

RENEWABLE NATURAL GAS (RNG)

The Solution to a Major Transportation Challenge

A Clean, Secure, Commercially Viable Replacement for Diesel Fuel TODAY



Facts and Case Studies
by
Energy Vision and CALSTART





*CALSTART, North America's leading
clean transportation technologies and
solutions consortium:
Tel: 626 744-5600 Web: www.calstart.org.*



*Energy Vision, a national non-profit organization
promoting strategies for a sustainable transportation future:
Tel: 212 228-0225 web: www.energy-vision.org.*

RENEWABLE NATURAL GAS (RNG)

The Solution to a Major Transportation Challenge

A Clean, Secure, Commercially Viable Replacement for Diesel Fuel TODAY

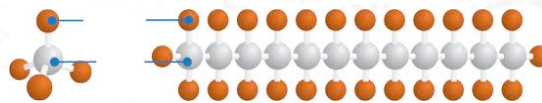
RENEWABLE NATURAL GAS, A FUEL MADE FROM WASTE, CAN FREE MILLIONS OF BUSES AND TRUCKS FROM RELIANCE ON OIL

- **The 10 million trucks and buses on U.S. roadways, provide essential services to virtually every American community, and they transport goods worth nearly 70% of the GDP.** Buses and trucks make up just 4% of all vehicles but they use 23% of all highway fuel – almost entirely high-carbon diesel produced from foreign oil. Fossil-based natural gas and renewable natural gas (RNG) are the only clean, secure fuels currently able to replace major quantities of diesel.
- **RNG use requires no technology breakthroughs so it is an easy fuel to introduce in the heavy duty truck and bus sectors.** It can be transported through the same pipelines, stored in the same tanks, dispensed through the same refueling facilities, and used to power the same engines as fossil natural gas. It can be blended with fossil gas or used separately.
- **Every bus or truck fleet already converted to fossil natural gas is poised to shift to RNG.** The challenges of this shift involve ramping up production of RNG from local organic wastes and getting the fuel to vehicle markets either via refueling equipment at the fuel production site or by sending it to markets further away by tanker trucks or pipeline.

RNG IS JUST LIKE FOSSIL GAS BUT BETTER

- **RNG is a commercially viable sustainable fuel!** It is made from a renewable source (organic wastes). It is virtually free of particulate (soot) emissions and has close to zero net carbon impact. It requires no drilling.
- **Both RNG and fossil natural gas are primarily methane, containing four atoms of hydrogen and one of carbon (CH₄).** Methane produces fewer dangerous pollutants than gasoline or diesel. Because it is a simpler molecule, it burns more completely. *Figure 1* compares methane and diesel.

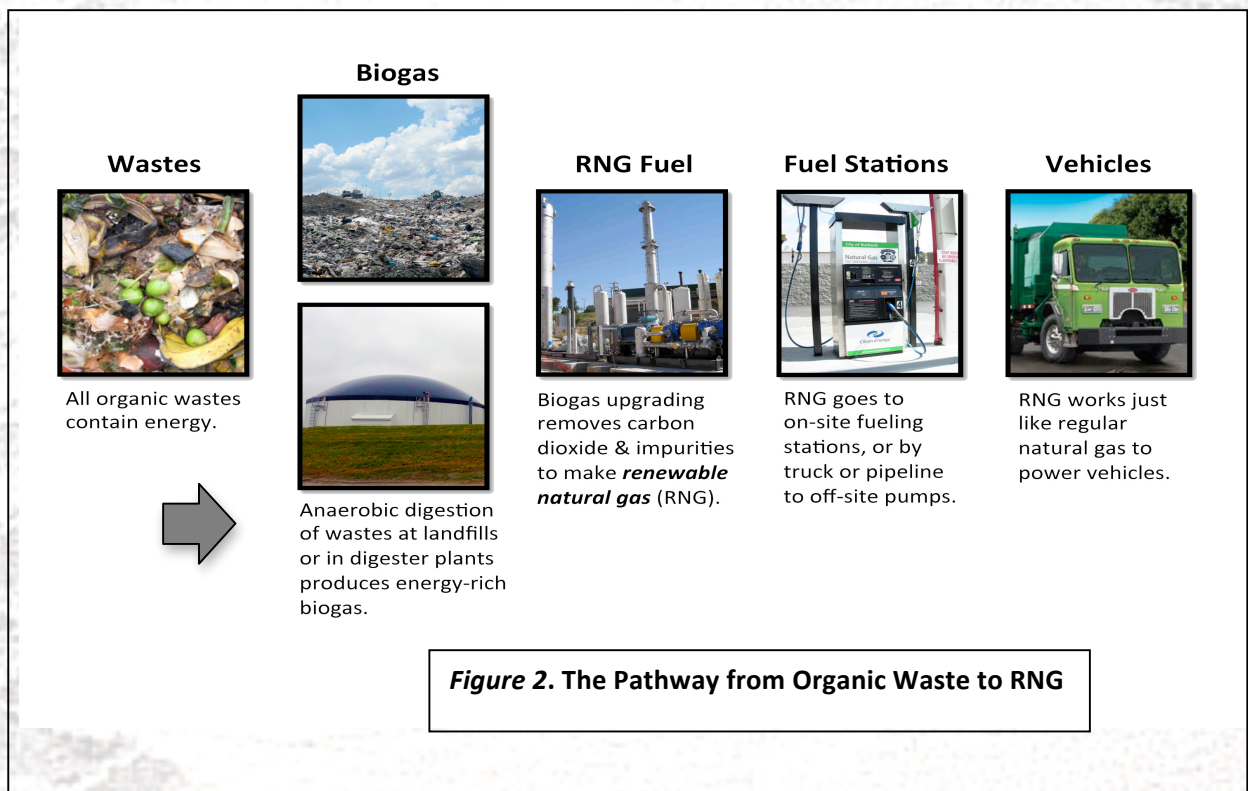
Figure 1



Chemical structures of methane (left) and diesel fuel molecules (right). A typical diesel molecule has 12 carbon atoms and 26 hydrogen atoms while a methane molecule has only 1 carbon atom and 4 hydrogen atoms.

THE MAJOR DIFFERENCE BETWEEN RNG AND FOSSIL NATURAL GAS LIES IN HOW IT IS MADE

- **RNG is made from biogases that are emitted as organic wastes break down.** These wastes (in descending order of availability¹) include the following:²
 - Landfill waste (including household garbage and yard clippings)
 - Certain agricultural crops and wood residues
 - Livestock manures from farms and dairies
 - Institutional and commercial wastes (from universities, hospitals, resorts, supermarkets, food processing plants, etc.)
 - Municipal wastewater treatment plant sludge
 - Numerous animal by-products including fats, oils, and grease (called FOG)
- **Different types of organic wastes differ in energy value.** Food wastes and FOG have higher energy values than livestock manures and wastewater. So combining energy-rich wastes with wastes having lower energy value increases biogas production.³



- **The biogases are formed as bacteria consume the organic wastes when they are contained in airless environments.** This can be in landfills or in special tanks called “anaerobic digesters,” which can be built at sewage treatment plants, on farms, or elsewhere.

- **The biogases are collected and then cleaned up into nearly pure methane, the chemical equivalent of fossil natural gas.** The gases from landfills, farms, dairies or in anaerobic digesters are captured instead of being allowed to escape into the air as powerful climate-changing greenhouse gases. Because of this, RNG, on a “life cycle” basis, is close to a zero carbon emission fuel. Proven gas cleanup technologies can be used to remove moisture, carbon dioxide (CO₂), hydrogen sulfides, siloxanes and other gases and impurities, depending on the biogas composition.

RNG CAN BE MADE IN COMMERCIAL QUANTITIES NOW

- **The organic wastes thrown away daily in every city, town or rural region can be turned into enough fuel, using today’s technologies, to displace 16% of all diesel fuel consumed in the U.S..⁸**
- **Some of the largest potential sources of RNG are found in the sites listed below.** At present, where biogas is being captured (to prevent greenhouse gas escape) most is used to generate electricity rather than to make vehicle fuel, largely because this use is encouraged by federal tax incentives and state renewable energy programs.
- **The 1,750 large landfills:** These landfills regulated by the U.S. Environmental Protection Agency (EPA). Of these, 541 sites convert biogas to power and heat, but only five make vehicle fuel. Another 501 sites are good candidates for energy projects. The remaining 715 may be good sites as more efficient small-scale technologies develop.⁴
- **The 17,000 municipal wastewater treatment plants:** Of the more than 3,500 plants processing at least a million gallons of sewage a day, only 1,500 currently use their biogas – most for electricity generation. The other 2,000 are ideal candidates for anaerobic digesters.⁵
- **Over 8,000 large dairy, cattle, hog, and poultry farms:** Of these, only 186⁶ now use anaerobic digestion to prevent runoff of nitrogen, phosphorous, and potassium fertilizers, to reduce odors, to produce biogas for heating buildings, generating power, or selling for farm income.⁵



- **Communities, cities and large Institutions:** Food processing plants, resorts, universities, supermarkets, etc. may produce sufficient organics worth collecting to put in anaerobic digesters⁷ - but most still send them to landfills or waste-to-energy plants.



RNG WILL BE ABLE TO DISPLACE MUCH MORE DIESEL IN THE FUTURE

- **“Thermal gasification” technologies are now on the horizon.** These processes will make it possible to process tougher forestry wastes and energy crops.⁸
- **Through both anaerobic digestion and thermal gasification, renewable natural gas could displace 45% (17.9 billion gallons) of the 38 billion gallons of diesel fuel used in transportation annually** based on estimates by the American Gas Foundation.⁸ With federal and state incentives, the contribution of RNG could be even greater.

WHY IS IT SMART TO USE RNG AS A VEHICLE FUEL INSTEAD OF FOR GENERATING POWER OR HEATING HOMES?

- Many renewable energy sources – wind, solar, geothermal, etc. – can be used to generate power. **But renewable natural gas and fossil gas are the only vehicle fuels that can displace significant amounts of oil while safeguarding U.S. national security and strengthening the economy.**⁹
- **RNG production is the most efficient way to convert biomass to fuel.** It requires less “energy in” to produce each unit of “energy out” than any other fuel made from biomass, including ethanol and biodiesel.¹¹

RNG MEANS A STRONGER ECONOMY AND NEW JOBS

- **The U.S. economy is sapped of almost \$845 million a day that is sent abroad to buy 45% of the oil to meet our needs. Some \$110 million of this goes daily for the oil needed in diesel production.** About half of U.S. imports come from sources in the Middle East and elsewhere where priorities are not allied with our own.⁹ The fluctuating price of this oil destabilizes the U.S. economy and upsets the budgets of local communities. Being powered by locally-produced RNG, essential fleets for sanitation, road repair, emergency, resident and student transportation would be protected from unpredictable price swings.

Figure 3

Rollercoaster Diesel Prices



The national average cost of diesel fuel soared from \$2.63 to \$4.06 a gallon over a 20-month period from fall 2009 to spring 2011 and remains above \$4.00 today. The primary cause of this hike of more than 50% was volatility in world oil markets, but the impact has been felt across the U.S.¹⁰

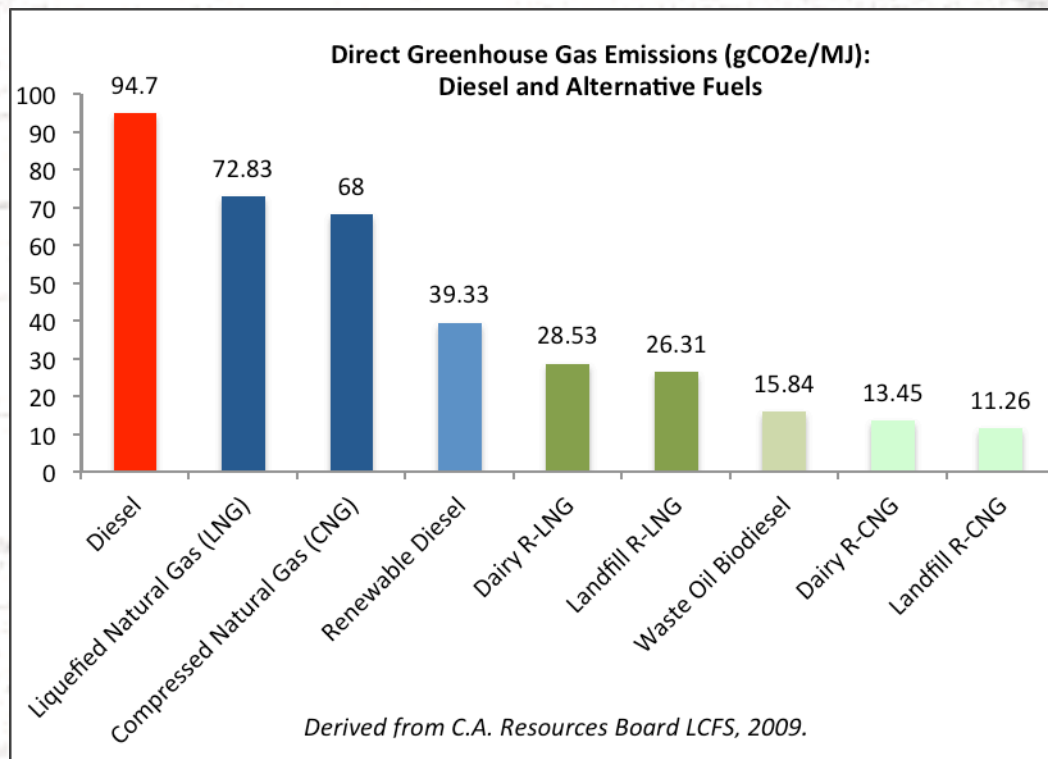
- **Using today's RNG anaerobic digestion processes to displace 16% of diesel fuel used by heavy duty vehicles would free up some \$17.6 million a day – or \$6.4 billion a year – now sent abroad to buy oil for diesel production.⁸**
- **Risks also exist of an oil supply disruption, which could be caused by political conflict cutting off a major pipeline, by a fuel embargo, or just by the rising competition for the world's remaining oil.** Any such event could disrupt the operations of the country's essential "workhorse" bus and truck fleets on which virtually every city and community relies as well as trucking operations nationwide.
- **RNG production can create thousands of permanent non-exportable jobs.** Every city, town, and rural area in the U.S. can turn its waste into fuel. Rural areas, in particular, can benefit because more than half the waste feedstocks come from livestock farms and crop residues. A 2011 American Gas Foundation study estimated that design, construction and operation of RNG plants supplying fuel to displace 45% of diesel demand would create more than 250,000 jobs.⁸
- **RNG production and use can be economically profitable.** This is especially the case where owners of the organic wastes from which RNG is made are also the users of the fuel. Some landfill, farm, dairy and wastewater treatment plant initiatives fall into this category. The costs and financial

benefits of any particular waste-to-fuels initiative will vary based on a wide range of factors including:²

- the type of organic feedstocks to be used
- the distance organics have to be transported
- land availability
- biogas upgrading needs
- the type and location of refueling infrastructure
- fleet markets
- the “tipping fees” that may be paid for organics disposal
- the cost savings of RNG fuel use
- the quality of the biosolids left after gas collection
- the availability of state or federal financial incentives

RNG WILL HELP MEET U.S. ENVIRONMENTAL GOALS

- **RNG slashes carbon emissions to near zero:** RNG’s carbon footprint, measured over the “life cycle” of the fuel’s production, transport and use, is the lowest of any vehicle fuel that is commercially available today according to research by the California Air Resources Board.¹¹



- **RNG means cleaner air:** Vehicles powered by RNG and fossil natural gas produce up to 80% fewer nitrogen oxide emissions than diesel and virtually no particulate emissions without the need for expensive pollution controls that diesel-powered vehicles must use. They meet the 2013 EPA clean-air standards today.¹²
- **RNG improves the environment by making use of waste and conserving natural resources.** RNG production turns the costly environmental burden of solid waste into a clean fuel solution.

Approximately 28% of the U.S. municipal waste stream is comprised of organics (food scraps and yard clippings), some 187,000 metric tons a day or close to 68 million metric tons per year.¹³

- **The greatest environmental value is gained from organic wastes when they are separated and processed in anaerobic digesters.** Landfilling of mixed wastes does not capture the valuable biosolids remaining after anaerobic digestion of separated organics. These include liquids which are rich in nutrients and useful as crop fertilizers as well as fibrous materials which can condition soils and may increase soil-moisture retention.

OBSTACLES HAMPERING PRODUCTION AND USE OF RNG VEHICLE FUEL

- **Limited access to vehicle fuel markets is a barrier** to industry growth. Federal economic incentives established by the 2005 energy and transportation legislation have been eliminated. These helped communities and fleets overcome the high initial costs of shifting from diesel to natural gas vehicles and building new refueling stations and gave natural gas fuel an economic edge.
- **The U.S. tax code (IRS Investment Tax Credit) currently provides an incentive for producing biogas for power generation but not for vehicle fuel.**
- **The lack of uniform federal or state specifications for gas acceptance and the absence of a national quality standard for RNG injected into the pipeline system** requires RNG project developers to negotiate acceptance with each gas utility, adding considerable time and cost, according to a recent transportation fuels study by the National Petroleum Council.¹⁴
- **State-level renewable portfolio standard rules** include incentives supporting production of high-Btu RNG for electricity generation. They do not support production of RNG for vehicle fuel use.
- **Absence of state-level “low carbon fuel standards” means that fuel producers and distributors are not rewarded for reducing the overall carbon content of their fuels by shifting to the lowest-carbon alternatives.**
- **Lack of state-level mechanisms, for example “feed-in tariffs,”** with assured price means that RNG suppliers, which have higher production costs (largely related to the biogas upgrading process) than those for CNG or LNG, find it uneconomic to put their product into a pipeline for vehicle fuel use if it is sold at the lower CNG rate.
- **Instability in vehicle fuel credit markets,** primarily Renewable Identification Numbers (RINs) administered under EPA’s Renewable Fuels Standard, makes it very difficult to structure long-term contracts with end users.
- **Permitting, regulations, and tax exempt status** can determine whether or not a project goes ahead. The tax classification and permitting processes for biomethane production now vary by state. When combined with regulatory hurdles, access to gas pipelines, a crucial component of more widespread adoption of biomethane as a vehicle fuel, can be difficult and/or prohibitively expensive.
- **Cheap and abundant natural gas has made it difficult for RNG and other renewable technologies to compete.** The current glut of natural gas and the near all-time low price of this fuel, mean that the economics of RNG (and renewables in general) are less attractive without state and federal support.

EIGHT PROFILES OF RNG INITIATIVES IN THE U.S.

The eight profiles of RNG projects in the U.S. that follow illustrate the many settings in which this sustainable fuel can displace diesel. They use proven technology and the fuel is cost competitive to diesel today (in 2012). It creates both skilled and un-skilled jobs in key parts of the country. Encouraged with government incentives, it can be scaled up more rapidly to deliver significant volumes of fuel.

Renewable Natural Gas (RNG)

8 Projects in the US

<u>Waste site</u>	<u>Location</u>	<u>Vehicles fueled with RNG</u>
Altamont Landfill	CA	300-400 refuse trucks
Fair Oaks Dairy	IN	42 milk delivery trucks
Rodefeld Landfill	WI	25-30 vehicles
Sauk Trail Hills Landfill	MI	NA (RNG leaves site via pipeline)
Columbus bio-Energy Digester	OH	25+ vehicles
Janesville Wastewater Plant	WI	40+ vehicles by 2022
St. Landry Parish Landfill	LA	15+ vehicles
Rumpke Landfill	OH	10-15 refuse trucks

Fair Oaks Dairy



Partners:

Fair Oaks Dairy,
Renewable Dairy Fuels LLC,
Ruan Transport, and Clean Energy
Fuels Corp.

Location:

Fair Oaks, IN

Contact:

Mark Stoermann
Renewable Dairy Fuels LLC
marks@fairoaksdairy.com

The first long-haul fleet in the US to be powered by renewable compressed natural gas (R-CNG) transports milk from Indiana to Kentucky and Tennessee.

Summary: An anaerobic digester built in 2009 - using bacteria in an oxygen-free environment to convert organic waste to R-CNG - processes 500,000 gals/day of liquid manure. In 2012, production will exceed 1.5 million diesel gallon equivalents a year of R-CNG. The biogas will be upgraded for use as vehicle fuel at an on-site plant near the digester and subsequently sent via pipeline to two refueling stations, built by Clean Energy Fuels Corp. The R-CNG will fuel 42 long-haul milk trucks, operated by Ruan Transportation Services - one of the nation's largest fleet operators, delivering 53 loads (over 300,000 gallons) of milk per day. The digester technology is from DVO Inc. (formerly GHD), a Chilton, WI based company, and Flotech Greenlane, an international leader in the field, provided a Totara+ biogas upgrading system. UTS-Residual Solutions has a "design-build-operate" contract for the entire system, including technology selection, installation and management, and the construction and maintenance of the fuel delivery and storage system (except for the fueling station). Use of R-CNG will result in \$2.5 million in annual fuel savings and CO₂ emissions reductions of more than 16,500 tons.

Funding: The private financial partners are Fair Oaks Dairy and AMP Americas. Together they covered the majority of the total \$19 million investment. Public funds provided under the Obama Administration's American Recovery & Reinvestment Act of 2009, through Clean Cities of Greater Indiana, totaled \$750,000 for the CNG stations. A grant from Indiana's State Energy Program (SEP) of \$2 million covered the incremental cost of the CNG trucks equipped with extra gas tanks for extended range use.

Rodefild Landfill



Partners: BioCNG-Cornerstone
Environmental Group, Dane County,
Alliant Energy, Unison Solutions, ANGI
and Madison College

Location: Dane County, WI

Contact:

Mark Torresani
Cornerstone Environmental Group
mark.torresani@cornerstoneeg.com

A Wisconsin community earns top EPA award by showing how a biogas-to-vehicle fuel system can work on a small scale.

Summary: In January 2011, the first Bio-CNG vehicle at the site was fueled using biogas from the existing Rodefild Landfill in Dane County, WI. The facility has now been in operation for over a year and fuels 10-15 vehicles with Renewable Natural Gas (C-RNG). Annual fuel capacity is approximately 39,000 diesel gallon equivalents (DGE), costing as much as \$1.70 less per DGE, amounting to considerable fuel savings over the life of the facility. There is one refueling station at the landfill, and a second, delivering conventional CNG, located in Madison. The Bio-CNG 50 System, at a cost of \$400,000, is intended for the smallest levels of commercial production, making it ideal for the Dane County project. The system is designed by Cornerstone Environmental Group of Middletown, NY and Unison Solutions of Dubuque, IA, and manufactured by Unison, both domestic leaders in the growing biogas industry. In January 2012, the EPA named this innovative facility the Project of the Year under the Landfill Methane Outreach Program (LMOP).

Funding: The project was paid for with capital from Unison Solutions and Cornerstone Environmental Group. Both groups helped develop the technology and wanted to get a full size system up and operating. Dane County will be purchasing and expanding the system, paid for through the sale of bonds and a \$150,000 Wisconsin State Energy Office grant. There were no grants or tax credits involved in the financing of the pilot facility.

Altamont Landfill



Partners:

Waste Management
Linde North America
Gas Technology Institute

Location: Livermore, CA

Contact:

Ken Lewis
Director of Landfill Operations
California Bay Area
Waste Management
510-613-2158
klewis@wm.com

In California, the world's largest renewable liquid natural gas (R-LNG) plant uses landfill gas to fuel 300-400 refuse trucks.

Summary: Since September 2009, Waste Management, in collaboration with NJ-based Linde NA, an international gas-producer, has successfully operated the largest R-LNG plant in the world at the Altamont Landfill in Livermore, CA. The facility produces up to 13,500 gallons of clean burning R-LNG daily, enough to power a fleet of more than 300 WM collection trucks. By using R-LNG, among the cleanest burning vehicle fuels to date, WM eliminates close to 30,000 tons of carbon dioxide emissions every year while also enjoying significant fuel cost savings. WM estimates the supply of R-LNG at Altamont will last for at least 30 years. WM has already converted 1/3 of its Alameda County waste collection trucks to natural gas. In part due to the success of the Altamont facility, the company plans to convert the entire WM Alameda County fleet to natural gas in the coming years.

Funding: The Altamont Landfill project is cited by many as the greatest evidence for the economic viability of RNG. Of the more than \$16 million in initial capital investment required to build the facility, \$14 million was privately funded by Linde NA and WM. Public funding sources for the remaining amount included: California Air Resources Board (\$610,000), CalRecycle (\$740,000), Southern California Air Quality Management District (\$250,000) and California Energy Commission (\$990,000). Subsidies and tax credits earned under the "Advanced Biofuel" section of the Federal Renewable Fuel Standard continue to offset costs, but unlike many other renewable energy projects, the Altamont facility is largely a private endeavor.

Sauk Trail Hills Landfill



Partners: Republic Services and
Clean Energy Fuels Corp.

Location: Canton, MI

Contacts:

Harrison Clay, President
Clean Energy Renewable Fuels
hclay@cleanenergyfuels.com

William Held, Senior Director
Republic Services
wheld@republicservices.com
(480) 627-7123

In Michigan, the first interstate pipeline transports renewable natural gas (RNG) for use as vehicle fuel across the U.S.

Summary: Clean Energy, the largest supplier of natural gas fuel for transportation in the U.S., and Republic Services, the second largest domestic trash collection and recycling company, have recently launched a project that will allow for the capture of landfill gas from municipal solid waste, and its refinement into pipeline quality gas and vehicle fuel. Through this collaboration, Clean Energy has built a large biogas processing facility at the Republic landfill site, scheduled to begin operation in 2012, which will be capable of producing six million diesel gallon equivalents (DGE) at maximum capacity. Republic Services may use some of the RNG produced for its natural gas-powered refuse collection vehicles. But most will be distributed throughout the country, via natural gas pipeline, to Clean Energy customers, and potentially other users. In a separate agreement, Clean Energy will also design, build and operate 14 CNG refuse truck fueling stations at various Republic fleet locations. Republic has so far converted 550 of its 16,000 refuse trucks to CNG.

Funding: Equity financing for the large capital investment was provided by Clean Energy. Public funding sources, primarily the Michigan Strategic Fund and the Township of Canton, approved a \$12 million tax-exempt bond inducement resolution and a five-year personal property tax exemption, respectively.

Ohio Bio-Energy Digester



Partners: quasar energy group, Solid Waste Authority of Central Ohio, Kurtz Bros. Inc.

Location: Columbus, OH

Contact:

Sam Spofforth
Clean Fuels Ohio
(614) 884-7336
sam@cleanfuelsohio.org

In Columbus, Ohio, the first in a new generation of anaerobic digesters includes vehicle fuel production as a standard feature along with electric power generation.

Summary: Through the collaboration of quasar energy, Kurtz Bros. and the Solid Waste Authority of Central Ohio (SWACO), a large-scale facility has been constructed outside Columbus, Ohio, to convert bio-solids (from wastewater treatment), food and beverage waste, and fats, oils and greases (FOG) to biogas and R-CNG for use as electricity and vehicle fuel respectively. The facility utilizes Ohio-based quasar energy's ecoCITY System 1325, patented technology comprised primarily of a large anaerobic digester adjacent to waste storage tanks, which combine to turn approximately 50,000 wet tons of waste (annually) into enough electricity to power 750 homes, and R-CNG to fuel a local municipal fleet. The remnants of the conversion process will be used, distributed or sold by Kurtz Bros., Inc., a local leading resource management company specializing in recycled lawn and garden products. The Columbus plant is one of four operational digesters (and four more under construction) designed and built by quasar, with a long-term focus on using RNG as vehicle fuel.

Funding: State funds, dedicated to alternative energy and green job creation projects, made available to quasar accounted for a large portion of the total facility construction costs. A small grant was also given to Kurtz Bros. from the Ohio Department of Natural Resources to help purchase organic waste recycling equipment. The facility expects to create and sustain, directly and indirectly, more than 20 jobs.

Janesville Wastewater Plant



Partners: City of Janesville, AECOM, Unison Solutions, BioCNG-Cornerstone

Location: Janesville, WI

Contacts:

Daniel Lynch, P.E.
Utility Director
lynchd@ci.janesville.wi.us

Jay S. Kemp, P.E., BCEE
Project Manager, Water
608.828.8136
jay.kemp@aecom.com

A Wisconsin wastewater treatment plant produces biogas for electricity production and R-CNG vehicle fuel.

Summary: Since 1970, the City of Janesville, WI has been converting the solids residuals from its wastewater treatment plant (WWTP) into biogas, which it then uses to offset some of its electricity costs. Prior to 2010, the City had used biogas to fuel engine-generators, which provided electricity and heat for the anaerobic digestion process. As part of a major upgrade and expansion, the City replaced the engine-generators with four microturbines and added a process to remove siloxanes and other impurities. The microturbines have required minimal maintenance and have been reliable in the production of electricity and recovered heat. In 2011, due to the success of the biogas upgrades, the City decided to further enhance its biogas resource by adding the capability to refine the biogas for use as a vehicle fuel. The just-completed state-of-the-art facility will have 25% lower operating costs and will process high-energy organic wastes from food industries with its low-energy sewage waste in the anaerobic digesters to increase biogas production. A portion of the biogas will power some of the City's natural gas vehicles. The facility will initially produce 3,650 gasoline gallon equivalents of R-CNG annually, with the potential to produce significantly more in the future.

Funding: The gas treatment module and the R-CNG compression and dispensing equipment were added for \$350,000. A grant of \$125,000 from the State of Wisconsin will allow the City to purchase additional compressed gas storage vessels to improve the fill time for larger vehicles. Public funds were used for the other upgrades.

St. Landry Parish Landfill



Partners: St. Landry Parish Solid Waste Commission, GT Environmental Finance, RPH Engineering, Aucoin & Associates

Location: Beggs, Louisiana

Contact:

Katry Martin
Executive Director
St. Landry Parish Landfill
kmartin@slpsolidwaste.org
337.826.5211

Community-driven renewable natural gas (R-CNG) vehicle fuel project is first to harness landfill gas in Louisiana.

Summary: In April 2012, at the St. Landry Parish landfill, the Town of Washington (Beggs), Louisiana, opened a fueling station to supply its municipal fleet with landfill gas-derived RNG fuel. This is the first RNG vehicle fuel project in Louisiana, and it was inspired and guided by the community's leaders. In 2009, the St. Landry Parish Solid Waste Commission (SLPSWC) began educating itself about the potential of an economically viable RNG vehicle project to reduce its carbon emissions by utilizing the landfill gases generated at their municipal solid waste facility. Since January of 2011, with the help of consultants and contractors including GT Environmental Finance, RPH Engineering, Aucoin & Associates, and Cornerstone Environmental, SLPSWC began planning for a biogas upgrading facility and fueling station. The facility will initially supply fuel to 15 light-to-medium duty municipal vehicles that were recently retrofitted with CNG engines by Control Tech of New Iberia, LA. The landfill, which accepts waste from approximately 40,000 households, has the potential to generate fuel for more than 50 vehicles in the foreseeable future.

Funding: The project is entirely funded by public sources: a \$551,000 grant from the Louisiana Department of Natural Resources; \$250,000 in State Tax Incentives given for renewable energy projects, and \$200,000 to be generated through municipal taxes.

Rumpke Landfill



Partners: Rumpke Consolidated Companies, Montauk Energy Capital, Duke Energy

Location: Cincinnati, OH

Contact:

Amanda Pratt
Amanda.Pratt@rumpke.com

Pilot project at Ohio's largest landfill initiates use of R-CNG fuel to power its refuse fleet.

Summary: Rumpke Sanitary Landfill, located outside of Cincinnati, OH in Colerain Township, is the biggest landfill in Ohio by volume; it also boasts the largest landfill gas-to-direct pipeline in the world. In operation since 1986, the pipeline is jointly owned and operated by North Carolina-based Duke Energy and Montauk Energy Capital, of Pittsburgh, PA. Until recently, landfill gas from the facility has been used solely for electrical power generation, supplying enough energy to power 25,000 homes a year. However, the commercial success of R-CNG vehicles has led Rumpke to convert 10 collection trucks and install an on-site R-CNG fueling station. This pilot project aims to determine the potential for expanded use of R-CNG trucks in its fleet of more than 1,600 vehicles. To fuel these 10 vehicles will require less than 10% of the total landfill gas being produced, suggesting that expansion to a larger fleet of R-CNG trucks would be feasible at this location.

Financing: The \$3.1 million project was funded through the combination of an \$800,000 Clean Fuels Ohio grant in addition to \$2.3 million in private investment by Rumpke. If the pilot is successful, Rumpke could lead the way for other large landfills, with existing gas-to-pipeline facilities, to utilize R-CNG as a vehicle fuel.

Footnotes

- ¹ National Grid, “Renewable Gas – Vision for a Sustainable Gas Network,” white paper (July 2010): available at http://www.nationalgridus.com/non_html/NG_renewable_WP.pdf.
- ² U.S. Department of Energy: Clean Cities Coalition. “Renewable Natural Gas: Current Status, Challenges and Issues” 2009. http://www1.eere.energy.gov/cleancities/pdfs/renewable_natural_gas.pdf
- ³ EPA Region 9 Report: “Organics: Anaerobic Digestion”. <http://www.epa.gov/region9/organics/ad/>
- ⁴ U.S. EPA: Landfill Methane Outreach Program, Energy Projects and Candidate Landfills 2011. <http://www.epa.gov/lmop/projects-candidates/index.html#map-area>
- ⁵ American Biogas Council: “Current and Potential Biogas Production”. <http://www.americanbiogascouncil.org/pdf/biogas101.pdf>
- ⁶ EPA AgStar: “U.S. Anaerobic Digester Status: A 2011 Snapshot”. http://www.epa.gov/agstar/documents/2011_digester_update.pdf
- ⁷ EPA Region 9 Report: “Organics: Anaerobic Digestion”. <http://www.epa.gov/region9/organics/ad/>
- ⁸ American Gas Foundation: “The Potential for Renewable Natural Gas: Biogas Derived from Biomass Feedstocks...” <http://www.gasfoundation.org/ResearchStudies/agf-renewable-gas-assessment-report-110901.pdf>
- ⁹ Nerurkar, Neelesh. Congressional Research Service: U.S. Oil Imports and Exports. April 4, 2012. <http://www.fas.org/sgp/crs/misc/R42465.pdf>
- ¹⁰ Sanderson, Tom. TransPlace Blog: “Diesel Prices Continue to Surge.” August 28, 2012. <http://blog.transplace.com/archive/2012/08.aspx>
- ¹¹ CARB: Low Carbon Fuel Standard Report 2009. <http://www.arb.ca.gov/fuels/lcfs/lcfs.htm>
- ¹² U.S. DOE: Alternative Fuels and & Advanced Vehicles Data Center. http://www.afdc.energy.gov/afdc/vehicles/emissions_natural_gas.html
- ¹³ U.S. EPA: Municipal Solid Waste Generation, Recycling & Disposal in the U.S.: Facts and Figures for 2009. <http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2009-fs.pdf>
- ¹⁴ NPC Future Transportation Fuels Study: “Advancing Technology for America’s Transportation Future: Fuel and Vehicle System Analyses.” Natural Gas Analysis. August 1, 2012. http://www.npc.org/FTF-report-080112/Natural_Gas_Analysis-080112.pdf

"New York State is committed to meeting ambitious greenhouse gas reduction goals, and Energy Vision's report is a valuable new resource. It introduces a promising strategy – converting municipal, industrial and agricultural organic wastes into vehicle fuel – which would not only reduce our greenhouse gases but also cut air pollution, the costs of transportation fuel, and New York's dependence on foreign oil.

Mark Lowery, Office of Climate Change
New York State Department of Environmental Conservation

"*Renewable Natural Gas* does an excellent job of explaining the fundamentals: what RNG is, how it is produced, where it can be utilized, and how it compares to diesel fuel and fossil natural gas. One of the biggest challenges the renewable natural gas sector faces today is how to effectively educate the public and private sectors, as well as elected officials, nongovernmental organizations and citizens, about the benefits and opportunities provided by RNG. Energy Vision's report really fills that bill."

Nora Goldstein, Editor
Biocycle Magazine

"*Renewable Natural Gas* provides a comprehensive look at the inherent value of this country's organic wastes for producing a clean, economically viable fuel for vehicle fleets. This is a frontier that our company is actively pursuing with several projects in development. This is a winning solution, resulting in lowering greenhouse gas emissions, reducing landfilling of organic waste and lessening our dependency on fossil fuels."

Eric Herbert, CEO
Zero Waste Energy, LLC.

"The Renewable Natural Gas market is on the verge of making a huge positive impact on clean transportation and energy independence in the U.S., and the analysis and public education that Energy Vision has done will be one of the reasons why. This new EV report provides a clear picture of the contribution this waste-based fuel can make. We hope it will be read by policymakers and citizens alike."

Richard A Peluso, President
Cornerstone Environmental Group (BioCNG, LLC.)

For further information:

Energy Vision
138 East 13th Street
New York, NY 10003
Tel: 212-228-0225
www.energy-vision.org

CALSTART
48 South Chester Avenue
Pasadena, CA 91106
Tel: 626-744-5600
www.calstart.org

