



A New Energy Resource for America: Organic Waste to Biomethane

Environmental Benefits & Expanding Gas Utility Interest

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About Energy Vision

- Mission: To advance the adoption of the low-carbon renewable energy sources, transport fuels, and new technologies needed for a sustainable future.
- Program: Since 2010, primary focus on methane emissions capture and utilization to displace fossil fuels — especially in transportation — through reports, workshops, education and outreach, advisory and media.
- Energy Vision's Impacts:
 - Core team published the first U.S. reports on natural gas for refuse trucks ("Greening Garbage Trucks") and transit buses ("Bus Futures") in the early 2000's.
 - Hosted the first national workshop on "Renewable Natural Gas" in 2010 with the U.S. Dept. of Energy (+ 16 regional workshops since)
 - Published dozens of case studies, articles and Op-Eds on the RNG opportunity, inspiring new projects and positive change
 - Performed RNG technology and market assessments for various state, regional and federal government agencies/entities

Why Focus on Methane?

- ▶ Methane accounts for 10% of total US greenhouse gas emissions and 16% of total global GHG emissions.
- ▶ Methane is 25x more potent than carbon dioxide in its “global warming potential” over the 100 year timeframe and 86x more powerful over the 20-year horizon.
- ▶ The U.S. dairy sector generates more manure than any other country in the world. Other livestock operations (hog and chicken especially) face similar challenges.
- ▶ Preventing the escape of agricultural methane (biogas) via anaerobic digestion AND using this energy-rich resource to displace fossil fuels offers significant net-benefits.



Biogas-to-Electricity

- ▶ Historically, biogas-to-electricity has been the norm, because of technology and policy:
 - ▶ Renewable Portfolio Standards
 - ▶ Feed-in Tariffs/Net-Metering
 - ▶ Investment/Production Tax Credits
- ▶ Access to the above programs was largely restricted to generating renewable power

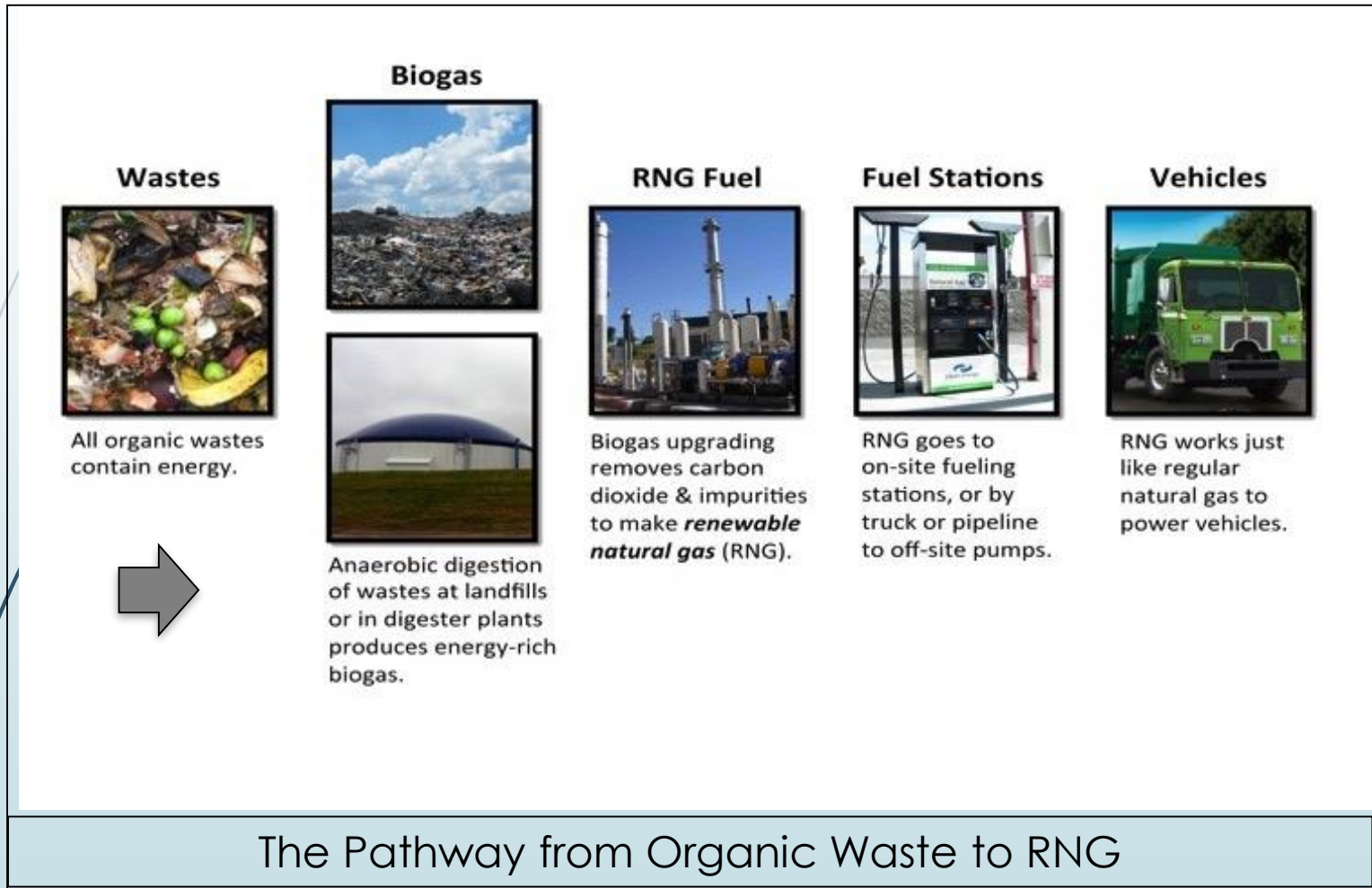


Upgrading Biogas to Renewable Natural Gas (RNG), which is interchangeable with geologic gas

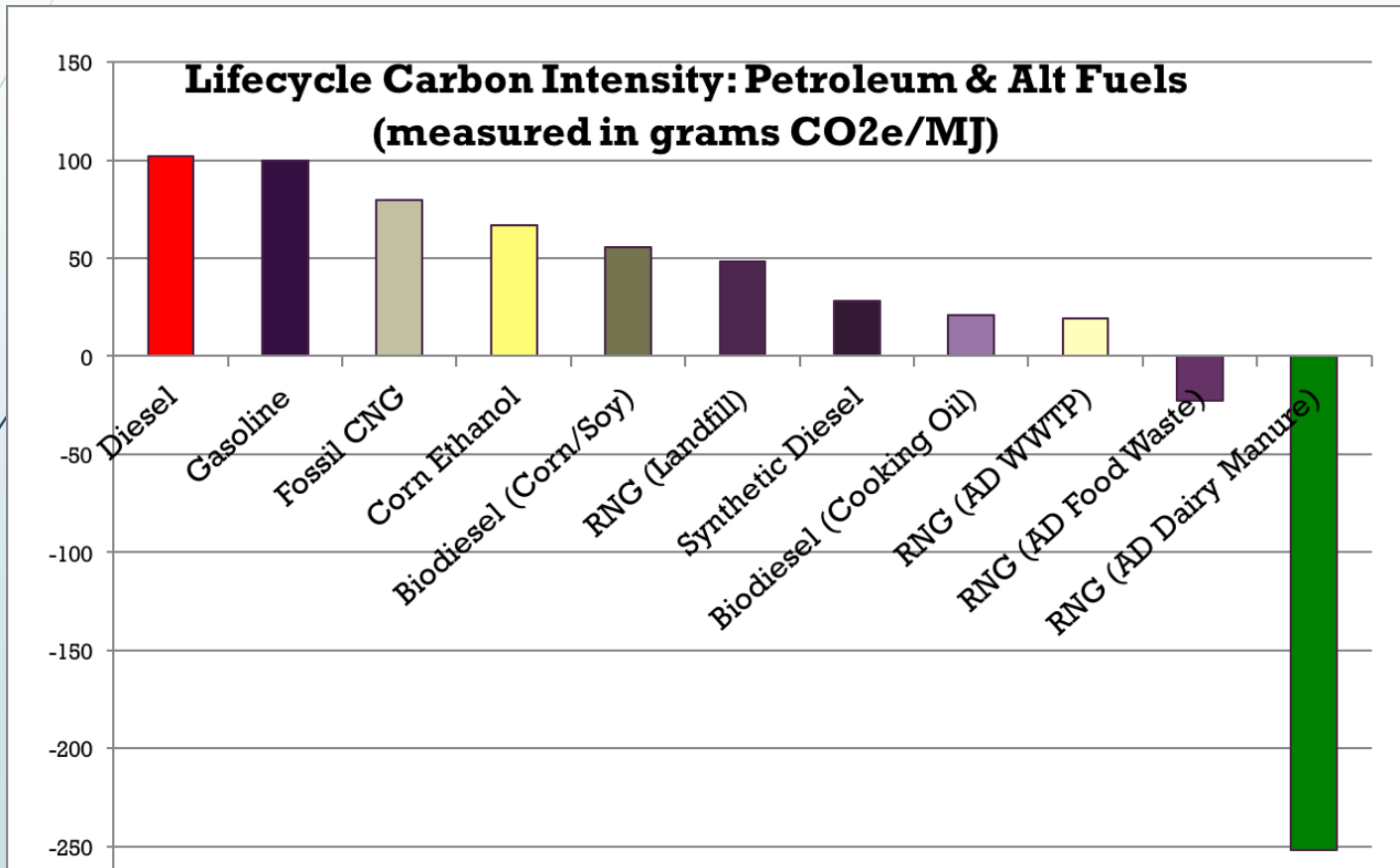
- Heating/Cooling/Cooking
- Power Generation
- Industrial Uses
- **Transportation** (use in Natural Gas Vehicles)



RNG for Transportation

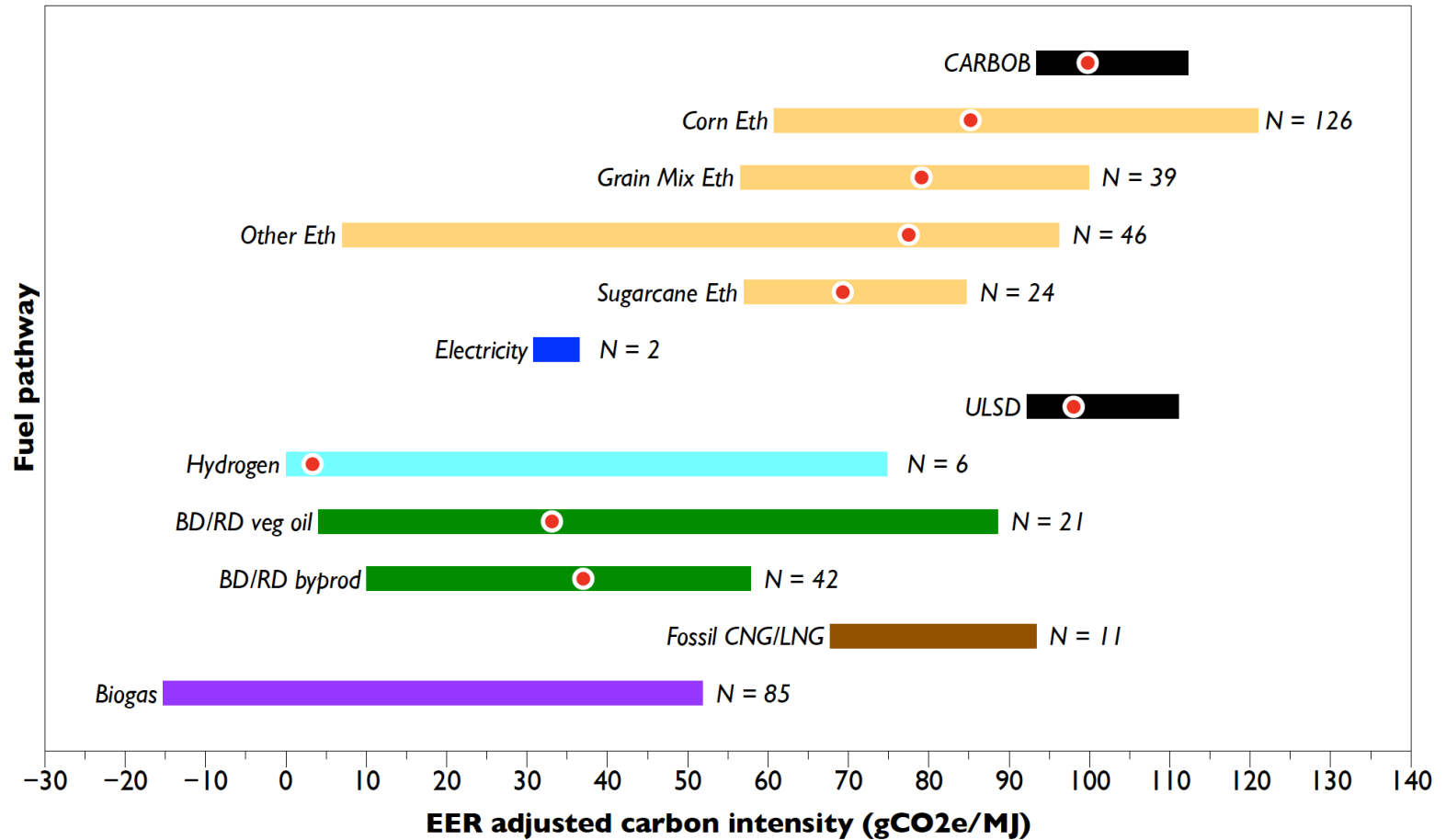


The Climate Case for RNG use as a Vehicle Fuel



Source: CARB LCFS Pathway Data, 2018

Climate Case for RNG, Continued



Source: Yeh, Sonia, et al. "A review of low carbon fuel policies: Principles, program status and future directions." *Energy Policy* 97 (2016): 220-234.

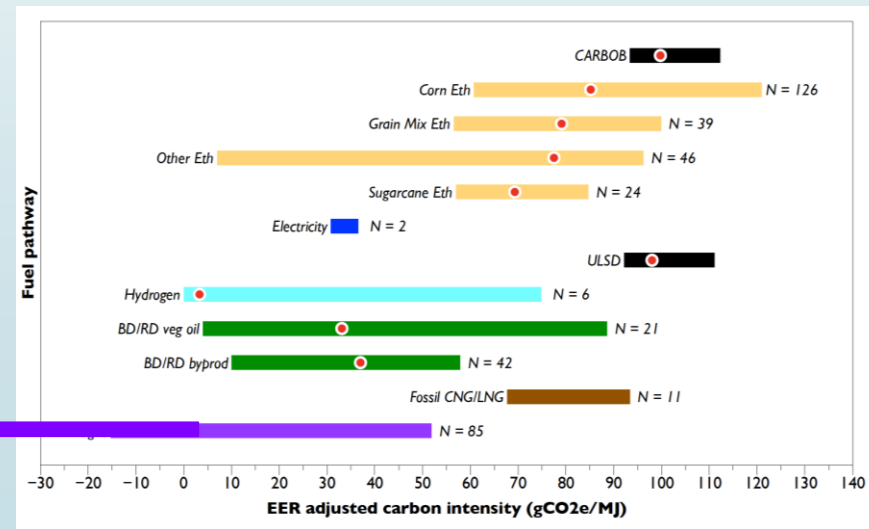
The Need to go Negative



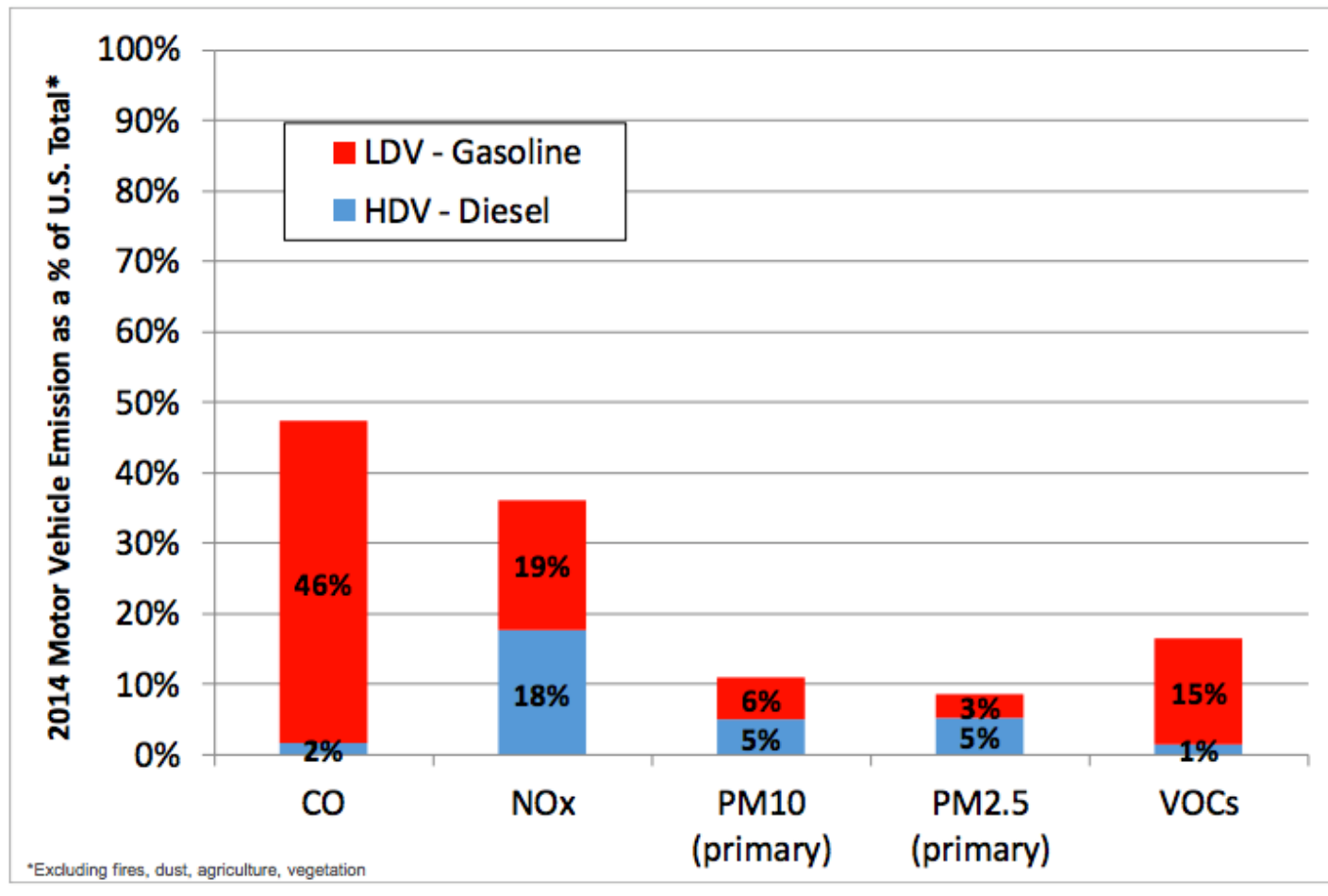
Dairy AD RNG

RNG

-276 gCO₂e/MJ



Why a Focus on Heavy-Duty Vehicles?



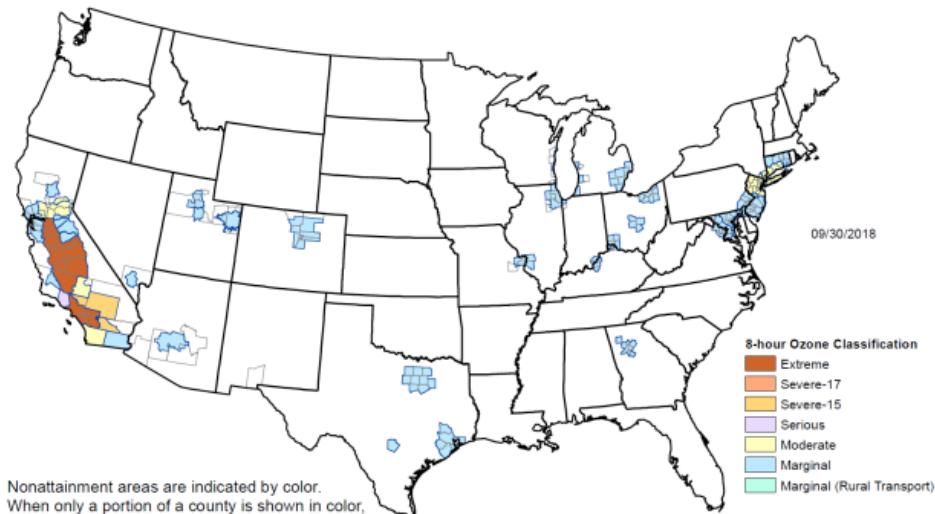
- HD Diesel vehicles account for 18% of TOTAL US NOx

Source: Argonne National Lab HDVEC Presentation, 2018

Heavy-Duty Diesel Vehicles & Smog

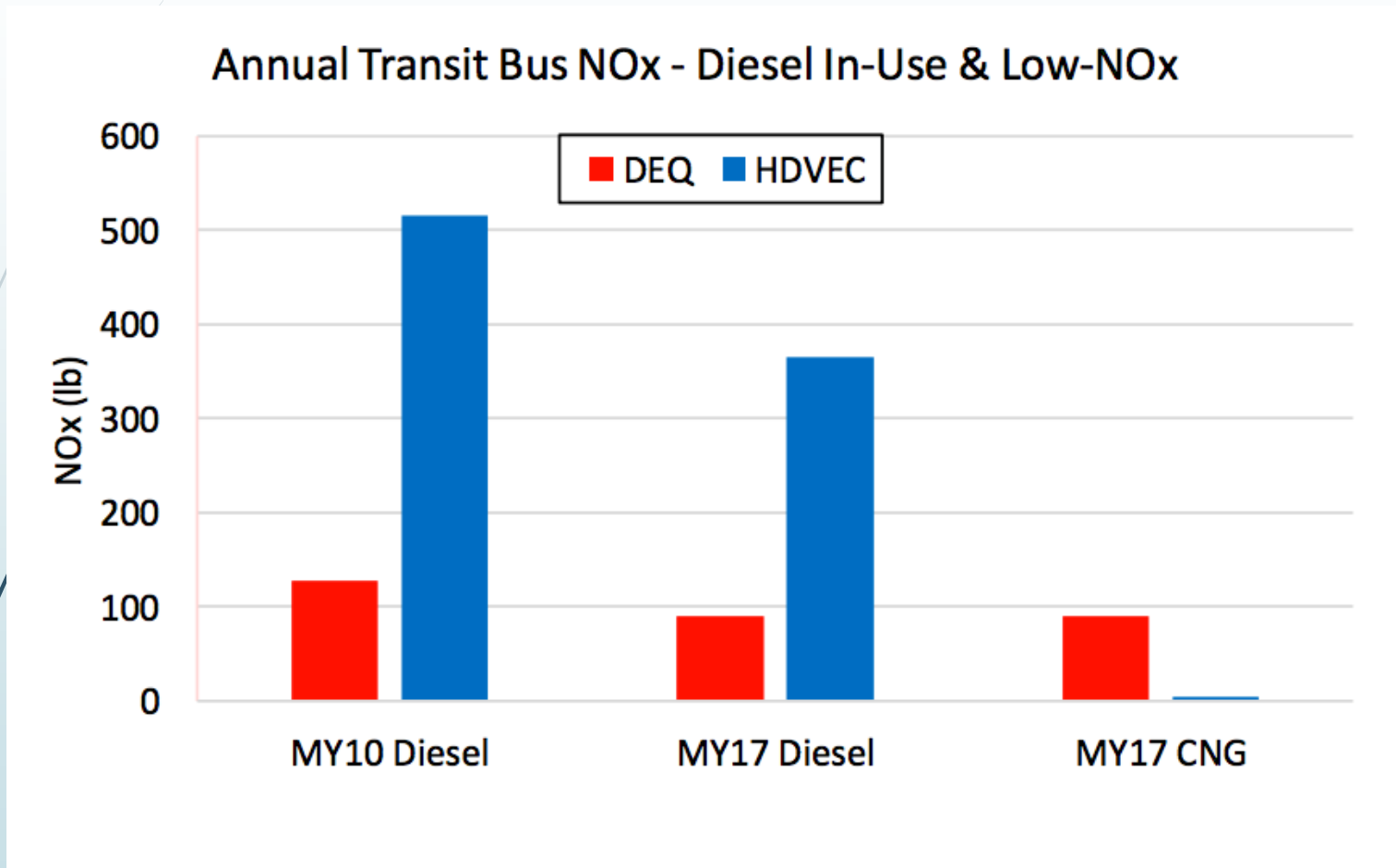


8-Hour Ozone Nonattainment Areas (2015 Standard)



Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.

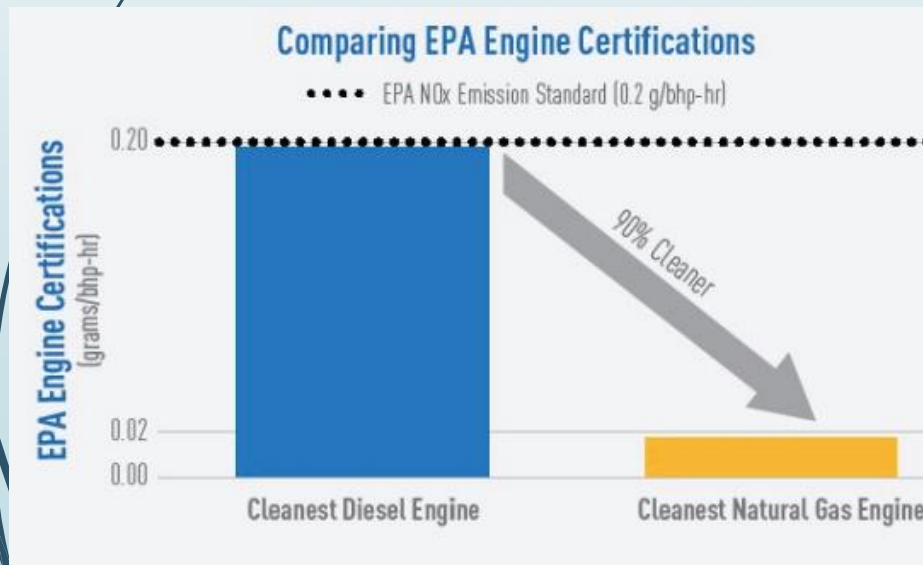
In-Use NOx Emissions vs. Regulatory Standards (DEQ)



Source: Argonne National Lab HDVEC Presentation, 2018

The Environmental Case for RNG

- ▶ 90% reduction in smog-forming NO_x compared to EPA 2010 standard (certified by EPA/CARB at .02 g/bhp)
- ▶ Up to 80% reduction in CO emissions
- ▶ Advanced “Near Zero” natural gas engines are also 50-80% quieter than comparable diesel models, improving conditions for drivers and passengers alike



Growing Gas Utility Interest in RNG



Inter-Agency & Inter/Intra-State Efforts to Advance Acceptance of RNG are Underway



Interconnect Guide for Renewable Natural Gas (RNG) In New York State

Final Draft



Department of Commerce

RNG Quality Standards for Pipeline Injection



Additional RNG Resources & Upcoming Events

- ▶ Energy Vision RNG Case Studies:
<http://energy-vision.org/resources/project-profiles/>
- ▶ Argonne National Labs/NREL:
<https://www.afdc.energy.gov/case>
- ▶ The Coalition for Renewable Natural Gas:
<http://www.rngcoalition.com/>
- ▶ The American Biogas Council:
<https://www.americanbiogascouncil.org/>

- ▶ **SAVE THE DATE - April 30, 2019; Phoenix, Arizona:**
Energy Vision's "Power of Waste" Workshop

The Power of Organic Waste: RNG For Arizona
<https://power-of-waste-arizona-2019.eventbrite.com>



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