



Renewable Natural Gas (Biomethane)

Its Production Through New and Old Conversion Technologies
Holds Key to Waste Disposal and Ultra-Low Emission,
Sustainable Truck & Bus Transportation in California

RNG or Electric for Trucks?

- CARB – 32% of NOx and 40% of Particulate Matter emissions in California are from Existing Diesel trucks and buses
- CARB – wants all vehicles to be electric
- CEC & UC Davis 2015 Workshop – earliest for practical electric drive for medium & heavy duty trucks is 2050 (34 years from now!)
 - Weight, range and torque shortcomings for electric today



RNG or Electric for Trucks?

- **Cummins-Westport CARB certified Ultra-Low NOx new dedicated CNG engine**
 - .02 grams NOx/bhphr (10 times lower than new engine standard)
 - Particulate Matter emissions reduced by more than 90% with CNG/RNG
- **North American Repower has CARB certified remanufactured dedicated CNG engine for conversion of existing diesel trucks to CNG and has applied for research grant to develop lean-burn Ultra-Low NOx remanufactured dedicated CNG engine for existing and new diesel trucks**



RNG + Ultra-Low NOx Engine = Emissions Solution for Trucks Today

- **GREET emissions model developed by Argonne National Lab and used in modified form by CARB**
 - Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model
 - Well to Wheels Emission Analysis
- **RNG is among lowest carbon intensity transportation fuels**
- **RNG used in Ultra-Low NOx dedicated CNG engine has wells-to-wheels emission profile equal to or lower than electric vehicle**



RNG Market Needs More of These...



CNG Truck



What Other California Sustainability Goals Can RNG Help to Address?

- 50% Renewable Portfolio Standard Goal
- Low Carbon Fuel Standard
- Reduction of Petroleum Transportation Fuels by 50%
- 75% Diversion of Organics from Landfill



Where Does RNG Now Used in California Come from? How is it Produced?

- **Almost all RNG used in California today is imported from outside of California**
 - No access to pipeline market for California projects
- **RNG (Biomethane) is produced by several methods from organic materials in waste streams**
 - Anaerobic digestion of organics in landfills
 - Anaerobic digestion of organics in anaerobic digesters, including wastewater treatment plants
 - Upgrading of SynGas produced from gasification or other thermal conversion processes of organics in solid waste to pipeline quality biomethane (RNG)
 - No incineration processes can be permitted in California



Access to Market is Key Barrier for RNG in California

- **For any recycling program to work, there must be a market for the recycled product**
 - Applies to renewable energy products such as RNG
 - Also applies to recycled inorganics, such as metals and glass
- **Need access to Market for value of recycled product, including RNG, to be realized**
- **California RNG must access California natural gas pipeline system for widest reach to available markets**



What's happened to AB 1900?

- **AB 1900 passed in 2012 to overturn Hayden Amendment (prohibited RNG with vinyl chloride content from pipeline injection – made it a crime on producer & pipeline company for violation)**
 - Purpose was to promote use of Biomethane in California
- **CPUC order in AB 1900 proceedings included new prohibitive standards for pipeline injection of RNG that remain barriers to California RNG projects**
 - High cost of interconnection to pipeline
 - \$1,500,000 to \$3,000,000 in CA vs \$80,000 to \$1,000,000 outside of CA
 - Maximum siloxane standard at level that cannot be reliably measured
 - Other states with RNG projects have no siloxane injection standard
 - Minimum heating value of 990 btus/scf
 - Prior minimum heating value standard in California was 970 btus/scf



How Have California's New Laws to Divert Organics from Landfills Affected Waste Disposal and RNG?

- **AB 341 & AB 1826 – 75% of organics to be diverted from landfills**
 - To where? Uh Oh.....
- **Has created waste disposal conundrum and increased hurdles and costs to produce RNG**



How Have California's New Laws to Divert Organics from Landfills Affected Waste Disposal and RNG?

- **Available technologies for waste disposal and percentage of potential RNG production – listed in order of increasing costs of disposal**
 - Composting
 - No energy recovery
 - Challenge – disposal of all composted material to be sustainable
 - Anaerobic Digestion
 - RNG production (or onsite electric power) of 10% to 40% of digested organic material
 - Challenge – disposal of recovered liquids and same challenge to dispose of all remaining organic material after digestion
 - Gasification or Other Thermal Conversion
 - 90% capture of energy content in organic materials gasified or thermally converted
 - Residual material is vitrified or biochar that can be landfilled or used as soil supplement to reduce water needs for agriculture
 - Permitting barriers exist to these technologies in California
 - Zero emissions required
 - 500 tons per day per project limit
 - No diversion credit for waste feedstocks
 - Inaccurate definition of Gasification in statute
 - Far more expensive per ton of waste disposal cost than composting or anaerobic digestion
- **Billions in investment needed to replace use of landfills in California for waste disposal - both municipal solid waste and forest and agricultural organic residues**



What Needs to be Done to Create Sustainable Solutions to California's Waste Disposal and RNG Production Conundrums?

- Need Cohesive Legislative & Regulatory Framework to Correct Current Antiquated and Dysfunctional laws and regulations
- Conclusively correct current barriers to access natural gas pipelines for RNG projects
- Task Force of Legislative Leaders and Governor's Office working with Stakeholders to Harmonize Conflicting Laws and Regulations to Allow Development of ALL Technologies Needed to Sustainably Handle Waste Disposal and RNG and Other Renewable Energy Production from California's waste stream



Thanks for Listening!!

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