



Prime Minister Jean Cretien has stated that Canada would sign the Kyoto Protocol by the end of the year. This action would commit Canada to annual emissions of carbon dioxide



(CO₂) and other greenhouse gases during the first commitment period (2008 to 2012) that are 6% below the level they were in 1990. This is equivalent to a reduction of 240 Mt CO₂ below projected emissions. In May 2002, the federal government released a discussion paper that offered four options to meet the reduction target. A detailed plan is expected this fall. The Prime Minister's announcement has triggered a lot of debate in parliament and in the media about the potential economic implications for Canada. Attention has focused on impacts to the fossil fuel sector, but little has been said about what Kyoto means for the forest sector. The forest industry uses fossil fuels to run logging equipment and mills to process wood. Carbon dioxide is lost from the forest to the atmosphere through disturbances such as harvesting, fire and pests, and respiration, and is taken up by the forest through photosynthesis.

Over the last decade the forest industry has made substantial increases in fuel efficiency and is switching to fuels with lower carbon emissions. It is hoped that they will get credit for this early action and not be burdened with excessive demands for further reduction. In the November 2001 issue of *Canadian Silviculture*, Deborah Bakker suggested that Canadian forests could also play a role addressing global warming, and how the Forests 2020 initiative could be part of this. This is achieved by forests taking up carbon dioxide through photosynthesis and sequestering it as wood in the tree and eventually some of it in the soil. A number of analyses have been done to determine the potential of forest carbon sequestration and the creation of carbon credits in Canada. What have they found and where are we in Canada in making this happen?

The recent negotiations in Bonn and Marrakech clarified how Canada's forests fit into the Kyoto Protocol. Article 3.3, which is a mandatory article, discourages the permanent loss of forests (deforestation) and encourages the creation of new forests where they have not existed for many years (afforestation in North American terminology). Deforestation must be counted as an emission of carbon to the atmosphere and growth of new forest can be counted as sequestration of carbon from the atmosphere.

There are no limits on the credits that can be obtained from afforestation. A number of countries with areas that were deforested in the past, prior to the

Kyoto Protocol, are actively pursuing the afforestation option as a way to create carbon credits that can be sold to offset fossil fuel emissions. They are planting fast growing tree species such as eucalypts or hybrid poplar. However, once sold, the carbon must be sequestered permanently. If these plantations are harvested or are destroyed by fire or pests, the carbon removed from the site must be offset by purchasing credits from elsewhere or by growth in other forests owned by the seller. In 1999, Canada's National Sinks Table suggested that there was about one million hectares of land as marginal farmland and as prairie shelterbelts 'readily' available for afforestation in Canada. The Table identified a number of barriers to this activity such as availability of suitable planting stock and up-front costs. Part of the Forest 2020 initiative focuses on this issue in considering ways to promote afforestation.

Article 3.4 is an optional part of the Kyoto Protocol. It addresses the use of managed forests to sequester carbon. Managed forests are our existing forests where we perform activities such as harvesting, reforestation, stand tending, fire protection and control of disease and insects. Canada has to decide by 2006 if it wishes to have the managed forest counted in Canada's carbon balance and to define the land area to be included. Canada negotiated hard to get the managed forest included in the protocol so it is likely we will take this option. Countries have been given limits on how much sequestration in the managed forest they can claim to offset fossil fuel emissions. Canada has a limit of 44 MtCO₂ per year during the first commitment. This is equivalent to the annual net sequestration of CO₂ on 3 million hectares of 60-year-old, site index 30 coastal Douglas-fir in BC; or the merchantable volume on 100,000 ha of the same forest. The federal government has assumed that sequestration in forest growth will be used to meet about 20% of Canada's reduction target during the first commitment period. Carbon credits are predicted to be worth from \$2 to \$10/tonne CO₂ by the first commitment period, consequently sequestration could generate annually up to \$440 million in income for forest owners in Canada by 2010.

Forest growth on what was once non-forested land is an obvious sequestration of carbon in the trees and soil, but how can this occur on the managed forest? Consider



the managed forest as a leaky bucket of carbon. Carbon enters the bucket through photosynthesis and leaks out through plant respiration, decay, streamflow, harvest, and disturbance by fire, insects and disease. Increasing the carbon content of the bucket requires us to reduce the rate of leakage (e.g., reduced harvest and increased fire protection), and/or increase the uptake of carbon through photosynthesis (e.g. improved reforestation, faster growing trees and longer rotations). The downside is that this cannot go on indefinitely. Disturbance is a fact of life in the forest, and once you have increased the carbon store, you will be penalized for future natural or artificial reductions.

Scientists in the federal and provincial governments are involved in the difficult task of assessing the carbon balance at provincial and Canada wide scales. Forest inventory, growth and yield and disturbance (harvest, fire and insects) information are combined in a computer model to track changes in tree and soil carbon over the past and project the changes in carbon stock over the next few decades. The answers they are getting highlight the importance of the data quality and the differences between provinces in the scale of the data available. For example, in a Canada wide assessment with an old database, BC's forests are a net sink at present but becomes a source about 30 years from now. However, using more recent inventory data and a much finer biological and geographical resolution of forest type, BC can show that its forests are a bigger sink today and stay as a sink over the next 30 years. It is unlikely that all the provinces can provide the same resolution of information as BC for all their forested land within the

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implementation time frame. On the other hand, the detail that was available for BC may not be fine enough to meet future international rules for forest carbon accounting.

What are the implications of all this for Canada in general and forestry in particular? The analysis done by the Sinks Table showed that Canada will have significant emissions of carbon through deforestation and that by the first commitment period gains through afforestation will not be sufficient to offset these losses. Consequently, sequestration in the managed forest will be required to offset these losses as well as to offset fossil fuel emissions. But before this can happen there is a long way to go. Internationally acceptable accounting rules are still being developed. There will be costs associated with the accounting such as improvements in forest inventory data and ongoing monitoring. Risk analyses must be done on how much carbon we can maintain on the landscape in the face of the future age class structure of the forest, and the increasing risk of large-scale forest fires and insect disturbance. Trading mechanisms and verification systems for forest carbon are being developed. There have already been a number of private trades, mainly in Australia, where companies are paying for planting trees in the expectation of being able to claim the future sequestered carbon as an offset to their fossil fuel emissions.

To develop a parallel market in Canada there are a number of policy questions that have to be considered. Different provinces within Canada may prefer different definitions of the managed forest. Depending on the definition, a province's forest could go from being a sink

to a source. How do we deal with a situation that within a province some management areas may be sinks while others are sources? How should Canada's cap on forest sink credits be allocated between the provinces? Is private land also included under the cap and if so how would they be allocated credits? There is a debate as to whether forest companies own a share of any credits on the Crown land that they manage. The Canadian government maintains that forests sinks are a 'national treasure' and because the federal government is the 'Party' to the Kyoto agreement, it owns forest credits. The government of New Zealand has also claimed its forest sinks, including those on private land, as a national resource. Provinces incur the expense of forest management. For example, BC spends about \$50 million annually on fire protection to protect potentially over \$150 million a year in forest sinks. If the 'national treasure' argument prevails, would the federal government compensate provinces for actions to maintain its national carbon 'treasure'? Will the federal government pressure provincial forest management agencies to minimise sources and maximise sinks?

In conclusion, there are opportunities for Canada in using forests to help offset fossil fuel emissions, at least in the near term. How long this can be continued will depend on the cost effectiveness of forest sinks as opposed to other options to reduce emissions. As noted earlier, there is the potential for a substantial revenue in forest carbon credits in Canada; however, the ownership issue will have to be resolved before people will be keen to take management actions related directly to carbon storage in the managed forests. Until the national and international forest management issues are resolved, afforestation seems to be the only 'safe bet' for investment in the use of Canada's forests to offset fossil emissions.

*Dave Spittlehouse is with the Ministry of Forest in Victoria.
He can be reached at 250-387-3453 or
dave.spittlehouse@gems4.gov.bc.ca*