NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Processing fugitives

Reference Flow: 1 kg of natural gas

Brief Description: Fugitive emissions of natural gas from natural gas processing facilities

Section I: Meta Data

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

Year Data Best Represents: 2016

Process Type: Extraction Process (EP)

Process Scope: Cradle-to-Gate Process (CG)

Allocation Applied: Yes

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:

3_EL_CH4

[tonnes] Methane emissions from equipment leaks

3_NG_processed

[MCF] Natural gas throughput in terms of processed natural gas

3_NGL_processed

[bbl] Natural gas liquids separated from natural gas streams at processing facilities

nat_mCH4

[dimensionless] Mass fraction of methane in natural gas

NG_equiv

[kg] Mass of natural gas equivalents, calculated by normalizing the energy contents of natural gas and natural gas liquids.

Fugitive_3_EL

[kg NG/kg NG] Fugitive emissions of NG from equipment leaks per unit of natural gas gathered

NG_gathered

[kg] Natural gas product input plus natural gas that is vented

Parameter

Units per RF

NG_gathered

kg

Tracked Input Flows:

Natural gas, from gathering [intermediate flow]

[Intermediate flow] Gathered natural gas input; equal to processed natural gas exiting processing facilities and what is vented at processing facilities.

Tracked Output Flows:

Natural Gas [intermediate flow]

Reference flow

Fugitive_3_EL [to venting and flaring]

[kg NG/kg NG] Fugitive emissions of NG from equipment leaks per unit of natural gas gathered

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Processing_Fugitives_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 fugitive emissions from natural gas processing facilities. It accounts for equipment leaks. The outputs of this unit process are the reference flow of processed natural gas and 1 intermediate flow of a vented stream to be connected to NETL's venting and flaring unit process for speciation of whole natural gas into its hydrocarbon and other components. 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 fugitive emissions from natural gas processing facilities. It accounts for equipment leaks. The outputs of this unit process are the reference flow of processed natural gas and 1 intermediate flow of a vented stream to be connected to NETL's venting and flaring unit process for speciation of whole natural gas into its hydrocarbon and other components. The reference flow of this unit process is: 1 kg of natural gas

Fugitive emissions are unintentional releases to the atmosphere. They are leaks that occur during routine natural gas operations.

Figure 1 shows input and output flows of the unit process. The reference flow is 1 kg of transmitted natural gas. Output includes an instances of natural gas sent to another unit process where it is speciated into specific hydrocarbons and other gas components and then released as air emissions.

Figure 1: Unit Process Scope and Boundary

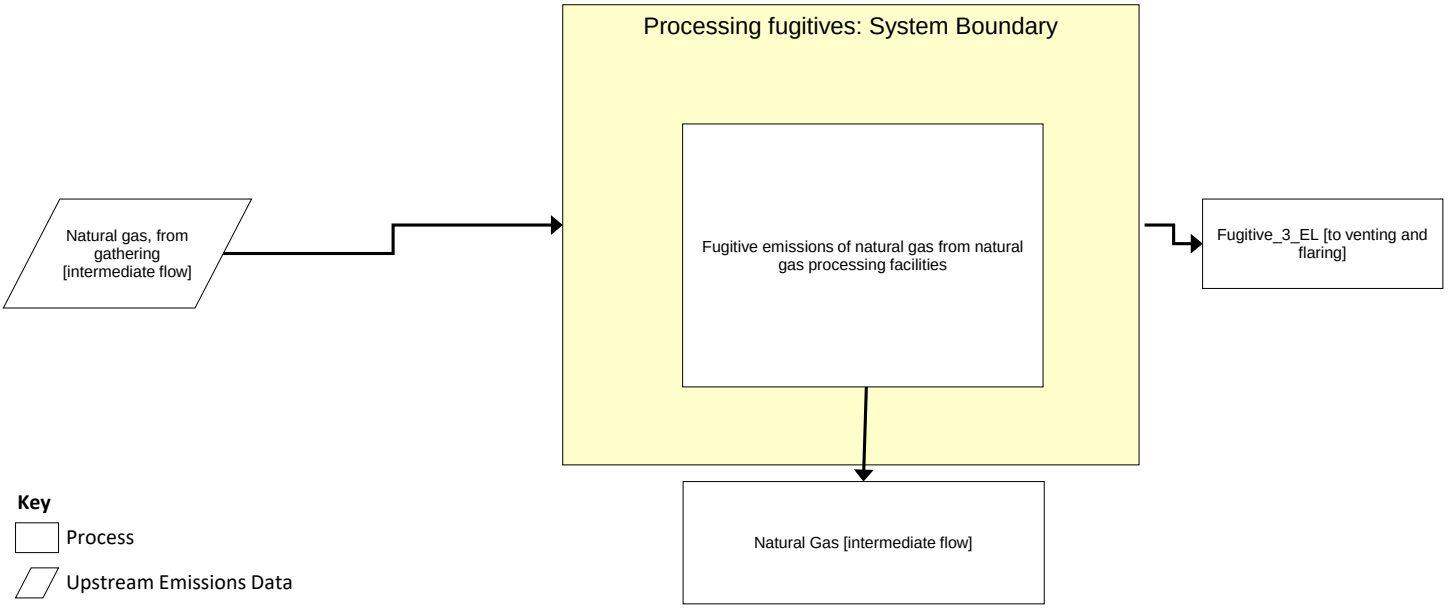

Table 1 shows the input parameters, which include emission factors for each fugitive emission source. The emission factors are based on EPA's Greenhouse Gas Reporting Program (GHGRP) (EPA, 2016a) and EPA's Greenhouse Gas Inventory (GHGI) (EPA, 2018). The low, expected, and high bounds represent the variability 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. The DS file has a parameter scenario (PS) worksheet with 27 scenarios that match the scenarios for the onshore production unit processes, but at this stage in the supply chain, the average U.S. is the only supply chain scenario that is modeled. After natural gas is gathered, the remaining supply chain stages model it as a commodity for which the energy requirements and emissions are the same for all sources of natural gas.

Table 2 shows the output values for natural gas resource and venting flows for Appalachian production scenario. The natural gas resource flow accounts for the total amount of input natural gas resource that goes to product (the reference flow of 1 kg) and total fugitive emissions; this allows the model to account for the total amount of natural gas resource extraction associated with this process. The fugitive output shows the quantity of natural gas to be sent to separate instance of NETL's "venting and flaring" unit process wherein the vented flows are speciated into hydrocarbons and other gas components and emitted to the atmosphere.

Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
3_EL_CH4	8.73E+01	7.16E+01	1.06E+02	tonnes	Methane emissions from equipment leaks
3_NG_processed	3.36E+07	2.84E+07	3.88E+07	MCF	Natural gas throughput in terms of processed natural gas
4_NGL_processed	0.00E+00	0.00E+00	0.00E+00	bbl	Natural gas liquids separated from natural gas streams at processing facilities
nat_mCH4	7.34E-01	7.31E-01	7.38E-01	dimensionless	Mass fraction of CH4 in natural gas.

Table 2: Unit Process Input and Output Flows

Flow Name	Expected	Low	High	Units (Per Reference Flow)
Inputs				
Natural gas, from gathering [intermediate flow]	1.00019E+00	1.00018E+00	1.00019E+00	kg NG
Outputs				
Natural Gas [intermediate flow]	1.00	1.00	1.00	kg NG
Fugitive_3_EL [to venting and flaring]	1.86E-04	1.81E-04	1.95E-04	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.

EPA. 2018. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2016. EPA 430-R-18-003. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2016. https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf Accessed August 20, 2018.

Section III: Document Control Information

Date Created: January 14, 2019

Point of Contact: Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV

Revision History:

Original/no revisions

How to Cite This Document: This document should be cited as:

NETL (2018). NETL Life Cycle Inventory Data – Unit Process: Processing fugitives. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: October 2018 (version 01). www.netl.doe.gov/LCA (http://www.netl.doe.gov/LCA)

Section IV: Disclaimer

Neither the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) nor any person acting on behalf of these organizations:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights; or

B. Assumes any liability with this report as to its use, or damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by NETL. The views and opinions of the authors expressed herein do not necessarily state or reflect those of NETL.