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Canada

Bioenergy and *Biomass* in *Canada*

Bioenergy is the oldest energy source.

Up until a century ago, combustion of wood was the principal method for providing energy for Canadian industries and homes.

Presently, Canada is deriving 600 PJ (Petajoules) or 6% of its energy demand from forest biomass. This is striking given the diverse existing and new biomass supplies available in this vast country.

What are bioenergy and industrial bioproducts?

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Bioenergy is made available by the conversion of materials derived from sources of either living organisms or metabolic by-products. Canada has an abundant supply of many types of biomass, which is important in the production of energy, biofuels, materials and chemicals. A key difference that distinguishes this source of energy from other natural resources such as petroleum, coal and nuclear is that bioenergy can be sustainably derived from renewable feedstocks. Biomass can be converted into solid, liquid or gaseous energy carriers. This allows a wide range of applications:

- biomass can be burned directly to produce heat and/or electricity,
- converted biochemically to produce liquid fuels (such as ethanol);
- digested or gasified to produce gaseous fuel; and
- pyrolized to produce oils and high value chemicals.

Bioproducts result from running sources of biomass through processes that convert them into fuels, chemicals and/or bio-materials. Some examples of industrial bioproducts in Canada are:

- renewable diesel fuels
- ethanol
- lubricants and chemical intermediates for applications such as plastics
- biomaterials such as composites, insulation and textiles
- modified proteins
- adhesives, resins and solvents

Canadian researchers are developing new and improving current technologies to make bioenergy cleaner, more sustainable, efficient and viable.

The two largest sources of biomass supply in Canada come from forestry and agricultural operations. Typical biomass supply is derived from:

- Woody - mill residues, forest residue, short rotation crops
- Non-woody - agricultural crops, crop residue, processing residues
- Other organic waste - animal waste such as manure from feed lots, municipal solid waste and industrial wastes

6 KEY BIOMASS CONVERSION & UTILIZATION TECHNOLOGIES

Combustion. The most common conversion of biomass is through combustion. It produces electric power, steam and heat. It is commercially available and regarded as proven technology. However, improvements to further the technology are being developed to help increase efficiencies, reduce emission levels, and reduce costs.

Gasification. Production of a sythesis gas (syngas) in an oxygen starving environment at high temperatures. The syngas can be used either as fuel gas for production of heat, electricity and process steam or the syngas can be cleaned to remove contaminants and used for production of synthetic natural gas, high value chemicals.

Pyrolysis. A thermal decomposition process that involves rapidly heating biomass at high temperatures in the absence of oxygen. Products of pyrolysis are condensed to form liquid fuel (bio-oil). Bio-oil can be produced from the pyrolysis of various biomass feedstocks such as hardwoods and softwoods, grasses and agricultural residues.

Fermentation. In simple terms, fermentation is a specialized method of decomposition. Bioethanol is produced mainly from fermentation of carbon sugars. Increased environmental awareness and the commitment to reduce greenhouse gases have heightened the need for increased production of ethanol in Canada. At present 179 million litres of fuel ethanol are produced in Canada each year from cereal grain and corn. Canada is a world leader in the production of ethanol from cellulose-based biomass (straw, forest biomass, etc.) and the technology is rapidly approaching commercialization. Interestingly, ethanol, when made from biomass, can significantly reduce the greenhouse gas emissions compared with gasoline.

Transesterfication. Biodiesel is produced when vegetable or animal fats are separated into glycerol and methyl esters by a process known as transesterfication. Generally speaking, the process involves introducing sodium hydroxide and methanol to the source oil in order to separate its glycerol from its combustible methyl esters. The process, however, is substantially energy intensive.

Anaerobic Digestion (AD). AD is a naturally occurring process whereby biomass is broken down or 'digested' by bacteria in an air free environment. AD takes place in landfills and is used to treat certain fractions of municipal waste water and other industrial waste waters. More recently, AD has been introduced to the Canadian farming community to treat manure, animal processing wastes and other agricultural residues. The anaerobic bacteria produce methane rich biogas which can be converted to heat and electricity.

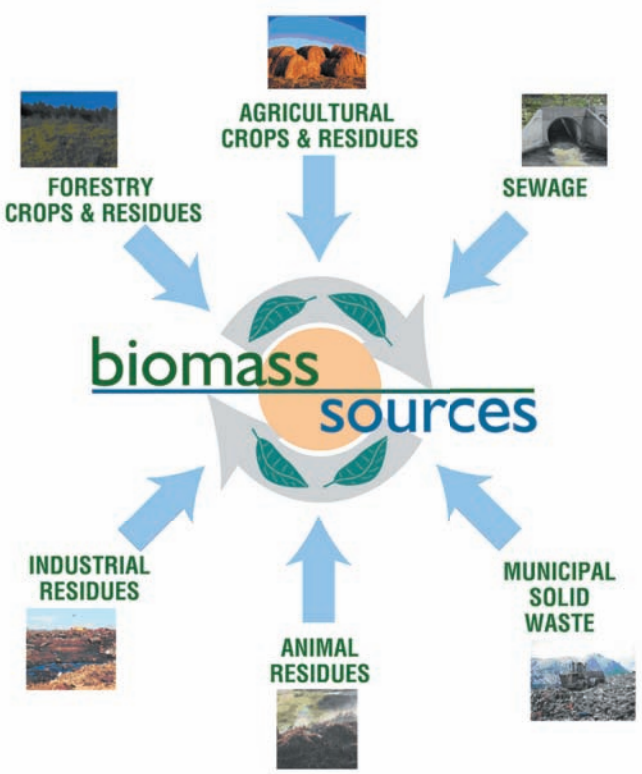
Integrated bio applications

Further research could be directed to developing integrated biorefineries whereby two or more products are produced at the same site and products from one operation can be feedstocks for another. An example of this is combining an anaerobic digester with a fuel ethanol plant and a beef feedlot. Distiller dried grains from the ethanol production could be fed to the cattle and excess could be used in combination with the cattle manure to feed the digester. The digester, in turn, would produce biogas. This would not only replace fossil fuel used in the production of ethanol, but also increase the overall economic viability of the plant.

The Canadian Biomass Innovation Network (CBIN)

CBIN is an applied R&D program designed to harness the potential for bioresources, bioenergy, bioproducts and bioprocesses to help Canadian industry meet efficiency, sustainability and climate change challenges. The Program coordinates its activities with the Canadian provinces, universities, non-government and government research organizations to maintain a nationally focused effort on the development of biomass conversion technologies. The bioenergy component of the Program, in partnership with industry, provides cost-shared support for the development of new, or improvement of existing, technologies for conversion of biomass to energy. Technologies for biomass combustion and for biochemical and thermochemical conversion of biomass to fuels and chemicals are all under development in Canada.

Natural Resources Canada's Bioenergy Development Program (BDP) exists to assist Canadian industry in the research and development (R&D) and commercialization of bioenergy technologies that can serve as reliable, cost-effective and environmentally responsible alternatives to conventional energy production.



FOR MORE INFORMATION
on any of the technologies described in this Fact Sheet, visit our websites:

CANMET Energy Technology Centre (CETC)
Natural Resources Canada
www.cetc.nrcan.gc.ca

The Canadian Renewable Energy Network (CANREN)
http://www.canren.gc.ca/bio/index.asp

The Clean Energy Portal
http://cleanenergy.gc.ca/

The Canadian Biomass Innovation Network (CBIN)
www.cbin-rcib.gc.ca

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