

Proposal Summary



Process Boiler #1 Non-Condensing Stack Economizer Requirement

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Measure Description

This proposal would require boiler stack (non-condensing) economizers on process boilers with capacities at or above 5 MMBtu/hr. The requirement would apply to all new process boilers, including replacement boilers and boilers in additions to existing facilities. Boilers with stack temperatures below 350°F at lowest firing rate would be exempt from this requirement. The Statewide CASE Team is evaluating two additional potential exemptions for the requirement:

1. Boilers that burn combustible fuels that have high potential for fouling in the heat exchanger, such as woody biomass.
2. Sites where the retrofit building ceiling height or existing footprint shape results in insufficient room to install a standard boiler plus stack economizer combination.

In addition, this proposal would adjust the 2025 Title 24 Part 6 code language which calls for process boilers to maintain excess oxygen concentrations at 3.0 percent or lower over firing rates of 20 to 100 percent. The proposed code changes would update the code language to allow excess oxygen concentrations as follows:

- ultra-low NOx burners: maximum 7% excess O₂ at or above 20% of maximum fire
- mesh burners: maximum 10% excess O₂ at or above 20% of maximum fire
- boilers equipped with Selective Catalytic Reduction (SCR) systems: maximum 4% excess O₂ at or above 25% of maximum fire

Boilers used in oilfield production and utility and municipal power generation are not expected to be within the scope of Title 24, Part 6. Table 1 summarizes the scope of the proposed code change.

Table 1: Scope of Proposed Code Change

An "X" indicates the proposed code change is relevant.

Building Type(s)		single family	Construction Type(s)	X	new construction
		multifamily		X	additions
	X	nonresidential		X	alterations
Type of Change	X	mandatory	Updates to Compliance Software	X	no updates
		prescriptive			update existing feature
		performance			add new feature
Third Party Verification		no changes to third party verification			
		update existing verification requirements			
	X	add new verification requirements			

Justification for Proposed Change

Most steam boilers lose 20% or more of their input fuel energy in the form of combustion exhaust. A stack economizer, which is an assembly of finned tubing placed in the boiler exhaust stream, can recover a significant fraction of this waste heat by preheating the boiler feedwater with the hot boiler flue gas. This reduces load and thermal stress on the boiler, lowers fuel consumption, and extends boiler useful life.

The use of boiler stack economizers has been listed in Department of Energy literature as a best practice since at least the early 2000s. Despite its cost-effectiveness, this measure often goes unimplemented because of its first cost and the general lack of owner and operator awareness of the energy benefits. In general, boiler system vendors and contractors are highly familiar with this technology, and it is widely available. Stack economizers can be installed in various configurations, including roof boxes, making them feasible in most facilities.

The use of a stack economizer is typically the highest-impact action that sites can take to reduce their boiler natural gas usage, saving 2-3% of fuel energy by preheating boiler feedwater. Preliminary statewide natural gas savings from a stack economizer requirement are estimated at 1.37 million therms per year. Preliminary savings calculations and assumptions can be found in the stack economizer savings calculations document.

2025 Title 24 Part 6 requirements dictate that qualified boilers shall maintain stack-gas oxygen concentrations lower than or equal to 3.0 percent over firing rates of 20 to 100 percent. However, boilers that comply with California's local air quality district NOx emission rate limits, require higher amounts of excess oxygen than non-compliant, higher-Nox boilers—often above 3.0 percent. Updating the Title 24 Part 6 requirements to allow for oxygen concentrations higher than 3.0 percent would allow for boilers to comply with California's local air quality district requirements. The proposed requirements would account for different boiler types that require different oxygen concentrations to maintain efficiency. Eliminating conflicting regulations through this proposal would improve ongoing code compliance. In addition, NOx monitoring often drives utilization of a control monitoring console, which enhances data utilization to improve decision-making and is synergetic with the monitoring requirements in this proposal.

Additional benefits of this proposed code change include job creation in the manufacturing and installation of stack economizers, as well as improved local air quality. Many industrial facilities are located near Low- and Moderate-Income (LMI) housing, which is disproportionately exposed to lower air quality. This proposal would reduce photochemical smog in these communities.

Data Needs / Information Requests

The Statewide CASE Team is seeking the following information to inform the code change proposal. Data may be provided anonymously. To participate or provide information, please email Emma Conroy, emmaconroy@2050partners.com directly and copy info@title24stakeholders.com.

- Typical annual operating hours and load factors for boilers in various industries
- Typical boiler lifetimes across different boiler sizes
- Labor and material costs of stack economizers across different boiler sizes
- Maintenance costs, the frequency of maintenance on stack economizers, lifetimes of stack economizers, and economizer retube costs
- Prevalence of boilers that have stack temperatures below 350°F
- Prevalence of inadequate overhead space, when a roof box cannot be added to accommodate a stack economizer in a boiler replacement
- Barriers to implementing non-condensing stack economizers on boilers
- Market prevalence of stack economizers by boiler capacity
- New construction and additions rate for process boilers

Draft Code Language

Guide to Marked Up Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2025 documents are marked with [blue underlining](#) (new language) and ~~strikethroughs~~ (deletions).

Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

Title 24, Part 6

120.6 (d) Mandatory requirements for process boilers.

1. Combustion air positive shut-off shall be provided on all newly installed process boilers as follows:
 - A. All process boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
 - B. All process boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).
2. Process boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:
 - A. The fan motor shall be driven by a variable speed drive; or.
 - B. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.
3. Newly installed process boilers with an input capacity greater than [or equal to 5 MMBtu/h \(5,000,000 Btu/h\)](#) shall maintain stack-gas oxygen concentrations at less than or equal to ~~3.0 percent~~ [the following percentages](#) by volume on a dry basis ~~over firing rates of 20 to 100 percent~~:
 - A. [ultra-low NOx burners: maximum 7% excess O2 at or above 20% of maximum fire](#)
 - B. [mesh burners: maximum 10% excess O2 at or above 20% of maximum fire](#)
 - C. [boilers equipped with Selective Catalytic Reduction \(SCR\) systems: maximum 4% excess O2 at or above 25% of maximum fire](#)

Combustion air volume shall be controlled with respect to measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

Exception to Section 120.6(d)3: Boilers with steady state full-load combustion efficiency 90 percent or higher.

4. Stack economizer. Newly installed process boilers with an input capacity equal to or greater than 5 MMBtu/h (5,000,000 Btu/h) shall have a boiler stack economizer.

Exception to Section 120.6(d)4: Boilers where the stack temperature measured at their lowest firing rate is below 350°F as documented in manufacturer performance data.

Add definitions:

BOILER STACK ECONOMIZER is a heat exchanger that recovers heat from boiler flue gas and transfers it to boiler feedwater or a combination of boiler feedwater and makeup water. Unless otherwise specified, this term refers to a non-condensing heat exchanger that does not condense water vapor from the boiler flue gas.

FIRING RATE is a scale from 0 to 100% output of the boiler combustion controls where the lower bound of firing rate is set at the site and based on burner characteristics to ensure stable combustion. [Note: The team proposes defining firing rate in this bound of code revisions due to ultra-low Nox practices where the firing rate and burner max load output are no longer 1:1.]

PERCENT OF MAXIMUM FIRE is the firing rate as a percent of burner's maximum capacity, equivalent to a burner's:

$$\frac{\text{Input (Btu/hr)}}{\text{Maximum Input (Btu/hr)}}$$

or

$$\frac{\text{Steam Flow (lbshr)}}{\text{Maximum Steam Flow (lbshr)}}$$

Reference Appendices

Appendix NA7 – Installation and Acceptance Requirements for Nonresidential Buildings and Covered Processes.

Acceptance testing, performed by field technician, shall be added to verify the following for newly installed process boilers with an input capacity equal to or greater than 5 MMBtu/h (5,000,000 Btu/h):

1. the stack economizer is not bypassed at time of testing.
2. stack-gas oxygen concentrations are at or under the following maximums while meeting local Air Quality Management District requirements:
 - a. ultra-low NOx burners: maximum 7% excess O2 over firing rates of 20 to 100 percent
 - b. mesh burners: maximum 10% excess O2 over firing rates of 20 to 100 percent
 - c. boilers equipped with Selective Catalytic Reduction (SCR) systems: maximum 4% excess O2 over firing rates of 25 to 100 percent