



An Overview of North American Biogas

EBA 2020 Conference

Sept 1, 2020

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Biogas Market Opportunities North America

- **About Iogen**
- **Comparison of EU and North American biogas**
- **Policy in North America**
- **Value and volume trends**
- **Opportunities**



Who is Iogen?

- **Family owned and run technology business since 1975**
- **Successful Developer of 2nd Gen Biofuels Technology & Projects**
 - Leading cellulosic ethanol technology (implemented in Brazil)
 - Leading biomethane player in USA (CNG/LNG) – offering structured offtakes
 - Landfill gas and AD biomethane used in CNG/LNG
 - Top 4 RFS fuel credit generator, Largest AD LCFS credit generator
 - Technology for refinery co-processing to make renewable fuels
 - Biogas project development pipeline
 - Large IP portfolio, 300+ patents

- **Major partners and investors over the years:**

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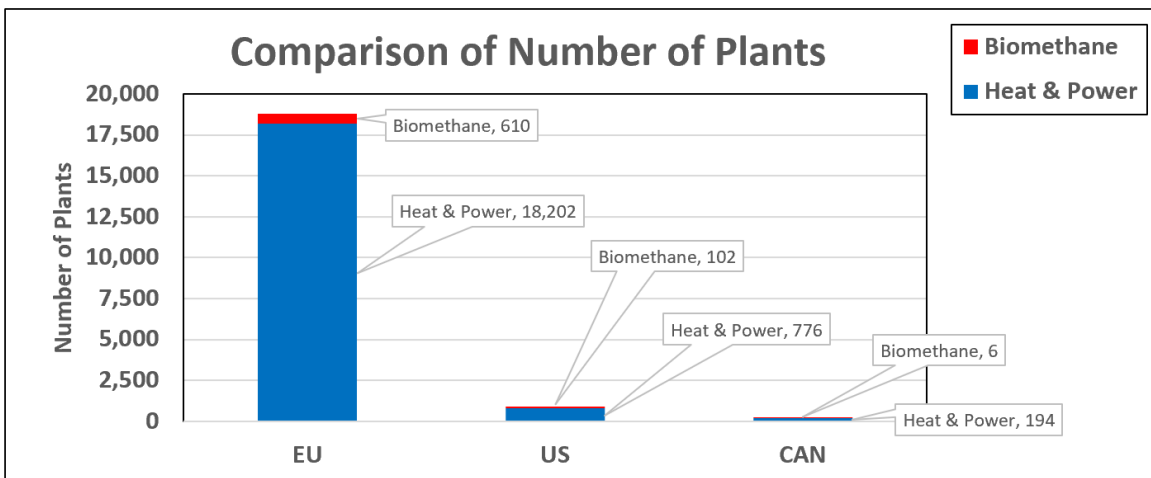
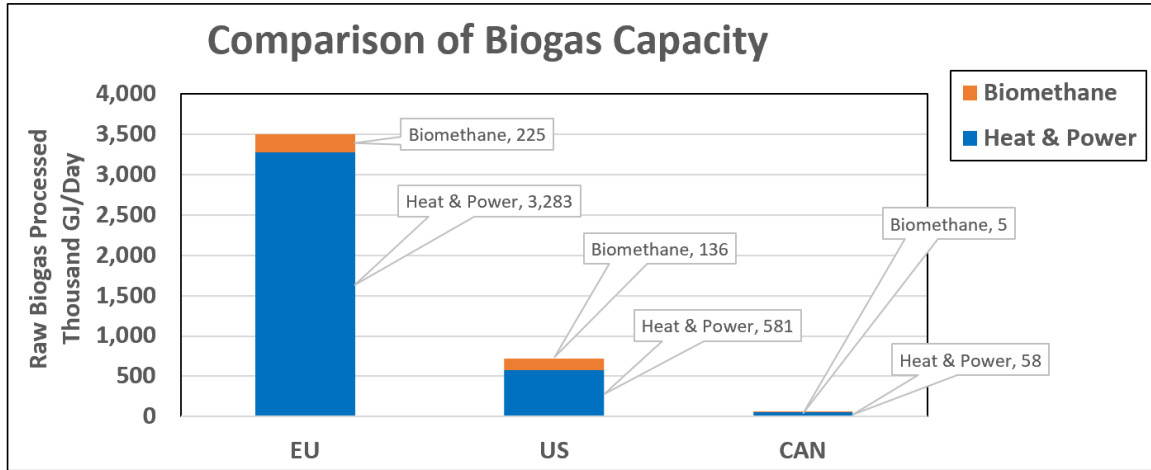


- **Biogas relationships include**





EU Biogas Business is Much Larger than in US/Canada

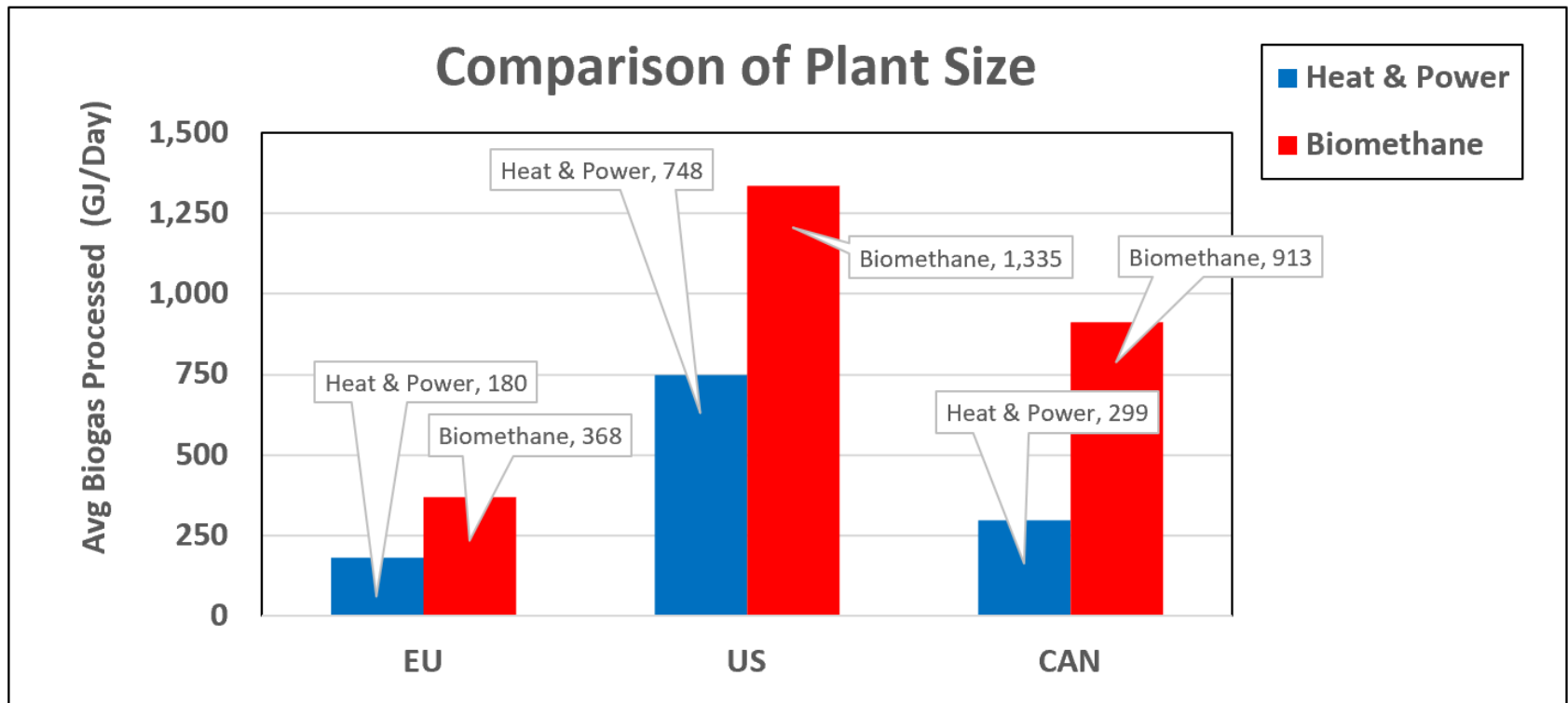


Sources: EU: EBA US: LMOP, AgStar, EPA, Iogen CAN: CBA, Iogen



North American Biogas Plants are on Average Larger

NA plants are 2-4 times larger than EU plants





Canada & US Policies Impact Biogas Markets & Opportunities

A Mix of Federal and State/Provincial Policies

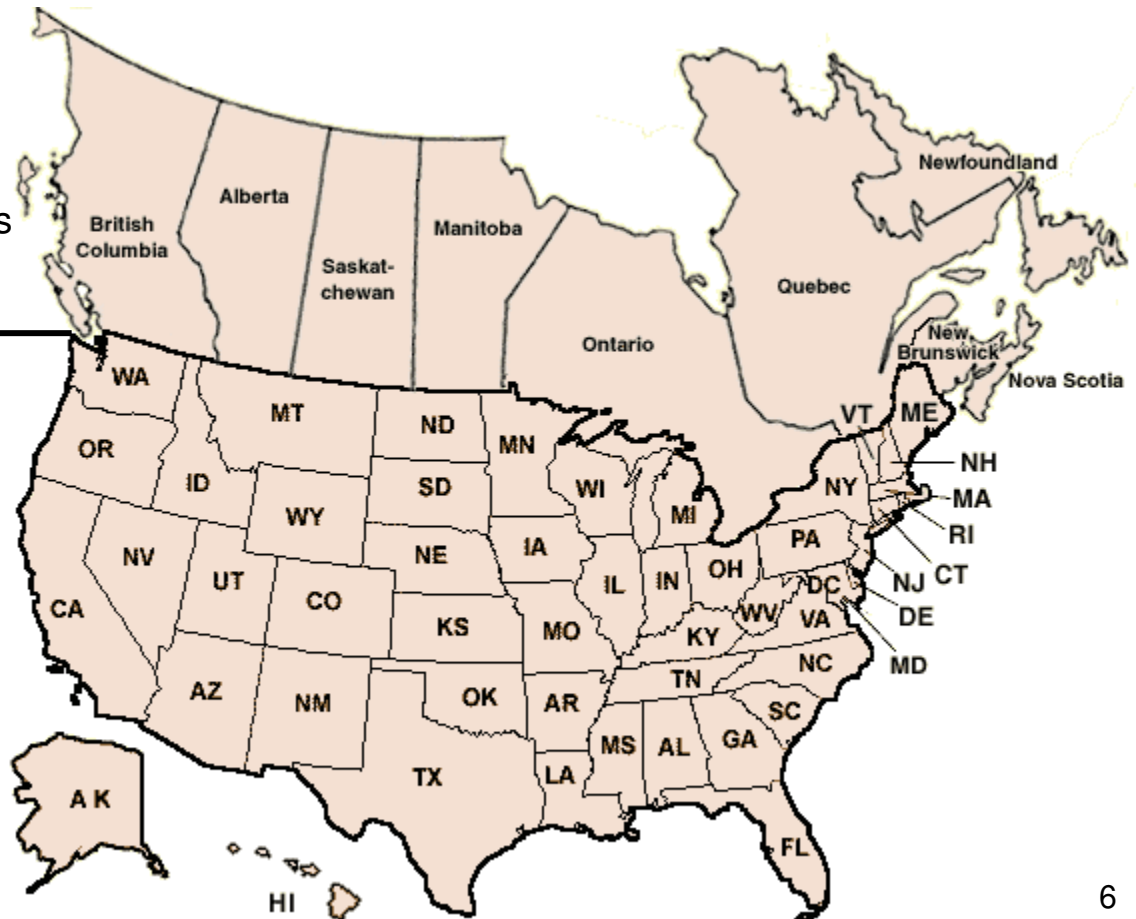
Canada

Federal:

Renewable Fuels Regulations
Clean Fuel Standard (in devel, CO₂)

Provincial:

Electricity PPAs
Renewable fuels mandates/incentives
BC: LCFS (CO₂ credits)
NG grid renewability (emerging)



United States

Federal:

Renewable Fuels Standards
Trading system for RINs
2 relevant RIN types

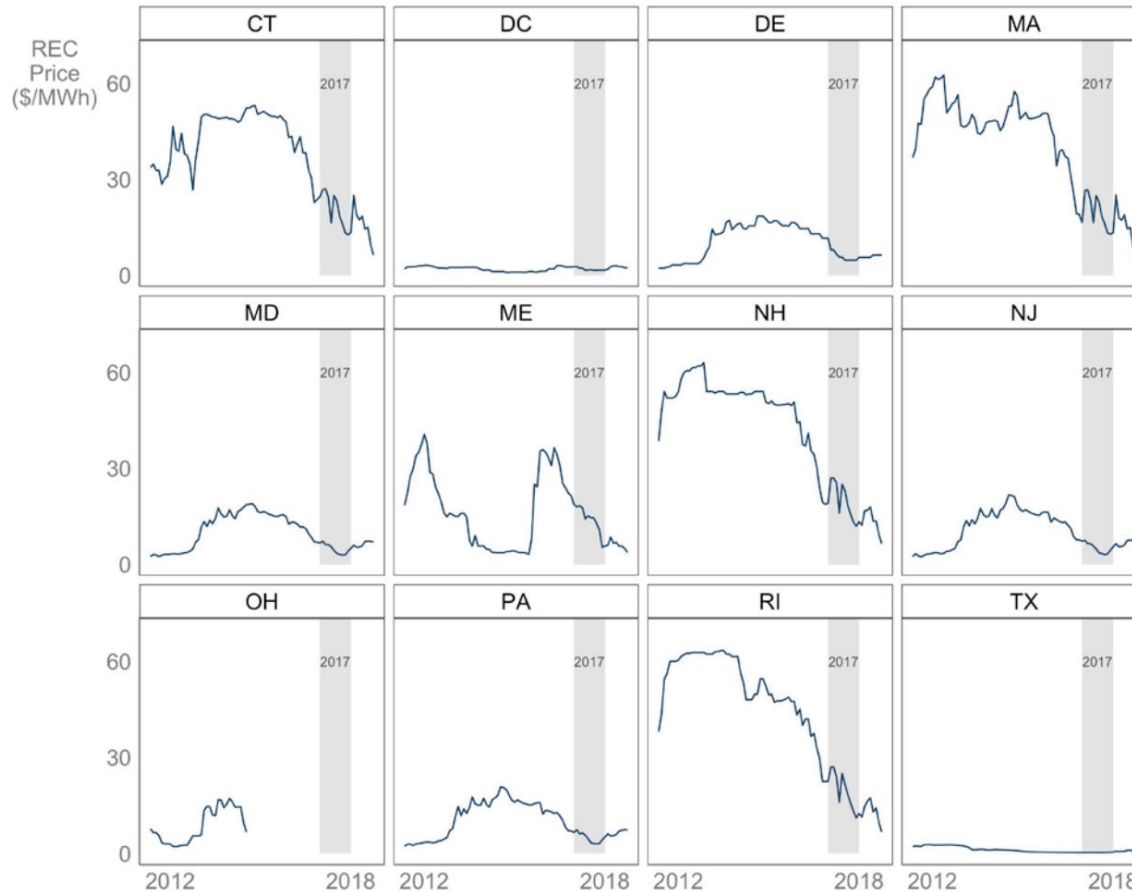
State:

Renewable Portfolio Standards
Trading system for RECs
Selective interstate trading
Low Carbon Fuel Standards
California LCFS (LCFS Credits)
Several states (emerging)
NG grid renewability (emerging)



US REC Prices (Green Power Premiums) have Trended Down

Renewable Energy Certificate Prices 2012-2018

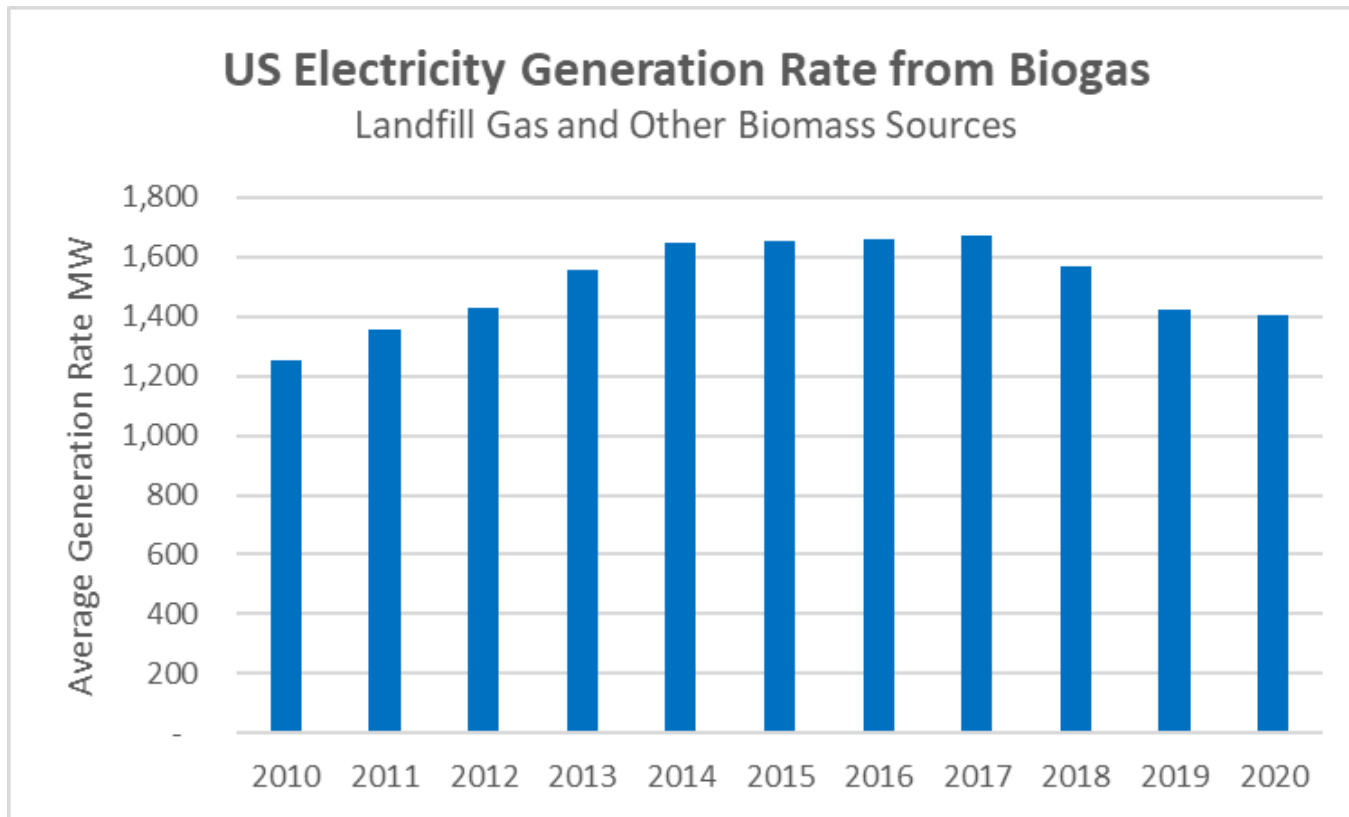


Note: More recent data shows a partial recovery in REC prices in some states

Source: NREL



US Biogas-Based Electricity Generation is Shrinking



Source: US EIA



Policy Shifts are Driving Biomethane Growth

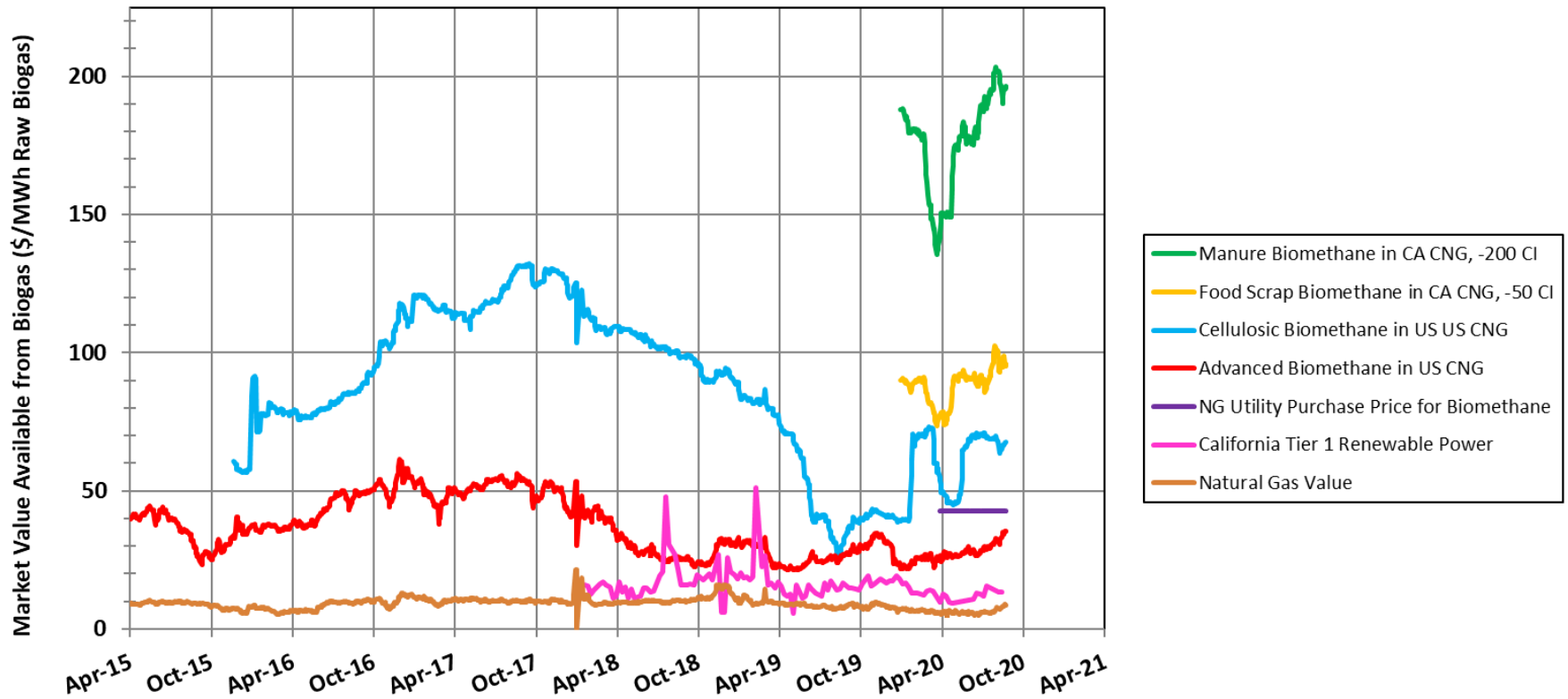
- **US Renewable Fuels Standard (RFS), since 2015**
 - For “cellulosic” biomethane used as CNG/LNG, can generate a “D3 cellulosic biofuel RIN”
 - Applies to landfill, wastewater treatment, manure, and certain other agricultural biogas
 - For industrial and food waste used as CNG/LNG, can generate a “D5 advanced biofuel RIN”
 - Applies to industrial and food waste biogas
- **California Low Carbon Fuels Standard (LCFS), new provisions since 2019**
 - Additive value to RFS when CNG/LNG is used in California
 - Based upon carbon intensity of the CNG/LNG relative to diesel
 - Since 2019, substantial premiums are available for certain manure AD operations
- **Emerging state/provincial green natural gas grid targets**
 - Provincial/State utility regulators are inducing the purchase of biomethane through grid renewability targets
 - Some Canadian and US utilities are buying under long term supply agreements



Transportation Fuel Markets offer the Highest Value for Biogas

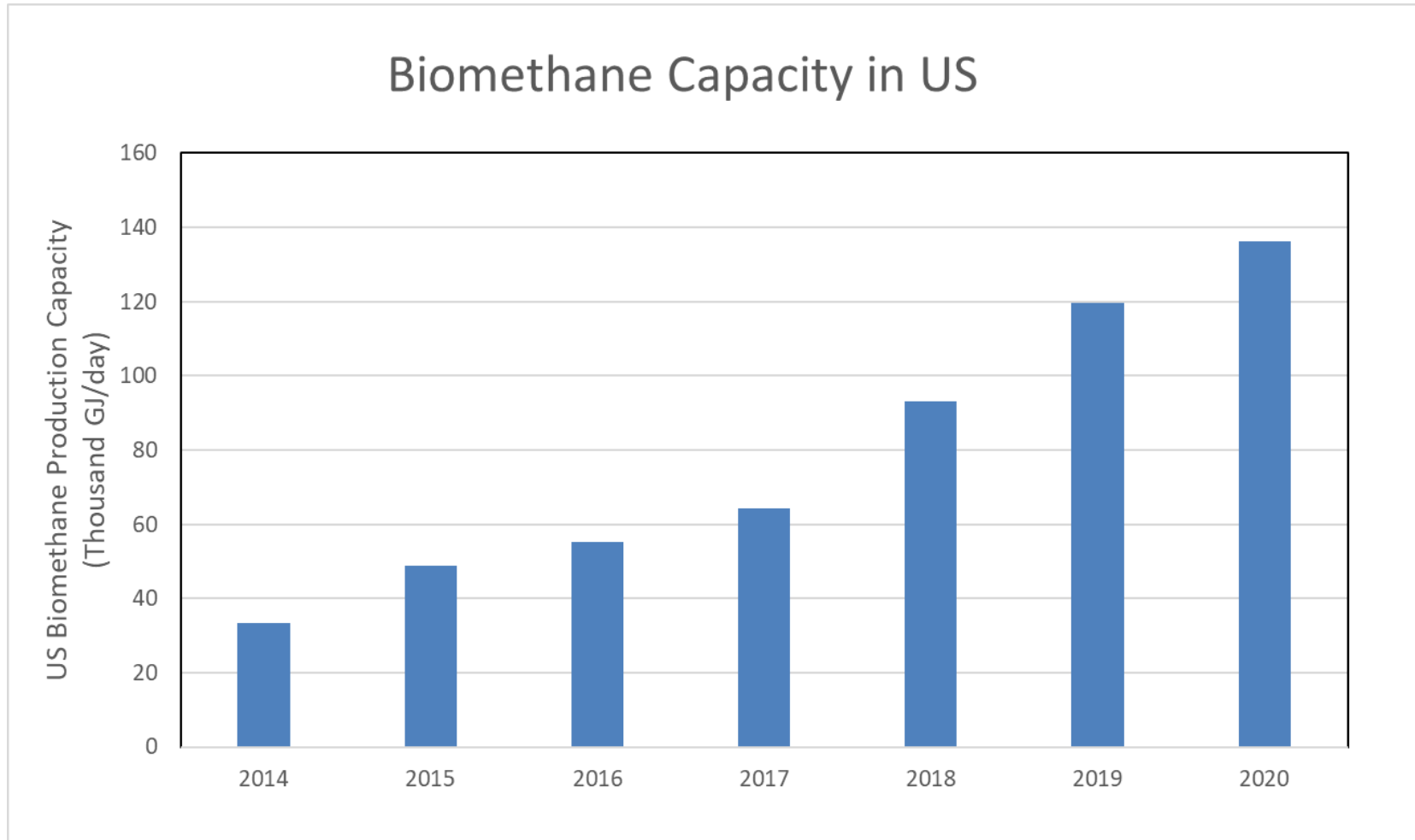
Market Value Available for Raw Biogas

Selected Market Data





US Biomethane Production has Grown at about 25%/yr.





Outlook for Biogas in North America (logen View)

- **Transportation fuels (via biomethane) will remain the highest value use for biogas**
 - RFS
 - Volume requirements are currently set annually by EPA, and are subject to political forces (Trump/Biden result will have impact)
 - Prices will be driven by supply/demand balance (political) and fossil/bio fuel spreads (commodity markets)
 - LCFS:
 - The California LCFS program incents low CI biomethane for fuel
 - CNG/LNG, Electricity, and refinery pathways approved
 - Prices will be driven by the complex of CO₂ reduction technologies, currently HVO (renewable diesel) is an important cost driver
 - Fuels and Feedstocks
 - CNG, LNG and Electricity for Vehicles
 - Iogen has developed a pathway to use RNG as a feedstock to make diesel and petrol by refinery co-processing
- **There will be a continued trend of redevelopment of biogas-to-electricity operations toward biomethane**
- **Emerging policies driving “greening of the natural gas grid” will compete to help finance expansion of the landfill and WWT biogas operations.**
 - NG utility offtake options have longer term fixed prices compared to transportation fuel offtake options
- **Investment will be predicated upon an expectation of policy stability**



US Opportunities for European Biogas Players

Opportunities include:

- Equipment supply and services
 - Europe has much more vendor experience
 - European operations have addressed small scale operations
- EU Biomethane supply chains serving the US
 - Low CI EU-produced fuels made with EU biomethane

Key areas of growth

- Conversions from electricity production to make biomethane
 - Addition of biomethane purification equipment & pipeline interconnect
 - Landfill gas and wastewater treatment facilities
 - Manure digesters
- New AD project developments
 - Manure digesters with AD and biomethane production
 - Food scraps AD with biomethane production



Questions?

Thank You!

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