• Project Overview
• Current Tasks
  – Waste Feedstock Review
  – Review of Technologies
• Next Steps
• Questions
Challenges:
– Continue to improve the sustainability of waste management
– Continue to fulfill service-level and budgetary constraint expectations of taxpayers

Backdrop:
– Growing recognition of the material and energy resources contained in residual wastes

Project Purpose:
– To review the viability and potential of alternative waste management technologies to further broaden and enhance Niagara’s integrated waste management system
– Focus on residual municipal solid waste as the primary “feedstock”
– Consider biosolids as a potentially beneficial supplementary feedstock

Key Project Steps:
✓ Feedstock Review - profile available feedstocks - focus on municipal solid waste and biosolids
✓ Review of Technologies - available, existing, proven and emerging
  – Screening of Technologies - identify pass/fail criteria to develop short list of technologies for detailed evaluation
  – Evaluation of Technologies - compare and weigh technology options to identify preferred system for possible implementation
  – Reporting - document work of the assessment, recommend course of action and outline next-steps for consideration

Embedded in these steps are numerous interim reports, workshops and points of consultation and interaction with engaged Committee members
Waste Feedstock Review:
- Understand Regional systems for management of municipal solid waste and biosolids
- Review Regional data on quantity and composition of municipal solid waste and biosolids
- Projections of future municipal solid waste and biosolids
- Solid waste and biosolids quantity and characteristics estimates are adequate for assessment of alternative technologies
- Uncertainties and opportunities:
  - Assumptions address uncertainties (growth rate, IC&I and other private sector materials, regulatory changes) are adequate for the purposes of this assessment
  - Private sector wastes may represent potential additional feedstock opportunity to supplement Regional sources, if advantageous (i.e. economies of scale and revenues)

### Summary - Review of Alternative Waste Management Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Feedstock</th>
<th>Status</th>
<th>Beneficial Outputs</th>
<th>Key Environmental Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaerobic digestion*</td>
<td>Organic solid wastes, biosolids</td>
<td>Proven</td>
<td>Bio-gas fuel for electricity and/or heat energy</td>
<td>Odour</td>
</tr>
<tr>
<td>Composting*</td>
<td>Organic solid wastes, biosolids</td>
<td>Proven</td>
<td>Compost (soil amendment)</td>
<td>Odour, solid residues</td>
</tr>
<tr>
<td>Direct combustion*</td>
<td>Mixed solid wastes, biosolids</td>
<td>Proven</td>
<td>Electricity and/or heat energy, recovered metals</td>
<td>Air emissions, solid residues</td>
</tr>
<tr>
<td>Gasification (conventional)</td>
<td>Select pre-processed waste</td>
<td>New and emerging</td>
<td>Syngas fuel for electricity, heat energy, recovered metals</td>
<td>Air emissions for syngas end-use, solid residues</td>
</tr>
</tbody>
</table>

*Intersect with biosolids management technologies
### Summary - Review of Alternative Waste Management Technologies

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<tr>
<td>Hydrolysis*</td>
<td>Select organic solid wastes, biosolids</td>
<td>New and emerging</td>
<td>Fuel-grade ethanol</td>
<td>Odour (potential), residues</td>
</tr>
<tr>
<td>Mechanical-biological treatment</td>
<td>Mixed solid wastes</td>
<td>Proven</td>
<td>Recovered recyclables, RDF or compost or biogas fuel</td>
<td>Odour, solid residues</td>
</tr>
<tr>
<td>Organics recycling landfill bio-cell*</td>
<td>High organic content solid wastes, biosolids</td>
<td>Proven*</td>
<td>Landfill gas fuel for electricity, heat energy, compost*</td>
<td>Odour and leachate management</td>
</tr>
<tr>
<td>Plasma arc gasification</td>
<td>Select pre-processed waste</td>
<td>New and emerging</td>
<td>Syngas fuel for electricity and/or heat energy, recovered metals</td>
<td>Air emissions for syngas end-use, solid residues</td>
</tr>
</tbody>
</table>

*Intersect with biosolids management technologies

*Some technology components are pilot/demonstration
### Overview of Markets:

<table>
<thead>
<tr>
<th>Product</th>
<th>Primary Market</th>
<th>Market Status</th>
<th>Potential Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compost</td>
<td>Consumers of soil amendment (agricultural operations, greenhouses, etc.)</td>
<td>Well established market in Ontario.</td>
<td>Market related to compost quality and availability of comparable alternatives</td>
</tr>
<tr>
<td>Biogas and Syngas</td>
<td>Generation of electricity, heating applications or potentially for sale as renewable natural gas.</td>
<td>Not established, project-specific</td>
<td>Marketability dependent on biogas quality and cost/availability of natural gas</td>
</tr>
<tr>
<td>Electricity</td>
<td>Electrical grid</td>
<td>Large and well established</td>
<td>Location must allow access to electrical grid. Substantial administrative requirements for participation in power market.</td>
</tr>
<tr>
<td>Thermal Energy</td>
<td>Large commercial and institutional facilities, potentially some residential developments, district heating systems</td>
<td>Not established, project-specific based on geographic opportunity</td>
<td>Access to heat consumer(s) with suitable demand profile and price of comparable heating alternatives</td>
</tr>
</tbody>
</table>

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<tr>
<td>Ethanol</td>
<td>Ethanol is used in a variety of engines</td>
<td>Potentially large once established</td>
<td>Market dependent on facility location and fuel quality</td>
</tr>
<tr>
<td>Slag</td>
<td>Aggregate-like material for use in construction and/or manufacturing</td>
<td>Undefined – emerging market</td>
<td>Demonstration of suitability for application(s), potential regulatory hurdles and cost of alternatives</td>
</tr>
<tr>
<td>Pyrolysis oil and liquid bio-fuels</td>
<td>Liquid fuels typically used as a diesel substitute</td>
<td>Potentially large, however currently project-specific</td>
<td>Compliance with fuel quality standards and cost of alternatives</td>
</tr>
<tr>
<td>RDF</td>
<td>Solid fuel consumers</td>
<td>Not established, project-specific</td>
<td>Market dependent on RDF quality, cost of alternatives and approvals required to allow combustion of RDF in consumer’s equipment</td>
</tr>
</tbody>
</table>
Inventory of existing processing facilities:

- Examined alternative technology facilities located in Ontario, New York, Pennsylvania, Ohio and Michigan
  - **Ontario**: 2 anaerobic digestion, 2 direct combustion, 1 plasma arc gasification (demonstration), 1 RDF plant
  - **New York**: 10 direct combustion, 1 gasification, 1 composting
  - **Michigan**: 1 direct combustion, 1 RDF plant
  - **Ohio**: 0
  - **Pennsylvania**: 6 direct combustion, 1 plasma arc gasification (test plant)

- Distance range: 40 to 760 km
- One way travel time: 50 mins to 7.5 hours
- 5 facilities within 3 hours; 3 facilities: 3 to 5 hours; 16 facilities: more than 5 hours

Transportation Analysis:

- Transportation can profoundly impact financial and environmental impacts of waste management
- Break-point analysis illustrates the cost efficiency rationale for transfer to long-haul vehicles for one way distance greater than 65 km
- Transportation options and implications will be evaluated in more detail in future project steps
Next Steps

- Screening of Alternative Technology Options
  - Conduct workshops to develop pass/fail screening criteria
  - Apply screening criteria to define short list of technologies for detailed evaluation
- Evaluation of Technologies
  - Conduct workshops to develop evaluation criteria with weighting
  - Complete comparative evaluation of options including life cycle impact analysis
  - Review alternative funding models i.e. partnerships and shared infrastructure for potential option implementation
- Reporting
  - Prepare and present final report with recommended course of action
  - Prepare executive summary of the project

QUESTIONS?