June 2003

Commercial Boiler GHG Emission Offset Opportunities

Background

- Boilers burn fuel to generate steam and/or hot water
- The steam/hot water is a secondary energy carrier serving different end-uses in the commercial sector, (e.g., space heating, washing)
- The major GHG emissions source in a boiler system is carbon dioxide (CO_2) from the combustion of fossil fuels.
- Substantial cost-effective opportunities for greenhouse gas emission reduction exist in boiler and steam distribution systems.

Background

- Project definition: types of commercial boiler projects
  - Replacement or retrofit/upgrade of an existing boiler
  - Fuel change of an existing boiler
  - Upgrade of distribution system (including condensate return)
  - Replacement by a cogeneration system
- Project benefits
  - Reduce GHG emissions
  - Replacement of older boilers can reduce particulates, and can result in local reductions in SO_x and NO_x
  - Reduce fuel, operation and maintenance costs

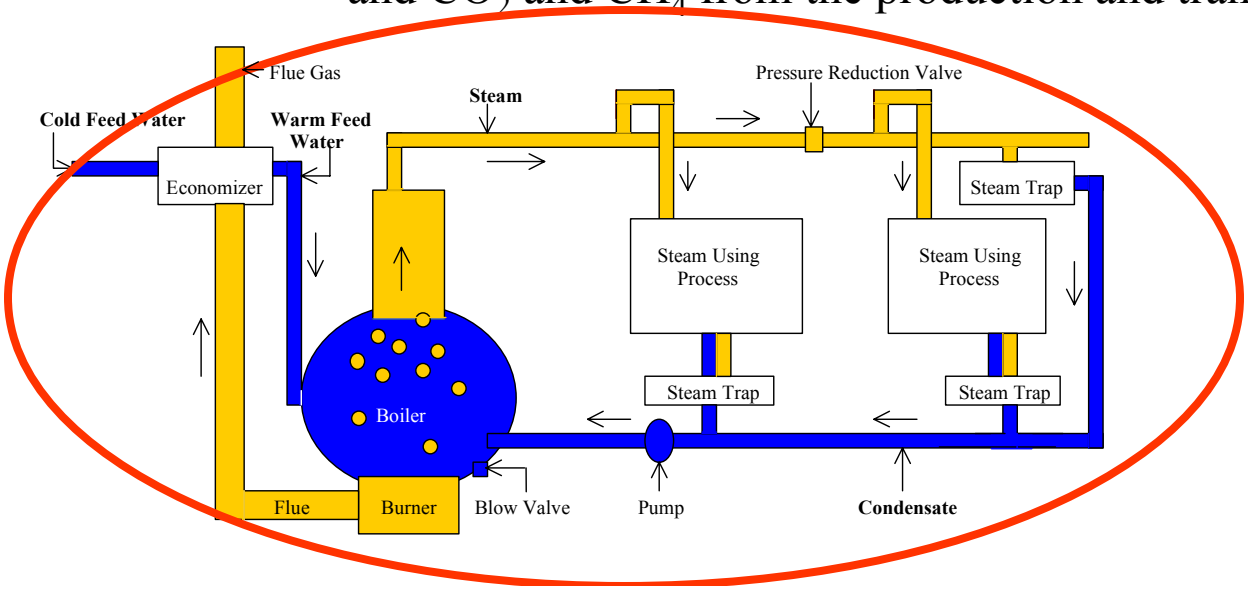
Determining Offset GHG Potential

- Step 1: Identify project type
  - e.g., Replacement or retrofit of an existing boiler

- Step 2: Determine eligibility
  - Where Federal, State and/or Local law mandates that boilers comply with certain standards, projects are eligible if they achieve reductions greater than what would have been achieved by technologies used to reach compliance.

Determining Offset GHG Potential

- Step 3: Define project boundary
  - Boundary may include just the boiler or include both the boiler and the steam/hot water distribution system.
  - All project-related emission sources should be identified:
    - CO_2 from fuel combusted in the boiler
    - CO_2 from the fuel used to generate electricity for feedwater treatment, pumps and boiler fans
    - Emissions that are likely insignificant and thus do not need to be accounted for include, CH_4 leakage and N_2O from stationary combustion, and CO_2 and CH_4 from the production and transport of fuels



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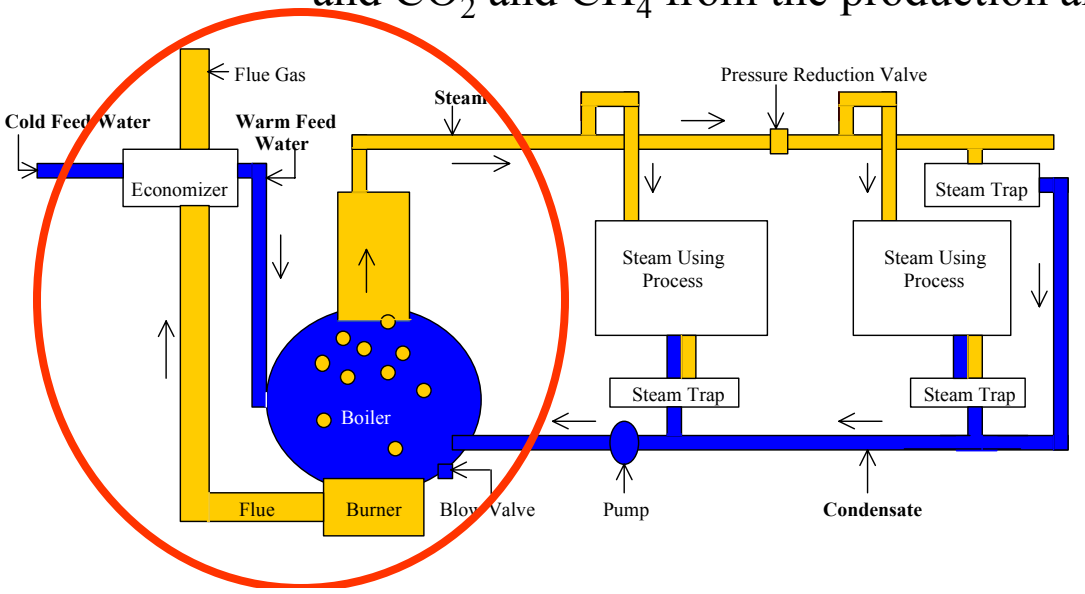

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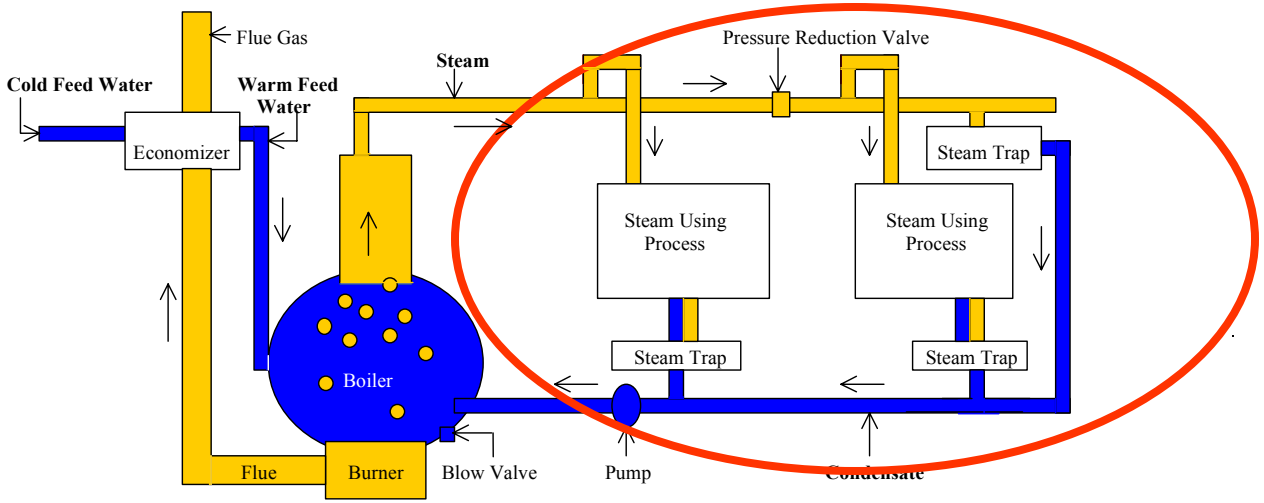

Determining Offset GHG Potential

- Step 4: Establish baseline
  - An emissions based performance standard should be developed considering typical boiler lifetime and/or performance for similar projects in the region.
  - For example, if the typical lifetime of a boiler is 40 years; a project that replaces a 10 year old boiler would have a project lifetime of 30 years.
  - In order to estimate baseline boiler emissions, data on fuel use, operating hours, load, boiler efficiency and a carbon emissions factor need to be obtained.
  - Where electricity use is displaced the carbon intensity of the displaced electricity should be determined.
- Step 5: Pre-installation estimation of project emissions and savings
  - Emissions resulting from implementation of the proposed project should be estimated from all sources included in the baseline established in Step 4.
  - Estimated project emissions should be subtracted from baseline emissions in order to estimate total emissions reductions due to the project.

Calculating Offset GHG Savings

- Step 6. Monitoring
  - Fuel use may be determined by metering, or alternatively, through the use of accurate fuel records.
  - Where electricity use is displaced the carbon intensity of the displaced electricity should be determined.

- Step 7: Post-installation calculation of project GHG savings
  - Emissions reductions are determined by subtracting actual project emissions from baseline emissions (determined above) .
  - Leakage for this project type is assumed to be minimal, therefore, does not need to be considered.

Example Project: Replacing a 2 MW Coal-Fired Boiler (1)

- Project description
  - A 25 year old 2 MW coal-fired boiler is replaced by a new gas-fired boiler
  - Boiler is operated 8760 hours/year
  - Project lifetime is estimated at 15 years
- Old boiler emissions: 6987 t CO_2/year
- Baseline for the calculation of emission reduction is estimated on the basis of recently installed boilers in the region

Example Project :Replacing a 2 MW Coal-Fired Boiler (2)

- Estimated baseline based on:
  - Current boiler emissions: 6987 t CO_2/year
  - Average of recent boilers: 6735 t CO_2/year
  - Best 10% of recent boilers: 6654 t CO_2/year
- New boiler emissions are 3968 t CO_2/year
- Project results depend on appropriate baseline
  - Current: 3019 t CO_2/year, or 45,285 t CO_2 for project lifetime of 15 years
  - Average: 2767 t CO_2/year, or 41,505 t CO_2 for project lifetime of 15 years
  - Best 10%: 2686 t CO_2/year, or 40,290 t CO_2 for project lifetime