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BIOFUELS AND BIOTECHNOLOGY

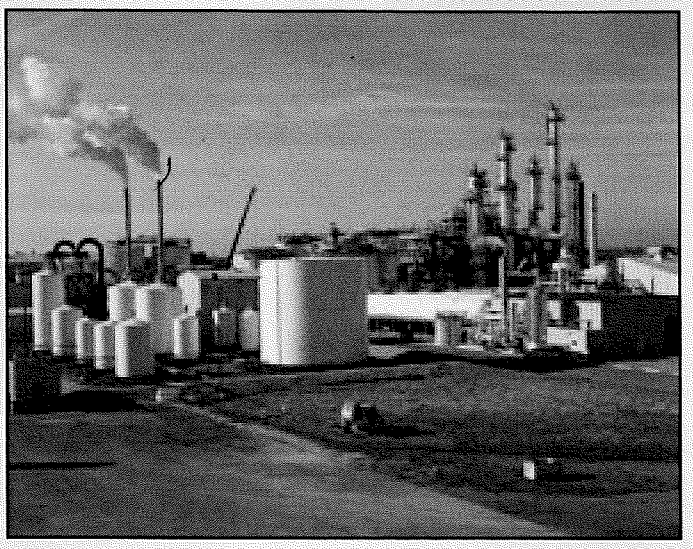
WHAT DO THE TERMS BIOFUELS & BIOTECHNOLOGY REFER TO?

Biofuels... are fuels produced from biological sources, such as corn, sugar cane, straw or wood chips. ("Fossil fuels" – oil, coal, and natural gas – are also derived from once-living sources, but have been created in their present form by geological processes over millions of years.) The two most widely used biofuels today are ethanol and biodiesel. Both mainly serve as replacements or supplements for gasoline, diesel, and other transportation fuels.

Ethanol is sometimes referred to as grain alcohol, and is made by a fermentation process, using crops like corn and sugar beets as the feedstock. It can be blended with gasoline to run today's vehicles, or, with modest engine modifications, can be used as a fuel by itself.

Biodiesel is plant oil extracted from oil seeds like canola and refined; it can be used as an additive to gasoline or alone as a fuel very similar to diesel. New processes are currently being developed that allow production of bio-based ethanol and diesel fuels to be made from more easily obtained straw, wood, and similar cellulosic materials, rather than from starches, sugars, and oils that have value as human food.

Biotechnology... in the broadest colloquial sense means the use of biological processes to create various products, such as cheese or new varieties of plants. Statistics Canada and the OECD also use a broad definition of biotechnology in compiling sectoral economic statistics: "The application of science and technology to living organisms as well as parts, products and models thereof, to alter living and non-living materials for the production of knowledge, goods and services."[1]



Biotechnology (contd...)

As we use it here, the term refers to techniques for manipulating tissue, cellular and genetic material, especially transferring genes from one organism to another, sometimes of a different species, in order to create special new characteristics in the genetically treated (or *transgenic*) organism.

Biofuels can be made by conventional fermentation and other processes without any use of transgenic biotechnology. However, there can be biotechnology applications used in creating biofuels. These include using transgenic feedstock crops, such as Bt corn or certain GE poplar trees, in order to increase yields or to alter other crop traits to improve processing.

As well, biotechnology can be used to produce and modify the enzymes and yeasts used in making ethanol; cellulose-based ethanol from materials like wood chips or sawdust rather than grains greatly increases the potential of the technology.

[1] Munn-Venn, Trefor and Paul Mitchell, *Biotechnology in Canada: A Technology Platform for Growth,* published by The Conference Board of Canada, 2005

BIOFUELS AND BIOTECHNOLOGY

WHAT POTENTIAL BENEFITS ARE CLAIMED FOR THESE TECHNOLOGIES?

Environmental

The most difficult problem in addressing climate change is replacing the fossil fuels used in transportation. While a hydrogen-based transportation sector is a long-term possibility, it requires a huge and expensive investment in new infrastructure, and is not without potential environmental and other concerns. Biofuels are another option that, by contrast, can be (and are being) used today with relatively minor changes to vehicle engines and fueling infrastructure.

Biofuels would also reduce acid precipitation and a number of air pollutants like carbon monoxide and particulate matter.

Ethanol can replace environmentally problematic anti-knock compounds and increase octane in gasoline.

Socioeconomic

Use of biofuels could support farmers' incomes almost everywhere in the world, since almost all countries can grow feedstock crops. The present transportation fuel supply relies on a globalized system based on unevenly distributed petroleum resources, and biofuel use could lessen risks of interruption because of terrorist actions, war, and storms like Hurricane Katrina.

It is claimed that some 70% of an ethanol plant's revenues are typically spent within 150 km of the facility; rural municipalities would benefit from local economic activity.

WHAT SUSTAINABILITY CONCERNS ABOUT BIOFUELS HAVE BEEN RAISED?

While most of the impacts of these technologies are seen as potentially positive, much depends on specifics.

Environmental

There are questions about how much actual reduction in greenhouse gases would occur if biofuel crops exclusively used fossil fuels for fertilizer feedstock, harvesting equipment, and the like. Badly managed biofuel crops could increase rates of soil depletion and erosion.

> ***Will biofuel crops displace native forests and grasslands with genetically engineered monocultures?***

An important issue relates to land use limits and priorities: will biofuel crops displace native forests and grasslands with genetically engineered monocultures, threatening genetic cross-contamination and diminishing important habitat; and/or displace food crops, reducing food supplies? In part, this depends on the particular technologies used; some recent conversion technologies can make use of waste cellulosic materials like straw and corn husks and can use native species like switchgrass for ethanol production. At present, biofuels production is relatively minor, and would have to increase substantially before large scale competition for land use became a problem. It is clear, however, that simply substituting biofuels for fossil fuels without substantial efforts to curb energy demand and improve efficiency is not a sustainable strategy.

> ***Some 70% of an ethanol plant's revenues are typically spent within 150 km of the facility.***

WHAT IS THE STATUS OF THESE TECHNOLOGIES IN TERMS OF COMMERCIALIZATION?

Biofuel technology has been in use since World War II. In the 1970s, responding to dramatic global jumps in oil prices, Brazil undertook a major initiative to reduce its oil dependence by developing an ethanol-based transportation system.

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COMMERCIALIZATION (contd.)

Using its sugar cane as a feedstock, and a variety of policy instruments from subsidies and tax breaks to mandated requirements for biofuel use, by the mid-80s almost all new car sales were ethanol vehicles. Ethanol use there declined with falling oil prices in the following decade, but a decision in 2003 to require flexible-fueling capability in vehicles changed the economics significantly and ethanol production and vehicle use once again expanded. Global production of ethanol has doubled since 2000, and biodiesel nearly tripled.

> ***Canada produced 245 million litres of ethanol in 2004, and renewable fuels associations would like to double that by 2010***

After Brazil, the U.S. comes second in ethanol production, chiefly using corn, while Europe produces almost all of the world's biodiesel, largely from rapeseed and sunflower seeds.[2] Canada produced 245 million litres of ethanol in 2004, and renewable fuels associations would like to double that by 2010.

Specifically in the biotechnology resource sector in Canada, there are some 21 biotechnology companies (though not necessarily involved with biofuels), with about $13 million invested in R&D.[3]

WHAT ABOUT GOVERNMENT OVERSIGHT AND POLICY?

Biofuels Policy

In Canada, there are modest initiatives to support quality and availability of biofuels through an online supplier registry by Natural Resources Canada. Saskatchewan, and, more recently, Ontario have developed programs to support ethanol production; Ontario has a target of 5% ethanol in gasoline by January 1, 2007.

Federal biotechnology policy and support for research & development

The Canadian Biotechnology Strategy of 1998 proposes as its main theme that Canada should position itself to be a responsible world leader in biotechnology, including explicit attention to ethical and social responsibilities. The Strategy sets up the Canadian Biotechnology Secretariat (CBS), which assists an external advisory committee, the Canadian Biotechnology Advisory Committee (CBAC) and a federal ministerial committee of the main departments involved, which are Industry; Agriculture and Agri-Food; Health; Environment; Natural Resources; Fisheries and Oceans; and International Trade.

In Canada, total federal expenditures for biotechnology research and development nearly tripled between 1997-98 and 2003-04, going from $254 million to $717 million.[4] Canada's federal tax credit program for scientific research, the Scientific Research and Experimental Development (SR&ED) program, is considered one of the best such mechanisms in the world for supporting biotechnology research.

> ***In Canada, federal expenditures for biotechnology research and development nearly tripled between 1997 and 2004, going from $254 million to $717 million.***

Regulation

Regulation of biotechnology in Canada is a confusing patchwork of legislation originally created for controlling other products, substances, and processes. The main departments responsible include Health Canada, Environment Canada, the Department of Fisheries and Oceans (DFO), and the Canadian Food Inspection Agency (CFIA). For biofuels, relevant regulations might include

[2] Hunt, Suzanne C. And Janet L. Sawin and Peter Stair, "Cultivating Renewable Alternatives to Oil," Ch. 4 in *State of the World 2006* by Worldwatch Institute (New York: W.W. Norton & Company, Inc., 2006)

[3] In *Biotechnology in Canada,* above, Reference 1

[4] In *Biotechnology in Canada,* above, Reference 1 Statistics Canada, *Canadian Trends in Biotechnology, 2nd edition,* 2005

GOVERNMENT OVERSIGHT (contd.)

laboratory biosafety guidelines, CFIA environmental regulations dealing with field trials (for feedstock crops), or the *Canadian Environmental Protection Act* (CEPA) regulations for Living Modified Organisms (for yeasts).

Liability

There is no Canadian legislation that puts in place a liability regime. In Canada, biotechnology issues are subject to the traditional common law rules of civil liability. If the use of biotechnology causes damage to a person, their property or their economic interests, the producer or user of that biotechnology might or might not be held liable for that damage by a court. The common law, as it has developed in Canada, may not be flexible enough to meet the novel challenges raised by the potential for harm that biotechnology applications may cause. These technologies bring up general policy issues that are better resolved by legislators rather than judges. A strict liability regime, entrenched in legislation, would hold producers of biotechnology responsible for damage to human or environmental health.

WHAT INTERNATIONAL IMPLICATIONS ARE THERE?

The widespread introduction of biofuels worldwide would have positive implications for national security for many countries, and could contribute significantly to meeting the international targets in the Kyoto agreement for reducing greenhouse gas emissions.

ADDITIONAL SOURCES OF INFORMATION

Specific to Terminator Technology:

- **The Canadian Biotechnology Secretariat** www.biogateway.gc.ca
- **Worldwatch Institute's** *State of the World 2006,* Ch. 4 (see **References** - endnote 2)
- **The Canadian Institute for Environmental Law and Policy's** *A Citizen's Guide to Biotechnology* (March 2002) at www.cielap.org

Concerned about Biotechnology

- **Union of Concerned Scientists** www.ucsusa.org/
- **Greenpeace Canada** www.greenpeace.ca

Pro-Biotechnology

- **Biotechnology – Good to Grow** www.biotechgoodtogrow.com/
- **BIOTECanada** – www.biotech.ca/
- **Council for Biotechnology Information** http://whybiotech.com/

Government of Canada

- **The Government of Canada's BioPortal** www.bioportal.gc.ca/
- **The Government of Canada's BioStrategy** http://biostrategy.gc.ca/
- **Canadian Biotechnology Advisory Committee** www.cbac-cccb.ca/

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