WASTE EXPO CONFERENCE 2013 – NEW ORLEANS
First Annual Organics Section

The collection of commercial organics and compostable plastics and converting these materials to an energy product and/or a transportation fuel will require innovation. Anaerobic digestion facilities are becoming commercialized in various scales to produce biomethane that can be used for both renewable energy to run the parasitic energy needs of the facility while producing a carbon negative renewable fuel to run the fleet that collects these materials. The material recovery facility technology has been developed that separates more organic materials for these facilities in a cost effective manner. The Blue Line Biogenic CNG Facility in South San Francisco, California, will be the first in the nation to use a dry-fermentation anaerobic digestion process at a demonstration scale of 10,000 tons per year to produce enough biomethane to runs a fleet of 6 compressed natural gas (CNG) trucks. The Facility will be operational by the fall of 2013, and will become a game changer in the industry to handle commercial organics and compostable plastics in an urban setting, without the need for long-hauling the material to regional compost facilities or a landfill.

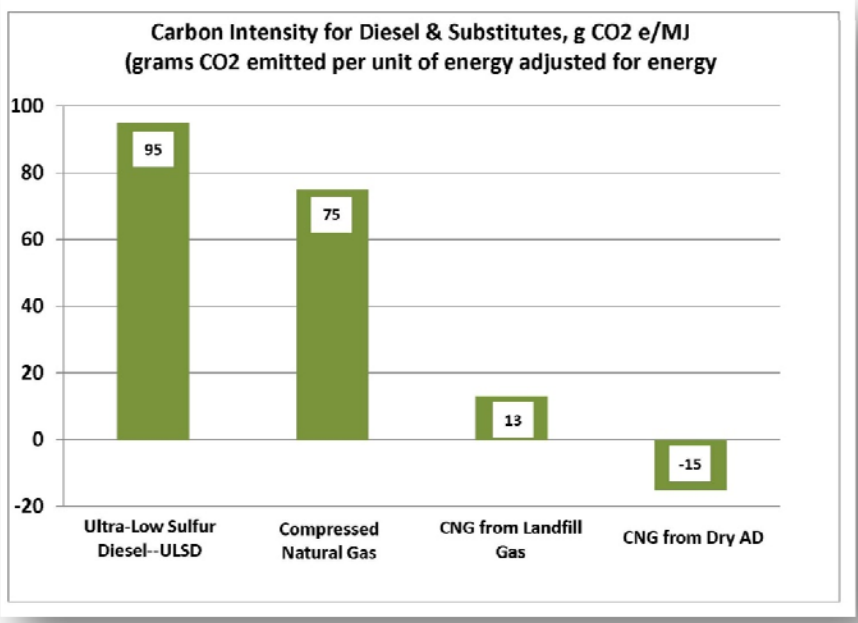
Just a few years ago, T. Boone Pickens pointed out that only 1% of the nation's 200,000 trash trucks ran on CNG, and that market would grow by 4 percent per year. Within the decade, Boone expected that half of America's trash truck fleet would be on CNG. Boone promoted the nationwide trend in the refuse and recycling industry to convert fleets from diesel to CNG, where pipeline CNG will serve as the primary fuel. Eventually there will be a partial transition to biogenic or renewable CNG produced from biomethane generated at food waste and green waste anaerobic digestion facilities. We will become true Recycling Innovators when the fleet that collects the organic waste can be fueled by the biomethane that is generated from the anaerobic digestion facilities of the same organic waste it collects. Understanding that the renewable CNG from these facilities has been determined to be carbon negative, it will soon be possible to operate a carbon negative fleet. We are realizing that we can transform the industry when a facility can generate biomethane in just 30 days at anaerobic digestion facilities, where it takes up to 30 years at a landfill to decompose, and then return the biomethane as renewable CNG back into the truck that collects the organic waste. With a demand for CNG fuel from the growing CNG fleet, and a demand for commercial organics and compostable plastics recycling infrastructure, producing carbon negative CNG fuel appears to be a strong business model to address sustainability measures with the appropriate and available technology.

Waste Management (WM) has grown its natural gas powered truck fleet to 1,400 of its 24,000 vehicles. The natural gas fleet is part of WM's environmental sustainability initiative to direct capital spending of up to $500 million per annum over a 10-year period to reduce its fleet emissions. Republic Services has a fleet of 15,000 vehicles and is committed to CNG, with more than 1,000 vehicles currently running on alternative fuels, and plans to have more than 3,100 trucks nationwide running on natural gas and other alternative fuels by the end of 2015, expecting to have about a third of its fleet running on natural gas within a five years. Today, there are over 15,000 refuse and recycling collection vehicles in California, with over 2,000 collection vehicles running on CNG, or about 13% of the fleet. The South Coast Air Quality Management District (SCAQMD) adopted Rule 1193 requiring the use of CNG vehicles for all new refuse and recycling contracts, and a five-year phase-in for current contracts. SCAQMD reports that today there are over 1,850 CNG vehicles in the district, with a projected 4,500 CNG vehicles by 2020.

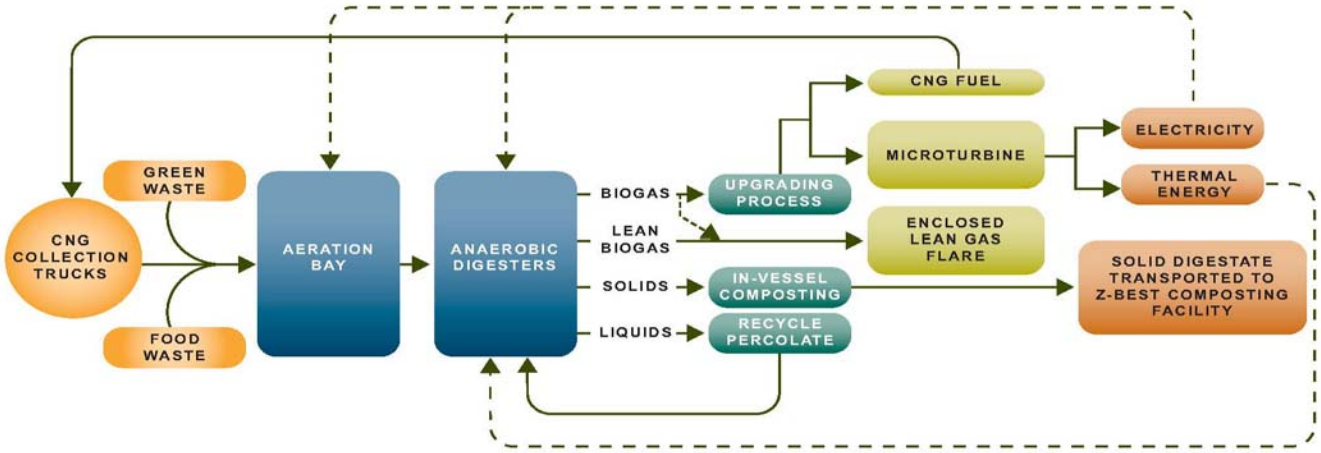
The refuse and recycling collection fleet is rapidly transitioning to CNG, as Boone astutely predicts that 50% of the fleet will be on CNG within the decade. The first facility to supply renewable CNG from a dry-fermentation process at a demonstration scale is being built this year, and the concept is being considered throughout California. There will be a significant market penetration over the next five years as mandated commercial recycling programs are being implemented targeting the diversion and conversion of commercial organics and compostable plastics.

Diesel has cleaned up its act over the years with ultra-low sulfur blends, with newer high-performing engines, and is still favored by many in the industry. CNG technology has caught up on reliability, and is now making a case for lower maintenance costs and fuel pricing. As diesel prices sporadically hover around $4 per gallon, CNG prices for diesel gallon equivalents is averaging $2.30 per gallon with tens of thousands of dollars per year saved on fuel costs and maintenance. CNG is the proven solution for the waste and recycling hauling fleet, because it is cleaner than diesel, greener, economical, and domestically abundant. CNG is 22% less carbon intensive then diesel. The US Energy Information Administration estimates that 98% of the natural gas consumed in North America is sourced here, with supplies projected to last for over 120 years. In terms of clean air performance – when compared to older diesel models – today's CNG trucks produce significantly less smog-generating nitrogen oxides and harmful particulate matter. In addition to running cleaner, they run quieter, and there has been no significant sacrifice in terms of truck operating performance. According to the Federal EPA, the benefits of using CNG engines compared to conventional or diesel engines are overwhelmingly positive, (1) 22 percent reduction in greenhouse gases; (2) 35-60 percent reduction in nitrogen oxide emissions; (3) 50-75 percent reduction in non-methane hydrocarbon emissions; and (4) Fewer toxic and carcinogenic pollutants. CNG truck deployment has show to be a low-cost option and a strong business model. Producing your own carbon negative CNG is the next step.

The California Air Resources Board (CARB) studied the lifecycle analysis of diesel and substitutes for diesel, and adopted carbon intensity for each fuel type. The Low Carbon Fuel Standard requires a 10% reduction in fuel carbon intensity from 2010 to 2020. As noted in the graph below, ultra-low sulfur diesel is 95 on the carbon intensity scale using units of g CO2e/MJ, and pipeline CNG is 75 g CO2e/MJ, a 22% reduction in greenhouse gases. CNG from landfill gas is 13 g CO2e/MJ on the carbon intensity scale, or an 86% reduction in greenhouse gases. CARB staff has releases a fuel path for renewable, or biogenic, CNG to be minus 15 g CO2e/MJ for carbon intensity, as noted on



adjacent chart. Imagine CNG generated from the anaerobic digestion of food waste and green waste that is carbon negative, where the industry could have a carbon negative fleet run on the organic waste it collects. Below is a material flow diagram that shows the flow of organic waste to digestion to energy products that are return back into the system. The mass of the digestate is reduced by 25% to 30% and is hauled to a permitted compost facility.



The California Department of Resources Recycling and Recovery (CalRecycle) adopted a Program Environmental Impact Report (EIR) in 2011 for the statewide development of anaerobic digestion (AD) facilities. One of the 100 adopted measures of the AB 32 Scoping Plan in 2008 was the development of AD facilities to reduce greenhouse gases by 2 million metric tons of CO2 by 2020. CalRecycle, in the recently adopted Program EIR, has projected that 80 facilities of 200 tons per day, or 52,000 tons per year (TPY), or 210 anaerobic digestion facilities of 20,000 tons per year, would be needed by 2020. These AD facilities would meet the AB 32 goals, as well as address the statewide 75% diversion goals by 2020, their Strategic Directive No. 6 to divert 50% of landfilled organics by 2020, and implementation of mandated commercial recycling regulations. The metrics of BioCNG production show it is more efficient for larger scale commercial facilities of 20,000 TPY or more, and these larger facilities will be commercialized in the future, such as the much larger 78,000 TPY facility now under construction in San Jose by ZeroWaste Energy. In addition, these AD facilities produce an organic digestate that is further processed into a valuable compost product that can be return to the local farm for food production.

The tipping fee at these facilities for commercial organics and compostable plastic varies from $60 per ton to $90 per ton, based upon the size of the facility (10,000 TPY to 20,000 TPY), and the amount of contamination that needs to be process. The typical tipping fee at transfer stations in the San Francisco Bay area is about $100 per ton and in the Los Angeles area is about $60 per ton. The value of the BioCNG will be indexed to the market rate of pipeline CNG, where the savings will be realized in the transition from diesel fuel to CNG. These facilities can typically be sited in-town using the best available control technologies for power generation, a microturbine, and a biofilter for volatile organic compounds and odor control. The footprint of the facility is compact varying from 15,000 square feet to 40,000 square feet and can co-located at a transfer station or material recovery facility, or site in abandoned commercial warehouses. Hauling costs to remote landfills and regional compost facilities would be avoided.

The High-Diversion Mixed Waste Processing Facilities are being developed in California to recover the traditional dry recyclables and the commercial organic waste. Using *Bulk Handling Systems* technology,

Green Waste Recovery and Newby Island are both experiencing high levels of organic waste diversion designed for these anaerobic digestion facilities, which can accommodate levels of contamination typical to mixed waste processing. Having tolerance for contamination, the High-Diversion Mixed Waste Processing Facilities can get more materials separated to deliver to anaerobic digestion.

The goals of developing an AD-to-CNG facility address numerous AB 32 Scoping Plan adopted measures in California to reduce greenhouse gas emissions, and is at the nexus of increasing diversion of solid waste with mandated commercial recycling programs and reducing greenhouse gases with anaerobic digestion projects and compost use, while producing low carbon fuel using renewable energy sources. The AD/CNG facilities can be replicated throughout California and the United States, based upon its modular design and small footprint, where it could be co-located at other existing permitted material recovery facilities, compost facilities, and transfer stations. The statewide commercialization of projects of this type could yield 23.5 million diesel equivalent gallons per year, or enough fuel for 1,800 CNG fueled refuse and recycling vehicles, based upon collecting 2.5 million tons per year of food waste and mixing it with 1.7 million tons of green waste. With over 6 million tons of food waste disposed of in 2008, the amount of BioCNG could double to almost 50 million diesel equivalent gallons per year, or enough for 3,500 vehicles.

Today, there are over 15,000 refuse and recycling collection vehicles in California, with over 2,000 CNG collection vehicles on pipeline CNG fuel. With a dramatic transition underway from diesel to CNG vehicles, there will be a demand for renewable or BioCNG. Using BioCNG from biomenthane has been declared to be carbon negative where you could have a carbon negative fleet. We have shown true innovation when the fleet that collects the organic waste can be fueled by the biomethane that is generated from the anaerobic digestion of the same organic waste it collects. We can close the organic loop locally as BioCNG is used to fuel our carbon negative fleet, and compost is used to grow our food. Having your fleet run on the commercial organics and compostable plastic that it collects is the best possible outcome while fully utilizing the waste resources. The time is now in 2013 for the demonstration project that is ready to be replicated in larger scale throughout California in the next 5 year and throughout the United States thereafter.