



# NETL Life Cycle Inventory Data

## Process Documentation File

**Process Name:** Natural gas combustion in an auxiliary boiler  
**Reference Flow:** 1 kg of natural gas combustion in auxiliary boiler  
**Brief Description:** Air emissions from the combustion of natural gas in an auxiliary boiler

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### Section I: Meta Data

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**Geographical Coverage:** US **Region:** N/A  
**Year Data Best Represents:** 2010  
**Process Type:** Basic Process (BP)  
**Process Scope:** Gate-to-Gate (GG)  
**Allocation Applied:** No  
**Completeness:** Individual Relevant Flows Captured

#### Flows Aggregated in Data Set:

Process  Energy Use  Energy P&D  Material P&D

#### Relevant Output Flows Included in Data Set:

Releases to Air:  Greenhouse Gases  Criteria Air Pollutants  Other  
Releases to Water:  Inorganic Emissions  Organic Emissions  Other  
Water Usage:  Water Consumption  Water Demand (throughput)  
Releases to Soil:  Inorganic Releases  Organic Releases  Other

#### Adjustable Process Parameters:

None.

#### Tracked Input Flows:

Natural gas *Natural gas extraction and delivery to auxiliary boiler*

#### Tracked Output Flows:

Natural gas combustion in auxiliary boiler *Reference flow; 1 kg of natural gas combusted in an auxiliary boiler*



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### Section II: Process Description

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#### Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS\_Stage3\_O\_NG\_Auxiliary\_Boiler\_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

#### Goal and Scope

This unit process provides a summary of relevant input and output flows associated with the combustion of natural gas in an auxiliary boiler. The only input to this unit process is natural gas. Air emissions include GHG (greenhouse gas) emissions and CAPs (criteria air pollutants).

The reference flow of this unit process feeds into the unit process for Natural Gas Energy Conversion by GTSC (gas turbine simple cycle).

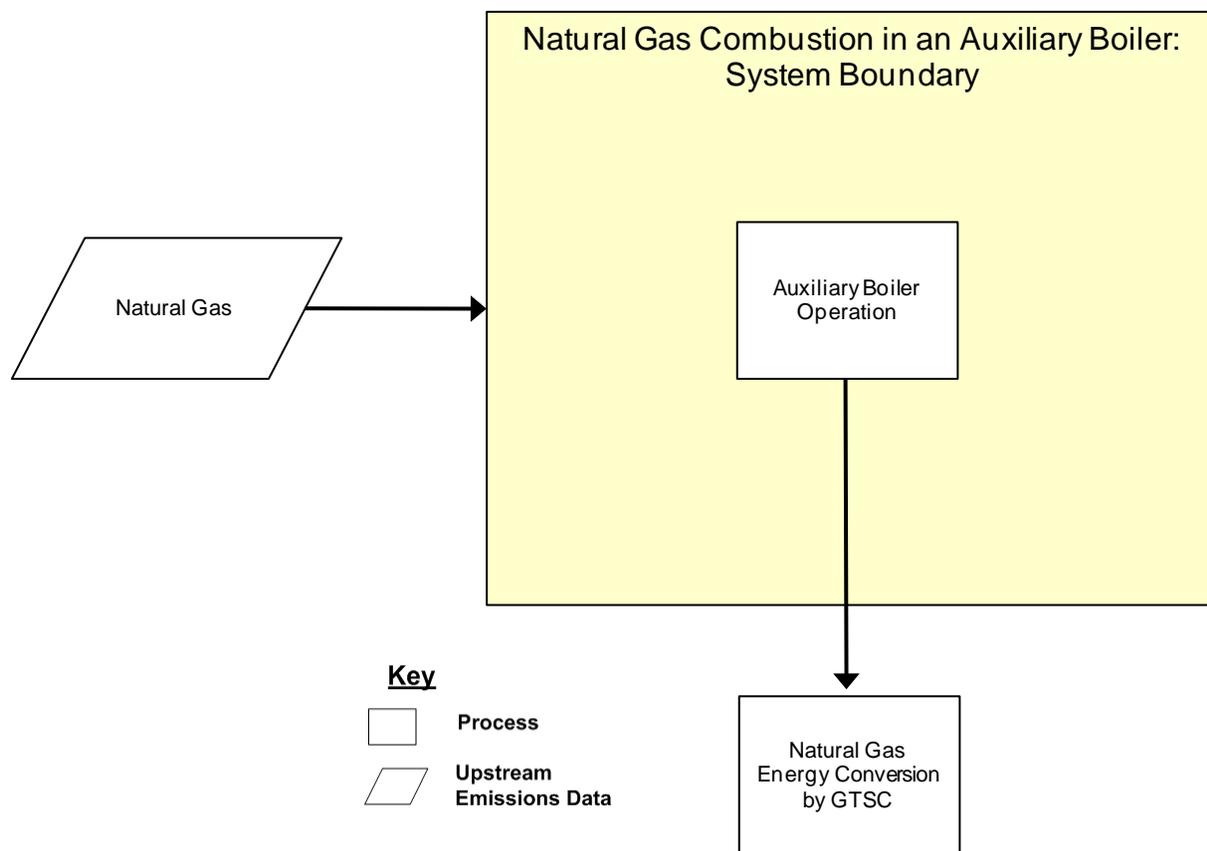
The relevant flows of this unit process are described below and shown in **Figure 1**.

#### Boundary and Description

An auxiliary boiler is used by a natural gas or coal fired power plant to provide heat necessary for supporting operations when the turbine is not operating and is also used during the startup of a power plant in order to prevent thermal shock of larger equipment. An auxiliary boiler is not used for power generation. This unit process accounts for the natural gas consumed by an auxiliary boiler and the air emissions (specifically GHG and CAPs) from the combustion of natural gas by an auxiliary boiler.

The Baseline Report specifies a shop fabricated water tube boiler with the following design specifications: 40,000 lb/h steam flow rate, 2.8 MPa pressure rating, and 343 °C temperature rating (NETL 2010). However, no details on the fuel use or emissions associated with the auxiliary boiler operation are included. Natural gas was assumed as the fuel used (versus fuel oil) due to the large and constant supply of natural gas at NGCC (natural gas combined cycle) or GTSC (gas turbine simple cycle) facilities. Fuel use was estimated from the specifications of a similar boiler; a 40,000 lb/h, 2.4 MPa water tube boiler that consumes 1010.1 kg/hr of natural gas (Wabash Power Equipment Company 2009). EPA AP-42 emission factors for natural gas combustion in a large-walled boiler were assumed for the auxiliary boiler operation (EPA 1995). Mercury emissions are assumed to be negligible. Emissions are assumed to be controlled.

The values for auxiliary boiler operation were converted to a reference flow of 1 kg of natural gas combustion. For a 360 MW GTSC plant, the auxiliary boiler combusts 0.248 kg of natural gas per MWh of electricity generation. For a 332 MW GTSC plant (the CCS case of this analysis), the auxiliary boiler combusts 0.269 kg of natural gas per MWh of electricity generation.



**Figure 1: Unit Process Scope and Boundary**

Default parameters for this unit process are shown in **Table 1**. The inputs and outputs of this unit process (representative of the default values of **Table 1**) are summarized in **Table 2**.

**Table 1: Emission Factors for NG Auxiliary Boiler Combustion**

Air Emission	Value (kg emission/kg natural gas combusted)	References
NOx (controlled)	3.33E-03	EPA 1995
CO	2.00E-03	EPA 1995
CO2	2.86	EPA 1995
N2O (controlled)	1.52E-05	EPA 1995
PM (total)	1.81E-04	EPA 1995
SO2	1.43E-05	EPA 1995
Methane	5.48E-05	EPA 1995
VOC	1.31E-04	EPA 1995

**Table 2: Unit Process Input and Output Flows**

Flow Name*	Value	Units (Per Reference Flow)
<b>Inputs</b>		
Natural gas USA [Natural gas (resource)]	1.00	kg
<b>Outputs</b>		
Natural gas combustion in auxiliary boiler	1.00	kg
Carbon dioxide [Inorganic emissions to air]	2.86	kg
Methane [Organic emissions to air (group VOC)]	5.48E-05	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	1.52E-05	kg
Nitrogen oxides [Inorganic emissions to air]	3.33E-03	kg
Sulphur dioxide [Inorganic emissions to air]	1.43E-05	kg
Carbon monoxide [Inorganic emissions to air]	2.00E-03	kg
NMVOC (unspecified) [Group NMVOC to air]	1.31E-04	kg
Dust (PM10) [Particles to air]	1.81E-04	kg

\* **Bold face** clarifies that the value shown *does not* include upstream environmental flows. Upstream environmental flows were added during the modeling process using GaBi modeling software, as shown in Figure 2.

**Embedded Unit Processes**

None.

**References**

EPA, 1995. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42. US EPA Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. 1995. <http://www.epa.gov/ttnchie1/ap42> (Accessed May 18, 2010)

NETL (2010). *Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity Report*. National Energy Technology Laboratory. DOE/NETL-2010/1397. Pittsburgh, PA. March 2010.

Wabash Power Equipment Company,(2009). 40000 PPH Nebraska, Watertube, Trailer mounted, 350 psi, gas/oil. Surplusrecord.com, [cited February 2 2009] Available from: <http://www.surplusrecord.com/cgi-bin/adpop.pl?097693>.

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**Section III: Document Control Information**

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**Date Created:** October 20, 2010

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Original/no revisions

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**Section IV: Disclaimer**

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