Submission to the Office of Climate Change, Energy Efficiency and Emissions Trading
Government of Newfoundland and Labrador

Response to Newfoundland & Labrador Public Discussion Document "Climate Change: Responding to Climate Change in Newfoundland & Labrador"

July 31, 2010
Submitted by the Environmental Policy Unit

Environmental Policy Unit
Sir Wilfred Grenfell College
Memorial University of Newfoundland
1 University Drive
Corner Brook, NL A2H 6P9

E-Mail: epu@swgc.mun.ca
Tel: (709) 637-6200 ext. 6534
www.swgc.mun.ca/epu

Executive Summary

Environmental Policy Unit Response to the Newfoundland and Labrador Climate Change Discussion Paper

The international scientific community considers climate change to be one of the greatest threats of our time and to limit the very worst consequences of this problem, the global community must reduce carbon emissions steeply and immediately. Newfoundland and Labrador is already experiencing climate change impacts and the province has a responsibility to act given its major fossil fuel industry. This challenge also represents an opportunity for Newfoundland and Labrador to become a leader in addressing climate change in Canada.

The province has taken important first steps and this document outlines some of the next key policy directions available to the province to reduce carbon emissions.

#1. Set emissions reduction targets that respect the scientific consensus and Canada's international commitments.

#2. Put a fair price on carbon emissions. Provide market signals to encourage emission reductions via a cap and trade system. As a national or regional cap and trade system develops, implement a carbon tax.

#3. Facilitate the transition to a renewable energy economy by investing in sustainable, "green" energy research and technology and by requiring energy efficiency standards.

#4. Reduce energy demand through, for example, addressing the building code and vehicle standards and investing in public and alternative transit.

#5. Integrate climate change considerations into land-use planning across the sectors.

5.1. Forestry: target climate change forest research and focus on broadening current forest management strategies.

5.2. Peatlands: integrate peatland carbon sequestration and storage dynamics into land use policy decisions. This includes trade-offs to be made between GHG mitigation and other policy sectors (food security, energy, economic).

5.3. Water resources: increase monitoring of ground and surface water interactions to support the water needs of natural and managed ecosystems.

5.4. Agriculture: increase research and education to facilitate adaptation and enhance agricultural productivity.

Environmental Policy Unit Response to the Newfoundland and Labrador Climate Change Discussion Paper

INTRODUCTION

The Environmental Policy Unit (EPU) at Sir Wilfred Grenfell College (SWGC), Memorial University, welcomes the opportunity to comment on the discussion document *Responding to Climate Change In Newfoundland and Labrador*, provided by the Government of Newfoundland and Labrador's Office of Climate Change, Energy Efficiency and Emissions Trading.

In this response, the EPU suggests policy directions and policy options to guide policy makers and stakeholders on responding to climate change in Newfoundland and Labrador.

The EPU and Our Approach

The EPU is a new initiative at Grenfell College dedicated to addressing environmental policy issues in Newfoundland and Labrador with a current emphasis on climate change, energy and related areas. Our three main objectives include 1) facilitating debate on critical environmental policy issues, 2) conducting, facilitating and disseminating research on these issues and 3) enhancing provincial capacity in environmental policy. Given this mandate, we are pleased to contribute to the public discussion on the development of a provincial strategy on climate change and energy efficiency.

Soon after the provincial government requested comments on the discussion paper on May 31, 2010, the EPU invited faculty and staff at Grenfell College to research and write a joint submission.[1] The team reviewed the discussion document and agreed our contribution would be to suggest policy directions to best reduce emissions causing climate change based on our specific areas of expertise.[2]

Note that these are initial analyses and we look forward to further opportunities to provide assistance in the development of a strategy for addressing climate change in our province.

The Scientific Consensus and Urgency to Act

The international scientific consensus on climate change indicates that climate change will have devastating, far-reaching impacts on all aspects of our society, environment and economy. As documented by the most recent report by the Intergovernmental Panel on Climate Change (IPCC)), "Warming of the climate system is unequivocal": air and ocean temperatures are rising—over the twelve years of the study period for this report (1995-2006),

[1] The team includes (in alphabetical order): Dr. Ilka Bauer, Assistant Professor (Biology and Environmental Science); Dr. Wade Bowers, Professor (Biology and Environmental Science and Sustainable Resource Management); Sara Carson, EPU Research Assistant (Forestry Sector); Angela Carter, EPU Co-facilitator and Assistant Professor (Environmental Studies and Political Science); Karen Daniels, EPU Administrative Staff Specialist; Dr. Mario Levesque, EPU Co-facilitator and Assistant Professor (Environmental Studies and Political Science); Candice Pike, EPU Summer Student Research Assistant; Susan Pottle, EPU Research Assistant (Agriculture Sector); Terry Randell, President of the Grenfell College Student Union; and, Dr. Gabriela Sabau, Associate Professor (Economics and Environmental Studies).

[2] This document is in addition to Dr. I. Bauer, Dr. M. Levesque and S. Pottle participating in the government consultation session held at the Glynmill Inn, Corner Brook, June 29, 2010.

eleven of these were the "warmest years in the instrumental record of global surface temperature" (Bernstein 2007, 2). This warming is causing detrimental changes such as rising sea levels, worse and more frequent extreme weather events, threats to global food and freshwater supplies, the spread of disease, and increasing rates of species extinction. Since the time the Kyoto Protocol was negotiated, scientific consensus regarding the likelihood of future climate change due to anthropogenic emissions of GHGs has grown (Watson 2001, Pachauri 2008). Therefore, the scientific community strongly encourages steep and immediate global reductions in carbon emissions (Gupta et. al. 2007). Economic analysis also increasingly notes the wisdom of policy action (Shogren & Toman 2000; Kolstad & Toman 2001; Nordhaus 2008a, 2008b).

Newfoundland and Labrador's Motivation and Responsibility to Act

The urgency and responsibility to address climate change is particularly relevant for Newfoundland and Labrador for four major reasons.

First, our communities are already experiencing serious repercussions of climate change and these are expected to worsen in coming years (Catto 2010; Janes 2010; Vasseur & Catto 2007). Northern regions in Labrador will experience some of the most dramatic global temperature increases, while coastal regions across the province will be seriously impacted by rising sea levels. The devastation already experienced by small island nations such as Tuvalu, which has resulted in the relocation of entire communities, should serve as a warning to this province.

Second, Newfoundland and Labrador has a responsibility to reduce emissions given that it is a major producer of oil, a fossil fuel whose production and consumption is a leading cause of climate change. Our major industries are a significant part of the problem.

Third, in the absence of a national climate change policy, provinces (e.g. B.C., Quebec, Ontario) are now taking the lead in developing policies for reducing emissions. Newfoundland and Labrador can and should join these initiatives and become a leader in taking action on climate change.

Fourth, the benefits of reducing greenhouse gases (GHGs) are more than environmental: reducing carbon emissions means economic growth through the creation of a new and long-term "green" energy economy. If Newfoundland and Labrador is an "energy warehouse" for eastern North America, we must provide the energy of choice for future consumers: renewable and environmentally sustainable energy.

The Government of Newfoundland and Labrador has taken valuable steps to address climate change, notably through the development of the 2005 Climate Change Strategy and the establishment of the Office of Climate Change, Energy Efficiency and Emissions Trading. However, the province is still seeing *increasing* emissions in great part due to expanding offshore oil development.

Policies and action are required that bring down emissions significantly. To meet this need, the following policy directions and options draw on lessons learned from other provinces or regions that have been successful in addressing climate change. This document outlines tangible ways in which the province can make real inroads to reducing emissions. Five policy directions along with several policy options for each are outlined. These are summarized in list form in the last section of this document.

Policy Direction #1: Set Emissions Reduction Targets

Clear targets are needed to reduce emissions. To stay within a temperature increase of 2°C, the IPCC has recommended deep emissions cuts for developed countries: 25% to 40% below 1990 levels by 2020 and 80% to 95% below 1990 levels by 2050 (Gupta et. al. 2007, 776). Unfortunately, this recommendation was not reflected in the Kyoto Protocol, an international agreement Canada ratified in 2002, which has binding targets to reduce emissions by only 6% below 1990 levels by 2012. Furthermore, based on the Government of Canada's most recent commitment to reduce emissions by 17% below 2005 levels by 2020 (made following the United Nations Framework Convention on Climate Change Conference of the Parties in Copenhagen), Canada is not aiming to meet these binding targets.

Given the lack of commitment shown by the federal government to reduce emissions, provinces are assuming a leadership role. In 2007, for instance, British Columbia legislated GHG reductions equivalent to 14% below 1990 levels by 2020 and 74% below 1990 levels by 2050. Similarly, Ontario and Québec aim to meet the Kyoto Protocol (Pembina Institute 2009).

What is Newfoundland and Labrador's current position? As party to the Conference of New England Governors and Eastern Canadian Premiers' (NEG-ECP) *Climate Change Action Plan,* the Government of Newfoundland and Labrador has agreed to reduce regional GHGs to 1990 levels by 2010, 10% below 1990 emissions by 2020 and 75-85% below 2001 levels by 2050 (NEG-ECP 2001). Yet the short-term targets fall far short of the recommendations of the scientific community by as much as 30%.

Ambitious targets are required by the province, targets that are at least in line with the Kyoto Protocol. Ideally, however, the province's targets would match the B.C. example or respect scientific recommendations.

Policy Options:

- **Implement the minimal target (2010-2012).** Meet emissions reductions required by the Kyoto Protocol: reduce emissions by 6% below 1990 levels by 2012.
- **Implement leadership targets.** Follow the example of B.C., the province currently leading the way on addressing climate change: reduce emissions by 14% below 1990 levels by 2020 and 74% below 1990 levels by 2050.
- **Implement science-base targets.** Follow the advice of IPCC scientists: reduce emissions by 25% to 40% below 1990 levels by 2020 and 80% to 95% below 1990 levels by 2050.

Policy Direction #2: Price Carbon Emissions

There is no denying that the market is a powerful force. Several recent studies have shown that *the single most effective solution to rising greenhouse gas emissions is using the market to put a price on carbon*.
(Rivers & Sawyer 2008, 5, emphasis added)

Literature analyzing effective methods for reducing emissions indicates that pricing carbon is the most effective—perhaps the only effective—way to achieve this goal. If there is no cost on emitting GHGs, if carbon emissions are not included in the price we pay for goods and services, then there is little incentive to reduce emissions. Without a price on carbon, the atmosphere is treated like a "free dumping ground" (Rivers & Sawyer 2008).

Would a price on carbon negatively impact our provincial economy? Research on the impacts in our province is currently lacking; however, studies on Canada indicate that pricing emissions would have a very limited impact on economic growth—at worst, the equivalent of one or two years' worth of annual growth over a 43-year period (National Roundtable on the Environment and the Economy 2007). This low cost pales in comparison to the steep cost of not taking action on climate change. As documented in the Stern Review on the Economics of Climate Change, the economic impact of climate change will be extraordinarily high: 5% to 20% of global GDP each year (Stern 2006).

The economic risk of pricing carbon in Newfoundland and Labrador would be low, yet the cost of inaction could be extraordinarily high. In fact, pricing carbon could prove to be an economic advantage as more jobs are created in sustainable sectors (see Policy Direction #3 below).

Policy Options:

- **Implement a Carbon Tax or Cap and Trade System.** Two methods are currently widely used to provide market signals to encourage emission reductions: a carbon tax or a cap and trade system. A plan to reduce the province's emissions significantly must implement one of these systems or a combination of the two. Note that research by the National Roundtable on the Environment and the Economy, which focused on achieving "the greatest amount of carbon emission reductions, at the least economic cost," determined that above all carbon pricing methods, Canada needs "an economy-wide cap-and-trade system to price carbon and provide real market incentives for firms and households in Canada to change their technology choices and behaviour in order to reduce emissions" (this system is to be supported by regulations covering gaps left by market incentives) (National Round Table on the Environment and the Economy 2009; see also Pembina Institute and David Suzuki Foundation 2009). As our province collaborates with the federal government, other provinces and potential American states to implement this cap and trade system, we recommend the Government of Newfoundland and Labrador begin to price carbon by implementing a (gradually increasing) carbon tax.
- **Establish an Accurate Price on Carbon.** Of course, the price of carbon has to be right: if it is too low, the incentives to reduce emissions will be understated. The Pembina Institute and the David Suzuki Foundation, two major environmental organizations working on climate change policy, recommend a carbon price starting at $50 per tonne of carbon dioxide and equivalent, increasing to $200 per tonne by 2020 (2009). Pricing in Newfoundland and Labrador should reflect this standard.
- **Re-Invest Revenue from Carbon Pricing into Low-Carbon Initiatives.** Revenue from the tax or cap and trade system would be re-invested in new low-carbon industries (renewable energies, public transportation and energy efficiency for homes and businesses—see Policy Direction #3 below on shifting to renewable energy) and in helping vulnerable groups who have been negatively impacted by the tax (such as by providing rebates, income tax breaks, or tax refunds, particularly to low income families). Revenue could also be used to reduce personal income tax: research on a Canadian price on carbon shows that a national carbon tax could be targeted to reduce personal income tax by 50% (Rivers & Sawyer 2008).

Policy Direction #3: Facilitate the Transition to a Renewable Energy Economy

As outlined in the "Responding to Climate Change in Newfoundland and Labrador" discussion document, emissions in this province are predominantly coming from oil extraction and refining, mining, newsprint operations, electricity generation and transportation. In addition, emissions are rapidly growing from waste (Environment Canada 2010). Ensuring emission reductions by these sectors must be the focus of any climate change policy in this province. A sector-by-sector analysis of emissions and a strategy to reduce emissions is needed.

In addition to reducing the emissions from current industries, policies are required that move the province away from fossil fuels and towards renewable energy. There should be support for further research on small scale, renewable energy projects in this province, expanding on work by Fisher et. al. (n.d.), as well as further exploration and development of solar, wind, geothermal and biomass energy. This must also include environmental safeguards for new developments such as adequate land-use planning, regulations, and enforcement to ensure new energy sources have a low environmental impact across their life cycle.

Policy Options:

- **Commit to generating at least 95% of electricity from renewable sources for the province as a whole.** Note that B.C. has committed to having 90% of electricity generated from clean sources and Ontario has a target to double renewable energy by 2025.
- **Ensure incentives for renewable power generation that includes adequate protection for consumers.** Germany and Spain have policies that provide access to the grid and support for renewable energy developers, policies that create strong domestic renewable energy industries. Ontario has implemented a standard offer program (SOP) which guarantees access to the grid at a set price. This program resulted in the addition of 1,000 megawatts of new capacity in its first year.
- **Include energy efficiency and renewable energy requirements into the construction, transportation and industrial sectors**. This will promote the development of green technologies and create "green jobs". Green jobs—defined as "high-quality jobs that are saved or created by policies that will shift our economy toward greater sustainability" (Thompson 2009)—are a critical part to the long-term success of the province's future economy and society. We need a plan, developed in collaboration with labour and environmental groups, that supports a labour market shift towards this new economy.
- **Use oil and gas revenues to shift to a renewable energy economy.** The provincial government's 2007 *Energy Plan* committed to using revenue from the finite oil and gas resources to shift our economy to a sustainable energy system that is not dependent on fossil fuels. The plan specified a commitment to "Leverage our non-renewable oil and gas wealth into a renewable future by investing a significant portion of our non-renewable resource revenues in renewable energy infrastructure and development" (Focusing Our Energy 2007, 13). This commitment now needs to be implemented. One method to do this is via a natural resource fund (such as the Petroleum Fund of Norway, Alaska's Permanent Fund and Alberta's Heritage Fund), which can be an effective tool to save oil wealth or direct oil wealth toward other social goals (Warrack and Keddie 2002; Smith 1991; McBeath 2008; Warrack

2007). Newfoundland and Labrador could develop such a fund by committing a high percentage of revenues from oil royalties and corporate income taxes to invest in reducing demand for energy and developing clean energy sources.

- **Create an offset fund to invest in GHG-reducing projects.** Where businesses and individuals cannot reduce emissions or wish to offset the impacts of unavoidable emissions, they should be able to contribute to an offset fund that invests in emission reduction projects. Nova Scotia has recently established a voluntary offset fund (Nova Scotia 2010). To be credible, this fund must invest in projects that result in actual emission reductions as verified by an independent third party.

Policy Direction #4: Reduce Energy Demand

Reducing the amount of energy used by individuals, businesses and government sectors remains one of the most significant means of reducing GHGs (Metz et al. 2007). Not only is the environment protected but money can be saved. This is money that can be reinvested in goods and services or used to fuel business expansion and vital public services such as health care and education. Reducing energy demand also means less power generation is required. Coupled with managing energy usage during peak times (mornings and evenings), existing generating facilities can better meet provincial needs. Thus, additional power generation facilities may not be required or the power can be exported on the open market.

Numerous ways exist to reduce energy usage. This involves choices about the appliances and tools we use, how we heat our buildings, how we commute, and how we design our communities and buildings.

The Government of Newfoundland and Labrador has played an important leadership role in energy efficiency and conservation. The provincial commitment to purchase fuel-efficient vehicles as part of the 2007 *Energy Plan* and its recent continuation of the Newfoundland and Labrador EnerGuide for Houses are two notable items (Department of Natural Resources 2007, 2010). But more can be done.

Policy Options:

- **Update the Building Code.** Ensure *all* newly constructed buildings (residential, commercial, industrial) and those that undergo significant renovations *meet or exceed* the Model National Energy Code. Mandate the use of energy efficient appliances such as for lighting fixtures, stoves, refrigerators, furnaces, washers, dryers and low flow toilets and provide incentives for the transition.
- **Set stringent Vehicle Fuel Efficiency Standards.** As in California, Europe and in Canadian provinces such as B.C., Manitoba, Quebec, Nova Scotia, and New Brunswick, a higher average fuel efficiency requirement for *all* vehicles is needed. For example, in 2004, California introduced new GHG emission standards for light-duty vehicles. The standard is expected to decrease emissions between 25% to 30% for new vehicles sold (California EPA).
- **Establish a 5-year capital works program for public transit.** Reduce the need for travel by private vehicles and encourage the use of public transit and car pooling. This requires working in partnership with municipalities to re-invest in public transit (vehicles and facilities). Examination of the purchase of electric buses is required.
- **Increase investment in alternative modes of transportation.** Work with municipalities to

provide cost matching funds (50/50) to build bicycle lanes, pedestrian walkways and improve accessibility for persons with disabilities. This includes funding awareness campaigns encouraging alternatives. Provide tax deductions for users of public transit.

- **Increase incentives for the purchase of fuel efficient vehicles.** Rebates need to be created for the private sector for purchases of fuel efficient vehicles. The more fuel efficient the vehicle, the larger the rebate, the less fuel efficient the vehicle, the larger the surcharge associated with the vehicle (see Marbek Resource Consultants 2005 for implementation ideas). Provide "old clunker" rebates for vehicles over 10 years of age when purchasing a new vehicle. This would build on the federal government's Retire Your Ride program for vehicles built in 1995 or earlier (see Canada 2010).
- **Mandate speed-limiters on large trucks.** Slower speeds can significantly save on fuel used and increase public safety on our roads. This could be modeled on legislation in other jurisdictions such as Ontario and Quebec (Ontario 2009; Transports Québec 2009).
- **Encourage businesses to invest in fuel-efficient heavy equipment.** Provide a cash rebate or accelerated depreciation for purchases of new fuel efficient heavy equipment or for retrofits for older equipment.
- **Mandate metering of all water usage and price water in increasing block rates.** Installation of water meters is required to gauge individual water use. Using less water means we need to pump less water to begin with. It also means less wastewater flowing through our sewage treatment plants. Combined, significant energy savings can be achieved. Pricing water in increasing block rates (where the more water is used, the more it costs), can significantly cut related energy usage (see Shrubsole 2001; Christenson and Magwood 2005).
- **Mandate "Smart Meters" and time of use electricity rates.** Smart meters allow easy monitoring of electricity consumption. Coupled with time of use electricity rates, where higher prices for electricity are charged during peak demand periods (mornings, late afternoons), individuals can monitor electricity consumption to minimize costs. It also means less stress on the power generation system during peak time periods necessitating less on-demand generation contributing to lower energy usage (see the Ontario model at Ontario Energy Board 2010).
- **Continue with existing programs.** Both the Newfoundland and Labrador EnerGuide for Houses and the Residential Energy Efficiency Programs need to be continued and extended.
- **Develop "buy local" programs and incentives.** Encourage businesses and individuals to buy local thereby reducing the energy in shipping goods.
- **Build low carbon communities.** Work with municipalities to create low carbon communities by intensifying land use to curb urban sprawl.

Policy Direction #5:
Integrate Climate Change Considerations into Land-Use Planning

Newfoundland and Labrador's land and water resources are significant. Combined, they comprise an area of 40,572,000 hectares with the majority being land (37,387,200 ha). With over 95% of land being Crown or public land, the province remains central in land-use planning activities (Prospectors and Developers Association of Canada 2008). Legislative and regulatory activity and broader planning initiatives involving the use of Crown or public lands must be referred to the Interdepartmental Land Use Committee (ILUC), which coordinates the government's resource development activities, prior to

approval and implementation. It is critical that decision makers and the ILUC integrate climate change considerations into land management and resource use decisions, including both mitigation and adaptation measures. Mitigation measures should aim to protect existing landscape carbon stocks and carbon sequestration capacity, important especially over the next 20 to 30 years and potentially providing significant co-benefits for other aspects of the environment (Smith 2004, Metz et al. 2007). At the same time, since some climate change is inevitable even given existing atmospheric GHG concentrations (Solomon et al. 2007), effective adaptation measures are required. For Newfoundland and Labrador, these measures are particularly relevant for the forestry sector, peatlands, water resources and agricultural productivity.

5.1. Forestry

Forest-climate interactions are complex and involve substantial feedback mechanisms because forests represent both sinks and sources of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20) (Hättenschwiller et al. 1997; Kurz & Apps 1999). Bousquet et al. (2000) suggest that about 1–2 Gt of carbon is sequestered annually in pools on land in temperate and boreal regions. Such sinks represent 15–30% of annual anthropogenic carbon emissions, making terrestrial carbon stores an important part of the global carbon cycle. The Canadian boreal forest (soils and above-ground biomass) is estimated to store 71 billion tons of carbon, with another 137 billion tons in peatlands. These ecosystems have a net cooling effect on climate due to their ability to remove atmospheric CO_2 and store it underground for thousands of years. Conversely, when they are disturbed, GHGs are released back into the atmosphere and aid in accelerating climate change.

Under the United Nations Framework Convention on Climate Change (UNFCCC 1992), Canada annually reports GHG emissions from anthropogenic activities. Landscape-based GHG emissions and/or sequestration are mostly reported under the Land Use, Land Use Change and Forestry (LULUCF) sector, and only a limited sub-set of LULUCF activities are currently considered for Kyoto accounting purposes (UNFCCC 1998 Article 3.3 and 3.4; Schlamadinger et al. 2007). While the nature of LULUCF accounting in any post-2012 framework is under discussion, there is widespread agreement that protection and enhancement of natural carbon reservoirs and sinks can play a crucial role in GHG abatement strategies especially in the short term (Smith 2004; Metz et al. 2007; Ostlea et al. 2009); van Oosterzee et al. 2010). In Newfoundland and Labrador as elsewhere in Canada, studies are underway to assess the potential of forest biomass sinks to sequester carbon as part of a global mitigation effort.

In a forest management context, changes in the carbon sink size are largely attributed to the dynamics of forest age distribution and can be controlled at least in part through planning activities. However, stochastic events such as fire and insect outbreaks complicate predictions. Taking these disturbances into account, modeling suggests that the managed forests of Canada could be a source of between 30 and 245 Mt CO_2e yr^{-1} during the first Kyoto Protocol commitment period (2008–2012; Kurz et al. 2008). The range of these predictions (215 Mt CO_2e yr^{-1}) is equivalent to nearly 30% of Canada's emissions in 2005. Collectively, uncertain but increasing impacts of natural disturbances and the Kyoto Protocol accounting rules contributed to Canada's decision not to elect forest management under Article 3.4**.**

Under a warmer climate, insects and pathogen ranges are expected to shift north (Grey 2008). In Newfoundland and Labrador, the intensity and duration of outbreaks of some species (eastern Hemlock looper, adelgids, and balsam fir sawfly) may increase, meaning climate

change will bring uncertainty both economically and ecologically. Thus, future efforts to influence carbon balance through forest management will remain a major challenge. Moreover, given different insect outbreak regimes and forest composition, a forest climate strategy for insular Newfoundland may differ from strategies suitable for Labrador.

Policy Options:

- **Broaden management strategies.** Consider options to enhance and protect the capacity of forests to cope with shifting climate conditions and affected site conditions. Review and integrate current research on Canada's boreal forests and terrestrial ecosystems in Newfoundland and Labrador to advance adaptive forest management in the province.
- **Enhance and preserve genetic variability.** Genetic variability is linked to the ability of a forest stand to offset the outbreak of widespread insect disturbances and to adapt to climate change. Thus, forest management needs to maintain maximum possible variability.
- **Target climate change forestry research.** Information is required to quantify, measure, monitor and manage carbon pools in NL forests under a changing climate. This requires study of the relationship between climate change projections and disturbance regimes (insect, fire, wind) and analysis of its impacts on landscape-level forest structure.
- **Develop new approaches to integrating wood products and biomass into local economies.** A significant loss in timber supply, especially within certain age class structures, could negatively impact the pulp and paper sector. However, more innovative approaches to product development along the value chain offer significant potential for the province.

5.2. Peatlands

Peatlands (bogs and fens) are wetland ecosystems where plant primary production exceeds decay, leading to a long-term accumulation of dead organic matter (=peat) in the soil profile. Peatlands are the most carbon-dense terrestrial ecosystem on Earth, storing more carbon per hectare than boreal or tropical forests (Kayranli et al. 2010). They develop in areas where precipitation exceeds potential evapotranspiration and are abundant in boreal and subarctic regions of the northern hemisphere (Gignac & Vitt 1994). Peatlands accumulate carbon slowly and over long timescales, with average rates of ~17 – 20 g m^{-2} yr^{-1} —largely within the past ~9,000 years (Turunen et al. 2002; Gajewski et al. 2001). While long-term carbon sequestration has been positive, many peatlands are a net source of methane (CH_4), and at any point in time, a given site can act as either a source or sink of carbon (Blodau 2002; Limpens et al. 2008). Thus, while the net effect of peatlands on global climates has been (and still is) one of cooling (Frolking & Roulet 2007), local and short-term GHG dynamics are complex. Moreover, future peatland carbon dynamics are uncertain given climate change and human land use pressures (Limpens et al. 2008; Tarnocai 2009).

Canada's reported peat-based emissions are small compared to those from other sectors (Environment Canada 2010), but such emissions can make up significant portions of national GHG budgets in countries such as Finland that have developed a large proportion of their peatland resource (see Lapveteläinen, Regina & Perälä 2007). Thus, protection and enhancement of this natural carbon reservoir is an important element of a wider climate change strategy (Smith 2004; Ostlea et al. 2009)

In Newfoundland and Labrador, peatlands cover an estimated 6,429,000 hectares (Wells & Hirvonen 1988), with 1,115,000 hectares on the island of Newfoundland alone storing 16,958 million cubic metres of peat (Dawe 1993). Assuming an average bulk density of 81 kg m^{-3} (based on Thibault 1992), and a peat carbon content of 50% (e.g., Turunen et al. 2002), this represents an estimated 687.9 megatons of stored peatland carbon (2520 Mt CO_2 eq.) on the island portion of the province alone. In comparison, the total anthropogenic GHG emissions for NL in 2008 were just over 10 Mt CO_2 eq. (Environment Canada 2010). Given the magnitude of Newfoundland and Labrador's ecosystem carbon stocks and associated GHG fluxes, quantification and management of natural carbon stocks and sequestration capacity are important elements of a provincial climate change strategy.

Policy Options:

- **Consider making maintenance of ecosystem carbon storage and sequestration stated objectives of land-use planning.** This is the approach taken in the proposed Ontario Far North Act (Bill 191), which defines a framework for land-use planning and protection in the Far North of Ontario. As a more limited (wetland-specific) measure, adoption of a wetland protection policy that recognizes peatland carbon storage as an ecosystem function could be considered (PEI Department of Environment Energy & Forestry 2003; Nova Scotia Environment 2009).
- **Create mechanisms for trade-offs between land-based GHG mitigation and other policy objectives.** Future land-use decisions are likely to involve trade-offs between protection of carbon stocks and other policy objectives such as food security (Ostlea et al. 2009). Policy and administrative frameworks are needed to balance such trade-offs.
- **Create an interdepartmental working group on wetlands.** Wetlands are a cross-cutting field that is relevant to several government departments. Creation of an interdepartmental working group on wetlands under the ILUC could help define and deliver wetland objectives such as carbon storage and other environmental benefits.
- **Develop a targeted research program to address knowledge gaps**. Current impacts of human land-use on NL peatland carbon storage and fluxes cannot be quantified, and emissions factors for different types of land use are mostly untested. Filling these knowledge gaps is required to support policy development and assess the effectiveness of future management strategies.

5.3. Water Resources

Water is a fundamental resource for Newfoundlanders and Labradorians. As the World Health Organization states, it is the "essence of life" (WHO 2003). Yet less than 2.5% of all water on earth is freshwater and only approximately 1% is available for direct human use (Johns, Sproule-Jones & Heinmiller 2008, 22-24). Provincially, 71% of the population relies on surface sources of drinking water and the rest (29%) depend on groundwater (Department of Environment & Conservation 2010). Provincial residential water use is also the highest in Canada (Canada Mortgage and Housing Corporation 2000). Water is vital for the crops we grow, the fish we harvest, navigation and shipping and the tourism sector among others. Collectively, these sectors comprised 12.2% of the provincial

economy (directly and indirectly) and continue to grow (Department of Finance 2002, 2007).

Climate change will impact the province's water resources in many ways. The risk and magnitude of flooding may increase. Salt water intrusion may increase. Such events could negatively impact ground and surface drinking water sources and adversely affect the broader environment. Likewise, rising sea levels may intensify coastal erosion processes and necessitate modifications to ports and harbours.

Policy Options:

- **Expand the network of groundwater monitoring wells.** This is required in areas of saltwater intrusion and in areas of intense land activity (mining, urbanization). It would also build on the province's groundwater monitoring wells for farming areas. Monitoring changes in salinity levels and other contaminants (quality parameters), and variations in water levels (quantity parameters) would help communities plan changes to their water supply systems. Given the interconnectedness of ground and surface water, the benefits of such data can extend to communities kilometers away (Worthington et al. 2002; Driscoll 1986). This would also enhance the ability to monitor and support the water needs of natural and managed ecosystems.
- **Enhance research capacity and dissemination.** Research on the number, intensity and location of precipitation events is required (rain, snow, ice, flooding and related mudslides). Research also needs to examine salt water intrusion time of travel parameters. The information then needs to be integrated into longer term infrastructure planning such as for water, sewer and emergency services. Financial support is needed for provincial academic institutions and the provincial Flood Forecasting Centre to conduct the research. Assessment of how incremental rises in sea levels may impact the province's ports and harbours is required to determine potential infrastructure modifications. In addition, the province needs to maintain an important role in facilitating research dissemination.

5.4. Agricultural Productivity

Agricultural production in Newfoundland and Labrador is a complex endeavour. Historically, many Newfoundlanders and Labradorians, especially those in coastal outports, survived on subsistence harvesting and the consumption of local food (Turner et al. 2007). However, with only 1% of the land mass arable, the peat and mineral soils as well as the climate pose various crop challenges (Newfoundland and Labrador Institute of Agrologists 2005). These challenges combined with the global economy and the availability of products from other places has resulted in the importation of approximately 90% of our food (Hussey 2007). This means that the province is potentially vulnerable to interruptions in supply and price fluctuations.

However, the agri-foods sector in the province is growing and provides over 6,000 jobs and contributes over $500 million to the provincial economy (Department of Natural Resources 2010). Agricultural research conducted at the federal Atlantic Cool Climate Crop Research Centre (St. John's and Avondale) and the province's Western Agriculture Centre near Pynn's Brook have played an important role in this success (see Agriculture and Agri-Foods Canada 2010). Farming practices and new crops have been developed to suit the unique soils and climate. Yet these centres have had a precarious existence with the federal facility previously targeted for closure and the

provincial facility underdeveloped (Newfoundland and Labrador Institute of Agrologists 2005).

Climate change will add new challenges but may also present opportunities. Warming temperatures may extend growing seasons and expand the variety of crops that can be grown. At the same time, it also means potential changes to insect and disease dynamics.

Changes in precipitation patterns add another layer of complexity. Less snow cover may mean lower water tables while more intense rainfall events have implications for soil erosion and flooding thus necessitating changes in tillage practices.

Policy Options:

- **Increase research on provincial agricultural productivity and adaptation.** Consultation between the Government of Newfoundland and Labrador, agricultural producers, processors, the research community and the federal government is required to identify specific needs and potential new crops for farmers. The results of these consultations need to be turned into an increased agricultural and horticultural research agenda. This agenda needs to include research transfer to industry as well as the development of business and marketing plans. Partnership with the federal government and industry is required to fund this increased research activity which would require expansion of the Atlantic Cool Climate Crop Research Centre. It would also be important to develop a specific research agenda for the Western Agriculture Centre focused on the Humber Valley and more broadly Western Newfoundland where we have the greatest concentration of farmland.
- **Develop agricultural and horticultural education modules.** The Government of Newfoundland and Labrador could also partner with provincial educational institutions and other stakeholders to develop modules in various aspects of horticulture and agriculture. These can include modules related to soils, plant biology, animal husbandry, crop production, irrigation and business management. Modules could be delivered in various formats (classroom, field, electronically).
- **Promote the development and marketing of local, healthy products that are produced sustainably.** It is important that safe, high quality food is available in adequate amounts to meet the needs of the population. Producing food locally can reduce food chain complexity and vulnerability. Thus, there needs to be a consideration of the potential impacts of climate change on food security in the province as well as the implementation of policies supporting the production and accessibility of local food.

CONCLUSION

There is a great need for Newfoundland and Labrador to take action on climate change. This response has proposed five major policy directions with specific policy options to meet this need.

#1. Set emission reductions targets.

- Targets need to be at least in line with the Kyoto Protocol (reduce emissions by 6% below 1990 levels by 2012)
- Ideally, the province will match the B.C. example (reduce emissions by 14% below 1990 levels by 2020 and 74% below 1990 levels by 2050) or go farther to implement science-based targets (reduce emissions by 25% to 40% below 1990 levels by 2020 and 80% to 95% below 1990 levels by 2050)

#2. Price carbon emissions.

- Implement a carbon tax or cap and trade system
- Establish an accurate price on carbon
- Re-invest revenue from carbon pricing into low-carbon initiatives

#3. Facilitate the transition to a renewable energy economy.

- Commit to generate 95% of electricity from renewable sources for the province as a whole
- Ensure incentives for renewable power generation that includes adequate protection for consumers
- Include energy efficiency and renewable energy requirements into the construction, transportation and industrial sectors
- Use oil and gas revenues to shift to a renewable energy economy
- Create an offset fund to invest in GHG-reducing projects

#4. Reduce energy demand.

- Update the building code
- Set stringent vehicle fuel efficiency standards
- Establish a 5-year capital works program for public transit
- Increase investment in alternative modes of transportation
- Increase incentives for the purchase of fuel efficient vehicles
- Mandate speed-limiters on large trucks
- Encourage businesses to invest in fuel-efficient heavy equipment
- Mandate metering of all water usage and price water in increasing block rates
- Mandate "Smart Meters" and time of use electricity rates
- Continue with existing eco-/energy efficiency programs
- Develop "buy local" programs and incentives
- Build low carbon communities

#5. Integrate climate change considerations into land-use planning across the sectors.

5.1. Forestry

- Broaden management strategies
- Enhance and preserve genetic variability
- Target climate change forestry research
- Develop new approaches to integrating wood products and biomass into local economies

5.2. Peatlands

- Consider making maintenance of ecosystem carbon storage and sequestration stated objectives of land-use planning
- Create mechanisms for trade-offs between land-based GHG mitigation and other policy objectives

- Create an interdepartmental working group on wetlands
- Develop a targeted research program to address knowledge gaps

5.3. Water Resources

- Expand the network of groundwater monitoring wells
- Enhance research capacity and dissemination

5.4. Agriculture

- Increase research for provincial agricultural productivity and adaptation
- Develop agricultural and horticultural education modules
- Promote the development and marketing of local, healthy products that are produced sustainably

There will be economic costs associated with lowering emissions but they will be much lower than the cost of inaction. Research on Canada indicates that taking action on climate would have a very limited impact on economic growth—at worst, the equivalent of one or two years' worth of annual growth over a 43-year period (National Roundtable on the Environment and the Economy 2007). At the same time, addressing climate change also represents an economic *opportunity* for developing a new, localized and sustainable "green" economy with significant job growth potential (Thompson 2009). In contrast, the costs of inaction would be much higher: the economic impact of climate change will be extraordinarily high: 5% to 20% of global GDP each year (Stern 2006).

In addition, we would like to stress that as the government implements policies to reduce emissions, attention must be paid to the potential financial burden on people in vulnerable groups, such as low-income families. Revenue from taxing carbon or from the cap and trade system should be invested to offset these costs through, for example, rebates, income tax breaks, or tax refunds.

As a final point, we encourage the Government of Newfoundland and Labrador to continue and build on current climate partnerships, such as the New England Governors – Eastern Canadian Premiers initiative. It would be useful to seek out more relationships like this with other levels of government across Canada to address cost issues and explore other opportunities.

The EPU thanks the Office of Climate Change, Energy Efficiency and Emissions Trading for the opportunity to comment on the public discussion document and we look forward to working with Government of Newfoundland and Labrador to develop and implement policies to reduce emissions in our province.

References

Agriculture and Agri-Foods Canada. 2010. Atlantic Cool Climate Crop Research Centre – Areas of Research. http://www4.agr.gc.ca/AAFC-AAC/displayafficher.do?id=1180549265180&lang=eng Accessed July 08, 2010.

Bernstein, L., et. al. 2007. Climate Change 2007: Synthesis Report: An Assessment of the Intergovernmental Panel on Climate Change. Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Blodau, C. 2002. Carbon cycling in peatlands – a review of processes and controls. *Environmental Reviews*, 10: 111.

Bousquet, P., Peylin, P., Ciais, P., Que´re´, C. L., Friedlingstein, P., & Tans, P. P. 2000. Regional changes in carbon dioxide fluxes of land and oceans since 1980. *Science*, 290, 1342–1346.

California EPA. Air Resources Board., 2010. Clean Car Standards - Pavley, Assembly Bill 1493. http://www.arb.ca.gov/cc/ccms/ccms.htm Accessed July 23, 2010.

Canada. *Retire Your Ride*. http://www.retireyourride.ca/home.aspx Accessed July 24, 2010.

Canada Mortgage and Housing Corporation. 2000. *Household Guide to Water Efficiency*.

Catto, N. 2010. A Review of Academic Literature Related to Climate Change Impacts and Adaptation in Newfoundland and Labrador. http://www.exec.gov.nl.ca/exec/cceeet/external/pdf/Review_Literature_ClimateChangeImpactsAdaptation_inNL.pdf Accessed July 25, 2010.

Christenson, R. & Magwood, S. 2005. Case Study: Groundwater Pricing Policies in Canada. In L. Nowlan (Ed.), *Buried Treasure: Groundwater Permitting and Pricing in Canada*. Toronto: The Walter and Duncan Gordon Foundation.

Dawe, E. 1993. Peat Resources of Newfoundland. In *Newfoundland Peat Opportunities*. Proceedings of an International Conference held at the Glynmill Inn, Corner Brook, NL. September 7–10.

Driscoll, F. G. 1986. *Groundwater and Wells* (2nd ed.). St. Paul, Minnesota: Johnson Filtration Systems Inc..

Environment Canada. 2010. *National Inventory Report 1990 – 2008: Greenhouse Gas Sources and Sinks in Canada.* http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=492D914C-2EAB-47AB-A045-C62B2CDACC29 Accessed July 14, 2010.

Fisher, K., Iqbal, M. T. & Fisher, A. n.d.. Community Owned Renewable Energy for Newfoundland: An Alternative Strategy. St. John's: MUN.

Fisher, K., M. T. Iqbal, and A. Fisher. n.d.. Small Scale Renewable Energy Resource Energy Resource Assessment for Newfoundland. St. John's: MUN.

Frolking, S. & Roulet N. T. 2007. Holocene radiative forcing impact of northern peatland carbon accumulation and methane emissions. *Global Change Biology*, 13, 1079-1088.

Gajewski, K., Viau, A., Sawada, M., Atkinson, D., & Wilson, S. 2001. *Sphagnum* peatland distribution in North America and Eurasia during the past 21,000 years. *Global Biogeochemical Cycles*, 15, 297-310.

Gignac, L. D. & Vitt, D. H. 1994. Responses of northern peatlands to climate change: effects on bryophytes. *Journal of the Hattori Botanical Laboratory*, 75: 119-132

Goulder, L. H. & Schneider, S. H. 1999. Induced Technological Change and the Attractiveness of CO2 Abatement Policies. *Resource and Energy Economics,* 21(3-4), 211–53.

Grey, D. 2008. The relationship between climate and outbreak characteristics of the spruce budworm in eastern Canada. *Climate Change*, 87, 361–383.

Gupta, S., Tirpak, D. A., Burger, N., Gupta, J., Höhne, N., Boncheva, A. I., Kanoan, G. M., Kolstad, C., Kruger, J. A., Michaelowa, A., Murase, S., Pershing, J., Saijo, T. & Sari, A. 2007: Policies, Instruments and Co-operative Arrangements. In B. Metz, O. R. Davidson, P. R. Bosch, R. Dave & L. A. Meyer (Eds.)], Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Hättenschwiller, S., Miglietta, F. & Raschi, A. 1997. Thirty years of in situ tree growth under elevated CO2: a model for future forest response? *Global Change Biology*, 3, 463-471.

Hussey, B. 2007. Wholesale and Other Opportunities In the Vegetable Industry of Newfoundland and Labrador. Prepared for NL Department of Natural Resources Forestry and Agrifoods Agency. http://www.nr.gov.nl.ca/agric/pdf/WholesaleReport.pdf Accessed 20 July 2010.

Janes, J. 2010. The Office of Climate Change, Energy

Efficiency and Emissions Trading. Presented at the Humber River Basin Project 2nd Annual Networking Conference.

Johns, C., Sproule-Jones, M. & Heinmiller, T. 2008. Water as a Multiple-Use Resource and Source of Political Conflict. In M. Sproule-Jones, C. Johns & T. Heinmiller (Eds.), *Canadian Water Politics*, (pp 19-58). Montreal: McGill-Queen's University Press.

Kayranli, B., Scholz, M., Mustafa, A. & Hedmark, Å. 2010. Carbon storage and fluxes within freshwater wetlands: a critical review. *Wetlands*, 30, 111-124.

Kolstad, C. D. & Toman, M. 2001. The Economics of Climate Policy. Discussion Paper 00-40REV. Washington, D.C.: Resources for the Future. Reprinted in K-G. Mäler & J. Vincent (Eds). 2005. *Handbook of Environmental Economics*, Volume II. Amsterdam: Elsevier Science.

Kurz, W. A., Stinson, G., Rampley, G. J., Dymond, C. C. & Neilson, E. T. 2008. Risk of natural disturbances makes future contribution of Canada's forests to the global carbon cycle highly uncertain. http://www.pnas.org_cgi_doi_10.1073_pnas.0708133105 Accessed 15 July 2010.

Kurz, W. A. & Apps, M. J. 1999. A 70-year retrospective analysis of carbon fluxes in the Canadian forest sector. *Ecological Modelling*, 9, 526-547.

Lapveteläinen, T., Regina, K. & Perälä, P. 2007. Peat-based emissions in Finland's national greenhouse gas inventory. *Boreal Environment Research*, 12, 225-236.

Limpens, J., Berendse, F., Blodau, C., Canadell, J. G., Freeman, C., Holden, J., Roulet, N., Rydin, H. & Schaepman-Strub, G. 2008. Peatlands and the carbon cycle: from local processes to global implications – a synthesis. *Biogeosciences*, 5, 1475-1491.

Marbek Resource Consultants. 2005. Development of Options for a Vehicle Feebate in Canada. Report prepared for the National Round Table on the Environment and the Economy.

McBeath, J. 2008. Managing the Wealth. In J. McBeath, M. Berman, J. Rosenberg & M. F. Ehrlander (Eds.), *The Political Economy of Oil in Alaska: Multinationals vs. the State*, Boulder: Lynne Rienner Publishers.

Metz, B., Davidson O. R., Bosch, P. R., Dave, R. & Meyer, L. A. (Eds). 2007. *Climate Change 2007: Mitigation of Climate Change.* Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. Cambridge University Press, Cambridge, UK.

National Roundtable on the Environment and the Economy. 2007. Getting to 2050: Canada's Transition to a Low-emission Future — Advice for Long-term Reductions of Greenhouse Gases and Air Pollutants. Ottawa. http://www.nrtee-trnee.com/eng/publications/getting-to-2050/index-getting-to-2050.php Accessed July 05, 2010.

National Roundtable on the Environment and the Economy. 2009. Achieving 2050: A Carbon Pricing Policy for Canada. Ottawa. http://www.nrtee-trnee.com/eng/publications/carbon-pricing/carbon-pricing-eng.php Accessed July 15, 2010.

Newell, R. G. 2008. International Climate Technology Strategies. Discussion Paper 08-12, Harvard Project on International Climate Agreements, Belfer Center for Science and International Affairs, Harvard Kennedy School, October.

New England Governors – Eastern Canadian Premiers (NEG-ECP). 2001. *Climate Change Action Plan*. http://www.negc.org/documents/NEG-ECP%20CCAP.PDF Accessed July 23, 2010.

Newfoundland and Labrador. Department of Environment & Conservation. 2005. *Climate Change Action Plan 2005*. St. John's: DEC. http://www.env.gov.nl.ca/env/climate_change/govt_action/climatechangeplanfinal.pdf Accessed July 04, 2010.

Newfoundland and Labrador. Department of Environment & Conservation. 2010. *Groundwater Useage Statistics*. http://www.env.gov.nl.ca/env/waterres/cycle/groundwater/data/useage.html Accessed May 15, 2010.

Newfoundland and Labrador. Department of Finance. 2002. Estimating the Value of the Marine, Coastal and Ocean Resources of Newfoundland and Labrador.

http://www.economics.gov.nl.ca/oceans2002/6.stm Accessed July 02, 2010.

Newfoundland and Labrador. Department of Finance. 2007. *The Economy*. http://www.economics.gov.nl.ca/E2006/TheEconomy2006.pdf Accessed June 21, 2010.

Newfoundland and Labrador. Department of Natural Resources. AgriFoods. 2010. We Are Growing. http://www.nr.gov.nl.ca/agric/ Accessed July 08, 2010.

Newfoundland and Labrador. Department of Natural Resources. 2007. *Focusing Our Energy*. Provincial Energy Plan. http://www.nr.gov.nl.ca/energyplan/EnergyReport.pdf Accessed July 08, 2010.

Newfoundland and Labrador. Department of Natural Resources. 2010. Newfoundland and Labrador EnerGuide for Houses. http://www.nr.gov.nl.ca/savingenergy/energuide_houses.htm Accessed July 08, 2010.

Newfoundland and Labrador Institute of Agrologists. 2005. Stop the closure of the NL Atlantic Cool Climate Crop Research Centre. http://www.petitiononline.com/NLACCCRC/petition.html Accessed July 03, 2010.

Nordhaus, W. D. 2008a. Economic Analyses of Kyoto Protocol: Is There Life After Kyoto? In E. Zedillo (Ed.), *Global Warming: Looking Beyond Kyoto*, (pp. 91-100). Washington, DC: Center for the Study of Globalization, Yale University and Brookings Institution Press.

Nordhaus, W. D. 2008b. *A Question of Balance: Weighing the Options on Global Warming Policies*. New Haven: Yale University Press.

Nova Scotia. 2010 (April 22). Carbon Offset Fund for Environment, Economy. News Release. http://www.gov.ns.ca/news/details.asp?id=20100422003 Accessed July 25, 2010.

Nova Scotia Environment. 2009. Nova Scotia Wetland Conservation Policy (draft for consultation). http://www.gov.ns.ca/nse/wetland/docs/Nova.Scotia.Wetland.Conservation.Policy.pdf Accessed July 14, 2010.

Ontario Energy Board. 2010. Time-of-Use Pricing for Smart Meters. http://www.oeb.gov.on.ca/OEB/Consumers/Electricity/Smart+Meters/FAQ+-+Time+of+Use+Prices Accessed July 08, 2010.

Ontario. Statutes. 2009. *Far North Act.* http://www.mnr.gov.on.ca/en/Business/FarNorth/ Accessed July 23, 2010.

Ontario. Ministry of Transportation. 2009. Mandatory Truck Speed Limiters. http://www.mto.gov.on.ca/english/trucks/trucklimits.shtml Accessed July 08, 2010.

Ostlea, N. J., Levy, P. E., Evans, C .D. & Smith, P. 2009. UK land use and soil carbon sequestration. *Land Use Policy*, 26S, 274–283.

Pachauri, R. K. 2008. The IPCC: Establishing the Evidence. In E. Zedillo (Ed.), *Global Warming: Looking Beyond Kyoto*, (pp. 13-20). Washington, DC: Center for the Study of Globalization, Yale University and Brookings Institution Press.

Pembina Institute & David Suzuki Foundation. 2009. Climate Leadership, Economic Prosperity: Final Report on an Economic Study of Greenhouse Gas Targets and Policies for Canada. http://pubs.pembina.org/reports/climate-leadership-report-en.pdf Accessed July 10, 2010.

Pembina Institute. 2009. Highlights of Provincial Greenhouse Gas Reduction Plans. http://pubs.pembina.org/reports/highlights-of-provincial-greenhouse-gas-reduction-plans.pdf Accessed July 25, 2010.

Pershing, J. & Tudela, F. 2003. A Long-Term Target: Framing the Climate Effort. In E. Diringer (Ed.), *Beyond Kyoto: Advancing the International Effort Against Climate Change*, (pp. 11-36). Arlington, Virginia: Pew Center on Global Climate Change.

Prince Edward Island Department of Environment Energy and Forestry. 2003. *A wetland conservation policy for Prince Edward Island.* http://www.gov.pe.ca/photos/original/fae_wetland_con.pdf Accessed July 14, 2010.

Prospectors and Developers Association of Canada. 2008. Newfoundland: Protected Areas, Lands and Regulations, Issues & Advocacy.

http://www.pdac.ca/pdac/advocacy/land-use/pa-newfoundland.html Accessed July 14 2010.

Rivers, N. & Sawyer, D. 2008. Pricing Carbon, Saving Green: A Carbon Price to Lower Emissions, Taxes and Barriers to Green Technology: David Suzuki Foundation. http://www.climateactionnetwork.ca/e/publications/dsf-pricing-carbon.pdf Accessed July 12, 2010.

Schlamadinger, B., Bird, N., Johns, T., Brown, S., Canadell, J., Ciccarese, L., Dutschke, M., Fiedler, J., Fischlin, A., Fearnside, P., Forner, C., Freibauer, A., Frumhoff, Pl., Hoehne, N., Kirschbaum, M. U. F., Labat, A., Marland, G., Michaelowa, A., Montanarella, L., Moutinho, P., Murdiyarso, D., Pena, N., Pingoud, K., Rakonczay, Z., Ramentsteiner, E., Rock, J., Sanz, M. J., Schneider, U. A., Shvidenko, A., Skutsch, M., Smith, P., Somogi, Z., Trines, E., Ward, M., & Yamagata, Y. 2007. A synopsis of land use, land-use change and forestry (LULUCF) under the Kyoto Protocol and Marrakech Accords. *Environmental Science & Policy*, 10, 271-282.

Shogren, J. F. & Toman, M. A. 2000. Climate Change Policy. In P. R. Portney & R. N. Stavins (Eds.), *Public Policies for Environmental Protection*, 2nd Ed., (pp. 125-168). Washington, DC: Resources for the Future,

Shrubsole, D. 2001 (June). Virtually Untapped: Water Demand Management in Ontario. Report prepared for Environment Canada, Ontario Region.

Smith, P. 1991. The Politics of Plenty: Investing Natural Resource Revenues in Alberta and Alaska. *Canadian Public Policy* 17 (2):139-154.

Smith, P. 2004. Soils as carbon sinks: the global context. *Soils Use and Management*, 20, 212-218.

Solomon, S. D., Quin, M., Manning, Z., Chen, M., Marquis, M., Averyt, K. B., Tignor, M., & Miller, H. L. (Eds). 2007. *Climate Change: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, UK.

Stavins, R. N. 2008. Addressing climate change with a comprehensive US cap-and-trade system. *Oxford Review of Economic Policy*, 24(2), 298–321.

Stern, N. 2006. Stern Review Report on the Economics of Climate Change. London: Grantham Research Institute on Climate Change and the Environment, London School of Economics.

Tarnocai, C. 2009. The Impact of Climate Change on Canadian Peatlands. *Canadian Water Resources Journal*, 324, 453-466.

Thibault, J. J. 1992. The New Brunswick peatland database./La base de données des tourbières du Nouveau-Brunswick. New Brunswick Department of Natural Resources and Energy, Mineral Resources, Mineral Resource Report 6, 84 p.

Thompson, D. 2009. Green Jobs: It's Time to Build Alberta's Future. Edmonton: Greenpeace, Sierra Club Prairie & The Alberta Federation of Labour http://prairie.sierraclub.ca/greenreport/Greenjobs_v4.0.pdf Accessed July 12, 2010.

Transports Québec. 2009. Speed Limiters. http://www.mtq.gouv.qc.ca/portal/page/portal/entreprises_en/camionnage/limiteurs_vitesse Accessed July 08, 2010.

Turner, N., Parrish, C., & Solberg, S. 2007. Introduction: Food security in coastal communities in the context of restructuring: Coasts under stress. In C. Parrish, N. Turner, & S. Solberg (Eds.), *Resetting the kitchen table* (pp. 1-12). New York: Nova Science Publishers, Inc.

Turunen, J., Tomppo, E., Tolonen, K., & Reinikainen, A. 2002. Estimating carbon accumulation rates of undrained mires in Finland – application to boreal and subarctic regions. *The Holocene*, 12, 69-80.

UNFCCC. 1992. *The United Nations Framework Convention on Climate Change.* http://unfccc.int/resource/docs/convkp/conveng.pdf Accessed July 14, 2010.

UNFCCC. 1998. *Kyoto Protocol to the United Nations Framework Convention on Climate Change.* http://unfccc.int/resource/docs/convkp/kpeng.pdf Accessed July 14, 2010.

van Osterzee, P., Preece, N. & Dale, A. 2010. Catching the baby: accounting for biodiversity and the ecosystem sector in emissions trading. *Conservation Letters*, 3, 83-89.

Vasseur, L., and N. Catto. 2007. Atlantic Canada. In D. Lemmen, F. Warren, J. Lacroix & E. Bush (Eds.), *From Impacts to Adaptation: Canada in a Changing Climate 2007*. Ottawa: Climate Change Impacts and Adaptation Division, Earth Sciences Sector, Natural Resources Canada.

Warrack, A. & Keddie, R. 2002. Natural Resource Trust Funds: A Comparison of Alberta and Alaska Resource Funds. Edmonton: Western Centre for Economic Research.

Warrack, A. 2007. Whither a Heritage Fund Public Dividend Policy? In *Alberta's Energy Legacy: Ideas for the Future*, ed. R. Roach: Canada West Foundation.

Watson, R. T. (Ed.), 2001. *Climate Change 2001: Synthesis Report. Contributions of Working Group I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press.

Wells, E. D. & Hirvonen, H. E. 1988. Wetlands of Atlantic Canada. In National Wetland Working Group, *Wetlands of Canada* (pp. 252-303). Polyscience Publications Inc.

World Health Organization. 2003. *Right to* Water. Geneva. http://www.who.int/water_sanitation_health/rtwintro.pdf Accessed 09 September 2009.

Worthington, S. R. H., Smart, C. C. & Ruland, W. W. 2002 (October). Assessment of Groundwater Velocities to the Municipal Wells at Walkerton. Proceedings of the 55th Canadian geological and 3rd Joint IAH-CNC and CGS Groundwater Specialty Conference. Niagara Fall, On., pp. 1081-1086.