CANADIAN COUNCIL OF FOREST MINISTERS

FACT SHEET

CANADA'S FORESTS: CO_2 SINK OR SOURCE?

The world's forests contain more carbon in living trees and plants, organic matter and soil than is contained in the atmosphere—and, each day, forests continue to accumulate and emit vast quantities of CO_2. Canada's managed forest lands store large amounts of CO_2 in trees and soil, but in some years they are net sinks for CO_2—removing more CO_2 from the atmosphere than they emit—while in other years they are net sources. Effective forest management practices can enhance the sink potential of forest lands, thus providing an important opportunity for climate change mitigation.

Photograph from "The Forests of Canada" collection, Natural Resources Canada, Canadian Forest Services, 2003.

How Sequestration Works

The mechanism for carbon sequestration in trees and plants is photosynthesis, the conversion of atmospheric carbon dioxide into plant material using energy from the sun, releasing oxygen in the process. A single hectare of mature trees absorbs approximately 6.4 tonnes of CO_2 per year—an amount approximately equal to the amount produced by driving a mid-sized car with an average fuel efficiency rating of 7.5 litres per 100 kilometres more than 30,000 kilometres.

When a tree is harvested and converted into forest products, the CO_2 it has sequestered over a lifetime is retained within its cellular structure. If the wood is used, for instance, to build a typical 216 square metre wooden house, the house will contain 28.5 tonnes of CO_2.

However, there is another side to the story. When trees die and decompose or are burned, some of the sequestered carbon remains as forest litter and soils, but much of the rest is released back into the atmosphere as carbon dioxide. This is also true for residues left on the forest floor after harvesting. Similarly, as wood products such as paper or building materials decay gradually over time, they, too, return their sequestered CO_2 to the atmosphere.

So, depending on circumstances, forests have the potential to perform either as net *carbon sinks* (sequestering more carbon than they release), or net *carbon sources* (releasing more stored carbon than they capture). Most of this exchange between forests and the atmosphere is by natural processes such as tree growth, decomposition of plant material and disturbances such as forest fires. Human actions such as logging, tree planting, and the long-term preservation of wood products in buildings, furniture or other goods can also strongly influence the forest's role in the global carbon cycle.

Harvesting and Forest Carbon

Forest management activities such as harvesting, tree planting and efforts to fight forest fires and insects have a modest impact on the forest carbon balance. Less than one per cent of the managed forest is harvested in any given year in Canada. During harvesting activities, only a fraction of the carbon in the harvested wood is emitted into the atmosphere as carbon dioxide through processes such as the decay of branches, roots and leaves left on the forest floor. Regeneration of

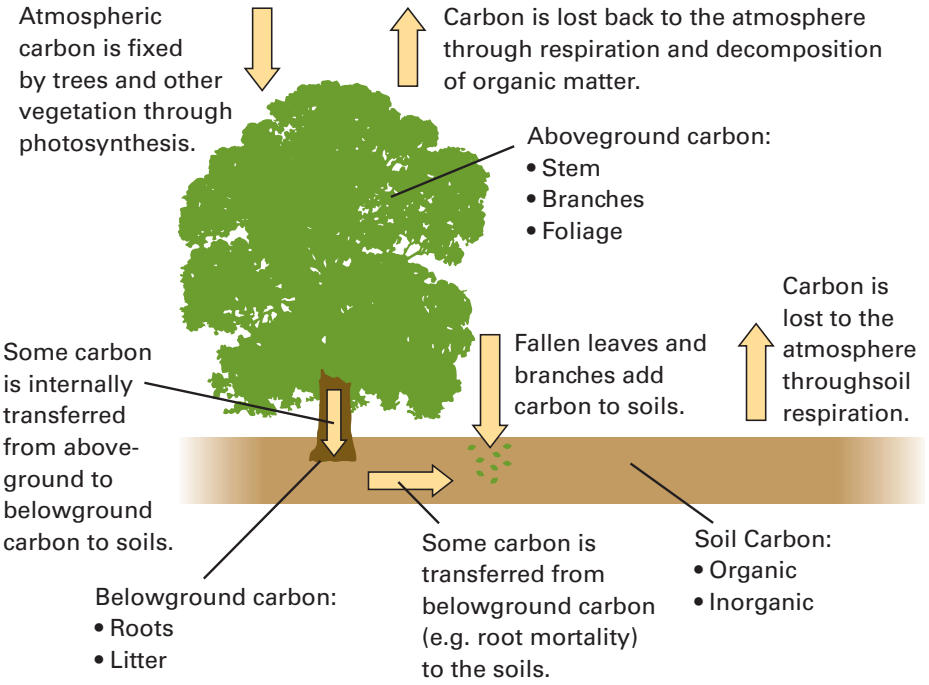
What is Embodied Energy?

Every material used in construction has embodied energy. This is the sum of the energy required to extract, harvest, process, manufacture, transport, construct and maintain a material or product used in building applications. Embodied energy is also related to emissions of water and air pollutants, including greenhouse gases, associated with the production and use of a given product. Consequently, embodied energy plays an important role in determining the environmental friendliness of a building product.

Lumber, with an embodied energy value of approximately 2.5 MJ/kg (megaJoules per kilogram), is thus much more environmentally friend-ly than building materials such as gypsum wallboard (6.1 MJ/kg), glass (15.9 MJ/kg), steel (32 MJ/kg), or aluminum (227 MJ/kg).

Photograph from "The Forests of Canada" collection, Natural Resources Canada, Canadian Forest Services, 2003.

The CO_2 Sequestration Cycle



Source: US Environmental Protection Agency http://www.nrs.fs.fed.us/niacs/forests/carbonsequestration/

the forest, as well as the absorption of CO_2 and nutrients by other plants, animals and organisms, then takes up large amounts of carbon in the area harvested, which tends to balance earlier emissions.

Much of the harvested carbon is stored for a long time in forest products. In Canada, about 50 per cent of the carbon harvested and removed from the forest is stored in long-lasting structures such as houses, with another 25 per cent going into less-durable products such as wooden pallets and paper products. The remaining carbon (about 25 per cent) is in the form of harvesting residues. There is increasing interest in using these residues to produce bioenergy, which substitutes for fossil fuels.

Are Canada's Forests a Carbon Sink?

Throughout most of the past century, Canada's managed forest has been a strong *carbon sink*, adding more and more carbon to the amount already stored. However, in recent decades, the average annual *carbon sink* provided by Canada's managed forest has decreased.

According to estimates prepared by Natural Resources Canada's Canadian Forest Service and reported in Environment Canada's annual greenhouse gas *National Inventory Report*, between 1990 and 2010, Canada's managed forest was an overall sink in 11 out of 21 years. It ranged from a sink of 101 million tonnes CO_2e (carbon dioxide equivalents) in 1992, to a source of 182 million tonnes CO_2e in 1995.

Can the Forest Sector Help Mitigate Climate Change?

Ongoing research at Natural Resources Canada's Canadian Forest Service Forest has established that management activities and the use of forest products can contribute substantially to reductions in greenhouse gas emissions.

In the short term, the most effective approach is to seek emission reductions, for example, through protection against fire and insects and the use of site preparation methods that conserve carbon, such as avoiding the burning of logging slash. Avoiding deforestation—the permanent removal of forests and conversion of the land to other uses such as agriculture, roads or urban development—is also an effective means or reducing carbon emissions.

In the long term, increasing the forest area through afforestation (planting new forests) and forest management practices that increase forest carbon stocks, such as lengthening harvesting rotations and ensuring prompt regeneration after harvest and disturbances, can also contribute to increased forest carbon stocks.

Photograph from "The Forests of Canada" collection, Natural Resources Canada, Canadian Forest Services, 2003.

Wood products extend the time period during which the sequestered carbon is kept out of the atmosphere after harvesting. In addition, products and fuels derived from wood produced through sustainable forest management can offset fossil fuel emissions from other sectors of the economy, helping to reduce greenhouse gas emissions.

The fluctuation in the sink–source carbon balance during this period was closely associated with annual forest fires. In Canada, a full fire-suppression response is used in attempts to control fires as quickly as possible in forests managed for wood products. In other forest areas, mainly in northern Canada, a modified fire-suppression response attempts to control fires in a limited way or simply to monitor their progress. Wildfires started by natural phenomena such as lightning are responsible for about 85 per cent of the area burned in the total forest (managed plus unmanaged) each year. In extreme fire years, such as 1995, direct emissions from wildfires in the managed forest have represented up to 45 per cent of Canada's total greenhouse gas emissions.

In addition, since 1999, the mountain pine beetle infestation in western Canada has been increasing emissions as trees are killed and begin to decay. Accelerated harvesting of these trees is helping to reduce the climate change impacts of the infestation.

As natural conditions change and as effective forest management practices are applied, it is expected that the *sink* potential of Canada's forest lands will, more often than not, continue to play a significant role in climate change mitigation.

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Canada's Carbon Budget Model

The Canadian Forest Service (CFS) has developed a sophisticated model of Canada's forest carbon budget to help forest agencies and companies calculate carbon stocks for monitoring or projection purposes. The *Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3)* is a computer simulation program based on the latest scientific understanding of the factors that affect forest carbon. Drawing on the best available information on forests and tree growth from resource management agencies in all of Canada's provinces and territories, the simulation model enables users to apply their own stand- or landscape-level forest management information to simulate and compare various forest management scenarios in order to assess impacts on carbon.