Mexico Landfill

Protocol | Version 2.0 | October 5, 2022

Errata + Protocol

CLIMATE ACTION RESERVE

Mexico Landfill Protocol Version 2.0
ERRATA AND CLARIFICATIONS

The Climate Action Reserve ("Reserve") published its Mexico Landfill Protocol, Version 2.0 ("MX LFP V2.0") in October 2022. While the Reserve intends for the MX LFP V2.0 to be a complete, transparent document, it recognizes that correction of errors and clarifications will be necessary as the protocol is implemented and issues are identified. This document is an official record of all errata and clarifications applicable to the MX LFP V2.0.[1]

Per the Reserve's Program Manual, both errata and clarifications are considered effective on the date they are first posted on the Reserve website. The effective date of each erratum or clarification is clearly designated below. All listed and registered Mexico Landfill projects must incorporate and adhere to these errata and clarifications when they undergo verification. The Reserve will incorporate both errata and clarifications into future versions of the MX LFP.

All project developers and verification bodies must refer to this document to ensure that the most current guidance is adhered to in project design and verification. Verification bodies shall refer to this document immediately prior to uploading any Verification Statement to assure all issues are properly addressed and incorporated into verification activities.

If you have any questions about the updates or clarifications in this document, please contact Policy at policy@climateactionreserve.org or (213) 891-1444 x3.

[1] See Section 4.3.4 of the Reserve Offset Program Manual (March 2021) for an explanation of the Reserve's policies on protocol errata and clarifications. "Errata" are issued to correct typographical errors. "Clarifications" are issued to ensure consistent interpretation and application of the protocol. For document management and program implementation purposes, both errata and clarifications to the MX LFP are contained in this single document.

Errata and Clarifications (arranged by protocol section)

Section 6

1. Instrument QA/QC for a Stationary Flow Meter In Use for 60 Days or More That is Removed and Not Reinstalled During the Same Reporting Period (CLARIFICATION – July 19, 2023)

Section: 6.2 (Instrument QA/QC)

Context: Section 6.2 of the protocol states that:

"If a stationary meter that was in use for 60 days or more is removed and not reinstalled during a reporting period, that meter shall either be field-checked for calibration accuracy prior to removal or calibrated (with percent drift documented) by the manufacturer or a certified calibration service (with as-found results recorded) prior to quantification of emission reductions for that reporting period."

The intent of the requirement above is to ensure accurate flow meter data is being recorded and used for emission reduction calculations. However, the timeline and requirement to perform a field-check for calibration accuracy or calibration by the manufacturer is unclear.

Clarification: The following language has replaced the requirement mentioned above:

"If a stationary meter that was in use for 60 days or more is removed and not reinstalled during a reporting period, that meter shall either be:

- field-checked for calibration accuracy within 2 months of removal; or
- calibrated (with percent drift documented) by the manufacturer or a certified calibration service (with as-found results recorded) no more than 12 months prior to use of the meter to quantify emission reductions and no later than the commencement of verification activities for the relevant reporting period."

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CLIMATE ACTION RESERVE

Climate Action Reserve
www.climateactionreserve.org

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Abbreviations and Acronyms

ACF	Actual cubic feet
CDM	Clean Development Mechanism
CH_4	Methane
CNG	Condensed natural gas
CO_2	Carbon dioxide
EG	Emission Guidelines
EPA	U.S. Environmental Protection Agency
GWP	Global Warming Potential
GHG	Greenhouse gas
INE	Mexico’s National Institute of Ecology
INEGI	Mexico’s National Institute of Statistics, Geography and Informatics
IPCC	Intergovernmental Panel on Climate Change
LFG	Landfill gas
LNG	Liquefied natural gas
MG	Mega gram (1,000,000 grams or one tonne, or “t”)
MSW	Municipal solid waste
m^3	Cubic meter
m^3_s	Standard cubic meter (20^{o}C, 1 atm)
N_2O	Nitrous oxide
NG	Natural gas
NMOC	Non-methane organic compounds
NOM-083	Mexican Official Standard 083-SEMARNAT-2003
QA/QC	Quality Assurance/Quality Control
Reserve	Climate Action Reserve
SCF	Standard cubic feet at 0° C and 1 atm
SEDESOL	Mexico’s Ministry of Social Development
SEMARNAT	Mexico’s Ministry of Environment and Natural Resources
SENER	Mexico’s Ministry of Energy
VOC	Volatile organic compound

1 Introduction

The Climate Action Reserve (Reserve) Mexico Landfill Protocol provides guidance to account for, report, and verify greenhouse gas (GHG) emission reductions associated with installing a landfill gas collection and destruction system at a landfill located in Mexico. This protocol is designated to ensure the complete, consistent, transparent, accurate, and conservative quantification of GHG emission reductions associated with a landfill project.[1]

The Climate Action Reserve is the most trusted, efficient, and experienced offset registry for global carbon markets. A pioneer in carbon accounting, the Reserve promotes and fosters the reduction of greenhouse gas (GHG) emissions through credible market-based policies and solutions. As a high-quality offset registry for voluntary carbon markets, it establishes rigorous standards and issues carbon credits under those standards. The Reserve also supports compliance carbon markets and serves as an approved Offset Project Registry for the State of California's Cap-and-Trade Program. The Reserve is an environmental nonprofit organization headquartered in Los Angeles, California with satellite offices around the world. For more information, please visit www.climateactionreserve.org.

On August 15, 2008, the State of California and the border states of Baja California, Sonora, Nuevo Leon, Tamaulipas, Chihuahua and Coahuila, working with the Pacific Gas & Electric Company and the Climate Action Reserve, signed a Memorandum of Understanding (MOU) agreeing to work cooperatively to develop quantification and verification protocols for GHG emission reduction projects in Mexico. This agreement led to a public, stakeholder-driven process in the first half of 2009 by which the U.S. Landfill Project Protocol was adapted for use in Mexico. Version 1.0 of the Mexico Landfill Project Protocol was adopted on July 1, 2009.

Project developers that install landfill gas capture and destruction technologies use this document to quantify and register GHG reductions with the Reserve. This protocol provides eligibility rules, methods to calculate reductions, performance-monitoring instructions, and procedures for reporting project information to the Reserve. Additionally, all project reports receive independent verification by Reserve-approved verification bodies. Guidance for verification bodies to verify reductions is provided in the Reserve Verification Program Manual and Section 8 of this protocol.

Project developers must comply with all local, state, and federal municipal solid waste (MSW), air and water quality regulations in order to register GHG reductions with the Reserve. To register GHG reductions with the Reserve, project developers are not required to take an annual entity-level GHG inventory of their MSW operations.

[1] See the WRI/WBCSD GHG Protocol for Project Accounting (Part I, Chapter 4) for a description of GHG accounting principles.

2 The GHG Reduction Project

2.1 Background

Landfills are used as a method for final solid waste disposal. In Mexico, around 57% of MSW is disposed of in landfills. Available data from the National Institute of Statistics and Geography (INEGI) for the period 1996-2006 indicates an increase in waste disposal at landfills in recent years. [2]

In landfills, bacteria decompose the organic material. A product of both the bacterial decomposition and oxidation of solid waste is landfill gas, which is composed of methane (CH_4) and carbon dioxide (CO_2) in approximately equal concentrations, as well as smaller amounts of non-methane organic compounds (NMOC), nitrogen (N_2), oxygen (O_2), and other trace gases. If not collected and destroyed, over time, this landfill gas is released to the atmosphere. According to the National Institute of Ecology, the agency responsible for the National Greenhouse Gas Inventory, landfill emissions represented around 24% of Mexico's total methane emissions in 2002. The greenhouse gas (GHG) emissions for this category, in CO_2 equivalent, increased 96% related to 1990, as a result of an increase of solid waste disposal in landfills.[3]

There is considerable uncertainty regarding the actual amount of fugitive methane emissions from landfills. Therefore, this protocol does not address fugitive landfill methane emissions. Instead, it addresses the methane that is captured and destroyed in excess of any regulatory requirements.

2.2 Project Definition

For the purpose of this protocol, the GHG reduction project is the use of an eligible qualifying device for destroying methane gas collected at an eligible landfill. An eligible landfill is one that:

1. Is not subject to regulations or other legal requirements requiring the destruction of methane gas; and
2. Is not a bioreactor, as defined by the U.S. EPA: "a MSW landfill or portion of a MSW landfill where any liquid other than leachate (leachate includes landfill gas condensate) is added in a controlled fashion into the waste mass (often in combination with recirculating leachate) to reach a minimum average moisture content of at least 40 percent by weight to accelerate or enhance the anaerobic (without oxygen) biodegradation of the waste"[4]; and
3. Does not add any liquid other than leachate into the waste mass in a controlled manner.

Captured landfill gas could be destroyed on-site, transported for off-site use (e.g., through a gas transmission and distribution pipeline), or used to power vehicles. Regardless of how project developers take advantage of the captured landfill gas, for the project to be eligible to register GHG reductions under this protocol, the ultimate fate of the methane must be destruction.[5] Passive flares do not qualify as eligible destruction devices under this protocol.

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[2] INEGI 2009. Sistema Nacional de Información Estadística y Geográfica. Residuos. http://www.inegi.org.mx/inegi/default.aspx?s=est&c=6116 (March 2009)

[3] INE, 2006. Tercera Comunicación Nacional a la Convención Marco de las Naciones Unidas sobre Cambio Climático. http://www.ine.gob.mx/cclimatico/comnal3.html

[4] 40 CFR 63.1990 and 40 CFR 258.28a.

[5] It is possible that at some point landfill gas may be used in the manufacture of chemical products. However, given that these types of projects are few, if any, these projects are not addressed in this protocol.

Landfill gas collection and destruction systems typically consist of wells, pipes, blowers, caps, and other technologies that enable or enhance the collection of landfill gas and convey it to a destruction technology. At some landfills, a flare will be the only device where landfill gas is destroyed. For projects that utilize energy or process heat technologies to destroy landfill gas, such as turbines, reciprocating engines, fuel cells, boilers, heaters or kilns, these devices will be where landfill gas is destroyed. Most projects that produce energy or process heat also include a flare to destroy gas during periods when the gas utilization project is down for repair or maintenance.

Direct use arrangements which entail the piping of landfill gas to be destroyed by an industrial end user at an off-site location are also an eligible approach to destruction of the landfill gas. For instances of direct use, agreements between the project developer and the end user of the landfill gas (i.e., an industrial client purchasing the landfill gas from the project developer), must include a legally binding agreement to assure that the GHG reductions will not be claimed by more than one party.

In addition to reducing methane, the installation and operation of a landfill gas collection and destruction system could impact anthropogenic carbon dioxide and methane emissions associated with the consumption of electricity and fossil fuels. Depending on the project's particular circumstances, this effect could either increase or decrease operational GHG emissions. Section 4, the GHG Assessment Boundary, delineates the scope of the accounting framework.

2.3 The Project Developer

The "project developer" is an entity that has an active account on the Reserve, submits a project for listing and registration with the Reserve, and is ultimately responsible for all project reporting and verification. Project developers may be landfill facility operators, GHG project developers, or other entities such as municipalities, or waste management companies.

In all cases, the project developer must attest to the Reserve that they have exclusive claim to the GHG reductions. Each time a project is verified, the project developer must attest that no other entities are reporting or claiming (e.g., for voluntary reporting or regulatory compliance purposes) the GHG reductions caused by the project.[6] The Reserve will not issue CRTs for GHG reductions that are reported or claimed by entities other than the project developer (e.g., waste generators, landfills, or municipalities not designated as the project developer).

2.4 Additional GHG Reduction Activities in the Solid Waste Sector

The Reserve recognizes that project developers could implement a variety of GHG reduction activities associated with the collection, transportation, sorting, recycling and disposal of solid waste; installing technology to capture and destroy methane from landfills is but one of many GHG emission reduction projects that could occur within the solid waste sector.

However, GHG reduction activities not associated with the installation of a landfill gas collection and destruction system do not meet this protocol's definition of the GHG reduction project. Furthermore, production of power for the electricity grid, which results in the displacement of fossil-fueled power plant GHG emissions, is a complementary and separate GHG project

[6] This is done by signing the Reserve's Attestation of Title form, available at: http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/

activity to destroying methane gas from landfills and is not currently included within this protocol's accounting framework.

3 Eligibility Rules

Project developers using this protocol must satisfy the following eligibility rules to register reductions with the Reserve. These criteria apply only to projects that meet the definition of a GHG reduction project as defined in Section 2.

Eligibility Rule I:	Location	→	*Mexico*
Eligibility Rule II:	Project Start Date	→	*No more than 12 months prior to project submission*
Eligibility Rule III:	Crediting Period	→	*Emission reductions may only be reported during the crediting period; the crediting period may be renewed two times*
Eligibility Rule IV:	Additionality	→	*Meet performance standard*
		→	*Avoid exceeding limits on credit stacking*
		→	*Exceed legal requirements*
Eligibility Rule V:	Regulatory Compliance	→	*Compliance with all applicable laws*

3.1 Location

All projects located at landfill operations in Mexico are eligible to register reductions with the Reserve. The scope of the analysis of landfill practices that formed the basis of the performance standard (Section 3.4.1) covered landfill operations in Mexico. Therefore, the Reserve will estimate GHG reductions from all Mexico-based projects that follow the guidance in this protocol in the same manner.

3.2 Project Start Date

The project start date shall be defined by the project developer but must be no more than 90 days after landfill gas is first destroyed in a project destruction device, regardless of whether sufficient monitoring data are available to report reductions. The start date is defined in relation to the commencement of methane destruction, not other activities that may be associated with project initiation or development.

To be eligible, projects are required to submit for listing within 12 months of becoming operational.[7] Those that fail to list within this 12-month period will be considered non-additional and excluded from eligibility. Projects may always be submitted for listing by the Reserve prior to their start date. Projects with previous destruction that have been inactive may be allowed to come back online under the Mexico Landfill Protocol as long as the project developer can demonstrate that the project can still be considered additional. The Reserve maintains the right to determine if the project is eligible. Contact the Reserve prior to project submittal to determine the eligibility of an inactive project.

[7] A project is considered "submitted" when the project developer has fully completed and filed the appropriate Project Submittal Form, available on the Reserve's website.

3.3 Project Crediting Period

The Reserve will issue CRTs for GHG reductions quantified and verified using this protocol for a period of ten years following the project start date. However, the Reserve will cease to issue CRTs for GHG reductions if at any point in the future landfill gas destruction becomes legally required at the landfill. If an eligible project has begun operation at a landfill that later becomes subject to a regulation, ordinance or permitting condition that would call for the installation and operation of a landfill gas control system, the Reserve will issue CRTs for GHG reductions achieved up until the date that the landfill gas control system is legally required to be operational.

The project crediting period begins at the project start date regardless of whether sufficient monitoring data is available to verify GHG reductions. If a project developer wishes to apply for eligibility under another 10-year crediting period, they must do so no sooner than six months before the end of the previous crediting period.

A project may be eligible for a renewed crediting period even if the project has failed to maintain continuous reporting up to the time of applying for a crediting period renewal, provided the project developer elects to take a zero-credit reporting period for any period for which continuous reporting was not maintained.[8] The renewed crediting period shall begin on the day following the end date of the previous crediting period. A project may only apply for a maximum of three crediting periods.

3.4 Additionality

The Reserve strives to support only projects that yield surplus GHG reductions that are additional to what might otherwise have occurred. That is, the reductions are above and beyond "business as usual," the baseline case. Project developers satisfy the "additionality" eligibility rule by passing two tests:

1. The Performance Standard Test
2. The Legal Requirement Test

3.4.1 The Performance Standard Test

Project developers pass the Performance Standard Test by meeting a program-wide performance threshold (i.e., a standard of performance applicable to all landfill projects, established on an *ex-ante* basis). The performance threshold represents "better than business as usual." If the project meets the threshold, then it exceeds what would happen under the "business as usual" scenario and generates surplus/additional GHG reductions.

For this protocol, the Reserve uses a practice-change threshold that focuses on the baseline scenario and changes made in the project scenario. A project passes the Performance Standard Test if it involves one of the following activities:

1. Installation of a landfill gas collection system and a new qualifying destruction device at an eligible landfill where landfill gas has never been collected and destroyed prior to the project start date.

[8] See zero-credit reporting period guidance and requirements in the Reserve Program Manual, http://www.climateactionreserve.org/how/program/program-manual/.

2. Installation of a new qualifying destruction device at an eligible landfill where landfill gas is currently collected and vented but has never been destroyed in any manner prior to the project start date.

3. Installation of a new qualifying destruction device at an eligible landfill where landfill gas was collected and destroyed at any time prior to the project start date using:
    a. A non-qualifying destruction device (e.g., passive flare); or
    b. A destruction device that is not otherwise eligible under the protocol (e.g., a destruction device installed prior to the earliest allowable project start date, a destruction device installed with or without metering prior to the installation of a new destruction device).

4. Installation of a new gas collection system on a physically-distinct[9] cell (or cells) where neither gas collection nor destruction has previously occurred, and connection of this new collection system to an existing landfill gas destruction system. The new collection system must have its own metering that satisfies the requirements of this protocol. In this scenario, more than one project may exist at a single landfill. The start date for this project shall be no more than 90 days following the first flow of landfill gas from the new collection system to the destruction system, regardless of the presence of adequate metering for crediting.

Destruction devices that were installed temporarily and utilized only for pilot or testing purposes specifically in anticipation of the GHG project shall not be considered in determining project eligibility or quantification. Devices may only be excluded under this provision if they were installed as a direct precursor to the project activity in order to gather information or determine project viability. Verifiable evidence of this intent must be presented, such as device invoices, service agreements, or monitoring data. Changes in landfill ownership, or in the ownership of destruction devices, are not considered in determining prior landfill gas management practices. If landfill gas was previously collected and destroyed (in the given cells of the project) by a party other than the project developer, it still qualifies as “prior” collection and destruction.

Under scenarios (1), (2), and (3) above, expanding an existing well-field constitutes a system expansion rather than initiation of a new project. Expanding a well-field is eligible as a new, separate project only if it meets the conditions described in scenario (4). In these scenarios, expanding a well-field initiates a new crediting period.

The practice change threshold is applied as of the project start date and is evaluated at the project’s initial verification.

All projects that pass this test are eligible to register reductions with the Reserve for the lifetime of the project crediting period, even if the Performance Standard Test changes during mid-period. If a project upgrades to a newer version of the protocol for a subsequent verification, it must meet the Performance Standard Test of that version of the protocol, applied as of the original project start date. If a project is submitted for a renewed crediting period, it is subject to the Performance Standard Test in the most current version of the protocol at that time, applied as of the original project start date.

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[9] The landfill cell must be engineered in such a way that landfill gas cannot migrate between that cell and other landfill cells.

3.4.2 Limits on Credit Stacking

When multiple forms of incentive credits are sought for a single activity at a single facility or on a single piece of land, with some temporal overlap between the different credits or payments, it is referred to as "credit stacking". Under this protocol, credit stacking is defined as receiving both offset credits and other types of mitigation credits for the same activity on spatially overlapping areas (i.e., in the same landfill). Mitigation credits are any instruments issued for the purpose of offsetting the environmental impacts of another entity, such as emissions of GHGs, or the displacement of fossil fuel emissions from transport applications, to name a few.

Project developers are strongly encouraged to reach out to the Reserve as early as possible when considering credit stacking. Furthermore, they must disclose any such payments to the Reserve at the time of listing and to the verification body and the Reserve at the time of verification. The Reserve maintains the right to determine if stacking has occurred, or is occurring, and whether it would impact project eligibility.

The Reserve has identified market opportunities for the upgrade of landfill gas into high-Btu fuels that provides an incentive sufficient to raise additionality concerns. Such opportunities include the United States Renewable Fuel Standard (RFS) and the California Low Carbon Fuel Standard (LCFS), where the carbon incentive is often orders of magnitude greater than that provided by the sale of offset credits. Analysis reveals that the strength of these incentives is driving investment in landfill gas projects at present, and that such projects can be considered "business as usual", without the additional presence of carbon offset revenues.[10] Therefore, projects that receive mitigation credits for upgrading landfill gas into high-Btu fuels will not be eligible to receive offset credits for the same period of time under this protocol.

If a landfill project transitions to reporting under one of these fuel standards but may wish to receive CRTs in future reporting periods, the project must maintain continuous reporting with the Reserve under the Mexico Landfill Protocol. To maintain continuous reporting, the project developer must submit a Zero-Credit Reporting Period Acknowledgment and Election form and a monitoring report no later than six months following the end of each relevant reporting period under the other fuel standard.

3.4.3 The Legal Requirement Test

All projects are subject to a Legal Requirement Test to ensure that the GHG reductions achieved by a project would not otherwise have occurred due to federal, state or local regulations, or other legally binding mandates. Projects pass the Legal Requirement Test when there are no laws, statutes, regulations, court orders, environmental mitigation agreements, permitting conditions or other legally binding mandates requiring the destruction of landfill gas methane at the project site. To satisfy the Legal Requirement Test, project developers must submit a signed Attestation of Voluntary Implementation form[11] prior to the commencement of verification activities each time the project is verified. In addition, the project's Monitoring Plan (Section 6) must include procedures that the project developer will follow to ascertain and demonstrate that the project at all times passes the Legal Requirement Test.

Landfills currently collecting and destroying landfill gas to comply with regulations or other legal mandates – or that are currently required by regulation or legal mandate to install a landfill gas control system in the future – are not eligible to register new projects with the Reserve. Landfills

[10] Further information about the Reserve's performance standard analysis is available in Appendix A
[11] Attestation of Voluntary Implementation form available at http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/.

currently collecting and destroying landfill gas to comply with regulations or other legal mandates are not eligible to register GHG reductions associated with the early installation of gas control systems during landfill expansion into new cells.

If an eligible project begins operation at a landfill that later becomes subject to a regulation, ordinance, or permitting condition that calls for the installation of a landfill gas control system, GHG reductions may be reported to the Reserve up until the date that the installation of a landfill gas control system is legally required to be operational. If the landfill's methane emissions are included under an emissions cap (e.g., under a state or federal cap-and-trade program), emission reductions may likewise be reported to the Reserve until the date that the emissions cap takes effect.

3.4.3.1 Federal Regulations

At the federal level, there are several regulations in Mexico for MSW and landfills which influence the eligibility of methane collection and destruction projects as voluntary GHG reduction projects. The federal level is in charge of conducting the national policies regarding waste and issuing the General Laws and Mexican Official Standards (NOM by its Spanish acronym) related to the integral management of any type of waste. These regulations include:

- The 1917 Political Constitution of the Mexican United States. In Article 115 it enumerates the responsibilities and attributions of the municipalities and indicates that these are responsible for providing the required services for cleaning, collection, transference, treatment and final disposal of urban waste. In the same article, the Constitution indicates that the municipalities should comply with the norms and regulations issued by the Federation.

- General Law of Ecological Equilibrium and Environmental Protection. Published in January 1988 and with entry into force after three months, this law states that waste should be controlled as it constitutes the main source of soil contamination. In addition, it establishes the need to prevent and reduce the solid, municipal and industrial waste generation; to incorporate techniques and procedures for its re-use and recycling, as well as to regulate its efficient management and final disposal.

- General Law for Solid Waste Prevention and Integral Management; published in October 2003, and with entry into force in January 2004. This law classifies waste in three categories: hazardous, of special management, and urban waste. This law promotes waste recovery as well as the development of by-products markets under the criteria of economic, technological and environmental efficiency, and adequate financing schemes.

- Mexican Official Standard NOM-083-SEMARNAT-2003, with entry into force in December 2004. The standard provides specifications for environmental protection related to the site selection, design, construction, monitoring, closure and complementary works of a final disposal site for urban solid waste and of special management.

As to LFG control, the NOM-083 is the only standard that establishes general specifications for its management. Article 7.2 of NOM-083, within the section related to the construction and operation of waste disposal sites, mentions that the biogas control should be guaranteed through its flaring in wells or by centralized burners. This article is applicable for landfills receiving more than 10 tonnes per day. Although Mexican standards are not retroactive, this standard also requires retrofitting of the existing disposal sites.[12]

Project developers pass the Legal Requirement Test by demonstrating that:

1. They apply the adjustment for the compliance with the Mexican Official Standard NOM-083 described in Equation 5.3 as $NOM_{discount}$.
2. There are no federal, state, or regional regulations or permitting requirements requiring the landfill to control emissions or requiring the installation of a landfill gas collection and destruction system at the project location.
3. If adding a destruction device to a passive landfill gas venting system, the regulation, ordinance or permitting condition that requires the landfill gas venting system does not require any treatment of the vented landfill gas.
4. The project meets all applicable federal, state, and local regulations or ordinances.

If an eligible project has begun operation at a landfill that later becomes subject to a regulation, ordinance or permitting condition that would call for the installation of a landfill gas control system, emission reductions can be reported to the Reserve up until the date that the landfill gas control system is legally required to be operational. The Legal Requirement Test must be applied at each verification.

3.4.3.2 State and Local Regulations

The formulation and enforcement of policies related to waste at the state level are designated to the State governments through the State Political Constitution, the State Environmental Law, and the State Waste Programs. Among the state waste laws, the following should be noted:

- Law for the integral waste management of the State of Querétaro, published on February 2004
- Law of prevention and integral management of the solid urban waste and of special management of the State of Veracruz, published in June 2004
- Law for the integral waste management in the State and municipalities of Guanajuato, published in May 2005
- Law of the solid waste of the State of Colima, published in April 2006
- Law for the integral waste of the State of Jalisco, published in February 2007
- Law for the integral waste management of the State of Baja California, published in September 2007
- Law of solid waste for the State of Morelos, published in October 2007
- The Federal District of Mexico City, as a federal entity and capital of the Mexican United States, published its Law of Solid Waste in 2003

[12] There are several technical and financial reasons why this standard has not been adopted and/or exceeded in landfills and final disposal sites in Mexico. There are technical reasons, such as the fact that the size and design of the pre-existing wells prior to entry into force of the NOM-083-2003 prevent the installation of burners, external factors that were not considered in the design, such as the wind conditions that turn off the passive flares, and issues related to the intermittency and low volume of biogas production that do not assure ignition at the passive flares. The lack of financial resources is another reason for the lack of complete compliance with the NOM-083. In addition, the standard does not establish the minimum quantity that should be collected and destroyed, or the specific technologies to be used. Finally, at the federal level, SEMARNAT, responsible for elaborating the technical standards, does not have mechanisms to penalize those municipalities that do not adopt the standard.

The majority of these state laws promote waste management and disposal practices for solid municipal and industrial waste; however, they do not establish specific guidelines for biogas control at landfills. Some laws, such as the one in the State of Querétaro, mention that the federal level should establish technical standards for biogas management. The Law of the Federal District states that the disposal of solid waste that releases gases and provokes fires should be avoided.

Municipalities are responsible for the management of urban solid waste, including the elaboration of applicable legal regulations, as well as the issuance of authorizations and concessions to conduct the waste collection, transference, treatment and final disposal, the establishment of the registration of large waste generators, and their participation in the enforcement and application of sanctions. Some of the legal instruments include: the Municipal Organic law, Rules of Cleaning, Police and Good Governance. As in the case of state legislation, these municipal regulations do not include guidelines for biogas management and control but focus mainly on cleaning. However, as it is established in the constitution, municipalities should comply with the standards and regulations published by the Federation, i.e., the NOM-083.

3.5 Regulatory Compliance

As a final eligibility requirement, project developers must attest that the project is in material compliance with all applicable laws (e.g., air, water quality, safety, etc.) prior to verification activities commencing each time a project is verified. Project developers are required to disclose in writing to the verifier any and all instances of non-compliance of the project with any law. If a verifier finds that a project is in a state of recurrent non-compliance or non-compliance that is the result of negligence or intent, then CRTs will not be issued for GHG reductions that occurred during the period of non-compliance. Non-compliance solely due to administrative or reporting issues, or due to “acts of nature,” will not affect CRT crediting.

Projects that are in non-compliance with the General Law of Ecological Equilibrium and Environmental Protection or the NOM-083 related to air or water quality regulations in final disposal sites (landfills and controlled sites) are not eligible to register GHG reductions with the Reserve.

Where projects are co-located at a single landfill, and in particular where projects share common equipment or infrastructure, the onus will be on the project developer(s) to demonstrate that a regulatory violation at the site is not relevant to all projects. Project developers should contact the Reserve to discuss potential regulatory non-compliance issues.

4 The GHG Assessment Boundary

The GHG Assessment Boundary delineates the GHG sources, sinks, and reservoirs (SSRs) that shall be assessed by project developers in order to determine the total net change in GHG emissions caused by a landfill project.

The GHG Assessment Boundary for the project includes all emission sources from the operation of the landfill gas collection system to the ultimate destruction of the landfill gas.

CO_2 emissions associated with the generation and destruction of landfill gas are considered biogenic emissions[13] (as opposed to anthropogenic) and will not be included in the GHG reduction calculation. This is consistent with the Intergovernmental Panel on Climate Change's (IPCC) guidelines for captured landfill gas.[14]

This protocol does not account for CO_2 reductions associated with the displacement of fossil-based grid-delivered electricity or natural gas. This is classified as an indirect emission reduction activity because the change in GHGs occurs from sources owned and controlled by the power producer or the end user of the natural gas. Capturing and using methane to displace fossil-based electricity on the grid or natural gas in gas transmission and distribution systems could potentially be considered complementary and separate GHG reduction projects but are not included in the boundaries of this protocol.

Figure 4.1 below provides a general illustration of the GHG Assessment Boundary, indicating which SSRs are included or excluded from the boundary. All SSRs within the dashed line are accounted for under this protocol.

Table 4.1 provides greater detail on each SSR and provides justification for the inclusion or exclusion of SSRs and gases from the GHG Assessment Boundary.

[13] The rationale is that carbon dioxide emitted during combustion represents the carbon dioxide that would have been emitted during natural decomposition of the solid waste. Emissions from the landfill gas control system do not yield a net increase in atmospheric carbon dioxide because they are theoretically equivalent to the carbon dioxide absorbed during plant growth.
[14] *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*; p.5.10, ftnt.

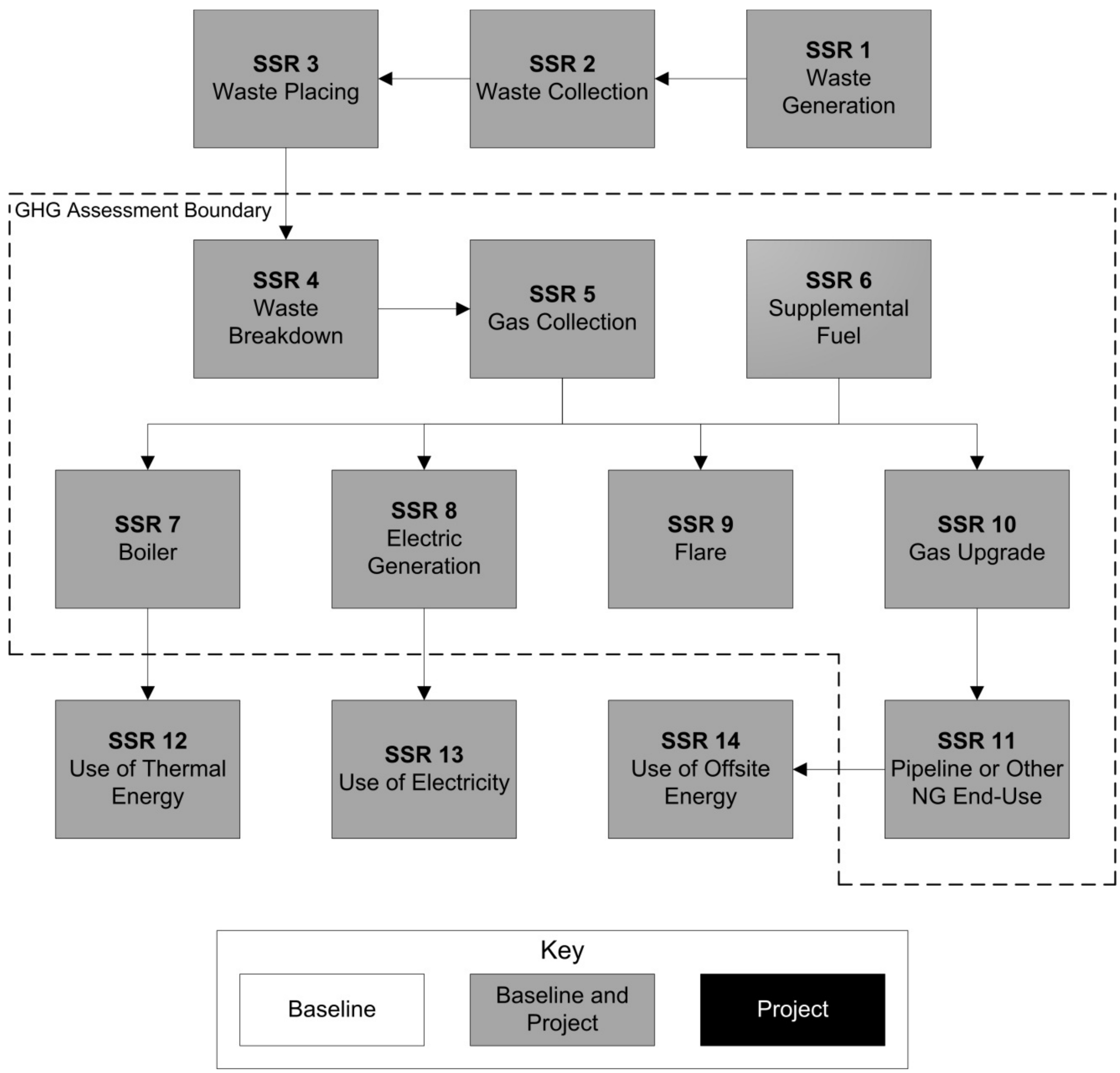


Figure 4.1. General illustration of the GHG Assessment Boundary

Table 4.1. Summary of Identified Sources, Sinks, and Reservoirs

SSR	Source	Gas	Relevant to Baseline (B) or Project (P)	Included/ Excluded	Justification/Explanation
1	Emissions from Waste Generation	N/A	B, P	Excluded	GHG emissions from this source are assumed to be equal in the baseline and project scenarios
2	Emissions from Waste Collection	CO_2	B, P	Excluded	GHG emissions from this source are assumed to be equal in the baseline and project scenarios
		CH_4		Excluded	GHG emissions from this source are assumed to be equal in the baseline and project scenarios
		N_2O		Excluded	GHG emissions from this source are assumed to be equal in the baseline and project scenarios s
3	Emissions from Waste Placing Activities	CO_2	B, P	Excluded	GHG emissions from this source are assumed to be equal in the baseline and project scenarios
		CH_4		Excluded	GHG emissions from this source are assumed to be equal in the baseline and project scenarios
		N_2O		Excluded	This emission source is assumed to be equal in the baseline and project scenarios
4	Emissions from Waste Breakdown in Landfill	CO_2	B, P	Excluded	Biogenic CO_2 emissions are excluded
		CH_4		Included	Primary source of GHG emissions in baseline. Calculated based on destruction in baseline and project destruction devices
5	Emissions from Gas Collection System	CO_2	P	Included	Landfill projects result in CO_2 emissions associated with the energy used for collection and processing of landfill gas
		CH_4		Excluded	This emission source is assumed to be very small
		N_2O		Excluded	This emission source is assumed to be very small
	Emissions from Baseline Gas Collection System	CO_2	B	Excluded	This emission source is assumed to be very small
		CH_4		Excluded	This emission source is assumed to be very small
		N_2O		Excluded	This emission source is assumed to be very small
6	Emissions from Supplemental Fuel	CO_2	P	Included	Landfill projects may require use of supplemental fossil fuel, resulting in significant new GHG emissions
		CH_4		Included	Calculated based on destruction efficiency of destruction device
		N_2O		Excluded	This emission source is assumed to be very small
	Emissions from Baseline	CO_2	B	Excluded	This emission source is assumed to be very small

SSR	Source	Gas	Relevant to Baseline (B) or Project (P)	Included/ Excluded	Justification/Explanation
	Supplemental Fuel Use	CH_4		Excluded	This emission source is assumed to be very small
		N_2O		Excluded	This emission source is assumed to be very small
7	Emissions from LFG Boiler Destruction	CO_2	B, P	Excluded	Biogenic CO_2 emissions are excluded
		CH_4		Included	Calculated in reference to destruction efficiency
		N_2O		Excluded	This emission source is assumed to be very small
8	Emissions from LFG Electricity Generation	CO_2	B, P	Excluded	Biogenic CO_2 emissions are excluded
		CH_4		Included	Calculated in reference to destruction efficiency
		N_2O		Excluded	This emission source is assumed to be very small
9	Emissions from LFG Flare Destruction	CO_2	B, P	Excluded	Biogenic CO_2 emissions are excluded
		CH_4		Included	Calculated in reference to destruction efficiency
		N_2O		Excluded	This emission source is assumed to be very small
10	Emissions from Upgrade of LFG	CO_2	B, P	Included	Landfill projects may result in GHG emissions from additional energy used to upgrade landfill gas
		CH_4		Excluded	This emission source is assumed to be very small
		N_2O		Excluded	This emission source is assumed to be very small
11	Emissions from LFG Pipeline or Other NG End-Use	CO_2	B, P	Excluded	Biogenic emissions are excluded
		CH_4		Included	Calculated in reference to destruction efficiency
		N_2O		Excluded	Assumed to be very small
12	Use of Generated Thermal Energy	CO_2	B, P	Excluded	This protocol does not cover displacement of GHG emissions from use of LFG-generated thermal energy
13	Use of Generated Electricity	CO_2	B, P	Excluded	This protocol does not cover displacement of GHG emissions from use of LFG-generated electricity
14	Use of Thermal Energy or Power from Pipeline Delivered NG	CO_2	B, P	Excluded	This protocol does not cover displacement of GHG emissions from use of LFG delivered through pipeline or other end uses

5 Quantifying GHG Emission Reductions

GHG emission reductions from a landfill project are quantified by comparing actual project emissions to baseline emissions at the landfill. Baseline emissions are an estimate of the GHG emissions from sources within the GHG Assessment Boundary (see Section 4) that would have occurred in the absence of the landfill project. Project emissions are actual GHG emissions that occur at sources within the GHG Assessment Boundary. Project emissions must be subtracted from the baseline emissions to quantify the project's total net GHG emission reductions (Equation 5.1).

GHG emission reductions must be quantified and verified on at least an annual basis. Project developers may choose to quantify and verify GHG emission reductions on a more frequent basis if they desire. The length of time over which GHG emission reductions are quantified and verified is called the "reporting period."

The calculations provided in this protocol are derived from internationally accepted methodologies.[15] Project developers shall use the calculation methods provided in this protocol to determine baseline and project GHG emissions in order to quantify GHG emission reductions.

Models that estimate biological and physical processes, such as the biological decomposition of solid waste in landfills and the migration of the landfill gas to the atmosphere are becoming increasingly refined and available. Process models typically rely on a series of input data that research has shown to be important drivers of the biological and geochemical process. In terms of GHG emission models, process models identify the mathematical relationships between inputs, basic conditions, and GHG emissions. The procedure for modeling landfills can be quite complex and subject to many different interpretations of how to address site-specific landfill gas generation factors and how to apply models effectively to landfills. At this time, no widely accepted method exists for determining the total amount of uncontrolled landfill gas emissions to the atmosphere from landfills. As new technologies and/or widely accepted modeling methods become available for the estimation of fugitive methane emissions from landfills, the Reserve will consider updating the protocol to incorporate these new approaches into the methane emission reduction quantification methodologies.

[15] The Reserve's GHG reduction calculation method is derived from the Kyoto Protocol's Clean Development Mechanism (ACM0001 V.6 and AM0053 V.1), the EPA's Climate Leaders Program (Draft Landfill Offset Protocol, October 2006), the GE AES Greenhouse Gas Services Landfill Gas Methodology V.1, and the RGGI Model Rule (January 5, 2007).

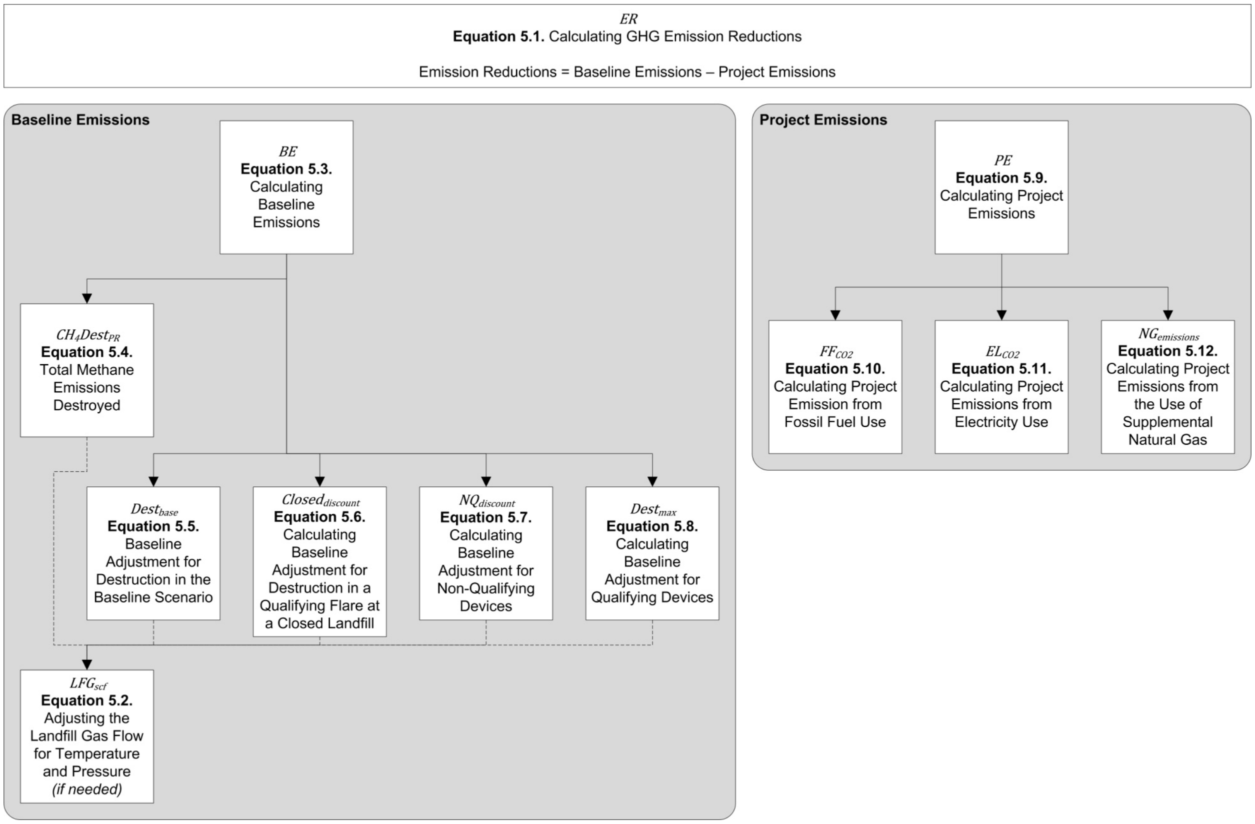


Figure 5.1. Organizational Chart for Equations in Section 5

Equation 5.1. Calculating GHG Emission Reductions

$$ER = BE - PE$$

Where,			<u>Units</u>
ER	=	GHG emission reductions of the project activity during the reporting period	tCO_2e
BE	=	Baseline emissions during the reporting period	tCO_2e
PE	=	Project emissions during the reporting period	tCO_2e

If any of the landfill gas flow metering equipment does not internally correct for the temperature and pressure of the landfill gas, separate pressure and temperature measurements must be used to correct the flow measurement. Corrected values must be used in all of the equations of this section. Apply Equation 5.2 only if the landfill gas flow metering equipment does not internally correct for temperature and pressure.

Equation 5.2. Adjusting the Landfill Gas Flow for Temperature and Pressure

$$LFG_{i,t} = LFG_{unadjusted} \times \frac{273.15}{T} \times \frac{P}{1}$$

Where,			Units
$LFG_{i,t}$	=	Adjusted volume of landfill gas collected for the given time interval, measured at 0°C (273.15 K) and 1 atm	m^3
$LFG_{unadjusted}$	=	Unadjusted volume of landfill gas collected for the given time interval	m^3
T	=	Measured temperature of the landfill gas for the given time period (K = °C + 273.15)	K
P	=	Measured pressure of the landfill gas in for the given time interval	atm

5.1 Quantifying Baseline Emissions

Traditional baseline emission calculations are not required for this protocol for the quantification of methane reductions. The baseline scenario assumes that all uncontrolled methane emissions are released to the atmosphere except for the portion of methane that would be oxidized by bacteria in the soil of uncovered landfills, absent the project.[16] Also, a deduction is required to account for the methane that would be destroyed to achieve compliance with NOM-083.

This NOM-083 discount factor accounts for the methane destruction occurring in a system of wells and burners sufficient to achieve compliance with NOM-083-2003. Based on the Reserve's research, this factor assumes compliance could be established by installation of passive wells with solar spark flares. Based on consultation with Mexican landfill managers, engineers, and industry experts, it was established that such passive wells achieve collection efficiency approximately 25% that of the active collection systems that will be installed under this protocol. Further, given the intermittency of flame presence and low combustion efficiency, an overall destruction efficiency of 25% of collected methane was suggested by industry experts. Under these assumptions, compliance with NOM-083 would require the destruction of 6.25% of methane collected in the project scenario. For conservativeness, the adjustment factor for compliance with NOM-083 has been rounded up to 7%.

As noted in Section 3.4.1, projects are grouped into different categories depending upon the baseline state of the landfill and level of landfill gas management. These categories require a slightly different methodology for calculating relevant baseline emissions.

1. Landfills where no previous destruction took place prior to project implementation must deduct the following from baseline emissions:
    a. The amount of methane that would have been oxidized by soil bacteria in the absence of the project.

[16] Landfill cover systems incorporating synthetic liners as part of the final cover systems should use a default methane oxidation rate of zero. A 10% methane oxidation factor shall be used for all other landfills, including those that utilize a synthetic cover in some, but not all of the area of the landfill with a final cover installed. A small portion of the methane generated in landfills (around 10%) is naturally oxidized to carbon dioxide by methanotrophic bacteria in the cover soils of well managed landfills. The 10% factor is based on Intergovernmental Panel on Climate Change (IPCC) guidelines (2006).

   b. The amount of methane that would have been destroyed to achieve compliance with NOM-083.

2. Landfills where previous collection and/or destruction took place with a non-qualifying destruction device must deduct the following from baseline emissions
   a. The amount of methane that would have been oxidized by soil bacteria in the absence of the project.
   b. The amount of methane that would have been destroyed to achieve compliance with NOM-083.
   c. The amount of methane destroyed from the non-qualifying destruction device (Equation 5.7).

3. Landfills where previous collection and destruction took place with a qualifying destruction device must deduct the following from baseline emissions:
   a. The amount of methane that would have been oxidized by soil bacteria in the absence of the project.
   b. The amount of methane that would have been destroyed to achieve compliance with NOM-083.
   c. The amount methane that could have been destroyed if the baseline destruction device was operating at full capacity (Equation 5.8).

4. Closed landfills where previous collection and destruction took place in a qualifying flare must deduct the following from baseline emissions:
   a. The amount of methane that would have been oxidized by soil bacteria in the absence of the project.
   b. The amount of methane that would have been destroyed to achieve compliance with NOM-083.
   c. The amount of methane collected by pre-project landfill gas wells and destroyed from the qualifying flare (Equation 5.6).

These conditions ensure that the reductions resulting from the GHG project can be accounted for separately from current collection and destruction. Only the landfill gas destroyed beyond that resulting from the baseline collection and destruction system is considered additional (i.e., those reductions resulting from the implementation of a new GHG reduction project).

As stated above, landfill operations that meet the U.S. EPA definition of a bioreactor are not eligible to use this protocol, as it is unclear what effects the bioreactor may have on the fugitive methane emissions relative to baseline conditions.

This protocol accounts for the difference in electricity consumption between the baseline scenario and the project by assuming no electricity consumption in the baseline and deducting the annual indirect CO_2 emissions due to the project activity from the annual project emission reductions.

Equation 5.3. Calculating Baseline Emissions

$$BE = [(CH_4Dest_{PR}) \times GWP \times (1 - OX) \times (1 - DF) \times (1 - NOM_{discount})] - Dest_{base} \times (1 - OX)$$

Where,			Units
BE	=	Total baseline GHG emissions	tCO_2e
$CH_4\ Dest_{PR}$	=	Total methane emissions destroyed by the project landfill gas collection and destruction system – see Equation 5.4	tCH_4
GWP	=	Global Warming Potential factor of methane to carbon dioxide equivalent[17]	tCO_2e / tCH_4
OX	=	Factor for the oxidation of methane by soil bacteria. Equal to 0.10 for all landfills except those that incorporate a synthetic liner throughout the entire area of the final cover systems where OX = 0	
$Dest_{base}$	=	Adjustment to account for baseline LFG destruction device (see Equation 5.8). Equal to zero if no baseline LFG destruction system is in place prior to project implementation	tCO_2e
DF	=	Discount factor to account for uncertainties associated with the project monitoring equipment (see Section 6.1). Equal to zero if using continuous methane monitor	
$NOM_{discount}$	=	Discount factor for the regulatory requirements of NOM-083 = 0.07	

The term CH_4Dest_{PR} represents the amount of methane destroyed by the project. This term is calculated according to Equation 5.4.

Equation 5.4. Calculating Methane Emissions Destroyed

$$CH_4Dest_{PR} = \sum_i (CH_4Dest_i) \times (0.717 \times 0.001)$$

Where,			Units
CH_4Dest_{PR}	=	Total methane destroyed by the project landfill gas collection and destruction system during the reporting period	tCH_4
$CH_4\ Dest_i$	=	Net quantity of methane destroyed by destruction device i (flare, engine, boiler, upgrade, etc.) during the reporting period	m^3
0.717	=	Density of methane at standard conditions, 0^oC, 1 atm	$kgCH_4 / m^3CH_4$
0.001	=	Conversion factor	$tCH_4 / kgCH_4$

Equation 5.4 continued on next page

[17] Refer to section 2.6.1 in the Reserve Offset Program Manual for the most recent GWP value.

Equation 5.4. Continued.

$$CH_4Dest_i = Q_i \times DE_i$$

Where, Units

$CH_4\,Dest_i$	=	Net quantity of methane destroyed by device i during the reporting period	m^3
Q_i	=	Total quantity of landfill methane sent to destruction device i during the reporting period	m^3
DE_i	=	Default methane destruction efficiency for device i. [18,19] See Appendix B for default factors	

And,

$$Q_i = \sum_t \left[LFG_{i,t} \times PR_{CH_4,t}\right]$$

Where, Units

Q_i	=	Total quantity of landfill methane sent to destruction device i during the reporting period	m^3 / t
$LFG_{i,t}$	=	Total quantity of landfill gas fed to the destruction device i, in time interval t, at standard temperature and pressure	m^3 / t
t	=	Time interval for which LFG flow and concentration measurements are aggregated. Equal to one day for continuously monitored methane concentration and one week for weekly monitored methane concentration	
$PR_{CH4,t}$	=	Average methane fraction of the landfill gas in time interval t as measured	m^3CH_4 / m^3LFG

[18] If available, the official source tested methane destruction efficiency shall be used in place of the default methane destruction efficiency. Otherwise, project developers have the option to use either the default methane destruction efficiencies provided, or the site-specific methane destruction efficiencies as provided by a state or local agency accredited source test service provider, for each of the combustion devices used in the project case.

[19] The default destruction efficiencies for enclosed flares and electricity generation devices are based on a preliminary set of actual source test data provided by the Bay Area Air Quality Management District. The default destruction efficiency values are the lesser of the twenty fifth percentile of the data provided or 0.995. These default destruction efficiencies may be updated as more source test data is made available to the Reserve.

For projects where methane was destroyed in the baseline, Equation 5.5 must be applied. This equation accounts for the methane emissions calculated in Equation 5.3 which would have been destroyed in the absence of the project activity.

Any project at a landfill where methane was collected and destroyed at any time prior to the project start date – even if the prior collection and/or destruction system was removed or has been dormant for an extended period of time – must apply the pre-project deduction.

Equation 5.5. Baseline Adjustment for Destruction at the Baseline Scenario

$$Dest_{base} = (Closed_{discount} + NQ_{discount} + Dest_{max}) \times 0.717 \times 0.001 \times GWP$$

Where,			Units
$Dest_{base}$	=	Adjustment to account for the baseline methane destruction associated with a baseline destruction device. Equal to zero if there is no baseline installation	tCO_2e
$Closed_{discount}$	=	Adjustment to account for the methane that would have been combusted in the baseline flare from baseline wells at a closed landfill. Equal to zero if the project is not a flare project at a closed facility	m^3CH_4
$NQ_{discount}$	=	Adjustment to account for the methane that would have been combusted in the baseline, non-qualifying combustion device. Equal to zero if there is no non-qualifying combustion device	m^3CH_4
$Dest_{max}$	=	Destruction of the un-utilized capacity of the baseline destruction device. This deduction is to be applied only when a new destruction device is used during project activity	m^3CH_4
0.717	=	Density of methane at standard conditions, 0^oC, 1 atm	$kgCH_4 / m^3CH_4$
0.001	=	Conversion factor	$tCH_4 / kgCH_4$
GWP	=	Global Warming Potential factor of methane to carbon dioxide equivalent	tCO_2e / tCH_4

Equation 5.6. Calculating Baseline Adjustment for Destruction of a Qualifying Flare at a Closed Landfill

$$Closed_{discount} = LFG_{B1} + B_{CH_4,closed}$$

Where,			Units
$Closed_{discount}$	=	Adjustment to account for the methane that would have been combusted in the baseline flare from baseline wells at a closed landfill. Equal to zero if the project is not a flare project at a closed facility	m^3CH_4
LFG_{B1}	=	Landfill gas from the baseline gas wells that would have been destroyed by the qualifying destruction system during the reporting period	m^3CH_4
$B_{CH4,closed}$	=	Methane fraction of landfill gas destroyed by the collection system during the reporting period	m^3CH_4 / m^3LFG

$NQ_{discount}$ may be determined using either of the following options:

1. $NQ_{discount}$ shall be equal to the measured quantity of methane recovered through an active gas collection system installed into the corresponding cell or waste mass of the landfill in which the baseline devices operated. The landfill gas flow from these active wells shall be determined using Equation 5.4 above for a minimum of one month.[20]
2. $NQ_{discount}$ shall be monitored and calculated per Equation 5.7.

Equation 5.7. Calculating Baseline Adjustment for Non-Qualifying Devices

$$NQ_{discount} = LFG_{B2} + B_{CH_4,NQ}$$

Where,			Units
$NQ_{discount}$	=	Adjustment to account for the methane that would have been combusted in the baseline, non-qualifying combustion device. Equal to zero if there is no non-qualifying combustion device	m^3CH_4
LFG_{B2}	=	Landfill gas from the baseline gas wells that would have been destroyed by the non-qualifying destruction system during the reporting period	m^3CH_4
$B_{CH4,NQ}$	=	Methane fraction of landfill gas destroyed by non-qualifying devices in the baseline. Equal to average methane concentration over the reporting period if maximum capacity is used for LFG_{B2}	m^3CH_4 / m^3LFG

[20] For the purpose of using Equation 5.4 to determine $NQ_{discount}$, the quantity of landfill gas would be only that which is being metered from the corresponding cell or waste mass in which the baseline devices had operated, and not necessarily all of the landfill gas being destroyed by the destruction system.

Equation 5.8. Calculating Baseline Adjustment for Destruction for Qualifying Devices

$$Dest_{max} = \sum_{t}\left[\left(LFG_{B\,max,t} - LFG_{B,t}\right) \times PR_{CH_4,t}\right] \times 0.717 \times 0.001 \times GWP$$

Where,

			Units
$Dest_{max}$	=	Deduction of the un-utilized capacity of the baseline destruction device. This deduction is to be applied only when a new destruction device is used during project activity. See Box 5.1 below for an example of the application of the $Dest_{max}$ adjustment	tCO_2e
$LFG_{Bmax,t}$	=	Maximum landfill gas flow capacity of the baseline methane destruction device (standardized at sea level according to the manufacturer specifications) in time interval t	m^3 / t
$LFG_{B,t}$	=	Actual landfill gas flow of the baseline methane destruction device in time interval t	m^3 / t
$PR_{CH4,t}$	=	Average methane fraction of the landfill gas in time interval t as measured	m^3CH_4 / m^3LFG
t	=	Time interval for which LFG flow and concentration measurements are aggregated. Equal to one day for continuously monitored methane concentration and one week for weekly monitored methane concentration	
0.717	=	Density of methane at standard conditions, 0°C, 1 atm	$kgCH_4$ / m^3CH_4
0.001	=	Conversion factor	tCH_4 / $kgCH_4$
GWP	=	Global Warming Potential factor of methane to carbon dioxide equivalent	tCO_2e / tCH_4

Box 5.1. Applying the $Dest_{max}$ Adjustment

This adjustment was designed to help differentiate system upgrades from truly new and additional projects, while encouraging project developers to use their landfill gas beneficially. In short, this methodology assumes that any gas which *could* have been destroyed in the baseline qualifying device is not additional; diversion of that gas to a new destruction device represents an upgrade. Therefore, this term deducts from calculated project reductions that portion of gas which, in the absence of the new destruction device still could have been destroyed.

Example:
An active flare with a capacity of 30 m^3/min was installed at a landfill in 2007. Therefore, because this flare was operational before August 15, 2008, the landfill gas control system is ineligible as a project under this protocol. However, in 2009, an electric generator with a 60 m^3/min capacity was installed, and all landfill gas was diverted to this device. The addition of the electric generator meets the eligibility requirements of this protocol, and therefore qualifies as a new project. Because the baseline flare is a qualifying destruction device under this protocol and is not eligible as a project due to other eligibility criteria (i.e., operational date), it must be accounted for using the $Dest_{max}$ adjustment.

In 2009, 25 m^3/min sent to generator, and 0 m^3/min was sent to the flare. In the year 2010, due to landfill expansion and installation of additional wells, the generator destroyed 40 m^3/min while the flare was non-operational. In 2011, further well expansion allowed the generator to operate at full capacity and the flare was used to destroy an additional 10 m^3/min of landfill gas.

Calculations:

Year	Generator Destruction (m^3/min)	Flare Capacity (m^3/min)	Flare Destruction (m^3/min)	Deduction (m^3/min)	Project Reductions (m^3/min)
2009	25	30	0	30	-5 (0)
2010	40	30	0	30	10
2011	60	30	10	20	40

Note: This example and the calculations are significantly simplified for illustrative purposes. The example values are calculated on a cubic meter per minute of landfill gas basis. Reporters are actually required to report the cumulative value of methane gas sent to the destruction device for each time interval t.

5.2 Quantifying Project Emissions

Certain GHG emissions may occur or increase as a result of the project activity, and therefore must be deducted from the overall project reductions. These added emissions are typically a result of the increased use of fossil-derived energy used to power project blowers, monitoring equipment, support vehicles, or gas treatment. As such, the following categories of emissions must be accounted for under this protocol:

- Total annual indirect carbon dioxide emissions resulting from consumption of electricity from the grid
- Total annual carbon dioxide emissions from the on-site destruction of fossil fuel
- Total annual carbon dioxide emissions from the combustion of supplemental natural gas
- Total annual methane emissions from the incomplete combustion of supplemental natural gas

However, unlike the emissions from incomplete destruction of supplemental natural gas, those resulting from incomplete destruction of landfill gas or the fugitive release of landfill gas do not need to be accounted for. It is assumed that these would have been released to the atmosphere in the baseline scenario as well.

Project emissions shall be calculated using Equation 5.9.

Equation 5.9. Calculating Project Emissions

$$PE = FF_{CO_2} + EL_{CO_2} + NG_{PR}$$

Where,

			Units
PE	=	Project emissions during the reporting period	tCO_2e
FF_{CO2}	=	Total carbon dioxide emissions from the destruction of fossil fuel during the reporting period	tCO_2
EL_{CO2}	=	Total indirect carbon dioxide emissions from the consumption of electricity from the grid during the reporting period	tCO_2
NG_{PR}	=	Total quantity of emissions from supplemental natural gas, including both uncombusted methane and carbon dioxide emissions during the reporting period	tCO_2

Equation 5.10. Calculating Project Emissions from Fossil Fuel Use

$$FF_{CO_2} = \frac{\sum_j \left(FF_{PR,j} \times EF_{FF,j}\right)}{1000}$$

Where,

			Units
FF_{CO2}	=	Total carbon dioxide emissions from the destruction of fossil fuel during the reporting period	tCO_2
$FF_{PR,j}$	=	Total fossil fuel consumed by the project landfill gas collection and destruction system during the reporting period, by fuel type j	GJ / yr
$EF_{FF,j}$	=	Fuel specific emission factor. See Appendix B	kg CO_2 / GJ fossil fuel
1000	=	Conversion factor	$kgCO_2$ / tCO_2

Equation 5.11. Calculating Project Emissions from Electricity Use

$$EL_{CO_2} = \frac{\left(EL_{PR} \times EF_{EL}\right)}{1000}$$

Where,

			Units
EL_{CO2}	=	Total indirect carbon dioxide emissions from the consumption of electricity from the grid during the reporting period	tCO_2
EL_{PR}	=	Total electricity consumed by the project landfill gas collection and destruction system during the reporting period	MWh
EF_{EL}	=	CO_2 emission factor for electricity used	$kgCO_2$ / MWh
1000	=	Conversion factor	$kgCO_2$ / tCO_2

Equation 5.12. Calculating Project Emissions from the Use of Supplemental Natural Gas

$$NG_{PR} = \sum_{i} \left[NG_i \times NG_{CH_4} \times 0.017 \times 0.001 \times \left[\left((1 - DE_i) \times GWP \right) + \left(DE_i \times \frac{12}{16} \times \frac{44}{12} \right) \right] \right]$$

Where,			Units
NG_{PR}	=	Total emissions from supplemental natural gas during the reporting period, including both uncombusted methane and carbon dioxide emissions	tCO_2e
NG_i	=	Total quantity of supplemental natural gas delivered to the destruction device i during the reporting period	m^3
DE_i	=	Methane destruction efficiency of destruction device i. See Appendix B	
NG_{CH4}	=	Average methane fraction of the supplemental natural gas as provided for by fuel vendor	m^3CH_4 / m^3FFG
0.717	=	Density of methane	$kgCH_4$ / m^3CH_4
0.001	=	Conversion factor	tCH_4 / $kgCH_4$
GWP	=	Global Warming Potential factor of methane to carbon dioxide equivalent	tCO_2e / tCH_4
12/16	=	Carbon ratio of methane	C / CH_4
44/12	=	Carbon ratio of carbon dioxide	CO_2 / C

6 Project Monitoring

The Reserve requires a monitoring plan to be established for all monitoring and reporting activities associated with the project. The monitoring plan will serve as the basis for verifiers to confirm that the stipulations of Sections 6 and 7 have been and will continue to be met, and that consistent, rigorous monitoring and record-keeping occurs. The monitoring plan does not require ISO or any other certification but must cover all aspects of monitoring and reporting contained in this protocol and must specify how data for all relevant parameters in Table 6.1 will be collected and recorded.

At a minimum the monitoring plan must include a written account of the frequency of data acquisition; the record keeping plan (see Section 7.2 for minimum record keeping requirements); the frequency of instrument cleaning, inspection, field check and calibration activities; and the role of the individual performing each specific monitoring activity, as well as QA/QC provisions to ensure that data acquisition and meter calibration are carried out consistently and with precision. The monitoring plan shall also contain a detailed diagram of the landfill gas collection and destruction system, including the placement of all meters and equipment that affect SSRs within the GHG Assessment Boundary (see Figure 4.1).

Finally, the monitoring plan must include procedures that the project developer will follow to ascertain and demonstrate that the project at all times passes the Legal Requirement Test (Section 3.4.3).

Project developers are responsible for monitoring the performance of the project and operating the landfill gas collection and destruction system in a manner consistent with the manufacturer's recommendations for each component of the system.

6.1 Monitoring Requirements

Project developers are responsible for monitoring the performance of the project and operating the landfill gas collection and destruction system in a manner consistent with the manufacturer's recommendations for each component of the system. Methane emission reductions from landfill gas capture and control systems must be monitored with measurement equipment that directly meters:

- The flow of landfill gas delivered to each destruction device, measured continuously and recorded every 15 minutes or totalized and recorded at least daily, adjusted for temperature and pressure
- The fraction of methane in the landfill gas delivered to the destruction device, measured continuously and recorded every 15 minutes and averaged at least daily (measurements taken at a frequency that is between daily and weekly may be used with the application of a 10% discount in Equation 5.3). Projects may not be eligible for crediting if methane concentration is not measured and recorded at least weekly.
- The operational activity of the destruction device(s), monitored and documented at least hourly to ensure landfill gas destruction

If discontinuous CH_4 concentration monitoring is to be employed, then the project developer shall develop a prescriptive methodology for how such monitoring is to be carried out. The method should be reasonable to the circumstances of the project and shall be consistently applied throughout the reporting period. Any such methodology, and adherence to the methodology (or otherwise), should be clearly set out in the project monitoring report.

Methane fraction of the landfill gas is to be measured on a wet/dry basis, depending on the basis (i.e., measured on the same basis) of measurement for flow, temperature, and pressure. The methane analyzer and flow meter shall be installed in the same relative placement to any moisture-removing component separating the measurement of the landfill gas system, where the moisture-removing component is not separating the measurement of flow and methane fraction. The meters themselves should also operate on the same basis (i.e., if one meter internally dries the sample prior to measurement, the same should occur at the other meters). An acceptable variation to this arrangement would be in the case where flow is measured on a dry basis, while the methane concentration is measured on a wet basis. The opposite arrangement is not permissible. No separate monitoring of temperature and pressure is necessary when using flow meters that automatically correct for temperature and pressure, expressing LFG volumes in normalized cubic meters.

A single flow meter may be used for multiple destruction devices under certain conditions. If all destruction devices are of identical efficiency and verified to be operational, no additional steps are necessary for project registration. Otherwise, the destruction efficiency of the least efficient destruction device shall be used as the destruction efficiency for all destruction devices monitored by this meter.

If there are any periods when not all destruction devices measured under a single flow meter are operational, methane destruction during these periods will be eligible provided that the verifier can confirm all of the following conditions were met:

1. The destruction device efficiency of the least efficient destruction device in operation shall be used as the destruction efficiency for all destruction devices monitored by this meter; and

2. All devices are either equipped with valves on the input gas line that close automatically if the device becomes non-operational (requiring no manual intervention), or designed in such a manner that it is physically impossible for gas to pass through while the device is non-operational; and

3. For any period where one or more destruction devices within this arrangement is not operational, it must be documented that the remaining operational devices have the capacity to destroy the maximum gas flow recorded during the period. For devices other than flares, it must be shown that the output corresponds to the flow of gas.

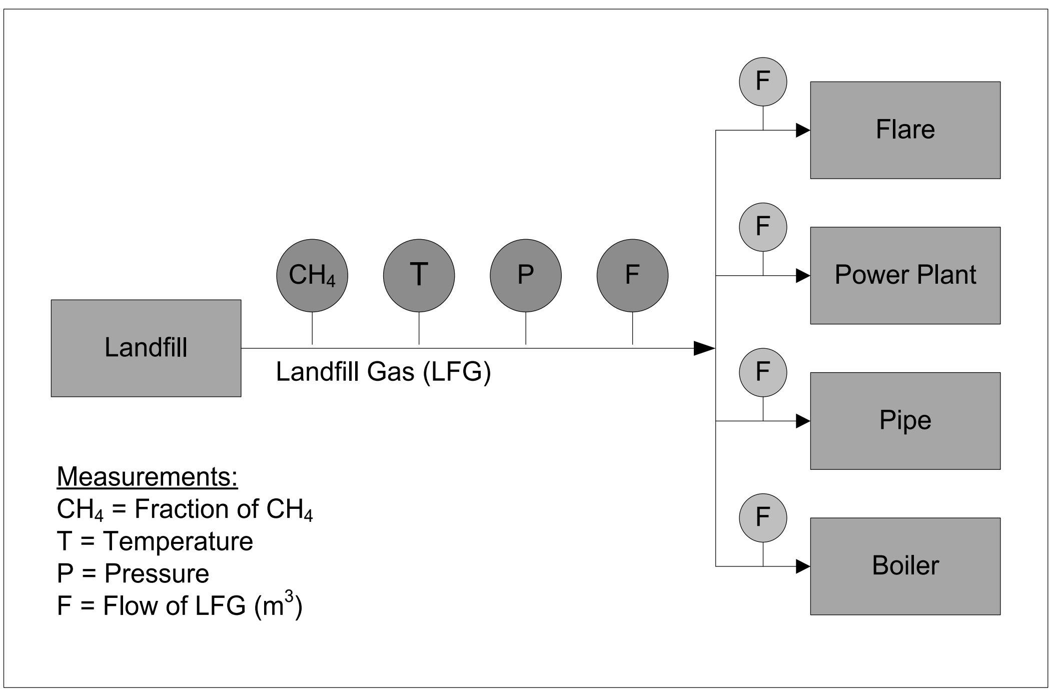
By allowing for a single device to monitor operational activity at multiple destruction devices, it shall not be construed to relax the requirement for hourly operational data for all destruction devices. Rather, this arrangement permits a specific metering arrangement during periods when one or more devices are *known* to not be operating. In order to know the operational status of a device, it must be monitored. All destruction devices must have their operational status monitored and recorded at least hourly. In other words, the project dataset will include an indication of operational status corresponding to each hour of landfill gas data. If these data are missing or never recorded for a particular device, that device will be assumed to be not operating and no emission reductions may be claimed for landfill gas destroyed by that device during the period when data are missing.

All flow data collected must be corrected for temperature and pressure at 0° C and 1 atm. If any of the landfill gas flow metering equipment does not internally correct for the temperature and pressure of the landfill gas, separate pressure and temperature measurements must be used to correct the flow measurement. The temperature and pressure of the landfill gas must be measured continuously. Corrected values must be used in all of the equations of this section. Apply Equation 5.2 only if the landfill gas flow metering equipment does not internally correct for temperature and pressure.

Often, the direct measurement instrument also uses a data recorder to store and document the landfill gas flow and methane concentration data and can be tailored to provide the amount of methane (by volume) collected from the landfill on a periodic basis as specified by the operator.

The continuous methane analyzer should be the preferred option for monitoring methane concentrations, as the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions (dilution with air at wellheads, leakage on pipes, etc.).[21] When using the alternative approach of weekly methane concentration measurement using a calibrated portable gas analyzer, project developers must account for the uncertainty associated with these measurements by applying a 10% discount factor to the total quantity of methane collected and destroyed in Equation 5.3.

Figure 6.1 represents the suggested arrangement of the landfill gas flow meters and methane concentration metering equipment.



Note: The number of flow meters must be sufficient to track the total flow as well as the flow to each destruction device. The above scenario includes one more flow meter than would be necessary to achieve this objective.
Source: Consolidated baseline methodology for landfill gas project activities, Clean Development Mechanism, Version 07, Sectoral Scope 13 (2007).

Figure 6.1. Suggested Arrangement of LFG Metering Equipment

[21] Consolidated baseline methodology for landfill gas project activities, Clean Development Mechanism, Version 07, Sectoral Scope 13 (2007).

The operational activity of the landfill gas collection system and the destruction devices shall be monitored and documented at least hourly to ensure actual landfill gas destruction. GHG reductions will not be accounted for during periods which the destruction device was not operational. For flares, operation is defined as thermocouple readings above 260°C (unless otherwise specified in manufacturer's guidance). For all other destruction devices, the means of demonstration shall be determined by the project developer and subject to verifier review. If relying on the difference between ambient temperatures and temperatures recorded by a thermocouple to demonstrate operational activity (instead of using a fixed temperature threshold), then a temperature difference of at least 200° F shall be used. If any destruction device is equipped with a safety shut off valve that prevents biogas flow to the destruction device when not operational, then demonstrating the presence and operability of the shut off valve will be sufficient to demonstrate operational activity of that device.

In "direct use" scenarios where landfill gas is delivered offsite to a third-party end user (not to a commercial natural gas transmission and distribution system or to a facility under management control of the project operator), reasonable efforts must be made to obtain data demonstrating the operational status of the destruction device(s). If it is not possible to obtain such data, the verifier must use their professional judgment to confirm that there has been no significant release of project landfill gas and that the project developer is using the destruction efficiency value appropriate for the end use. Evidence that may assist a verifier in making a determination to that effect may include, but is not limited to, one or more of the following:

- A signed attestation from the third-party operator of the destruction device that no catastrophic failure of destruction or significant release of landfill gas occurred during the reporting period, and that the safety features and/or design of the destruction equipment are such that the destruction device does not allow landfill gas to pass through it when non-operational and/or that the project developer is able to switch off the flow of landfill gas offsite in the event of emergencies (and has rigorous procedures in place to ensure such shutoff occurs immediately)

- The verifier confirming the same via a first-person interview with the third-party operator

- Examination of the safety features and/or design of the destruction equipment, such that the destruction device does not allow landfill gas to pass through it when non-operational and/or that the project developer is able to switch off the flow of landfill gas offsite in the event of emergencies (and has rigorous procedures in place to ensure such shutoff occurs immediately)

- Records that can corroborate the type and level of operation of the destruction device during the reporting period, such as engine output data, etc.

If the verifier is reasonably assured that no significant release of landfill gas has occurred offsite during the reporting period, the project can use the destruction efficiency appropriate to that offsite destruction device, despite the lack of hourly data from a monitoring device confirming operational status.

6.1.1 Indirect Monitoring Alternative

As an alternative to the direct measurement of LFG, projects may instead choose to demonstrate volumes of CH_4 destroyed using output data for their destruction device. Where the output of destruction devices (such as gensets) is measured via the use of a commercial transfer meter (i.e., a meter whose output is used as the basis for the quantification under an energy delivery contract), which is subject to regular, professional maintenance, the project may use such data as the basis for determining the volume of CH_4 destroyed. The meter output shall be subjected to an appropriate conversion methodology to calculate the volume of CH_4 destroyed during the reporting period. If using the indirect monitoring alternative, the commercial meter must be maintained by appropriately-trained professionals, in accordance with manufacturer requirements. In scenarios where projects are able to control the maintenance of such meters, the QA/QC requirements in Section 6.2 apply. In scenarios where projects are not able to control the maintenance of such meters, reasonable efforts must be made to obtain documentation demonstrating manufacturer maintenance requirements have been met during the reporting period.

The monitoring methodology to be employed must be clearly set out in the project monitoring report, it must be applied consistently throughout the reporting period, and it must be demonstrated to the satisfaction of the project's verifier and the Reserve that the use of such data and methodology is reasonable under the circumstances, and results in a conservative estimation of the volume of CH_4 destroyed.

6.2 Instrument QA/QC

The measurement equipment is sensitive for gas quality (humidity, particulate, etc.), so a strong QA/QC procedure for the calibration of this equipment should be built into the monitoring plan. Monitoring instruments shall be inspected and calibrated according to the following schedule.

All gas flow meters[22] and continuous methane analyzers must be:

- Cleaned and inspected on a regular basis, as specified in the project's monitoring plan, with activities and results documented by site personnel. Cleaning and inspection frequency must, at a minimum, follow the manufacturers' recommendations.
- Field checked for calibration accuracy by a third-party technician with the percent drift documented, using either a portable instrument (such as a pitot tube) or manufacturer specified guidance, at the end of – but no more than two months prior to or after – the end date of the reporting period[23]
- Calibrated by the manufacturer or a certified third-party calibration service per manufacturer's guidance or every 5 years when calibration frequency is not specified by the manufacturer.

Conformance with the factory calibration requirement is only required during periods of time where data gathered by the meter are used for emission reduction quantification. Periods where the meter did not meet this requirement will not cause the project to fail this requirement, provided the meter was not being used for project emission reduction quantification during such periods, and provided the meter was brought back into conformance before being employed to gather project data.

[22] Field checks and calibrations of flow meters shall ensure that the meter accurately reads volumetric flow, and has not drifted outside of the prescribed +/-5% accuracy threshold.
[23] Instead of performing field checks, the project developer may instead have equipment calibrated by the manufacturer or a certified calibration service per manufacturer's guidance, at the end of but no more than two months prior to the end date of the reporting period to meet this requirement.

If a stationary meter that was in use for 60 days or more is removed and not reinstalled during a reporting period, that meter shall either be field-checked for calibration accuracy prior to removal or calibrated (with percent drift documented) by the manufacturer or a certified calibration service (with as-found results recorded) prior to quantification of emission reductions for that reporting period.

If the required calibration or calibration check is not performed and properly documented, no GHG credits may be generated for that reporting period. Flow meter calibrations shall be documented to show that the meter was calibrated to a range of flow rates corresponding to the flow rates expected at the landfill. Methane analyzer calibrations shall be documented to show that the calibration was carried out to the range of conditions (temperature and pressure) corresponding to the range of conditions as measured at the landfill.

The as-found condition (percent drift) of a field check must always be recorded. If the meter is found to be measuring outside of a +/- 5% threshold for accuracy, the data must be adjusted for the period beginning with the last successful field check or calibration event up until the meter is confirmed to be in calibration (unless the last event occurred during the prior reporting period, in which case adjustment is made back to the beginning of the current reporting period). If, at the time of the failed field check, the meter is cleaned and checked again, with the as-left condition found to be within the accuracy threshold, a full calibration is not required for that piece of equipment. This shall be considered a failed field check, followed by a successful field check. The data adjustment shall be based on the percent drift recorded at the time of the failed field check. However, if the as-left condition remains outside of the +/- 5% accuracy threshold (whether or not additional cleaning and accuracy testing occurs), calibration by the manufacturer or a certified service provider is required for that piece of equipment.

For the interval between the last successful field check and any calibration event confirming accuracy below the +/- 5% threshold, all data from that meter or analyzer must be scaled according to the following procedure. These adjustments must be made for the entire period from the last successful field check until such time as the meter is properly calibrated.

1. For calibrations that indicate under-reporting (lower flow rates, or lower methane concentration), the metered values must be used without correction.

2. For calibrations that indicate over-reporting (higher flow rates, or higher methane concentration), the metered values must be adjusted based on the greatest calibration drift recorded at the time of calibration.

For example, if a project conducts field checks quarterly during a year-long reporting period, then only three months of data will be subject at any one time to the penalties above. However, if the project developer feels confident that the meter does not require field checks or calibration on a greater than annual basis, then failed events will accordingly require the penalty to be applied to the entire year's data. Frequent calibration may minimize the total accrued drift (by zeroing out any error identified), and result in smaller overall deductions. Additionally, strong equipment inspection and cleaning practices that include checking all probes and internal components will minimize the risk of meter and analyzer inaccuracies and the corresponding deductions. If it is not possible to determine the accrued drift and/or an appropriate method for scaling the data (e.g., drift is recorded in milliwatts, which cannot be directly translated into a drift percentage), the project developer should seek guidance from the instrument manufacturer to confirm when the 5% drift threshold has been reached and how to appropriately scale the relevant data. Such guidance should be provided to the verifier and the Reserve.

Additional field checks carried out during the reporting period at the project developer's discretion may be performed by an individual that is not a third-party technician. In this case, the competency of the individual and the accuracy of the field check procedure must be assessed and approved by the verification body. Furthermore, if the field check reveals accuracy outside of the +/- 5% threshold, calibration is required, and the data must be scaled as detailed above. In order to provide flexibility in verification, data monitored up to two months after a field check may be verified. As such, the end date of the reporting period must be no more than two months after the latest successful field check.

If a portable instrument either:

1. acquires project data (e.g., a handheld methane analyzer is used to take weekly methane concentration measurements), or

2. is used to field check the calibration accuracy of equipment that acquires project data and the portable instrument produces a data output that is or could be used in emission reduction calculations (i.e., flow or concentration); then,

the portable instrument shall be maintained and calibrated per the manufacturer's specifications, and calibrated at least annually by the manufacturer, by a laboratory approved by the manufacturer, or at an ISO 17025 accredited laboratory. Other pieces of equipment used for QA/QC of monitoring instruments shall be maintained according to the manufacturer's specifications, including calibration where specified. Portable methane analyzers must also be field calibrated to a known sample gas prior to each use.

6.3 Missing Data

In situations where the flow rate or methane concentration monitoring equipment is missing data, the project developer shall apply the data substitution methodology provided in Appendix C. If for any reason the destruction device monitoring equipment is inoperable (for example, the thermal coupler on the flare), then no emission reductions can be registered for the period of inoperability.

6.4 Monitoring Parameters

Prescribed monitoring parameters necessary to calculate baseline and project emissions are provided in Table 6.1.

Table 6.1. Project Monitoring Parameters

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Qualitative Monitoring Parameters						
		Legal Requirement Test	Project developer attestation of voluntary implementation	Each reporting period		Must be monitored and determined for each reporting period. The project shall document all federal, state, and local regulations, ordinances, and permit requirements (and compliance status for each) that apply to the GHG reduction project. The project developer shall provide a signed attestation of voluntary implementation of the project.
		Regulatory Compliance	Project developer attestation to compliance with regulatory requirements relating to landfill gas project	Each reporting period		Must be monitored and determined for each project period. The project developer shall document all federal, state, and local regulations, ordinances, and permit requirements (and compliance status for each) that apply to the GHG reduction project. The project developer shall provide a signed attestation to their compliance status for the above-mentioned federal, state, and local regulations, ordinances, and permit requirements
		Operation of destruction device		Hourly	o	Required for each destruction device. For flares, operation is defined as thermocouple readings above 260°C
Quantitative Monitoring Parameters						
Equation 5.1	ER	GHG emission reductions during the reporting period	tCO_2e		c	

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.1 Equation 5.3	BE	Baseline emissions during the reporting period	tCO_2e		c	
Equation 5.1 Equation 5.9	PE	Project emissions during the reporting period	tCO_2e		c	
Equation 5.2 Equation 5.4	$LFG_{i,t}$	Total quantity of landfill gas fed to the destruction device I, in time internal t, at standard temperature and pressure	scf	Continuous	m/c	Measured continuously by a flow meter and recorded at least once every 15 minutes. Data to be aggregated by time interval t (this parameter is calculated in cases where the metered flow must be corrected for temperature and pressure)
Equation 5.2	$LFG_{unadjusted}$	Unadjusted volume of landfill gas collected for the given time interval	acf	Continuous	m	Used only in cases where the flow meter does not automatically correct to 0°C and 1 atm
Equation 5.3 Equation 5.4	CH_4Dest_{PR}	Total methane destroyed by the project landfill gas collection and destruction system during the reporting period	tCH_4		c	
Equation 5.3	DF	Discount factor to account for uncertainties associated with the monitoring equipment	0, 0.10, 0.2		r	Equal to zero if using continuous methane monitor.
Equation 5.3	OX	Factor for the oxidation of methane by soil bacteria	0, 0.10		r	Equal to 0.10 for all landfills except those that incorporate a synthetic liner throughout the entire area of the final cover systems where OX = 0

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.3 Equation 5.5. Equation 5.8 Equation 5.12	GWP	100-year global warming potential for CH_4	tCO_2e / tCH_4	Per reporting period	r	Refer to the Reserve Offset Program Manual and policy memos for updated values.
Equation 5.3 Equation 5.5	$Dest_{base}$	Adjustment to account for the baseline methane destruction associated with a baseline destruction device	tCO_2e		c	Equal to zero if no baseline LFG destruction system is in place prior to project implementation
Equation 5.4	CH_4Dest_i	The net quantity of methane destroyed by destruction device i during the reporting period	m^3CH_4		c	
Equation 5.4	Q_i	Total quantity of landfill methane sent to destruction device i during the reporting period	m^3 CH_4	Daily/Weekly	c	Calculated daily if methane is continuously metered or weekly if methane is measured weekly

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.4	DE_i	Default methane destruction efficiency for device i	%	Once	r/m	Project developers have the option to use a state or local agency accredited source test service provider to test the actual methane destruction efficiency of each of the destruction devices used in the project case. If using source test data for destruction efficiencies in Equation 5.2, all source test documentation shall be provided to the verifier. See Appendix B for default values
Equation 5.4	*t*	Time interval for which LFG flow and concentration measurements are aggregated	Week, day, or smaller interval	Continuous/ Daily/Weekly	r	Projects employing continuous methane concentration monitoring may use the interval of their data acquisition system. Otherwise, this parameter is equal to one day for continuously monitored methane concentration and one week for weekly monitored methane concentration
Equation 5.4 Equation 5.8	$PR_{CH4,t}$	The average methane fraction of the landfill gas in time interval t	m^3CH_4 / m^3LFG	Continuous/ Weekly	m	Measured by continuous gas analyzer or a calibrated portable gas analyzer. Data to be averaged by time interval t
Equation 5.6	$Closed_{discount}$	Adjustment to account for the methane which would have been combusted in the baseline flare from baseline wells at a closed landfill	m^3CH_4	Yearly	C	Calculated per year, but may be scaled for project reporting periods less than one year

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.7	$NQ_{discount}$	Adjustment to account for the methane which would have been combusted in the baseline, non-qualifying combustion device	m^3CH_4	Yearly	C	Calculated per year, may be scaled for project reporting periods less than one year
Equation 5.8	$Dest_{max}$	Deduction of the un-utilized capacity of the baseline destruction device	m^3CH_4	Weekly, Monthly, or per reporting period (no more than weekly)	C	This deduction is to be applied only when a new destruction device is used during project activity
Equation 5.8	$LFG_{B,t}$	Actual landfill gas flow of the baseline methane destruction device in time interval t	m^3/t	Yearly	c	Calculated per Section 5. Calculated per year, but may be scaled for project reporting periods less than one year
Equation 5.6	$B_{CH4,\ closed}$	Methane fraction of landfill gas destroyed by baseline flares at a closed landfill	m^3CH_4 / m^3LFG	Continuously/ Other	m	Measured by continuous gas analyzer or calibrated portable gas analyzer
Equation 5.7	LFG_{B2}	Landfill gas that would have been destroyed by the original, non-qualifying destruction system during the reporting period	m^3LFG / year	Yearly	C	Calculated per Section 5, or according to guidance provided in Appendix C. Calculated per year, but may be scaled for project reporting periods less than one year
Equation 5.7	$B_{CH4,NQ}$	Methane fraction of landfill gas destroyed by non-qualifying devices in the baseline	m^3CH_4 / m^3LFG	Continuously/ Other	m	Measured by a continuous gas analyzer or a calibrated portable gas analyzer

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.8	$LFG_{Bmax,t}$	The maximum landfill gas flow capacity of the baseline methane destruction device in time interval t	m^3/t	At beginning of first reporting period	c	Calculated based on manufacturer's and/or engineers' specifications for the destruction device and blower system. The maximum capacity of the limiting component, either the destruction device or blower, shall be used
Equation 5.8	$LFG_{B,t}$	The actual landfill gas flow of the baseline methane destruction device in time interval *t*	m^3	Continuous	m	Measured continuously by a flow meter and recorded at least once every 15 minutes
Equation 5.9 Equation 5.10	FF_{CO2}	Total carbon dioxide emissions from the destruction of fossil fuel during the reporting period	tCO_2	Yearly	c	
Equation 5.10	$FF_{PR,j}$	Total fossil fuel consumed by the project landfill gas collection and destruction system during the reporting period, by fuel type j	GJ/yr	Monthly	o	Calculated from monthly record of fossil fuel purchased and consumed
Equation 5.10	$EF_{FF,j}$	Fuel specific emission factor	$kgCO_2$ / GJ fossil fuel	Annually	r	See Appendix B

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.9 Equation 5.11	EL_{CO2}	Total indirect carbon dioxide emissions from the consumption of electricity from the grid during the reporting period	tCO_2		c	
Equation 5.11	EF_{EL}	Carbon emission factor for electricity used	$kgCO_2$/ MWh	Annually	r	
Equation 5.11	EL_{PR}	Total electricity consumed by the project landfill gas collection and destruction system during the reporting period	MWh		m/o	Obtained from either on-site metering or utility purchase records. Required to determine CO_2 emissions from use of electricity to operate the project activity
Equation 5.9 Equation 5.12	NG_{PR}	Total quantity of emissions from supplemental natural gas used during the reporting period	tCO_2	Annually	c	Includes both uncombusted methane and carbon dioxide emissions
Equation 5.12	NG_i	Total quantity of supplemental natural gas delivered to the destruction device i during the reporting period	m^3	Continuous	m	Metered prior to delivery to destruction device

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Equation 5.12	NG_{CH4}	Average methane fraction of the supplemental natural gas as provided for by fuel vendor	m^3CH_4 / m^3FFG		r	Refer to purchase records
Equation 5.2	T	Temperature of the landfill gas	°C	Continuous	m	No separate monitoring of temperature is necessary when using flow meters that automatically adjust flow volumes for temperature and pressure, expressing LFG volumes in normalized cubic feet
Equation 5.2	P	Pressure of the landfill gas	atm	Continuous	m	No separate monitoring of pressure is necessary when using flow meters that automatically measure adjust flow volumes for temperature and pressure, expressing LFG volumes in normalized cubic feet

7 Reporting Parameters

This section provides guidance on reporting rules and procedures. A priority of the Reserve is to facilitate consistent and transparent information disclosure among project developers. Project developers must submit verified emission reduction reports to the Reserve annually at a minimum.

7.1 Project Submittal Documentation

Project developers must provide the following documentation to the Reserve in order to register a landfill project.

- Project Submittal form
- Project diagram
- Signed Attestation of Title form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form
- Verification Report
- Verification Statement

Project developers must provide the following documentation each reporting period in order for the Reserve to issue CRTs for quantified GHG reductions.

- Verification Report
- Verification Statement
- List of Findings
- Signed Attestation of Title form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form

At a minimum, the above project documentation will be available to the public via the Reserve's online registry. Further disclosure and other documentation may be made available on a voluntary basis through the Reserve. Project submittal forms can be found at https://www.climateactionreserve.org/how/protocols/mexico-landfill/.

7.2 Record Keeping

For purposes of independent verification and historical documentation, project developers are required to keep all information outlined in this protocol for a period of 10 years after the information is generated or 7 years after the last verification. This information will not be publicly available but may be requested by the verifier or the Reserve.

System information the project developer should retain includes:

- All data inputs for the calculation of the GHG reductions
- Copies of all solid waste, air, water, and land use permits, Notices of Violations (NOVs), and any administrative or legal consent orders dating back at least 3 years prior to the project start date, and for each subsequent year of project operation
- Project developer attestation of compliance with regulatory requirements relating to the landfill gas project
- Collection and control device information (installation dates, equipment list, etc.)

- LFG flow meter information (model number, serial number, manufacturer's calibration procedures)
- Methane monitor information (model number, serial number, calibration procedures)
- Destruction device monitor information (model number, serial number, calibration procedures)
- LFG flow data (for each flow meter)
- LFG flow meter calibration data (for each flow meter)
- Methane monitoring data
- Methane monitor calibration data
- Destruction device monitoring data (for each destruction device)
- Destruction device monitor calibration data (for each destruction device)
- CO_2e monthly and annual tonnage calculations
- Initial and annual verification records and results
- All maintenance records relevant to the LFG control system, monitoring equipment, and destruction devices
- Operational records of the landfill relating to the amount of waste placed onsite (scalehouse records, etc.), or most recent documented WIP report accepted by a regulatory agency

Calibrated portable gas analyzer information that the project developer should retain includes:

- Date, time, and location of methane measurement
- Methane content of LFG (% by volume) for each measurement
- Methane measurement instrument type and serial number
- Date, time, and results of instrument calibration
- Corrective measures taken if the instrument does not meet performance specifications

7.3 Reporting Period and Verification Cycle

7.3.1 Reporting Periods

The reporting period is the length of time over which GHG emission reductions from project activities are quantified. Project developers must report GHG reductions resulting from project activities during each reporting period. A reporting period may not exceed 12 months in length, except for the initial reporting period, which may cover up to 24 months.
The Reserve will accept verified emission reduction reports on a sub-annual basis, should the project developer choose to have a sub-annual reporting period and verification schedule (e.g., monthly, quarterly, or semi-annually). Reporting periods must be contiguous; there may be no time gaps in reporting during the crediting period of a project once the first reporting period has commenced.

7.3.2 Verification Periods

The verification period is the length of time over which GHG emission reductions from project activities are verified. The initial verification period for a landfill project is limited to one reporting period of up to 24 months of data. Subsequent verification periods may cover up to two reporting periods, with a maximum of 24 months of data (i.e., 12 months of data per reporting period). CRTs will not be issued for reporting periods that have not been verified. For any reporting period that ends prior to the end of the verification period (i.e., year 1 of a 2-year verification period), an interim monitoring report must be submitted to the Reserve no later than six months following the end of the relevant reporting period. The interim monitoring report shall contain a summary of emission reductions, description of QA/QC activities, and description of any potential nonconformances, data errors, metering issues, or material changes to the project.[24] All mandatory sections of interim monitoring reports must be verified in the subsequent verification.

To meet the verification deadline, the project developer must have the required verification documentation (see Section 7.1 submitted within 12 months of the end of the verification period. The end date of any verification period must correspond to the end date of a reporting period.

7.3.3 Verification Site Visit Schedule

A site visit must occur during the initial verification, and at least once every two reporting periods thereafter. A reporting period may be verified without a new site visit if the following requirements are met:

1. A new site visit occurred in conjunction with the verification of the previous reporting period;
2. The current verification is being conducted by the same verification body that conducted the site visit for the previous verification; and
3. There have been no significant changes in data management systems, equipment, or personnel since the previous site visit.

The above requirements apply regardless of whether the verification period contains one or two reporting periods. The Reserve maintains the discretion to require a new site visit for a reporting period despite satisfaction of the above requirements. For example, the approval of a significant variance during the reporting period could be considered grounds for denial of the option to forego a site visit for the verification.

[24] A template monitoring report is available at: http://www.climateactionreserve.org/how/program/documents/.

8 Verification Guidance

This section provides verification bodies with guidance on verifying GHG emission reductions from landfill gas projects developed to the standards of this protocol. This verification guidance supplements the Reserve's Verification Program Manual and describes verification activities in the context of landfill gas destruction projects in Mexico.

Verification bodies trained to verify landfill projects in Mexico must be familiar with the following Climate Action Reserve documents:

- Reserve Offset Program Manual
- Reserve Verification Program Manual
- Reserve Mexico Landfill Protocol (this document)

The Reserve Offset Program Manual, Verification Program Manual, and project protocols are designed to be compatible with each other and are available on the Reserve's website at http://www.climateactionreserve.org.

In cases where the Reserve Offset Program Manual and/or Verification Program Manual differ from the guidance in this protocol, this protocol takes precedent.

ISO-accredited verification bodies trained by the Reserve for this project type are eligible to verify landfill project reports. Verification bodies approved under other Reserve or California Air Resources Board waste handling and methane destruction protocols are also permitted to verify landfill projects. Information about verification body accreditation and Reserve project verification training can be found on the Reserve website at https://www.climateactionreserve.org/how/verification/.

8.1 Standard of Verification

The Reserve's standard of verification for landfill projects in Mexico is the Mexico Landfill Protocol (this document), the Reserve Offset Program Manual, and the Verification Program Manual. To verify a landfill project developer's project report, verification bodies apply the guidance in the Verification Program Manual and this section of the protocol to the standards described in Section 2 through 7 of this protocol. Sections 2 through 7 provide eligibility rules, methods to calculate emission reductions, performance monitoring instructions and requirements, and procedures for reporting project information to the Reserve.

8.2 Monitoring Plan

The monitoring plan serves as the basis for verification bodies to confirm that the monitoring and reporting requirements in Section 6 and Section 7 have been met, and that consistent, rigorous monitoring and record-keeping is ongoing at the project site. Verification bodies shall confirm that the monitoring plan covers all aspects of monitoring and reporting contained in this protocol and specifies how data for all relevant parameters in Table 6.1 are collected and recorded.

8.3 Verifying Project Eligibility

Verification bodies must affirm a landfill project's eligibility according to the rules described in this protocol. The table below outlines the eligibility criteria for a landfill project. This table does not represent all criteria for determining eligibility comprehensively; verification bodies must also look to Section 3 and the verification items list in Table 8.2.

Table 8.1. Summary of Eligibility Criteria

Eligibility Rule	Eligibility Criteria	Frequency of Rule Application
Location	Mexico	Once during first verification
Start Date	Project start date must be no more than 90 days after landfill gas is first destroyed by project destruction device. Projects must be submitted for listing within 12 months of the project start date	Once during first verification
Project Crediting Period	Ensure the project is within its first, second, or third crediting period	Once during each crediting period
Performance Standard	Installation of a qualifying destruction device where not required by law (see Section 3.4.1 for other requirements)	Once during first verification
Legal Requirement Test	Signed Attestation of Voluntary Implementation form and monitoring procedures that lay out procedures for ascertaining and demonstrating that the project passes the Legal Requirement Test	Every verification
Regulatory Compliance Test	Signed Attestation of Regulatory Compliance form and disclosure of all non-compliance events to verifier; project must be in material compliance with all applicable laws	Every verification
Exclusions	▪ Bioreactors ▪ Landfills which re-circulate a liquid other than leachate in a controlled manner ▪ Indirect emissions from the displacement of grid electricity or natural gas	Every verification

8.4 Core Verification Activities

The Mexico Landfill Project Protocol provides explicit requirements and guidance for quantifying GHG reductions associated with the destruction of landfill methane. The Verification Program Manual describes the core verification activities that shall be performed by verification bodies for all project verifications. They are summarized below in the context of a landfill project, but verification bodies shall also follow the general guidance in the Verification Program Manual.

Verification is a risk assessment and data sampling effort designed to ensure that the risk of reporting error is assessed and addressed through appropriate sampling, testing, and review. The three core verification activities are:

1. Identifying emission sources, sinks and reservoirs
2. Reviewing GHG management systems and estimation methodologies
3. Verifying emission reduction estimates

Identifying emission sources, sinks, and reservoirs

The verification body reviews for completeness the sources, sinks, and reservoirs identified for a project, such as system energy use, fuel consumption, combustion and destruction from various qualifying and non-qualifying destruction devices, and soil oxidation.

Reviewing GHG management systems and estimation methodologies
The verification body reviews and assesses the appropriateness of the methodologies and management systems that the landfill project uses to gather data on methane collected and destroyed and to calculate baseline and project emissions.

Verifying emission reduction estimates
The verification body further investigates areas that have the greatest potential for material misstatements and then confirms whether or not material misstatements have occurred. This involves site visits to the project to ensure the systems on the ground correspond to and are consistent with data provided to the verification body. In addition, the verification body recalculates a representative sample of the performance or emissions data for comparison with data reported by the project developer in order to double-check the calculations of GHG emission reductions.

8.5 Mexico Landfill Project Verification Items

The following tables provide lists of items that a verification body needs to address while verifying a landfill project in Mexico. The tables include references to the section in the protocol where requirements are further described. The table also identifies items for which a verification body is expected to apply professional judgment during the verification process. Verification bodies are expected to use their professional judgment to confirm that protocol requirements have been met in instances where the protocol does not provide (sufficiently) prescriptive guidance. For more information on the Reserve's verification process and professional judgment, please see the Verification Program Manual.

Note: These tables shall not be viewed as a comprehensive list or plan for verification activities, but rather guidance on areas specific to landfill projects that must be addressed during verification.

8.5.1 Project Eligibility and CRT Issuance

Table 8.2 lists the criteria for reasonable assurance with respect to eligibility and CRT issuance for landfill projects in Mexico. These requirements determine if a project is eligible to register with the Reserve and/or have CRTs issued for the reporting period. If any one requirement is not met, either the project may be determined ineligible or the GHG reductions from the reporting period (or sub-set of the reporting period) may be ineligible for issuance of CRTs, as specified in Sections 2, 3, and 6.

Table 8.2. Eligibility Verification Items

Protocol Section	Eligibility Qualification Item	Apply Professional Judgment?
2.1	Verify that the project meets the definition of a landfill project and is properly defined	No
2.1, 4	Confirm all baseline qualifying devices have been properly accounted for within project's GHG Assessment Boundary	No
2.2	Verify ownership of the reductions by reviewing Attestation of Title	No

Protocol Section	Eligibility Qualification Item	Apply Professional Judgment?
2.2, 2.3	For direct use agreements between the project developer and the end user of the landfill gas (i.e., an industrial client purchasing the landfill gas from the project developer), verify that a legally binding mechanism is built into the agreement language to assure that the GHG offset credits will not be double counted	No
3.2	Verify eligibility of project start date	No
3.2	Verify accuracy of project start date based on operational records	Yes
3.3	Verify that project is within its first, second, or third 10-year crediting period	No
3.4.1	Verify that the project meets the appropriate Performance Standard Test for the project type	No
3.4.2	Confirm execution of the Attestation of Voluntary Implementation form to demonstrate eligibility under the Legal Requirement Test	No
3.5	Verify that the project activities comply with applicable laws by reviewing any instances of non-compliance provided by the project developer and performing a risk-based assessment to confirm the statements made by the project developer in the Attestation of Regulatory Compliance form	Yes
6	Verify that the project monitoring plan contains procedures for ascertaining and demonstrating that the project passes the Legal Requirement Test at all times	Yes
6	Verify that monitoring meets the requirements of the protocol. If it does not, verify that a variance has been approved for monitoring variations	No
6	Verify that the landfill gas control system operated in a manner consistent with the design specifications	Yes
6	Verify that there is an individual responsible for managing and reporting GHG emissions, and that individual is properly trained and qualified to perform this function	Yes
6.2	Verify that all gas flow meters and methane analyzers adhered to the inspection, cleaning, and calibration schedule specified in the protocol. If they do not, verify that a variance has been approved for monitoring variations or that adjustments have been made to data per the protocol requirements	No
6.2	If any piece of equipment failed a calibration check, verify that data from that equipment was scaled according to the failed calibration procedure for the appropriate time period	No
6.3	If used, verify that data substitution methodology was properly applied	No
7.1, 7.2	Verify that appropriate documents are created to support and/or substantiate activities related to GHG emission reporting, and that such documentation is retained appropriately	Yes
	If any variances were granted, verify that variance requirements were met and properly applied	Yes
	If any zero-credit reporting periods were taken, verify that zero-credit reporting period requirements were met	Yes

8.5.2 Quantification of GHG Emission Reductions

Table 8.3 lists the items that verification bodies shall include in their risk assessment and re-calculation of the project's GHG emission reductions. These quantification items inform any determination as to whether there are material and/or immaterial misstatements in the project's

GHG emission reduction calculations. If there are material misstatements, the calculations must be revised before CRTs are issued.

Table 8.3. Quantification Verification Items

Protocol Section	Quantification Item	Apply Professional Judgment?
4	Verify that SSRs included in the GHG Assessment Boundary correspond to those required by the protocol and those represented in the project	No
5	Verify that the project developer correctly quantified and aggregated electricity use	Yes
5	Verify that the project developer correctly quantified and aggregated fossil fuel use	Yes
5	Verify that the project developer applied the correct emission factors for fossil fuel combustion and grid-delivered electricity	No
5.1	Verify that the project developer correctly accounted for baseline methane destruction in the baseline scenario	No
5.2	Verify that the project developer correctly monitored, quantified, and aggregated the amount of methane collected from the landfill and destroyed by the project landfill gas control system	No
5, Appendix B	Verify that the project developer applied the correct methane destruction efficiencies	No
Appendix B	If the project developer used source test data in place of the default destruction efficiencies, verify accuracy and appropriateness of data and calculations	Yes

8.5.3 Risk Assessment

Verification bodies will review the following items in Table 8.4 to guide and prioritize their assessment of data used in determining eligibility and quantifying GHG emission reductions.

Table 8.4. Risk Assessment Verification Items

Protocol Section	Item that Informs Risk Assessment	Apply Professional Judgment?
6	Verify that the project monitoring plan is sufficiently rigorous to support the requirements of the protocol and proper operation of the project	Yes
6	Verify that the individual or team responsible for managing and reporting project activities are qualified to perform this function	Yes
6	Verify that appropriate training was provided to personnel assigned to greenhouse gas reporting duties	Yes
6	Verify that all contractors are qualified for managing and reporting greenhouse gas emissions if relied upon by the project developer. Verify that there is internal oversight to assure the quality of the contractor's work	Yes
6.1	Verify that appropriate monitoring equipment is in place to meet the requirements of the protocol	No
6.2	Verify that the methane destruction equipment was operated and maintained according to manufacturer specifications	Yes
7.2	Verify that all required records have been retained by the project developer	No

8.6 Completing Verification

The Verification Program Manual provides detailed information and instructions for verification bodies to finalize the verification process. It describes completing a Verification Report, preparing a Verification Opinion, submitting the necessary documents to the Reserve, and notifying the Reserve of the project's verified status.

9 Glossary of Terms

Accredited verifier	A verification firm approved by the Climate Action Reserve to provide verification services for project developers.
Additionality	Landfill management practices that are above and beyond business-as-usual operation, exceed the baseline characterization, and are not mandated by regulation.
Anaerobic	Pertaining to or caused by the absence of oxygen.
Anthropogenic emissions	GHG emissions resultant from human activity that are considered to be an unnatural component of the Carbon Cycle (i.e., fossil fuel destruction, de-forestation, etc.).
Biogenic CO_2 emissions	CO_2 emissions resulting from the destruction and/or aerobic decomposition of organic matter. Biogenic emissions are considered to be a natural part of the Carbon Cycle, as opposed to anthropogenic emissions.
Bioreactor	Any landfill which: a. Meets the EPA definition of a bioreactor: “a MSW landfill or portion of a MSW landfill where any liquid other than leachate (leachate includes landfill gas condensate) is added in a controlled fashion into the waste mass (often in combination with recirculating leachate) to reach a minimum average moisture content of at least 40 percent by weight to accelerate or enhance the anaerobic (without oxygen) biodegradation of the waste.”[25] b. Has been designated by local, state, or federal regulators as a bioreactor. c. Has received grants or funding to operate as a bioreactor.
Carbon dioxide (CO_2)	The most common of the six primary greenhouse gases, consisting of a single carbon atom and two oxygen atoms.
Clean Development Mechanism (CDM)	One of the three flexible mechanisms established by the Kyoto Protocol. CDM is the market instrument in which certified emissions reductions can be achieved from a project developed in a “non-Annex I” country (developing country) with the assistance of an “Annex I” country (industrialized country). These reductions are accrued to the reduction commitment of the “Annex I” party (Art. 12 of the Kyoto Protocol) in the Kyoto Protocol’s first commitment period (2008-2012).
CO_2-equivalent (CO_2e)	The quantity of a given GHG multiplied by its total Global Warming Potential. This is the standard unit for comparing the degree of warming which can be caused by different GHGs.
Direct emissions	Greenhouse gas emissions from sources that are owned or controlled by the reporting entity.
Eligible landfill	A landfill that: 1. Is not subject to regulations or other legal requirements requiring the destruction of methane gas

[25] 40 CFR 63.1990 and 40 CFR 258.28a.

2. Is not a bioreactor
3. Does not add any liquid other than leachate into the waste mass in a controlled manner

Emission factor (EF)	A unique value for determining an amount of a greenhouse gas emitted for a given quantity of activity data (e.g., metric tonnes of carbon dioxide emitted per barrel of fossil fuel burned).
Emission Guidelines (EG)	Guidelines for state regulatory plans that have been developed by the U.S. EPA. For landfills, emission guidelines are codified in 40 CFR 60 Subpart Cc.
Flare	A destruction device that uses an open flame to burn combustible gases with combustion air provided by uncontrolled ambient air around the flame.
Fossil fuel	A fuel, such as coal, oil, and natural gas, produced by the decomposition of ancient (fossilized) plants and animals.
Greenhouse gas (GHG)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), or perfluorocarbons (PFCs).
Global Warming Potential (GWP)	The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one unit of a given GHG compared to one unit of CO_2.
Indirect emissions	Emissions that are a consequence of the actions of a reporting entity but are produced by sources owned or controlled by another entity.
Landfill	A defined area of land or excavation that receives or has previously received waste that may include household waste, commercial solid waste, non-hazardous sludge and industrial solid waste.
Landfill gas (LFG)	Gas resulting from the decomposition of wastes placed in a landfill. Typically, landfill gas contains methane, carbon dioxide, and other trace organic and inert gases.
Landfill gas project	Installation of infrastructure that in operating causes a decrease in GHG emissions through destruction of the methane component of landfill gas.
Liquefied petroleum gas (LPG)	Fuel obtained from oil distillation and after processing the natural gas liquids. It mainly consists on propane, butane or a mixture of both.
Metric ton or “tonne” (MT)	A common international measurement for the quantity of GHG emissions, equivalent to about 2204.6 pounds or 1.1 short tons.
Methane (CH_4)	A potent GHG with a GWP of 28, consisting of a single carbon atom and four hydrogen atoms.
Mexican Official Standard NOM-083-SEMARNAT-2003	Official Standard that provides specifications for environmental protection for the site selection, design, construction, monitoring, closure and complementary works for a final disposal site of urban solid waste and of special management.
MMBtu	One million British thermal units.

Mobile combustion	Emissions from the transportation of materials, products, waste, and employees resulting from the combustion of fuels in company owned or controlled mobile combustion sources (e.g., cars, trucks, tractors, dozers, etc.).
Nitrous oxide (N_2O)	A GHG consisting of two nitrogen atoms and a single oxygen atom.
Non-methane organic compounds (NMOC)	Non-methane organic compounds as measured according to the provisions of 40 CFR 60.754.
Non-qualifying destruction device	A passive flare or other combustion system that results in the destruction of methane, but which cannot serve as the primary destruction device for a methane destruction project under this protocol.
Project baseline	A business-as-usual GHG emission assessment against which GHG emission reductions from a specific GHG reduction activity are measured.
Project developer	An entity that undertakes a project activity, as identified in the Mexico Landfill Project Protocol. A project developer may be an independent third party or the landfill operating entity.
Reporting period	Specific time period of project operation for which the project developer has calculated and reported emission reductions and is seeking verification and issuance of credits. The reporting period must be no longer than 12 months.
Stationary combustion source	A stationary source of emissions from the production of electricity, heat, or steam, resulting from combustion of fuels in boilers, furnaces, turbines, kilns, and other facility equipment.
Verification	The process used to ensure that a given participant's greenhouse gas emissions or emission reductions have met the minimum quality standard and complied with the Reserve's procedures and protocols for calculating and reporting GHG emissions and emission reductions.
Verification body	A Reserve-approved firm that is able to render a verification opinion and provide verification services for operators subject to reporting under this protocol.

10 References

California Air Resources Board, Landfill Methane Control Measure web page http://www.arb.ca.gov/cc/ccea/landfills/landfills.htm.

Climate Action Reserve, Program Manual (March 2010).

Climate Action Reserve, U.S. Landfill Project Protocol Version 4.0 (2011).

Climate Action Reserve, Verification Program Manual (December 2010).

GE AES Greenhouse Gas Services, Landfill Gas Methodology, Version 1.0 (July 2007).

Intergovernmental Panel on Climate Change, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2001).

Intergovernmental Panel on Climate Change, IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 10: Emissions from Livestock and Landfill (2006).

International Organization for Standardization, ISO 14064 Greenhouses Gases Part 2, "Specification with Guidance at the Project Level for Quantification, Monitoring and Reporting of Greenhouse Gas Emissions Reductions or Removal Enhancements", First Edition 2006-03-01.

International Organization for Standardization, ISO 14064 Greenhouses Gases Part 3, "Specification With Guidance for the Validation and Verification of Greenhouse Gas Assertions", First Edition 2006-03-01.

Methane to Markets Partnership Landfills Subcommittee. 2007 Methane To Markets Partnership Expo, Preliminary Assessment For Landfill Methane Partnership Opportunities.

Nicholas Institute for Environmental Policy Solutions. "Harnessing Farms and Forests in the Low-Carbon Economy How to Create, Measure, and Verify Greenhouse Gas Offsets", Duke University Press, Durham & London (2007).

Regional Greenhouse Gas Initiative, Draft Model Rule (January 2007).

United Nations Framework Convention on Climate Change (UNFCCC), Revisions to the Approved Consolidated Baseline and Monitoring Methodology ACM0001, "Consolidated baseline methodology for landfill gas project activities," Clean Development Mechanism, Versions 06, Sectoral Scope 13 (July 2007).

United Nations Framework Convention on Climate Change (UNFCCC), Revisions to the Approved Consolidated Baseline and Monitoring Methodology ACM0001, "Consolidated baseline methodology for landfill gas project activities," Clean Development Mechanism, Versions 07, Sectoral Scope 13 (November 2007).

United Nations Framework Convention on Climate Change (UNFCCC), Approved Baseline and Monitoring Methodology AM0053, "Biogenic methane injection to a natural gas distribution grid" Clean Development Mechanism, Version 01, Sectoral Scopes 01 and 05 (2007).

U.S. Department of Energy 1605(b) Technical Guidelines for Voluntary Reporting of Greenhouse Gas Program.

U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005, EPA-430-R-07-002 (April 2007).

U.S. Environmental Protection Agency - Climate Leaders, Draft Offset Protocol – Landfill Methane Collection and Combustion (October 2006).

World Resource Institute and World Business Counsel for Sustainable Development, Greenhouse Gas Protocol for Project Accounting (November 2005).

Appendix A Development of the Performance Standard Threshold

A.1 Analysis of the Common Practice Performance Standard

This analysis is based on available data on websites of Mexican institutions, such as the National Institute of Ecology (INE), the National Institute of Statistics and Geography (INEGI), and data provided by the Ministry of Social Development (SEDESOL).

Two types of best practices are presented to define the performance standard threshold: first, the use of landfills as a final solid waste disposal technology instead of other technologies, such as open dumps or controlled sites; and second, the use of LFG collection and destruction systems instead of passive venting in landfills.

Use of Landfills

Definitions of the different types of final solid waste disposal methods in Mexico, according to the current legislation, are illustrated in Table A.1 and Table A.2. These tables depict the evolution of the use of the different types of disposal based on the quantity of disposed waste.

Table A.1. Definitions of the Mexican Official Standard NOM-083-SEMARNAT-2003

NOM-083	Definitions
Final disposal site	Site where municipal solid waste are disposed in a definitive manner
Non-controlled site	Inadequate waste disposal site that does not comply with the requirements established in the NOM-083
Controlled site	Inadequate waste disposal site that complies with the landfill specifications regarding infrastructure and operation, but does not comply with the impermeable cover material requirements
Landfill	Infrastructure that involves methods and engineering works for the final disposal of urban solid waste and of special management in order to control environmental impacts
Venting	Controlled outflow of landfill gases produced by the anaerobic decomposition of organic fractions in the municipal solid waste

Source: SEMARNAT. Normas Oficiales Mexicanas Vigentes. http://www.semarnat.gob.mx/leyesynormas/Normas%20Oficiales%20Mexicanas%20vigentes/NOM-083-SEMAR-03-20-OCT-04.pdf

In the last 10 years, the final disposal of solid waste in Mexico has evolved. In 1996, non-controlled sites and open dumps received around 64% of the waste, but in 2006 this percentage had diminished by half. Non-controlled sites are being closed and their use has decreased. On the other side, the construction of landfills is spreading, and the existing ones are receiving more waste. According to data in Table A.2, it can be concluded that landfills are the common practice for final solid waste disposal sites in Mexico, with a 57% penetration with regard to all of the waste disposed in 2006. Landfills, when operated technically and correctly, generate less environmental impacts and are better practices than open dumps and controlled sites for the disposal of solid waste.

Table A.2. Evolution of Final Solid Waste Disposal Sites in Mexico

Final Waste Disposal Sites in Mexico	Disposed Waste in 1996 (tonnes/year)	Percentage 1996	Disposed Waste in 2006 (tonnes/year)	Percentage 2006
Landfills	8,573,000	28%	19,772,100	57%
Controlled sites	2,606,000	8%	3,763,500	11%
Non-controlled sites	20,027,200	64%	11,423,400	32%
Total	31,206,200	100%	34,959,000	100%

Source: INEGI, 2009. Sistema Nacional de Información Estadística y Geográfica. Residuos. http://www.inegi.org.mx/inegi/default.aspx?s=est&c=6116 (March 2009)

Use of LFG Collection and Destruction Systems

Table A.3 illustrates the waste disposal by type of final disposal site in 2008 and the common practices of LFG management.

Table A.3. Waste Disposal and LFG Management Practices (2008)

Final Waste Disposal Sites	Number	Disposed Waste (tonnes/year)	Percentage[1]	LFG Collection and Destruction Practices[2]
Landfills	128	21,822,600	60%	Passive venting
Controlled sites	26	3,545,600	10%	Passive venting
Non-controlled sites	Not available	10,880,000	30%	Not existing
Total	154	33,707,000	100%	

Source: SEDESOL, Dirección General de Equipamiento e Infraestructura en Zonas Urbano-Marginadas (Statistics for 2008).
Notes:
[1] Percentage related to the total disposed waste quantity
[2] Common practice: There are no specific data available for each disposal site.

In Mexico, there are no inventories related to the operation of each landfill that include specific data regarding the current status of their existing venting systems (wells) and/or passive or spontaneous flaring systems. Available studies conducted by SEDESOL contain the disposed waste quantity, the daily generation and composition in the urban centers of the country.

As mentioned in Section 3.4.2.1, the NOM-083-2003 includes general specifications for LFG control in waste disposal sites in order to avoid LFG venting to the atmosphere through its flaring in punctual wells or through centralized burners. Nevertheless, the standard does not establish the minimum quantity of LFG that should be collected and burned, nor the specific technologies to be used. In practice, municipalities and landfill operators have not adopted or exceeded the NOM-083 due to the multiple reasons provided in Section 3.4.2.1, and as a result the LFG is vented in landfills and controlled sites.

This analysis reveals that passive venting is the common practice for LFG management. However, this does not constitute a GHG emissions reduction measure as CH_4 is directly released to the atmosphere. Hence, there are no LFG collection and destruction systems in final disposal sites in Mexico in the reference scenario. A project that implements a LFG collection and destruction system will pass the performance threshold.

A.2 Impact of CDM Projects on Common Practice

Following the entry into force of the Kyoto Protocol, the development of projects under the Clean Development Mechanism (CDM) may have altered the common practice landfill gas management activities in Mexico. The impact of landfill gas projects was calculated using information provided by INE related to the national GHG inventory from the waste sector. In 2004, the penetration level of LFG collection and destruction projects prior to the entry into force of the Kyoto Protocol was 0.5% with regard to total emissions and 0.7% with regard to landfill emissions only. This percentage was constituted by the first LFG collection and destruction project developed by Simeprodeso in the Monterrey landfill at the State of Nuevo León, started in 2003. This project had a demonstrative character for promoting the development of CDM projects and had financial support from the World Bank, the Global Environmental Fund (GEF), SEDESOL, and the National Bank for infrastructure and public utilities (BANOBRAS).

As of March 2009, only 5 years later, 11 CDM landfill projects have been registered by the CDM Executive Board. The penetration related to the GHG reductions of these projects was estimated as 2.5% of the total emissions of this sector (see Tables A.4 and A.5).

Table A.4. Summary of CDM Landfill Projects in Mexico (2009)

CDM Project Type	Number of Landfills	Percentage (By Number of Landfills)	GHG Emission Reductions (tonnes CO_2e/year)	Percentage (By Emissions)
Only active flaring	3	27%	312,195	25%
Active flaring and power generation[1]	4	33%	344,810	22%
Active flaring and energy	4	33%	742,910	53%
Total	11	100%	1,399,945	100%
Estimated market penetration of LFG collection and destruction projects implemented through CDM[2]			**2.5%**	

Sources: UNFCCC, 2009. CDM Project Search. http://cdm.unfccc.int/Projects/projsearch.html (March 2009); INE, 2005. Escenarios de Emisiones y Medidas de Mitigación de Gases de Efecto Invernadero en Sectores Clave – Sector Desechos http://www.ine.gob.mx/cclimatico/descargas/e2005a2.pdf (March 2009)
Notes:
[1] The second stage (power generation) will only be conducted if power purchase agreements are agreed, according to the Project Design Documents (PDDs).
[2] Reference emissions for this estimation were those reported by INE for 2004 (base year). Emissions from the Monterrey project were deducted; this project was registered at the CDM Executive Board on February 2009.

Table A.5. Details of Registered CDM Projects Related to LFG Collection and Destruction (2009)

CDM EB Registration Date	Project ID	Location	LFG Final Use	tCO_2e/ year
July 15, 2006	0425	Aguascalientes, Aguascalientes	Active flaring and power generation[1]	162,593
October 2, 2006	0523	Ecatepec de Morelos, Estado de Mexico	Active flaring and energy	209,353
October 5, 2007	1240	Zapopan, Jalisco	Active flaring and energy	137,735
November 30, 2007	1241	Tultitlán – Estado de Mexico[2]	Active flaring and power generation[1]	41,681
November 30, 2007	1123	Ciudad Juárez, Chihuahua	Active flaring and energy	170,499
January 31, 2008	1371	Mérida, Yucatán	Active flaring	106,340
February 25, 2008	1307	Durango, Baja California	Active flaring and power generation[1]	83,340
Under review	1699	Puerto Vallarta, Jalisco	Active flaring	52,267
November 6, 2008	1944	Milpillas, Estado de Morelos	Active flaring	153,588
February 12, 2009	2186	Monterrey, Nuevo Leon	Active flaring and energy	225,323
March 21, 2009	2271	Tecamac, Estado de Mexico	Active flaring and power generation[1]	57,196

Source: UNFCCC, 2009. CDM Project Search. http://cdm.unfccc.int/Projects/projsearch.html (March 2009)
Notes:
[1] The second stage (energy use) will only be conducted if power purchase agreements are agreed, according to the Project Design Documents (PDDs).
[2] Tultitlan – EcoMethane Landfill Gas to Energy Project, CDM Project 1242; http://cdm.unfccc.int/Projects/DB/SGS-UKL1184331485.06/view

Appendix B Emission Factor Tables

Table B.1. Fuel Emission Factor for Stationary and Mobile Combustion

Fuel	Emission Factors [kg CO_2/GJ]
Stationary Combustion [a]	
Crude oil	73.30
Natural gas liquids	64.20
Gasoline	69.30
Kerosene	71.90
Diesel	74.10
Residual fuel oil	77.40
Liquefied petroleum gas (LPG)	63.10
Naphtha	73.30
Lubricants	73.30
Petroleum coke	97.50
Coking coal	94.60
Bituminous coal	94.60
Sub-bituminous coal	96.10
Natural gas	56.10
Waste oils	73.30
Mobile combustion [b]	
Gasoline passenger car (without catalyst – Before 1990)	58.07
Gasoline passenger car (with oxidation 2-way catalyst – 1991-1992)	66.82
Gasoline passenger car (with used 3-way catalyst – open or closed cycle – 1993 – 1997)	70.07
Gasoline passenger car (with new 3-way closed cycle catalyst – After 1998)	71.07
Gasoline light duty trucks (without catalyst – Before 1990)	57.07
Gasoline light duty trucks (with improved technology, without catalyst – 1991-1992)	60.82
Gasoline light duty trucks (with used 3-way catalyst – open or closed cycle – 1993-1997)	68.97
Gasoline light duty trucks (with new 3-way catalyst – After 1998)	70.52
Gasoline heavy duty trucks and buses (without catalyst – Before 1992)	55.56
Gasoline heavy duty trucks and buses (with catalyst – After 1993)	60.87
Diesel vehicles (passenger cars, light and heavy trucks – with or without emissions control)	72.10
LPG vehicles (passenger cars and heavy trucks – without control and with 3-way catalyst)	61.23
Natural gas vehicles (passenger cars and heavy trucks – with 3-way catalyst)	56.10
Motorcycles (with or without emissions control)	72.10
Compressed natural gas vehicles (CNG) [c]	56.10
Liquefied natural gas vehicles (LNG) [c]	56.10
Airplanes (jet fuel) [c]	71.90

[a] IPCC, 2006. IPCC Guidelines for National Greenhouse Gas Inventories, Volumen 2, Chapter 2, Stationary Combustion, Table 2.5, pages 2.22-2.23.
[b] INE, 2005. Inventario Nacional de Emisiones de Gases de Efecto Invernadero 2002, Sector Transporte. INE-SEMARNAT, México. (Annexes, Tables 4-12, pages IA3-95 – IA3-99). Available on line: http://www.ine.gob.mx/cclimatico/inventario3.html
[c] IPCC, 2006. IPCC Guidelines for National Greenhouse Gas Inventories, Volumen 2, Chapter 3, Mobile combustion, Table 3.2.1, pages 3.16.

Table B.2. Fossil Fuels Net Calorific Values

Fuel	Net calorific value
Solid fuels	
National thermal coal	19.405 GJ/metric tonne
National metallurgic coal	23.483 GJ/metric tonne
Petroleum coke	31.424 GJ/metric tonne
Coking coal	26.521 GJ/metric tonne
Liquid fuels [a]	
Crude oil	0.03871 GJ/liter
Gasoline	0.03161 GJ/liter
Kerosene	0.03381 GJ/liter
Diesel	0.03555 GJ/liter
Residual fuel oil	0.03944 GJ/liter
Liquefied petroleum gas (LPG) [b]	0.02627 GJ/liter
Naphtha	0.03161 GJ/liter
Lubricants	0.03888 GJ/liter
Gaseous fuels	
Natural gas [c]	0.03391 GJ/m^3

[a] 1 barrel = 158.9873 liters
[b] Fuel obtained from oil distillation and after processing the natural gas liquids. It mainly consists on propane, butane or a mixture of both. It is mainly used in the residential and commercial sectors as well as in vehicles for passenger and freight transportation.
Source: SENER, 2006. *Balance Nacional de Energía 2007*, Dirección General de Información y Estudios Energéticos, SENER, México. Box 21, page 100. Available at: http://www.energia.gob.mx/webSener/res/PE_y_DT/pub/Balance_2007.pdf (March 2009)

Destruction Efficiencies for Combustion Devices

If available, the official source tested methane destruction efficiency shall be used in place of the default methane destruction efficiency. Project developers have the option to use either the default methane destruction efficiencies provided, or the site specific methane destruction efficiencies as provided by a state or local agency accredited source test service provider, for each of the combustion devices used in the project, performed on an annual basis.

Table B.3. Default Destruction Efficiencies for Combustion Devices

Destruction Device	Destruction Efficiency
Open flare	0.96
Enclosed flare	0.995
Lean-burn internal combustion engine	0.936
Rich-burn internal combustion engine	0.995
Boiler	0.98
Microturbine or large gas turbine	0.995
Upgrade and use of gas as CNG/LNG fuel	0.95
Upgrade and injection into natural gas transmission and distribution pipeline	0.98*
Off-site use of gas under direct-use agreement	Per corresponding destruction device factor (not pipeline)

Source: The default destruction efficiencies for enclosed flares and electricity generation devices are based on a preliminary set of actual source test data provided by the Bay Area Air Quality Management District. The default destruction efficiency values are the lesser of the twenty fifth percentile of the data provided or 0.995. These default destruction efficiencies may be updated as more source test data is made available to the Reserve.

***** The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories gives a standard value for the fraction of carbon oxidized for gas destroyed of 99.5% (Reference Manual, Table 1.6, page 1.29). It also gives a value for emissions from processing, transmission and distribution of gas which would be a very conservative estimate for losses in the pipeline and for leakage at the end user (Reference Manual, Table 1.58, page 1.121). These emissions are given as 118,000kgCH_4/PJ on the basis of gas consumption, which is 0.6%. Leakage in the residential and commercial sectors is stated to be 0 to 87,000kgCH_4/PJ, which equates to 0.4%, and in industrial plants and power station the losses are 0 to 175,000kg/CH_4/PJ, which is 0.8%. These leakage estimates are compounded and multiplied. The methane destruction efficiency for landfill gas injected into the natural gas transmission and distribution system can now be calculated as the product of these three efficiency factors, giving a total efficiency of (99.5% x 99.4% x 99.6%) = 98.5% for residential and commercial sector users, and (99.5% x 99.4% x 99.2%) = 98.1% for industrial plants and power stations. [26]

[26] GE AES Greenhouse Gas Services, Landfill Gas Methodology, Version 1.0 (July 2007).

Appendix C Data Substitution Guidelines

This appendix provides guidance on calculating emission reductions when data integrity has been compromised due to missing data points. No data substitution is permissible for equipment such as thermocouples which monitor the proper functioning of destruction devices. Rather, the methodologies presented below are to be used only for the methane concentration and flow metering parameters.

The Reserve expects that projects will have continuous, uninterrupted data for the entire verification period. However, the Reserve recognizes that unexpected events or occurrences may result in brief data gaps.

The following data substitution methodology may be used only for flow and methane concentration data gaps that are discrete, limited, non-chronic, and due to unforeseen circumstances. Data substitution can only be applied to methane concentration *or* flow readings, but not both simultaneously. If data is missing for both parameters, no reductions can be credited.

Further, substitution may only occur when two other monitored parameters corroborate proper functioning of the destruction device and system operation within normal ranges. These two parameters must be demonstrated as follows:

1. Proper functioning can be evidenced by thermocouple readings for flares, energy output for engines, etc.
2. For methane concentration substitution, flow rates during the data gap must be consistent with normal operation.
3. For flow substitution, methane concentration rates during the data gap must be consistent with normal operations.

If corroborating parameters fail to demonstrate any of these requirements, no substitution may be employed. If the requirements above can be met, the following substitution methodology may be applied:

Duration of Missing Data	Substitution Methodology
Less than six hours	Use the average of the four hours immediately before and following the outage
Six to 24 hours	Use the 90% lower or upper confidence limit of the 24 hours prior to and after the outage, whichever results in greater conservativeness
One to seven days	Use the 95% lower or upper confidence limit of the 72 hours prior to and after the outage, whichever results in greater conservativeness
Greater than one week	No data may be substituted and no credits may be generated

The lower confidence limit should be used for both methane concentration and flow readings for landfill projects, as this will provide the greatest conservativeness.

For weekly measured methane concentration, the lower of the measurement before and the measurement after must be used. This substitution may only be used to substitute data for one consecutive missing weekly measurement.