Mexico Boiler Efficiency Project Protocol Draft

Energy Efficiency Improvements for Mexican Boilers

Workgroup Discussion Draft

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NOTE: This is a Workgroup Discussion Draft, and as such, is subject to change. This draft reflects the Reserve's current thinking and recommendations for various protocol elements, including text boxes addressed to the workgroup in a number of sections where we have specific questions and/or seek specific feedback. Workgroup members are encouraged to submit written comments to the Climate Action Reserve.

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Abbreviations and Acronyms

BHP	Boiler Horsepower
CO_2	Carbon dioxide
CH_4	Methane
CRE	Comisión Reguladora de Energía
CRT	Climate Reserve Tonne
EMA	Entidad Mexicana de Acreditación (Mexican Accreditation Entity)
EPA	U.S. Environmental Protection Agency
FIDE	Fideicomiso para el Ahorro de Energía Eléctrica (Trust for Electric Energy Saving)
GHG	Greenhouse gas
ISO	International Organization for Standardization
kg	Kilogram
L	Liter
lb	Pound
NOM	Norma Oficial Mexicana (Mexican Official Standard)
N_2O	Nitrous oxide
PROFECO	Procuraduría Federal del Consumidor (Federal Attorney's Office of Consumer Protection)
Reserve	Climate Action Reserve
SCFI	Secretaría de Comercio y Fomento Industrial (Secretariat of Commerce and Industrial Development, now known as Secretariat of Economy, or Secretaría de Economía)
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources)
SENER	Secretaría de Energía (Secretariat of Energy)
SSMP	Startup, shutdown, and malfunction plan
SSR	Source, sink, and reservoir
t	Metric ton (or tonne)
UNEP	United Nations Environment Programme

1 Introduction

The Climate Action Reserve (Reserve) Mexico Boiler Efficiency Project Protocol provides guidance to account for, report, and verify greenhouse gas (GHG) emission reductions associated with boiler efficiency improvements in Mexico.

The Reserve is an offset registry serving the California cap-and-trade program and the North American voluntary carbon market. The Reserve encourages actions to reduce GHG emissions and works to ensure environmental benefit, integrity, and transparency in market-based solutions to address global climate change. It operates the largest accredited registry for the California compliance market and has played an integral role in the development and administration of the state's GHG offset program. For the voluntary market, the Reserve establishes high quality standards for carbon offset projects, oversees independent third-party verification bodies, and issues and tracks the transaction of carbon credits (Climate Reserve Tonnes or CRTs) generated from such projects in a transparent, publicly-accessible system. The Reserve is a private 501(c)(3) nonprofit organization based in Los Angeles, California.

Project developers that initiate Mexico Boiler Efficiency projects use this document to quantify and register GHG reductions with the Reserve. The 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 annual, independent verification by ISO-accredited and 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.

This protocol is designed to ensure the complete, consistent, transparent, accurate, and conservative quantification and verification of GHG emission reductions associated with a Mexico Boiler Efficiency project.[1]

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

2 The GHG Reduction Project

2.1 Background

NOTE: This section currently includes initial background information, which will need to be updated as more data is available.

Mexico's large industrial and power generation sectors provide significant opportunity to achieve emissions reductions through boiler efficiency improvements. In total, Mexico's industrial sector used 1,612 Petajoules (PJ) of energy in 2013[2]. Table 2.1 below indicates the consumption of secondary energy from fossil sources used in Mexico's industrial sector for 2013. Excluding indirect emissions from electricity use and energy used for transformation, we estimate that the industrial sector in Mexico produces approximately 71 million tonnes CO_2 per year.[3]

Table 2.1. Industrial energy use and emissions from fossil fuel consumption in the industrial sector in Mexico for 2009

	Petajoules[4]	EF ($kgCO_2/TJ$)[5]	tCO_2
TOTAL	**1,019**		**70,645,439[6]**
Dry gas	593	56,100	33,277,398
Petroleum coke	98	97,500	9,521,850
Residual fuel oil	25	77,400	1,962,864
Coal	127	94,600	12,038,796
Coke of coal	65	94,600	6,161,298
Diesel	65	74,100	4,781,673
Liquefied petroleum gas	45	63,100	2,842,655
Gasoline and naphtha	1	69,300	58,905

According to the International Energy Administration (IEA), approximately 50% of total industrial energy demand is heat related, with "20% for process energy at temperatures above 400°C …15% for steam at 100 – 400°C, [and] 15% for low temperature heat."[7] Based on Table 2.1, therefore, more than 10 million tCO_2 may be attributable to generating steam and process heat. IEA further estimates that the energy efficiency of steam production can be increased by over 10%, an improvement which would reduce emissions by as much as 1 million tCO_2 per year in Mexico.

[2] SENER, Balance Nacional de Energía 2013, Secretaría de Energía, 2014
[3] *Ibid.*
[4] *Ibid.*
[5] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Table 2.2
[6] Mexico's most recent National Communication to the UNFCCC reports 2006 industrial energy emissions of 56,552.3 tCO_2. Emissions for 2013 were calculated for this analysis.
[7] http://www.iea.org/textbase/nppdf/free/2007/tracking_emissions.pdf

Secondary energy used for transformation in Pemex, CFE and for power generation by independent producers for power sales or self-consumption amounted to 1,840 PJ in 2013[8] and produced GHG emissions amounting to near 114 million tonnes CO_2. A significant portion of that energy is used for steam generation. Under IEA's assumptions on heat types' share and considering 100% of this energy is used for heat generation[9], 34 million tonnes CO_2 would be due to steam generation devices' fuel consumption, i.e. several times more than the combined industrial GHG emissions.

The major source of GHG emissions from a boiler system is carbon dioxide (CO_2) from the combustion of fossil fuels in the boiler. Other minor sources of GHGs can include methane (CH_4) from leaks in the natural gas distribution system and CH_4 and nitrous oxide (N_2O) as byproducts of combustion processes.

This section provides information on the general parameters that the proposed boiler efficiency project must match to use this protocol.

2.2 Project Definition

NOTE: This section will serve to define the project and project activity, including identifying which sub-project types (commercial boilers, industrial boilers, power boilers) will be eligible. Refining the scope of this protocol has been one the first orders of business for the Workgroup, Reserve staff, and technical contractors. Please refer to the Workgroup Memo shared on September 18th, 2015 for an in-depth discussion of protocol scope and the rationale for limiting the scope.

For the purpose of this protocol, the GHG reduction project is defined as a project that implements eligible project activities, as defined in Section 2.2.2, at an eligible boiler, as defined in Section 2.2.1. Any equipment that does not fit within the capacity/size categories listed in Section 2.2.1 is ineligible.

2.2.1 Eligible equipment types

NOTE: This section will serve to define all of the **types of equipment** that will be eligible. We should consider the need for including any terminology specific to Mexico. Below is a list of equipment proposed to be included, which may change further during the work group process.

For the purpose of this protocol, project activities must be implemented at an eligible boiler. Eligible equipment includes:

- Boilers 9.8 to 30 MW (33.5 – 102.5 MMBtu/h)
- Boilers > 30 MW to 100 MW (>102.5 – 341.4 MMBtu/h)
- Boilers > 100 MW (>Boilers > 100 MW (>341.4 MMBtu/h)

[8] SENER, Balance Nacional de Energía 2013, Secretaría de Energía, 2014
[9] http://www.iea.org/textbase/nppdf/free/2007/tracking_emissions.pdf

Equipment ineligible under this protocol include boilers with nominal heat transfer capacity below 9.8 MW (<33.5 MMBtu/h), hot water heaters,[10] furnaces, and process heaters.[11]

2.2.2 Eligible project activities

NOTE: This section will serve to define all of the **types of activities** that will be eligible. Below is an interim list of potential project activities to be included, which may change during the work group process. We would like specific feedback on the WG on whether and to what extent early retirement is occurring in a business as usual scenario. In particular, we would like to know whether boilers are being retired early (retired before the end of their useful life) *for the purpose of replacing them with more efficient boilers*. If boilers are being retired early because the facility is being shut down, or the business is no longer operating, that is not something we want to capture here.

For the purpose of this protocol, the GHG reduction project is defined as a project that implements one or more of the following technologies and practices ("project activities") at an eligible boiler (as defined in Section 2.2.1):

1. **Early retirement of existing boilers.** Replacing an old, inefficient boiler or furnace with a more efficient boiler prior to the end of its useful life and scheduled retirement.

2. **Retrofitting existing boilers.** Installing new efficiency improvement technologies to existing boilers.

3. **Fuel Switching.** Through retrofits, switching boiler fuel use from a high-carbon intensity fuel to low-carbon intensity fuel.

4. **Installing new high-efficiency boilers.** Installing a new boiler that demonstrates greater efficiency than conventional alternatives.

NOTE: The matrix below provides a summary of the potential eligible project types and corresponding project activities, which will need to be considered by the WG for inclusion in the final protocol. Whether each of these alternatives is ultimately included in the protocol will depend upon data availability and further considerations, which will be discussed during the work group process. As set out in Section 5.1.1 the Reserve is recommending we seek to establish project-specific baselines for early retirement, retrofitting and fuel switching based on historical data, and to establish standardized baselines for new equipment based on technology based performance thresholds. Thus our preference would be to prioritize seeking out data to support such positions. Note that the subcomponents of boiler equipment listed below as part of the physical boundary of a project may not be common to all categories of boilers.

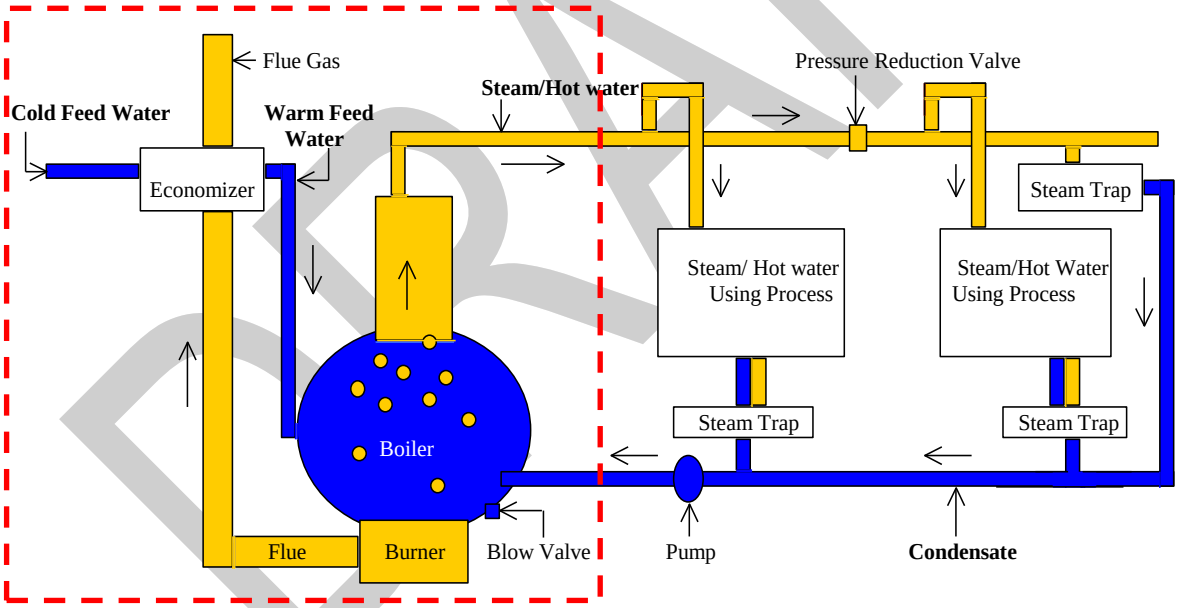
[10] Given their energy consumption levels, boilers < 9.8 MW and hot water heaters would likely need additional incentives to make verification of emission reductions under this protocol cost-effective.
[11] For each of these equipment categories, there is no comprehensive data set or sources to allow for proper analysis of performance efficiencies needed to establish sound efficiency thresholds. This is necessary to make a protocol application practical. Nevertheless, a dedicated protocol or future inclusion of these additional devices in this protocol could be discussed at a future date.

Table 2.2. Eligible Project Types

Category	Capacity (Thermal)	Retrofitting	Fuel switch	New equipment	Early retirement
Steam Boilers	9.8 to 30 MW (33.5 to 102.5 MMBtu/h)	✓	✓	✓	✓
	30 to 100 MW (102.5 to 341.4 MMBtu/h)	✓	✓	✓	✓
	>100 MW (>341.4 MMBtu/h)	✓	✓	✓	✓

The physical boundary of a project includes any components of the boiler system that will change between the baseline and project scenarios. The physical boundary will typically be limited to the components of the boiler unit which are most relevant for determining its rated thermal efficiency, namely the boiler, burner, flue stack, blowdown system, air preheater and economizer. See Figure 1.[12]

Figure 1. Physical Boundary for Industrial Boiler Projects[13]



NOTE: The Workgroup will consider and help make a determination on whether or not to include activities that reduce emissions upstream or downstream and allow credit for those reductions. If we cannot appropriately account for any significant emission increases resulting from such changes, then we should consider excluding projects with such effects from being eligible. Where emissions are unlikely to

[12] Taken (slight adaptation) from CDM methodology **AM0056 / Version 01**
[13] Diagram source: EPA Climate Leaders Protocol

increase significantly between the baseline and project scenarios, then such categories could be excluded from the SSRs as *de minimis* and noted as such in Section 4. Given the complexity involved in improvements to steam distribution systems, such changes will not be included in this boiler energy efficiency protocol (note this is the same approach adopted in several CDM boiler efficiency methodologies).

Specific circumstances which the Workgroup should explore include:

- The generation of electricity that displaces grid emissions;
- CO2 emissions increases from electricity consumption associated with auxiliary component upgrades; &
- Increases in CH4 leakage from new natural gas distribution lines (implemented in order to connect a fuel switch project to nearby main gas lines).

The Workgroup should also consider whether a restriction should be included that each project be limited to one boiler. The intention of this restriction would be to avoid perceived complications of having multiple boilers included in a project, where those boilers are interconnected, so that it is not easy to isolate the efficiency of one boiler, from others, and where changes made to one boiler may affect the efficiency of other boilers. This type of connectivity between multiple boilers could introduce complexity with respect to how to determine appropriate baselines, develop PSTs for such connected boilers, and potentially also complexity in quantifying and monitoring such connected boilers. The Reserve has been advised that in circumstances of a connected system of boilers, efficiency improvements could be assessed using Mean Heavy Efficiency calculations, which take into account operation time, steam generation and efficiency of each individual piece of equipment. It is unclear whether instances of connected boilers at a single facility are common enough and the associated potential emission reductions large enough to make it an appropriate use of resources to explore such issues further. The Reserve seeks further feedback on this. Note that robust data requirements will likely apply to each specific boiler, regardless of whether multiple boilers are ultimately included in a single project or not.

It is worth noting that a concept of aggregation, discussed further below whereby multiple projects are combined via some sort of streamlining of monitoring, reporting, and verification requirements, could provide a means to include multiple boiler projects at a single facility.

Since the project definition is tied to a single boiler system, it is possible to register multiple projects at a single facility that has multiple boilers, each with its own start date, crediting period, registration and verification. However, a single project shall not consist of more than one boiler system. Joint verifications for facilities with multiple projects is also possible, as described in more detail in Section 8.

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 energy service companies, facility owners, facility operators, or GHG project financiers, and may include entities wholly or partly controlled by government. In all cases, the project developer must attest to the Reserve that they have exclusive claim to the GHG reductions resulting from the project. 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.[14]

[14] This is done by signing the Reserve's Attestation of Title form, available at: http://www.climateactionreserve.org/how/program/documents/

Under this protocol, the project developer is the only party required to hold an account with the Reserve and be involved with project implementation.

3 Eligibility Rules

Projects must fully satisfy the following eligibility rules in order to register with the Reserve. The criteria only apply to projects that meet the definition of a GHG reduction project (Section 2.2).

Eligibility Rule I:	Location	⟶	*Mexico*
Eligibility Rule II:	Project Start Date	⟶	*No more than six months prior to project submission*
Eligibility Rule III:	Additionality	⟶	*Meet performance standard*
		⟶	*Exceed regulatory requirements*
Eligibility Rule IV:	Regulatory Compliance	⟶	*Compliance with all applicable laws*

3.1 Location

Only projects located in Mexico are eligible to register reductions with the Reserve under this protocol. All components of the physical boundary of each project, as described in Section 2.2, must be located in Mexico for the project to be eligible. Under this protocol, reductions from projects located outside of Mexico are not eligible to register with the Reserve.

3.2 Project Start Date

Note: The Workgroup will discuss options for start date, particularly discussing what type of time frame might be necessary for a boiler to be installed and become operational and whether we should allow for some sort of start up period (3-9 months?) before the project's official start date, allowing Project Developers to select a start date in that time period? Or whether we should define start date as "the day on which the boiler becomes operational"?

The project start date is defined as the date on which an improved-efficiency boiler system becomes operational. For the purposes of this protocol, a boiler system is considered operational on the date the system enters regular operation generating relevant energy outputs (i.e., steam, heat, electricity, or a combination thereof), following an initial start-up period. This date can be selected by the project developer within a 6 month period following the date on which the system first begins consuming energy inputs following the commissioning of efficiency improvements.

To be eligible, the project must be submitted to the Reserve no more than six months after the project start date, unless the project is submitted during the first 12 months following the date of adoption of this protocol by the Reserve board (the Effective Date).[15] For a period of 12 months from the Effective Date of this protocol (Version 1.0), projects with start dates no more than 24 months prior to the Effective Date of this protocol are eligible. Specifically, projects with start dates on or after are eligible to register with the Reserve if submitted by . Projects

[15] Projects are considered submitted when the project developer has fully completed and filed the appropriate Project Submittal Form, available at http://www.climateactionreserve.org/how/program/documents/.

with start dates prior to are not eligible under this protocol. Projects may always be submitted for listing by the Reserve prior to their start date.

3.3 Project Crediting Period

Note: At present this section describes the standard 10 year crediting period, used in Reserve protocols. As noted in Section 3.4.1, the Workgroup should also consider an alternative shorter crediting period for early retirement projects (in particular, setting the crediting period to be the remaining life of the original equipment which has been retired). Whether or not an alternative shorter crediting period will be used for early retirement projects will depend upon which Performance Standard options are ultimately chosen for early action projects.

The crediting period for all project types under this protocol except "early retirement" is ten years. For early retirement projects, the crediting period will be the expected remaining useful life of the retired equipment… [further discussion needed. See text box in Section 3.4.1]. Except in the case of early retirement projects, at the end of a project's first crediting period, project developers may apply for eligibility under a second crediting period. However, the Reserve will cease to issue CRTs for GHG reductions if at any point in the future, the efficiency levels achieved by project equipment become legally required. For further details on the effects of legal requirements, see the terms of the Legal Requirement Test (Section 3.4.2). Thus, the Reserve will issue CRTs for GHG reductions quantified and verified according to this protocol for a maximum of two ten year crediting periods after the project start date, or until the project activity is required by law. Section 3.4.1 describes requirements for qualifying for a second crediting period.

3.4 Additionality

The Reserve strives to register only projects that yield surplus GHG reductions that are additional to what would have occurred in the absence of a carbon offset market.

Projects must satisfy the following tests to be considered additional:

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

3.4.1 The Performance Standard Test

Projects pass the Performance Standard Test (PST) by meeting a performance threshold, i.e. a standard of performance applicable to all boiler efficiency projects, established by this protocol.

The Performance Standard Test is applied at the time a project applies for registration with the Reserve.

If a project developer wishes to apply for a second crediting period, the project must meet the eligibility requirements of the most current version of this protocol, including any updates to the Performance Standard Test.

Options for establishing a Performance Standard Test (PST)

Introduction:

In the text boxes below, a number of options are presented for the Performance Standard. Three may be suitable for all 4 project types, while additional alternative approaches specific to fuel switch projects and early retirement projects are also presented. All options have advantages and disadvantages, both in terms of data needs to establish the performance standard, ease/difficulty of applying the PST, and the PST's ability to screen for additional projects; the Reserve included some preliminary thoughts on those advantages/disadvantages, but additional feedback is requested. Though all options are still currently being considered, the Reserve has some initial recommendations as to which PST options appear most suitable at the outset.[16]

Please note that where the PST option calls for quantitative analysis of performance measures, to compare a project's performance against the performance threshold, the Reserve will provide project developers with clear quantification methods based on ASME Power Test Code 4 (PTC 4), methods which are used in the CDM and form the basis of quantification methods used widely in Mexico.

Initial Reserve recommendations and considerations:

- **Retrofit Projects:** The Reserve recommends the adoption of fuel specific efficiency benchmarks (Option 1 discussed in further detail below) for retrofit projects.
- **New equipment:** The Reserve recommends the adoption of technology based performance thresholds (Option 2, discussed in further detail below) for new boilers.
- **Fuel Switching:** The Reserve recommends that the performance threshold for fuel switch projects simply be that that there is some significant impediment to the switching of fuel use, which would need to be defined, perhaps with a positive list. For instance switching fuel in a boiler that's already configured for dual-fuel use would likely have weak additionality (unless there were a truly large fuel price differential), whereas boilers that require upgrading in order to use the more efficient fuel would be eligible.
- **Early retirement:** More research into BAU practices for what is happening to boilers/furnaces in Mexico that are being retired early is necessary to inform the PST. Depending on outcome of analysis and WG feedback on which assumption is most appropriate (re-commissioning or not) the Reserve recommends:
  - If retired boilers are assumed to not be re-commissioned, compare the project to the old-boiler emissions until the point where the old boiler would have reached the end of its life, then compare to baseline replacement;
  - If retired boilers are assumed to be re-commissioned - allowing repurposing, but treating such projects as new equipment projects, as the most conservative means to deal with potential indirect effects of the repurposing offsite.

Option #1 – Fuel-Specific Emissions Rate Performance Threshold (potentially applicable to all project types: Early Retirement, Retrofit, New Capacity, and Fuel Switching)

The type of performance threshold used is an emissions rate. The threshold represents a level of performance (emissions rate) that is beyond that expected compared to the emissions of recently installed boilers. To meet the performance threshold, a project is required to reduce CO_2 emissions per unit steam generated (or per unit of heat/hot air in the case of furnaces) below fuel-specific values.

An emissions rate performance threshold could be used for all project types, but the Reserve believes it is a particularly good option for retrofit projects.

[NOTE: The data and analysis currently included in this text box is derived from unpublished background research conducted for EPA's Climate Leaders program in 2011. As such, the data

[16] Much of the data underlying the development of PST options was sourced from unpublished background research conducted by EPA's Climate Leaders Program.

and analysis is illustrative but a bit dated. The Reserve will seek to update this data during Phase 2 of the WG process.

Retrofits

The thresholds specified below (expressed in High Heat Value) is based on the level of performance observed in 83 boilers at 27 Mexican facilities in a series of audits in the late 1990s. The 83 boilers were assigned to seven groups based on the fuel burned (fuel oil, diesel, natural gas, etc.), and each boiler was ranked from most efficient to least efficient within its group. The performance threshold was set at the efficiency within each fuel group corresponding to the upper 25th percentile[17]. A boiler that passes the performance threshold achieves a level of performance that is better than 75% of the boilers burning that type of fuel. For retrofit, early retirement, or fuel switching projects, the performance threshold is set according to the fuel *historically* used to fuel the boiler. These thresholds are:

Fuel	Upper 25th Percentile (%)	Emissions Rate (kgCO2/TJ)
Fuel Oil	82.4%	93,932
Diesel	82.0%	90,365
Natural Gas	81.0%	69,259
Gas Oil	81.2%	91,256
Liquefied Petroleum Gas	82.4%	76,578
Petroleum Coke	82.4%	118,325
Coke of Coal	82.4%	114,806

New boilers and new capacity

For new capacity or new boilers, the performance threshold shall be set higher to reflect both improvements in baseline common practice boiler efficiency, and available fuels. For those zones where natural gas is available, the common practice fuel is assumed to be natural gas (see Table below). Lacking sufficient data on new installations, this performance threshold errs on the side of being conservative (issuing fewer GHG reductions). For those zones where natural gas is not available, or for zones where natural gas is available but there is insufficient natural gas for a particular facility, project developers must obtain certification from SENER/CRE to evidence this lack of natural gas. This assumption of natural gas usage is conservative because natural gas boilers have lower GHG emissions than fuel oil, petroleum coke or coke of coal, as demonstrated in the analysis in Appendix A. For states where natural gas has been determined to be relatively unavailable, an alternative common practice fuel with the next lowest emissions rate compared to natural gas will be selected (to be provided by the Reserve upon request by the project developer).. Projects are not restricted to natural gas and fuel oil and may use any fuel they choose provided that the boiler achieves an emission rate below the specified threshold. These performance thresholds are:

Option 1a

Only those states where there is no natural gas consumption, as reported in Prospectiva del Mercado de Gas Natural, 2010-2025 are entitled to apply a performance threshold set according to the use of fuel oil. The performance threshold for all other states is set according to the use of natural gas.

[17] 25% has been selected for illustration purposes only, and for consistency with the standard used in Option #3 where Y_a% was set equal to 75%.

Fuel (States)	Efficiency (%)	Emissions Rate (kgCO2/TJ of steam produced)
Natural Gas (Aguascalientes, Baja California, Campeche, Chiapas, Chihuahua, Coahuila, Distrito Federal, Durango, Guanajuato, Hidalgo, Jalisco, México, Michoacán, Nuevo León, Puebla, Querétaro, San Luis Potosí, Sonora, Tabasco, Tamaulipas, Tlaxcala, Veracruz, Yucatán)	82.8%	67,729
Fuel Oil (Baja California Sur, Colima, Guerrero, Morelos, Nayarit, Oaxaca, Quintana Roo, Sinaloa, Zacatecas)	87.6%	88,356

Option 1b

A less restrictive performance threshold could be set by applying natural gas as a baseline fuel *only* in states with high rates of natural gas usage. Although there is some natural gas consumption in some of the states ranked below 1.0, research indicates that natural gas use in the industrial sector is relatively uncommon.

Fuel (States)	Efficiency (%)	Emissions Rate (kgCO2/TJ)
Natural Gas (Aguascalientes, Coahuila, Distrito Federal, Guanajuato, Hidalgo, Jalisco, México, Michoacán, Nuevo León, Oaxaca, Puebla, Querétaro, Tlaxcala)	82.8%	67,729
Fuel Oil (Baja California, Baja California Sur, Campeche, Chiapas, Chihuahua, Colima, Durango, Guerrero, Hidalgo, Morelos, Nayarit, Quintana Roo, Lan Luis Potosi, Sinaloa, Sonora, Tabasco, Tamaulipas, Veracruz, Yucatán, Zacatecas)	87.6%	88,356

Option # 2 – Technology-based Performance Threshold (potentially applicable to Early Retirement, Retrofit, New Capacity, and Fuel Switching)

The type of performance threshold used is a technology-based standard. The threshold represents a level of performance (technology) that is beyond that expected of a typical industrial boiler and is based on the suite of current technologies available for improving the efficiency of a boiler. The technology-based threshold can be selected when the efficiencies of industrial boiler applications fall within a range that is dictated by operational and emission requirements, making no single efficiency/emissions performance value applicable for a particular set of industrial boilers.

A technology-based performance threshold could be defined as the fuel-specific boiler design that meets the engineer's specifications and all applicable legal requirements, without the technologies or practices deemed additional. To generate reductions, a project developer would have to add at least one of the selected additional technologies to the boiler system in order to pass the performance threshold and make the project additional. The Reserve will continue to work with the WG and technical contractor to identify suitable technologies that might form part of a 'positive list' of technologies that appear to be additional, based on their existing low rate of uptake. It will be important to also project the business as usual expected future uptake rates for these technologies, and take those into consideration when assessing additionality.

As part of protocol development, the WG, technical contractor, and the Reserve will need to

update the underlying data and analysis, confirm/update the technology threshold assumptions for BAU, and explore what fuel types are typically used in boiler systems in Mexico, and include technology thresholds for each those most used fuel categories.

Option #3 – Emissions Rate Performance Threshold, Established Using CDM "Guidelines for the establishment of sector specific standardized baselines" (applicable to all project types: Early Retirement, Retrofit, New Capacity, and Fuel Switching)

The type of performance threshold used is an emissions rate. The threshold represents a level of performance (emissions rate) that is beyond that expected compared to the emissions of other technology within the industry sector. To meet the performance threshold, a project is required to reduce CO_2 emissions per unit steam generated (or per unit of heat/hot air in the case of furnaces?) below the specified value.

An emissions rate performance threshold could be used for all project types, including early retirement, new capacity, retrofit, and fuel switching. The additionality determination applies to all industrial boilers with a nominal capacity equal or higher than 9,800 KW in the country of Mexico.

Additionality is demonstrated by ranking boiler GHG emission intensity, and arranging the cumulative percent of output O_i produced in descending order of carbon intensity, as shown in **Error! Reference source not found.**, and discussed further in Appendix I. A cutoff of Y_a% qual to [75%][18] of the output O_i was applied, resulting in an emission intensity additionality standard of 70,442 kgCO2e/TJ steam produced. 70,442 kgCO2e/TJ corresponds to the emission intensity of the boiler just to the right of the Y_a cutoff in **Error! Reference source not ound.**. This means that [75%] of the steam produced in the sample population is produced with an emission intensity greater than 70,442 kgCO2e/TJ steam, and only 25% is produced with an intensity below that level.

While included for WG consideration, the Reserve recommends this approach not be adopted, as it may result in a fuel standard, more than an efficiency benchmark, and it would be less stringent than a fuel-specific benchmark would be for natural gas alone.

[18] 75% has been selected for illustration purposes only. Y_a% will be determined by the Reserve and Workgroup.

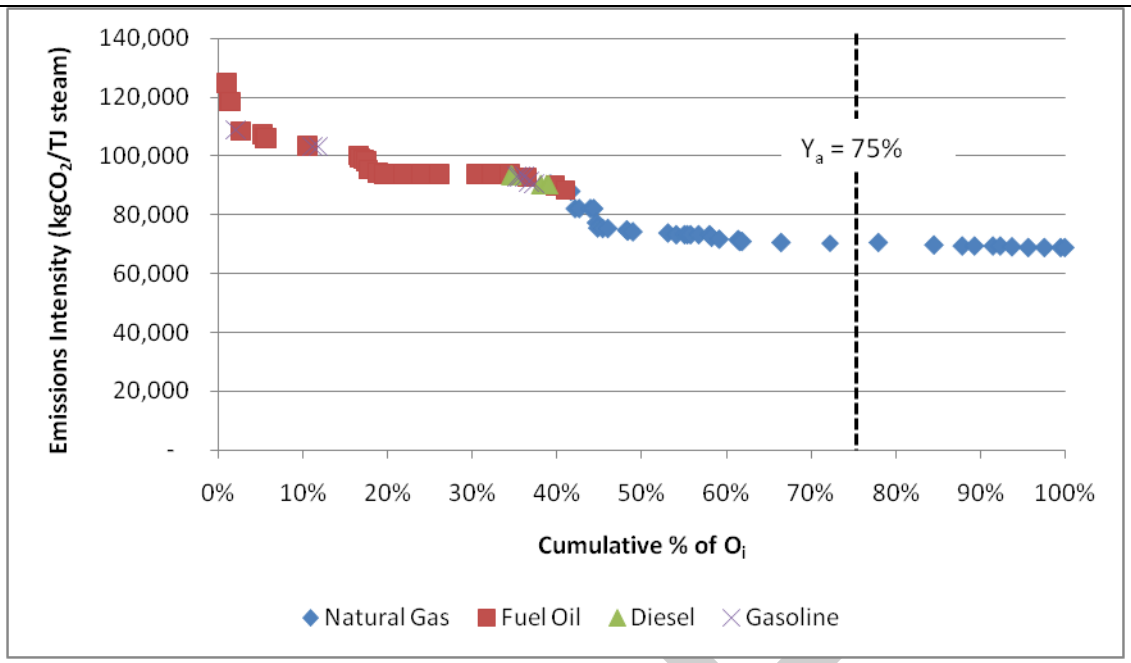


Figure 2. Emissions intensity of boilers in Mexico, arranged in descending order of intensity.

Any project that produces steam with a GHG emission intensity less than 70,442 $kgCO_2e/TJ$ steam is considered additional under Option #3.

Discussion of Options for Early retirement projects:

The Reserve has identified two options for how to approach early retirement projects, the suitability of which may depend largely on what typically happens to boilers/furnaces that are retired early in Mexico under business as usual. Part of the work to be done by the technical contractor, upon which we will need feedback from the workgroup, will be attempting to collect and analyze data that allow us to make assumptions on what happens to retired equipment.

Early retirement scenarios which the WG will evaluate and make recommendations on appropriate assumptions include:

- PST Option A: Where retired boilers are **assumed to not be re-commissioned**, PST should be based on a minimum amount of time that original equipment would have remained in operation in BAU.
- PST Option B: where retired boilers are **assumed to be re-commissioned**, PST based on new equipment technology based performance thresholds. This option is based on the premise that arguably if the adopted baseline is no early retirement for the boiler being replaced, but the assumption is that another end-of-life boiler somewhere else is getting replaced, then in effect the project is tantamount to a replacement of an end-of-life boiler (albeit with some shuffling going on) – in aggregate, one would compare the project boiler emissions to whatever *would have* been used to replace the end-of-life boiler. If early-retired boilers get repurposed, then any early-retirement project is simply equivalent to an old-boiler replacement project (you compare project to the standard baseline option for a new boiler).

3.4.2 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.

NOTE: A preliminary discussion of federal, state, and local laws are included below. The Workgroup should consider whether this list of regulations is comprehensive. The WG should also consider the interaction of Legal Requirement Test for this Protocol with specific anticipated climate change laws such as the carbon tax. The WG should also consider interaction with voluntary pledges (but first should have Jorge/Ana-Maria confirm existence of any such voluntary programs); The WG should also assess to what extent any existing regulations are effectively enforced. If enforcement is only partially effective, the WG could explore the use of a discount to account for the portion of boilers that would have complied with such regulations under BAU conditions, and otherwise such regulations would not be barrier to passing the LRT. If there are legal requirements that are implemented which require certain levels of energy efficiency for eligible equipment, when such requirements come on line they will need to be taken into consideration and potentially used to set minimum efficiency thresholds.

Federal Regulations.[19] At the federal level, two rules regulate boiler efficiency in Mexico (see Table 3.1), with combined applicability to boilers rated at 7.5-8,000 kW[20] (roughly 25 thousand to over 27 million btu/hour). Both standards apply only to *new* boilers. No rules related to existing boilers were identified.

Table 3.1. Mexican Regulations Related to the Efficiency of Boilers

Law	Title (Original Spanish)	Title (translated)
NOM-002-ENER-1995	Eficiencia térmica de calderas paquete. Especificaciones y método de prueba.	Package boiler thermal efficiency. Specifications and Test Method.
NOM-012-ENER-1996	Eficiencia térmica de calderas de baja capacidad (7.5 a 100 KW). Especificaciones y método de prueba.	Thermal efficiency of boilers of low capacity (7.5 to 100 KW). Specifications and test method.

Source: http://www.sener.gob.mx/webSener/portal/Mobil.aspx?id=982

As demonstrated in **Error! Reference source not found.** and **Error! Reference source not und.**, the Mexican standards differentiate boilers based on boiler type, capacity, and fuel type. In general, however, the primary factor is the fuel type. With the exception of water tube boilers between 100 and 200 kW, both standards dictate that natural gas or LPG boilers achieve a 76% thermal efficiency and those using gasoline or diesel achieve an efficiency of 80%. Water tube boilers between 100 and 200 kW are required to meet slightly lower efficiencies of 74% and 78%, respectively.

[19] Much of the data and some assumptions underlying this analysis come from unpublished background research conducted by EPA's Climate Leaders Program.

[20] These are not necessarily electricity-generating boilers. Convention in the Mexico rules is to measure boiler capacity in kW, an alternate metric to the btu/hour measurement common in the U.S., or boiler horse power (BHP) metric used elsewhere.

These two laws will serve as a regulatory screen for new boiler installations of 7.5-8,000 kW. For boilers above 8,000 kW or below 7.5 kW, we identified no mandated minimum thermal efficiencies.

There are no Mexican regulations governing which type of fuel must be used in industrial boilers or when they must be retired.

State and Local Regulations. Any relevant state or local regulation must be identified and assessed for its effect on regulatory eligibility. No state or local regulations relating to boiler efficiency or fuel type were identified at the time of developing the protocol.

To satisfy the Legal Requirement Test, project developers must submit a signed Attestation of Voluntary Implementation form[21] prior to the commencement of verification activities each time the project is verified (see Section 8). 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.

3.5 Regulatory Compliance

NOTE: In the Reserve's Mexico ODS Protocol (our most recently adopted protocol for use in Mexico), the Reserve included an Appendix listing relevant regulations with which a project might need to comply, as a tool to help both project developers and verifiers ensure regulatory compliance. The Reserve would like the Workgroup to consider inclusion of this type of list of relevant regulations that VBs should consider at a minimum.

Also, it is worth noting that the Reserve is currently working to update our regulatory compliance policy and expand relevant guidance, which will be released in the coming months. Language in this section of the protocol is largely based on standard protocol language at this point, and may be updated at that time, to bring this protocol in line with the updated policy.

Projects must be in material compliance with all applicable laws (e.g. air, water quality, and safety) at all times during each reporting period. The regulatory compliance requirement extends to the entire facility, not just the boiler system which comprises the project. These facilities must secure the required authorizations and permits to meet applicable regulatory requirements during implementation of project activities, as well as remain in compliance with those permits at all times during each reporting period.

Project developers must attest that project activities do not cause material violations of applicable laws (e.g. air, water quality, safety, etc.). To satisfy this requirement, project developers must submit a signed Attestation of Regulatory Compliance form[22] prior to the commencement of verification activities each time the project is verified. Project developers are also required to disclose in writing to the verifier any and all instances of legal violations – material or otherwise – caused by the project activities.

[21] Attestation forms are available at http://www.climateactionreserve.org/how/program/documents/.
[22] Attestation forms are available at http://www.climateactionreserve.org/how/program/documents/.

A violation should be considered to be "caused" by project activities if it can be reasonably argued that the violation would not have occurred in the absence of the project activities. If there is any question of causality, the project developer shall disclose the violation to the verifier.

If a verifier finds that project activities have caused one or more material violations during any phase of the project leading up to and including a destruction event, then no CRTs will be issued for GHG reductions from that destruction event. Verifiers shall use professional judgment to assess such violations, but are also encouraged to consult with the Reserve in making a determination as to whether or not the violation(s) were material and were caused by project activities. In these circumstances, the Reserve will assess the violation(s) and make a project-specific determination. Individual violations due to administrative or reporting issues, or due to "acts of nature," are not considered material and will not affect CRT crediting. However, recurrent administrative violations directly related to project activities may affect crediting. Verifiers must determine if recurrent violations rise to the level of materiality. If the verifier is unable to assess the materiality of the violation, then the verifier shall consult with the Reserve.

4 The GHG Assessment Boundary

The GHG Assessment Boundary delineates the GHG sources, sinks, and reservoirs (SSRs) that must be assessed by project developers in order to determine the net change in emissions caused by a boiler efficiency project.[23]

Figure 4.1 illustrates all relevant GHG SSRs associated with project activities and delineates the GHG Assessment Boundary.

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

NOTE: When reviewing Figure 4.1 and Table 4.1, the following questions should be considered:

- Are we missing any sources, sinks, or reservoirs? (Note: SSRs may vary across project types)
- For each individual SSR, how significant do we anticipate the change could be?
  - Will this be a source in the baseline, project, or both?
  - Is there directional certainty? Will emissions consistently go up? Down? Or will it be a mixed effect?

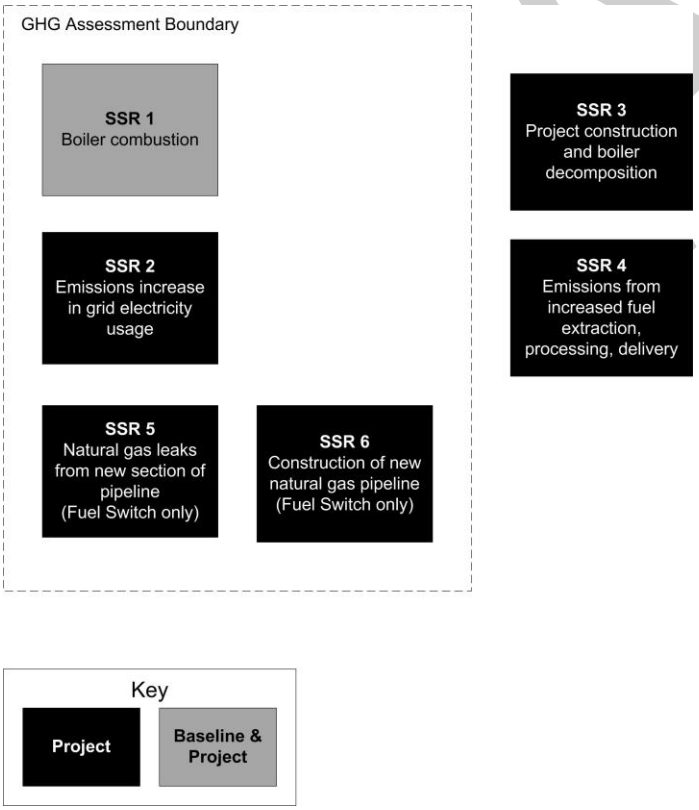


Figure 4.1. General illustration of the GHG Assessment Boundary

[23] The definition and assessment of SSRs is consistent with ISO 14064-2 guidance.

Table 4.1. Description of all Sources, Sinks, and Reservoirs **[NOT YET COMPLETE]**

SSR	Source Description	Gas	Included (I) or Excluded (E)	Quantification Method	Justification/Explanation
1 Boiler combustion	Emissions from fuel combustion at boiler, including emissions from incomplete combustion of fuels	CO_2	I	**Baseline:** **Project:**	CO_2 - Primary source of emissions for the project activities CH_4/N_2O - Emission source is assumed to be very small, with insignificant changes between BL and project.
		CH_4	E		
		N_2O	E		
2 Emissions increase from grid	Indirect emissions associated to consumption of grid-electricity according to grid emission factor	CO_2	I	**P**	Any increase in grid-electricity usage should be accounted for. It is conservative not to account for a decrease.
3 Project construction	Project construction and emissions from decommissioning old boiler	CO_2 CH_4 N_2O	E	**P**	The difference between baseline and project emissions for such changes should be negligible and therefore are excluded.
4 Emissions from fuel extraction, processing, delivery	Facilities where fuel used undergoes extraction, processing and delivery	CO_2 CH_4 N_2O	E	**P**	The difference between baseline and project emissions for such changes should be negligible and therefore are excluded.
5 Natural gas leaks from new sections of pipeline	Natural gas leaks from new sections of natural gas distribution pipeline	CH_4	I (Fuel switch projects only)	**P**	Fuel switch projects only
6 Construction of new pipeline	Emissions from construction of new sections of the natural gas pipeline	CO_2 CH_4 N_2O	I (Fuel switch projects only)	**P**	Fuel switch projects only.

5 Quantifying GHG Emission Reductions

GHG emission reductions from a boiler efficiency project are quantified by comparing actual project emissions to the calculated baseline emissions. 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 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 periodically quantified and verified is called the "reporting period."

Equation 5.1. Calculating GHG Emission Reductions

$$\boldsymbol{ER = BE - PE}$$

Where,

			Units
ER	=	Total emission reductions for the reporting period	$MTCO_2e$
BE	=	Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary (as calculated in Section 5.1)	$MTCO_2e$
PE	=	Total project emissions for the reporting period, from all SSRs in the GHG Assessment Boundary (as calculated in Section 5.2)	$MTCO_2e$

5.1 Quantifying Baseline Emissions

Total baseline emissions for the reporting period are estimated by calculating and summing the emissions from all relevant baseline SSRs that are included in the GHG Assessment Boundary (as (as indicated in Figure 4.1. General illustration of the GHG Assessment Boundary

Table).

Calculate total baseline emissions using Equation 5.2 (Equation C).

Equation 5.2. Quantifying total baseline GHG emissions (Equation C)

$$\boldsymbol{BE = FE_B + EE_B}$$

Where,			Units
BE	=	Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary (as calculated in Section 5.1)	$MTCO_2e$
FE_B	=	Baseline Fuel Emissions (Equation 5.3)	$MTCO_2e$
EE_B	=	**Baseline Electricity Emissions (** Equation 5.4)	$MTCO_2e$

5.1.1 Setting the Baseline

As the baseline is the continuation of business-as-usual (BAU) conditions if the project had not occurred, it is a counter-factual, which must be estimated. Where possible, historic emissions are often the most preferred way to estimate baseline emissions, as it is relatively straightforward to calculate a project-specific historic emission factor (ie. CO2 per unit of steam produced) and project it into the project reporting period. For most project types in this protocol, assuming data is available and projects are deemed additional (by meeting the PST in Section 3.4.1), the baseline should simply be a continuation of baseline emissions. Specifically, setting the baseline as a continuation of historic emissions would be appropriate for retrofits, fuel switching, and potentially early retirement projects (though early retirement projects do also have other additionality considerations, which might need to be addressed with a more complicated baseline). For new installations, the baseline should be standardized and linked to the performance standard threshold.

Based on the PST options presented in the section 3.4.1 corresponding options for setting baselines have been presented below. At this stage the idea is to explore these options and then choose the most appropriate one (or more) and delete the rest. The WG could also consider retaining one baseline option as a default, while allowing project developers to implement alternative options at the project developers' discretion, to be used if they have requisite data.

Option # 1 – Fuel Specific Emissions Rate Baseline Selection (Corresponds to PST Option 1)

Retrofits

Below 2 separate approaches are offered. We have been advised that approach 2 seems most suited to the Mexican boiler market, however baseline levels may be expected to change over time as a part of business as usual changes in the industry. It may be possible to account for such changes by altering the baseline over time, perhaps using a standard default adjustment every year (as is used in some CDM methodologies), to reflect ongoing/BAU efficiency improvements which are expected to occur regardless of the protocol.

If the emissions rate performance threshold is selected, then for retrofits, early retirement, and fuel switching projects the baseline will be set based on:

Approach 1: Performance threshold. Using this option, the baseline would be set equal to the performance threshold efficiency calculated in the previous section. This results in only the difference between the performance threshold and the emissions level achieved being credited, and the difference between historic emissions and the performance threshold being uncreditable.

Approach 2: Historic emissions. Under this option, the baseline would be set equal to the historic level of steam efficiency measured prior to project commencement. The entire improvement from historic emissions levels would be credited. WG should revisit underlying assumptions – determine whether historic emissions would have continued under BAU.

	Advantages	**Disadvantages**
Performance Threshold	Avoids crediting extremely poor performers who delay and meet, rather than significantly exceed, the performance threshold.	May not provide sufficient incentive for some facilities
Historic Emissions	Provides greatest overall incentive	

For new capacity or new boiler projects, the following baselines shall apply based on whether the state in which the boiler is located is deemed to have access to natural gas, per the Performance Threshold.

Fuel	**Efficiency (%)**	**Emissions Rate (kgCO2/TJ)**
Natural Gas	82.8%	67,729
Fuel Oil	87.6%	88,356

Option # 2 – Technology-based Baseline Selection (Corresponds to PST Option 2)

If the technology-based performance threshold is selected, the baseline scenarios below shall apply. The WG should explore underlying assumptions and make these explicit. If it is determined that only the identified technology "add-ons" are what make the project additional – rather than the act of early retirement of fuel-switching – then the baseline should not be linked to historical emissions: it should be linked to the new boiler system of fuel without the add-ons.

Project Type	**Baseline**
Boiler Early Retirement	Average annual emissions of the existing boiler, based on previous 3 years (more? Less?) of collected data.
New Boiler	Calculated fuel-specific emissions rate (kgCO2/TJ) of the boiler *without* efficiency measures that surpass the performance threshold.
Efficiency Improvement to Existing Boiler	Average annual emissions of the existing boiler, based on previous 3 years of collected data.
Fuel Switching	Average annual emissions of the existing boiler, based on previous 3 years of collected data.

Option # 3 – Baseline Established Using CDM "Guidelines for the establishment of sector specific standardized baselines" (Corresponds to PST Option 3)

If the CDM standardized baseline is selected, then for all project types the CO_2 baseline will be set equal to 70,442 kg CO_2/TJ steam. Of the boilers with the highest emission factor and contributing to produce in aggregate Y_b% [74%][24] of the output O_i 70,442 kg CO_2/TJ steam was the lowest carbon emission factor. As required by the CDM *Guidelines for the establishment of sector specific standardized baselines* this represents the baseline emission factor. For calculating baseline emissions of CH_4 and N_2O, an efficiency of 80% shall be applied assuming natural gas as the fuel source, corresponding to the baseline system at Y_b%.

DISCUSSION OF BASELINE SETTING FOR EARLY RETIREMENT PROJECTS:

- *Where assumption is retired boilers are not re-commissioned*, then you compare the project to the old-boiler emissions until the point where the old boiler would have reached the end of its life, then compare to you compare project to the standard baseline option for a new boiler
- *Where assumption is retired boilers are repurposed*: then any early-retirement project is simply equivalent to an old-boiler replacement project (you compare project to the standard baseline option for a new boiler)

5.1.2 Quantifying Baseline Emissions[25]

Consideration should be given during WG stage to include specific guidance necessary for calculation of any auxiliary components that will be added to project boundary. See initial discussion in section 2.2.

Separate equation parameters are presented for estimating baseline emissions from retrofit projects and new capacity projects using the equations in this section. Use Equations A, B, and C to calculate baseline emissions from boiler early retirement, new capacity, retrofits, and fuel switching projects. Calculate baseline fuel combustion emissions according to Equation A. Carbon content coefficients for natural gas, fuel oils, and other fuels are provided in **Table B1(a).** (Appendix B).

Equation 5.3. Quantifying baseline fuel emissions (Equation A.)

$$FE_B = EF_{steam} * H_i + (H_i/HR) * (EF_{CH4} + EF_{N20})$$

$$FE_B = (Q_{fuel} * HV_{fuel}) * (EF_{CO2} + EF_{CH4} + EF_{N20})$$

Where,			Units
FE_B	=	Baseline Fuel Emissions	

[24] [75]% is used for illustration purposes only. Y_b% will be determined by the Reserve and Workgroup.
[25] This analysis was based in part on data and preliminary analysis sourced from unpublished background research conducted by EPA's Climate Leaders Program.

EF_{steam} Q_{fuel}	= =	Emission factor for steam output Baseline fuel consumption for steam production at project facility	$KgCO_2$/TJ steam kg
HV	=	Baseline fuel heating value	TJ/kg
H_i	=	Estimated annual heat output requirement for project	TJ steam
HR	=	Baseline boiler efficiency or heat rate	TJ steam/TJ fuel
EF_{CO2}, EF_{CH4}, EF_{N20},	=	Fuel-related CO_2 CH_4 and N_2O emission factors, respectively, as provided in Appendix II.	$KgCO_2e$/TJ fuel

Projects employing new capacity boilers should apply the default values for ER_{CO2}, HR and baseline fuel for the additionality/baseline scenario from the TABLE 5.1 below.

Table 5.1 Default parameters for new capacity boilers

	Option 1: CDM Standardized Baseline	**Option 2:** Emissions-rate		**Option 3:** Technology-based
Fuel for EF_{CH4} and EF_{N2O}	Natural gas	Natural Gas	Fuel Oil	Per Engineering Specs
EF_{steam}	70,420	67,729	88,356	
HR	80%	82.8%	87.6%	Per Engineering Specs

EF_{steam} and HR can be established in two ways, depending on the project type. Approach 1 should be used for new installations, and should set EF_{steam} and HR based on the performance threshold for new installations. Approach 2 should be used for retrofit, early retirement and fuel switching projects, and should set EF_{steam} and HR based on historic emissions.

Approach 1 – New installations – Set ER Equal to Performance Threshold

Applying Approach 1 would set the fuel specific emission factor (EF_{steam}) heat rate (HR) and fuel for all projects equal to the performance thresholds indicated in the previous table. This method is the simplest to implement, as it requires little pre-project monitoring. It is also conservative, as it only credits projects based on efficiency improvements above the performance threshold. Disadvantages of this option include limiting the incentive available to inefficient boilers, because improvements up to the performance standard would not be credited.

Approach 2 – Retrofit, early retirement and fuel switching - Set ER, HR and fuel Equal to

Historic Emission Rate

Approach 2 uses historic boiler data to calculate variables corresponding to pre-project conditions prior to boiler upgrade.

Baseline fuel is assumed to be equal to the fuel in use prior to project implementation.

EF_{steam} is calculated according to Equation A.1

Equation A.1

$$EF_{steam} = (F_i * EF_i) / Steam$$

Where:

i= fuel type (use original fuel type if this is a fuel switching project)

F_i= fuel consumption, TJ (use the average annual fuel consumption for the past three years)

EF_i= emission factor of fuel type i (kg CO_2/TJ)

Steam = steam production, TJ (use the average annual steam production for the past three years)

HR is calculated according to Equation A.2

Equation A.2

$$HR = Steam / F_i$$

Where:

Steam = steam production, TJ (use the average annual steam production for the past three years)

F_i= fuel consumption, TJ (use the average annual fuel consumption for the past three years)

Use of Approach 2 increases the potential emission reduction opportunities, because offsets could be credited for improvements *up to* the performance threshold in addition to improvements *above and beyond* the performance threshold. This methodology increases the overall incentive, but also increases the potential that poor performers and late adopters could be rewarded above their early adopter counterparts.

Calculate baseline emissions from electricity consumption used in boiler operation using Equation B. For projects installing new high efficiency boilers/furnaces, EL is equal to electricity consumption during project activity.

Equation 5.4. Quantifying baseline electricity emissions (Equation B)

$EE_B = EL * (EF_{el, CO2} + EF_{el, CH4} + EF_{el, N2O})$			
Where,			Units
EE_B	=	Baseline Electricity Emissions (CO2, CH4 and N2O emissions from consumed electricity)	$KgCO_2e$
EL	=	Quantity of electricity consumed (use the average annual consumption for the past three years)	MWh
$EF_{el, CO2}$	=	Electricity-related CO_2, CH_4 and N_2O emission factors, respectively Should be determined based on either the emissions intensity of the electricity being purchased (if known - for example, through contacting the local power supplier). Where the specific emissions profile of the purchased electricity is not known, or for any electricity generated at the project, the project developer should use the electric power generation emission factors in Appendix B.	$KgCO_2e/MWh$
$EF_{el,CH4}$	=		
$EF_{el, N20}$	=		

5.2 Quantifying Project Emissions

Project emissions are actual GHG emissions that occur within the GHG Assessment Boundary as a result of the project activity. Project emissions must be quantified every reporting period on an *ex post* basis.

5.2.1 Quantifying Primary Project Emissions[26]

Note: Initially three quantification methods are presented below for estimating project emissions from boiler systems: (1) direct fuel volume measurement; (2) dealer certified fuel volume measurement; and (3) direct stack CO_2 measurement.[27] The WG should consider whether one or more of these should ultimately be included in the protocol.

Project-related emissions may be quantified using one of several methodologies depending on the monitoring system selected. Emissions from purchased electricity also are included to estimate total project-related CO_2 equivalent emissions. Use Equation 5.5 to calculate emissions from purchased electricity during the project, and the appropriate equation (from the choice of 3 methods below) to calculate emissions from fuel combustion.

[26] Much of the underlying data and initial analysis was based on information sourced from unpublished background research conducted by EPA's Climate Leaders Program.

[27] Clinton E. Burklin, Rick Lafleur, and Steve Erickson. "Measurement Methods for Commercial and Institutional Gas and Oil-Fired Boilers," U.S. Environmental Protection Agency, December 30, 2004.

Equation 5.5. Quantifying project electricity emissions (Equation B)

$EE_P = EL * (EF_{el, CO2} + EF_{el, CH4} + EF_{el, N2O})$			
Where,			Units
EE_P	=	Project Electricity Emissions (CO2, CH4 and N2O emissions from consumed electricity)	$KgCO_2e$
EL	=	Quantity of electricity consumed (use the average annual consumption for the past three years)	MWh
$EF_{el, CO2}$	=	Electricity-related CO_2, CH_4 and N_2O emission factors, respectively Should be determined based on either the emissions intensity of the electricity being purchased (if known - for example, through contacting the local power supplier). Where the specific emissions profile of the purchased electricity is not known, or for any electricity generated at the project, the project developer should use the electric power generation emission factors in Appendix B.	$KgCO_2e/MWh$
$EF_{el,CH4}$	=		
$EF_{el, N20}$	=		

Quantification methods (1) and (2) can be used to calculate CH_4 and N_2O emissions as well as CO_2, as long as fuel volume or heating value (MMBtu) is known. Where neither fuel volume nor heating value is known, then method 3 must be used. Quantification method (3) cannot normally be used to directly determine N_2O and CH_4 emissions as continuous emissions monitoring (CEM) equipment to measure these gases is not commercially available.

Method 1 – Direct Fuel Volume Measurement Approach

This method uses a volume meter positioned in the fuel line leading directly to the boiler to measure the volume of fuel burned in the boiler. At the end of each year, or some other designated period, the total volume of fuel burned is read from the meter and used in Equation E to estimate the emissions of CO_2 from the boiler over that period. For natural gas-fired boilers, the method also requires that temperature and pressure gauges be inserted in the fuel line to measure the temperature and pressure of the fuel gas. The average gas pressure and temperature over the measurement period is used in the equation to compensate for changes in gas density due to these two factors. Fuel oil is relatively incompressible and its density does not change appreciably over the year due to temperature and pressure fluctuations.

Equation E.

$$\text{Project } CO_2 \text{ Emissions measured} = V \times CF \times (44/12) \times CE \times 520/T \times P/14.7$$

$$\text{Project } CH_4 \text{ and } N_2O \text{ Emissions} = V \times (EF_{CH4} + EF_{N2O}) \times 520/T \times P/14.7$$

Where:

V = volume of fuel combusted (mscf/yr or mgal/yr)

CF = carbon factor (ton/mscf or ton/mgal)

44/12 = ratio of the weight of CO_2 to carbon

CE = combustion efficiency (select an appropriate combustion efficiency value from Table B.2 in

Appendix B)

520/T = ratio of standard temperature to temperature of fuel (oR)

EF_{CH4}, EF_{N20}, = Fuel-related CH_4 and N_2O emission factors, respectively ($KgCO_2e$/mscf or mgal), as provided in Appendix II.

Method 2 – Dealer Certified Fuel Volume Measurement Approach.

An alternative to the direct fuel volume measurement method is to allow the use of dealer certified fuel volume measurements that are provided by the fuel dealer as part of their billing records. Although there is no national standard for the accuracy of retail fuel deliveries, all but one state (North Dakota) has adopted the guidelines set by the National Conference on Weights and Measures (NCWM) [28]*, known as* Handbook 44*. Under this method, the boiler owner would not be required to install and maintain any fuel metering instrumentation. The natural gas retail dealers, however, would be required to maintain fuel delivery meters that meet the accuracy requirements of* Handbook 44 *and provide documentation that reported sales volumes comply with these requirements. If there are multiple boilers, the retail fuel dealer must provide separate fuel use records for each boiler.*

To estimate CO_2 emissions, the boiler owner would obtain a certified record of annual fuel use from the fuel retailer. The owner would use this fuel volume in Equation E to calculate the tons per year of CO2 emissions. Equation E requires natural gas boiler owners to obtain the temperature and pressure for which the certified natural gas volume has been adjusted from the fuel delivery company.

Equation E.

$$\textbf{Project } CO_2 \textbf{ Emissions monitored} = V \times CF \times (44/12) \times CE \times 520/T \times P/14.7$$

$$\textbf{Project } CH_4 \textbf{ and } N_2O \textbf{ Emissions} = V \times (EF_{CH4} + EF_{N2O}) \times 520/T \times P/14.7$$

Where:

V = volume of fuel combusted (mscf/yr or mgal/yr)

CF = carbon factor (ton/mscf or ton/mgal)

44/12 = ratio of the weight of CO_2 to carbon

CE = combustion efficiency (select an appropriate combustion efficiency value from Table B.2 in Appendix B)

520/T = ratio of standard temperature to temperature of fuel (oR)

EF_{CH4}, EF_{N20}, = Fuel-related CH_4 and N_2O emission factors, respectively ($KgCO_2e$/mscf or mgal),

[28] The National Conference on Weights and Measures (NCWM) developed the "Specifications, Tolerances, and Other Technical Requirements for Weighting and Measuring Devices" in partnership with the Office of Weights and Measures of the National Institute of Standards and Technology (NIST). This set of guidelines is also known as Handbook 44. http://ts.nist.gov/ts/htdocs/230/235/h130 04/PDF/h130 04all.pdf

as provided in Appendix II.

This method introduces risk and added verification requirements to ensure the accuracy of delivery records, particularly given the lack of a national standard for retail fuel deliveries.

Method 3 – Direct Stack CO_2 Measurement Approach.

The direct stack CO_2 measurement methodology uses a set of three instruments to directly measure the CO_2 emissions from the boiler stack. A gas analyzer is used to measure the concentration of CO_2 in the boiler stack. A flow rate meter is used to measure the flow rate of the flue gases in the boiler stack. And a data integrator is used to integrate the CO_2 concentration and the flue gas flow rate over a given time period, such as a year, to calculate an annual CO2 emission rate from the boiler.

5.2.2 Quantifying Project Secondary Emissions

The following is a list of SSR's (from Table 4.1) that do not seem to be addressed in Section 5 at present. We will need to figure out how to quantify each of these. Typically, we would only require that each SSR be quantified if the project scenario impacted the SSR in some way.

SSRs to be included:

- Emissions from natural gas leaks from new sections of natural gas distribution pipeline (API 2009 GHG Compendium could be a good reference, with units provided in per mile and per kilometer basis. It is our understanding that Mexican T&D losses are lower than those in the US, so the use of US emission factors would be conservative).
- [Are there any SSRs that we have missed?]

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 monitoring and reporting requirements in this section and Section 0 have been and will continue to be met, and that consistent, rigorous monitoring and record keeping is ongoing at the project site. The Monitoring Plan must cover all aspects of monitoring and reporting contained in this protocol and must specify how data for all relevant parameters in Table will be collected and recorded.

At a minimum, the Monitoring Plan shall include the frequency of data acquisition; a record keeping plan (see Section 7.2 for minimum record keeping requirements); the frequency of instrument cleaning, inspection, field check, and calibration activities; the role of individuals performing each specific monitoring activity; and a detailed project diagram. The Monitoring Plan should include QA/QC provisions to ensure that data acquisition and meter calibration are carried out consistently and with precision.

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 and the Regulatory Compliance Test (Section 3.4.2 and 3.5, respectively).

Project developers are responsible for monitoring the performance of the project and ensuring that the operation of all project-related equipment is consistent with the manufacturer's recommendations.

6.1 Monitoring Parameters

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

Table 6.1 will need to be updated once the Quantification Section (Section 5) is finalized.

Table

Table 6.1. Project Monitoring Parameters

Eq. #	Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Measurement Frequency	Comment
General Project Parameters						

Eq. #	Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Measurement Frequency	Comment
	Regulations	Project developer attestation of compliance with regulatory requirements relating to the composting project	Environmental regulations	n/a	Each verification cycle	Information used to.: 1) To demonstrate ability to meet the Legal Requirement Test – where regulation would require boiler efficiencies commensurate with project boiler efficiencies. 2) To demonstrate compliance with associated environmental rules, e.g. criteria pollutant limits.
Baseline Calculation Parameters						
	CF	Carbon factor	ton/mscf or ton/mgal			Let's find out what the norm is for measuring caloric content of fuel – I think in US each delivery comes with
	CE	Combustion efficiency	%	Default	N/A	Appropriate default values must be selected from Table B.2 in Appendix B.
	EL	Quantity of electricity consumed	MWh	O		Use average annual consumption for past 3 years
	$EF_{el, CO2}$		$kgCO_2e/MWh$	R		Where the specific emissions profile of the purchased electricity is not known, the project developer should use the electric power generation emission factors in Appendix II
	$EF_{el,CH4}$,		$kgCO_2e/MWh$	R		As above
	$EF_{el, N20}$		$kgCO_2e/MWh$	R		As above
	EF_{steam}	Emissions rate for the project fuel type	$KgCO_2/TJ$ steam			
	F	Fuel consumption	TJ	O		Use average fuel consumption for past 3 years

Eq. #	Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Measurement Frequency	Comment
	H	Estimated annual heat output requirement for project	TJ steam			
	HR	Boiler efficiency or heat rate	TJ steam/TJ fuel			
	i	Fuel type				(for BL) use original fuel type if this is a fuel switching project
	S	Steam production	TJ			the average annual steam production for the past three years
	V	volume of fuel combusted	mscf/yr or mgal/yr			
Project Calculation Parameters						

7 Reporting Parameters

This section provides requirements and 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 boiler efficiency project:

- Project Submittal form
- Project diagram
- Signed Attestation of Title form
- Signed Attestation of Voluntary Implementation form
- Signed Attestation of Regulatory Compliance 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
- Project diagram (if changed from previous reporting period)
- Signed Attestation of Title form
- Signed Attestation of Voluntary Implementation form
- Signed Attestation of Regulatory Compliance form

At a minimum, the above project documentation (except for the project diagram) 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 http://www.climateactionreserve.org/how/program/documents/.

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 project emission reductions, including all required sampled data
- Copies of all permits, Notices of Violations (NOVs), and any relevant administrative or legal consent orders dating back at least 3 years prior to the project start date
- Executed Attestation of Title, Attestation of Regulatory Compliance, and Attestation of Voluntary Implementation forms
- Onsite fossil fuel use records
- Onsite grid electricity use records

- Results of CO_2e annual reduction calculations
- Initial and annual verification records and results
- All maintenance records relevant to the monitoring equipment

7.3 Reporting Period and Verification Cycle

Project developers must report GHG reductions resulting from project activities during each reporting period. Although projects must be verified annually at a minimum, 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).

To meet the annual verification deadline, the project developer must have the required verification documentation (see Section 7.1) submitted within 12 months of the end of each reporting period. A reporting period cannot exceed 12 months, and no more than 12 months of emission reductions can be verified at once, except during a project's initial verification. Although there is some flexibility in the length of the initial reporting period, the project developer must still meet the 12-month verification deadline.

8 Verification Guidance

This section provides verification bodies with guidance on verifying GHG emission reductions associated with the project activity. This verification guidance supplements the Reserve's Verification Program Manual and describes verification activities specifically related to boiler efficiency projects.

Verification bodies trained to verify boiler efficiency projects must be familiar with the following documents:

- Climate Action Reserve Program Manual
- Climate Action Reserve Verification Program Manual
- Climate Action Reserve Mexico Boiler Efficiency Project Protocol

The Reserve's 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.

Only ISO-accredited verification bodies trained by the Reserve for this project type are eligible to verify boiler efficiency project reports. Verification bodies approved under other project protocol types are not permitted to verify boiler efficiency projects. Information about verification body accreditation and Reserve project verification training can be found on the Reserve website at http://www.climateactionreserve.org/how/verification/.

8.1 Standard of Verification

The Reserve's standard of verification for boiler efficiency projects is the Mexico Boiler Efficiency Project Protocol (this document), the Reserve Program Manual, and the Verification Program Manual. To verify a boiler efficiency project report, verification bodies apply the guidance in the Verification Program Manual and this section of the protocol to the standards described in Sections 2 through 0 of this protocol. Sections 2 through 0 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 0 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 are collected and recorded.

8.3 Verifying Project Eligibility

Verification bodies must affirm a boiler efficiency project's eligibility according to the rules described in this protocol. The table below outlines the eligibility criteria for boiler efficiency projects. This table does not present 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 for a **Mexico Boiler Efficiency** Project

Eligibility Rule	Eligibility Criteria	Frequency of Rule Application
Start Date	For 12 months following the Effective Date of this protocol, a pre-existing project with a start date on or after may be submitted for listing; after this 12 month period, projects must be submitted for listing within 6 months of the project start date	Once during first verification
Location	United States and U.S. territories and tribal areas	Once during first verification
Performance Standard		Every verification
Legal Requirement Test	Signed Attestation of Voluntary Implementation form and monitoring 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

8.4 Core Verification Activities

The Mexico Boiler Efficiency Project Protocol provides explicit requirements and guidance for quantifying the GHG reductions associated with the boiler efficiency improvements. 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 boiler efficiency project, but verification bodies must 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 (SSRs)
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, *inter alia*, fuel combustion, un-combusted fuel from the boiler, increased grid electricity consumption and new sections of natural gas pipeline.

Reviewing GHG management systems and estimation methodologies
The verification body reviews and assesses the appropriateness of the methodologies and management systems that the boiler efficiency project operator uses to gather data and 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 facility (or facilities if the project includes multiple facilities) 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 Boiler Efficiency Verification Items

The following tables provide lists of items that a verification body needs to address while verifying a boiler efficiency project. The tables include references to the section in the protocol where requirements are further specified. 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 boiler efficiency 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 boiler efficiency projects. These requirements determine if a project is eligible to register with the Reserve and/or have CRTs issued for the reporting period. If any requirement is not met, either the project may be determined ineligible or the GHG reductions from the reporting period (or subset 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?
2.2	Verify that the project meets the definition of a Mexico Boiler Efficiency project	No
2.3	Verify ownership of the reductions by reviewing Attestation of Title	No
3.2	Verify project start date	No
3.2	Verify accuracy of project start date based on operational records	Yes
3.2	Verify that the project has documented and implemented a Monitoring Plan	No
3.3	Verify that project is within its 10 year crediting period	No
3.4.1	Verify that the project meets the Performance Standard Test	No
3.4.2	Confirm execution of the Attestation of Voluntary Implementation form to demonstrate eligibility under the Legal Requirement Test	No
3.4.2	Verify that the project Monitoring Plan contains a mechanism for ascertaining and demonstrating that the project passes the Legal Requirement Test at all times	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 monitoring meets the requirements of the protocol. If it does not, verify that a variance has been approved for monitoring variations	No

8.5.2 Quantification

Table 8.3 lists the items that verification bodies shall include in their risk assessment and recalculation 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 all SSRs in the GHG Assessment Boundary are accounted for	No
5.1	Verify that the baseline emissions are properly aggregated	No
5.2	Verify that the project emissions were calculated according to the protocol with the appropriate data	No
	Verify that the project developer correctly monitored, quantified, and aggregated electricity use	Yes
	Verify that the project developer correctly monitored, quantified, and aggregated fossil fuel use	Yes
	Verify that the project developer applied the correct emission factors for fossil fuel combustion and grid-delivered electricity	No
	Verify that the project developer correctly applied emission factors	No
	If default emission factors are not used, verify that project-specific emission factors are based on official source-tested emissions data or are from an accredited source test service provider	No
	Verify that appropriate system boundaries in line with protocol guidance are chosen for any steam distribution system	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 appropriate monitoring equipment is in place to meet the requirements of the protocol	No
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
7.2	Verify that all required records have been retained by the project developer	No

8.5.4 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 Statement, 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	Project activities that are above and beyond "business as usual" operation, exceed the baseline characterization, and are not mandated by regulation.
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.
Carbon dioxide (CO_2)	The most common of the six primary greenhouse gases, consisting of a single carbon atom and two oxygen atoms.
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	GHG emissions from sources that are owned or controlled by the reporting entity.
Effective Date	The date of adoption of this protocol by the Reserve board: .
Emission factor (EF)	A unique value for determining an amount of a GHG emitted for a given quantity of activity data (e.g. metric tons of carbon dioxide emitted per barrel of fossil fuel burned).
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).
GHG reservoir	A physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store or accumulate a GHG that has been removed from the atmosphere by a GHG sink or a GHG captured from a GHG source.
GHG sink	A physical unit or process that removes GHG from the atmosphere.
GHG source	A physical unit or process that releases GHG into the atmosphere.
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	Reductions in GHG emissions that occur at a location other than where the reduction activity is implemented, and/or at sources not owned or controlled by project participants.
Metric ton (MT, tonne)	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 21, consisting of a single carbon atom and four hydrogen atoms.
MMBtu	One million British thermal units.
Mobile combustion	Emissions from the transportation of employees, materials, products, and waste resulting from the combustion of fuels in company owned or controlled mobile combustion sources (e.g. cars, trucks, tractors, dozers, etc.).
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 GHG project, as identified in Section 2.2 of this protocol.
Verification	The process used to ensure that a given participant's GHG 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

Still under Development

Appendix A Development of the Performance Standard

[still under development]

Appendix B Default factors

[still under development]

B.1 Default fuel and electricity emission factors

Table B1(a). Emission Factors for Various Fuels

Fuel Type	kg CO_2/TJ	kg CH_4/TJ	kg N_2O/TJ
Natural gas (Dry gas)	56,100	1	0.1
Petroleum coke	97,500	3	0.6
Residual fuel oil	77,400	3	0.6
Coke of coal	Per Source	Per Source	Per Source
Diesel	74,100	3	0.6
Liquefied petroleum gas	63,100	1	0.1

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy

Table B1(b). Emission Factor for Electricity Use by Project Equipment

Geographic Area	Emission factor for electricity used by project equipment (kg CO_2e/kWh)
All of Mexico	0.4999

Note: The factor in this table is from a 2013 estimate by the Programa GEI México (Mexico GHG Program). More information on the factor can be found at http://www.geimexico.org/factor.html. If more recent data, or data specific to the project's geographic region is available, the project proponent should use that data.