NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Distribution Venting
Reference Flow: 1 kg of natural gas
Brief Description: Venting of natural gas from natural gas distribution

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_mCH4

[dimensionless] Mass fraction of CH4 in natural

7_PRV_AF

[miles/kg NG] activity factor for PRV releases

7_PRV_EF

[kg CH4/mile] emission factor for PRV releases

7_PIPEBD_AF

[miles/kg NG] activity factor for piepline blowdown releases

7_PIPEBD_EF

[kg CH4/mile] emission factor for pipeline blowdown releases

7_DIG_AF

[miles/kg NG] activity factor for mishaps - dig ins releases

7_DIG_EF

[kg CH4/mile] emission factor for mishaps - dig ins releases

Vent_PRV

[kg NG/kg NG] Venting of NG from other sources per unit of natural gas through distribution

Vent_PIPEBD

[kg NG/kg NG] Venting of NG from emergency shutdowns per unit of natural gas through distribution

Vent_DIG

[kg NG/kg NG] Venting of NG from replacement or repair per unit of natural gas through distribution

NG_pipeline

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

Tracked Input Flows:

Natural gas [from pipeline transmission operations]

[intermediate flow] Natural gas from pipeline transmission operations input, including what is distributed and what is vented at distribution

Tracked Output Flows:

Natural Gas [intermediate flow]

Reference flow

Vent_PDhb [to venting and flaring]

[kg NG/kg NG] Venting of NG from other sources per unit of natural gas through distribution

Vent_PDib [to venting and flaring]

[kg NG/kg NG] Venting of NG from emergency shutdowns per unit of natural gas through distribution

Vent_PDlb [to venting and flaring]

[kg NG/kg NG] Venting of NG from replacement or repair per unit of natural gas through distribution

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Distribution_Venting_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 venting from natural gas distribution operations. It accounts for vented emission sources from 3 specific emitters that are comprised of pressure relief valve releases, pipeline blowdowns, and mishaps/dig ins. The outputs of this unit process are the reference flow of natural gas, and 3 intermediate flows of vented streams that are to be connected to the 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

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Vented emissions are intentional releases to the atmosphere and can be a part of well development activities, routine activities, or maintenance events.

Figure 1 shows input and output flows of the unit process. The reference flow is 1 kg of distributed natural gas. Outputs include 3 instances of natural gas sent to another unit process where they are speciated into specific hydrocarbons and other gas components and then released as air emissions. For simplicity, **Figure 1** shows only one output to the downstream venting unit process; when

implemented in a life cycle model, there are 3 instances of these intermediate flows that are connected to unique instantiations of venting unit processes.

Figure 1: Unit Process Scope and Boundary

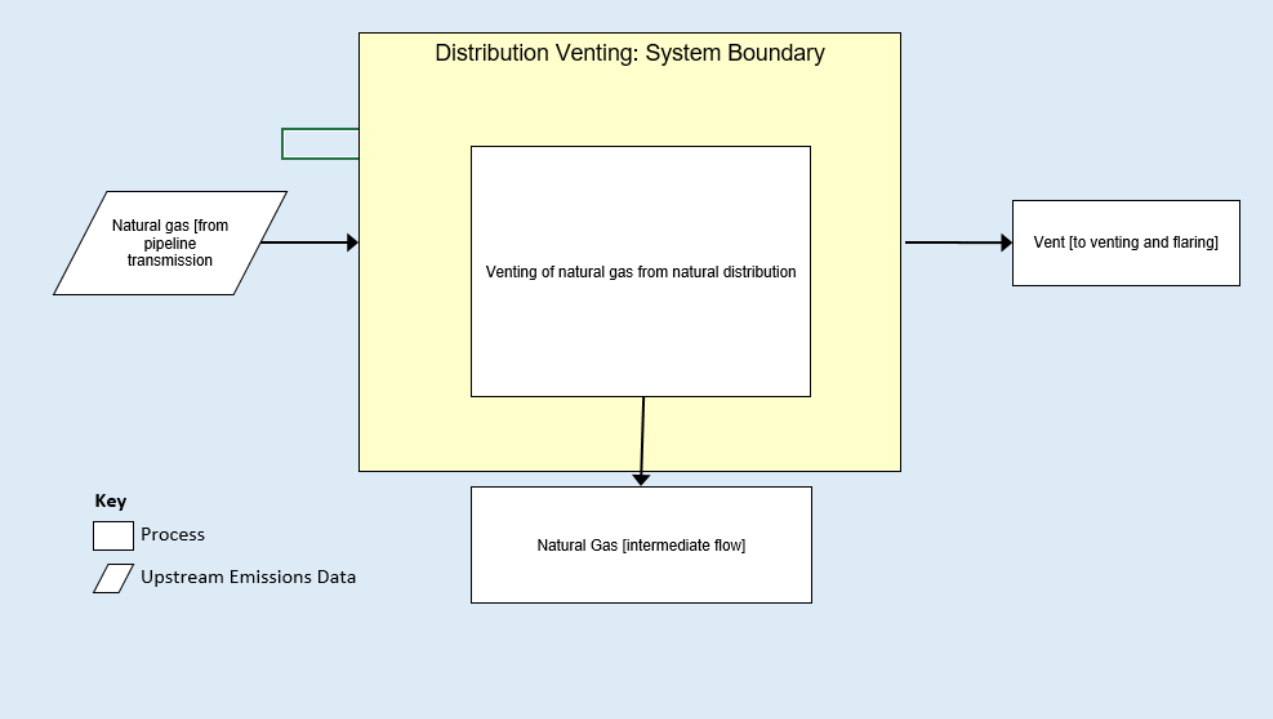

Table 1 shows the input parameters, which include emission factors and activity factors for each venting emission source. The emission and activity factors are based on EPA's Greenhouse Gas Reporting Program (GHGRP) (EPA, 2016a) and EPA's Greenhouse Gas Inventory (GHGI) (EPA, 2018). The low, expected, 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 venting; this allows the model to account for the total amount of natural gas resource extraction associated with this process. The 3 vented outputs show the quantity of natural gas to be sent to separate instances of NETL's "venting and flaring" unit processes 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
7_mCH4	7.34E-01	7.31E-01	7.38E-01	dimensionless	Mass fraction of CH4 in natural
7_PRV_AF	4.86E-06	4.86E-06	4.86E-06	miles/kg NG	activity factor for PRV releases
7_PRV_EF	9.63E-01	9.63E-01	9.63E-01	kg CH4/mile	emission factor for PRV releases
7_PIPEBD_AF	8.30E-06	8.30E-06	8.30E-06	miles/kg NG	activity factor for piepline blowdown releases
7_PIPEBD_EF	1.96E+00	1.96E+00	1.96E+00	kg CH4/mile	emission factor for pipeline blowdown releases
7_DIG_AF	8.30E-06	8.30E-06	8.30E-06	miles/kg NG	activity factor for mishaps - dig ins releases
7_DIG_EF	3.06E+01	3.06E+01	3.06E+01	kg CH4/mile	emission factor for mishaps - dig ins releases

Table 2: Unit Process Input and Output Flows

Flow Name	Expected Value	Low	High	Units (Per Reference Flow)
Inputs				
Natural gas [from pipeline transmission operations]	1.0004	1.0004	1.0004	kg NG
Outputs				
Natural Gas [intermediate flow]	1.00	1.00	1.00	kg NG
Vent_PDhb [to venting and flaring]	6.38E-06	6.41E-06	6.35E-06	kg NG
Vent_PDib [to venting and flaring]	2.22E-05	2.23E-05	2.21E-05	kg NG
Vent_PDlb [to venting and flaring]	3.46E-04	3.48E-04	3.45E-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. 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

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