the CDM. A company may do this as a pre-compliance measure in order to receive early-actor credits in preparation for later regulation. In the case of many financial firms, companies may purchase the credits to be resold later to regulated firms at higher prices.

That being said, according to a survey by Ecosystem Marketplace and New Carbon Finance released in 2011, the number one motivation for purchasing carbon offsets was for retirement of the offset (44%), with private firms buying the bulk of the offsets. The next most popular reason was resale for investment purposes to voluntary buyers at 22% (Peters-Stanley et al., 2011).

5.4 The Players

The carbon market can be divided up into the parties who take financial interest in GHG emission trading and those with interest in creating the infrastructure. Key players in the supply chain include: carbon credit suppliers, offset project developers, validators, verifiers, wholesalers, brokers, retailers, and the end-buyers consisting of individuals or institutions (see Figure 13).

Source: Hamilton et al., 2009

Figure 13: Simplified carbon projected supply chain.

It also includes specific regulatory bodies including organizations that set standards for compliance, as well as registries for carbon emissions registration and tracking. Finally, the carbon market also includes the specific exchanges that have been organized to facilitate trading. Below is a more detailed description of the primary stakeholders involved in the carbon market.

Carbon Credit Suppliers

Carbon credit suppliers can be divided into two major categories based on the type of market in which they are involved. The first category is based on regulated cap-and-trade schemes and includes organizations that produce less than their emission caps and are able to sell their leftover carbon credits in the market.

The second category includes offset project developers who generate carbon credits through the verified reduction of atmospheric GHG emissions. As described previously, several methods for producing carbon offset credits exist which feed primarily into the voluntary carbon market. At present, there are hundreds of accredited carbon offset project developers around the world.

Validators & Verifiers

The role of validators and verifiers within the carbon market is to ensure that carbon credits represent legitimate reductions in emissions.

Validation is a process that involves the independent evaluation of a project activity by an accredited entity against the requirements of the standard or program adopted. It involves assessment on a project baseline, monitoring plan, and compliance as required by the applicable standard. In order for a project to be eligible for registration, validators will confirm that it meets all the requirements.

Verification on the other hand involves the periodic review by a third-party to ensure that reductions in GHG emissions that have occurred as a result of the project activity are indeed, legitimate. In addition, the authenticity of GHG emission reductions by a project over a defined period of time must be confirmed. In order to do this, a project's emission reductions are monitored and the monitoring data for a verification period is reviewed and assessed.

The International Emissions Trading Association (IETA) has formed a Monitoring, Reporting and Verification (MRV) Working Group which conducts research and publishes policy positions geared towards common MRV regimes across GHG trading and accounting systems worldwide, helping to ensure the integrity of emission rights and enabling linking. As of April 2011, the IETA comprises more than 155 international companies from Organization for Economic Co-operation and Development (OECD) and non-OECD countries (International Emissions Trading Association, 2011).

By implementing strict procedures and policies for validation and verification, the standardization and transparency of the carbon markets has increased substantially in the last few years.

Wholesalers, Retailers & Brokers

As the carbon markets have evolved, so too has the complexity of the supply chain. Hundreds of wholesalers, retailers, and brokers around the world are now involved in the purchase, sale, and trade of carbon credits and offsets. Prices tend to increase as movement up the supply chain occurs. Not surprisingly, given the reduced transaction size across the value chain, the least expensive credits come directly from project developers, and the most expensive credits are sold by retailers.

Brokers facilitate transactions between all parts of the value chain (including developers and final buyers) and therefore report prices higher than those reported by developers and wholesalers in general. Brokers, unlike the other supply chain members, do not take title ownership of the carbon credits during their involvement in the trading process.

End Buyers

End-buyers range from individuals, to non-profits, to NGOs, to government entities. In the compliance market, the end-buyer purchases credits in order to stay within its cap for GHG emissions. In the voluntary market, reasons for purchasing carbon credits include retirement, resale, or for pre-compliance purposes in anticipation of a regulatory scheme down the road.

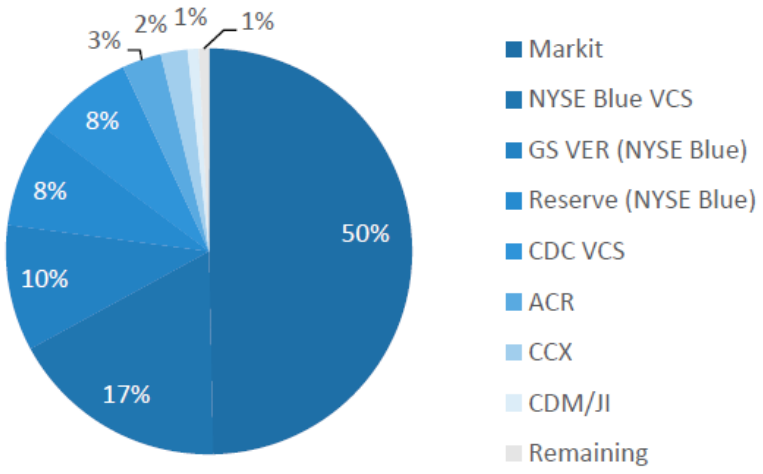
Registries & Standards

Registries are considered the backbone for the carbon market, coordinating the way credits originate, how they are validated and verified, and how they are tracked through their lifetime and retirement. The ability of parties to add allowance units or credits or move credits from one party (be it an individual, a company, or a country) to another (e.g., through emissions trading or JI projects) requires registry systems that can track the location of the credits at all times.

Registries can differentiate themselves through several methods including market position, entities served, standards accepted, transparency, fees, and rules or processes. Within the Kyoto scheme, the International Transaction Log (ITL) is an essential component of the trading infrastructure as it forms the central hub of the settlement system that delivers traded allowances from sellers to buyers. The ITL verifies transactions proposed by registries to ensure they are consistent with rules agreed under the Kyoto Protocol (UN Framework Convention on Climate Change (b), 2011).

Since live operations began on November 14, 2007, several national registries have connected to the ITL and as of October 2011, thirty-nine parties, (38 Annex B parties and the CDM registry) have successfully completed initialization (UN Framework Convention on Climate Change (b), 2011).

In the voluntary market, registries can be specific to a particular standard or exchange, such as the Gold Standard Registry for VERs. They may also accept credits from a variety of standards, for example the TZ1 and the GHG Clean Projects Registry. Figure 14 illustrates the 2010 OTC transaction volumes by the registry used.

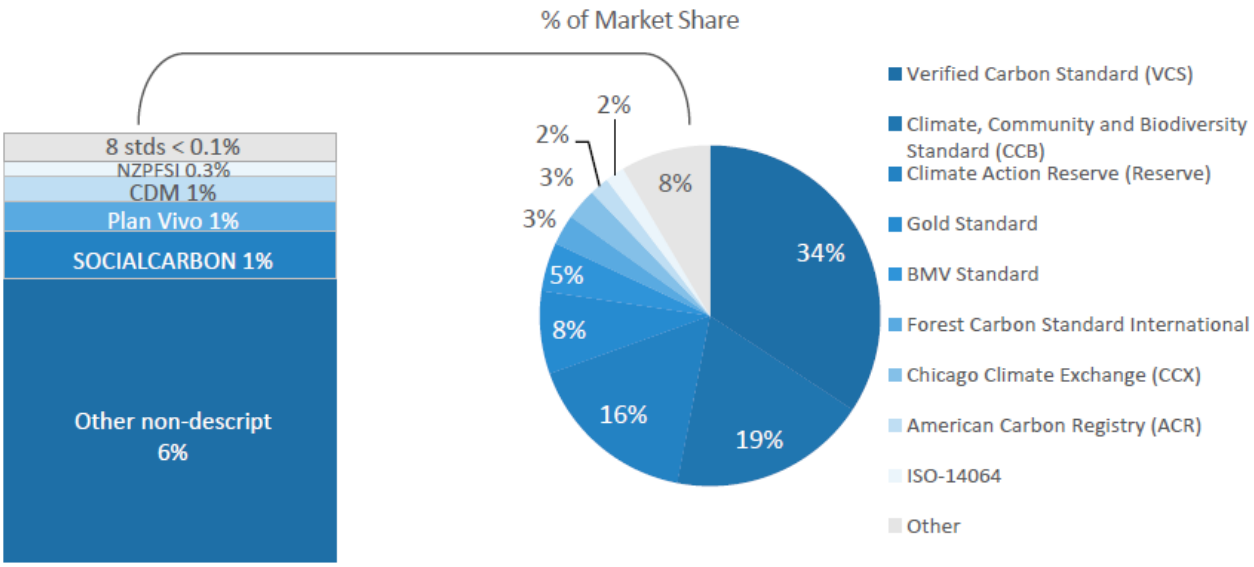


Source: Peters-Stanley et al., 2011

Figure 14: OTC transaction volume by registry, 2010.

Registries and standards have increasingly become the tools for assuring quality. A trend toward consolidation amongst the standards, as well as increased collaboration with exchanges and registries, has taken place in recent years in order to enhance trading and increase market transparency. It is the standard, combined with the specific project which has become the major determinant of a carbon credit's price.

At present, there are over 18 independent voluntary standards. According to a 2011 survey by Ecosystem Marketplace and New Carbon Finance, the Voluntary Carbon Standard (VCS) was the most popular choice by volume for emission offsets, as shown in Figure 15 below (Peters-Stanley et al., 2011).



Source: Peters-Stanley et al., 2011

Figure 15: Third party standard utilization by primary and secondary standard, OTC 2010.

Other popular standards included the Climate, Community and Biodiversity Standard, the Gold Standard, and the Climate Action Reserve. The International Organization for Standardization (ISO) has also set aside ISO 14064, ISO 14065, and ISO 14066, which set standards for quantification, reporting, validation, and verification of GHG emissions (International Organization for Standardization, 2011).

Exchanges

Climate exchanges provide an electronic platform for voluntary carbon market players to clear contracts for offsets, allowances, and environmental derivatives such as the Chicago Climate Futures Exchange (CCFE) which specializes in futures and options contracts. Exchanges are the platforms for free-market trading transactions between parties involved in the buying and selling of carbon credits. Depending on the exchange, the carbon credit units exchanged include AAUs, EUAs, CERs, VERs, and RECs.

Independent VER exchanges host credits from a variety of standards and project types, typically on an online platform (like Carbon Trade Exchange or World Green Exchange). *Dedicated VER exchanges* are designed with one credit type (CCFE Reserve contracts) or a specific domestic market in mind (China Beijing Environmental Exchange) (Peters-Stanley et al. 2011).

6 Emissions Trading Schemes

6.1 Compliance Schemes

Europe

European Union Emissions Trading Scheme (EU ETS)

Launched in January 2005, the EU ETS is a key tool in the European Union's policy to mitigate climate change through cost-effective reductions in industrial GHG emissions. The EU ETS continues to be the largest carbon market scheme in both volume and value and dominates allowance-based transactions. The scheme now covers approximately 11,000 power stations and industrial plants in 30 countries, including the 27 EU Member States plus Iceland, Liechtenstein, and Norway (European Commission Climate Action, 2010).

Allowances are held in electronic registries by the member states and overseen by the Community Independent Transaction Log. The EU ETS involves three trading periods in which member states set out National Allocation Plans (NAPs). Each country designs their NAP based on the total number of GHG emission allowances allocated to their companies for the first period (2005-2007) and the second period (2008-2012). Due to lessons learned from the first trading period on the complexity of NAPs and confusion associated with their use, NAPs for the third trading period will no longer be set out by member states, but instead will be determined directly at the EU level.

Looking to the future, the EU has proposed a reduction in overall emissions in 2020 of at least 21% below 2005 levels. Recently, following a series of stakeholder and public consultations and analysis of market-based solutions, the EU ETS opted to bring aviation into the system, an action which will account for emissions from aircraft arriving and departing from any EU airport. While airlines must legally report their emissions during the implementation year of 2012, they benefit from being capped at 97% of their baseline average emissions over the last decade. For carriers exceeding their baseline average, they must obtain allowances, 85% of which are free. This cap will be lowered in coming years as part of the phase-in strategy (Center for Aviation, 2012). The complexity of including global transportation systems into a regional emission-trading scheme is explored further in Section 8.2.

Another GHG reduction measure that the EU ETS is exploring, are opportunities to link with other international credit systems to potentially aggregate costs through a larger market (Point Carbon (a), 2011).

Switzerland

Currently, Switzerland operates its own form of ETS as a voluntary alternative to a mandated domestic fuel tax and covers some 350 installations, accounting for a total of three million tonnes of CO_2 (Schweizerische Eidgenossenschaft, 2010).

The Swiss scheme primarily involves companies that voluntarily assume a legally binding commitment to reduce their energy-related CO_2 emissions and accept a target for 2008-2012. In return, these

companies will be exempted from the otherwise mandatory carbon tax. Negotiating reduction targets and thus gaining exemption from a possible tax are key priorities for energy-intensive sectors such as the cement, paper and pulp, glass, and ceramics industries (Schweizerische Eidgenossenschaft, 2008).

In 2011, Switzerland began negotiations to bring their ETS program into alignment with the EU ETS. The European Commission is expected to start talks early in 2012 and is seen as "the first time that the EU seeks a connection with an existing scheme," according to EU ministers. When negotiations are concluded, the agreement will have to find final approval from the European Parliament and the EU Council of Ministers, which represents the 27 EU member countries (EurActiv, 2010).

North America

Regional Greenhouse Gas Initiative (RGGI)

The RGGI is the first mandatory, market-based carbon scheme in the United States. It was launched in January 2009, building on original voluntary commitments made through the Chicago Climate Exchange.

RGGI provides a market-based emissions auction and trading system where electric power generators can buy, sell, and trade CO_2 emissions allowances. The proceeds from the auction of allowances will be used to support low-carbon-intensity solutions, including energy efficiency and clean renewable energy, such as solar and wind power.

In addition, offsets will be used (GHG emissions reduction or sequestration projects at sources beyond the electricity sector) to help companies meet their compliance obligations.

It was first initiated in 2003 by governors from nine US states who came together looking to develop a regional cap-and-trade program addressing CO_2 emissions from local power plants. By 2007, ten Northeastern and Mid-Atlantic States had signed on, along with representatives from Pennsylvania and the provinces of New Brunswick, Ontario, and Quebec who are considered observers (Regional Greenhouse Gas Initiative (a), 2011).

RGGI Participating States:

1. Connecticut
2. Delaware
3. Maine
4. Maryland
5. Massachusetts
6. New Hampshire
7. New York
8. Rhode Island
9. Vermont

In 2011, the state of New Jersey pulled out of RGGI, leaving nine states (listed in the sidebar) who have put caps on CO_2 emissions from the power sector, requiring a 10% reduction of emissions by 2018 (Regional Greenhouse Gas Initiative (a), 2011). The option of expanding to other sectors in the future is also included.

The RGGI has acknowledged that as a result of a drop in GHG emissions due to the economic recession, the electricity sectors carbon market is oversupplied with allowances, leading to low prices that many believe aren't encouraging a transition to cleaner fuel sources in the region (Regional Greenhouse Gas Initiative (b), 2011). New Jersey Governor Chris Christie cited low carbon prices as one of the reasons that he withdrew his state from the initiative in 2011.

Alberta's Specified Gas Emitters Regulation (SGER)

As of July 1, 2007, the province of Alberta, Canada, requires facilities that emit more than 100,000 tonnes of GHGs a year to reduce emissions intensity by 12% (Government of Alberta, 2011).

Companies have four choices for complying:

- Make improvements to their operations;
- Purchase Alberta-based offset credits;
- Contribute to the Climate Change and Emissions Management Fund; and/or
- Purchase or use Emission Performance Credits.

One option for large industrial emitters who need to comply with the province's GHG emissions reduction program is to purchase offset credits from other sectors that have voluntarily reduced their emissions in Alberta. Credits must be created using protocols approved by the Alberta Government, which were developed in partnership with stakeholders and based on international research. The protocols outline how to quantify and verify emission reductions for different types of projects (e.g., no or reduced tillage, biomass, and biofuels). All credits used to meet the reduction targets must be verified by independent third parties.

The Government of Alberta states that since SGER's inception, more than 23 million tonnes of emissions that would have otherwise gone into the atmosphere have been avoided – the equivalent of removing 4.8 million cars from the road for a year (Government of Alberta, 2011).

Australasia

New South Wales Greenhouse Gas Abatement Scheme (GGAS)

In Australia, the New South Wales (NSW) Greenhouse Gas Abatement Scheme (GGAS) started on January 1, 2003, and was one of the first mandatory GHG emissions trading schemes in the world. Under this baseline-and-credit scheme, electricity distributors in NSW are required to reduce annual GHG emissions through offsets from project-based activities (Greenhouse Gas Reduction Scheme, 2011).

GGAS establishes annual state-wide GHG reduction targets, and then requires individual electricity retailers and certain other parties who buy or sell electricity in NSW to meet mandatory benchmarks based on the size of their share of the electricity market. If these parties, known as benchmark participants, fail to meet their benchmarks, then a penalty is assigned. Monitoring the performance of benchmark participants is undertaken by the Independent Pricing and Regulatory Tribunal (IPART) of NSW in its role as compliance regulator (Greenhouse Gas Reduction Scheme, 2011).

By year's end in 2010, the initiative had facilitated the offset equivalent of 118.34 $mtCO_2e$. To create and facilitate market assurance, the NSW Government passed legislation extending the GGAS scheme to 2020, or until a national trading scheme is introduced (Carbon Offset Research and Education, 2011). At present, there appears to be uncertainty as to how the GGAS program will function in tandem with the Australian federal carbon tax which is set to begin July 1, 2012, with the end goal of converting to a cap–and-trade system by 2015-2016.

Analysts at Thomson Reuters Point Carbon estimate that Australian firms will buy 350-400 million international offsets between 2015 and 2020, providing demand for credits, such as those from new projects in China and India that have been excluded from future use in the EU ETS (Point Carbon (b), 2011).

New Zealand Emissions Trading Scheme (NZ ETS)

New Zealand announced the introduction of a cap-and-trade ETS in September 2007. The first phase of the NZ ETS will run from 2008 to 2012 with the introduction of sectors to the scheme being staged, starting with forestry in 2008; liquid fossil fuels, energy, and industrial processes in 2010; and agriculture in 2015 (Climate Change Information New Zealand (a), 2011).

Beginning in May 2013, CER's generated from HFC-23 and N_2O projects will be banned in the EU ETS, a point which has spurred a debate about whether the NZ ETS should follow suit or become the only mandatory cap-and-trade scheme in which projects to reduce these GHGs are eligible to qualify for offset credits.

An interesting feature of the NZ ETS is that it includes carbon sequestered in forests and creates deforestation liabilities for landowners. Participants are required to:

1. Monitor, record, and report activities that lead to GHG emissions, some of which will be the indirect result of their activities; and

2. Surrender emission units (either Kyoto units or New Zealand-specific units called New Zealand Units or NZUs) equal to the amount of emissions associated with their activities in each compliance period (Climate Change Information New Zealand (a), 2011).

Secondary market traders, such as brokers, can hold and trade NZUs, but do not have reporting obligations and are not required to surrender emission units but are allowed to hold and trade emission units to take advantage of market opportunities. The Ministry of Economic Development administers the emissions trading scheme and is the main enforcement agency, responsible for verifying the compliance of participants under the scheme. Emissions units are held in the central New Zealand Emission Unit Registry (Climate Change Information New Zealand (a), 2011).

6.2 Voluntary Schemes

North America

Chicago Climate Exchange (CCX)

The CCX was North America's largest and longest running voluntary GHG emission reduction program made up of 450 members with activities in all 50 US states, 8 Canadian provinces, and 16 countries. From 2003 through 2010, the CCX operated as a comprehensive cap-and-trade program with an offsets component which saw its members reduce a total of 700 million tonnes of GHG emissions, equal to roughly one-third the size of the EU ETS (Intercontinental Exchange, 2011).

The year of 2010 was a bumpy ride for suppliers in the US, where the federal government's inability to reach a climate solution saw transactions collapse on the domestic market and hastened the closure of the CCX, as well as several state-side trading desks (Peters-Stanley et al., 2011).

Asia

Japan Voluntary Emissions Trading Scheme (JVETS)

Japan's Voluntary Emissions Trading Scheme (JVETS) was launched in May 2005 by the Government of Japan as a method of accumulating knowledge and experience on cost-efficient emissions reductions and trading. The government provides economic incentives for the corporations that make efforts to achieve self-imposed reduction targets. One third of the cost of GHG reduction activities is subsidized from the government as an incentive, so long as they meet their reduction targets.

In addition, Japan also has a facility-based scheme by which the government selects facilities based on the cost effectiveness of their GHG reduction activities. The government then issues tradable allowances (JPA) to each facility (not company), and the target facilities have the obligation to submit the same amount of emissions allowances to the government as their actual GHG emissions.

Out of the 81 participants that carried out emission reduction activities in 2009, 67 over-achieved their reduction commitments (for a total of 631,000 tCO_2e) and 14 did not reach their commitments (equal to 15,000 tCO_2e) (Japan's Ministry of the Environment, 2011).

China

China continues to support emissions trading and Kyoto Protocol flexibility mechanisms, and has established a number of environment and energy exchanges to provide infrastructure for trading in CERs and Voluntary Emission Reductions (VERs). As of December 2010, the National Development and Reform Commission had approved approximately 2,850 Clean Development Mechanism projects (Linacre et al., 2011).

In March 2011, as an effort to reduce its national carbon intensity, China released its five-year plan of national economic and social development. The plan sets a carbon-intensity reduction target (CO_2 emissions per unit GDP) of 17% and aims to cut energy intensity by 16% by 2015. These targets are consistent with the 40-45% reduction in carbon intensity from 2005 levels that was first announced at COP 15 and reaffirmed at the COP 16 (Linacre et al., 2011).

As a result of these initiatives, the most active dedicated voluntary exchanges are now found in China, where the government announced low-carbon pilot programs in eight cities and five provinces in 2010. Many of these programs are tied to regional exchanges.

The Tianjin Climate Exchange (TCX) was China's first integrated exchange for trading VERs and other major pollutants. The TCX was unveiled in the fall of 2008 as a joint venture between the China National Petroleum Corporation Asset Management Company, Ltd. (CNPC-AM), the City of Tianjin, and the Chicago Climate Exchange (Peters-Stanley et al., 2011). In January 2012, the Asian Development Bank approved a US$ 750,000 grant to support the TCX in its pilot program to build a Kyoto flexibility mechanisms platform by 2013.

One of the most popular exchanges found in China is the China Beijing Environmental Exchange (CBEEX), which partnered with BlueNext to develop its platform in 2009. CBEEX also supports VERs and the development of China's domestic Panda Standard. The credits were transacted via CBEEX in March 2011 (Peters-Stanley et al., 2011).

In 2010, the Shanghai Environment and Energy Exchange (SEEE) signed a Memorandum of Understanding with California-based Pacific Carbon Exchange (PCarbX) to help develop carbon markets in China and demonstrate the commitment of both companies to further building carbon markets and supporting clean technology development in their respective countries (Pacific Carbon Exchange, 2011).

6.3 Future Trading Schemes

North America

California Global Warming Solutions Act (AB-32)

California's Global Warming Solutions Act (AB-32) is an environmental law signed into effect by former Governor Arnold Schwarzenegger on September 27, 2006. It was designed to bring California into compliance with the Kyoto Protocol. The law requires that the state's GHG emissions be reduced to 1990 levels by 2020, a reduction of approximately 30%, and then an 80% reduction below 1990 levels by 2050 (California Environmental Protection Agency (a), 2011).

At the core of AB-32 is the cap-and-trade scheme which sets a statewide limit on sources responsible for 85% of California's GHG emissions and establishes a price signal to drive long-term investment in cleaner fuels and more efficient use of energy. The cap-and-trade program will join a suite of other emission reduction measures, including standards for ultra-clean cars, low-carbon fuels, and renewable electricity (California Environmental Protection Agency (a), 2011).

The California scheme is designed to provide regulated industries the flexibility to seek out and implement the lowest-cost options to reduce emissions. The regulation will cover 360 businesses representing 600 facilities and is divided into two phases: the first, beginning in 2013, will include all major industrial sources along with electricity utilities; and the second, starting in 2015, brings in distributors of transportation fuels, natural gas, and other fuels (California Environmental Protection Agency (b), 2011).

Once up and running, the California cap-and trade system is poised to become the second largest carbon market in the world and is designed so that California may link up with programs within the Western Climate Initiative (California Environmental Protection Agency (b), 2011).

Western Climate Initiative (WCI) / WCI Inc

Launched in 2007, the WCI was originally a collaborative effort by seven US states (Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington) and four Canadian provinces (British Columbia, Manitoba, Ontario, and Quebec) who has set a goal of reducing GHG emissions by 15% from 2005 levels by 2020 (Western Climate Initiative, 2010).

As support from several US states appeared to be fading over the course of 2011, the WCI announced in November 2011 the creation of WCI Inc. – a new non-profit corporation formed to provide administrative and technical services to support the implementation of state and provincial GHG emissions trading programs. The only member jurisdictions that are proceeding with the new WCI Inc. initiative at this time are: California, Ontario, Manitoba, British Columbia, and Quebec (Western Climate Initiative, 2011).

WCI Inc. will continue to develop and harmonize member jurisdictions' emission trading program policies through activities that include:

- Developing a compliance tracking system that tracks both allowances and offsets certificates;
- Administering allowance auctions; and
- Conducting market monitoring of allowance auctions and allowance and offset certificate trading. (Western Climate Initiative, 2011).

Asia

India

In 2011, India submitted its voluntary emission reduction objective under the Copenhagen Accord, a voluntary target of reducing emissions intensity of its GDP by 20-25% from 2005 levels by 2020 (Linacre et al., 2011).

This mission includes a market-based mechanism, called Perform, Achieve, and Trade (PAT) and is designed to enhance cost effectiveness of meeting energy efficiency improvement targets in energy-intensive industries and facilities (Linacre et al., 2011). The scheme will be applied to over 700 facilities across nine targeted sectors. The sectors, which have been classified as “designated consumers”, include: cement, fertilizer, iron and steel, paper and pulp, railways, and thermal power plants, as well as chlor-alkali, aluminum and textile facilities over a given emission output threshold (Institute for Global Economic Strategies, 2011).

With plans for a full rollout through 2011, India became the first developing country to put in place a market-based mechanism to control energy-related emissions.

South Korea

During 2010, the Republic of South Korea enacted its “Framework Act on Low Carbon, Green Growth”. This act establishes a legal framework for setting GHG and energy reduction targets and also provides a platform for GHG emissions reporting. The act also establishes the right to implement a cap-and-trade scheme for the purposes of reducing emissions and sets up fuel use and GHG emission standards for automobiles.

The framework has met resistance from industry groups concerned about the cost implications of cap-and-trade policies and has consequently seen the implementation of the trading scheme, originally planned for commencement in 2013, postponed until 2015 (Linacre et al., 2011).

Regardless of this delay, South Korea is continuing with its GHG target management system, which will require large facilities to report their GHG emission data and meet energy saving and GHG reduction targets. The system is believed to cap GHG emissions for 1,564 sites that collectively emit more than 442 $MtCO_2e$ a year (Linacre et al., 2011).

Once up and running, the trading plan will be managed by Korea Power Exchange, Korea Exchange or a new commodities exchange. The Kyoto instruments, CERs, are also said to be applicable in the Korean ETS (Climate Connect (b), 2011).

Australasia

Australia

In 2008, the Australian Government announced the Carbon Pollution Reduction Scheme (CPRS), a cap-and-trade emissions trading scheme designed to reduce Australia's GHG emissions to help move towards its long-term goal of an 80% reduction in emissions below 2000 levels by 2050. While originally slated to commence in 2011, the legislation to implement the scheme was twice rejected in the Australian Parliament.

CPRS is designed to cover the top 500 carbon polluters in Australia and will see most industrial sectors including metal, mining, paper and pulp, petroleum and coal, and chemicals allocated 94.5% free permits worth AUS $9.2 billion until fiscal year 2014-15. Free allocation for power generation units will continue until fiscal year 2016-17. Free permits will be reduced by a carbon productivity contribution of 1.3% annually (Climate Connect (a), 2011).

On July 10, 2011, the government released its Clean Energy Plan, which includes a carbon pricing mechanism (Australian's Department of Climate Change and Energy Efficiency, 2011). Starting in July 2012, select industries will be subject to an initial carbon tax of AUS $23/tonne of CO_2 released. The rate will rise by 5% per year until 2015 to keep it in-line with inflation, when a market-driven cap-and-trade system will take effect (Climate Connect (a), 2011).

The revenue from having a price on carbon will be re-distributed back to residents with 50% of the revenue stream being directly returned to Australian households via income tax reductions and pension increases, and 40% will be used to support businesses that might be competitively disadvantaged by the tax (Climate Connect (a), 2011).

One mechanism designed to support businesses which are subject to the tax is the Carbon Farming Initiative (CFI), which aims to provide new economic opportunities to farmers, forest growers, and landholders by reducing carbon pollution (Linacre et al. 2011). Through the CFI, farmers and land managers will be able to generate credits that can be sold to other businesses wanting to offset their CO_2 emissions. Since forestry and agriculture currently account for approximately 23% of the nation's emissions, these sectors will play a critical role in helping Australia meet its 2050 goals (Australian Government, 2011).

Emerging Market Participants

Recently, a number of market-based initiatives have emerged in other developing regions, as well as a number of dedicated exchanges. These include the Kenya-based Africa Carbon Exchange (ACX), Zambia-based Africa Carbon Credit Exchange (ACCE), Colombia-based Mechanism for Voluntary Mitigation of Emissions of Greenhouse Gases, Dominican-based Caribbean Basin Climate Exchange (CBCE), and most recently, the Chile-based Santiago Climate Exchange (SCX), launched in April 2011 (Peters-Stanley et al., 2011).

7 Private Sector Initiatives

In the absence of clear national and global climate policy frameworks, the private sector is moving ahead with several initiatives aimed at reducing GHG emissions in order to gain competitive positioning in a more carbon-constrained world. Below are a couple of examples of global private sector initiatives currently in operation.

Carbon Disclosure Project

The premise behind the Carbon Disclosure Project (CDP) is that improved disclosure of GHG emissions, energy use, and climate change strategies in a standardized form can help drive GHG emissions reductions. The CDP works with investors globally to advance the investment opportunities and reduce the risks from climate change by targeting 6,000 of the world's largest companies to report annually (Carbon Disclosure Project (a), 2011).

At present, over 3,000 organizations in some 60 countries around the world now measure and disclose their emissions as part of the CDP. This data is made available for use by a wide audience, including institutional investors, corporations, policymakers and their advisors, public sector organizations, academics, and the public at large (Carbon Disclosure Project (b), 2011).

A survey distributed as part of the CDP in 2011 saw the highest response rate yet for leading Canadian corporations signaling their willingness to join and disclose their carbon patterns and plans. It appears that an increasing number of organizations are deriving business value from the risks and opportunities associated with climate change.

GHG Protocol

The World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) have partnered to create the Greenhouse Gas Protocol. The GHG protocol is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage GHG emissions (Greenhouse Gas Protocol (a), 2011). Since 2001, more than 1,000 businesses and organizations worldwide have developed their GHG inventories using the GHG Protocol.

According to the GHG protocol, many corporate leaders are now adept at calculating emissions from Scope 1 and Scope 2 emissions shown in Figure 16, however, Scope 3 emissions are not commonly accounted for in today's emission tracking systems. Scope 3 emissions originate from upstream activities, such as the production of goods and services purchased by a company, as well as downstream activities such as consumer use and disposal of products sold by a company. Scope 3 emissions can be the largest source of emissions for many companies, and therefore represent a great opportunity for GHG reductions (Greenhouse Gas Protocol (a), 2011).

Emissions Type	Scope	Definition	Examples
Direct Emissions	Scope 1	Emissions from operations that are owned or controlled by the reporting company	Emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment
Indirect Emissions	Scope 2	Emissions from the generation of purchased or acquired electricity, steam, heating or cooling consumed by the reporting company	Use of purchased electricity, steam, heating or cooling
	Scope 3	All other indirect emissions that occur in the value chain of the reporting company, including both upstream and downstream emissions	Production of purchased products, transportation of purchased products, use of sold products

Source: Greenhouse Gas Protocol (b), 2011

Figure 16: Overview of GHG supply chain scopes.

Released in late 2011, the Corporate Value Chain (Scope 3) Standard allows companies to assess their entire value chain emissions impact and identify the most effective ways to reduce emissions. Users of the new standard can now account for emissions from 15 categories of Scope 3 activities, both upstream and downstream of their operations. The Scope 3 framework also supports strategies to partner with suppliers and customers to address climate impacts throughout the value chain (Greenhouse Gas Protocol (b), 2011).

8 The Future: What Lies Ahead?

8.1 The Future for Trading Schemes

Europe

The EU ETS continues to be at the heart of the global carbon market. The clear dedication by the EU to meet its goal of 21% reduction in GHG emissions below 2005 levels by 2020 has given the market some assurance for planning ahead and has supported investments in a low carbon economy. With aggressive moves to include the aviation industry and potentially the marine shipping industry (see Section 8.2), it is likely that other regions of the world will continue to look at the successes and failures of the European system to help shape their own policies and trading schemes.

North America

The North American market place will likely continue to be driven by the leadership of California. The AB-32 scheme is poised to become the second largest cap-and-trade system in the world after the EU ETS. With the transformation of the WCI into WCI Inc., it is unclear at present time how great of an influence the organization will have on the evolution of the carbon market in North America.

Asia

The entrance of trading schemes in China and the planned market based mechanisms in India mark important steps to bringing developing nations in Asia into the global carbon market. With tremendous room to both grow their trading schemes and rein in emission levels, these two countries will pave the way for other developing countries.

Japan continues to work on emission reductions, but there is some level of uncertainty surrounding power generation as the Fukushima nuclear disaster has the country searching for alternatives, which may include carbon-intensive technologies.

While South Korea appears to be uncertain as to what the future holds for the carbon markets, the successful implementation of schemes in China and India will likely create pressure for South Korea to push forward with its plan to enter the market in 2015.

Australasia

The regional New South Wales scheme provided proving grounds for carbon trading in Australasia, which has since seen New Zealand introduce a national cap-and-trade system. There are signals that pricing carbon will become the norm in the region driven by the recent push forward by the Australian Government to introduce a national carbon-tax on its heaviest polluters, which is designed to transition into a market driven cap-and-trade scheme by 2015.

8.2 Global Transportation

Aviation Industry

Currently, emissions from aviation account for approximately 3% of the EU's total GHG emissions, with the majority of these emissions from international flights. Aviation emissions are growing rapidly and the EU has acted to include emissions from all domestic and international flights that arrive at or depart from an airport in the EU as part of the EU ETS. The expansion of coverage will translate into approximately 200 million additional allowances annually. Of this number, 82% of the allowances will be freely allocated to aircraft operators and 15% will be auctioned (Linacre et al., 2011).

However, the move to include aviation in the EU ETS is not without controversy and pushback, and as a result:

- Washington lawmakers passed a bill on the Floor of the House of Representatives in late October 2011 that attempted to shield US airlines from complying with an EU emissions cap, but was rejected by the EU's highest legal body, The European Court of (Deutsche Welle, 2012);
- China Air Transport Association (CATA) Deputy Secretary General declared that "China will not cooperate with the EU on the ETS…" and has threatened retaliatory measures (Deutsche Welle, 2012); and
- The United Nations body responsible for civil aviation approved a working paper in late 2011 that urges the EU not to include non-EU carriers in its carbon emissions trading system as is could be considered discriminatory and illegal (Reuters (b), 2011).

Despite the resistance from airlines outside the EU and their respective government bodies, a growing number of EU airlines have taken the changes in stride by passing along nominal fees to passengers in an effort to recover any additional costs associated with the costs of emissions. A study released at the beginning of 2012 by the Massachusetts Institute of Technology and Germany's University of Muenster concluded that US airlines could make a profit by passing on the full cost of CO_2 emissions to consumers through a marginal price increase while benefiting from net gains as a result of free emission allocations from the EU (Reuters (b), 2012).

Marine Shipping Industry

Ships account for over 1 billion tonnes of CO_2e annually, or around 3% of global anthropogenic emissions, in addition to being the largest emitter of Nitrogen Oxides (NO_x) and a major contributor of Sulphur Oxides (SO_x) and particulate matter. According to the International Maritime Organization (IMO), CO_2e emissions from ships will reach 18% of all manmade GHG emissions by 2050 under "business as usual" (Carbon War Room, 2011).

There is currently no regulation on international maritime transport emissions, but this is currently under discussion within the IMO and at the UNFCC (Carbon Offsets Daily, 2010).

Several countries appear to be acknowledging that the shipping industry is a critical industry to include in emission reduction schemes, as described below.

- In February 2011, Japan submitted a joint proposal to the IMO to establish a new, legally-binding agreement, which would require new and existing ships to meet stringent, but realistic efficiency standards (World Shipping Council, 2011).
- The German Federal Environment Agency has commissioned a Nature Associates' report proposing the creation of a CO_2 emissions trading system for international shipping called the Maritime Emissions Trading Scheme (METS) that could be linked to the EU ETS, along with other existing or future regional and national cap-and-trade schemes (Marine Insight, 2011).
- The UK Committee on Climate Change has proposed that the UK international shipping emissions be included in the country's carbon budget and should be given targets to reduce emissions under the Climate Change Act. The UK has plans to reduce its GHG emissions by 80% by 2050; however, the emissions from the shipping industry are currently not included in the Act (Committee on Climate Change, 2011).

8.3 Financial Security

With billions of dollars at stake in the carbon market, it is critical that registry security is on par with systems in equivalent markets. That doesn't appear to be the case yet as in recent years there were problems related to framework loopholes and criminal activities directed against the EU ETS.

In addition to the "carousel" value-added tax (VAT) fraud that surfaced in 2009, 2010 and 2011 witnessed the sale of recycled CERs, phishing attempts on Germany's national registries, and a series of subsequent cyber-thefts that undermined the European market, highlighting security shortcomings and increasing the urgency of stakeholders' pleas to strengthen security infrastructure (Linacre et al., 2011).

According to the Climate Change Secretariat, October 2011 saw hackers target the UN-run carbon registry holding certified emission reductions (CERs), but the attack was stopped in time and no credits were stolen (ICIS Heron, 2011).

In an attempt to address these concerns with current registries, the European Commission has released details of its plan to create a centralized registry for emissions trading permits by January 2013, and security will be a paramount consideration. While many see this as a necessary step to ensure legitimacy, the proposal has not been welcomed by all stakeholders, and has been criticized by the IETA, which claims that the new rules could prove unnecessarily onerous (Business Green, 2011). Experts suggest that ensuring the security of the global carbon marketplace will continue to be a vital area of focus in the future.

9 Conclusion

While there continues to be some debate about global warming and the causes thereof, there is no question that climate change is occurring at a faster rate than normal, predominantly due to anthropogenic causes. As the IPCC noted in its 2007 report, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."

The current level of CO_2 in the atmosphere is at 388 ppm, having increased at an alarming rate since the start of the industrial revolution. Scientists suggest that reaching levels above 450 ppm could result in irreversible consequences for our planet. The full, long-term impacts of climate change can be hypothesized, but are still somewhat uncertain. Potentially, they are massive and will have a drastic effect on the future of all species on the planet. Minimally, they will be disruptive to socio-economic activities in many areas of the world and will force adaptive measures.

Many governments, businesses, and individuals are now concerned about the future impacts of climate change, and are ready to take action. Actions of international organizations such as the UN are vital, and the Kyoto Protocol represents an important commitment by many nations to reduce GHG emissions. With the final Kyoto commitment period over in 2012, there is a strong need to develop parallel efforts as any initiative that reduces GHG emissions in a relatively efficient manner will produce benefits in the longer-term.

The use of market-based mechanisms, such as carbon trading, is crucial to engaging the private sector to adopt low carbon solutions. Providing businesses with financial incentives to reduce GHG emissions, in turn, leads to innovation and creates a market for alternative energy and energy efficient technologies. Companies that are early entrants into carbon trading markets, both mandatory and voluntary, can gain valuable experience, which can provide them with a competitive advantage for the future.

What has been demonstrated over the last several years is that climate change is unequivocally real, that governments and their citizens will have to deal with its costly impacts, and that society must do what it can to mitigate GHG emissions. With the introduction of international governmental efforts and private sector initiatives, the world is now becoming engaged to deal with climate change. These efforts must continue and must be reinforced in a way that produces the environmental and economic conditions our society requires to thrive.

Clearly, climate change is an unfolding story. This Primer touches on the basics and hopefully provides a foundation upon which readers can form their own opinions on the many issues involved. More importantly, the Primer may help decision-makers in governments and companies, large and small, begin to make the changes that are necessary to deal with the inevitable impacts of climate change and to get involved in reducing their own GHG emissions.

10 Glossary

Abatement
Reduction in the quantity or intensity of greenhouse gas emissions.

Afforestation and Reforestation (A/R) Projects
Afforestation and reforestation (A/R) projects involve the growing of forest on land that has not been forested for a period of at least 50 years (afforestation) or on non-forested land (reforestation) through planting, seeding and/or the promotion of natural seed sources.

Allowance
Legally defined unit (EUAs, AAUs, RGAs, NZUs and others) that entitles the holder to emit one tonne of CO_2e or another quantity of greenhouses gases. Also known as emission allowance or emission permit. See also European Union Allowance (EUA).

Annex B Countries
Annex B countries are the 39 emissions-capped countries listed in Annex B of the Kyoto Protocol. In practice, Annex I of the UNFCCC (see below) and Annex B of the Kyoto Protocol are often used interchangeably.

Annex I Countries
Includes the industrialized OECD countries and countries with economies in transition listed in Annex I of the UNFCCC. Belarus and Turkey are listed in Annex I but not in Annex B; and Croatia, Liechtenstein, Monaco and Slovenia are listed in Annex B but not in Annex I. In practice, however, Annex I of the UNFCCC and Annex B of the Kyoto Protocol are often used interchangeably.

Annex II Countries
Annex II of the UNFCCC includes all original OECD member countries, but not the countries with economies in transition. Annex II countries are required to provide financial resources enabling developing countries to undertake emissions reductions.

Assigned Amount (AA) and Assigned Amount Units (AAUs)
The assigned amount is the total volume of greenhouse gases that each Annex B country is allowed to emit during the first commitment period (see explanation below) of the Kyoto Protocol. An Assigned Amount Unit (AAU) is a tradable unit of 1 tonne CO_2e.

Auctioning
Common term used for the sale of allowances, as opposed to allocating them for free.

Banking
The transfer of allowances or credits from one compliance period to the next. Parties to the Kyoto Protocol may bank as many AAUs they wish as long as they follow commitment period reserve rules, CERs corresponding to 2.5% of their targets, and ERUs corresponding to 2.5% of their targets, to use them in subsequent commitment periods. The EU ETS allows unlimited banking from the second compliance period (2008-12) onwards, but did not permit banking from the first to later periods. Also known as carry-over or hoarding.

Benchmarking
An allocation method in which allowances are distributed based on output (e.g. one allowance per MWh generated) or on intensity standards in the industry, based on best-performing companies.

California Global Warming Solution Act AB32 (AB32):
The passage of Assembly Bill 32 (California Global Warming Solution Act AB32) in August 2006 sets economy-wide GHG emissions targets as follows: Bring down emissions to 1990 levels by 2020 (considered to be at least a 25% reduction below business-as-usual) and to 80% of 1990 levels by 2050. Covering about 85% of GHG emissions the scheme begins in 2013 and will compliment renewable energy standards, energy efficiency standards for buildings and appliances as well as vehicle emissions standards.

Cap-and-Trade
A design for emissions trading systems under which total emissions are limited or 'capped'. Tradable emission allowances corresponding to the total allowed emission volume are allocated to participants for free or through auctioning. Contrasts with baseline-and-credit approaches where only deviations from a baseline are tradable. Examples are the EU ETS, RGGI, international emissions trading under the Kyoto Protocol and the proposed emissions trading scheme in Australia (Carbon Pollution Reduction Scheme).

Carbon Capture and Storage (CCS)
Process consisting of the separation of CO_2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere. CO_2 may be stored under ground in old oil and gas fields, non commercial coal fields and saline aquifers. It may also be injected into the ocean. Also known as carbon capture and geological storage (CCGS).

Carbon Dioxide Equivalent (CO_2e)
Measurement unit used to indicate the global warming potential (GWP) of greenhouse gases. Carbon dioxide is the reference gas against which other greenhouse gases are measured. See Global Warming Potential for conversion rates.

Carbon leakage
Carbon leakage occurs when production of goods is moved to countries with less strict climate policy (e.g. India and China) than the original country (e.g. EU).

Carbon Neutrality
The practice of purchasing and retiring emission credits or allowances corresponding to the amount of GHG emissions from for instance an activity, company or country.

Carbon Sink
Natural or human-made systems that absorb carbon dioxide from the atmosphere and store them. Forests are the most common form of sink, in addition to soils, peat, permafrost, ocean water and carbonate deposits in the deep ocean.

Certification
A process by which a GHG reduction project is audited by a government agency or independent authority to determine that it meets established criteria. For instance, the act of approving emission reductions from a carbon project and issue emission reduction credits to the entity that owns the rights to the project credits.

Certified Emission Reductions (CERs)
CERs are carbon credits generated through the CDM. It can be used to meet an Annex B Party's emission commitment or as a unit of trade in GHG emissions trading systems.

Clean Development Mechanism (CDM)
The CDM is a mechanism for project-based emission reduction activities in developing countries (non-Annex B countries). Certified emission reductions (CERs) are generated from projects that lead to certifiable emissions reductions that would otherwise not occur.

Chicago Climate Exchange (CCX)
Voluntary cap-and-trade scheme that started trading in 2003 and ended in 2010. Members made a voluntary commitment to reduce GHG emissions. Among the members were companies from North America, municipalities, US states, universities.

Conference of the Parties (COP)
The COP is the supreme body of the UNFCCC. It meets once a year to review the progress. COP-11 took place in Montreal, Canada in November/December 2005 and was also the first Meeting of the Parties to the Kyoto Protocol (MOP-1). COP-12 was held in Nairobi in November 2006 and COP-13 in December 2007 in Bali. COP-14 Poznan in 2008. COP-15 in Copenhagen 2009, COP-16 in Cancun 2010 and COP-17 will be held in Durban South Africa at the end of 2011.

Economies in Transition (EIT)
Fourteen Annex I countries that include some Central and East European countries and former republics of the Soviet Union that are in transition from centrally-planned economies to market-based economies.

Emission Reduction Units (ERUs):
A unit of emission reductions issued pursuant to Joint Implementation. One ERU represents the right to emit one metric tonne of carbon dioxide equivalent.

European Union Allowances (EUA)
The tradable unit under the EU ETS. Each allowance equals 1 tonne of CO_2. EUAs are bankable from Phase 2 to Phase 3 of the EU ETS.

European Union Emissions Trading Scheme (EU ETS)
The EU ETS was launched on January 1, 2005, as a cornerstone of EU climate policy toward its Kyoto commitment and beyond. Through the EU ETS, Member States allocate part of the efforts toward their Kyoto targets to domestic emission sources (mostly utilities). Over 2008–12, emissions from mandated installations (about 40% of EU emissions) are capped on average at 6% below 2005 levels. Participants can internally reduce emissions, purchase EUAs or acquire CERs and ERUs (within a 13.4% average limit of their allocation over 2008–12). The EU ETS will continue beyond 2012, with further cuts in emissions (by 21% below 2005 levels in 2020 or more, depending on progress in reaching an ambitious international agreement on climate change).

Flexible mechanisms
Under the Kyoto Protocol, a collective term for International Emissions Trading, the Clean Development Mechanism and Joint Implementation.

Global Warming Potential (GWP)
The global warming potential is the impact a greenhouse gas (GHG) has on global warming. By definition, CO_2 is used as reference case, hence it always has the GWP of 1. GWP changes with time, and the IPCC has suggested using 100-year GWP for comparison purposes.

Gold Standard
Initiated by WWF, SSN and Helio International, the Gold Standard for CDM projects offers project developers a tool with which they can ensure that CDM, JI and VER projects have real environmental benefits and, in so doing, give confidence to host countries and the public that projects represent new and additional investments in sustainable energy services. Eligible project types are renewable energy and energy efficiency.

Greenhouse gases (GHGs)
Greenhouse gases (GHGs) are trace gases that control energy flows in the Earth's atmosphere by absorbing infra-red radiation. Some GHGs occur naturally in the atmosphere, while others result from human activities. There are six GHGs covered under the Kyoto Protocol - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). CO_2 is the most important GHG released by human activities.

Hydrofluorocarbons, or HFCs
One of the six GHGs, controlled in the Kyoto Protocol. Are produced commercially and are largely used in refrigeration and insulating foam.

International Emissions Trading (IET)
International emissions trading, one of the three flexible mechanisms under the Kyoto Protocol, allows for transfer of AAUs across international borders or emission allowances between companies covered by a cap-and-trade scheme. See emissions trading.

International Organization for Standardization (ISO)
The world's largest developer and publisher of International Standards. The ISO is composed of a network of the national standards institutes of 157 countries, with a Central Secretariat in Geneva, Switzerland. In March 2006, ISO launched the ISO 14064:2006 standards for GHG accounting and verification.

International Transaction Log (ITL)
Database of all tradable credits under the Kyoto Protocol and the application that verifies all international transactions and their compliance with Kyoto rules and policies.

Intergovernmental Panel on Climate Change (IPCC)
The IPCC was established by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP) in 1988 to assess scientific, technical and socio- economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is open to all Members of the UN and of WMO

Japan-Voluntary Emissions Trading Scheme (J-VETS):
Under the J-VETS, companies receive subsidies to implement mitigation activities in line with voluntary commitments and can resort to emissions trading (incl. offsets) to meet their commitments with more flexibility. Though growing, impact remains limited: over the first three years of the scheme, participants (288 companies) have reduced their emissions by about one million tCO2e. The J-VETS has contributed to the development of MRV system, third-party verification system, and the registry system. The J-VETS has been incorporated to the Experimental Integrated ETS as one of participating options.

Joint Implementation (JI)
Joint Implementation is one of the three flexible mechanisms under the Kyoto Protocol, for transfer of emissions permits from one Annex B country to another. JI generates ERUs on the basis of emission reduction projects leading to quantifiable emissions reductions.

Kyoto Protocol
The Kyoto Protocol originated at COP-3 to the UNFCCC in Kyoto, Japan, December 1997. It specifies emission obligations for the Annex B countries and defines the three so-called Kyoto flexible mechanisms: JI, CDM and emissions trading. It entered into force on 16 February 2005.

Land Use, Land Use Change and Forestry (LULUCF)
The land-use, land-use change and forestry (LULUCF) sector was included under the Kyoto Protocol to take into consideration certain human-induced activities that remove greenhouse gases from the atmosphere, also known as carbon "sinks". The following activities referred to in Article 3, paragraphs 3 and 4 of the Kyoto Protocol, as defined in paragraph 1 of the annex to decision 16/CMP.1: afforestation, reforestation, deforestation (the direct human-induced conversion of forested land to non-forested land), re-vegetation, forest management, cropland management, grazing land management.

Monitoring
Monitoring refers to the collection and archiving of all relevant data necessary for determining the baseline, measuring anthropogenic emissions by sources GHG within the project boundary of a project activity and leakage, as applicable.

New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS)
Operational since January 1, 2003 (to last at least until 2012), the NSW Greenhouse Gas Abatement Scheme aims at reducing GHG emissions from the power sector. NSW and ACT (since January 1, 2005) retailers and large electricity customers have thus to comply with mandatory (intensity) targets for reducing or offsetting the emissions of GHG arise from the production of electricity they supply or use. They can meet their targets meet their targets by purchasing certificates (NSW Greenhouse Abatement Certificates or NGACs) that are generated through project activities.

Offset credits or offsets
Emission reduction credits from project-based activities that can be used to meet compliance or corporate objectives as a supplement or alternative to reducing one's own emissions. In a cap-and-trade scheme, offsets may be used instead of allowances, sometimes up to a limit (see credit limit). CERs and ERUs are types of offset credits.

Over the Counter (OTC) market
Trades arranged by brokers, as opposed to trades on exchanges or bilateral (direct) trades.

Perfluorocarbons or PFCs
One of the six GHG controlled by the Kyoto Protocol. PFCs are a by-product of aluminum smelting and are replacement for CFCs in manufacturing semiconductors.

Reduced emissions from deforestation and degradation (REDD)
Reducing emissions from deforestation and [land] degradation. Mitigation action that seeks to preserve existing carbon stocks in forests (typically tropical rainforests), peat lands etc. The approach would be additional to project-based efforts such as the CDM. Issues to be solved are permanence, leakage, monitoring and baselines.

Regional Greenhouse Gas Initiative (RGGI)
A regional cap and trade system that currently includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont. In addition, the District of Columbia, Pennsylvania, the Eastern Canadian Provinces, and New Brunswick are observers in the process. The scheme covers CO_2 emissions from power plants in the region, and requires a 10% reduction in these emissions by 2018. The first three-year compliance period started on 1 January 2009.

Registration
Registration is the formal acceptance by the Executive Board of a validated project activity as a project activity. Registration is the prerequisite for the verification, certification and issuance of credits related to that project activity.

Re-vegetation
A direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation and reforestation.

Regional Greenhouse Allowance (RGA)
Tradable unit under the Regional Greenhouse Gas Initiative, corresponds to 1 short ton (0.907 metric tonne).

Secondary Market
The secondary market signifies the second transaction or trading of Certified Emissions Reductions (CERs) related to CDM projects or Emission Reduction Units (ERUs) from JI projects.

Sinks
The removal of greenhouse gases (GHGs) from the atmosphere through land management and forestry activities that may be subtracted from a country's allowable level of emissions.

Sulphur Hexafloride or SF_6
One of six GHGs curbed under the Kyoto Protocol. It is mostly used in the heavy industry to insulate high-voltage equipment and assist in the manufacturing of cable-cooling systems.

United Nations Framework Convention on Climate Change (UNFCCC)
The UNFCCC was established 1992 at the Rio Earth Summit. It is the overall framework guiding the international climate negotiations. Its main objective is "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system".

Validation
The process of independent evaluation of a CDM project by a designated operational entity according to requirements to CDM projects.

Verification
The process of formal confirmation by a recognized independent third party that inventories and carbon reduction claimed by participants in carbon trading schemes are in conformity with reality and established rules. Under the CDM, verification is performed by designated operational entities (DOEs).

Verified Emission Reductions (VERs)
VERs are generated by carbon reduction projects that are assessed and verified by third party organizations rather than through the UNFCCC.

Voluntary carbon market
The sum of all transaction of carbon credits in non-compliance markets. The generation of non-compliance credits — or voluntary offset credit supply — comprises the reduction of GHG emissions for the purpose of selling them to voluntary end users and not to compliance buyers. Voluntary markets for emissions reductions include generation and transaction of carbon credits in non-compliance markets. The voluntary market permits the use of credits such as verified emission reductions (VERs), non-verified emission reductions (ERs) and prospective emission reductions (PERs), as well as the non-compliance use of CERs, ERUs, EUAs and other credits and allowances generated for the compliance market.

Voluntary Carbon Standards (VCS)
VCS is a certification standard for offset credits in the voluntary market. The standard provides project-level quantification, monitoring, and reporting, validation, and verification of greenhouse gas emission reductions or removals. The VCS is an initiative of the World Business Council for Sustainable Development, International Emissions Trading Association, The Climate Group, and the World Economic Forum.

Voluntary Gold Standard
A voluntary standard, launched in May 2006 by WWF-UK and endorsed by 45 environmental NGOs. It is a simplified version of the CDM Gold Standard and is only available for projects in developing countries.

Western Climate Initiative (WCI)
The WCI has created a new non-profit organization called WCI Inc. which is comprised of California and four Canadian provinces (British Columbia, Manitoba, Ontario, and Quebec).

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