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# Waste-to-methanol: a commercial reality with Enerkem



# Enerkem at a glance

- Biofuels and renewable chemicals from garbage
- Proprietary clean technology developed in-house
- 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







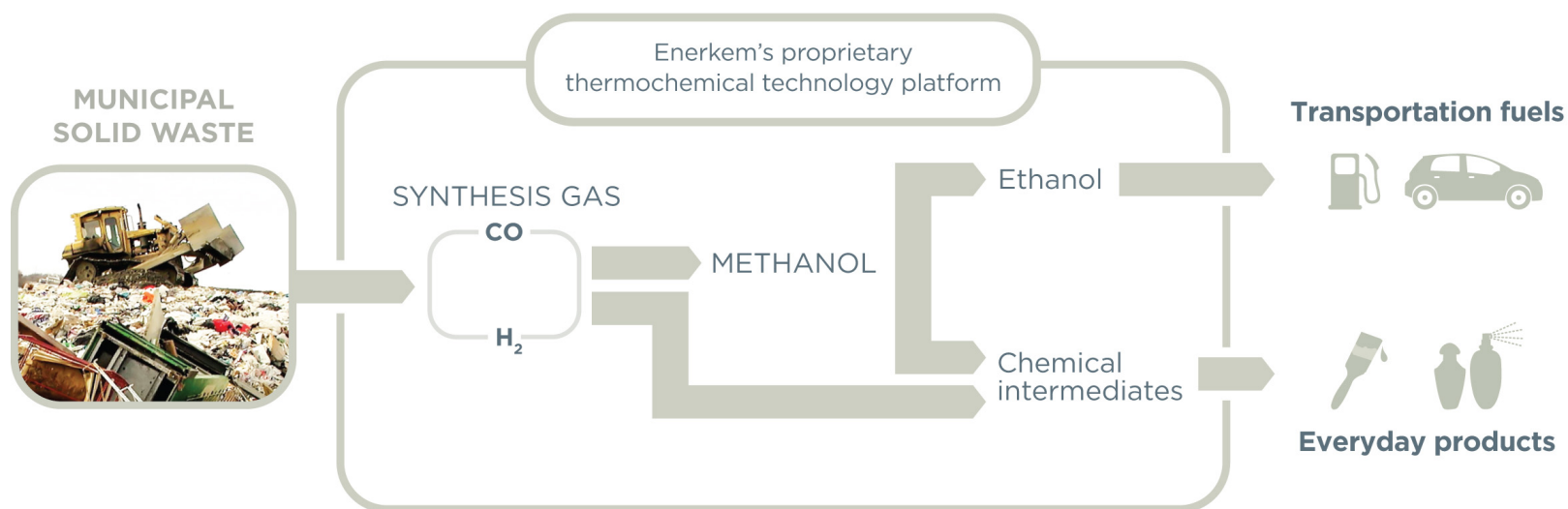
# Key market drivers for waste as feedstock

- Increased scarcity of urban landfill airspace and societal desire for waste diversion
- Circular economy or “cradle-to-cradle” approach
- Low cost unconventional feedstocks
- Renewable fuels mandates around the world
- Consumer pull for renewable and biobased products
- Focus on carbon footprint and GHG emissions reduction



# Enerkem's biorefinery process

## Methanol as end-product & chemical intermediate



# Bringing the model to reality

## Rigorous path to commercialization

UNIVERSITY OF  
SHERBROOKE  
PILOT



SHERBROOKE



WESTBURY FACILITY



MODULAR COMMERCIAL BIOREFINERIES



Laboratory

Pilot

Syngas  
Demo

Methanol  
Demo

Ethanol  
Demo

Full-scale commercial  
production





Production of biomethanol at the  
demonstration facility in Westbury,  
Canada



**Enerkem**





Ethanol production in Westbury,  
Canada



# Large market potential

## MSW IN THE EU



**254 MILLION**  
METRIC TONS OF MSW  
GENERATED PER YEAR

**75 MILLION**  
METRIC TONS OF MSW  
SUITABLE FOR ENERKEM'S  
TECHNOLOGY PLATFORM

THE POTENTIAL:  
**28.3 BILLION**  
LITRES USING  
ENERKEM'S TARGET YIELD<sup>1</sup>

<sup>1</sup> 375 litres of cellulosic ethanol per metric ton  
Source: Eurostat (European Commission), 2011

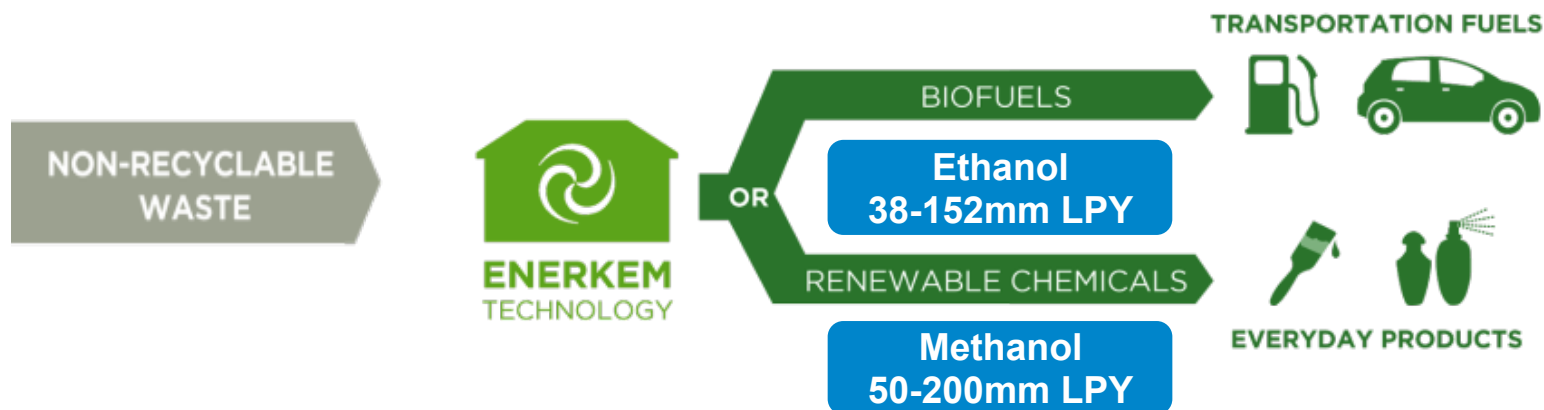




# Methanol as a fuel in Europe

- Methanol is blended with gasoline in some countries (ex. UK, Netherlands, Iceland)
- EU mandates 10% minimum target for the share of biofuels in transport petrol and diesel consumption by 2020.
  - Biofuels must provide a 35% GHG emissions savings compared to fossil fuels, 50% in 2017, and 60% in 2018 for new plants
- As of April 2015:
  - Biofuels from food crops are limited to 7% of all transport energy
  - 3% must come from other renewable transportation sources including a minimum of 0.5% from advanced biofuels such as Enerkem's biofuels
  - Double counting for biofuels from waste feedstocks such as municipal solid waste (member states are responsible for implementing this measure)

# Cost-competitive and sustainable solution



## Municipality:

- Supplies between 100,000 to 400,000 tons of MSW per year (as available)
- Long-term contract
- Pays tipping fee – attractive compared to status quo
- Suggests sites

## Enerkem:

- Investor, technology provider and/or joint venture partner in project
- Converts RDF into biofuels and renewable chemicals up to 4x scale of Edmonton
- Works with waste and municipal partners to optimize MSW sorting and for site selection
- Manages business risks incl. sale of final product
- Creates high-quality jobs
- Generates \$C65 M/year in net economic benefits in the region (for 1 X standard Enerkem system of 100,000 tons / year)



# City of Edmonton's Integrated Waste Management Centre



|           |   |     |
|-----------|---|-----|
| Recycled  | ➡ | 20% |
| Composted | ➡ | 40% |
| Biofuels  | ➡ | 30% |
| Landfill  | ➡ | 10% |



**Waste diversion = 90%**





World's first commercial  
MSW-to-biofuels and  
chemicals facility

## ENERKEM ALBERTA BIOFUELS

Capacity: 38 million litres per year (10 MGY)  
(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



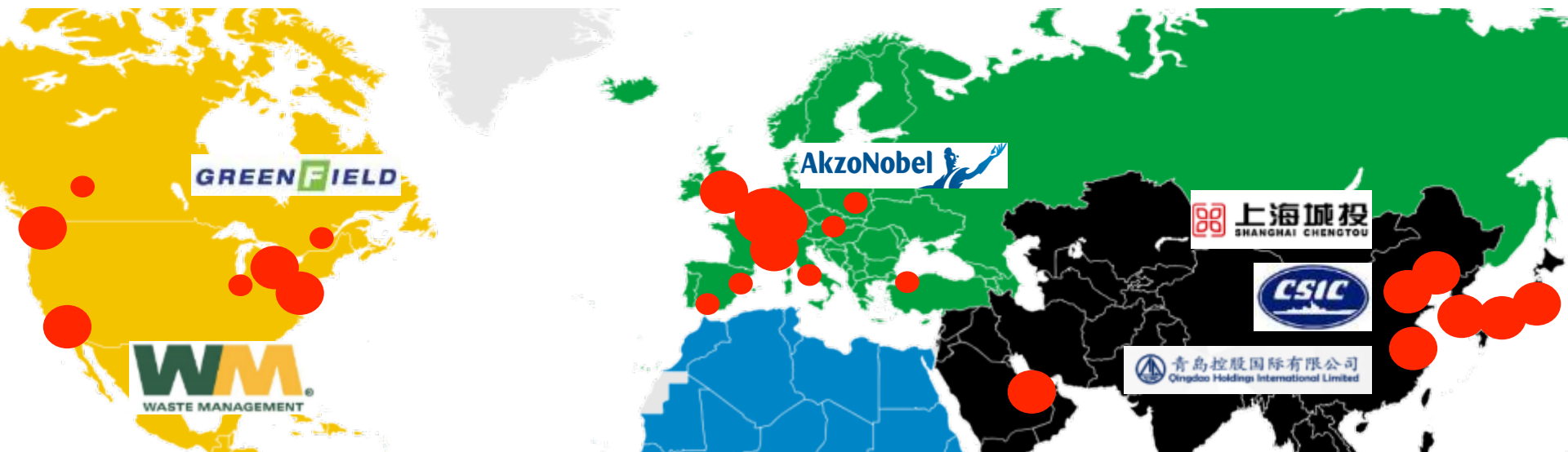
# Manufacturing for growth

- Moving beyond Build-Own-Operate model → licensing and equipment supply
- Modular manufacturing approach with pre-fabricated modules enabling global expansion





# Target growth areas for global partnerships



- Strategic partnerships with leading industrial groups
- Selection based on market attractiveness:
  - public policies, tipping fees, proximity to petrochemical infrastructure, population and growth

## Using **waste as feedstock** for the chemical industry



[www.akzonobel.com](http://www.akzonobel.com)

**Fourteen partners have joined forces to assess the use of waste for the production of chemicals in the Netherlands.**

The public-private partnership will study the options for setting up Europe's first plant, either in Rotterdam or Delfzijl.

Other partners involved in the initiative:



Visser & Smit Hanab



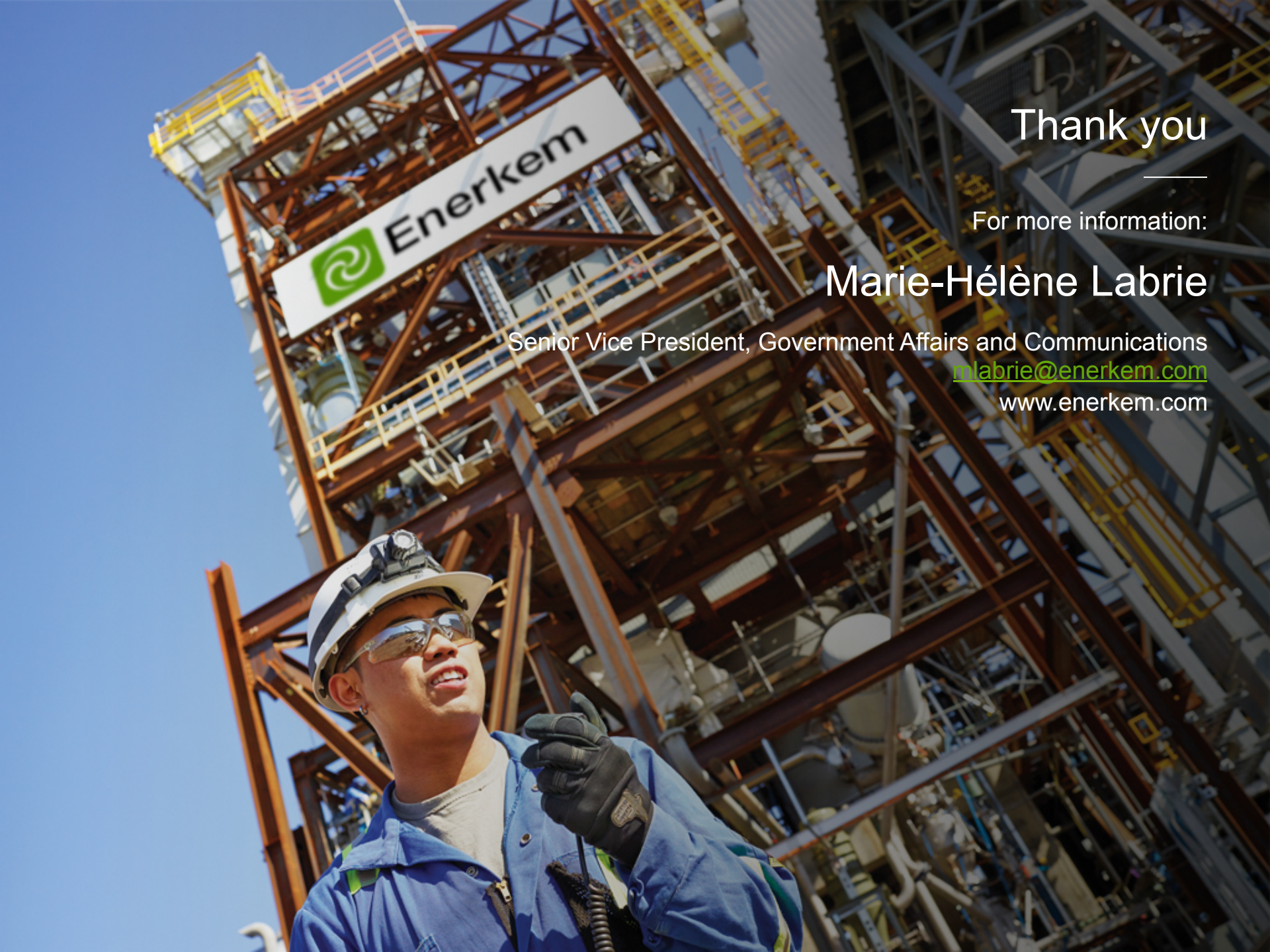




# Public policies in Europe: what's next?

Key elements are needed to further stimulate investments in low carbon transportation fuels and renewable chemicals:

- Certainty on biofuels and low carbon fuels mandate beyond 2020
- Capital programs to build infrastructure and commercial capacity for advanced biofuels
- Policies and programs for a circular economy which values the use of waste as a resource for biofuels and chemicals
- Feedstock diversity and technology neutrality in regulations and programs
- Coherence between waste management, biofuels and chemicals policies to ensure efficient deployment of waste-based biorefineries
- Continued R&D support to further improve processes and develop new products



Thank you

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