NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Processing venting

Reference Flow: 1 kg of natural gas

Brief Description: Venting of natural gas from onshore natural gas processing facilities

Section I: Meta Data

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

3_PD_AF

[count] Count of high-bleed pneumatic devices

3_PD_EF

[hrs] Activity factor: operating hours for high bleed pneumatic devices

3_DEHYdes_CH4

[tonnes] CH_4 emitted from desiccant dehydrators

3_DEHYlg_CH4

[tonnes] CH_4 emitted from large glycol dehydrators

3_BDother_CH4

[tonnes] CH_4 emitted from "other" sources of venting

3_BDcomp_CH4

[tonnes] CH_4 emitted from compressor venting

3_BDesd_CH4

[tonnes] CH_4 emitted from emergency shutdown venting

3_BDfacpip_CH4

[tonnes] CH_4 emitted from facility piping venting

3_BDpig_CH4

[tonnes] CH_4 emitted from pigging venting

3_BDscrub_CH4

[tonnes] CH_4 emitted from scrubber venting

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

Tracked Input Flows:

Natural gas, from gathering [intermediate flow]

[Intermediate flow] Gathering and boosting natural gas input, including what ends up as marketed product and what is vented at processing

Tracked Output Flows:

Natural Gas [intermediate flow]

Reference flow

Vent_3_PD [to venting and flaring]

[kg NG/kg NG] Venting of NG from high bleed pneumatic devices per unit of natural gas processed

Vent_3_DEHYdes [to venting and flaring]

[kg NG/kg NG] Venting of NG from desiccant dehydrators per unit of natural gas processed

Vent_3_DEHYlg [to venting and flaring]

[kg NG/kg NG] Venting of NG from large glycol dehydrators per unit of natural gas processed

Vent_3_BDother [to venting and flaring]

[kg NG/kg NG] Venting of NG from "other" sources of venting per unit of natural gas processed

Vent_3_BDcomp [to venting and flaring]

[kg NG/kg NG] Venting of NG from small glycol dehydrators per unit of natural gas gathered [kg NG/kg NG] Venting of NG from compressor venting per unit of natural gas processed

Vent_3_BDesd [to venting and flaring]

[kg NG/kg NG] Venting of NG from emergency shutdown venting per unit of natural gas processed

Vent_3_BDfacpip [to venting and flaring]

[kg NG/kg NG] Venting of NG from facility piping venting per unit of natural gas processed

Vent_3_BDpig [to venting and flaring]

[kg NG/kg NG] Venting of NG from pigging venting per unit of natural gas processed

Vent_3_Bdscrub [to venting and flaring]

[kg NG/kg NG] Venting of NG from scrubber venting per unit of natural gas processed

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Processing_Venting.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 processing facilities. It accounts for vented emission sources from 9 specific emitters: pneumatic devices, 2 types of dehydrators, 6 types of blowdown events. The outputs of this unit process are the reference flow of natural gas, and 9 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. All inputs and outputs are normalized per the reference flow (e.g., per 1 kg of natural gas processed).

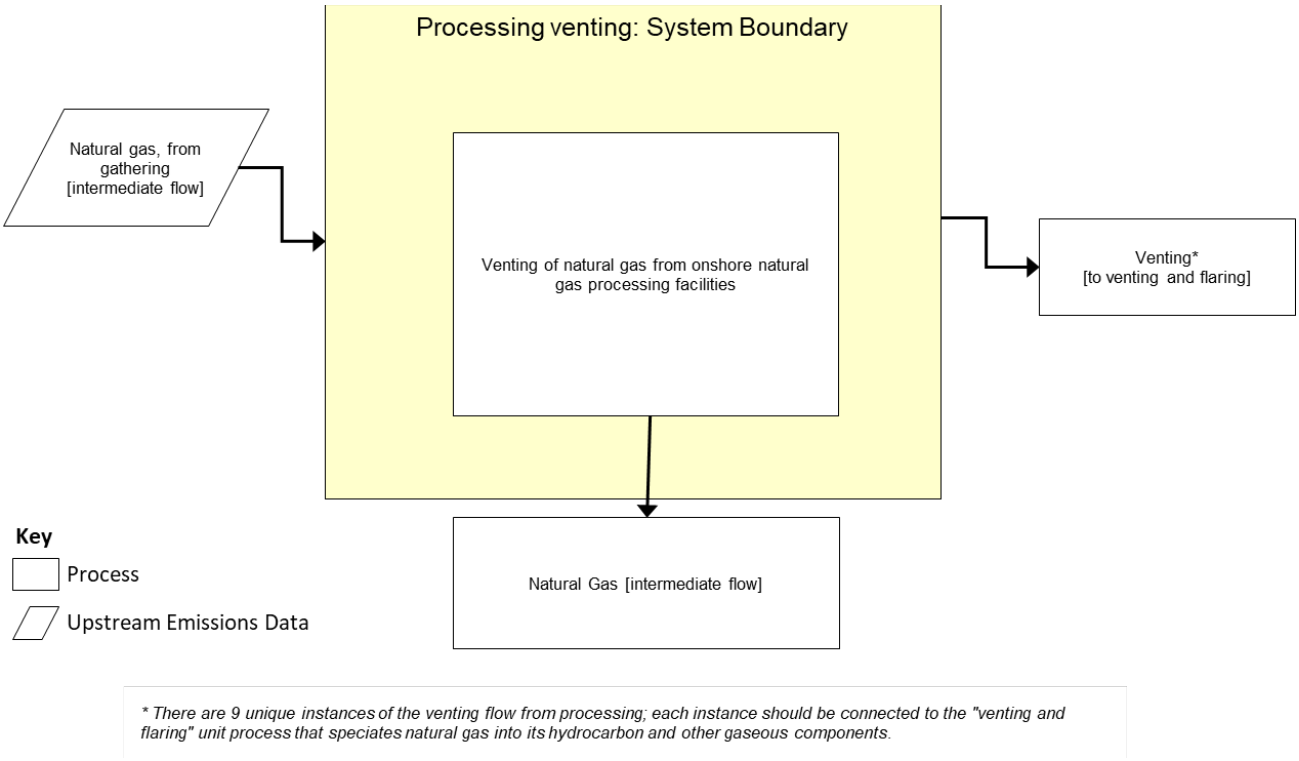
Boundary and Description

This unit process provides a summary of relevant input and output flows associated with venting from natural gas processing facilities. It accounts for vented emission sources from 9 specific emitters: pneumatic devices, 2 types of dehydrators, 6 types of blowdown events. The outputs of this unit process are the reference flow of natural gas, and 9 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. All inputs and outputs are normalized per the reference flow (e.g., per 1 kg of natural gas processed).

Vented emissions are intentional releases to the atmosphere and can be a part of routine activities (e.g., pneumatic devices and dehydrator vents), or maintenance events (e.g., equipment blowdowns and pigging activity).

Figure 1 shows input and output flows of the unit process. The reference flow is 1 kg of processed natural gas. Outputs include 9 instances of natural gas venting streams, which from a modeling perspective, are sent to another unit process for speciation into 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 9 instances of these intermediate flows that are connected to unique instantiations of venting unit processes.

Figure 1: Unit Process Scope and Boundary



** There are 9 unique instances of the venting flow from processing; each instance should be connected to the "venting and flaring" unit process that speciates natural gas into its hydrocarbon and other gaseous components.*

Table 1 shows the input parameters, which include emission factors and activity factors for each venting emission source, as well as natural gas throughput on the basis of natural gas processed (the reference flow) and the input of natural gas from gathering and boosting. 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.

Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
Venting					
3_PD_AF	1.00E+00	1.00E+00	1.00E+00	facilities	Count of processing facilities
3_PD_EF	3.17E+03	3.17E+03	3.17E+03	kg CH_4/facility	Activity factor: operating hours for high bleed pneumatic devices
3_DEHYdes_CH4	7.58E-02	1.33E-02	2.16E-01	tonnes	CH_4 emitted from desiccant dehydrators
3_DEHYlg_CH4	5.38E+00	1.50E+00	1.22E+01	tonnes	CH_4 emitted from large glycol dehydrators
3_BDother_CH4	7.83E+00	1.92E+00	1.63E+01	tonnes	CH_4 emitted from "other" sources of venting
3_BDcomp_CH4	2.26E+01	1.52E+01	3.17E+01	tonnes	CH_4 emitted from compressor venting
3_BDesd_CH4	2.48E+00	7.19E-01	5.94E+00	tonnes	CH_4 emitted from emergency shutdown venting
3_BDfacpip_CH4	2.23E+01	1.46E+00	5.38E+01	tonnes	CH_4 emitted from facility piping venting
3_BDpig_CH4	1.03E+00	4.62E-01	1.74E+00	tonnes	CH_4 emitted from pigging venting
3_BDscrub_CH4	3.58E-01	3.85E-02	1.04E+00	tonnes	CH_4 emitted from scrubber venting
Natural gas throughput and composition					
3_NG_processed	3.36E+07	2.84E+07	3.88E+07	Mcf	Natural gas throughput in terms of processed natural gas

3_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 methane in natural gas

Table 2 shows the values for intermediate inputs of natural gas (from gathering and boosting) and outputs of vented natural gas. The input flow of natural gas (from gathering and boosting) accounts for the total amount of input natural gas input that ends up as the reference flow of (1 kg of processed natural gas) and total venting; this allows the model to account for the total amount of natural gas input from the gathering and boosting stage. The 9 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 2: Unit Process Input and Output Flows

Flow Name	Expected Value	Minimum	Maximum	Units (Per Reference Flow)
Inputs				
Natural gas [intermediate flow]	1.00014E+00	1.00006E+00	1.00023E+00	kg NG
Outputs				
Natural Gas [intermediate flow]	1	1	1	kg NG
Vent_3_PD [to venting and flaring]	6.75E-06	8.03E-06	5.82E-06	kg NG
Vent_3_DEHYdes [to venting and flaring]	1.61E-07	3.36E-08	3.96E-07	kg NG
Vent_3_DEHYlg [to venting and flaring]	1.14E-05	3.79E-06	2.25E-05	kg NG
Vent_3_Bdother [to venting and flaring]	1.67E-05	4.86E-06	2.98E-05	kg NG
Vent_3_Bdcomp [to venting and flaring]	4.82E-05	3.84E-05	5.81E-05	kg NG
Vent_3_Bdesd [to venting and flaring]	5.28E-06	1.82E-06	1.09E-05	kg NG
Vent_3_Bdfacpip [to venting and flaring]	4.75E-05	3.70E-06	9.87E-05	kg NG
Vent_3_BDpig [to venting and flaring]	2.19E-06	1.17E-06	3.19E-06	kg NG
Vent_2_Bdscrub [to venting and flaring]	7.61E-07	9.74E-08	1.91E-06	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.

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Section III: Document Control Information

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