NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Distribution combustion

Reference Flow: 1 kg of natural gas

Brief Description: Combustion of natural gas for energy generation during distribution (not including combustion for compressor drivers)

Section I: Meta Data

Geographical Coverage: United States **Region:** United States

Year Data Best Represents: 2016

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: All 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:

7_COMB_CO2_5M

[tonnes] CO2 emissions from distribution combustion in equipment with 5 MMBtu/hr capacity.

7_COMB_CO2_1M

[tonnes] CO2 emissions from distribution combustion in equipment with 1 MMBtu/hr capacity.

7_NG_deliv

[MCF] Annual natural gas delivered by distribution systems, volume

7_NG_deliv_kg

[kg] Annual natural gas delivered by distribution systems, mass

NG_combusted

[kg] Quantity of natural gas that is combusted for energy per unit of natural gas distributed. Formula uses an emission factor of 2.826 kg CO2 per combustion os 1 kg of NG.

NG_transpipeline

[kg] Total natural gas from transmission pipelines, which is the sum of natural gas that is flared and natural gas processed.

Tracked Input Flows:

Natural gas [Intermediate Flow]

[Intermediate flow] Natural gas input, delivered via tranmission pipeline. This includes NG eventually delivered to consumer and NG combusted for energy during distribution.

Tracked Output Flows:

Natural Gas [intermediate flow]

Reference flow

NG fuel [to combustion]

[kg] Quantity of natural gas that is combusted for energy per unit of natural gas distributed. Formula uses an emission factor of 2.826 kg CO2 per combustion os 1 kg of NG.

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Distribution_Combustion_2018.01.xlsx*, 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 for energy generation at during natural gas distribution. (It does not include combustion by compressor drivers, which is accounted for by another unit process.) The reference flow of this unit process is: 1 kg of natural gas

Boundary and Description

This unit process provides a summary of relevant input and output flows associated with the combustion of natural gas for energy generation at during natural gas distribution. (It does not include combustion by compressor drivers, which is accounted for by another unit process.) The reference flow of this unit process is: 1 kg of natural gas

Figure 1 shows input and output flows of the unit process. The reference flow is 1 kg of distributed natural gas

Figure 1: Unit Process Scope and Boundary

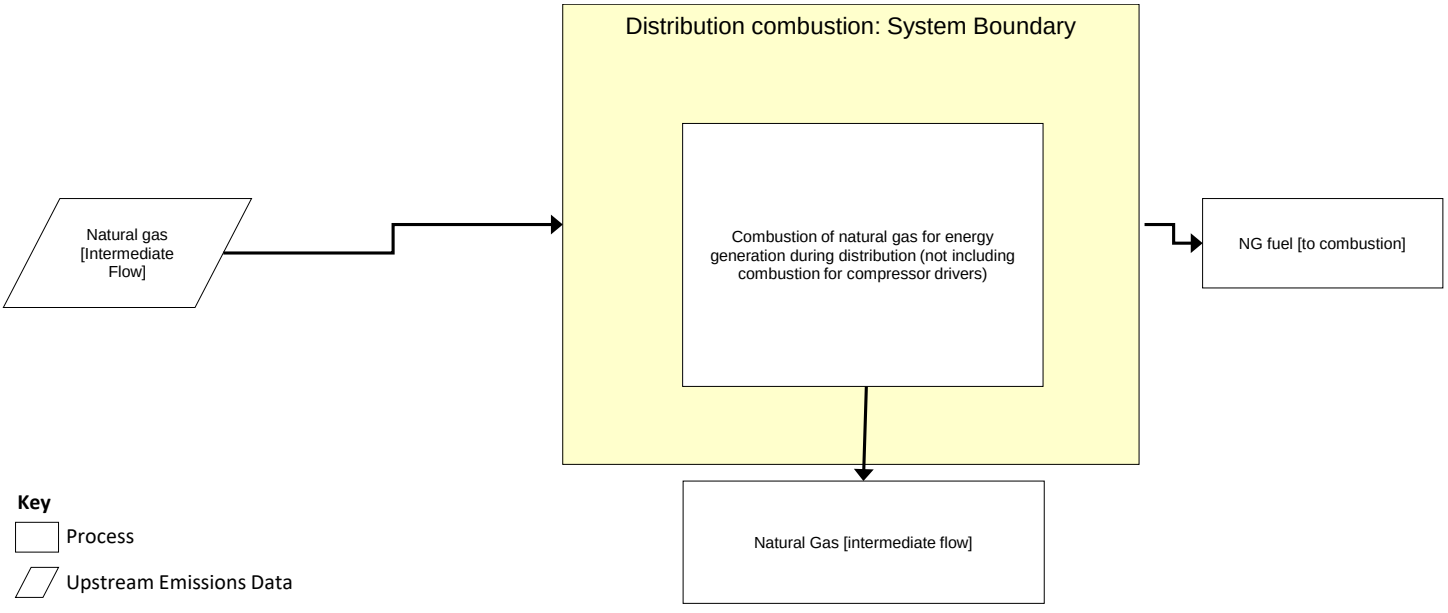

Table 1 shows the input parameters, which includes the emission rates from distribution combustion as well as total natural gas delivered annually. The natural gas volumes are based on EPA's Greenhouse Gas Reporting Program (GHGRP) (EPA, 2016a). NETL stratified the GHGRP data into regional variable to account for onshore production in 14 key production regions. Further these data were stratified by extraction technology using well identification codes in DI Desktop (Drilling Info, 2018). The low, expected, and high bounds represent the variability in the underlying data and were developed via throughput-weighted statistical bootstrapping. The bootstrapping technique allows computation of the confidence intervals around average activity factors. **Table 1** shows parameters for the Appalachian Shale production scenario; the DS file holds data for Appalachian Shale production as well as 26 other onshore production scenarios. The full scenario list is as follows:

- Quantity of NG combusted for energy at distribution facilities in Appalachia - Shale
- Quantity of NG combusted for energy at distribution facilities in Gulf - Conventional
- Quantity of NG combusted for energy at distribution facilities in Gulf - Shale
- Quantity of NG combusted for energy at distribution facilities in Gulf - Tight
- Quantity of NG combusted for energy at distribution facilities in Arkla - Conventional
- Quantity of NG combusted for energy at distribution facilities in Arkla - Shale
- Quantity of NG combusted for energy at distribution facilities in Arkla - Tight
- Quantity of NG combusted for energy at distribution facilities in East Texas - Conventional
- Quantity of NG combusted for energy at distribution facilities in East Texas - Shale
- Quantity of NG combusted for energy at distribution facilities in East Texas - Tight
- Quantity of NG combusted for energy at distribution facilities in Arkoma - Conventional
- Quantity of NG combusted for energy at distribution facilities in Arkoma - Shale
- Quantity of NG combusted for energy at distribution facilities in South Oklahoma - Shale
- Quantity of NG combusted for energy at distribution facilities in Anadarko - Conventional
- Quantity of NG combusted for energy at distribution facilities in Anadarko - Shale
- Quantity of NG combusted for energy at distribution facilities in Anadarko - Tight
- Quantity of NG combusted for energy at distribution facilities in Strawn - Shale
- Quantity of NG combusted for energy at distribution facilities in Fort Worth - Shale
- Quantity of NG combusted for energy at distribution facilities in Permian - Conventional
- Quantity of NG combusted for energy at distribution facilities in Permian - Shale
- Quantity of NG combusted for energy at distribution facilities in Green River - Conventional
- Quantity of NG combusted for energy at distribution facilities in Green River - Tight
- Quantity of NG combusted for energy at distribution facilities in Uinta - Conventional
- Quantity of NG combusted for energy at distribution facilities in Uinta - Tight
- Quantity of NG combusted for energy at distribution facilities in San Juan - CBM
- Quantity of NG combusted for energy at distribution facilities in San Juan - Conventional
- Quantity of NG combusted for energy at distribution facilities in Piceance – Tight

Table 2 shows the output values for natural gas resource and venting flows for Appalachian production scenario. The DS File can compute the output for all 27 onshore production scenarios. Inputs comprise natural gas combustion emissions and diesel combustion emissions. The input for natural gas combustion should be linked to a unit process that accounts for emissions only, not the quantity of natural gas actually combusted; the quantity of natural gas combusted is accounted for

within the boundaries of this unit process. The input for diesel combustion should be linked to a unit process that accounts for both the quantity of diesel combusted and the emissions from diesel combustion. The natural gas resource input accounts for total natural gas consumed by the unit process plus the reference flow of the unit process (1 kg of natural gas distributed). The only output of this unit process is the reference flow.

Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
Combustion activity					
7_COMB_CO2_5M	2.701E+03	1.691E+03	3.733E+03	tonnes	CO2 emissions from distribution combustion in equipment with 5 MMBtu/hr capacity
7_COMB_CO2_1M	3.159E+00	1.454E+00	5.259E+00	tonnes	CO2 emissions from distribution combustion in equipment with 1 MMBtu/hr capacity
7_NG_deliv	2.472E+08	2.122E+08	2.800E+08	MCF	Annual natural gas delivered by distribution systems, volume

Table 2: Unit Process Input and Output Flows

Flow Name	Expected	Low	High	Units (Per Reference Flow)
Inputs				
Natural gas [Resource]	1.00020E+00	1.00015E+00	1.00025E+00	kg NG
Outputs				
Natural Gas [intermediate flow]	1.00	1.00	1.00	kg NG
NG fuel [to combustion]	2.032E-04	0.000148185	0.000247968	Kg NG

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Note: Inventory items not included are assumed to be zero based on best engineering judgment or assumed to be zero because no data was available to categorize them for this unit process at the time of its creation.

Embedded Unit Processes

None.

References

EPA. 2016a. Greenhouse Gas Reporting Program. Environmental Protection Agency. https://www.epa.gov/enviro/greenhouse-gas-customized-search. Accessed August 22, 2018.

DrillingInfo. 2018. DI Data & Insights.

USGS. n.d. Energy Resources Program Geochemistry Laboratory Database (EGDB). https://energy.usgs.gov/GeochemistryGeophysics/GeochemistryLaboratories/GeochemistryLaboratories-GeochemistryDatabase.aspx#4413382-introduction Accessed July 18, 2018

EPA. 1996. Report on Revisions to 5th Edition AP-42, Section 3.3: Gasoline and Diesel Industrial Engines. Accessed on October 22, 2018 at https://www3.epa.gov/ttnchie1/ap42/ch03/bgdocs/b03s03.pdf.

Section III: Document Control Information

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