2017 **Title:** **Plant and Boiler Energy Efficiency Evaluations**

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ABSTRACT:

Assessing the energy efficiency of any power or industrial plant is a first step to finding improvement opportunities that reduce generation or production costs while also reducing the plant's carbon footprint. One way of doing this is by performing an energy audit which is a good tool to identify possible target projects. Budget prices for possible energy improvement projects together with expected energy savings can be used to generate simple payback periods. This allows filtering of possible projects and determination of which projects to target for further evaluation or implementation. Often it is beneficial to contract an external energy consultant that brings experience from other plants and a fresh look at the plant equipment and conditions.

Examples of possible energy improvement projects can range from missing insulation, to process changes, to changing heating sources, to more efficient steam generation. Selected examples of plant improvement opportunities are discussed in more detail.

On the steam generation side, the boilers are a major focus when targeting energy improvements. An important metric to measure a boiler's energy performance is thermal efficiency. The most common energy losses and the different basis for calculating the thermal efficiency of boilers are discussed. This includes losses from dry flue gas, water in the fuel and air, water from hydrogen in the fuel, CO, unburned carbon, etc. Methods to estimate these losses are discussed. Evaluating the current thermal efficiency performance will help identify possible improvement opportunities.

Three thermal efficiency evaluation projects for boilers burning a variety of fuels are discussed. Examples include a case study with two identical natural gas fired package boilers that showed strongly differing efficiencies, and another case study to evaluate modification options to use a high pressure back-up boiler. The measures considered to improve energy efficiency include reducing excess air, installing economizer surface, re-using another boiler's condensing economizer, and variable frequency drives for fans. A third case study discusses evaluating efficiency improvements on a boiler burning biomass. Energy savings and their impact on reducing CO_2 emissions are presented for natural gas, coal with 28% moisture content, and three biomass fuels with varying moisture content.