FEEDSTOCK CO-PRODUCT DEVELOPMENT OPPORTUNITY

Charles Tremblay, Eng
VP, Project Delivery

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Enerkem

ETHANOL SYNTHESIS
METHANOL SYNTHESIS
SCRUBBING TOWERS
GASIFIER
COMPRESSOR
ENERRKEM’S TECHNOLOGY VALIDATION
Gasification can complement mechanical recycling because it produces (near) virgin-grade polymers from after-use plastics

Organization ready for continued commercial scale-up for cellulosic Biofuel & Renewable Chemicals

- Feedstock Flexibility: demonstrated ability to produce stable clean syngas from wide range of feedstocks:
  - Mixed solid waste (MSW), contaminated biomass, and 100% plastics
  - IMPCA grade Methanol and Ethanol
    - Obtained ISCC certification in 2015 for low CI methanol into chemicals
    - Ethanol sold into British Columbia LCFS market
  - Foundation of future plant design

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Chemicals: Olefin’s production pathways

Enerkem’s circular syngas can replace 2 out of 4 routes:
- Naphtha can be produced using the Fischer Tropsch route (F-T)
- Methanol can be produced and used in current MTO infrastructure

Feedstock

- Natural Gas
- Crude Oil
- Coal
- Gas Oil

Intermediates

- Methane, Ethane, Propane, Butane
- Naphtha

Processes

- Dehydrogenation
- FCC
- Steam Cracker
- MTO/MTP

Olefins

- Ethylene
- Propylene
- C4 Olefins

Proven technology through Edmonton plant

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Opportunity

- Low plastics recycling rate globally (12%)
- Surge of interest from polymer and specialty chemical industry
- No clear alternatives for surplus of waste plastics

Waste To Syngas & Conversion Technologies

- Uniquely positioned to offer a solution with syngas to MeOH, ETOH or Fisher Tropsch platform
- F-T, MTO, and MTP are well established processes in practice for several decades
BIOFUEL MARKET IS GROWING MARKET
INCENTIVE FOR CARBON RECYCLING ARE NEXT

While plastics packaging contribute to sustainability by keeping products fresh and reducing wastage, plastic is difficult to recover and recycle. Breaking down waste and plastics into their molecular building blocks with a system like Enerkem allows the perspective of achieving zero waste.

**WASTE ARE RICH IN CARBON**

Typical Composition of MSW
- 50-60% biogenic (Organics, paper packaging, cardboard, Organic textile)
- 40-50% Fossil base carbon (plastic, textile, etc.)

**DRIVERS OF WASTE CARBON RECYCLING**
- Fuel Blend (E10-E15) (RFS)
- Low Carbon Fuel Standard (LCFS)
- Landfill Ban or Tax (Tipping fees)
- Demand for Carbon Recycling Content in chemicals or and other fuels (maritime, SAF)

**PRODUCT INCENTIVES**
- Biofuel (incentives 250-500 $Mt of CO2) push the focus for biogenic
- Plastics and other Fossil base waste generate more yield in the conversion process to address demand renewable chemicals’ market
Companies are under immense pressures to reduce their carbon footprint:
- Major players are allocating significant resources and capital toward these goals
- This carbon reduction goal is a defining industry shift – not just a short-term trend
- Increasing costs for non-compliance are going to further incentivize players to invest in carbon reduction efforts

Companies need scalable solutions given the massive endeavor.

Regulation is different from jurisdiction to jurisdiction, however trend in increasing targets is consistent.

<table>
<thead>
<tr>
<th>Market</th>
<th>Market Size (in gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation fuel Market¹</td>
<td>186.6B</td>
</tr>
<tr>
<td>Sustainable Aviation Fuel³</td>
<td>81.0B</td>
</tr>
<tr>
<td>Low Transportation Fuel Alternative Market⁴</td>
<td>6.4B</td>
</tr>
<tr>
<td>Renewable Chemical Market⁵ (Ethylene)</td>
<td>183.0M(Mt)²</td>
</tr>
</tbody>
</table>

¹Source: US, Canada Europe and UK motor gasoline consumption; FuelsEurope, Statistical Report 2018; Government of the United Kingdom; United States Environmental Protection Agency; Statistics Canada.
²Unless otherwise specified. Renewable Chemicals Market (Ethylene) expressed in metric tons
⁴Source: US, Canada Europe and UK motor gasoline consumption; FuelsEurope, Statistical Report 2018; Government of the United Kingdom; United States Environmental Protection Agency; Statistics Canada.
Evolution of the Feedstock Pool via New Technologies

Oils & fats (biodiesel and renewable diesel) are limited in terms of volumes.

Enerkem’s flexible technology platform is particularly well suited for plastics, lignocellulose residues, and MSW.

Enerkem Technology converts waste into clean fuels and renewable chemicals.

Source: Illustration based on IEA, UNDP, Correa et al 2019 and others.

**KEY DRIVERS**

**IMPACT ON PRODUCT**

**UNIT**

**CALORIC VALUE (HHV)**

The amount of heat released by combusting the material. This is directly correlated with syngas & product yield (CHONS)

GJ / mT

**INERTS**

The quantity of ashes remaining after combustion. A higher inert content will reduce yield

% on a dry basis

**MOISTURE**

The quantity of water in feedstock. If moisture is not removed by drying & heat recovery, yield will be lowered

% on a wet basis

**DENSITY**

Feedstock density is the weight by m³. A low-density feedstock will increase processing costs and reduce ability to convert CO2 into product

Kg / m³

**BIOGENICITY**

The biogenicity content is the % of Carbon in feedstock that is coming from an organic source drive most of the premium price for Low Carbon Fuel

% in end product

**CHLORINE, SULFUR AND HEAVY METALS WILL IMPACT OUR COST RELATED MANAGEMENT AND WATER TREATMENT**

Waste is an abundant and scalable source of ‘next progression’ carbon-rich feedstock.
ENERKEM MONTREAL – $875MCAD PLANT FULLY-FUNDED AND IN CONSTRUCTION

World’s Largest Waste to Methanol & Ethanol Facility – Located near Montreal, Canada

Key Highlights

- More than 200,000 tonnes of non-recyclable waste & residual biomass converted into annual production of nearly 125mm litres of biofuels (MeOH)
- Green hydrogen & oxygen supplied by a 88 MW electrolyser, one of the world’s largest leveraging on Quebec’s green electricity
- GHG reduction equivalent to taking 50,000 vehicles off the road annually – 160,000 tons of CO₂ / yr – Biogenic carbon intensity of -6 g/MJ
- One production line Methanol and Ethanol facility – 35mm gallons of methanol / 25mm gallons of ethanol per year
  - Flexibility to drop in gasoline
- Construction began in 2020, to be completed Summer 2023

Ownership structure

<table>
<thead>
<tr>
<th>Biorefinery</th>
<th>Ownership</th>
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</thead>
<tbody>
<tr>
<td>Shell</td>
<td>Global Upstream &amp; Downstream Oil &amp; Gas company; leader in refined products and chemicals</td>
</tr>
<tr>
<td>Quebec Government</td>
<td>Acts as a catalyst in funding and project facilitator</td>
</tr>
<tr>
<td>Enerkem</td>
<td>Technology provider &amp; project execution</td>
</tr>
<tr>
<td>Suncor</td>
<td>Leading Canadian Oil &amp; Gas company</td>
</tr>
<tr>
<td>Proman</td>
<td>Global leader in natural gas derived products and services</td>
</tr>
</tbody>
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<tr>
<th>Electrolyser</th>
<th>Ownership</th>
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<tr>
<td>Hydro-Quebec</td>
<td>Clean, renewable energy sources, Will play a central role in the emergence of a low-carbon economy</td>
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Total: 100%

World-class partners

Note: FX rate of 1 CAD / 0.79 USD