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OPPORTUNITIES AND CHALLENGES FOR THE PRODUCTION OF ETHANOL FROM LIGNOCELLULOSIC BIOMASS IN WESTERN CANADA

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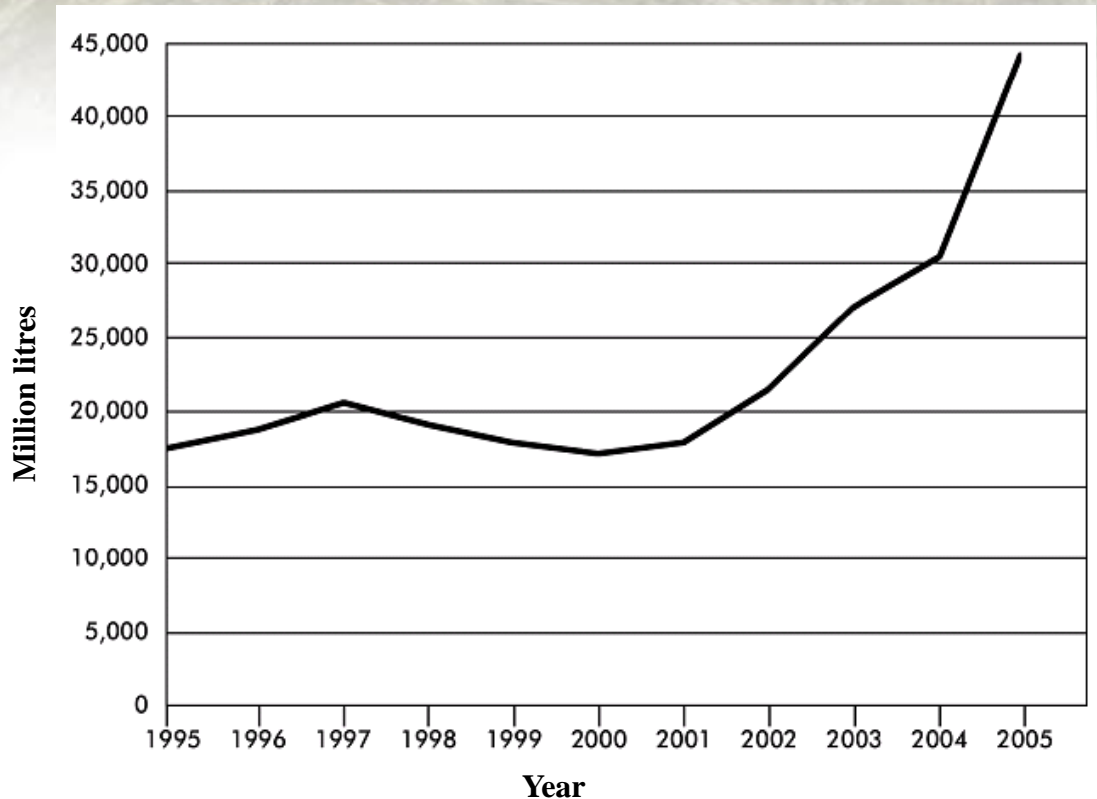
Canada 

Outline

- Introduction
- Importance of Cellulosic Ethanol
- Opportunities
- Challenges
- Conclusion
- Acknowledgement

World Ethanol Production

- 2008 world fuel ethanol production is 65.13 million of cubic meters*
- Avg. growth rate 10.9%**



1 gallons (US, liquid)= 0.003785 cubic meters
17206.89 gallons= 65.13 cubic meters

(Licht, 2008)*
(Dunnette, 2007)**

Why Cellulosic Ethanol

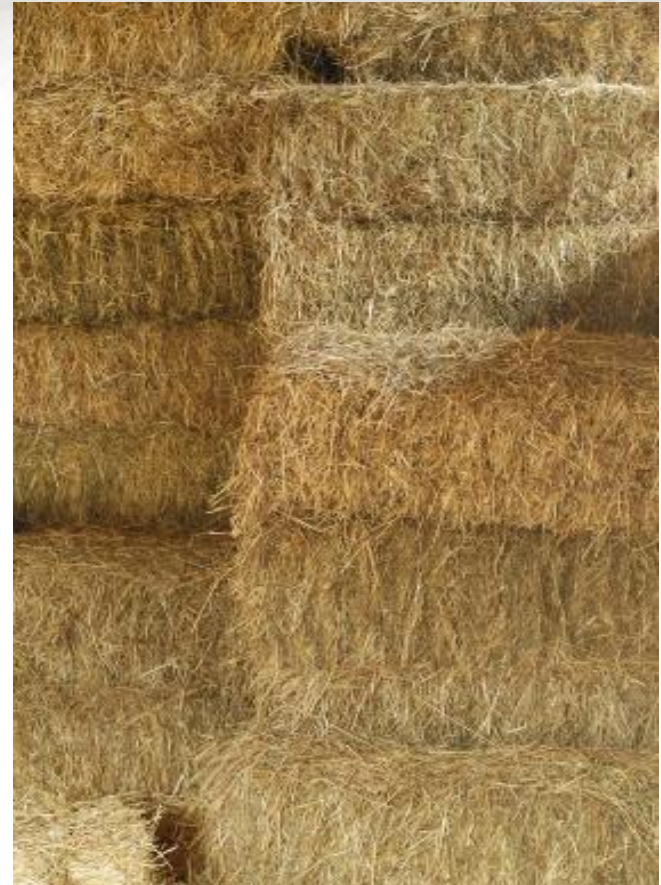
- Wide array of feedstocks
- No conflicts with land use
- Net GHG emissions (70-90%)
- Energy security
- Rural development
- New market opportunities

Lignocellulosic plants in Canada

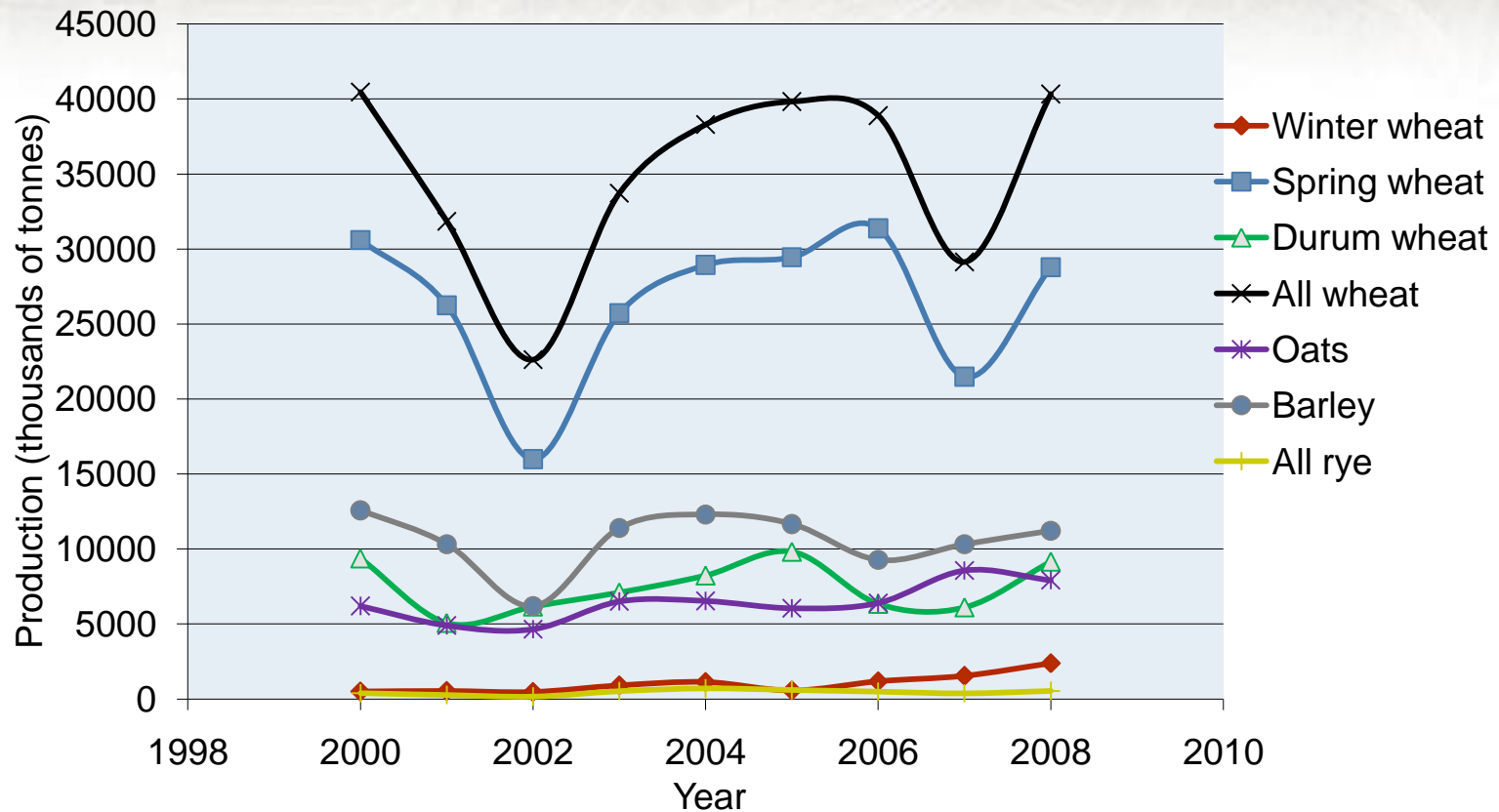
Company and Headquarters Location	Technology	Feedstock	Ethanol capacity (million cubic meters/yr)	Status
Paszner Technologies, Inc, Surray, BC	Acidified aqueous	wood		Commercial plant under construction
KL Energy corp, SD and Prarie green renewable energy, SK	N/A	wood waste	0.0189	March 2009 (planned)
Greenfield Ethanol-Enerkem Inc,Edmonton, AB	Thermochemical gasification /catalytic synthesis	MSW, waste/treated wood, forest residues,agr.waste	0.036	Operational End of 2009
Enerkem Inc.,Westbury, PQ	N/A	wood waste	0.005	2005
Ethxx International, ON	Gasification with catalytic conversion	wood		Pilot plant operating
Iogen, Ottawa, ON	Enzymatic	Oat hulls switchgrass, wheat straw. and corn stover	0.378	Experimental plant operating

Availability of Lignocellulosic Biomass

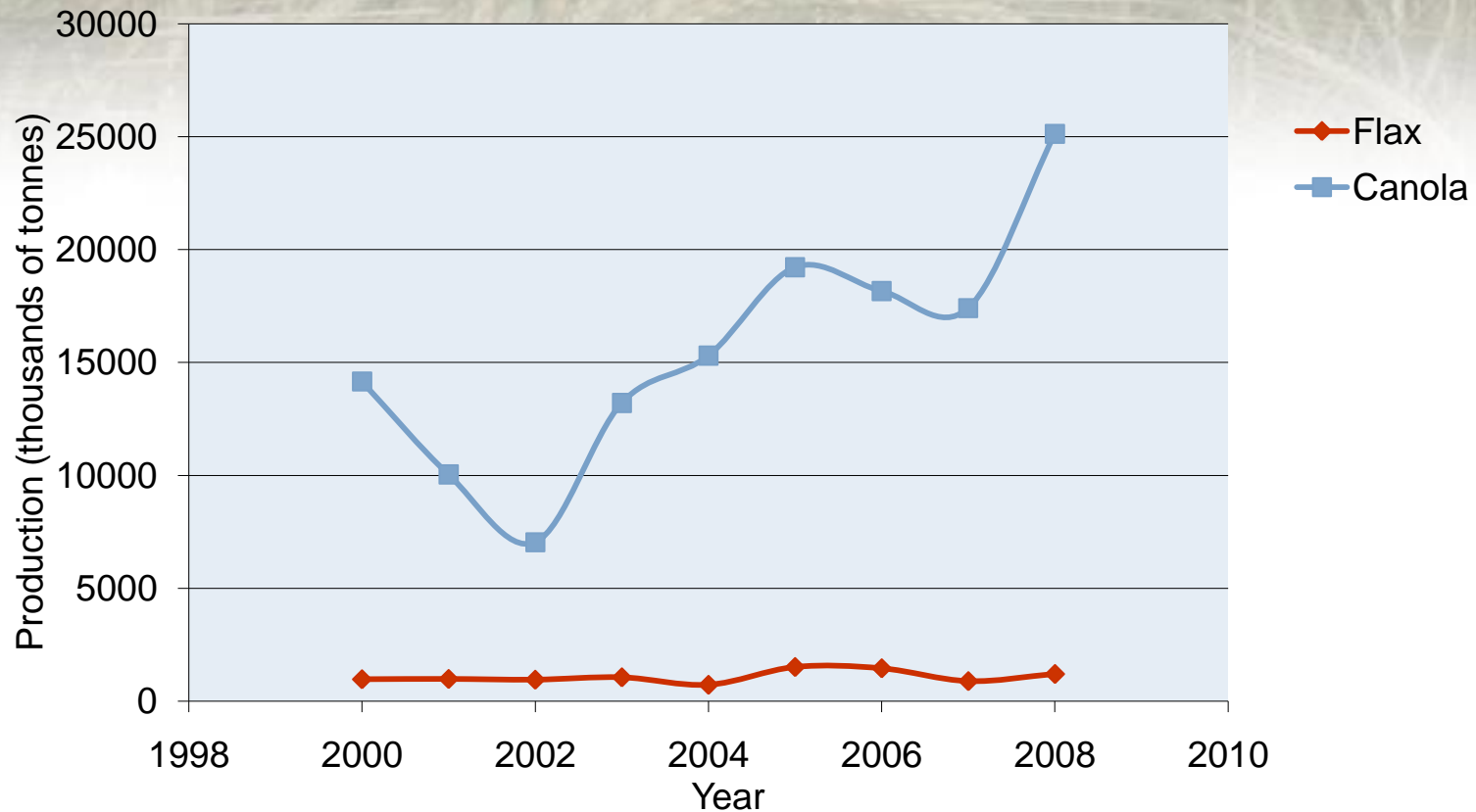
- ❑ Cereal straw
 - Wheat
 - Oats
 - Barley
 - Rye
- ❑ Other
 - Canola
 - Flax



Straw Biomass Production in Western Canada



Straw Biomass Production in Western Canada



Straw Production in Western Canada, 2008

Crop	Straw Production (thousands of tonnes)	Ethanol yield (L/Kg of dry biomass)
All wheat	40333.76	0.29*
Barley	7917.8	0.31*
Oats	11209.3	0.26*
All rye	541	
Flax	1205.54	
Canola	25120	

1 tonne of straw= 350 L of ethanol**

Grasses

Cool-season

Northern wheatgrass
Green needlegrass
Mammoth wildrye
Western wheatgrass



Warm-season

Big bluestem
Sideoats grama
Prairie sandreed
Little bluestem
Indiangrass
Switchgrass



Government Incentives

- Ethanol Expansion Program
- Excise gasoline tax exemption
- Eco-Energy for Biofuels
- EcoAgriculture Biofuels Capital Initiative
- NextGen Biofuels Fund™
- Canmet Energy

Energy Efficiency

Net energy balance for different sources

Source	Energy input vs output ratio
Corn	1.3
Wheat	1.16-1.20
Sugarcane	1.8
Cellulosic biomass	2-6
Biodiesel	2.5

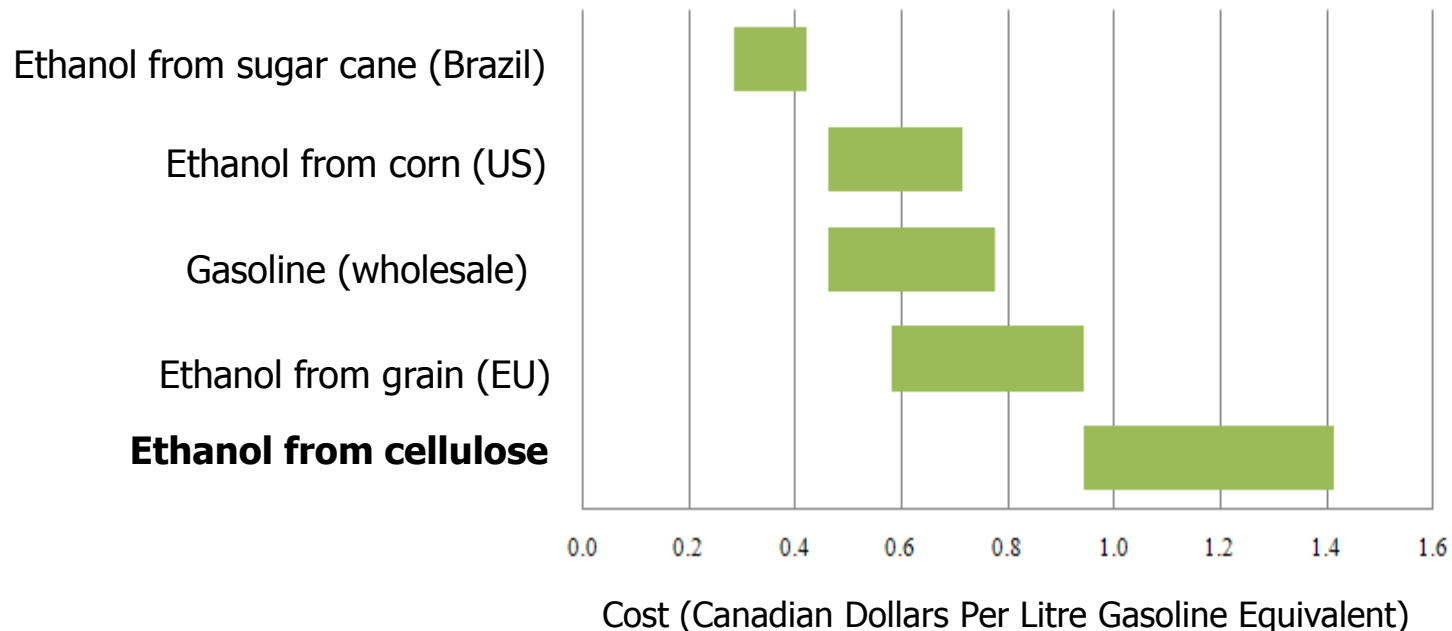
Challenges

- Cost of production
- Complex conversion mechanism
- Logistical issues

Cost of Production

Mainly raw material and capital cost

Cost ranges for ethanol and gasoline production, 2006



Capital and Operating Costs

Fuel	Total capital cost (\$ millions)	Capital cost per unit production (pcmpd)*	Operating cost (\$ per cubic meters)**
Grain ethanol	111	2067	322.3
Cellulosic ethanol	756	12083	465.0

*Per cubic meters per day (pcmpd) gasoline equivalent

** cubic meters gasoline equivalent

(Wright and Brown, 2007)

Conclusion

- Ethanol production will continue to grow
- Lignocellulosic ethanol has advantages over corn based ethanol
- Drawbacks of conventional ethanol is a stimulus
- Agricultural residues and native grasses are potential biomass in Western Canada
- Complex conversion mechanisms , cost of production, logistics are major barriers
- Technology advancement overcomes some of the barriers

Acknowledgement

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Thank you for
your attention

Questions?

