



Biofuels and Chemicals from Mixed Waste: The Enerkem Contribution to Sustainability

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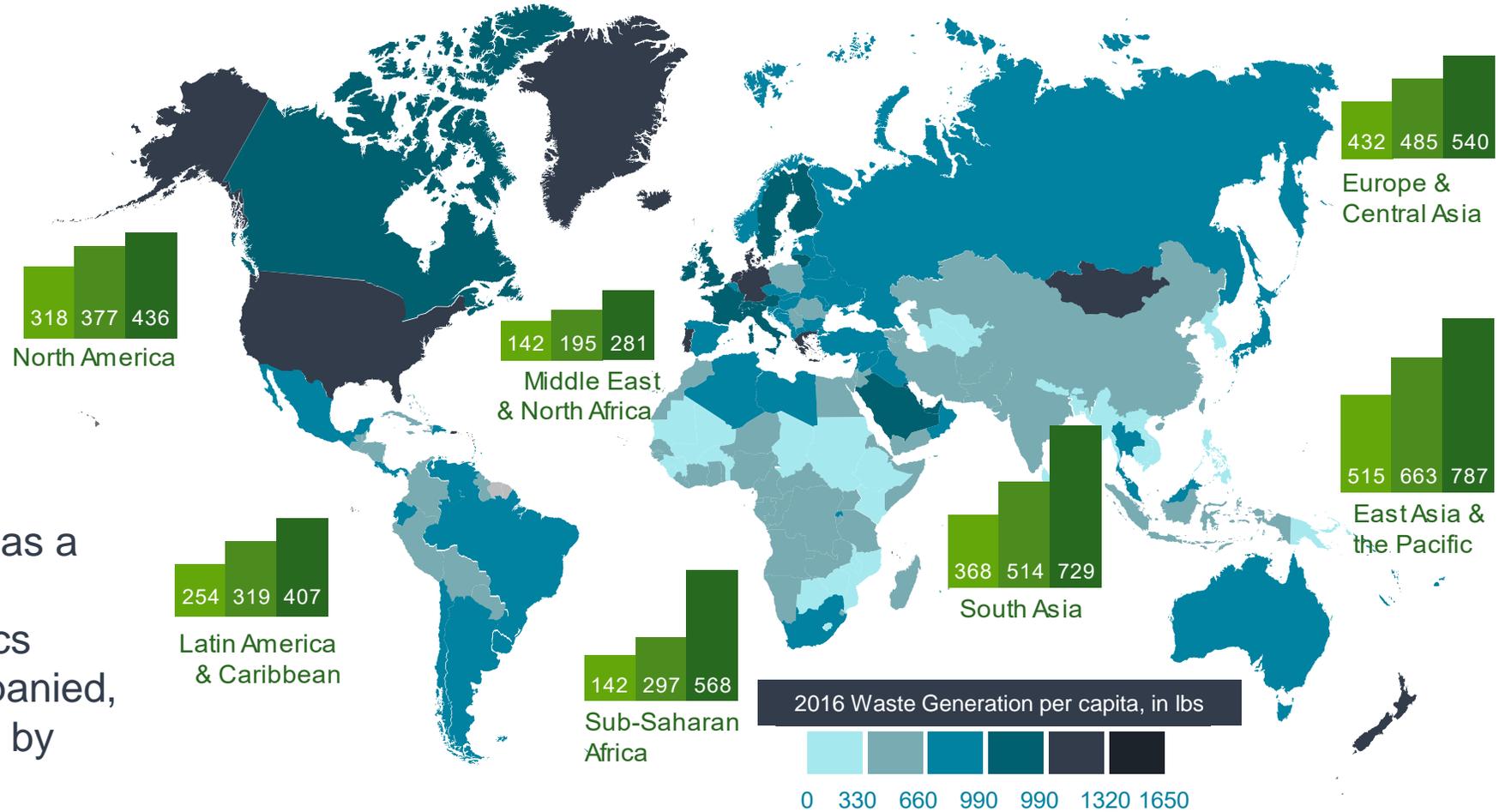


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SOLVING THE PROBLEMS OF THE THROWAWAY WORLD...

Regional waste generation
US ton (millions)

2016 2030 forecast 2050 forecast



Waste is considered as a mixture of biomass, plastics and inorganics (mainly silica accompanied, at much lower levels, by other metal oxides)

5% OF 2030 GLOBAL WASTE PRODUCTION IS EQUIVALENT TO 350+ ENERKEM MODULAR TRAINS



DRIVING THE TRANSITION TO A CIRCULAR ECONOMY



4

Value added bio-based products to the consumer



3

Replacing fossil sources with low-carbon methanol and ethanol



1



Post-consumption waste generation

2



Converting waste into biofuels and renewable chemicals

The Enerkem Solution Utilizes **SUSTAINABLE** Carbon, comprising of:

- **RENEWABLE** Carbon (from biomass)
- **RECYCLED** Carbon (from fossil Carbon in plastics & from Carbon in CO2)



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ENERKEM SOLUTION

FEEDSTOCK



PRODUCTS



Ethanol



Methanol

MARKETS



Transportation Fuels



Solvents & Coatings



Plastics & Renewable Chemicals

The City of Edmonton's integrated waste management center (EWMC) is the place where Enerkem has implemented its first commercial plant transitioning to the circular economy

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

90%
WASTE DIVERSION



- 1 Integrated Processing & Transfer Facility
- 2 Recycling center
- 3 Composting center / AD Facility
- 4 Enerkem biorefinery





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FULL-SCALE FACILITY

Edmonton, AB

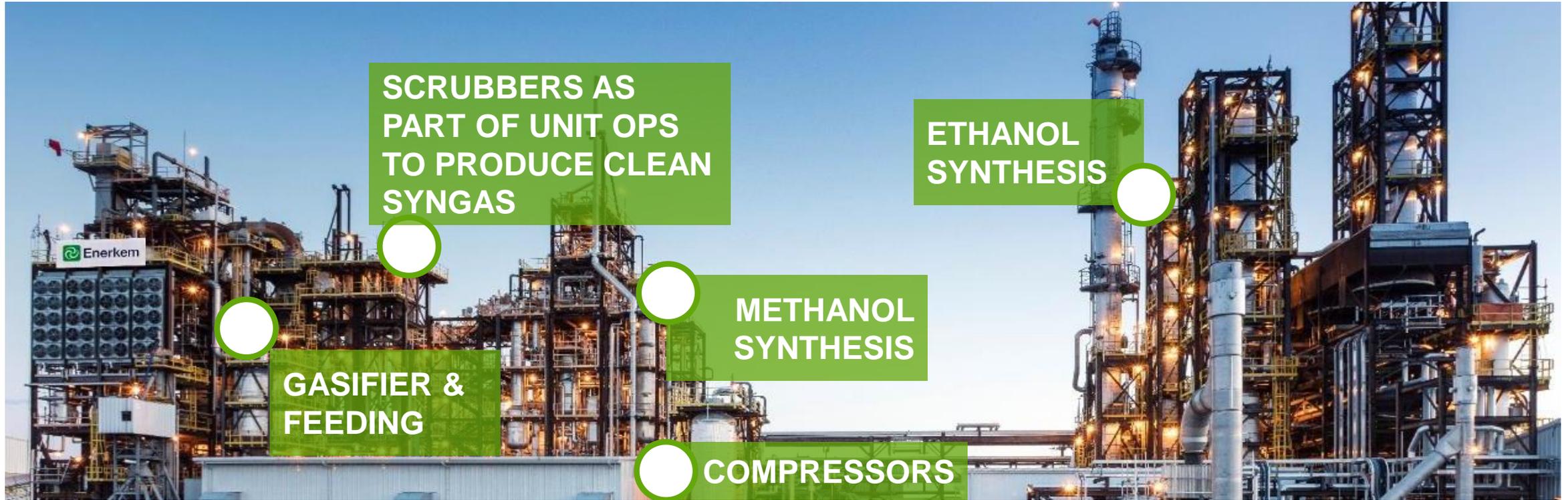




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ENERKEM ALBERTA BIOFUELS (EAB)

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



International Sustainable Carbon Certification (ISCC)

2016-2017 **METHANOL**



British Columbia Carbon Intensity certification (in addition to Alberta and Canadian RFS certifications)

2017-now **ETHANOL**



U.S. EPA approval to collect RIN's for cellulosic ethanol produced at EAB



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FACILITY SNAPSHOT EDMONTON ALBERTA BIOFUELS (“EAB”)



LOCATION	Edmonton, Alberta, Canada
CAPACITY	14.5 tph of waste feed
FEEDSTOCK	MSW from City of Edmonton, wood biomass, C&D, waste plastics
KEY FEATURES	Proprietary technology transforming the ultimate residue of sorted MSW into clean Syngas Syngas is used to produce, thermo-catalytically and with the option of additional H ₂ , MeOH. The latter is carbonylated and Ethanol produced by hydrogenolysis

PHASED CONSTRUCTION FOR SUCCESSFUL SCALE-UP	KEY ACHIEVEMENTS	COMPLETION STATUS
PHASE 1+2 WASTE TO SYNGAS & SYNGAS TO METHANOL	1 st Commercial plant to convert heterogeneous waste feedstock to chemical grade syngas Senior lenders “Bankability / Reliability” test passed (February 2017): • IMPCA industry-compliant Bio-Methanol sold	
PHASE 3 METHANOL TO ETHANOL	Installation of Bio-Methanol to Bio-Ethanol island completed in fall 2017, on time and on budget. Commissioned on 2018. In EtOH production since Q1 2019; ramping-up production in Q2 & Q3	



PROJECT PIPELINE





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CONTINUOUS INNOVATION PROGRAM

① Feedstock Pre-treatment

Making heterogenous feedstock more homogeneous while enhancing sustainable Carbon content and decreasing Oxygen and inerts, whilst improving C efficiency

② CFD & Chemical Kinetics

Modeling the core gasification technology *via* simulation linked to experimentation



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CONTINUOUS INNOVATION PROGRAM

3

Reforming Technologies

Novel designs, testing *via* prototypes, pilot units & commercial implementation

4

Catalytic Technologies

- Value- added chemicals from methanol and ethanol
- Stable catalyst for CO₂ valorization
- Iodine-free carbonylation



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**CONTRIBUTING TO MEET WASTE
MANAGEMENT CHALLENGES**





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THANK YOU

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