Conversion Technologies and Best Practices Throughout the World
Enerkem at a glance

• MSW-based biofuels and renewable chemicals producer
• World’s first full-scale commercial MSW biorefinery beginning operations in Edmonton, Alberta
• $400M invested to date to move from R&D to commercial stage
• 200 employees
• New alternative to landfilling and incineration
Large market potential

MSW IN NORTH AMERICA

84 MILLION METRIC TONS OF MSW
SUITABLE FOR ENERKEM’S TECHNOLOGY PLATFORM

63% TO LANDFILL

282 MILLION METRIC TONS OF MSW GENERATED PER YEAR

THE POTENTIAL:
35 BILLION LITRES USING ENERKEM
(9 B GALLONS)

1 Tonnage based on a weighted average

Sustainable waste management solution

Complementary to recycling and composting

100,000 DRY METRIC TONS NON-RECYCLABLE WASTE PER YEAR

OR

38 M LITRES or 10 MMGYPY

BIOFUELS

OR

RENEWABLE CHEMICALS

TRANSPORTATION FUELS

EVERYDAY PRODUCTS
Alternative to landfilling and traditional waste to energy

Helping increase waste diversion to 90%

Source Reduction and Reuse
Recycling / Composting

Biorefinery (liquid fuels, chemicals)

Waste-to-Energy (heat, electricity)

Landfill
World’s first commercial MSW-to-biofuels and chemicals facility

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
Bringing the model to reality

Rigorous path to commercialization

UNIVERSITY OF SHERBROOKE PILOT
SHERBROOKE

Laboratory  Pilot  Syngas Demo  Methanol Demo  Ethanol Demo  Full-scale commercial production

WESTBURY FACILITY

MODULAR COMMERCIAL BIOREFINERIES
Unique partnership with the City of Edmonton

• Leader in waste management practices
• Edmonton Waste Management Centre
  • North America’s largest collection of modern, sustainable waste processing and research facilities
  • 233-hectare site
• Enerkem selected as part of a thorough selection process involving over 100 technology providers
City of Edmonton’s Integrated Waste Management Centre

- Integrated Processing and Transfer Facility
- Recycling center
- Composting center
- ENERKEM biorefinery

Recycling center: 20%
Composting center: 40%
Biofuels: 30%
Landfill: 10%
Waste diversion = 90%
Benefits of the Enerkem Alberta Biofuels facility

Environmental/Social

• Solves a waste problem and avoids methane emissions
• Reduces GHG emissions by 60% when compared to gasoline
• Can become a model for municipalities around the world
## Trends towards Low Carbon Transportation Fuels

<table>
<thead>
<tr>
<th>Gasoline, Gasoline Blendstock or Replacement</th>
<th>Definition</th>
<th>Carbon Intensity (including land use effect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBOB</td>
<td>CARBOB</td>
<td>99.78</td>
</tr>
<tr>
<td>Corn ethanol*</td>
<td>Derived from corn</td>
<td>75.97</td>
</tr>
<tr>
<td>Cellulosic Ethanol*</td>
<td>Derived from corn stover</td>
<td>41.05</td>
</tr>
<tr>
<td>Sugarcane Ethanol*</td>
<td>Derived from Brazilian sugarcane</td>
<td>56.66</td>
</tr>
<tr>
<td>Electricity</td>
<td>CA grid electricity</td>
<td>105.16</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>Compressed H2 from central reforming of NG</td>
<td>151.01</td>
</tr>
</tbody>
</table>

*California Air Resources Board temporary CIs for fuels with indeterminate CIs

Source: California ARB, July 31, 2015 (Proposed re-adoption of the LCFS: Third 15-Day Modified Regulation Order, Table 6. Tier 2 Lookup Table for Gasoline and Diesel and Fuels that Substitute for Gasoline and Diesel and Table 7. Temporary FPCs for Fuels with Indeterminate CIs)
Next facility: VANERCO

First advanced biofuels facility in Canada to be co-located with a conventional biofuels production facility

Capacity: 38 million litres
(1 standard Enerkem system → possibility to add more systems)

Feedstock: Non-recyclable/non-compostable urban waste
(industrial, commercial, institutional, construction, etc.)
Next projects

- Biomethanol facilities in Europe
- Projects under development in Canada and the U.S.
- MOUs in China and other regions of the world
Renewable chemicals from waste help transition to a circular economy
## Renewable chemicals for everyday products

### Chemical building blocks in our syngas

- **CO**
- **H₂**

### Renewable Methanol

### Alcohols
- Transportation fuels
- Solvents for pesticides and coatings
- Pharmaceuticals
- Polymers
- Cosmetic products
- Plastics
- Textiles

### Acrylates
- Architectural and industrial coatings
- Plastics
- Adhesives

---

We're building the bioeconomy. © Enerkem, 2016
Using waste as a feedstock for the chemical industry - "carbon recycling from waste residuals"

Public-private partnership with AkzoNobel in Europe
Thank you

For more information:

Timothy J. Cesarek
Senior Vice President, Business Development
tcesarek@enerkem.com
www.enerkem.com