From Biogas to Vehicle Fuel: 
*RNG for Heavy-Duty Buses & Trucks*

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Energy Vision

**Mission:** to advance global collaboration in adoption of the low-carbon, renewable energy sources, transport fuels, and new technologies needed for a sustainable future

**Program:** Research of alternative vehicle fuels to reduce reliance on petroleum in transportation, publication of reports on best options, newsletters, media, & educational outreach

**Impacts:**
- Inspired trend of truck/bus shifts to natural gas in the U.S.
- Building awareness of U.S. policy, business, and solid waste leaders of RNG fuel as leading transportation strategy for tackling climate change
- EV's Step-by-Step Guide to converting organic wastes into fuel, used in regional workshops, leading to expanding initiatives
**Why a Focus on Trucks & Buses?**  
Small Numbers, Big Impact  
(U.S. Example)

- **Class 3-8 Trucks**
  - 10M = 4% Vehicles

- **Light Trucks**
  - 110 M

- **Passenger Cars**
  - 135 M

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**Haul 70% GDP**

- Provide vital services

**23% road fuel, 26% road GHG, Most road-related soot & NOx**

***Diesel Fuel Accounts for > 95% of all on-road heavy-duty buses and trucks***
An Emerging Non-Petroleum Option: Renewable Natural Gas (RNG)

- RNG is chemically identical to pipeline quality natural gas, but derived from renewable sources of organic waste.

- RNG can use the same infrastructure as fossil gas: pipelines, gas compressors, refueling stations, and vehicle engine technology.

- Major difference: RNG is sustainable: made from biogases emitted as organics decompose in airless environments; no drilling; virtually no soot, and much lower in carbon.
RNG: Multiple Sources

- Landfills
- Wastewater Treatment Plants
- Farms/Dairies
- Commercial Food Waste
- Residential Organic Waste
RNG for Transportation: How It Works

- **Wastes**: All organic wastes contain energy. Anaerobic digestion of wastes at landfills or in digester plants produces energy-rich biogas.

- **Biogas**: Biogas upgrading removes carbon dioxide & impurities to make **renewable natural gas** (RNG).

- **RNG Fuel**: RNG goes to on-site fueling stations, or by truck or pipeline to off-site pumps.

- **Fuel Stations**: RNG works just like regular natural gas to power vehicles.

- **Vehicles**: 

**The Pathway from Organic Waste to RNG**
RNG: The Ultra-Low-Carbon Option TODAY

- RNG is a net-carbon negative fuel when made via anaerobic digestion of food and other organic waste.
RNG in the U.S.: 33 Projects in 15 States

**In total, these 33 projects produced more than 90 million gallons of ultra-low-carbon RNG in 2015**

Source: [www.energy-vision.org/organics-to-fuel-case-studies/](http://www.energy-vision.org/organics-to-fuel-case-studies/)
Sacramento Food Waste Biodigester (CA)

See Project Profile: http://bit.ly/1Kv1U07
Pierce County Transit (Tacoma, WA)

- Pierce Transit in Tacoma, WA became the first transit fleet in the U.S. to transition from CNG to RNG by beginning to refuel 143 public transit buses on locally-produced RNG from the Cedar Hills landfill in Seattle.

- They were also the first to run a transit fleet on fossil CNG, making the switch in 1989. The transition to RNG was strictly a matter of sourcing the fuel – the pump price is unchanged.

See Project Profile: http://bit.ly/1DCtCFJ
Persigo Wastewater RNG (Colorado)

- In 2015, the City of Grand Junction, Colorado (pop. 60,000) installed a small system to convert biogas into vehicle-quality fuel at a cost of $2.8M USD

- The City and County now fuel 38 natural gas buses and refuse trucks with locally-produced RNG, displacing ~170,000 gallons of diesel/year

See Project Profile: http://bit.ly/1SdbKtB
Organics-to-RNG in Surrey (BC)

- Public-Private Partnership
- 110,000 tonnes residential and commercial organics processed
- Enough RNG for the entire refuse fleet + other municipal CNG vehicles once fully operational

**REDEEM™ by Clean Energy Fuels**

- Utilize Existing Natural Gas Infrastructure to Offer RNG at 40+ Retail Stations in California + stations in Texas and Tennessee (UPS is the largest customer)

- ~50 Million GGE’s of REDEEM (sourced from a number of landfills across the country) hit the market in 2015

- >100,000 GGE’s of REDEEM dispensed daily in California, largely because of the state’s Low Carbon Fuel Standard (carbon program)

For more on REDEEM, visit:  
RNG Policy Drivers & Hurdles

- Current Policy Drivers Include:
  - US EPA Renewable Fuel Standard
  - California Low-Carbon Fuel Standard
  - Natural Gas Vehicle/Infrastructure Incentives
  - City & State Level Landfill Diversion Laws

- Primary Hurdles to RNG are Logistics & Financing:
  - All Technologies are Proven & Commercial

- Carbon Price/Tax would greatly incentivize RNG
Conclusions

- **RNG: A Winning Climate Change Strategy for Transportation.** Supportive energy and environmental policy and private sector investment can turn one of the world’s major waste burdens & sources of anthropogenic methane into a clean close to carbon-free fuel using commercial technology.

- **RNG: A fully sustainable fuel to displace diesel in heavy-duty fleets.** Many other renewables exist for power generation.

- **Growing a Waste-to-Fuel Industry is an economic winner:** displaces diesel with a modestly priced, secure, homegrown fuel; cuts waste disposal costs, creates permanent high and low level jobs, while protecting our environment.

- **Quebec has an immense opportunity to take advantage of its organic waste resource(s)**
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