

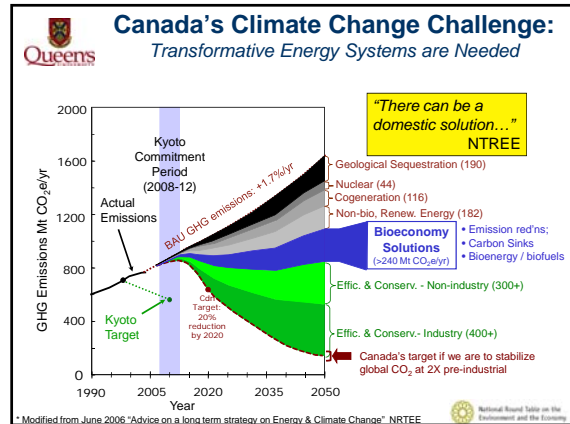
Queens **Towards a Sustainable Bioeconomy**
A Great Lakes / St. Lawrence Bioenergy Corridor

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Energy 2100 – Making the Lakes Great
MaRS Discovery Centre - April 24, 2008 - Toronto, Ontario

Special Thanks to:



Queens **The Scale Needed to Make a Difference in Canada**

Climate Change:
• Need: GHG reductions of 100+ million tonnes CO₂e/yr from biological systems.
(= displacing 50% of all diesel & gasoline with 0 GHG fuels)

GHG GAP [MtCO₂e/yr]
2012 (Kyoto): 300
2050 (from bau): 1300

Energy Security:
• Need: ~75 Mt dry biomass/yr to provide 10% Cdn energy demand.
(wheat harvest=25 Mt/yr)

Supplying Cdn Energy Demand
2008: over \$100/boe
2010: Peak in Cdn NG production
2008-2015: Global Peak oil?
2014: Ontario off-coal commitment

Transformative changes will be required, with huge potential benefits to the rural economy. ...How do gov't policies align?

Queens **Canada's Bioenergy / Biofuel Policies?**

Official Gov't of Canada 'Drivers' in 2008

What Canada's (& Ontario's) Biofuel Policy Drivers' Should be.

Rural Economy
• New markets

Climate Change
• Reducing GHG emissions

Energy Security
• Rapidly rising FF prices;
• Global supply-demand issues;
• Political disruptions in supply
• Ontario power supply

The wrong 'Drivers' lead to wrong Policies and Programs (e.g. grain-based biofuels) and squander opportunities.

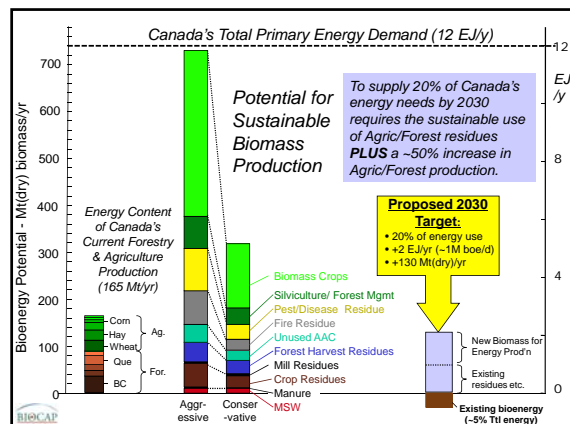
Queens **Biomass as an Energy Resource**

Energy Comparison

1 tonne dry biomass = ~3 barrels oil

About \$50 to \$100 Farm gate, forest road or wellhead price

About \$300+ oil



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*What is the best way to use biomass to address **climate change** priorities?*



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Optimal Use of Biomass to Address Climate Change


Feedstock	Process	Product	To replace...	Climate Benefit	Ontario Subsidy	Cost \$/CO ₂ e
Starch Grains	Fermentation	Ethanol	Gasoline (oil)	Small	\$0.17/L	~\$100-530
Oil Seeds	Trans-esterification	Biodiesel	Diesel (oil)	Medium	\$0.20/L	~\$100
Straw or Wood	Combustion, Pyrolysis, Gasification	Power, Cement, Indust. Heat	Coal	High	\$0 [Proposed: \$0.065/kg]	[-\$8-70]

Refs: Robinson et al 2003; Layzell et al. 2006; Kampman et al. 2006; Zhang et al 2007; Samson et al. 2008

- If climate change is the major driver, **solid biofuels** would be 'it'.
- On an energy basis, an incentive of \$4/GJ (half that for now given for ethanol) would provide 2-8 X the GHG benefit, and help the rural economy.

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Wood and Straw Pellets




Regular Wood Pellets Water Resistant Wood Pellets
Regular Straw Pellets

Could pellets made with this process be pipelined like a coal slurry?

WOOD PELLET ASSOCIATION OF CANADA

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*What is the best way to use biomass to address **climate change** priorities while providing the transportation fuels that will address **energy security** priorities?*




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Comparing Land use Efficiency for Biofuel Production

Biomass to Liquid (BTL) fuels:

- alcohols,
- diesel,
- dimethylether,
- methane,
- pyrolysis lqd (biooil)

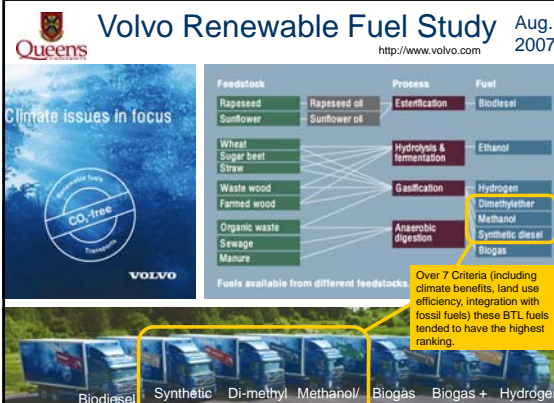
From: German Gov't Biomass / Bioenergy Service (www.bio-energie.de)

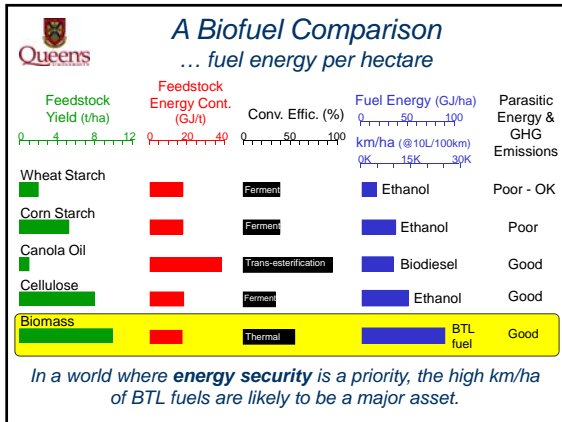


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Volvo Renewable Fuel Study Aug. 2007
<http://www.volvo.com>

Climate issues in focus





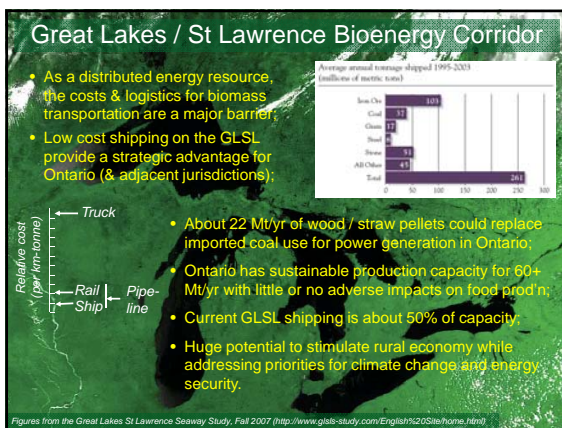
Queens So...

- ✓ Solid biofuels replacing coal give the best GHG ROI;
- ✓ Liquid biofuels made by thermo-chemical conversion of solid biomass provide superior performance and integrate well into existing fossil fuel infrastructure.

Then...

How can Ontario become a international leader in a sustainable, climate-friendly bioeconomy?

...Great Lakes / St Lawrence Bioenergy Corridor



Queens Phase 1. Creating the Sustainable Production Capacity and Supply Chain.

Strategy: Implement existing technologies to achieve immediate benefits for GHGs, rural economy & coal replacement while building the tools & technologies for Phase 2.

- A. Incentive:** Introduce a \$3-4/GJ incentive for solid biofuel pellet production & use in the province;
- B. Fuel Standard:** Set a solid biofuel cofiring standard for coal users;
- C. Research Investments:**
 - New biomass crop dev't;
 - Mobile pelletizer;
 - Pellet pipelining technologies;
 - Large scale biomass processing to liquid fuels & chemicals.
- D. Brand:** Ontario as the epicenter for large scale, sustainable biomass production and processing.

Fig from (<http://www.glsis-study.com/English%20Site/home.html>)

Queens Phase 2. Transition to more value-added uses for biomass resources.

Strategy: Become THE global site for innovation and implementation of transformative bioenergy systems for large scale sustainable production and conversion of biomass into fuels and commodity chemicals; allow new nuclear capacity to take over the role for biomass/coal in power generation.

- A. Engage:** major petrochemical refineries and chemical companies to develop and implement the BTL processes that will complement and extend dwindling and expensive fossil fuel resources.
- B. Biofeedstock Standard for refineries:**
 - Improvements in efficiency and environmental sustainability of both production and processing ;

Fig from (<http://www.glsis-study.com/English%20Site/home.html>)

Queens Conclusions

- Biofuel policies should address climate change / energy security priorities: the rural economy will benefit naturally.
- Solid biofuels replacing coal gives the best climate benefit and can be implemented now.
- BTL biofuels have the high 'km/ha' needed to address energy security & CC priorities, but commercial scale implementation needs research and investment.
- The Great Lakes / St Lawrence offers a unique opportunity for a bioenergy corridor that links sustainable production to large scale use:
 - **Phase 1:** Coal replacement with benefits to climate & rural economy;
 - **Phase 2:** Integration of BTL technologies into petrochemical refineries & chemical co's, with climate, energy security & economic benefits.

June 8-9, 2008 – Conference on Biomass & Energy for GL Economy, Kingston