NETL Life Cycle Inventory Data
Process Documentation File

Process Name:	Storage centrifugal compression
Reference Flow:	1 kg of natural gas
Brief Description:	Storage compression, including fuel used by centrifugal compressor drivers and venting from centrifugal compressors.

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:

5_CENT_CH4_vent

[tonnes] Methane emissions from storage centrifugal compressors.

5_storcap

[MCF] Storage facility capacity

nat_mCH4

[dimensionless] Mass fraction of CH4 in natural gas

5_CENT_energy

[HPh] Operating centrifugal compressor horsepower at a storage facility

Turbine_thermalefficiency

[dimensionless] Thermal efficiency of gas-fired turbines

5_storcap_kg

[kg] Annual natural gas mass through a storage facility

Vent_NG

[kg] Natural gas vented from centrifugal compressors.

Compressor output_energy

[Btu] Output energy from gas-fired turbine. Conversion factor: 2544 Btu/HPh.

Compressor_input_energy

[Btu] Input energy requirement for a gas turbine. Calculated by dividing output energy by turbine efficiency.

Compressor input_fuel

[kg] Mass of natural gas fuel used by storage facility for centrifugal compression per unit of natural gas storage capacity. Conversion factors: 1031 Btu/scf, 0.042 lb/scf, and 2.205 lb/kg.

Tracked Input Flows:

Natural gas, combusted

[Intermediate flow] Unit process for natural gas combustion emissions. A

Tracked Output Flows:

Natural Gas [intermediate flow]

Reference flow

Vent_NG [to venting and flaring]

[kg] Natural gas vented from centrifugal compressors.

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Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Storage_Compressor_Centrif_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 emissions from storage centrifugal compression, including fuels used by centrifugal compressor drivers and venting from centrifugal compressors. Natural gas (from the product stream) is consumed as a fuel; there are no other purchased fuels or energy (e.g., diesel or electricity). Outputs include the reference flow (1 kg of storage capacity) and the quantity of gas vented from the compressor; gas vented from the compressor is sent to another NETL unit process for component speciation. 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 emissions from storage centrifugal compression, including fuels used by centrifugal compressor drivers and venting from centrifugal compressors. Natural gas (from the product stream) is consumed as a fuel; there are no other purchased fuels or energy (e.g., diesel or electricity). Outputs include the reference flow (1 kg of storage capacity) and the quantity of gas vented from the compressor; gas vented from the compressor is sent to another NETL unit process for component speciation. The reference flow of this unit process is: 1 kg of natural gas

Figure 1: Unit Process Scope and Boundary
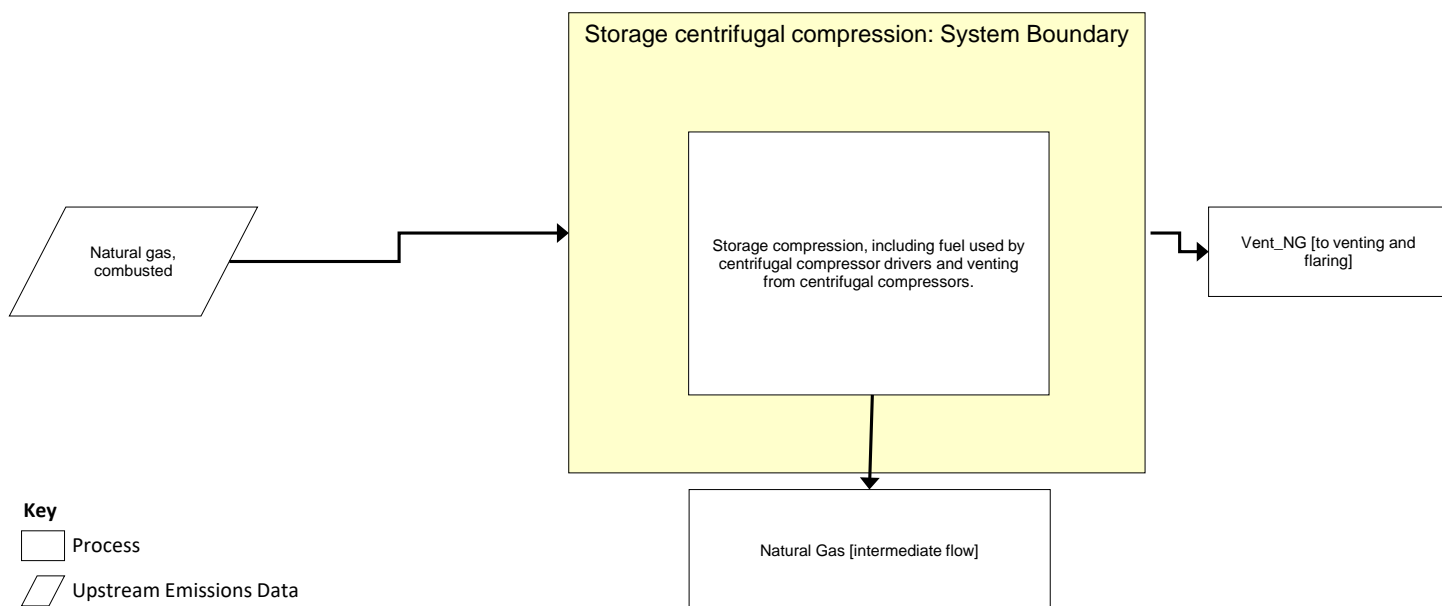
Table 1 shows the input parameters, which include methane emissions and storage facility capacity. The vented emission data are based on EPA's Greenhouse Gas Reporting Program (GHGRP) (EPA, 2016a). The low, expected, and high bounds represent the variability in the underlying data and were developed 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 inputs and output for natural gas throughput and venting for Appalachian production scenario. The produced natural gas input accounts for total natural gas vented by the unit process plus the reference flow of the unit process (1 kg of natural gas gathered and boosted). Vented natural gas (which is emitted through centrifugal compressor seals and does not include the gas that is vented through combustion exhaust from the compressor driver) is an output that should be linked to NETL's "venting and flaring" unit process, which speciates the vented gas into hydrocarbons and other components. The reference flow of this unit process is 1 kg of stored natural gas.

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Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
5_CENT_CH4_vent	1.31E+01	7.52E-01	3.18E+01	tonnes	Methane emissions from storage centrifugal compressors.
5_storcap	1.07E+08	9.32E+07	1.20E+08	MCF	Storage facility capacity
nat_mCH4	7.34E-01	7.31E-01	7.38E-01	dimensionless	Mass fraction of CH4 in natural gas
5_CENT_energy	6.93E+03	3.21E+03	1.18E+04	HPh	Operating centrifugal compressor horsepower at a storage facility
Turbine_thermalefficiency	2.60E-01	2.60E-01	2.60E-01	dimensionless	Thermal efficiency of gas-fired turbines

Table 2: Unit Process Input and Output Flows

Flow Name	Expected	Low	High	Units (Per Reference Flow)
Inputs				
Natural gas, combusted	6.14E-07	6.22E-06	1.78E-05	kg NG
Outputs				
Natural Gas [intermediate flow]	1.00	1.00	1.00	kg NG
Vent_NG [to venting and flaring]	8.74E-06	5.80E-07	1.90E-05	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. Environmental Protection Agency. EPA 430-R-18-003. https://www.epa.gov/sites/production/files/2018-01/documents/2018_complete_report.pdf Accessed August 20, 2018

DrillingInfo. 2018. DI Data & Insights.

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Section III: Document Control Information

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