Natural Resources Canada | Ressources naturelles Canada

CANADIAN FOREST SERVICE

Science HIGHLIGHTS

BIOENERGY

How much biomass could be available to produce bioenergy after fires, insect outbreaks and harvesting?

Researchers are calculating the amount of potential bioenergy feedstocks that are both available and ecologically sustainable

Interest in generating energy from biomass is increasing. The need to mitigate climate change, the increasing cost and finite supply of fossil fuels, and the potential revenues from bioenergy are behind this heightened interest. The dominant producer of biomass-based energy in Canada is the forest industry, which largely uses waste products from regular processing operations in pulp and paper mills and sawmills.

Some companies are also starting to collect leftover material after harvesting, like branches piled at the side of logging roads, to produce biomass-based energy. There is also increasing interest in the potential for collecting and using dead trees in areas that have been affected by natural disturbances like fire and insect outbreaks, especially mountain pine beetle. These biomass sources—or feedstocks—are currently a small portion of what is used for bioenergy in Canada, in large part because of the high cost of collecting this material.

Projecting feedstock availability

Canadian Forest Service–Natural Resources Canada researchers are working to estimate the total theoretical amount of potentially available feedstocks from the forest, including the level of biomass that can be removed from sites after harvest and natural disturbances, while ensuring long-term environmental sustainability.

"Published estimates of total potential biomass availability vary widely," says Brian Titus, a research scientist from the Canadian Forest Service–Natural Resources Canada at the Pacific Forestry Centre in Victoria, B.C. "Caren Dymond (now with BC Ministry of Forests, Mines and Lands) led a Canadian Forest Service Carbon Accounting Team study that used their carbon budget model (CBM-CFS3) to provide more precise estimates based on the latest forest inventory data. As a first step, we estimated the total potential amount of future bioenergy feedstock available from harvesting residues and disturbances from 2005–2020 for Canada's managed forest." The team at the Canadian Forest Service in Victoria then reduced their estimates by 50 percent to approximate the level of available feedstock removals that could be ecologically sustainable, based on a literature review by Titus. There is considerable research underway to determine the environmentally sustainable levels of potential removals for different sites and species, in order to develop guidelines for forest managers.

The calculations showed that future annual potential biomass feedstocks from natural disturbances averaged more than 50 megatonnes per year and harvesting

Overview

If the energy from forest feedstocks displaces energy from fossil fuels, the net effect could help mitigate climate change.

Bioenergy feedstocks from harvesting are the easiest to predict because they result from planned operations.

Feedstocks available after insect outbreaks are the next most predictable because of their multi-year cycles.

Residual materials leftover following harvesting which can be used as a source of bioenergy

residue feedstocks averaged 20 megatonnes per year. By comparison, this total of 70 megatonnes of wood is equivalent to 140 solid blocks of wood each as big as Canada's tallest office building—First Canadian Place in Toronto, which is 72 storeys high. In terms of energy potential, 70 megatonnes of forest biomass has an energy content equivalent to about 12 percent of Canada's current annual energy consumption (at 2007 rates); the 20 megatonnes from harvesting residue alone could only supply about 3.5 percent of energy needs.

Predictability of future feedstock availability

While salvaging biomass after fire or insect disturbances may have the potential to provide a large quantity of feedstock, the cost of harvesting, collecting and delivering that feedstock to a mill for use as bioenergy can be prohibitive. At a minimum, the areas for salvage need to be readily accessible for transportation of the material which may not always be the case for fire or insect-disturbed areas. They also need to be somewhat predictable in location—investments in infrastructure to use this potential biomass (e.g, by building stand-alone bioenergy units) will only happen where there is a predictable source of biomass within a reasonable radius of transportation.

This makes the idea of using salvage feedstocks after fires somewhat challenging as no one can accurately predict where exactly fires will happen in any given year. However, in certain areas, like Western Canada's boreal plains, forest fires are a fairly constant part of the landscape, and may be more likely to be able to provide a consistent source of bioenergy feedstock across a wide area.

By contrast, feedstock availability is more predictable in areas with large insect outbreaks like spruce budworm in Eastern Canada's boreal forest. This predictability potentially increases the longer-term investment opportunities. For example, simulating expected future spruce budworm outbreaks shows a production of potentially available bioenergy feedstock of as much as 10 megatonnes a year in the Boreal Shield East ecozone.

Bioenergy feedstocks based on residues after harvesting are the easiest to predict because they result from regulated, planned commercial operations. These feedstocks also have the advantage of being more accessible because the roads needed for extraction are already in place. But the economics of recovery can still be challenging, and new technologies are being explored to reduce costs of collection and processing.

Bioenergy feedstock and climate change

Climate change is likely to increase the areas affected by natural disturbances, which will further increase the amount of potentially available feedstock in the future.

Trees take up carbon dioxide from the atmosphere and store the carbon in their wood and foliage, but dead trees will decompose over time and release carbon dioxide, a major greenhouse gas linked to climate change. While salvaging and using dead wood for bioenergy will accelerate the release of carbon dioxide in the short term, in many cases there is a net benefit as bioenergy displaces energy from fossil fuels, helping to mitigate climate change, and the forests over time will regrow and recapture the carbon.

"The net benefit to the atmosphere of forest bioenergy use is affected by many factors. Future research should further assess which post-disturbance forest biomass recovery strategies, energy conversion processes, and forest product use make the most sense, including providing the greatest greenhouse gas benefits," Titus says.

Trees affected by a spruce budworm outbreak