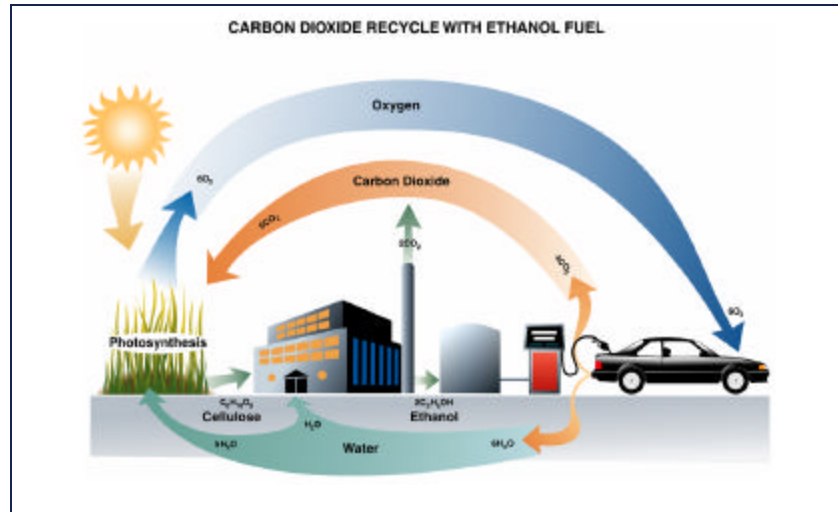


Ethanol the 'Green Gasoline'

Bioenergy Development Program

Ethanol has many environmental advantages over gasoline - a major contributor to climate change. It is estimated that a litre of biomass ethanol used to replace a litre of gasoline reduces the accumulation of atmospheric carbon dioxide - a harmful greenhouse gas - by 70 per cent.

For the past two decades, Natural Resources Canada's CANMET Energy Technology Centre (CETC) has assisted Canadian firms in making ethanol from biomass a commercial reality.



The automotive industry's first investigation into fuel ethanol dates back to Henry Ford's original Model "T" design. While gasoline soon replaced ethanol as the fuel of choice, modern environmental concerns have revived interest in this "green gasoline".

Until recently, environmental concerns were outstripped by the fact that gasoline was far cheaper and more accessible than ethanol. However, with heightened environmental awareness and a global commitment to reduce greenhouse gases, ethanol has emerged as an available option for consumers.

130 million litres of grain based fuel ethanol are produced in Canada each year. With the addition of new production plants currently under construction, this is expected to at least triple over the next few years.

Grain ethanol, as an additive to transportation fuels, has now gained commercial acceptance. Over 950 retail outlets across Canada offer E10 - ethanol-blend fuels (10% ethanol, 90% gasoline).

Biomass Ethanol

Ethanol can be made from products other than grain. Major breakthroughs are being made to convert biomass products into ethanol.

Currently, the focus of CETC's Bioenergy Development Program is on forestry wastes such as wood chips and sawdust, and agricultural wastes such as straw and chaff. Great strides are also being made to convert municipal wastes as well. There is enough wood waste in British Columbia alone to replace half of Canada's gasoline with E10.

Based on the amount of waste currently available across the country, it is predicted that wastes alone could theoretically produce all of Canada's fuel ethanol needs. (3.8 billion litres/year or 10% blend in the 38 billion litres/year vehicle fuel demand projected for 2005). The challenge is that these wastes contain 'lignocellulosic' or woody materials that require special treatment not required in traditional grain ethanol production.

At present, the production of alcohol from lignocellulosic feedstocks is a four stage process: pre-treatment to expose the cellulose and hemicellulose components, converting the cellulose and hemicellulose components into sugars, fermenting the sugars to produce ethanol and recovering the ethanol.

In 1974, it cost \$2.50 to produce a litre of ethanol from wood. As a result of cooperative R&D, the cost is now estimated at \$0.30-0.35/litre. Within ten years, researchers expect production costs to drop to \$0.22/litre.

Technology Advancement

Innovative, high-tech systems are being developed to meet the specific requirements of producing ethanol from wastes. Basically, they all

Partners in Research and Development

Technical experts at CETC work in close partnership with industry to bring ethanol-from-wastes to the market place. Our clients include:

- Iogen Corporation
- University of British Columbia
- Tembec Inc.
- Kemestrie Inc.
- Commercial Alcohols Inc.

consist of four unit operations, each with its own technical and economic barriers. Through our partnerships in research and development, we serve as a catalyst to remove these barriers and to make commercial implementation a reality.

- **pre-treatment:** the pre-treatment of hard wood, soft wood and agricultural residues using steam or extrusion based processes has been optimized;
- **hydrolysis:** specifically tailored acid or enzyme based processes have greatly improved the efficiency of conversion of the pre-treated feedstock to fermentable sugars;

- **fermentation:** new genetically engineered strains of bacteria show promise for significantly improving ethanol production volumes; and
- **ethanol recovery:** extractive fermentation and other new developments have greatly enhanced overall efficiency.

As a result of some of these innovations, Canada's first demonstration plant to produce ethanol from agricultural and wood wastes is scheduled for construction in 1999.

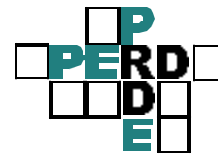
CETC is proud of its role in moving ethanol-from-waste out of the laboratory and into the marketplace.

To find out more about CETC's Bioenergy Development Program please contact:

*Bioenergy Development Program
CANMET Energy Technology Centre
Natural Resources Canada
580 Booth Street, 13th Floor
Ottawa, Ontario
Canada K1A 0E4*

*Visit the Canadian Renewable Energy Network Web site at:
www.canren.gc.ca*

*Bill Cruickshank
Tel: (613) 996-8732
Fax: (613) 996-9416
E-mail: wcruicks@nrca.gc.ca*



*Or Visit our Web Site at:
www.cetc-ctec.gc.ca*