Ontario
Anaerobic Digestion
and
Biomass Crops
Update

Compost Matters in Ontario
March 19, 2015

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Ministry of Agriculture, Food, and Rural Affairs
Why farm-based biogas in Ontario?

- New revenue on the farm
- Renewable energy production [heat, electricity, gas]
- Support food processing
- Increased nutrient utilization
- Societal benefits:
  - Pathogen reductions/ Clean Water
  - Reduced GHG emissions / Clean Air
  - Reduced Odour / Less Nuisance
- Supports farmers’ environmental goals and reducing product C-footprint through the value-chain
Ministry of Environment and Climate Change (MOECC) Climate Change Discussion Paper

Questions

1. How can Ontario better support scientific research to advance future technologies that can help fight climate change?

2. In what ways could sectors such as industry, transportation, electricity, agriculture, waste and forestry foster economic growth while reducing carbon emissions?

3. What could be done to shift more buildings and communities to low-carbon technologies?

4. What market mechanism(s) could be most effectively used to price carbon?

5. How can we best leverage the traditional knowledge of First Nations and Métis communities in developing and implementing the climate change strategy and action plan?

Public comments until March 29, 2015
Mixing food waste: what has changed?

- On October 25, 2013, the Government filed amendments to O. Reg. 267/03 to enhance the anaerobic digestion approval program under the Nutrient Management Act (NMA).

- The changes provide more operational capacity for on-farm anaerobic digesters regulated under the NMA and also apply new environmental requirements.
  - **Key Change:** Facilities can now treat up to 50% off-farm materials under the **Regulated Mixed Anaerobic Digestion Facility** program.

- The goal is a more streamlined NMA approval while ensuring similar level of environmental protection required through the REA or ECA process.
25% Versus 50% Off-farm Feedstock

- University of Guelph Biogas Calculator:  
  [http://bioeconproject.com](http://bioeconproject.com)

- Average Ontario Dairy Farm: 85 milking cows  
  - 25% off-farm material (1300 m$^3$/yr), mid strength vegetative waste, $10/tonne tipping fee  
    = 57 kW capacity, negative NPV

  - 50% off-farm material (same material)  
    = 100 kW, positive NPV
Agricultural biogas system growth

Ontario Biogas Systems, Power Generation and Anticipated as of Dec 2014

- Green Energy Act [FIT, REA]
- $11.2M Biogas Financial Assistance Program


Installed Electrical Capacity (kWe)

- 100kW
- 101-250kW
- 251-500kW
- >500kW
- System Numbers
Dairy farm, Embro – 250 kWe

Up to 90% operational capacity with 2000 MWh per yr
• Manure + food waste
• OMAFA-supported GHG emissions research by University of Guelph
Niagara-on-the-Lake – 335 kWe plus heat
Municipal, Chatsworth and Georgian Bluffs – 100 kWe

- Septage, food waste, holding tank pump-out
How Much Food Waste is Out There?

- Ivey (Western), Value Chain Mgmt, Provision Coalition Study 2013
  - 30-40% of food produced becomes waste, ~$27 billion
  - Barriers to recovering food waste as alternative revenue:
    - Insufficient volume
    - Lack of local destination: animal feed mfg, biogas
    - Focus on diversion rate, regardless of end-use
    - Inability to segregate at the source due to:
      - Poor infrastructure
      - Lack of employee engagement
    - Waste management part of facility lease
    - Thin margins, lack of capacity

Source: Gooch et al. (2010)
How Much Food Waste is out There?

Estimated Flow of Organic Waste

- IC&I Repurposing: <2,000,000
- Industrial Anaerobic Digestion: 100,000
- On Farm Anaerobic Digestion: 100,000
- Landfill: >2,100,000

Organic Waste

- Industrial Composting: 950,000
- Backyard Composting: 150,000

2CG

OWMA
RPWCO
Regional Public Works Commissioners of Ontario
Collaborative Feedstock Reception

- Collaboration of biogas system operators
- Offer consistent relationship for feedstock generators:
  - Higher quality service
  - Dependability of destination: redistribution if for instance one site has down time – up-time advantage
  - Consistent message on pricing, value, quality
  - Flexibility in approvals and equipment amongst many AD systems
Role of Government / Role of Industry

- Government policy (carrot or stick) needs to reflect societal goals
  - What are the goals? Reduced landfill? Viable food companies? Manure treatment? Lowest cost disposal?
  - Opportunity to achieve multiple societal benefits if done right.
- Desire for clear marketplace framework where companies can choose their best path forward.
  - Biogas/Compost/NASM/Landfill: different rules and costs
- Need appropriate level of regulatory oversight relative to technology risk.

Activities to advance the sector:

- Need for more information on waste characteristics, location, availability.
- Improved networking between food companies and downstream players (waste/compost/biogas)
- Evaluations suggested doing another event within a year
Land-Application of Biogas Digestate

- Composition will vary with inputs – nutrient testing is important
- Opportunity for liquid solid separation
- Lower odour and pathogens relative to manure
- Ideal for spring/ in-crop application
- Demos of dribble application in Ontario
OMAFRA Research: Maximize use of digestate nutrients and organic matter

**Right rate**
- Frequent analysis for nutrient content (including pH)
- Calibrate equipment to apply the rate that meets crop needs
- Uniform application

**Right field**
- Select crop that needs the nutrients
- Ensure soil conditions maximize infiltration / minimize runoff

**Right application timing**
- Apply in spring or into growing crops
- Don’t apply in fall without a cover crop

**Right placement**
- Rapid incorporation/injection to minimize ammonium-N volatilization
- Avoid concentrated deep placement to minimize leaching / movement to tile

**Right storage management**
- Promote crusting during warm season
- Permanent cover helps eliminate storage losses
Digestion Performance Project
University of Guelph – Alfred Campus

• Monitor seven on-farm digesters and evaluate digestate quality and digester performance
• Evaluate whether current digester design standards (i.e. minimum retention time, temperature, and volatile solids reduction) are appropriate for ensuring sufficient anaerobic digestion
• Determine whether operational and output-based methods can be alternatives to the current 20-day retention time requirement
• Compare Ontario digester operation standards with other jurisdictions
### Substrates and Digester Performance

#### Substrate & Digestate Analysis
- pH
- Alkalinity
- FOS/TAC
- VS, TS (VS/TS)
- VFAs (acetic, propionic, butyric)
- Pathogen Indicators (*E.coli*, *Salmonella*)

#### Digester Performance
- Biogas production and composition
- Feed composition and rate
- Operating Temperature
- Residual methane production

- Sample collection is bi-weekly
- Samples are collected for all feed inputs and digestate
- Two tank systems are sampled from effluent of each tank

![VFA Analysis at ORWC Laboratory](image-url)
Digestion Performance: Preliminary Data Results

• FOS/TAC and acetic acid concentrations are good indicators of digester health
• Reduction of solids ranges between 50 to 70% (wet basis) in digester system – which is typical for digester systems
• 1 to 2 log reduction in bacteria indicators (*E.coli* and *Salmonella*)
• *Salmonella* typically present in low concentrations
• Digester monitoring is on-going at all digester systems in study
### September 30, 2014 Feed-In Tariff Prices

<table>
<thead>
<tr>
<th>Renewable Fuel</th>
<th>Project Size Tranche*</th>
<th>Price (¢/kWh)</th>
<th>Escalation Percentage**</th>
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</thead>
<tbody>
<tr>
<td>Solar (PV) (Rooftop)</td>
<td>≤ 10 kW</td>
<td>38.4</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>&gt; 10 kW ≤ 100 kW</td>
<td>34.3</td>
<td>0%</td>
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<tr>
<td></td>
<td>&gt; 100 kW ≤ 500 kW</td>
<td>31.6</td>
<td>0%</td>
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<tr>
<td>Solar (PV) (Non-Rooftop)</td>
<td>≤ 10 kW</td>
<td>28.9</td>
<td>0%</td>
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<tr>
<td></td>
<td>&gt; 10 kW ≤ 500 kW</td>
<td>27.5</td>
<td>0%</td>
</tr>
<tr>
<td>On-Shore Wind</td>
<td>≤ 500 kW</td>
<td>12.8</td>
<td>20%</td>
</tr>
<tr>
<td>Waterpower</td>
<td>≤ 500 kW</td>
<td>24.6</td>
<td>20%</td>
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<tr>
<td>Renewable Biomass</td>
<td>≤ 500 kW</td>
<td>17.5</td>
<td>50%</td>
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<tr>
<td>On-Farm Biogas</td>
<td>≤ 100 kW</td>
<td>26.3</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>&gt; 100 kW ≤ 250 kW</td>
<td>20.4</td>
<td>50%</td>
</tr>
<tr>
<td>Biogas</td>
<td>≤ 500 kW</td>
<td>16.8</td>
<td>50%</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>≤ 500 kW</td>
<td>17.1</td>
<td>50%</td>
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**FIT PRICE ADDERS**

<table>
<thead>
<tr>
<th>Participation Level (Equity)</th>
<th>Aboriginal Participation Project</th>
<th>Community Participation Project</th>
<th>Municipal or Public Sector Entity Participation Project</th>
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<tbody>
<tr>
<td>Participation Level (Equity)</td>
<td>&gt; 50%</td>
<td>≥ 15% ≤ 50%</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td>Price Adder (¢/kWh)</td>
<td>1.5</td>
<td>0.75</td>
<td>1.0</td>
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<td></td>
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<td>1.0</td>
<td>0.5</td>
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Feed-in Tariff Status for Biogas

- FIT3 had applications for 35 on-farm AD systems.
  - Priority points difficult to secure for farm-based projects: 6 co-op projects secured FIT3 contracts
- Prices of 26.3 ¢/kWh and 20.4 ¢/kWh for 100 kW and 250 kW systems: energy crop use may be viable.
- Rural grid connections eliminate many projects
- Mid to large projects >500 kW are now part of “Large Project Procurement” – increased requirements for team experience including public and aboriginal consultation, infrastructure project experience, etc.

  – FIT4 expected spring 2015
Amber Energy Co-op – Elgin County

- Six FIT3 co-operative anaerobic digestion contracts, 6 X 250 kW
  - FIT3 maximum co-op level: >50 landowners in the county, 100% co-op ownership
- Co-op will own and operate the anaerobic digesters, contract with the host land-owner:
  - 3 dairy sites, 2 vegetable sites, 1 hog site
  - Manure/digestate exchange, annual rental fee
- Co-op coordinates centralized feedstock reception/distribution
- Central feedstock receiving hub:
  - Home to biodiesel production: glycerine feedstock produced
  - <10 km to each site: sharing equipment is possible
- Regulated Mixed AD Facility 50% food waste model is intended
- Some energy crops as feedstock
- Ground-breaking on 3 projects in August 2015
Renewable Natural Gas (RNG)

- RNG price = diesel price
- Return-to-base fleets converting to natural gas
- Can supplement with RNG to reduce GHG emissions
  - 10%-100%

<table>
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<tr>
<th>Fuel</th>
<th>Price</th>
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<tr>
<td>Gasoline and diesel</td>
<td>$1.20/litre</td>
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<tr>
<td>Compressed natural gas</td>
<td>$0.60/litre</td>
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<tr>
<td>Compressed RNG</td>
<td>~$1.20/litre</td>
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Renewable Natural Gas (RNG): GHG Benefits

![Graph showing Direct Greenhouse Gas Emissions (gCO2e/MJ) for Diesel and Alternative Fuels:
- Diesel: 94.7 gCO2e/MJ
- Liquefied Natural Gas (LNG): 72.83 gCO2e/MJ
- Compressed Natural Gas (CNG): 68 gCO2e/MJ
- Renewable Diesel: 39.33 gCO2e/MJ
- Dairy R-LNG: 28.53 gCO2e/MJ
- Landfill R-LNG: 26.31 gCO2e/MJ
- Waste Oil Biodiesel: 15.84 gCO2e/MJ
- Dairy R-CNG: 13.45 gCO2e/MJ
- Landfill R-CNG: 11.26 gCO2e/MJ

Derived from C.A. Resources Board LCFS, 2009.

Building the Biogas Sector With You

Biogas Association
| Stream A: Electricity Production for Municipalities  
Moderator: Jim MacDougall | Stream B: Closing the Loop for Municipalities and Food Processors  
Moderator: Ed Seaward | Stream C: Tapping the Potential in the Agricultural Sector  
Moderator: Jake DeBruyn |
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<tr>
<td>- <a href="http://www.biogasassociation.ca">www.biogasassociation.ca</a></td>
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</table>
Great Lakes Agricultural Stewardship Initiative

- Four-year initiative, announced February 2015
- Growing Forward 2 (GF2) funding of $16 million (2014-2018)
  - Federal and provincial funds
- Delivered by Ontario Soil and Crop Improvement Association
- Healthy soils = healthy waters approach
- Lake Erie and southeast shores of Lake Huron regions.
GLASI Components

A. Farmland Health Check-ups (*full launch April 2015*)
   • Assessing soil health, identifying priority actions
   • Ontario Certified Crop Advisors working with producers

B. Equipment Modifications (*now accepting applications*)
   • Manure and Biosolids Management Program

C. Best Management Practices in Priority Areas (*starting in 2015-16*)
   • Cost-share funding, targeted to highest risk areas

D. Education, Outreach, Applied Research, Demonstrations and Pilot Projects (*starting in 2015-16*)
   • Supporting projects for knowledge transfer, advancing GLASI goals
GLASI Funding for Land Application

- Cost-share funding is available for eligible businesses custom applying manure and/or biosolids on agricultural land in GLASI areas
- GLASI’s Manure and Biosolids Management Program provides:
  - Cost-share funding of 75%
  - Up to a cap of $25,000 per project
  - APPLY NOW for projects completed after April 1, 2014. All purchases must be made by March 31, 2015 to be eligible for this program.
- GLASI will support (2015) Best Management Practices targeted at:
  - Reducing the risk of phosphorous leaving farm fields
  - Innovative spreading practices such as slurry seeding or in-crop applications during the growing season
  - Increased precision of applications
  - Decreased impacts of spills
  - Reducing soil compaction
  - Decreasing risk of disease transfer
Agricultural Biomass
Switchgrass and Miscanthus

• Soil health: perennial crops for erosion prevention

• Wheat straw: normally 4-5 ¢/lb
  ➢ Currently 10-12 ¢/lb
  ➢ Low winter wheat acres (low grain price, late fall soybean harvest) and cold winter mean on-going price pressure.

• Result: interest in dedicated biomass crops
  ➢ Predictable availability
  ➢ Interesting performance characteristics
Switchgrass and miscanthus

- Switchgrass: planted from seed (perennial), cut in the fall, left in the field to leach nutrients, baled in spring: low nutrient high C straw.

- Miscanthus: rhizome establishment, winter stand, spring baled, low nutrient high C straw. Higher yield than switchgrass.
Ontario Biomass Producer’s Co-op (OBPC)

• Sustainable production and marketing of biomass.
• Principles:
  – Economical return to the farmer (7 ¢/lb, $300/ac)
  – Buyer deals with the co-op, co-op looks after supply.
• Membership open to all Ontario farm operations, from small to large scale
• Associate members who are engaged in the biomass industry
OBPC Ag Biomass Day March 27, 2015

- [www.ontariobiomass.org](http://www.ontariobiomass.org)
- One day workshop in Guelph
- Morning: biomass production, agronomy, experiences
- Afternoon: biomass markets (livestock, Combined Heat and Power, bioproducts, etc)

- No one is talking about compost… yet?
Questions?