The Power of Organic Waste: Renewable Natural Gas
U.S. Perspectives on a Global Opportunity

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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:** Primary focus on resource recovery and alternative vehicle fuels to reduce reliance on fossil fuels—especially petroleum use in transportation—through reports, workshops, education and outreach, partnerships and media.

- **Impacts:**
  - Published the first U.S. reports on natural gas for refuse trucks (Greening Garbage Trucks) and transit buses (Bus Futures)
  - Hosted the first national workshop on “Renewable Natural Gas” in 2010 with the U.S. Dept. of Energy (+ 12 regional workshops since)
  - Led a 2017 U.S. Biogas Study Tour for municipal officials from Durban, South Africa through USAID
Why a Focus on “Waste” & Transportation?

- The U.S. generates more solid waste per capita and uses more petroleum per capita than any other country.
- Within transportation, heavy-duty trucks and buses—many operating in urban centers—consume ~40 Billion gallons of diesel/year.
- Turning organic waste into biogas (and ultimately RNG), is a proven, commercial, cost-effective strategy to address both our solid waste and transportation challenges.
Biogas: Multiple End-Uses

- Biogases (60% methane; 40% CO2) can be used generate heat or power on-site, when combusted.

- Refined biogases (removing moisture, CO2 & impurities) become “renewable natural gas” (RNG) or biomethane, a fuel that can be used like fossil gas to cook, heat, generate electricity, or power vehicles.
Upgrading Biogas to Pipeline & Vehicle Quality

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

The Pathway from Organic Waste to RNG

Wastes
All organic wastes contain energy.

Biogas
Anaerobic digestion of wastes at landfills or in digester plants produces energy-rich biogas.

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

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

Vehicles
RNG works just like regular natural gas to power vehicles.
Existing Infrastructure + Commercial Technology

There are more than 210 natural gas pipeline systems in the U.S. comprising of 2.5 million miles of distribution and transmission pipeline.

Today there are 1,640 CNG and 123 LNG refueling stations.

Over 20% of transit buses operate on NG.
Over 60% of new refuse truck orders are NG.
The heavy-duty truck market continues to transition to NG.
The Climate Case for RNG in Vehicles

![Lifecyle Carbon Intensity: Petroleum & Alt Fuels](image)

Source: CARB LCFS Pathway Data
The Clean Air Case for RNG in Vehicles

- 90% reduction in smog-forming NOx compared to EPA 2010 standard (certified by EPA/CARB at .02 g/bhp)
- Up to 90% reduction in health-threatening PM emissions
- 80% reduction in CO emissions
The Business Case for RNG in Vehicles

- Existing Refueling Infrastructure (+1,500 stations)
- Growing Heavy-Duty Vehicle Market (60% of new refuse trucks; ~25% of transit buses)
- State & Federal Renewable Fuel Production Incentives = RNG at parity with competitively priced natural gas*

Source: ICF
In 2017, Energy Vision completed a comprehensive RNG project database in collaboration with the U.S. Dept. of Energy/Argonne Lab.

There are now 60+ RNG projects and another 25 in development; 40+ deliver gas to transportation.
RNG in the N.A.: 60+ Operating Projects
Case Study 1: Small Landfill
St. Landry Parish, Louisiana

- 100 scfm landfill gas collected, refined and compressed on-site; then dispensed to municipal CNG cars/trucks and private refuse trucks.

- Capital cost of $2.7M; ~170,000 GGE’s/yr at $1.50/gallon
Case Study 2: Small Wastewater Facility

- **Persigo Wastewater Biogas Project (CO)**

- 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 PBS NewsHour Story: www.youtube.com/watch?v=ASoXPy8RWlQ
Case Study 3: Large Landfill

- **Seneca Meadows Landfill (NY) and Aria Energy & Clean Energy Renewables**
- 3,000 scfm of landfill gas refined and injected into natural gas pipeline at Seneca Meadows (Progressive Waste landfill)
- Capacity to produce ~25,000 GGE’s/day of RNG (9M GGEs/yr)
- 60% delivered to SMUD in Sacramento; 40% is delivered to the transportation market in California through a partnership with Clean Energy
ampCNG and Fair Oaks Farms convert manure from 11,500 cows into fuel - more than 1.5 Million gallons/year - which powers 42 long-haul delivery trucks hauling 300,000 gallons of milk a day.

Total capital cost for biogas upgrading, refueling and CNG truck purchase was approximately $18M.
Emerging On-Site Organics Management Options Coming to a City Near You
Eliminate the Hauler & Turn a Liability into an Asset
Additional RNG Resources

- 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/