

FACT SHEET

BIOENERGY FROM CANADIAN FORESTS

The Canadian forest industry has a long history of using wood residues as a renewable energy source. First used mainly for facility heating, mill and forest residues such as bark, sawdust, wood chips, branches, and tree tops have today become feed stocks for sophisticated steam and electricity cogeneration facilities, lumber drying kilns, and new bioenergy products such as wood pellets, syngas, cellulosic ethanol, biodiesel, bio-oil, biocarbon, and much more.

Leading the way is Canada's pulp and paper industry, in which forest biomass already supplies as much as 60% of the fuel used to generate heat and electricity in some locales. In the foreseeable future, that percentage could increase as the costs of alternative fuels rise and as forest companies take advantage of new generating technologies. For instance, many kraft pulp mills are installing condensing turbines to generate more electricity from cogeneration (capture of waste heat) from black liquor, sludge, and harvest residue combustion.

Bioenergy from forest sources is also gaining attention in other sectors. Some provincial electrical utilities that currently use coal or natural gas as fuels have begun to substitute manufactured wood pellets for part of their needs. For example, Ontario Power Generation is preparing to convert its plants in Nanticoke and Atikokan,

which are currently fueled entirely by lignite coal, to use a combination of coal and wood pellets.

Some institutional power generators such as hospitals also see bioenergy as an attractive alternative to conventional fuels. For instance, in Amqui, Quebec, located on the Gaspé Peninsula not far from Rimouski, the local hospital has embarked on a \$1.3 million conversion of its heating system to a wood-fired biomass boiler. The management, maintenance and supply of fuel stocks for the project is the responsibility of the Coopérative Forestière de la Matapédia. Initially, the new system will supply the hospital with heat. In the longer run, other municipal buildings may be connected to the system. Importantly, supplying the boiler with fuel will create a new market for local forest companies that have seen declines in traditional markets.



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

The Wood Pellet: Bioenergy Product Extraordinaire

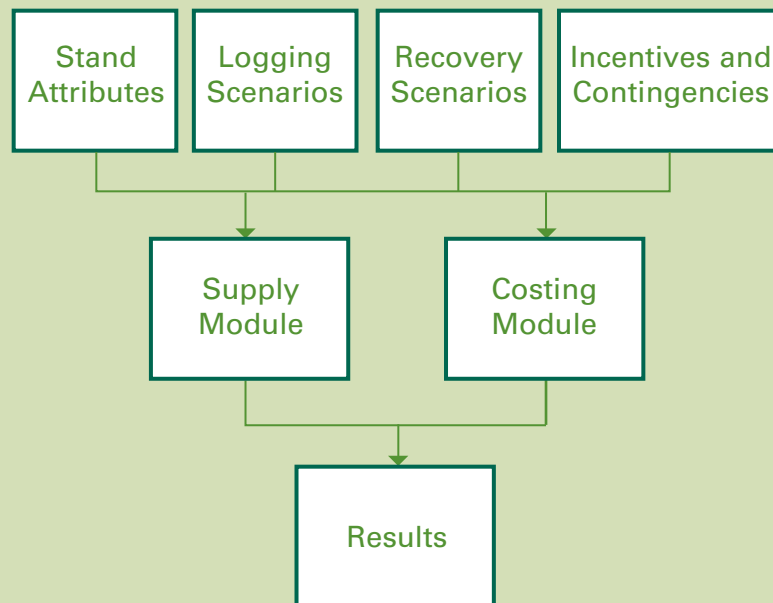
A bioenergy product that has gained a great deal of attention in recent years is the wood pellet—a cylinder of densely compacted wood fibres measuring about a quarter-inch in diameter by an inch in length. Low in humidity content (generally less than 10%), wood pellets can be burned with a very high combustion efficiency. When used for cogeneration in coal plants, wood pellets can be put through the same grinders that crush coal into a powder before feeding it into furnaces. Already used extensively in European power plants, wood pellets are being produced in several large-scale Canadian plants both for export and to supply a growing domestic demand from industrial and household consumers.

Recognizing the Energy Value in Wood Waste

Wood residuals generated from conventional harvesting operations represent an important potential feedstock for alternative energy solutions. To help Canada's forest industry capitalize on this potential, the Feric Division of FPInnovations, one of Canada's leading forest sector research organizations, has developed an innovative spreadsheet model designed for estimating the supply of forest-origin biomass within a defined forest management area and the cost of delivering it to a conversion facility. With reliable numbers in hand, forest companies are able to make informed investment decisions.

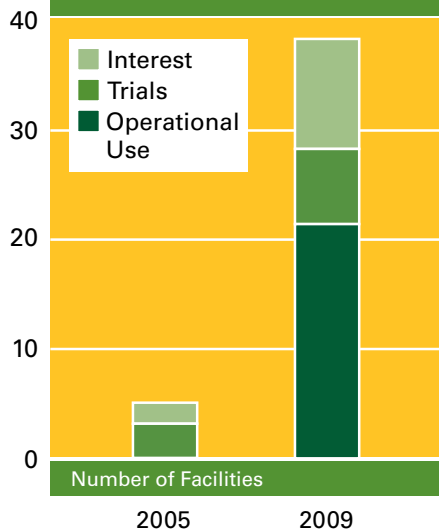
BiOS (Biomass Opportunity Supply), which was initially developed for use in Ontario, has since been adapted for use in other provinces where terrain, tree species, transportation logistics, cost structures, and other factors may be quite different. Today, there are versions of the software available or under development for Quebec, Alberta, Saskatchewan, and British Columbia.

BiOS Framework



Current uses of bioenergy from forest origins

Pulp Mill and Independent Power Producers Using Forest-origin Biomass. Evolution of 60 mills across Canada



Even home owners are embracing a new generation of high-efficiency wood stoves and furnaces that eliminate the airborne particulates from partially combusted wood fuel that once contributed to urban smog. Wood biomass now accounts for about 8% of residential energy use across the country.

Drivers for Change

What is behind this interest in bioenergy? Those close to the industry point to three main drivers: concerns about greenhouse gases; an intense drive towards sustainable forest management practices; and economics.

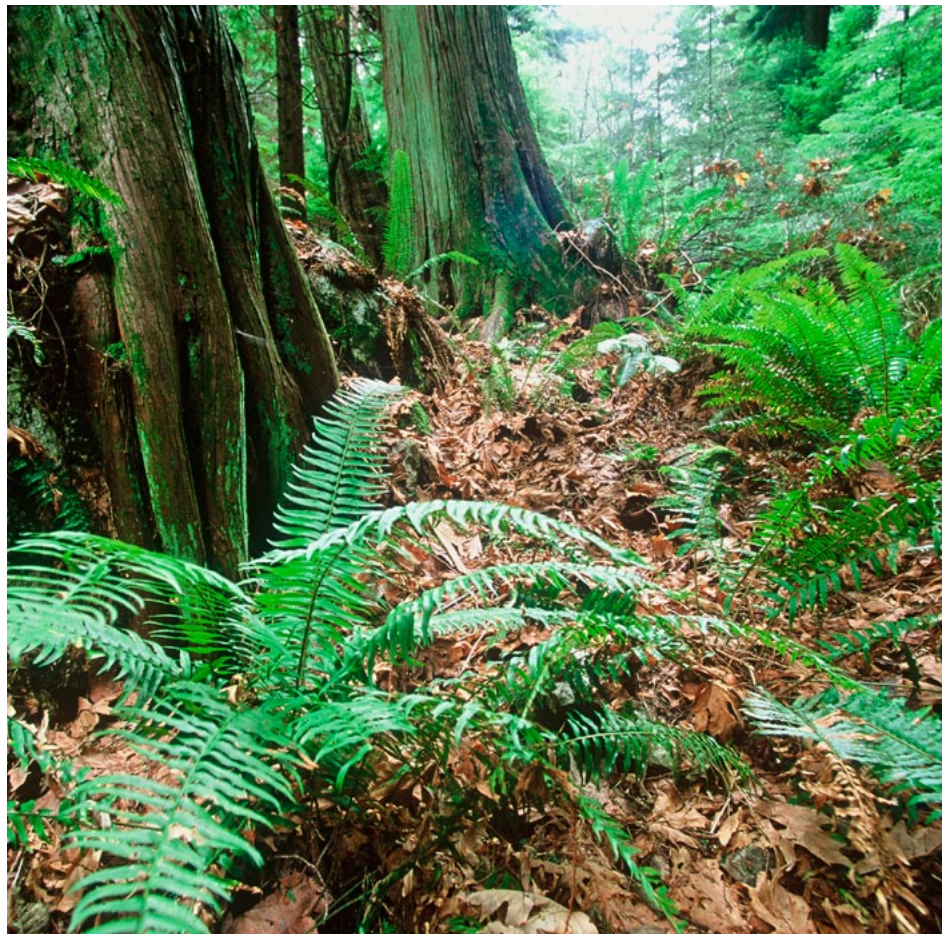
Over its full life cycle, wood biomass used for energy production is CO₂ neutral. During tree growth, CO₂ is

absorbed. When wood residues decay or are burned, they return that CO₂ to the atmosphere. If CO₂ reclamation technology is used, the net result is a reduction in atmospheric CO₂. At the same time, using wood biomass reduces the need to use hydrocarbons such as coal, natural gas or oil—which are prolific contributors of greenhouse gases. At a time of intense concern about global warming, bioenergy from forest sources has obvious appeal.

Sustainable forest management is the goal of all forest practices on Canadian public lands—practices that promote the sustainable use of forest resources while addressing ecological issues such as forest health, wildlife habitat and biodiversity. From an economic perspective, sustainable forest management also means

Canada's bioenergy installed generating capacity, by province, in megawatts (2006)

Province	MW
Newfoundland	15
Prince Edward Island	2
Nova Scotia	66
New Brunswick	129
Québec	303
Ontario	313
Manitoba	22
Saskatchewan	–
Alberta	231
British Columbia	673
Canada	1,754



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

making the most efficient use of all harvested materials—including wood residues—in order to reduce costs or create new revenue streams. However, removing *all* forest residue for uses such as bioenergy production is not always the best approach. Depending on the location, it may be important to leave some biomass on the forest floor to preserve wildlife habitats and to regenerate soil nutrients. Sustainable forest management decisions about the use of forest biomass must be decided on a site-by-site basis guided by a science-based approach.

Economics can be both a driver of—and a brake on—bioenergy development. At a time of low conventional energy prices, higher-cost biofuels may lose

some of their attractiveness. This puts intense pressure on producers to keep their costs to a minimum by developing more efficient approaches to harvesting, production and, in particular, feedstock transportation, which currently accounts for about 60 per cent of the total production cost. In some instances, success in managing these factors has already made biofuels competitive with the alternatives. For instance, one biomass conversion technology now in use remains competitive as long as the cost of a barrel of oil stays above \$17 (US). As the costs of conventional energy sources rise, the attractiveness of biofuels is expected to increase significantly.

Forest Biomass Sources in Canada

Although Canadian forest operations create a rich source of materials suitable for the production of bioenergy, the route from forest to bioenergy application is changing rapidly. In the past, many pulp and paper mills had a wood room that created a byproduct known as "hog fuel"—bark and other wood residues that could be used for heating and power generation. As many pulp mills became integrated with sawmills during the 1980s and 90s, the wood room disappeared as wood chips were received by truck from the sawmill. Economic conditions during the past decade have changed that relationship. The closure

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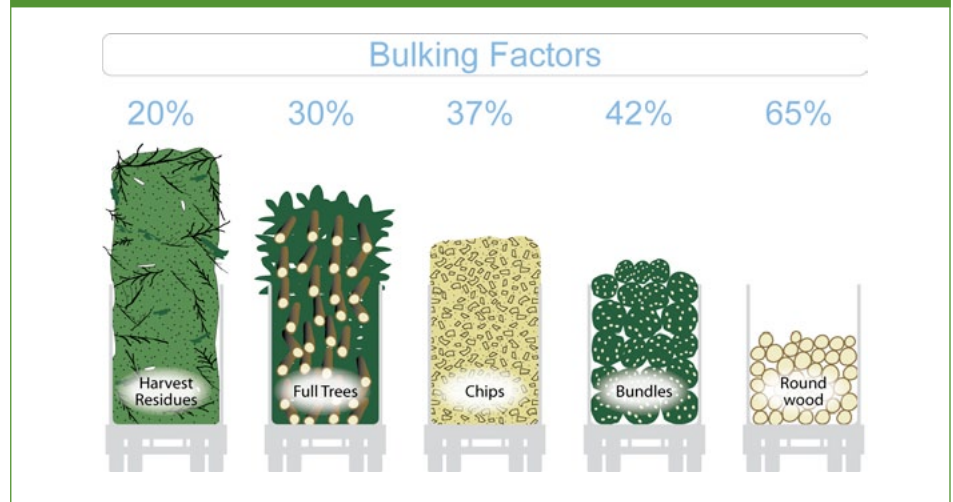
of many sawmills has greatly reduce sources of both wood chips and hog fuel, resulting in increased interest in obtaining biomass directly from the forests.

Forest biomass for energy production is available in a variety of forms. Harvest residues such a tree tops, branches, needles and bark are favoured because they can often be recovered in conjunction with logging operations, although transportation costs may be high. Silvicultural thinning, right-of-way clearing, the harvesting of sphagnum peat, and salvage from forests damaged by wild-fire, disease or insects are among many other possible sources of biomass. Mill residues are usually the cheapest source of biomass, but new, more efficient processing methods are beginning to make even the long-distance transportation of biomass economically viable.

There is also growing interest in harvesting tree species such as Tamarack or Larch that are not currently used for lumber or paper-making, but that are entirely suitable for bioenergy production. Alternatively, the cultivation of fast-growing



Volumes occupied by biomass in various states



Credit: John Deere (FERIC Winning Solutions 2006)

tree species on strategically located plantations may one day offer an economical approach to sustainable energy biomass production.

Addressing Cost Challenges

To make bioenergy from forest biomass attractive from a cost standpoint, the high costs of transporting a low density, high-moisture-content material over long distances must be overcome. Three strategies that are showing great promise are *comminution*, *compaction*, and *conversion to liquid fuel or biocarbon*.

Comminution is the reduction of wood residues into finer particle sizes by means of chipping and pulverization; *compaction* squeezes the grains together to increase their density. A good strategy is to chip, grind and compact in the field before loading into trucks for transport. Increasing density in this way

reduces transportation costs significantly. Reducing wood residues to small particles and slashing transportation costs vastly increases the viability of secondary processing operations such as syngas and ethanol production or wood pellet manufacturing.

Even greater cost reductions may be possible through the conversion of feed stock into liquid fuel by means of a portable bio-refinery, a process referred to as carbonization. These truck-mounted units use pyrolysis—the decomposition of biomass by heating in the absence of oxygen—to produce an energy-dense liquor that can be transported to a refinery for further processing into a variety of fuel products. Carbonization increases calorific values and provides the ability to economically transport the energy further distances.

Energy from forest biomass clearly offers huge opportunities for the future.