Introduction to Enerkem

Waste as an Unconventional Feedstock for Renewable Fuels and Chemicals

June 2014

Enerkem

Leading waste to fuels and chemicals company

First to reach commercial operation with Edmonton facility

Setting new standard in waste management and chemicals industries, globally

Lowest-cost waste disposal and biomass processing

Lowest-cost transportation fuel producer

Key strategic shareholders/partners in place

WM WASTE MANAGEMENT

VALERO

GREENFIELD

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Enerkem at a glance

- Produces biofuels and renewable chemicals from garbage
- Proprietary clean technology developed in-house
- Private company founded in 2000
- 170 employees
- Operates 2 facilities in Québec (pilot and demonstration facilities)
- Entering commercial phase with first biorefinery under commissioning in Edmonton, Alberta

The Enerkem solution

Feedstock

Municipal Solid Waste

Approximately 1.3B MT(1) of trash generated per year globally

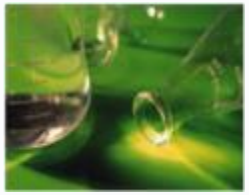
Process

Syngas

Proprietary Thermochemical Technology

10 year history – Largest operating demo plant in cellulosic ethanol

Products



Ethanol / Methanol

Renewable Chemicals

Power Generation

Product cost competitive with those derived from fossil-based feedstocks

Markets

Transportation Fuels

Solvents, Polymers, Coatings, Plastics, Adhesives

End Products Flexibility

(1) Source: World Bank 2013

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World’s first MSW-to-Chemicals and Biofuels facility now in commissioning

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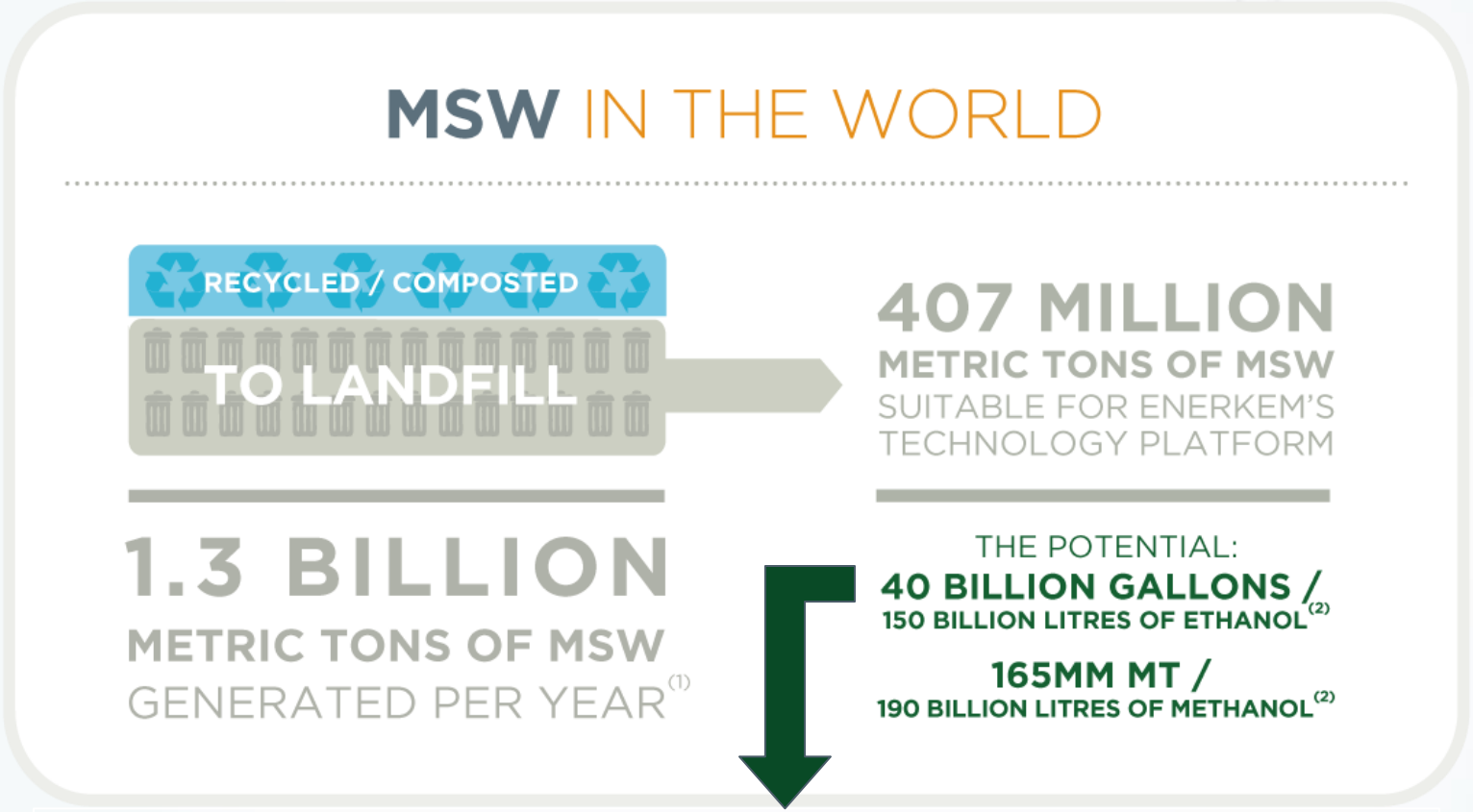
Key market drivers

- **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 that would have otherwise been burned or landfilled 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

(1) Source: World Bank, 2012

Global waste market



98.9% OF GLOBAL ETHANOL CONSUMPTION

EXCEEDS 2018 GLOBAL METHANOL DEMAND

(1)Figure does not include commercial and industrial waste
(2)Using Enerkem's yield

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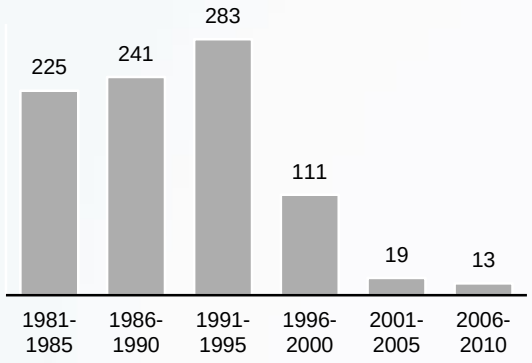
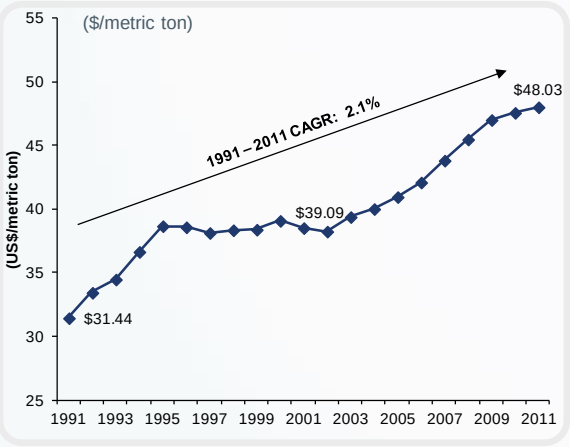
Solving the waste problem – United States Example

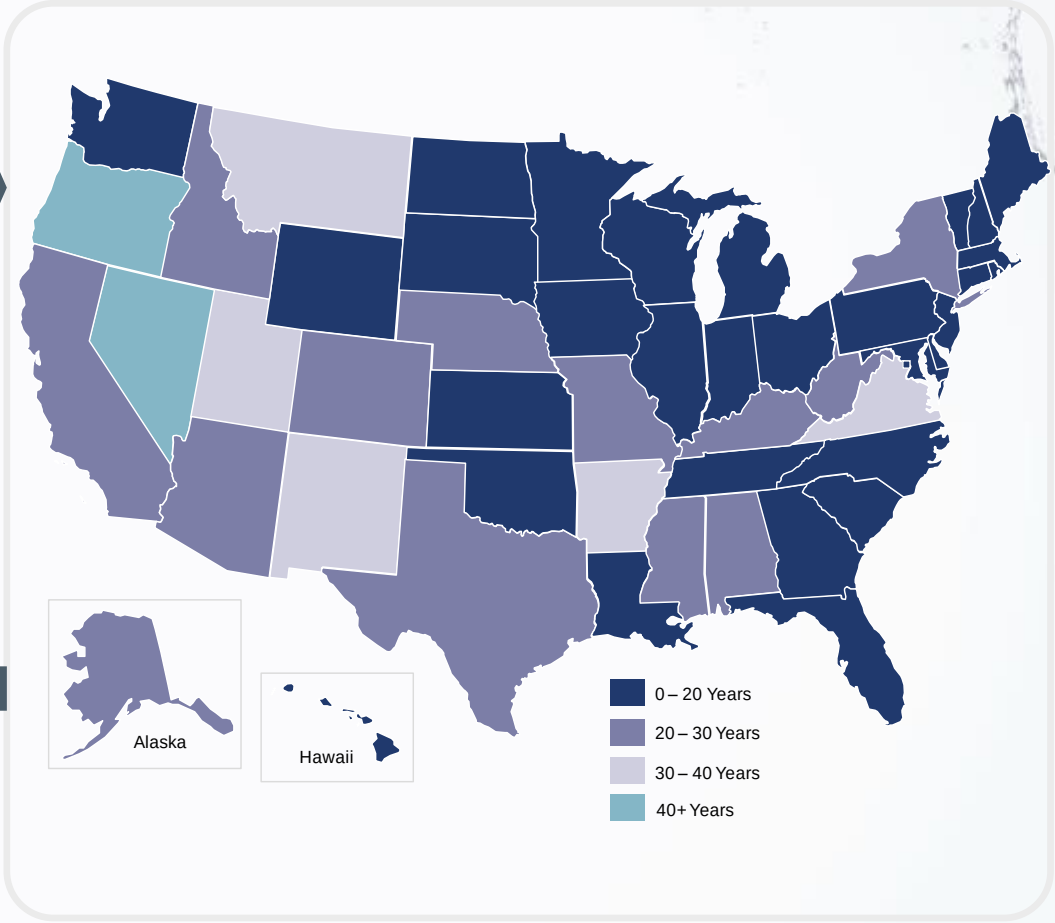
New Landfills Permitted in the U.S.



MSW Landfill Tipping Fees



Average Remaining Life of U.S. Landfills



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

Source: Waste Business Journal (2011).
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.

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The Enerkem opportunity

459 million MT[1]
(per year in the U.S.)

MSW

Required density to support Enerkem modules		
	1-module facility	4+ module facility
Population density	0.3 – 0.5 million	1.0 – 1.5 million
Identified areas in the U.S.	125 - 150 areas	30 - 50 areas

31 % → **Materials Recovery Facility** → **Recycle Depots**

6 % → **Incineration**

63 % → **Landfill**

~1.0 MT/capita per year in the U.S.

52 % → **Inert and Humidity**

48 % → Suitable for Enerkem's technology platform

140 million MT = 1,400 potential Enerkem modules

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14 billion gallons ethanol potential

(1) MSW volumes generated, recovered, landfilled and incinerated from Waste Business Journal, *Waste Industry Overview*, 2012

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Enerkem partnering 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

THE CITY OF Edmonton

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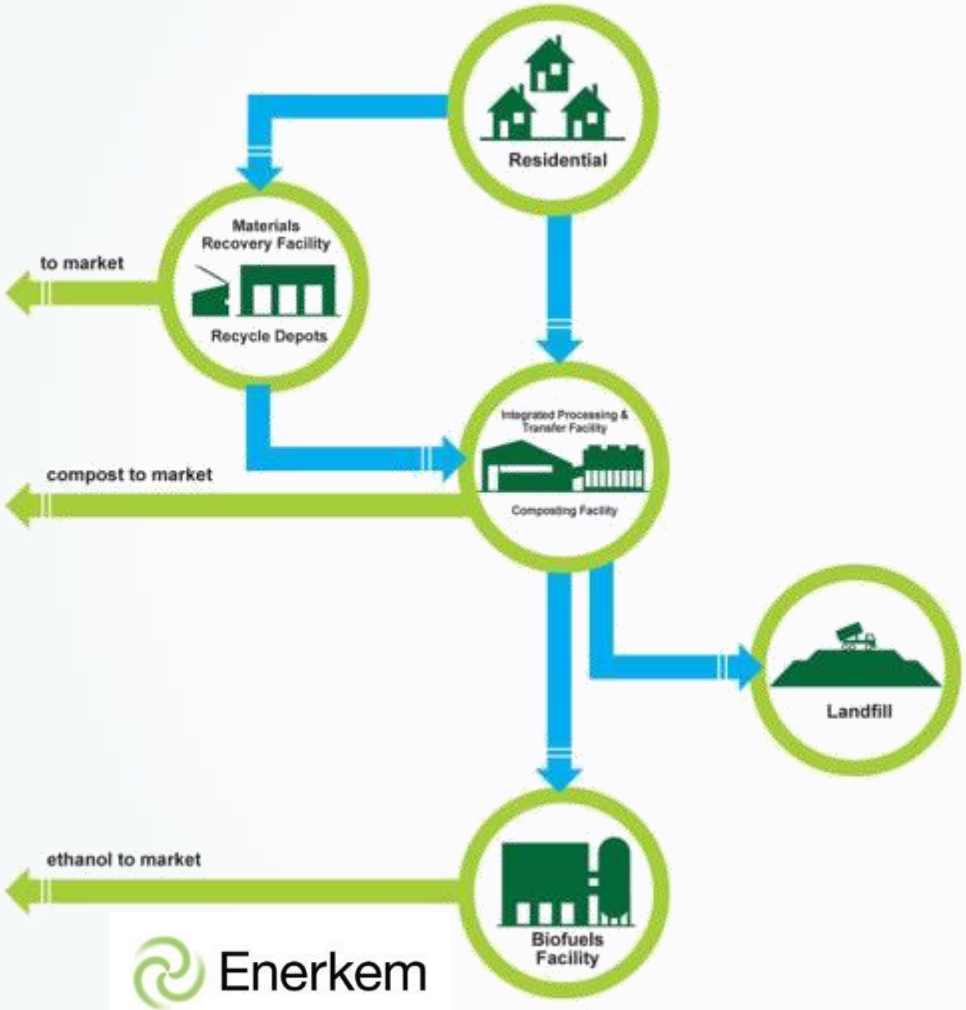
Enerkem partnering with the City of Edmonton



THE CITY OF Edmonton

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

Waste diversion = 90%

RDF FACILITY

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World’s first MSW-to-Chemicals and Biofuels facility now in commissioning

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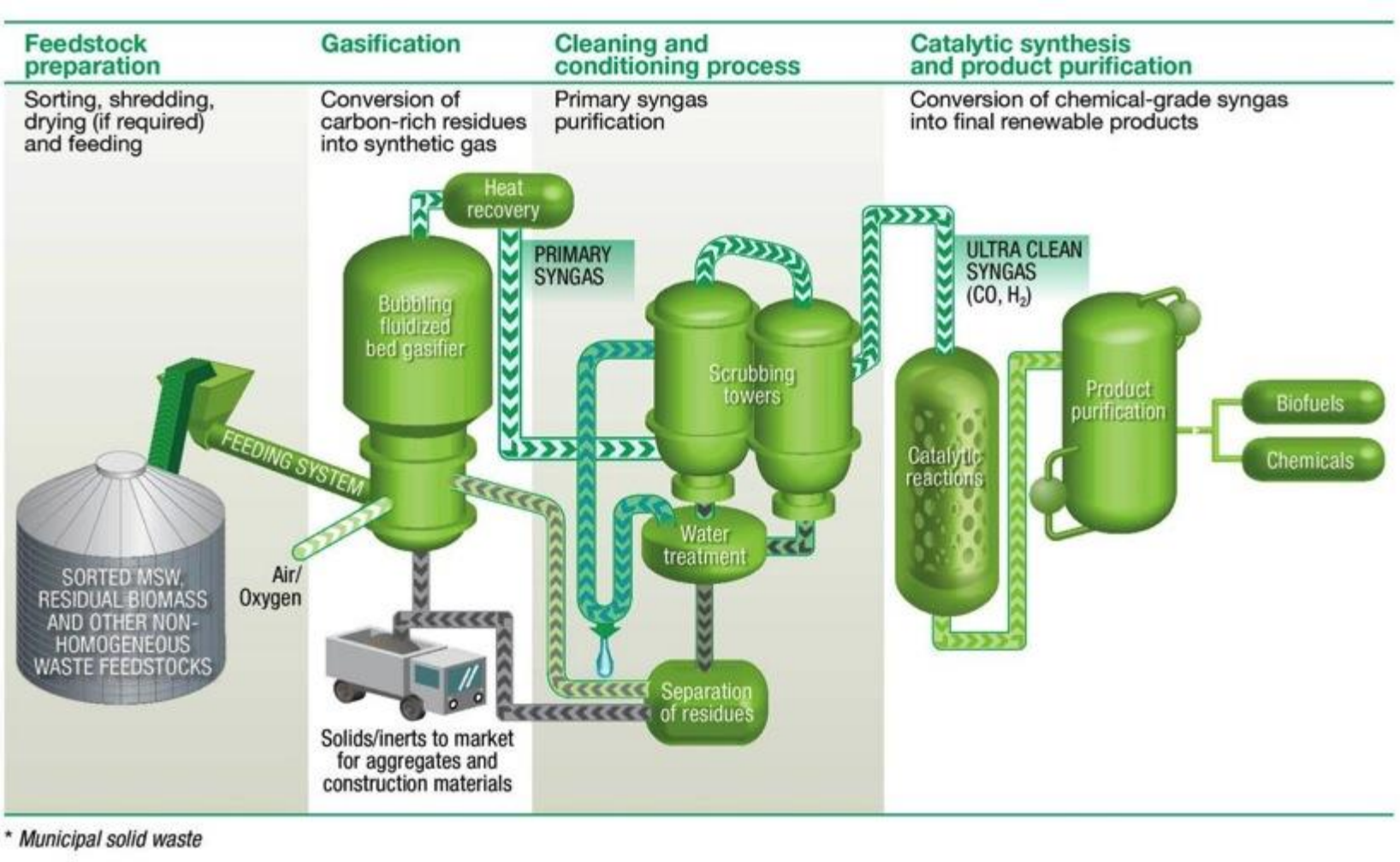
An efficient ‘carbon-recycling’ process



* *Municipal solid waste*

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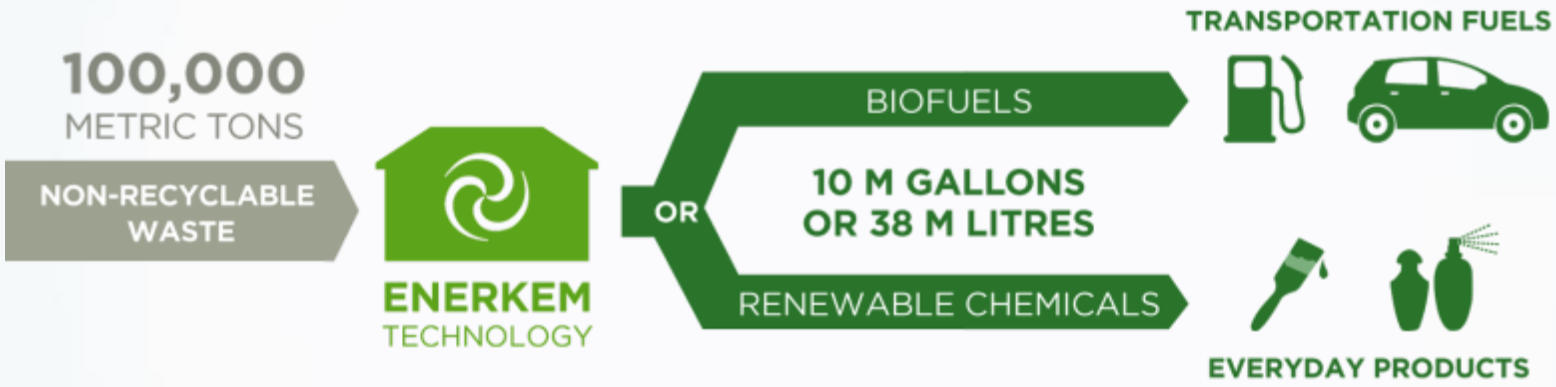
Community-based commercial facilities
Standard smallest scale commercial plant model



1 to 4 x is standard scale with multiple plant opportunities for most demographic regions

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Setting new cost and sustainability standards for waste disposal

	Enerkem	Incineration
CAPEX	Capital efficient (2x more efficient per ton of waste converted)	Capital intensive
Break-even tipping fee	▪ *Fuels and chemicals:* less than 1/4 the tipping fee vs. incineration	Greater than $80/MT
Primary revenue source	Sale of liquid fuels and chemicals	Sale of waste disposal service and electricity
Where does the carbon go?	Biofuels and chemicals	Smokestack emits CO_2
Finality	Chemical recycling of carbon into alcohols	Waste elimination
Technology	▪ Partial oxidation ▪ Reforming ▪ Catalytic conversion	Mass combustion

Feedstock Flexibility

More than 25 feedstocks tested successfully in the process

MSW
(Toronto, Sherbrooke, London (UK) and Edmonton)

Agriculture biomass (wheat straw, corn stovers)

Forest biomass
(as well as treated wood and C&D wood, both pelletized and chipped)

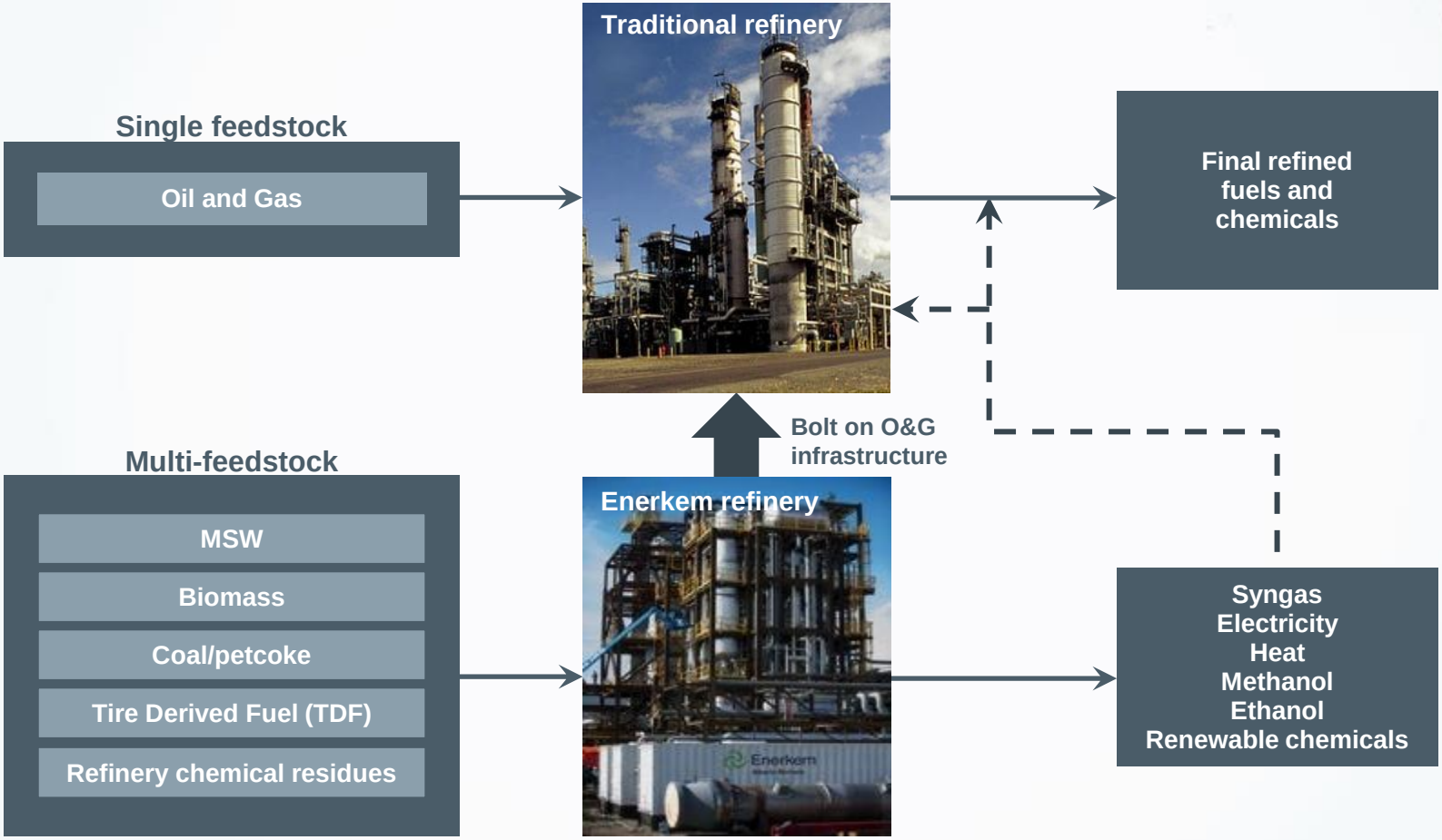
Plastics (various forms: pelletized, shredded, fluffed and mixed)

Biosolids (dried, from Montreal and from pulp & paper operation)

Glycerin

Petcoke (Alberta, with 8% humidity and 5-6% sulfur)

Best available solid feedstock bolt-on to existing oil and gas infrastructure



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Potential new products

- Biofuels and advanced chemicals represent a multibillion dollar market globally
- In the near term, Enerkem can produce methanol, ethyl acetate, methyl acetate with the focus on ethanol

Chemical building blocks in Enerkem's synthesis gas

CO

H_2

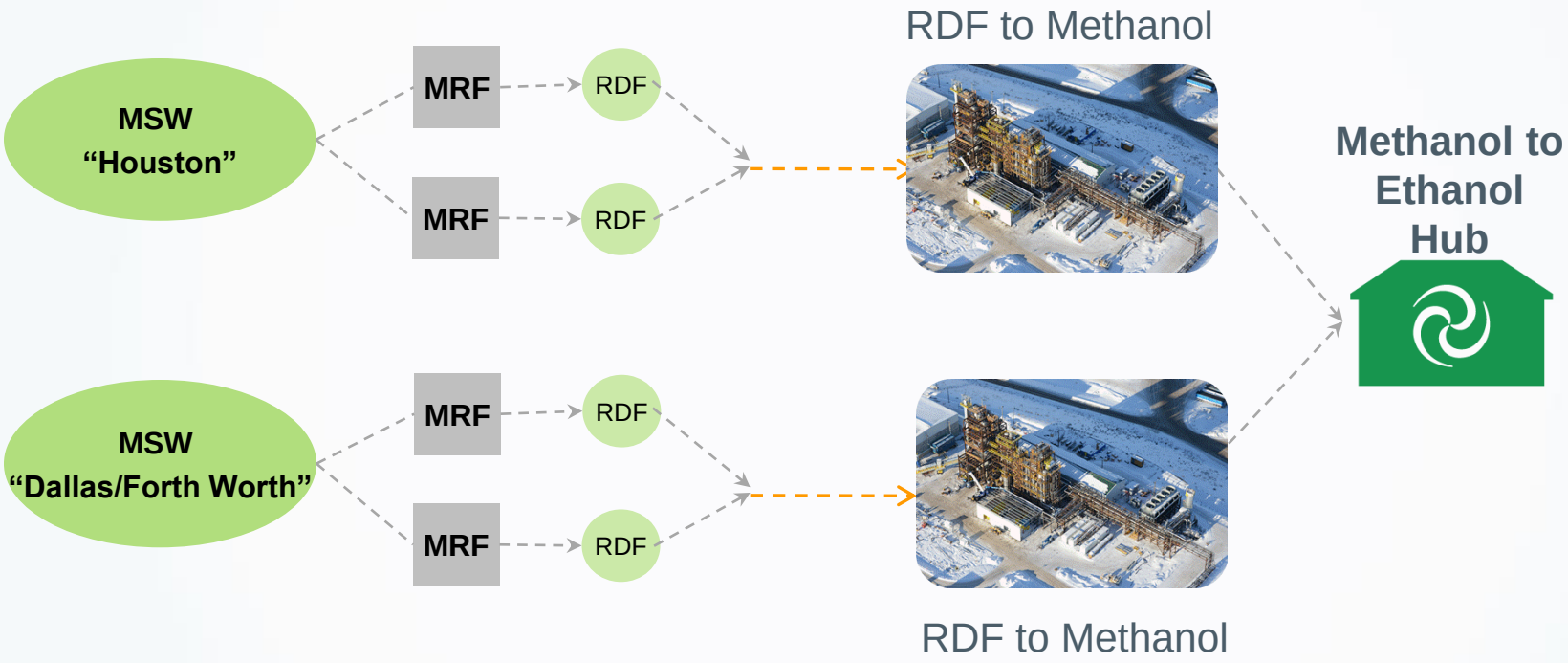
CO_2

Product type	N.A. market size and prices		Applications
N-Propanol	$500 million *	*$3,125/MT*	Solvent pesticides and coatings, chemical intermediate
Acrylic Acid	$2.9 billion *	*$2,590/MT*	Architectural and industrial coating
Acetic Anhydride	$1.7 billion *	*$1,653/MT*	Cellulosic acetates, VAM
Ethylene	$29 Billion *	*$1,100MT*	Packaging
Propionic Acid	$228 million *	*$3,125/MT*	Preservatives, food additives, pesticides and esters for flavorings

Sources:

* Markey size estimates – Internal company estimates & Argus DeWitt

Distributed - Hub and Spoke Approach



Key relationships provide meaningful support

Government and municipalities

Natural Resources Canada / Ressources naturelles Canada
Canada

Sustainable Development Technology Canada

USDA

Ressources naturelles et Faune Québec

Government of Alberta

Edmonton

Alberta Innovates Energy and Environment Solutions

IQ Investissement Québec

Key strategic partnerships

WM Waste Management

Valero

Greenfield

Strong financial backing

rho

Braemar Energy Ventures

Cycle Capital Management

The Westly Group

Fonds de solidarité FTQ

Fondaction CSN pour la coopération et l'emploi