NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Processing acid gas removal (AGR)

Reference Flow: 1 kg of natural gas

Brief Description: Acid gas removal (AGR) at natural gas processing plants.

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: 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_AGR_CO2

[tonnes CO2] Annual CO2 emissions from acid gas removal units at a natural gas processing facility

3_NG_processed

[MCF] Annual natural gas processed at a processing facility

3_NGL_processed

[bbl] Annual natural gas liquids processed at a processing facility

3_AGR_CH4ef

[kg CH4/kg NG] Methane emission factor from acid gas removal at processing

nat_mCO2

[dimensionless] Mass fraction of CO2 in natural gas

nat_mCH4

[dimensionless] Mass fraction of CH4 in natural gas

3_NG_equiv_mcf

[MCF] Annual natural gas and natural gas liquids processed at a processing facility, converted to equivalent energy of natural gas and then converted to units of volume.

3_NG_density

[kg/MCF] Density of natural gas, using reported methane and CO2 compositions and assuming that the balance of the product gas is ethane.

3_NG_equiv_kg

[kg] Mass of natural gas equivalents processed per year.

Emission_CO2

[kg] Mass of CO2 emissions from AGR at a natural gas processing facility per mass of natural gas processed.

NG_gathered

[kg] Mass of natural gas gathered per mass of natural gas processed. Equals mass of natural gas that exit the processing facility and natural gas vented via acid gas removal.

Tracked Input Flows:

Natural gas [from gathering and boosting]

[intermediate flow] Natural gas from gathering and boosting.

Tracked Output Flows:

Natural Gas [intermediate flow]

Reference flow

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_NG_Processing_AGR_2018.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

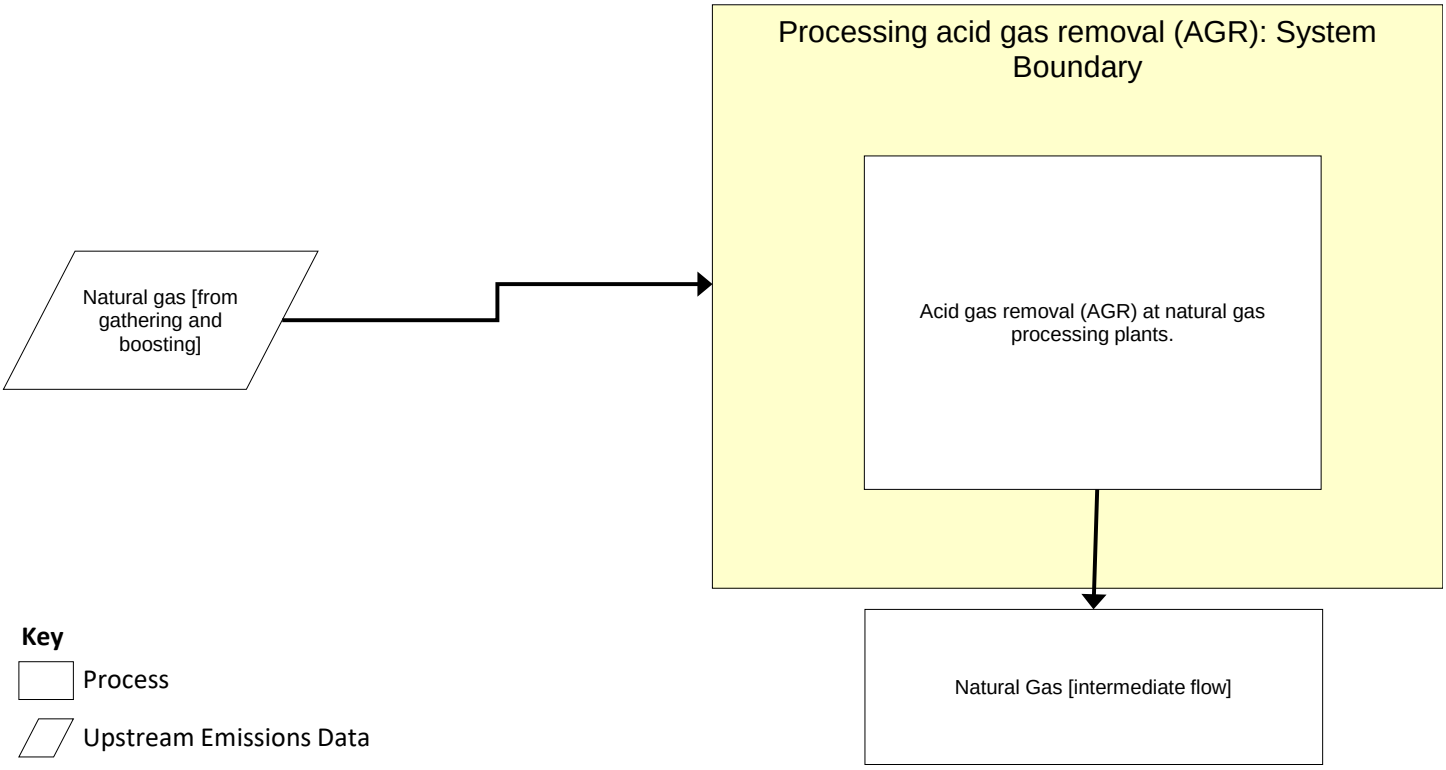
Goal and Scope

This unit process provides a summary of relevant input and output flows associated emissions from acid gas removal at natural gas processing facilities. Outputs include the reference flow (1 kg of gathered natural gas) and the quantity of methane and CO2 emitted. 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 acid gas removal at natural gas processing facilities. Outputs include the reference flow (1 kg of gathered natural gas) and the quantity of methane and CO2 emitted. The reference flow of this unit process is: 1 kg of natural gas

Figure 1: Unit Process Scope and Boundary



Acid gas removal uses solvents to extract CO_2 and hydrogen sulfide from product gas streams. The air emissions accounted for in this unit process represent the emissions that are vented during the regeneration of solvent.

Table 1 shows the input parameters, which include emission factors for each emission source, as well as annual volume of natural gas processed at the facility. CO_2 emissions are based on EPA's Greenhouse Gas Reporting Program (GHGRP) (EPA, 2016a); CH_4 emissions are based on 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 inputs and output for natural gas resource and emission flows. The natural gas resource input does not link to an upstream unit process, but accounts for total natural gas consumed by the unit process plus the reference flow of the unit process (1 kg of natural gas produced). Emissions comprise CO_2 and CH_4 emissions to air; like the natural gas resource input, these emissions are elementary flows that are not connected to other unit processes (the scenario

shown in **Table 2** has zero CO_2 emissions, but other instances of the 27 scenarios have non-zero value for this emission). The reference flow of this unit process is 1 kg of processed natural gas.

Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
Combustion activity for compression					
3_AGR_CO2	2.85E+04	2.02E+04	3.92E+04	metric tonnes	Annual CO_2 emissions from acid gas removal units at a natural gas processing facility.
3_AGR_CH4ef	3.73E-05	3.73E-05	3.73E-05	kg CH4/kg NG	Methane emission factor from acid gas removal at processing
Natural gas processing rates					
3_NG_processed	3.36E+07	2.84E+07	3.88E+07	MCF	Annual natural gas processed at a processing facility
3_NGL_processed	0.00E+00	0.00E+00	0.00E+00	bbl	Annual natural gas liquids processed at a processing facility

Table 2: Unit Process Input and Output Flows

Flow Name	Expected	Low	High	Units (Per Reference Flow)
Inputs				
Natural gas [Resource]	1.042886E+00	1.035823E+00	1.051067E+00	kg NG
Outputs				
Natural Gas [intermediate flow]	1.00	1.00	1.00	**kg NG**
Carbon dioxide [Inorganic emissions to air]	4.284909E-02	3.578607E-02	5.102989E-02	kg CO_2
Methane [Organic emissions to air (group VOC)]	3.73E-05	3.73E-05	3.73E-05	kg CH_4

* **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

Section III: Document Control Information

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