

# *New Financing Options and Incentives for Landfill Gas Energy*

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## ABSTRACT

Stakeholders promoting landfill gas (LFG) energy projects are identifying new funding incentives to implement LFG energy (LFGE) projects. This article focuses on how landfills are participating in voluntary carbon and renewable energy markets, and presents case studies from award-winning projects that utilize these funding mechanisms.

Landfills participate in the voluntary carbon markets using one of two main mechanisms: on an exchange or through an over-the-counter (OTC) transaction. An exchange, such as the Chicago Climate Exchange (CCX), is likely the most well known mechanism. At present, CCX has 35 registered landfill methane offset project providers in the United States [1]. As of April 2008, landfill methane projects comprised approximately 9 percent of all the carbon credits issued by CCX. OTC transactions are private between the seller, buyer, and/or broker involved in the transaction. Despite their private nature, the volume of OTC traded emissions has substantially grown in recent years according to research from Ecosystem Marketplace [2]. Recent data from Point Carbon indicate that 132 U.S. landfills have either made a transaction in the carbon market, or are in the process of developing, producing, certifying, or verifying their emissions reductions to prepare for an OTC transaction or exchange on the CCX [3].

In addition to carbon finance, LFGE projects generating electricity are also selling renewable energy certificates (RECs). These RECs are then purchased by companies wishing to reduce their environmental footprint or used by utilities to comply with various renewable portfolio standards.

Stakeholders are also using state and federal financial incentives to promote LFGE projects. In 2008, the IRS awarded 45 applicants the authority to issue Clean Renewable Energy Bonds (CREBs) to support LFGE projects [4]. Several other new financial incentives were funded under the American Recovery and Reinvestment Act of 2009 (ARRA) including the Energy Efficiency and Conservation Block Grants (EECBG) and extensions to the federal production tax credits.

This article summarizes financial incentives available for LFGE projects and provides case study examples of several landfills that are implementing projects with these funds.

## LANDFILL GAS ENERGY PROJECT COSTS

Making the switch to landfill gas can help companies and municipalities reduce their carbon footprint and provide a hedge against volatile prices in the natural gas markets. From 1999 to 2009, the price of natural gas has ranged from below \$2 per thousand cubic feet (MCF) to \$18 per MCF [5]. Despite environmental and economic benefits, the current economy may make it difficult to access the capital required to develop these projects.

For any type of LFGE project, there are costs associated with developing a system to collect the gas. For larger landfills, a system may already be in place to prevent methane migration or to comply with regulatory requirements. For smaller sites, a series of gas extraction wells and active flare system may need to be installed as part of an LFGE project. After the gas is collected, all LFGE projects will then need a system to treat, de-water, and compress the gas for use in an energy application. This treatment system is typically skid-mounted near the landfill flare station.

In addition to the basic gas collection and treatment costs, electricity projects incur additional costs for purchasing generators, and interconnecting the LFGE to the nearby grid. For direct-use projects the major costs are associated with purchasing rights-of-way and installing a pipeline from the treatment skid to the point of energy use. Adjustments may also be needed on the combustion equipment to be fueled by LFG. For example, boilers designed to operate on natural gas or liquid fuels may need to have their nozzles or burners upgraded or replaced to accommodate a fuel with a lower heating value. For projects in which LFG

is cleaned to pipeline quality (high-Btu) gas, the major cost components include a system to separate the LFG into methane and carbon dioxide. These separation systems are based on pressure-swing adsorption or membrane filtration technologies. High-Btu projects also require a pipeline to transport the gas from the landfill to a natural gas pipeline or industry that will use the gas. Table 1 summarizes the typical project costs for three common LFGE project types based on data available in the Landfill Methane Outreach Program (LMOP)'s Landfill Gas Energy Cost Model (LFGcost) version 2.0.

To help promote development of these renewable LFGE projects, landfill owners and project developers are using a variety of funding mechanisms to finance their projects. Some smaller landfills are offsetting the costs of gas collection by measuring and verifying the greenhouse gas (GHG) emissions voluntarily reduced at the landfill, and then selling those reductions on the carbon markets. Others are selling LFG-fueled electricity at a premium to utilities that are required to generate a certain percentage of their electricity from renewable resources. This year's ARRA also provided several other funding opportunities to landfills who could demonstrate job creation from LFGE projects.

## PROJECT FINANCE USING THE CARBON MARKETS

For an LFG-related project to qualify for a GHG emission credit, the destruction of LFG must be "additional." What constitutes "additionality" may vary, depending on what standard is being used to verify GHG reductions. All of the voluntary market standards include a regulatory additionality component, meaning that any local, state, or federal regulations, such as U.S. EPA Emission Guidelines or New Source Performance Standards (NSPS), do not require LFG to be collected and controlled. Some standards limit their regulatory additionality to federal requirements while others use a more comprehensive approach to assess national, state and local ordinances to determine additionality. Landfills that are subject to the NSPS, but install additional gas collection equipment ahead of the schedule set forth within NSPS are also considered to be additional. Some standards also require a project to demonstrate financial additionality, meaning that it can be proven that the GHG destruction would not have happened in the absence of carbon market incentives.

**Table 1. LFGE Project Cost Summary [6]**

<i>Project Type</i>	<i>Capital Costs (2010 million \$)<sup>5</sup></i>	<i>Annual O&amp;M Costs (2011 million \$)<sup>6</sup></i>
<b>Gas Collection System<sup>1</sup></b>		
Wells, Wellheads and Pipe Gathering System	\$0.6	\$0.07
Flare, Knockout and Blower	\$0.23	\$0.04
<b>Reciprocating Engine<sup>2</sup></b>		
Gas Treatment/Compression/ Engine and Generator	\$4.9	\$0.5
Interconnect Equipment	\$0.26	negligible
<b>5-mile Direct-Use<sup>3</sup></b>		
Gas Treatment/Compression	\$1.1	\$0.13
Pipeline	\$1.7	negligible
<b>5-mile High-Btu<sup>4</sup></b>		
Gas Treatment/ Separation/ Compression	\$8.6	\$0.88
Pipeline	\$1.7	negligible

- 1 Costs for a 30-acre gas well field, assumed to collect 700 standard cubic feet per minute (scfm) of LFG.
- 2 Costs for a 3-megawatt (MW) engine project
- 3 Costs based on 1,000 scfm direct-use project.
- 4 Costs based on a 2,000 scfm high-Btu project.
- 5 Capital costs assume project is constructed in 2010 and begins operation in 2011.
- 6 Annual operations and maintenance (O&M) costs reflect the annual costs in 2011, the first year of project operation. Due to variable gas flows and escalated O&M costs, these costs may change from year to year.

Recent legislation has introduced some uncertainty to the future of regulatory additionality. On June 26, 2009, the U.S. House of Representatives approved H.R. 2454, The American Clean Energy and Security Act of 2009 (ACES). Landfills are not included in the carbon credit cap and trade provision of the bill, but Section 811 requires

the EPA Administrator to use existing Clean Air Act authority to set GHG emission performance standards for uncapped stationary sources within 12 months of the bill's enactment. According to the bill, landfills with annual GHG emissions of more than 10,000 metric tons of carbon dioxide equivalents (mtCO<sub>2</sub>e) would be subject to the NSPS. Currently the Senate is debating its own version of climate legislation.

Separate from the "additionality" issue, a potential LFG project owner will also need to assess for what part of the carbon market they are eligible. All standards establish a date of operation that a project needs to be brought into operation on or after. The date may be as early as January 1, 1999 for some standards and as recent as within 6 months of project commencement. Various standards may have other eligibility requirements, such as requiring that the project contribute to sustainable development, or requiring that the landfill be in compliance with all air and water quality environmental regulations, regardless of whether or not they are related to the destruction of GHG emissions. Standards may also want proof of what entity has ownership of the gas rights at the landfill. Specific definitions of what makes a project additional and eligible are available in the project protocol documents for each standard.

After assessing whether or not a project is additional and eligible for various portions of the carbon market, a project owner may also be interested in evaluating the costs to participate in the market. Although revenue from the carbon markets can potentially provide a landfill with the revenue necessary to make a project economically feasible, there are certain staffing requirements, system costs, and transaction costs that are necessary to successfully participate in the carbon marketplace.

Costs associated with carbon offset projects can be divided into four main categories: costs to install additional equipment required to verify emission reductions, costs to conduct additional monitoring and recordkeeping required to verify emission reductions, costs to verify emissions, and costs to register and issue credits.

To develop real and measurable emission reductions, landfills will need to install equipment or develop routine monitoring schedules to collect data on LFG flow and LFG methane quality. Depending on the protocol being used, these reductions may be measured by using both a flow meter and continuous methane monitor, or alternatively, a hand-held GEM monitor can be used to take periodic readings of the gas flow and methane quality. When discrete measurements are

used in lieu of continuous measurements, many protocols often apply a discount factor to account for uncertainty of reductions between discrete data points. Both the continuous and discrete measurement systems should include a system to automatically collect and back-up the data in an electronic format. Some systems at closed landfills with no staff on site employ modems to transfer data from the site to a remote server. Training will need to be provided to ensure that staff properly collect the data, keep records, and calibrate equipment used to take any measurements. Based on quotes from various engineering firms working with landfills to evaluate and develop carbon credit projects, the costs to install methane monitors vary from \$8,000 for a handheld periodic GEM monitor, \$8,000 to \$25,000 for continuous infrared monitors, and \$40,000 for gas chromatograph continuous monitors. Costs for LFG flow meters range from \$3,000 to \$7,000 and costs for data loggers/recorders range from \$1,500 for paper-based systems to more than \$3,000 for electronic recording systems [7]. Additional O&M beyond what would typically be required for an LFG energy or flare project that does not follow a carbon offset protocol is estimated to be an additional \$5,000 to \$7,000 per year. These O&M costs cover additional labor and recordkeeping systems [8].

After GHG reductions have been measured and recorded, a landfill will need to hire a third party verifier to conduct an audit of the site and required documentation. The verifier will then make a statement verifying that the emission reductions were real and measurable and that proper carbon offset protocols were followed. The costs to verify carbon offset projects may vary widely, depending on level of credibility associated with the emission reduction, number of years or quantity of emissions being verified, and organization of records at the facility. The higher the credibility, the more rigorous and expensive the verification needs to be. Costs may also be influenced by the accessibility and organization of records about the project. First-time verification can be more expensive than subsequent years, because landfill owners will later get used to developing and improving a records system. It cost the Gardner Landfill in Massachusetts \$5,500 to verify 61,100 mtCO<sub>2</sub>e of GHG reductions for the Chicago Climate Exchange [7]. Costs to verify the emissions for the City of Woodland, California were approximately \$11,700 in the first year and \$8,300 for each subsequent year [9].

Finally, there are costs associated with registering and transacting carbon credits. These fees support a registry staff and electronic

platform to provide carbon offset purchasers with the confidence that offsets represent true incremental reductions in GHG emissions. Often these registries assign the equivalent of a serial number to each reduction to prevent double counting of reductions. Table 2 summarizes these fees for the common registries in the U.S. Voluntary Market: American Carbon Registry (ACR), Chicago Climate Exchange (CCX), Climate Action Reserve (CAR), Gold Standard (GS), and Voluntary Carbon Standard (VCS).

**Table 2. Summary of Registry Costs in the Carbon Market [10]**

<i>Standard</i>	<i>American Carbon Registry</i>	<i>Chicago Climate Exchange</i>	<i>Climate Action Reserve</i>	<i>Gold Standard</i>	<i>Voluntary Carbon Standard</i>
Initial Account Fee	\$1,000	\$5,000	\$500	\$500	\$500
Annual Account Fee	\$500	\$250	\$500	\$500	\$500 traders/ \$100 individual acct.
Submittal Fee	\$1,000 once, \$500 annually	\$5,000 per vintage	\$500	N/A	N/A
Issuance Fee	N/A	\$15/CFI	\$0.20/CRT	2% of GS VERs	\$0.05 + €0.04 levy
Transfer Fee	\$0.05 – \$0.14/ mtCO <sub>2</sub> e	\$5/CFI	\$0.03/CRT	\$0.01/ mtCO <sub>2</sub> e	\$0.02/ mtCO <sub>2</sub> e

The submittal fee in Table 2 refers to the costs incurred when submitting a project to one of the registries to have a registry evaluate a project's eligibility. Issuance costs refer to the act of issuing a specific quantity of GHG emission reductions to a specific account, after those reductions have been verified. Similar to issuance fees, transfer fees are assessed on a per unit basis. These fees cover the costs of transferring a GHG reduction credit to another account holder. Issuance and transfer fees are assessed in terms of the GHG reduction currency specific to each standard. A CFI represents a carbon financial instrument, which is equivalent to 100 metric tons of CO<sub>2</sub>. A CRT refers to a carbon reserve ton, which is equivalent to 1 metric ton of CO<sub>2</sub>. GS VERs refer to Gold Standard verified emission reductions—each equivalent to 1 metric ton of CO<sub>2</sub>.

After a project's GHG reductions have been measured, verified, and registered, a landfill owner or project developer may want to sell their GHG reduction credits to others. This sale may occur in an exchange format on the Chicago Climate Exchange, or the sale may occur between private parties in what is typically termed an over-the-counter or OTC transaction. In the OTC market, companies may purchase these credits to offset their own GHG emissions or carbon market traders may purchase these credits in the hopes to resell them for a higher price. Because information about most OTC GHG transactions is not publicly available, it is difficult to determine the value of these credits. According to research from Ecosystem Marketplace, the average carbon price in 2008 on the OTC market was \$7.34/tCO<sub>2</sub>e, while the average price on the CCX was \$4.43/tCO<sub>2</sub>e. A follow-up pricing index indicated a downward trend in early 2009 when prices/tCO<sub>2</sub>e were \$2.90 for CCX, \$3.70 for VCS, and \$6.80 for CAR [11]. More current pricing for CRT and CFI futures can be viewed on the Chicago Climate Futures Exchange [12].

## PROJECT FINANCE USING RECs

The REC market is another favorable development for the LFGE industry. RECs represent the environmental and other non-power attributes of electricity generated from renewable sources. When renewable energy is generated, the RECs can be separated from the physical electricity and sold as a distinct product. RECs represent proof that 1 megawatt-hour (MWh) of electricity was generated from a renewable energy source. RECs can be purchased directly from a renewable energy generator or through several types of REC providers, including retail and wholesale REC marketers, such as utilities, non-profits, or other environmental organizations.

Similar to the registration process discussed for the carbon markets, those wanting to sell RECs from LFGE projects must work with a certification body to register a block of RECs and assign an identification code to ensure that each REC is not double counted or sold more than once. The leading REC certifier is Green-e. To certify RECs, there are a series of initial and annual account fees, in addition to volumetric fees that are assessed according to the number of RECs that were verified in previous years.

RECs also represent the accounting standard for utilities obligated to provide a certain percentage of their electricity from renewable resources. Landfills can target utilities that are located in states that have Renewable Portfolio Standard (RPS) programs as potential purchasers of RECs from LFGE projects. In Massachusetts, for example, the state RPS requires electric retailers to acquire RECs to cover 4 percent of their 2009 electricity sales. These RECs are being sold for between 3 and 4 cents per kilowatt-hour (kWh), on top of the price received for selling the electricity, and provide an excellent revenue stream for LFG electricity projects. A recent auction of RECs in New Jersey yielded over \$22,000 for 6,772 RECs created from an LFG turbine project in Monmouth, New Jersey [13].

## PROJECT FINANCE USING TAX INCENTIVES

LFGE projects that generate electricity can benefit from two major federal tax incentives. The first incentive is called a production tax credit for renewable energy, which currently pays 1.1 cents per kWh generated and sold to a third party. This credit is available to entities for a 10-year period after the project begins operation. To receive this credit the LFGE project must begin generating electricity on or before December 31, 2013.

In addition, there are tax exempt CREB programs that allow municipalities or not-for-profit electric cooperatives, which are typically exempt from federal taxes, to use bonds to fund renewable electricity generating projects. Unlike traditional bonds that pay interest, tax credit bonds pay the bondholders by providing a credit against their federal income tax. In effect, CREBs provide interest-free financing for clean energy projects. To qualify for CREB financing, the project must be deemed to be technically, financially, and legally feasible. Table 3 shows that LFG electricity projects have qualified for a large number of CREBs in the past, and they constitute the third largest number of awards, behind solar and wind power project awards. Applications for 2009 CREBs were due on August 4, 2009 and they will be issued by the end of 2009.

One CREB recipient was the Delaware County Electric Cooperative in Walton, NY. This cooperative is self-regulated and has the ultimate goal of providing customers with a reliable source of electricity, at the lowest cost possible. The cooperative was approved for 2006 CREB funding for an LFG-fueled 1-MW GE-Jenbacher reciprocating engine generator.

**Table 3. CREB Allocations**

<i>Year</i>	2007	2008	2009
Total Applications	709	342	TBD
Total Awards (number/\$ amount)	610/ \$800 million	312/ \$406 million	TBD/ Up to \$2.4 billion <sup>1</sup>
Electric Cooperative awards for LFG	13	4	TBD
Municipality awards for LFG	23	41	TBD

<sup>1</sup> This includes \$800 million appropriated in the 2008 Energy Improvement and Extension Act and an additional \$1.6 billion appropriated in the ARRA.

## ARRA PROVIDING INCENTIVES TO LFGE PROJECTS

The 2009 ARRA expanded the funding of existing incentives and provided for many new incentives to promote LFG and other renewable energy resources. Among the incentives is a U.S. Treasury Department grant that provides an alternative to the aforementioned production tax credit. This grant will cover 30 percent of the construction and installation costs of the facility, including costs for the generator, and gas treatment systems, up to the point of transmitting the electrons. To qualify for this grant the project must begin operation by December 31, 2010, or begin significant construction activity (defined to be physical work of a significant nature) by that same deadline and the project begin operation on or before December 31, 2013. The Treasury will review each grant application and if the request meets all grant criteria, the funds will be awarded within 60 days of when the project began operating.

ARRA also appropriated \$3.2 billion for fiscal year 2009 to a formula and competitive grant program called the Energy Efficiency and Conservation Block Grant or EECBG. This program is administered through the U.S. Department of Energy and provides grants for communities and state governments to use to fund energy efficiency, renewable energy, and perhaps most relevant, methane capture and reduction projects at landfills. The grant amounts were already awarded to the 10 largest counties and municipalities in each state, and separate funds

were awarded to each state, according to a population-based formula. Smaller local governments within each state must apply for funds from their state governments. The Department of Energy (DOE) will also be issuing an application process for local and state governments to apply for an additional \$400 million in a competitive-based EECBG program. The DOE will be issuing guidance on eligible projects and a timeline for the competitive EECBG program in the near future.

Another component of the ARRA was to establish a fund for state energy programs (SEPs). SEPs provide grants to states to address their energy priorities in the areas of energy efficiency and development of renewable energy technologies. The ARRA appropriated \$3.1 billion for the program for fiscal year 2009. Several states have begun asking for proposals for projects that could benefit from ARRA funding and create jobs in the local communities. Pennsylvania's Economic Development Authority (PEDA) used SEP funds to award funding to two LFGE projects. The first project will use LFG from a landfill in Easton to generate electricity and thermal energy for a new energy business park. The park will be developed on 23 acres of brownfield and is estimated to create 160 jobs [14]. The second project receiving funding will use LFG to increase the electric generating capacity at the Southeastern Chester County Refuse Authority Landfill. The state of Ohio received over 20 applications for ARRA funding of LFGE or LFG collection and flare projects. As of August 2009, these applications were under review. North Carolina recently issued a request for proposals under a grant program that will provide funding to the private sector for 25 percent of LFGE project costs, and funding to the public and non-profit sectors for 50 percent of LFGE project costs, up to \$200,000 per project. South Carolina is planning to use some of its SEP funds for a renewable energy feasibility study funding grant that will reimburse landfills for 50 percent of feasibility study costs, up to \$50,000. These feasibility studies will evaluate the technical and economic feasibility of LFGE projects at various landfills in the state. The Landfill Methane Outreach Program (LMOP) is working with state energy offices from across the nation to help track which ARRA funds are available for LFGE projects.

#### SPOTLIGHT ON ENOREE LANDFILL

The Enoree Landfill in Greer, South Carolina, completed an LFG electricity project in August 2008 with the help of revenue from the

carbon market, REC market, and federal tax incentives. This project uses LFG to fuel 3.2 MW of electric generating capacity in two Caterpillar G3520 reciprocating engines that were designed to operate on LFG. Duke Energy buys the electricity and RECs, EcoSecurities purchased and brokered the carbon credits, and Det Norske Veritasand verified the GHG emission reductions. As of January 2009 the project has sold more than 90,000 mtCO<sub>2</sub>e of verified GHG emission reductions [15]. In addition to receiving revenue from the carbon market this project also qualifies to receive 10 years of federal production tax credits for generating and selling electricity. Currently that tax credit is valued a 1.1 cents per kWh sold, or approximately \$266,700 per year for this 3.2 MW project. The project developers share the revenue from the electricity sales, RECs, carbon and tax credits with Greenville County, the owner of the landfill.

## SPOTLIGHT ON CITY OF COLUMBIA LANDFILL

Columbia Water and Light (CW&L) in Missouri is mandated by a local RPS to generate or purchase renewable energy. To meet these requirements, CW&L partnered with the City of Columbia Landfill to build a 3.2-MW LFG electricity project in 2008 and agreed to pay a fixed cost for green power for the next 20 years. This extra revenue from green electricity sales helped improve the project economics, and this project constitutes 2 percent of CW&L's portfolio to help them comply with the local RPS.

## CONCLUSION

The options for financing landfill methane projects are vast, but each incentive carries its own specific set of qualifications and rules. LMOP tracks and classifies several types of federal and state incentives and offers a variety of free documents and tools pertaining to project finance. These include fact sheets, spreadsheet-based preliminary economic feasibility models, a Web-based funding guide, and an online project development handbook. In addition, LMOP has established a group of over 800 partners from both the public and private sectors, each with their own niche in project development and finance. These resources may help you navigate your way through the project finance maze and join the portfolio of 500 LFGE projects nationwide.

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