



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

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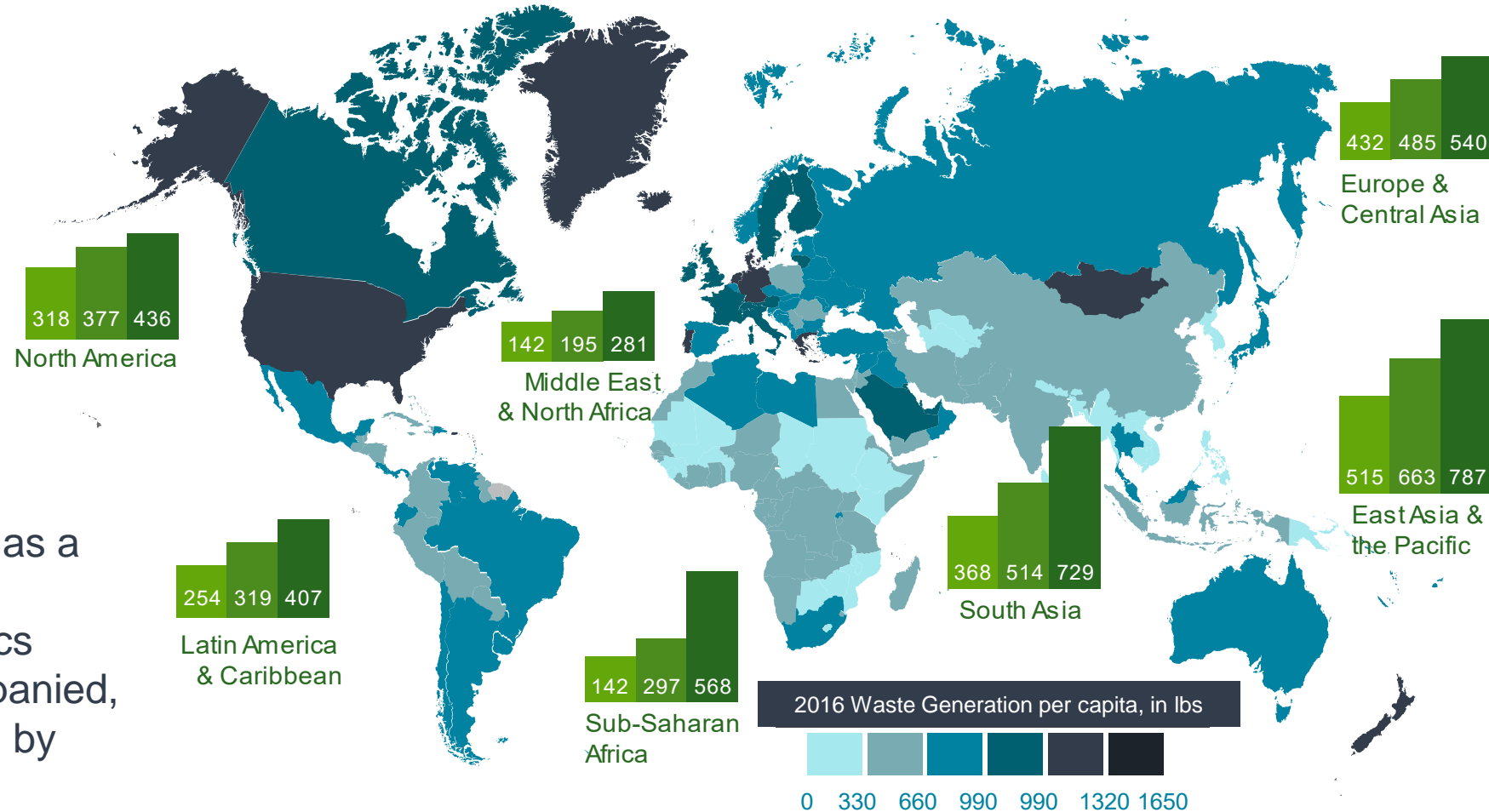


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SOLVING THE PROBLEMS OF THE THROWAWAY WORLD...

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



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DRIVING THE TRANSITION TO A CIRCULAR ECONOMY



Value added bio-based products to the consumer

4



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

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



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

90%
WASTE DIVERSION

Edmonton

ALBERTA
INNOVATES



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FULL-SCALE FACILITY

Edmonton, AB

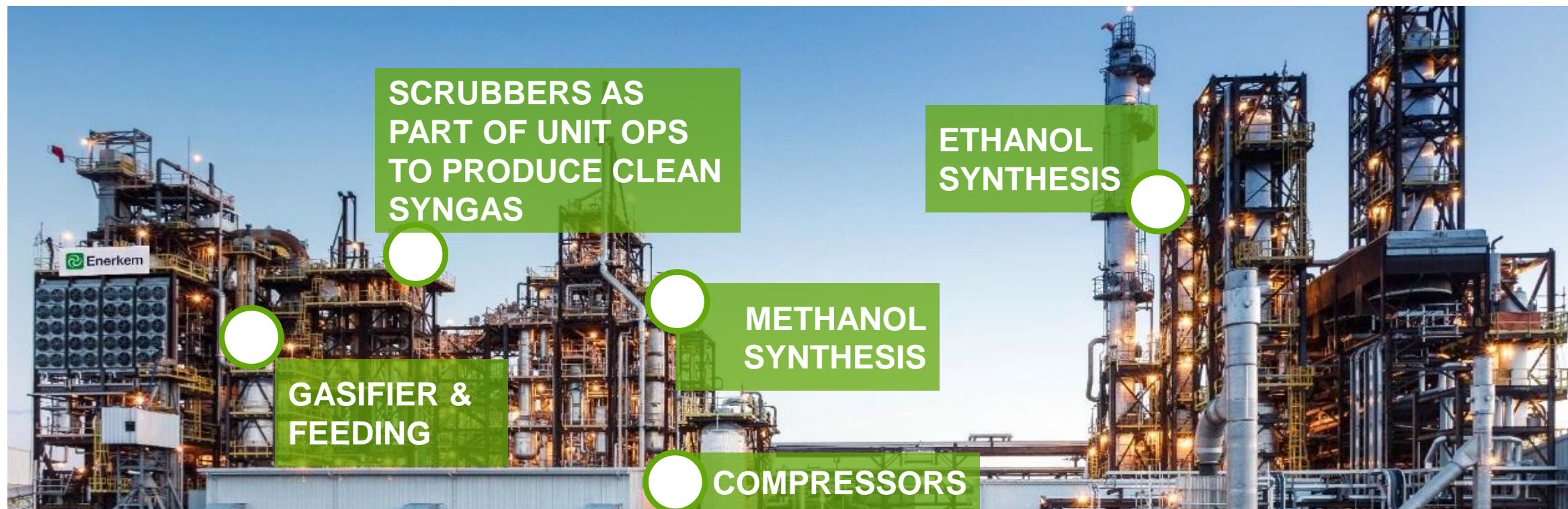




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ENERKEM ALBERTA BIOFUELS (EAB)

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 H₂, 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

1st 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



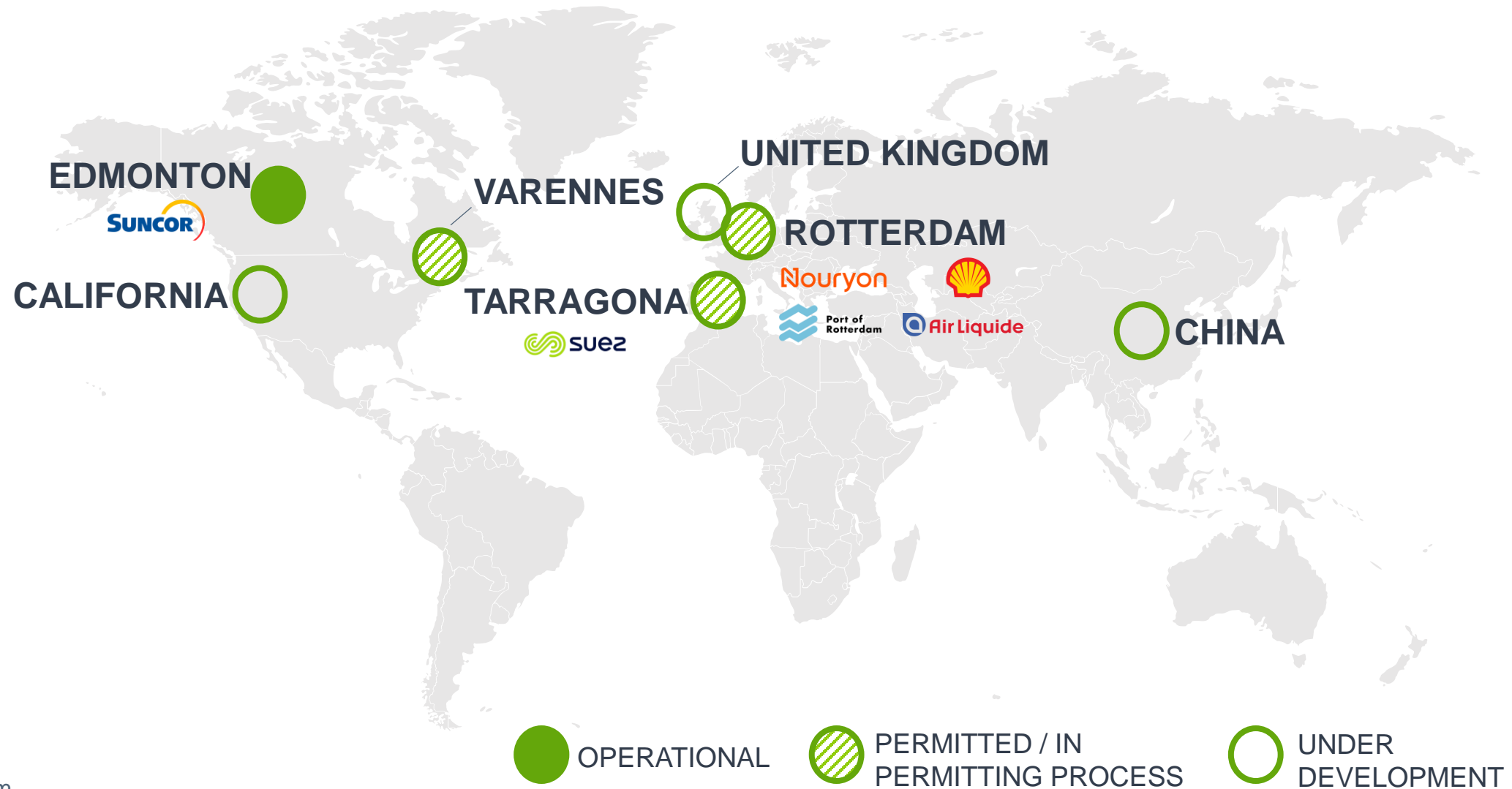
PHASE 3 METHANOL TO ETHANOL

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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