Memo to the Mexico Boiler Efficiency Workgroup: Recommendations from the Climate Action Reserve for a Refined Protocol Scope

During the 1st workgroup meeting of the Mexico Boiler and Furnace Efficiency Workgroup, the Climate Action Reserve and Tetra Tech stated that initially we hoped to include a wide range of boiler and furnace[1] types in the protocol under development. Over the past two months, through further research and analysis, including via further engagement with workgroup members, we have developed a better understanding of the current state of boiler and furnace efficiency in Mexico. As a result, the Reserve and technical team have refined our recommendations for which equipment types should ultimately be included in this protocol.

Given the high level of variability between boiler efficiency and furnace efficiency, and the high variability in efficiency among furnace types, the Reserve and Tetra Tech believe it will be the most efficient use of the funding from SENER and from the Mexico Low Emission Development program (MLED) to focus exclusively on boilers. More specifically, we recommend that the protocol focus exclusively on steam boilers greater than 9.8 MW (or 1,000 boiler horsepower – BHP). The rationale for limiting the scope of the protocol to steam boilers greater than 9.8 MW (or 1,000 BHP), at this time,[2] can be broken down into policy-driven, data-driven, and technical rationale, as will be discussed in depth below.

Policy Driven Rationale

Mexico has set some aggressive greenhouse gas reduction goals, setting the bar high with its General Law on Climate Change (LGCC in Spanish), passed in June 2012, that set mitigation goals of 30% reduction of emissions by 2020 and 50% reduction of emissions by 2050 relative to 2000 levels,[3] which is also reflected in the "Intended Nationally Determined Contribution" (INDC) that Mexico submitted to the UNFCCC in advance of the Conference of the Parties in Paris.[4] While it is clear that there are numerous opportunities for energy efficiency improvements across Mexico's industrial and commercial sectors, there is no international precedent for attempting to include such a wide range of energy efficiency measures across an entire sector(s) in a single carbon offset protocol. In fact, standard best practice in international carbon offset energy efficiency methodologies (as demonstrated by the CDM, for instance) is to focus methodologies on a narrow classification of eligible equipment to ensure a strong methodology.

From a policy perspective, too broad of a definition would invite unnecessary scrutiny from the environmental community and other stakeholders, while also preventing us from dedicating resources efficiently. Instead, we must focus on a strong protocol to incentivize improved boiler efficiency in a subset of large boilers that represent a major portion of

[1] For the purposes of this memo (and protocol), furnaces might be defined as "a direct fired device other than a boiler or hot water heater"; translated into Spanish, this could include "calentadores", "hornos", "calcinadores", "reformadores").
[2] While the Reserve recommends focusing the protocol on these particular types of equipment, it is definitely possible in the future to develop additional protocols to include further equipment types.
[3] "Quinta Comunicación Nacional Ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático", México, Submitted to UNFCCC, 6 December 2012.
[4] "Intended Nationally Determined Contribution", Mexico, Submitted to UNFCCC, 30 March 2015.

industrial energy consumption and the majority of emission reduction opportunities. In developing this protocol, the lack of available data, which is addressed further below, combined with the complexity and disparity among the many potential eligible equipment types, means the scope of the protocol must be refined and narrowed from the initial starting position, to best ensure the protocol can be developed on time and within budget and be accepted by the international community. If and when that protocol development effort is successful, only then will it make sense to tackle additional equipment classifications. It would do the MLED program and nascent Mexico carbon market a disservice to attempt to tackle too much in a single protocol, as setting the scope too wide with fixed resources and time may result in an incomplete or weak protocol.

Data Driven Rationale

The Climate Action Reserve is known for developing standardized protocols, unlike in other programs like the CDM, where every project must demonstrate project-specific additionality. Best practice in terms of standardized carbon offset additionality assessment requires that methodologies only include equipment and activities for which there is sufficient data to develop robust scope and additionality assumptions. In developing protocols, the Reserve follows these best practice standards and will often focus narrowly on specific equipment for which there is sufficient data to support those robust standardized additionality assumptions, and then consider other protocol applications over time, as further data is made available.

Under the Reserve's approach, performance standards allow for the evaluation of projects against a set of consistent criteria designed to exclude non-additional projects and include additional ones on a sector-wide basis. These performance standards are developed through extensive analysis of standard practices and technology deployment in relevant sectors, as well as incorporating an assessment of "typical" financial, implementation, and operating conditions. In the case of boilers and furnaces, the Reserve is examining data on fuel type and consumption, boiler/furnace heat output, energy efficiency measures, etc.

While collection of the right data is likely to be a challenge in the development of any standardized protocol, collection of energy efficiency data in Mexico is proving to be a particular challenge. Data demonstrating the performance of large boilers (particularly those at PEMEX and CFE) is limited, but there appears to be sufficient data, collected by PEMEX and CFE and reported to government agencies (CONUEE, SEMARNAT), for an analysis of "business as usual" practices, which will be useful for setting additionality thresholds and baselines. For intermediate-size boilers, we have been advised that users normally keep records of efficiency levels, therefore making it easier to develop standardized efficiency assumptions, even while limited data exists. The level of effort needed to collect and analyze this data may be significant. Preliminary research indicates that there should be at least some data for analysis.

For smaller boilers and furnaces, however, no comprehensive data set has been found to support analysis of performance efficiencies; furthermore, we have been unable to locate information on the operating practices and design characteristics for small boilers in use in Mexico. This lack of data is partly related to the types of technologies, but also due to our inability to locate any information on operating practices and fuels used. It is likely that substantially more resources and time could be spent seeking data on smaller boilers and furnaces, with no guarantee of success.

The Reserve's standardized approach is heavily reliant on the availability and analysis of data. While many energy efficiency upgrades at many small boilers and furnaces can be expected to be "additional," without data to understand what business-as-usual efficiencies would be expected for a given boiler design, it is difficult to determine where a threshold should be set, dividing additional projects from non-additional ones. Lacking such data, the Reserve and partners would not have sufficient confidence in setting a performance standard for this project type. At this point, it appears that the most efficient use of SENER and MLED resources will be to focus on obtaining and analyzing data on larger boilers, rather than continuing to search for datasets for smaller boilers.

Technical Rationale

As noted above, there are numerous technical reasons to refine the scope of the protocol, excluding both furnaces and smaller capacity (below 1,000 BHP) boilers. Rationale for excluding furnaces is somewhat distinct from the rationale for excluding certain boiler capacities and, as such, they will be addressed separately.

For the purposes of analysis of "business as usual" trends, the Reserve has proposed that boilers and furnaces be grouped together based on capacity, due to the different efficiency levels expected from different capacity groupings, as outlined in Table 1. Such groupings would allow for differing performance standard thresholds (e.g. different efficiency thresholds) based on those different capacities, while retaining other common protocol features (such as MRV requirements) across groupings.

Table 1. Preliminary Eligible Project Types

Category	Capacity (Thermal)	Retrofitting	Fuel switch	New equipment	Early retirement
Steam boilers	Up to 9.8 MW (33.5 MMBtu/h or 1,000 BHP)	✗	✗	✗	✗
	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)	✓	✓	✓	✓
Hot water boilers	Up to 4.9 MW (Up to 16.7 MMBtu/h or 500 BHP)	✗	✗	✗	✗
	>4.9 MW (>16.74 MMBtu/h or >500 BHP)	✗	✗	✗	✗
Furnaces (all)		✗	✗	✗	✗

Exclusion of Furnaces

The term "furnace" comprises a vast array of device types having different construction designs, purposes, capacities, and operational features. Significant variability exists among furnaces for design purposes, fuels used, and current energy efficiency levels, as well as significant variability in terms of opportunities for practical energy efficiency improvements.

Most furnaces currently employed in industrial applications are designed to match specific process needs at a specific site or facility. Energy efficiency levels of furnaces vary greatly among designs and their use: some furnaces serve to heat air or gases, directly or indirectly, liquids, mostly in an indirect way, and solids, mostly in a direct way. The performance measures and potential uses of such equipment vary greatly; certain furnace-types are in use in a limited number of applications in Mexico, and therefore, have limited emission reduction potential. A comprehensive treatment of furnaces would require, depending on type and service, an industry-by-industry, type-by-type, or case-by-case analysis in order to establish differentiated efficiency and GHG performance levels.

Commercial or residential furnaces for space heating purposes in HVAC systems are the exception to this, in that this category is a bit more uniform in terms of design and application, but the use of furnaces in such HVAC systems in Mexico is not frequent or extensive. The limited application in Mexico and the limited potential emission reductions per individual HVAC/furnace does not justify the additional effort necessary to include just this limited HVAC category in the protocol.

In an attempt to manage this variability in furnace applications, it was suggested that the protocol focus on large industrial furnaces, particularly process heaters in use in the chemical, petrochemical, gas processing, and refining industries,[5] where similarity in design and significant capacities make these particular process heaters more suitable for potentially studying as a group. However, as this analysis progressed, it became apparent that many boiler retrofitting measures were not applicable to these process heaters, essentially requiring the separation of boilers and process heaters for analysis purposes.

Due to the above, and given the great difference between boiler populations and furnace populations in Mexico, and the need to study boiler populations by subgroups, we believe it will be the most efficient use of MLED resources to focus exclusively on boilers at this time, as boilers produce most of the GHG emissions and have the largest GHG emission mitigation potential of all the direct fired devices (including availability of many technical solutions suited for them). Both process heaters and other classifications of furnaces could potentially be study subjects for separate future protocols if potential reductions are both cost-effective and significant to the country. Thus, our recommendation is to focus this protocol exclusively on boiler efficiency at this time, excluding all furnaces until they can be addressed in a future separate protocol.

Exclusion of Boilers with Capacities less than 9.8 MW (<1,000 BHP)

While the recommendation to exclude furnaces significantly refines the scope of the protocol, including *all* boiler sizes and types within the same protocol would likely still be unmanageable in terms of the variability of applications and designs included. As such, we are recommending that the protocol be further limited to only boilers with capacities greater than 9.8 MW (or 1,000 BHP).

[5] "Process heater" in the oil & gas and chemical industries refers to all direct fired devices used to transfer heat to process substances, particularly liquids and gases, in order to condition them for subsequent process stages.

Boilers with a capacity of less than 9.8 MW (1,000 BHP) make up the category of the smallest boilers in Mexico and according to a boiler population study by CONUEE, boilers of this size represent more than 90% of all boilers installed in Mexico.[6] Boilers of this size consistently emit significantly less that 25,000 tons CO2e/year, which is notably Mexico's mandatory reporting threshold, even if they are under continuous operation (24-7-365). The implication from this being that it is less likely performance data for such equipment is collected and routinely reported to government. Small boilers, however, are often operated at a lower utilization rate than larger boilers. Their performance characteristics ultimately limit the types of mitigation options available for this category and due to lesser utilization of these boilers, the amount of emissions to be reduced will be small.

This boiler group also includes, due to size and capacity, the subgroup of hot water boilers, often referred to as hot water heaters, which typically have a higher efficiency than steam boilers of the same capacity and configuration, due to more efficient heat transfer mechanisms and system operation.

While significant potential emission reductions may appear to exist economy-wide, if all boilers below 9.8 MW (1,000BHP) were to implement efficiency improvements, emissions (and subsequently potential emission reductions) on a per boiler basis are relatively low. Therefore, it is less likely that emission reductions generated from a carbon offset project at this scale would be sufficiently cost-effective to cover monitoring and verification costs, meaning that projects involving such equipment would not be financially attractive.

Finally, as noted above, most critically there is little to no boiler efficiency data available for these small steam or hot water boilers. While data availability is proving to be a challenge across potential boiler categories, the level of data *collection* that would be required to perform sufficient analysis of this boiler category would likely be unworkable within the resources available.

Thus, our recommendation is to exclude all equipment smaller than this minimum capacity threshold of 9.8 MW (1,000 BHP) from the protocol.

Proposed Protocol Scope: Focus on Steam Boilers with Capacities of more than 9.8 MW (>1,000 BHP)

Having recommended that all furnaces and any boiler smaller than 9.8 MW (1,000 BHP) be excluded from the protocol scope, the Reserve would like to briefly address those boilers that we propose *should be* included in this current protocol. We believe that these boilers represent a significant emission reduction potential based on their share of emissions from Mexican industry and electricity generation, as well as the most significant emission reduction potential on a per boiler basis, likely making these projects most cost effective as well.

The Reserve proposes grouping steam boilers above 9.8 MW (1,000 BHP) into the following capacity-based categories:

- Steam boilers with capacities of more than 9.8 and up to 30 MW
- Steam boilers with capacities of more than 30 and up to 100 MW
- Steam boilers with capacities of more than 100 MW

[6] Estudio relacionado con la estimación del parque de calderas en México, CONAE 1997

The Reserve believes that these groupings by capacity range will allow us to assess boilers of similar design and application and, as such, we are hopeful that boilers within each category have similar energy efficiency profiles.

The first boiler group (9.8 to 30 MW) includes primarily medium-sized industrial boilers used for process steam production in a range of industrial applications, though it may also include boilers used for powering electric generators up to 7.5 MW in capacity. Most of the boilers in this category are watertube designs, some of which are equipped with heat recovery devices, while there are also a small number of firetube designs in this category, ranging from 1,000 to 2,000 BHP.

The second boiler group (30 to 100 MW) includes large industrial boilers used both for process steam production and for power generation. All boilers in this category are watertube designs and most of them are typically equipped with heat recovery devices, although usually in variable configurations. The biggest industry in this group would be the oil and gas processing industry, followed by the petrochemical and chemical industries. Most PEMEX steam boilers fall into this category, for example.

Finally, the third boiler group (100 MW and up) includes mainly power boilers used in conventional thermoelectric power plants for commercial electric power generation, such as those used by CFE and by power suppliers to CFE. Boilers in this category are equipped with several heat recovery devices as energy efficiency is very important to keep generation costs at adequate levels.

As we move forward with protocol development, particularly data collection and analysis efforts, and as we learn more about BAU energy efficiencies of the boilers in each of the proposed boiler groupings, these categories may need to be refined further. Ultimately, we aim to establish a performance threshold for each category, reflecting a minimal level of energy efficiency which projects must achieve to demonstrate their additionality. We expect the largest boilers (100 MW and up) to have the highest energy efficiency levels (and subsequent performance threshold), followed by the second largest boilers (30 to 100 MW), followed by the smallest (9.8 to 30 MW).

The Reserve has begun working with workgroup members whose organizations are in possession of data that may inform this analysis. If you believe your organization has data or a study that may be useful to the Reserve's analysis of "business as usual" energy efficiency levels in Mexican boilers, please let us know.