Enerkem biorefineries: setting a new global standard in sustainability for biofuels, chemicals and waste management
Enerkem at a glance

• Producer of biofuels and renewable chemicals from garbage
• Proprietary clean technology developed in-house
• Sustainable alternative to landfilling and incineration
• Private company founded in 2000; 200 employees
• First full-scale commercial biorefinery beginning operations in Edmonton
  • 2 facilities in Québec (pilot and demonstration)
• Developing similar facilities in North America and abroad
  • Several MOUs in China and EU
The Enerkem solution

**Feedstock**
- Municipal Solid Waste

**Process**
- Syngas
- Proprietary Thermochemical Technology
- 15 year history – Operating facilities since 2001

**Products**
- Ethanol / Methanol
- Renewable Chemicals
- Power Generation

**Markets**
- Transportation Fuels
- Solvents, Polymers, Coatings, Plastics, Adhesives

Approximately 1.3B MT\(^{(1)}\) of trash generated per year globally

Product cost competitive with those derived from fossil-based feedstocks

End Products Flexibility
The Enerkem solution: Feedstock Flexible

- Municipal solid waste
- Energy crops
- Forest residues
- Agricultural residues
Key market drivers for Waste as Feedstock

Increased scarcity of urban landfill airspace and societal desire for waste diversion: 70% of global waste is landfilled or burned\(^1\)

Circular economy or “cradle-to-cradle” approach: economy whereby waste products can be beneficially re-used as feedstock for the production of new products which are usually produced from fossil based sources

Low cost unconventional feedstocks: petrochemical industry is considering lower cost carbon relative to regional fossil alternatives

Renewable fuels mandates around the world: driven by increasing need to reduce dependence on oil

Consumer pull for renewable and biobased products: increased consumer awareness of health and environmental concerns

Focus on carbon footprint and greenhouse gas emissions reduction: low carbon fuels, waste diversion solutions to avoid methane emissions

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\(^1\) Source: World Bank, 2012
Solving the waste problem – United States

New Landfills Permitted in the U.S.

Average Remaining Life of U.S. Landfills

MSW Landfill Tipping Fees

Population density

- 0.3 – 0.5 million
- 1.0 – 1.5 million

Identified areas in the U.S.

- 125 - 150 areas
- 30 - 50 areas

Enerkem’s technology can help municipalities divert up to 60-90% of waste that would have to be landfilled.

Note: Average remaining life of landfill by State calculated as: remaining MSW landfill capacity (2010) divided by average MSW landfilled per year from 2000 to 2010.

We’re building the bioeconomy. | © Enerkem, 2015
Alternative to landfilling and traditional WTE

Helping increase waste diversion to 90% or more
An efficient “carbon-recycling” process

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* Municipal solid waste
## Comparison with incineration

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<td>Sale of waste disposal service and electricity</td>
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Case Study: Sustainable Landfill Diversion

Recycled  ➤  20%
Composted ➤  40%
Biofuels  ➤  30%
Landfill  ➤  10%

Waste diversion = 90%
ENERKEM ALBERTA BIOFUELS

Capacity: 38 million litres per year (i.e. 1 X standard Enerkem system)
Feedstock: 25-year agreement with City of Edmonton for 100,000 dry tonnes of MSW per year
Products: Biomethanol, cellulosic ethanol

World’s first commercial MSW-to-biofuels and chemicals facility
Feedstock preparation
VANERCO
First advanced biofuels facility in Canada to be co-located with a conventional biofuels production facility

Capacity: 38 million litres
Feedstock: Urban waste (industrial, commercial, institutional, construction, etc.)
Status: Pre-construction work started
Best available solid feedstock bolt-on to existing oil and gas infrastructure

- Single feedstock
  - Oil and Gas

- Multi-feedstock
  - MSW
  - Biomass
  - Coal/petcoke
  - Tire Derived Fuel (TDF)
  - Refinery chemical residues

- Unconventional feedstocks

- Traditional refinery

- Bolt on O&G infrastructure

- Final refined fuels and chemicals

- Enerkem refinery

- Syngas
- Electricity
- Heat
- Methanol
- Ethanol
- Renewable chemicals