An Examination of the Impacts of Production and Use of Liquid Biofuels for Transportation on Biodiversity

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Introduction

Ethanol-gasoline blending mandates and target implementation years in Canada and provinces.

Jurisdiction	% ethanol	By:
PEI	30	2020
Quebec	5	2012
Ontario	5	2007
Manitoba	8.5	n.d.y.
Saskatchewan	7.5	2006
Aberta	0	n.d.y.
B.C.	7.5	2010
Canada	5	2010

n.d.y. = no date set yet

As reported by McIntyre, 2008

Scope and objectives

Special consideration to transport fuels

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Co-development of biofuels and vehicles

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What are biofuels

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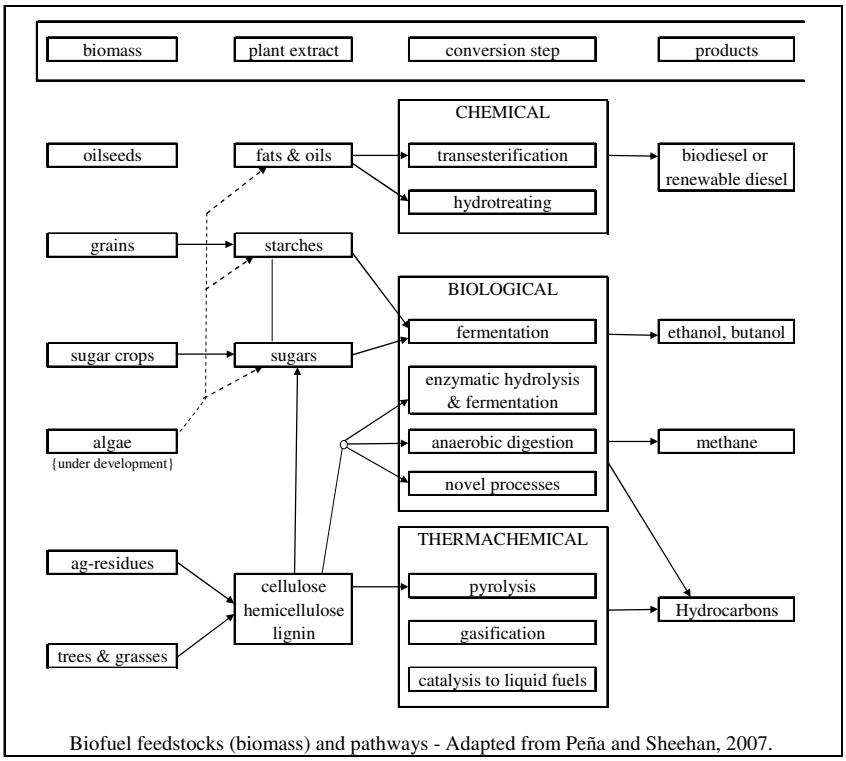

Biofuel feedstocks (biomass) and pathways - Adapted from Peña and Sheehan, 2007.

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Grain ethanol

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Key Steps in the Production of Corn Ethanol Biofuel (Auld, 2008):

1	Growing and Harvesting Corn
2	Dry Milling or Wet Milling
3	Fermentation
4	Distillation
5	Dehydration and Denaturing
6	Blending with Gasoline to Produce Biofuel

Source: Renewable Fuels Association, Ethanol Industry Outlook 2002: Growing Homeland Energy Security, Washington.

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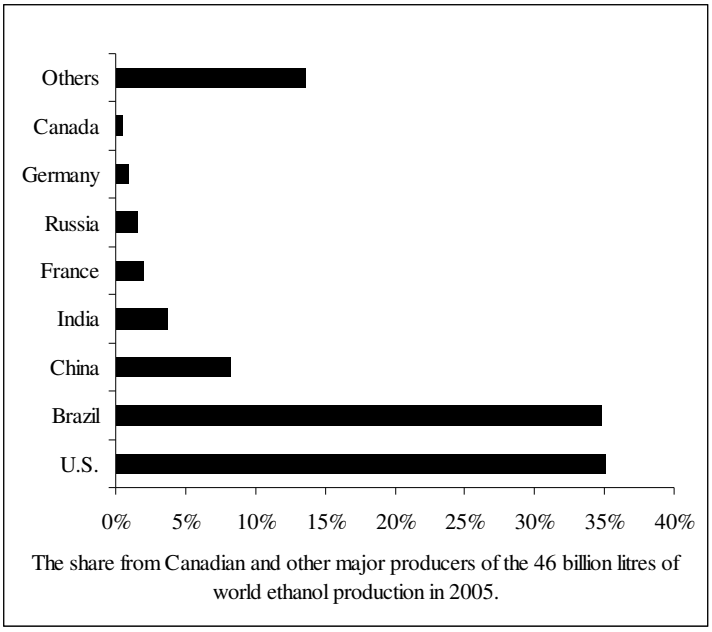

The share from Canadian and other major producers of the 46 billion litres of world ethanol production in 2005.

Relevant Events in the Historical Development of the Ethanol Industry		
1900-1920	-	ethanol being displaced by oil here - from above]
1914-1918	-	WWI - Germany used ethanol when oil was unavailable.
1970s	-	oil embargoes exposed the vulnerability of U.S. energy supplies.
	-	Brazil initiated a massive ethanol production program
1980s	-	ethanol established as octane enhancer as US-EPA phases out lead in gasoline.
1990	-	US Clean Air Act Amendments - blending ethanol with gasoline for higher oxygen and more complete ignition.
1989-1992	-	start of evaluating biofuel wrt GHG emissions, rather than/as well as the energy balance.
1999	-	elimination of Methyl tertiary butyl ether (MTBE) increased demand for ethanol.
2006	-	the Government of Canada announced (in Bill C-33) re fuel blend mandates

Cellulosic ethanol

Biodiesel

Algal biofuel

[redacted]

[redacted]

[redacted]

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Biogas

[redacted]

[redacted]

Growing concerns

[redacted]

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Carbon footprint and energy balance

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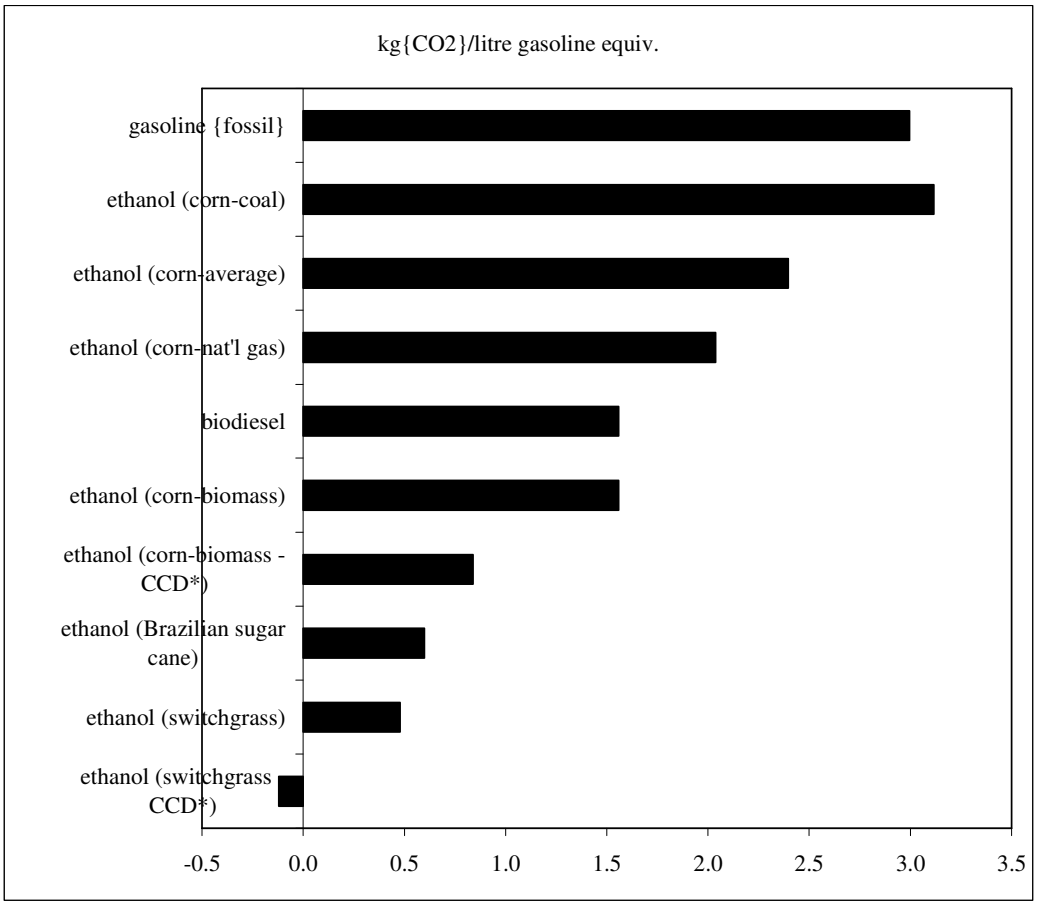

*, CCD = carbon capture and disposal. The CO2 removed from the atmosphere during photosynthesis that is not returned to the atmosphere.

Comparison of biofuels (Adapted from Peña, 2008; PEW Center on Global Climate Change)

Interactions with food supply

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Land use issues and feedstocks

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The biofuel-livestock interface

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[redacted] *et al.*

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Food balance equation

transport <= food supply => high protein diet (meat)
(a quantifiable dynamic flow)

transport = *f* {liquid biofuel fuel = *f* {land use}
meat = *f* {livestock farming & feed supply} = *f* {land use}

land use = *f* {grains (starch), forage (cellulose), oilseeds (protein)}

The role of trade policy

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Links to biodiversity

[redacted]

[redacted] *Populus spp.*, *Salix spp.*, [redacted]

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Harvest residues and soil health

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Secondary land shift effects

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Biofuel standards

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Environmental Impacts and Lifecycles

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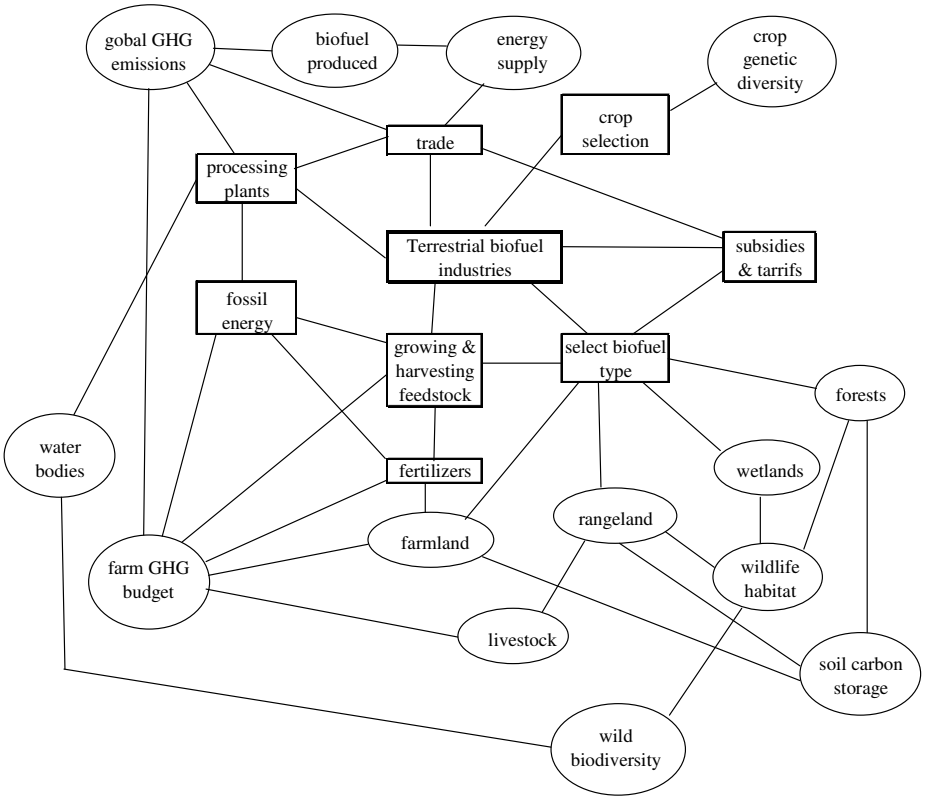

Environmental impact diagram showing the links among the activities and decisions related to a generic terrestrial biofuel development project (squares) and the components of the environmental setting (circles), including both the atmospheric greenhouse (GHG) emissions budget and biodiversity.

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3 [redacted] *et al.* [redacted]
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Recommendations

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The way forward – final comments

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References

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