The Case for a Biospheric Carbon Network (BCN)

Appendix A

Summary of Emerging Carbon Markets and Related Policies

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I. Global Carbon Markets and Support Systems[1]

A. Global Voluntary Markets

Numerous ad-hoc global carbon markets have emerged, but no standard methods for carbon data verification, monitoring or regulation exist. The United States is the largest provider of global voluntary carbon offsets (28% of all global offsets) (Lovell 2010). In 2008, the United States Government Accountability Office reported that "over 600 organizations develop, market, or sell offsets in the United States, and the market involves a wide range of participants, prices, transaction types, and projects." (USGAO 2008) The report goes on to note that little quality assurance is available to the purchasers of voluntary market carbon credits and that shares purchased from one vendor may not be equivalent to those purchased from another. The GAO report conducted an experimental purchase of offsets from 33 providers. Of these, only three providers supplied information on additionality, and only nine of the providers offered information on verification and monitoring methods, though many of them offered general reference to some of these items online. Voluntary markets include The CarbonNeutral Company, MyClimate, TerraPass, Carbonfund, the Conservation Fund, Recycle One, 3Degrees, STI, ClimateCare (a division of JP Morgan), Myclimate, Cleaner Climate, and many more. The primary legal authorities governing voluntary markets are state-level fraud and consumer protection laws (USGAO 2008). In spite of this, the value of the voluntary carbon market has grown from $43 million in 2002 to $705 million in 2008 (Hamilton 2009).

B. Global Compliance Markets

1. The Kyoto Protocol

The Kyoto Protocol is a widely-known and influential market-oriented compliance carbon policy organ that arose from a series of meetings of the United Nations Framework Convention on Climate Change.

The Kyoto Protocol, or more formally, the Kyoto Protocol to the United Nations Framework Convention on Climate Change, is a non-binding international treaty intended to bring about the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." (Breidenich et al 1998) The greenhouse gases targeted by Kyoto include carbon dioxide (CO_2), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) (Lee-Andersen 2005; Myers-Madeira 2008). The Kyoto Protocol arose from a series of United Nations Framework Convention on Climate Change (UNFCCC) conferences of participating countries, described as Conferences of the Parties (COP). The protocol was

[1]This section prepared by the Canadian team

developed at the COP3 conference, which occurred in 1997, and took effect in 2005. The history of the United Nations Framework Convention on Climate Change (UNFCCC) conferences is described in the following sections.

a. Kyoto Protocol Classification of Nations (abridged)

Countries are classified in the Kyoto Protocol according to development status as defined by the World Bank. Two broad categories exist: Annex I Countries and Developing Countries. Of the Annex I countries, a subset of industrialized countries (Annex II countries) are tasked with providing aid to developing nations for the purpose of reducing greenhouse gas emissions. The nations' respective commitments to emissions reduction are as follows:

- Annex I Countries: Developed countries – using defined mechanisms, reduce emissions to varying pre-1990 levels defined according to the Kyoto Protocol Reference Manual on Accounting of Emissions and Assigned Amounts. (see Table I)
- Annex II Countries: Industrial countries– abide by Annex I provisions, and additionally, provide emissions reduction assistance to Developing Countries.
- Developing Countries: No emissions reduction requirements.

Table 1 Kyoto Protocol Classification of Nations (Breidenich et al. 1998)

Annex I Countries	Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States of America (40 countries and separately the European Union).
Annex II Countries	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States of America
Developing Countries	Afghanistan, Albania , Algeria, Angola, Antigua and Barbuda, Argentina, Armenia , Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Cook Islands, Costa Rica, Cuba, Cyprus, Côte d'Ivoire, Democratic People's Republic of Korea, Democratic Republic of the Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, The former Yugoslav Republic of Macedonia, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Jamaica, Jordan,

	Kazakhstan , Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia (Federated States of), Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Niue, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Republic of Korea, Republic of Moldova , Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tajikistan, Thailand, The former Yugoslav Republic of Macedonia, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan , Tuvalu, Uganda, United Arab Emirates, United Republic of Tanzania, Uruguay, Uzbekistan , Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Yemen, Zambia, Zimbabwe

b. Kyoto Protocol Mechanisms

The protocol establishes a number of mechanisms for achieving greenhouse gas reductions. These mechanisms provide varying methods for the reduction of CO_2. The treaty is non-binding in that it does not specify any mandatory limits on emissions and has no provisions for enforcement. However, it does set out legally binding obligations to follow a series of protocols (the Kyoto protocols) for voluntarily reducing emissions. The United States declined to sign the treaty and has no intention of signing; however, a number of individual states have passed individual initiatives affirming their commitment to following the Kyoto protocol. These states include California, Maine, New Hampshire, Vermont, Connecticut, New York, New Jersey, Delaware, Massachusetts, and Maryland. Numerous individual U.S. cities have adopted programs to reduce greenhouse gas emissions. A majority of the nations that signed on to the Kyoto protocol are not likely to meet their 2012 emissions reduction goals (DiMento 2003).

Emissions goals are not fluid, but quantum-based, and allowances are described according to the mechanism used to achieve the target reduction of one metric tonne of CO_2 as the default quantity. Allowance acronyms include AAUs, RMUs, ERUs, and CERs (defined and described below) (Breidenich *et al.* 1998).

- Emissions trading - allowances traded as AAUs (Assigned Amount Units): The emissions trading mechanism establishes the ability for countries that have exceeded their emissions reduction goals to sell "credits," or excess carbon allowances, to countries that have not been as effective in reducing emissions. Countries may purchase sell AAUs to offset unachieved greenhouse gas reduction goals, or the converse. (Breidenich *et al.* 1998)

- Joint Implementation - allowances traded as ERUs (Emission Reduction Units): Joint implementation projects allow for reductions to be credited to an Annex I (investor) nation when that nation invests in an emissions reducing project in another Annex I (beneficiary) nation. Though the actual reductions occur in the beneficiary nation, because the investor nation initiated the project, it receives credit for the reductions. The investor nation may then use or sell the ERUs it has generated (Breidenich *et al.* 1998).
- The Clean Development Mechanism - allowances traded as CERs (Certified Emission Reductions): Similar to Joint Implementation, the Clean Development Mechanism (CDM) allows for investment by an Annex I nation in another nation, however, in CDM projects, the beneficiary nation is a developing nation. The investor nation receives CERs allowances (Breidenich *et al.* 1998).

c. Brief Relevant History of the United Nations Framework Convention on Climate Change (UNFCCC), sponsor organization for the Kyoto Protocol

i) Pre-Kyoto Agreements: Marrakesh Accords

The Marrakesh Accords originated at a United Nations conference occurring from June 3 to 14, 1992, commonly known as the Earth Summit (Vrolijk 2002). The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, resulted in an international environmental treaty and gave rise to the United Nations Framework Convention on Climate Change (UNFCCC). Annual meetings of the parties attending the convention, or Conferences of the Parties (COP), have taken place since 1995. At the seventh meeting (COP7), held in 2001 in Marrakesh, Morocco, policy-makers proposed the development of a co-operative international agency or agencies that would oversee international carbon trading mechanisms such as emissions trading, the clean development mechanism (a flexibility mechanism geared to promote sustainable development) and joint implementation (another flexibility mechanism allowing developed countries to receive carbon allowances for investing in CO_2-reducing technologies in foreign nations) (Godal and Klaassen 2006), (Schlamadinger *et al.* 2007)).

The Marrakesh document specifies that, "Financial and technical resources should be made available, through an operating entity of the financial mechanism and, as appropriate, through multilateral and bilateral agencies and the private sector, to assist developing countries, in particular the least developed countries and small island developing States among them, in the implementation of this framework." Marrakesh placed a high emphasis on management of biospheric resources, particularly for the developing nations where the changing climate will have the most impact. Five out of the seven crucial capacity-building recommendations for developing nations focus on protection and preservation of biospheric (and

related) resources. The "Guiding Principles" section (UNFCCC 2002) notes the following areas crucial to easing the impact of climate change for developing nations:

(a) Fragile ecosystems; (emphasis added)

(b) High population pressure [on natural resources] and isolated geographic locations; (emphasis added)

(c) Weak economies, low incomes, high levels of poverty and a lack of foreign investment;

(d) Land degradation, desertification; (emphasis added)

(e) Undeveloped services, inter alia, meteorologic and hydrological services and water resources management; (emphasis added)

(f) Lack of early warning systems for natural disaster management;

(g) Inadequate food security (emphasis added)

Since Kyoto, the activities of the UNFCCC have generated global interest. Most notable among these are the Copenhagen conference (2009) and the Cancún conference (2010).

ii) Post-Kyoto Conferences of the Parties (COP) / Meetings of Parties of the Kyoto Protocol (MOP) - Copenhagen

COP 15, held in Copenhagen, Denmark in December of 2009, set forth an ambitious goal of establishing a global climate agreement. Though no agreement for a continuing action plan resulted, an accord document signed by the U.S. and China (who produce the world's largest volume of national emissions per GDP) paved the way for later achievements at the COP 16/MOP 6 conference held in Cancún, Mexico the following year.

iii) Post-Kyoto Conferences of the Parties (COP) / Meetings of Parties of the Kyoto Protocol (MOP) - Cancún

The primary product of the COP 16 Cancún summit involved the development of an agreement that established a "Green Climate Fund," originally developed in the Copenhagen conference. By the year 2020, fund architects proposed that the value of this fund should approach $100 billion per year (Schalatek *et al.* 2010). Fund monies will be used to provide less affluent nations with financial assistance for the purposes of reducing emissions, with a primary focus on preserving biospheric

sinks. The mechanisms for backing this funding are still undetermined, as are the details regarding emissions reductions allotments and methods for developed nations. A board of 24 members (the Green Climate Fund Board) is proposed to govern the fund, managed by a trustee designated to administer assets following board consensus authorizing projected expenditures.

C. The World Bank Carbon Finance Unit (Support System)

The World Bank has established a Carbon Finance Unit (CFU) tasked with incentivizing emissions reductions in developing nations. The CFU works in conjunction with the World Bank's Environment Department in an attempt to align their respective missions of a) addressing climate change issues and b) reducing poverty and improving living standards in the developing world.

At the COP 16 summit, World Bank Group President Robert Zoellick announced the establishment of a fund entitled "Partnership for Market Readiness" (World Bank 2010). This fund would support work in designing new market instruments as well as implementing these market instruments in the developing countries will be served by them. The World Bank's coffers have already gained over US$20 million in promised deposits, with pledges from Australia: (A$10M), the European Commission (€5M), and the US (US$5M) following Norway's commitment to pledge US$5M to the fund. Unspecified pledges to the fund have also been made Germany, Japan and the UK. The Partnership has projected a US$100M capitalization target and operational start date in 2011 (World Bank 2010).

D. The United Nations Collaborative Programme on Reducing Emissions from Deforestation (REDD)

Launched in 2008, REDD seeks to address land use change that is thought to account for approximately 20% of global greenhouse gas emissions. REDD quantifies biospheric carbon sequestration endeavours so that they may be deemed in compliance with requirements for Clean Development Mechanisms. REDD focuses attention on the preservation of vegetation carbon stocks that could potentially, depending on the health of these ecosystems, mitigate or augment atmospheric warming (Myers-Madeira 2008). REDD suggests adopting limited free market methods for reducing declines in ecosystems that provide emissions reduction, and that these methods must be real, measurable, and verifiable (Myers-Madeira 2008). REDD proposes three general schemas to accomplish this goal: projects, policies, and sector activities. These activities are not mutually exclusive (Myers-Madeira 2008).

1. REDD Activities:

a. Projects: Projects include local conservation efforts directed at maintaining vegetated areas that face likely deforestation, and usually target a small, specific area. The formation of conservation units is an example of a REDD acceptable project that could generate carbon allowances (Myers-Madeira 2008).

b. Policies: Policy changes that result in diminished deforestation are eligible to generate carbon allowances. Acceptable efforts to preserve functioning carbon sequestering biomes can include a number of techniques, including land-use policy reform that discontinues agricultural subsidies that result in deforestation, or policies that encourage selective lumbering in favour of clear-cutting (Myers-Madeira 2008).

c. Sector Activities: Sector activities reward national or sub-national (state or province) entities for committing to take steps to reduce emissions. Agreeing to targeted emissions caps in the forestry sector would be one example of a sector activity that could generate carbon allowances (Myers-Madeira 2008).

2. REDD Compliance:

REDD's goal of establishing biospheric carbon sequestration standards that are real, measurable and verifiable necessitates an effective system for monitoring compliance (Danielsen *et al.* 2010). Early resistance to adopting biospheric carbon sequestration as a method for emissions reduction generally focused on the compliance monitoring obstacle. However, many recent articles suggest that deforestation can be adequately measured through remote sensing (DeFries *et al.* 2005, DeFries *et al.* 2007, Mollicone *et al.* 2007, UNFCCC 2008).

REDD Forest Monitoring Policy

REDD suggests that an acceptable forest monitoring system eligible for carbon allowances requires three elements:

i. An initial forest inventory should assess the state and extent of a forest.
ii. Ongoing remote sensing and/or field sampling; the detail of the monitoring should reflect the qualifying program. Monitoring for deforestation would require less intensive methods than monitoring forest degradation.
iii. Forest cover carbon sequestration values should be estimated via direct field sampling or, less ideally, ecosystem look-up tables (Houghton 2003, Achard *et al.* 2004, Mollicone *et al.* 2007, Myers-Madeira 2008).

3) REDD Glossary

REDD, according to Myers-Madeira 2008, also provided a more definitive description of common carbon market terminology.

Selected terms clarified in REDD:
Additionality: Additionality issues occur when carbon allowances are sought in areas where deforestation is unlikely due to the existence of an ancillary project. For example, a forest protected by a biodiversity enhancement project is not eligible for allowances.

Baseline: A baseline, or threshold, is established given a particular set of conditions at a particular (or projected) time. A qualifying REDD program must present quantitative evidence of reduced deforestation in comparison to a baseline scenario. Because baseline scenarios require projected deforestation estimations, devising satisfactory baseline determination methods have been the subject of much speculation. Also referred to as Business as Usual (BAU) and Reference Area.

Business As Usual (BAU): This scenario assumes that emissions continue in the same trajectory as current. (Interchangeable with Baseline.)

Buffers/Reserve Accounts: REDD issues allowances on the assumption that permanence will endure for 100 years. Since disturbance is expected for some percentage of the participating ecosystems, a buffer/reserve account holds some allowances in reserve against loss. The risk of loss determines the size of the required reserve.

Cap and Trade: A market trading technique for carbon that assumes a policy-based cap on emissions. Entities meeting or exceeding projected reductions their emissions caps may trade unused emissions allowances for cash or services. This represents a financial incentive for emissions reduction.

Clean Development Mechanism (CDM): A method of allowing Annex I countries to obtain allowances for financing emissions reducing projects in developing nations.

Discounting: Given that baseline projections are approximations, reductions in emissions within a range are eligible for discounted allowances according to the level of success in emissions reductions achieved.

Ex Ante Crediting: Allowances issued in expectation of compliance per an agreement.

Ex Post Crediting: Allowances issued after independent validation of actual emissions reductions.

Fungibility: Establishes the equivalence of a ton of carbon dioxide generated or sequestered in one location or by one method to carbon dioxide from any other location or by any other method. In REDD, fungibility also theoretically provides for the possibility of inter-substitution of one greenhouse gas for another, for example, CO_2 and methane (though not at 1:1 proportions).

Leakage: Leakage occurs when averted deforestation in the project location does not reduce deforestation, but rather displaces it. For example, forest protection in one location may encourage deforestation in an adjacent plot. Leakage can be generalized to include feedback loops where forest product prices encourage deforestation that would not have otherwise occurred (Market Leakage).

Permanence: To be considered permanent, averted deforestation or degradation is required to persist past the peak projected atmospheric CO_2 levels, this peak estimated to occur at 100 years. Biospheric ecosystems, though they sequester carbon, are dynamic, living organisms, and may release carbon due to natural disturbances such as fire, pest infestation and drought, in addition to deliberate human land-use change (Kurz *et al.* 2008a and b). See buffers/reserve accounts.

Reference Area: See Baseline.

Reserve Accounts/Buffers: REDD issues allowances on the assumption that permanence will endure for 100 years. Since disturbance is expected for some percentage of the participating ecosystems, a buffer/reserve account holds some allowances in reserve against loss. The risk of loss determines the size of the required reserve.

II. Canada[2]

A. Canada and the Kyoto Protocol

Canada took a leading role in the development of the Kyoto protocol, and participated as an original member nation. However, Canada has not succeeded well in meeting its Kyoto goals. Canada's 2007 emissions show an increase of an estimated 24.1% over 1990 levels (UNFCCC 2008). Factoring in the estimated Land Use, Land Use Change and Forestry changes (LULUCF), Canada's 2008 emissions are estimated at 33.6% over

[2] This section prepared by the Canada team.

1990 levels (UNFCCC 2008). These figures become even more striking when compared with 14.4% anthropogenic emissions (15.3% including LULUC increase) generated by the U.S. for the same general period (1990-2004), where no compliance market was in place. LULUCF changes responsible for moving Canada's biospheric carbon resources from sink to source include wood and timber removal, pine beetle infestation, drought and wildfires (Kurz *et al.* 2008a). Explanations for Canada's failure to meet the Kyoto goals have centered on the changing Canadian political landscape, particularly the Harper-led removal of funding for the Kyoto Protocol Implementation Act (KPIA) (Court Case FC 1183 2009). In 2006, substantial funding for pine beetle research was suspended. Similarly, Canadian federal support for Canada's eddy covariance network (Fluxnet Canada, later renamed the Canadian Carbon Program) which provided essential information, monitoring and data distribution services for numerous Canadian forests including information on carbon dioxide, water, and energy exchange. Many research locations have been abandoned, including a site that was one of the longest running flux sites on earth (Running 2010).

Between 1997 and 2005, the Government of Canada spent approximately $1.7 billion on climate change-related issues (Natural Resources Canada 2006). However, disjointed policy that did not include firm emissions caps or carbon taxes on industry rendered emissions reductions policy ineffectual (Schatz 2009).

B. Canadian Climate Policy in Brief

In 1990, Canada launched the $3 billion, five-year Green Plan, which designated $175 million and 24 policies targeting GHG reduction. The Green Plan's primary focus was on increasing energy efficiency and developing alternative energy resources, (Jaccard *et al.* 2006) with a strong emphasis on persuading businesses and consumers to enter the voluntary market (Hoberg and Harrison 1994). Also in 1990, Canada established the National Action Strategy on Global Warming, a measure intended to foster GHG reduction by means of sharing information among municipalities, provinces and industry.

The National Action Program on Climate Change was established in 1995, essentially a restatement of the two 1990 programs. Various incarnations followed, Action Plan 2000 on Climate Change, the 2002 Climate Change Plan for Canada and Project Green in 2005, and the latest policy, Project Green, which all share the fundamental policy device of providing information and subsidies to encourage voluntary reductions in emissions. The Climate Change Plan for Canada offered the first cap and trade programs, where Large Final Emitters (LFEs) have the option to pursue any combination of the following emissions reductions methods a) reducing in-house emissions, b) buying an unlimited number of permits from the government at $15/t CO_2e, c) buying permits on the open

market from LFEs, d) purchasing offset credits from recognized domestic sources outside the LFE system, e) purchasing GHG reduction credits from recognized international sources, or f) investing the money they would have had to pay in permits into a GHG fund established for investing in new, clean technologies.

The phased policy implementation with heavy emphasis on information and voluntary participation allowed for rampant emissions growth during the 1990's. Rigorous emissions reductions programs were scheduled to follow reforms instituted between 2002 and 2005, but this plan did not carry provisions for changes in government, and many of the budgets and programs were gutted. Some claim that the implementation phase of the programs resulted in emissions declines in 2003 (Figure 1) when reforms began to take effect (Schatz 2009); some claim that emissions reductions occurring after 2003 resulted from economic downturn (Jaccard *et al.* 2006).

Table 2: Primary Canadian Programs for GHG Reduction (adapted from Jaccard *et al.* 2006)

Canadian Policy Summary		
Green Plan (1990) Note: the Green Plan established numerous environmental policies including plans to regulate emissions. The table highlights policy described in the section, "Global Warming" of the Green Plan.		
Sector	Elements of Program	Policy Type
Industry	Develop Energy Efficiency Standards	Information
	Product Labeling for Energy Efficiency	Information
	Collect Statistics on Energy Use	Information
	Limiting greenhouse gases in agriculture	Information
Buildings	Energy Efficiency Standards	Voluntary
	Federal buildings initiative	Direct government action
Energy	Environmental Impact research	Information
Transportation	Improved new-vehicle efficiency	Voluntary
	Develop strategies for reducing CO_2	Information
	Educational packages for fleet managers	Information
	Advisory Council to determine energy efficiency targets	Information
	Training for Energy Efficiency Management	Information
Public	Tree planting	Subsidy
	Develop climate change policy	Information
National Action Strategy on Global Warming (1990)		
Sector	Elements of Program	Policy Type
All	Informing all Canadians that they have a	Information

	responsibility and a role in reducing GHG emissions	
	Work towards a protocol addressing international GHG emissions	Information
	Work to develop targets and schedules for reducing GHG emissions	Information
	Prepare a phased, progressive approach for limiting emissions to be implemented after adequate assessment	Information
National Action Program on Climate Change (1995)		
Sector	Elements of Program	Policy Type
Industry	Voluntary Challenge and Initiative	Voluntary
	Industrial Energy Innovators Initiative	Voluntary
	Industrial Energy Efficiency Technology Program	Information
	Industrial Energy Efficiency Targets (CIPEC)	Voluntary
Buildings	Federal buildings initiative	Direct government action
	Model National Energy Codes	Information
	EnerGuide (for appliances, etc.)	Information
All	National Communication Program	Information
	Energy Efficiency Standards	Regulation
Transportation	Fleetwise	Direct government action
	Auto$mart	Information
Action Plan 2000 on Climate Change (2000)		
Sector	Elements of Program	Policy Type
Transportation	Partnerships with automotive manufacturers and ethanol producers and ethanol producers	Subsidy and information
	Information provision through EnerGuide for Vehicles	Information
	Demonstration projects for hydrogen distribution infrastructure and efficient urban transportation	Information
Energy Supply	Demonstration project for carbon sequestration	Information
	Information provision and moral suasion through Canadian Industry Program for Energy Conservation	Voluntary
	Voluntary agreements with industry	Subsidy
	Financial incentive for renewable energy	Subsidy
	Purchase of green power by government	Information
Industry	Information gathering and benchmarking	Information

	Energy-efficiency audits for small and medium-sized enterprises	Subsidy and information
	Information provision to encourage retrofits in commercial sector	Information
	Information provision through EnerGuide for Houses	Information
Climate Change Plan for Canada (2002)		
Sector	Elements of Program	Policy Type
Transportation	Increased ethanol and biodiesel blending in fuels through excise tax exemption and agreements with provinces	Subsidy
	Labelling of consumer vehicles	Information
	Increased use of public transit	Subsidy and funding
	Increased freight transportation efficiency	Voluntary
	Improved new-vehicle efficiency by 25% by 2010	Voluntary
Energy Supply	Negotiated covenants and regulations with large final emitters	Cap and trade
	Targeting of renewables for 10% of new supply	Subsidy
	Building of a CO_2 pipeline	Subsidy
	Demonstration coal plant with CO_2 capture and storage	Subsidy
Industry	Negotiated covenants and regulations with large final emitters	Cap and trade
	Cost-shared investments in innovative technologies	Subsidy
Buildings	Energy efficiency retrofits for houses	Information and subsidy
	Increased new-house efficiency (R-2000)	Voluntary
	Increased new commercial building efficiency (MNECB + 25%)	Voluntary
	Energy efficiency retrofits for commercial buildings	Voluntary

The $15/tonne price ceiling for CO_2 was established in 2002 when the Canadian government entered into an agreement with key industry representatives where abatement costs would be limited to $15/tonne CO_2, and guaranteed that required emissions reductions would be limited to 15% below business-as-usual projections for 2010 (Harrison 2007). This $15/tonne upper price limit holds for both the proposed federal system and the Alberta system. A report performed for Natural Resources Canada under the National Climate Change Implementation Process suggested that a $250/tonne price would be needed to reduce domestic emissions by 200 MT, a reduction under which

Canada would still remain out of compliance with Kyoto (Figure 2) (Natural Resources Canada 2006). This weak regulation is particularly problematic in Canada, where industry accounts for fully half of emissions (Harrison 2007). According to Lee-Anderson (2005), "To date, Canada is the only jurisdiction to commit to such a price cap." By setting a low fixed cost, industry incentives to reduce emissions are weak, and Canada has limited its ability to implement effective cap and trade policies.

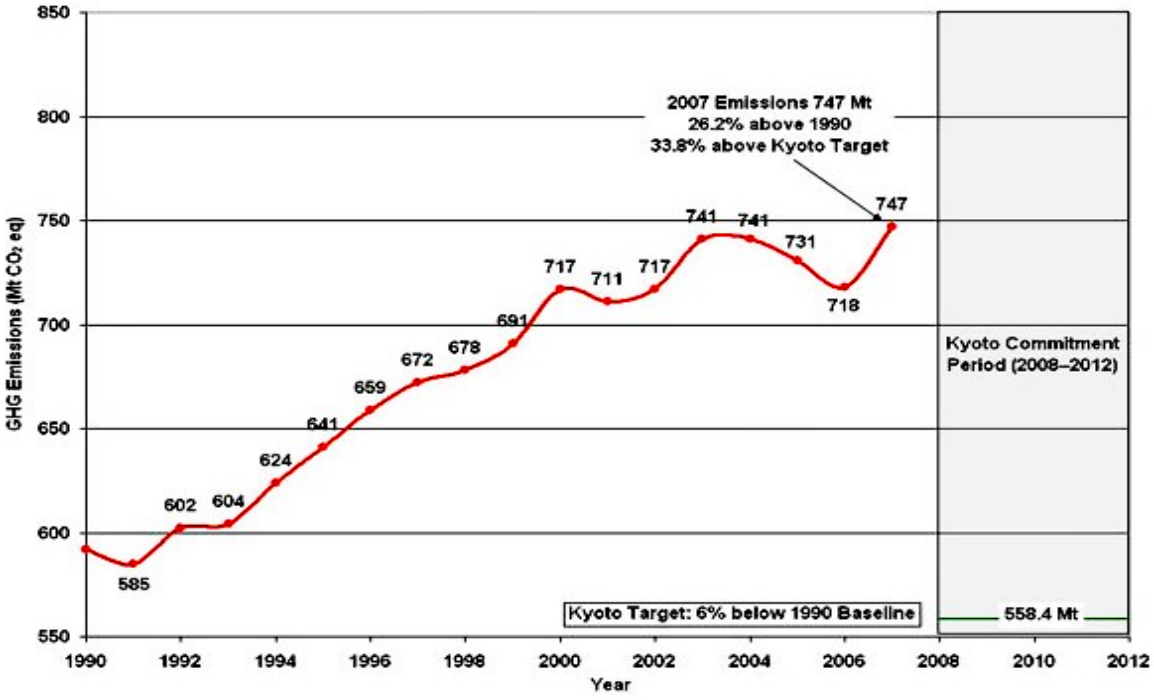

Figure 1: Greenhouse Gas Emissions M CO_2eq, Environment Canada 2007 GHG inventory 1990 – 2007: A Summary of Trends

Cost Curve of GHG Emissions for Canada, 2010.

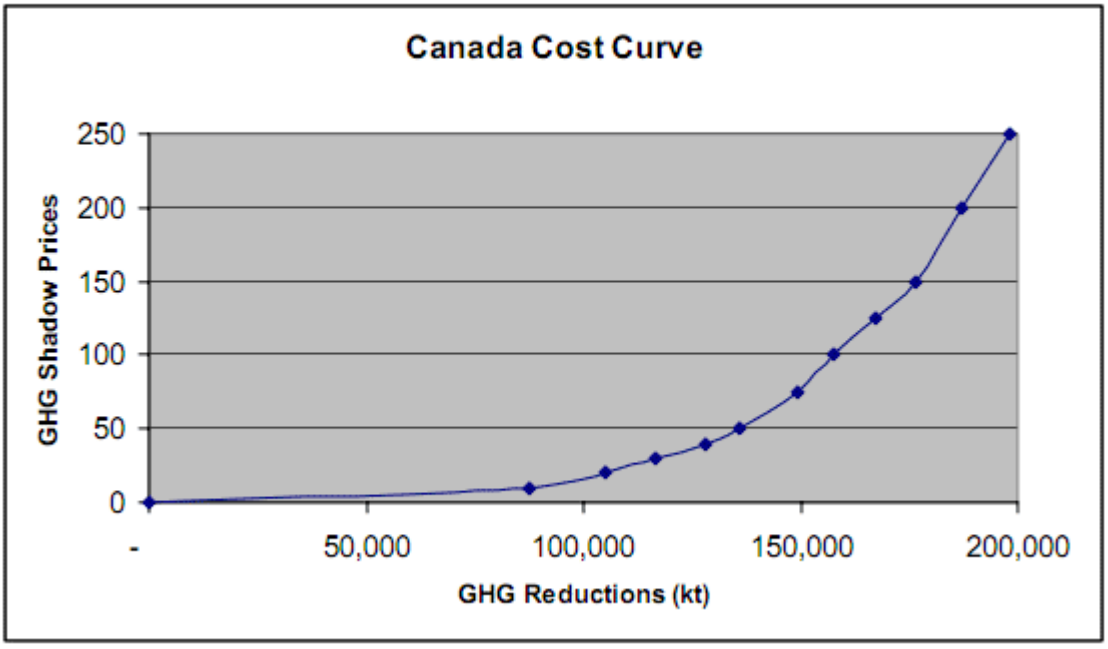

Figure 2 Estimates of GHG price on GHG reduction (Bataille *et al.* 2002)

C. Provincial Carbon Markets

As in the U.S. where states have enacted independent approaches to greenhouse gas reduction in the absence of strong national leadership, Canada's provinces have adopted separate legislation policies.

1. Alberta

While many policy approaches to greenhouse gas reduction have been suggested within Alberta, including biosequestration (Haugen-Kozyra & Mihajlovich, 2010), the province's current emphasis seems to be geological carbon capture and sequestration (CCS), where $2 billion have been allocated for developing CCS programs (http://www.energy.alberta.ca/Initiatives/1769.asp). Alternate programs involving energy efficiency or biosequestration have received far less attention and funding. A primary mechanism for achieving Alberta's reduction goals has been the Climate Change and Emissions Management Act (CCEMA). Enacted in 2007, CCEMA addresses emissions by regulating facilities that emit more than 100,000 tonnes of greenhouse gases a year (Carbon Offset Solutions Alberta Legislation 2010). Emitters are required to reduce their emissions intensity by 12 per cent annually (Government of Alberta 2007).

The CCEMA relies on three regulations:

1. The Alberta Specified Gas Reporting Regulation – this portion of the CCEMA describes reporting requirements for large emitters in the province (Government of Alberta 2007).
2. The Specified Gas Emitters Regulation – this portion of the CCEMA sets targets for regulated entities and guidelines for achieving compliance (Government of Alberta 2007).
3. The Administrative Penalty Regulation – this portion of the CCEMA provides penalties for non-compliance with the Climate Change and Emissions Management Act (Government of Alberta 2007).

At this point, there is considerable speculation among forestry, agricultural and rangeland sectors about the potential for biosequestration within the province, and increased funding for biosequestration programs would be needed to provide an effective test of this potential.

2. British Columbia

British Columbia initiated plans to implement a carbon tax of $10 per tonne CO_2e in February of 2008. BC is the first North American jurisdiction to implement such a tax. The tax will increase each year until 2012, reaching a final price of $30 per tonne. To offset the carbon tax, the province has promised to reduce corporate and income taxes at an equivalent rate (Ministry of Small Business and Revenue 2008).

In addition, BC was the first international participating member of the Western Climate Initiative (WCI), described below.

3. Manitoba

See Western Climate Initiative (WCI), described below.

4. New Brunswick, Newfoundland, Nova Scotia, and Prince Edward Island

No individual carbon market policies exist for these provinces.

5. Quebec

Quebec imposed a carbon tax on energy producers in 2007, targeting approximately 50 companies and refineries operating in Quebec. The tax rate varies by fuel type, depending on the amount of carbon produced during combustion. Initial rates were 0.8 cents per litre of gasoline distributed in Quebec, 0.9 cents for diesel fuel, 0.96 cents for light heating oil, 0.5 cents for propane, and $8.00 per metric ton for coal. The volume or mass of fuel attributable to a regulated company will be determined, in any given year, by the numbers disclosed in its annual declaration submitted under the terms of Quebec's Loi sur la Régie de l'énergie. No levy will be placed on the use of hydrocarbons in air or marine transport.

In addition, Quebec is a participating member of the Western Climate Initiative (WCI), described below.

Table 3 Overview: Existing and forthcoming emission pricing policies by Canadian Province. Notably absent are biospheric carbon sequestration policies. (adapted from Pembina Institute 2007)

Province	Type	Effective Date	Flexibility Mechanisms	Coverage
Alberta	Intensity cap and trade (12% intensity reduction)	2007	Unlimited domestic offsets; unlimited technology fund at \$15/t CO_2	~55%
British Columbia	Carbon tax (\$10 → \$30 / tCO_2)	2008	None	~70%
	Absolute cap and trade (WCI)	2012/2015	Limited offsets	~50/80%
Manitoba	Absolute cap and trade (WCI)	2012/2015	Limited offsets	~50/80%
New Brunswick	None	NA	NA	NA
Newfoundland	None	NA	NA	NA
Nova Scotia	None WCI Observer	NA	NA	NA
Ontario	Absolute cap and trade (WCI)	2012/2015	Limited offsets	~50/80%
Prince Edward Isl.	None	NA	NA	NA
Quebec	Carbon tax (\$3 / tCO_2)	2007	None	~70%
	Absolute cap and trade (WCI)	2012/2015	Limited offsets	~50/80%
Saskatchewan	None WCI Observer	NA	NA	NA
Yukon	None WCI Observer	NA	NA	NA

Canada National	Intensity cap and trade (18% intensity reduction by 2010 + 2%/yr)	2010	Limited technology fund at ~ $20/t; unlimited domestic offsets	~50%

Canada Conclusions

Reaching greenhouse reduction goals remains a challenge for Canada, in part due to the low price cap on emissions, providing weak incentives for industrial emission reductions at a time when overall emissions continue to expand. Additionally, the lack of a strong national policy, combined with contrasting provincial approaches, provide unclear market incentives for greenhouse gas reductions. Despite a recognition that opportunities for biosequestration abound, current Canadian policy and market mechanisms do not take full advantage of these opportunities. In contrast to Canada, policy and market mechanisms in California appear to be poised to implement a range of carbon reductions tools including biosequestration.

III. Western Climate Initiative

A. WCI History and Objectives

The WCI is a collaboration of several Canadian, US, and Mexican states and provinces working to "identify, evaluate, and implement policies to tackle climate change at a regional level" (WCI). The Western Climate Initiative combines and augments individual state and provincial efforts to address climate change. The first interstate climate change collectives began as the 2003 West Coast Global Warming Initiative (California, Oregon and Washington), followed by the 2006 Southwest Climate Change Initiative (Arizona and New Mexico). In 2007, Governors of Arizona, California, New Mexico, Oregon and Washington formed the Western Regional Climate Action Initiative to develop a joint strategy to reduce GHG emissions.

The WCI provides an overarching policy umbrella under which individual state and provincial governments may collectively develop regional targets for reducing greenhouse gas emissions. The organization also provides these governments with the opportunity to participate in market-based programs for meeting emissions targets and the use of a comprehensive registry system that tracks and manages regional greenhouse gas emissions. WCI members' collective goal is to establish a regional cap and trade system to reduce emissions of global warming pollution 15% below 2005 levels by 2020 (WCI 2010).

B. Membership

WCI states and provinces select their level of participation by electing to be Participating Members or Observers. Regional voluntary participation involves joining a regional initiative and agreeing to GHG reductions in accordance with the policies collaboratively set forth. Observers may participate in discussions leading to the development and implementation of an initiative with the prospect of eventual Participating Membership, but are not bound by their participation (Benson 2010).

1. Participating Members

Original Participating Members included Arizona, California, New Mexico, Oregon and Washington. In 2010, Arizona elected to alter its membership to that of Observer, choosing to emphasize solar and green energy and remove itself from the cap and trade initiative. Arizona has not withdrawn from the WCI and remains a voting member (Bhanoo 2010). The current list of Participating Members (in chronological order) is as follows: California, Oregon, Washington, New Mexico, British Columbia, Utah, Manitoba, Montana, Quebec and Ontario (WCI 2010).

2. Observer Members

Alaska, Arizona, Colorado, Idaho, Kansas, Nevada, Wyoming, Nova Scotia, Saskatchewan, Yukon, Baja California, Chihuahua, Coahuila, Nuevo Leon, Sonora, Tamaulipas have joined as observer members of the coalition (Drumheller 2010).

C. WCI Future Plans and Goals

"The Western Climate Initiative plans to lay the foundation for an international cap and trade program that would involve both the United States and Canada (Wikipedia: Western Climate Initiative 2011)." The true cap and trade phase begins January 1, 2012 and is limited to large emitters generating greater than 25,000 metric tons CO_2e (Benson 2010). Beginning in 2015, emissions regulation will include items not covered during the initial cap and trade phase, covering transportation fuels. In addition, residential, commercial and industrial emissions not addressed in the first phase will be required to meet compliance measures. Regulations implemented in 2015 will address nearly 90 percent of emissions (Benson 2010), including all six greenhouse gases (carbon dioxide, methane, nitrous oxide,

sulfur hexafluoride, hydroflourocarbons, and perflourocarbons) addressed under the Kyoto protocols (Barnett 2010).

No WCI registry has yet been implemented. The WCI Offsets Essential Elements recommends that, "The WCI Partners should establish a registry of offset certificates issued and make the registry publicly available" (WCI 2010).

IV California[3]

Introduction

California Governor Arnold Schwarzenegger signed the California Global Warming Solutions Act of 2006 (State Assembly Bill 32, hereinafter AB32), because the state is the world's 12th largest carbon emitter, despite its leadership in energy efficiency standards and environmental protection. With AB32, California has established a leadership role in reducing emissions by adopting a subnational approach to climate policy that sets standards for others. Recognizing the importance of moving ahead with concrete solutions to climate change issues prior to international agreements, California's Governor Arnold Schwarzenegger said, "As we await negotiations on an international agreement, we as subnational leaders can and must take action now. We must work to drive green projects that both stimulate our economies and protect and preserve our most precious resources" (Governors' Global Climate Summit 3). California's AB32 is the foundation for long-term climate change policy, which authorizes regulations affecting all segments of California's economy. Implementing and enforcing the emission regulations will require the establishment of a credible Carbon Market as well as methods to measure and validate carbon stocks and fluxes on a global scale. California's 2009 Climate Action Team's Executive Summary Report states: "Further research into both terrestrial and geologic sequestration of carbon dioxide for implementation technologies, accounting methodologies, and appropriate life cycle analysis will help to identify the future role of sequestration techniques in state climate policies" (Climate Action Team, 2009). Development of a Biospheric Carbon Network to accurately analyze and predict future carbon sequestration is an essential step towards the viable Carbon Market goal.

Global Warming Solutions Act of 2006 (AB32)

This "first-in-the-world" legislation establishes a timetable for California to comply with the Kyoto Protocol. This act defines a "comprehensive program of regulatory and market mechanisms to achieve quantifiable, cost-effective reductions of greenhouse gases." (CEPA/ARB)

[3] This section prepared by California team.

California's emission reduction program under the Global Warming Solutions Act of 2006 (AB 32) utilizes the GHG inventory estimates. AB32 describes the six Kyoto "greenhouse gases" as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Adoption of AB32 requires regulations for reporting and verification, monitoring, and enforcement compliance. California's emission reduction program under AB32 utilizes the GHG inventory estimates compiled by the California Air Resources Board (CARB). AB32 further requires a statewide GHG emissions limited to emissions in 1990 that will be achieved by 2020. The difference between the 2020 emissions limit and the 2020 business-as-usual forecast is the amount of emission reductions that must be achieved by the State through the CARB Scoping Plan. These targets, have established California as an international leader in efforts to reduce emissions. California's goal is to clear more than 170 M tons of GHG emissions by 2020. AB32 requires mandatory caps will begin in 2012 for significant sources, so that the state meets the 2020 goals.

California's Climate Plan

California's Climate Change Scoping Plan (CA Climate Plan) is the state's "roadmap" to reach the GHG reductions goals required by AB32. Reducing emissions to 1990 levels requires approximately 30% cuts from business-as-usual emissions levels by 2020. On a per-capita basis, that means reducing 14 tons of annual carbon emissions to about 10 tons per person by 2020. California recognizes that this challenge also represents an opportunity to transform the economy using green, clean and sustainable technologies that will secure energy independence, clean air and water, and a healthy and safe environment.

Key strategies described in the AB 32 Climate Action Team Scoping Plan (2008) related to biological activity include:

1) A broad-based Cap-and-Trade Program to provide a firm limit on 85% of California's emissions.
2) Forest sequestration and voluntary reduction from forestry projects.
3) More efficient agricultural energy use, reductions from point pollution sources, and addressing impacts on agricultural productivity.
4) Reduce methane emissions from landfills.

AB32 Climate Action Team Scoping Plan Agriculture Sector

California is the largest agricultural economy in the U.S. (http://www.netstate.com/economy/ca_economy.htm). Its 75,000 farms produce $37B in annual income (http://www.calclimateag.org/wp-content/uploads/2010/11/Governor-recommendations-Sept-2010_Final.pdf) and grows nearly half of the U.S. production of fruits and vegetables, many exclusively grown in California (http://www.netstate.com/economy/ca_economy.htm).

Agriculture is vital to California's economic strength providing many jobs and income to the State. Distributed throughout California, agriculture totals and 26.3 M acres (AB 32 Climate Action Team Scoping Plan: **Agriculture Sector, 2008**). Nearly 82% of all GHG emissions from the agriculture sector involve biological processes (AB 32 Climate Action Team Scoping Plan: **Agriculture Sector, 2008**). While other states have adopted incentives for sustainable farming systems, California's agricultural policies to promote conservation have lagged (http://www.calclimateag.org/wp-content/uploads/2010/11/Governor-recommendations-Sept-2010_Final.pdf). The PIER (2004) report found conservation tillage to be one of the most promising areas of carbon sequestration in California's agricultural lands since less than 1% of agricultural lands current practice conservation tillage. Although not restricted to agriculture, one issue acknowledged to limit California's potential to achieve the sector's reductions, is the availability of site specific data. BCN can help fill this information gap.

AB32 Climate Action Team Scoping Plan Forest Sector

The Forest Sector includes "wilderness, rural, urban, and suburban landscapes and in rangelands capable of growing trees, and the production and consumption of forest products" (AB 32 Climate Action Team Scoping Plan: **Forestry Sector, 2008)**. One-third of California's land mass is characterized as forest (2/3 conifer, 1/3 hardwood) and about half the land mass is rangeland (AB 32 Climate Action Team Scoping Plan: **Forestry Sector, 2008)**. The forest sector is a unique site of long-term carbon storage but is also a biological system that has a slow responses to management. It is generally believed that it takes about ten years growth before trees are sufficiently established to sequester carbon at significant rates and sequestration reaches maximum in 40-80 years (PIER, 2004). Older trees may have lower rates of net carbon uptake, but the assumption of lower sequestration rates in older trees may not actually represent the true carbon storage potential and rates of growth. For example, the oldest forest in the AmeriFlux program, at approximately 500 years, has among the highest stored carbon biomass of any forest globally, but also has high carbon sequestration under favourable climate conditions (Paw U et al. 2004). This example illustrates why direct monitoring is required to validate carbon sequestration. Establishing carbon markets for forest carbon, will increase forest sequestration by providing incentives to increase carbon stocks. Reduced tax or regulatory liabilities on landowners are incentives that will encourage retention of forest lands (AB 32 Climate Action Team Scoping Plan: **Forestry Sector, 2008)**.

The Climate Action Team Scoping Plan for the Forest Sector has identified reforestation, forest conservation, forest management, urban forestry, and fuels management/biomass energy as strategies to further increase carbon sequestration. The Scoping Plan identifies the net increase in carbon stocks based on full life-cycle considerations, which encompasses the "carbon associated with growth, harvest and mortality occurring both within and outside of carbon projects." Implementing strategies in the forest sector include a wide range of choices and policy

implications, and the cost of implementing individual measures is highly variable. The value of carbon credits will depend on the accuracy and reliability of information provided to the market sector. A cost-effective remotely sensed monitoring plan as described in the White Paper is a necessary component of this program.

Proposition 23: California cap-and-trade survives electoral challenge

In the November 2010 election Californians strongly supported (by 61% to 39%) California plans for cap-and-trade on GHG emissions, rejecting a ballot initiative supported by oil companies to suspend the introduction of AB32, despite more than 12% unemployment in the state's most serious recession since the Great Depression (carbonpositive.net). This result demonstrated strong public support for AB32 implementation in California.

California Greenhouse Gas Emissions Cap-and-Trade Program

The California Air Resources Board (ARB) met a January 1, 2011 deadline to develop an enforceable comprehensive cap-and-trade program and an environmental emission trading scheme that meets the requirements of AB32. Adoption is scheduled to begin in 2012 (CA Climate Change Portal Cap-and-Trade). Cap and Trade entities may choose from offset options authorized by CARB. The program will provide incentives for developing new technologies to reduce the cost of carbon emissions and to produce validated offsets (SNR Denton, 2010). This option has opportunities for developing a BCI-net structure that reduces cost while increasing confidence in the estimate of carbon stocks. Through the **Western Climate Initiative** (WCI, described above), California is working with six western states and four Canadian provinces to design and implement a regional cap-and-trade program that will reduce GHG emissions at lower cost than possible in the California-only program (California Air Resources Board, Cap-and-Trade).

Governors' Global Climate Summits

As California Governor, Arnold Schwarzenegger co-hosted three Governors' Global Climate Summits. The Governor's Global Climate Summits provided opportunities to compare and learn best practices, share ideas, and develop collaborations on projects. The first two summits meetings were held in 2008 and 2009. In November 2010, the third annual Governors' Global Climate Summit took place at the University of California Davis. These summits attracted top leaders of local, regional, and international entities, as well as those from academia, business and nonprofits. The Governors' Global Climate Summits demonstrated how actions at the state and regional level can influence national and international climate negotiations (Governors' Global Climate Summit 3).

Governors' Global Climate Summit 3: Building the Green Economy

Governor Schwarzenegger, with the United Nations Development Programme and United Nations Environment Programme, and co-sponsored by University of California Davis, developed the vision that the Climate Summit was to catalyze climate change solutions that promote a clean, green global economy and economic prosperity for developed and developing nations (Governors' Global Climate Summit-3, 2010). Governor Schwarzenegger predicted that most of the climate-related policies advanced by the United Nations Framework Convention on Climate Change will be implemented at the subnational level and that California's role is pivotal to move climate policy forward (Governors' Global Climate Summit-3, 2010). The summit included sessions on Carbon Markets and opportunities for land based offsets (Governors' Global Climate Summit-3, 2010). A non-profit organization, the R20, was started at the conference. The R20 coalition proposes to develop low-carbon projects that are "climate-resilient" (e.g. green investments) and are encouraged and implemented through cooperation among subnational governments. This innovative coalition will act to catalyze partnerships between developed and developing subnational regions as a way to enhance energy efficiency, renewable energy, and clean transportation (Schwarzenegger Press Release, 2010). Governor Schwarzenegger signed a Memorandum of Understanding (MOU) with Governor Arnóbio Marques de Alemeida Júnior from Acre, Brazil and Governor Juan José Sabines Guerrero from Chiapas, Mexico to combat climate change and protect tropical forests through carbon credits and poverty relief. This groundbreaking agreement takes advantage of the progress made through the Governors' Climate and Forests Taskforce, which grew out of the first Governors' Summit in 2008. This program helps accelerate collaborative work to "reduce GHG emissions from deforestation and land degradation in the worlds' tropical forests" (Schwarzenegger Press Release, 2010).

California Conclusions

Based on the passage of California's Global Warming Solutions act of 2006 (AB32), the defeat of Proposition 23, implementation of the State's cap-and-trade program, endorsement of R20 – Regions of Climate Action, and partnership in the Western Climate Initiative, the State's policy makers are serious about policies and strategies to reduce dependence on fossil fuels, create green jobs, promote clean energy solutions, and reduce greenhouse gas pollution. The continuing lack of U.S. national leadership over several decades contrasts with the successes of the subnational approach to climate change policy and management. The policies of AB32 will encourage the development of new technologies to accurately determine the cost of carbon emissions, measure the amount of carbon sequestration, and reduce the costs of implementing carbon credits and a cap and trade market. The plan to implement a cap-and-trade market presupposes the availability of accurate information needed to properly evaluate the value of carbon credits. As the California carbon marketplace becomes a reality, public confidence will depend mostly on perceptions of offset quality, the transparency of accounting, and the distribution of costs and benefits of climate policy (Niemeier and Rowan, 2009). Development

of a Biospheric Carbon Network as described in the CCSIP documents, which will accurately analyze current carbon sequestration and predict future carbon sequestration, is an essential step towards the goal of a viable Carbon Market that reduces GHG emissions, as outlined in California's AB32, The Global Warming Solutions Act of 2006.

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