NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Gathering and boosting acid gas removal (AGR)

Reference Flow: 1 kg of natural gas

Brief Description: Acid gas removal (AGR) at natural gas gathering and boosting facilities.

Section I: Meta Data

Geographical Coverage: United States **Region:** 14 U.S. production regions

Year Data Best Represents: 2016

Process Type: Extraction Process (EP)

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:

2_AGR_CO2

[tonnes CO2/yr] Annual CO_2 emissions from acid gas removal units at natural gas gathering and boosting facilities

2_AGR_CH4ef

[kg CH4/kg NG] Methane emission factor from acid gas removal at gathering and boosting facilites

2_NG_sent

[Mcf] Annual gathering and boosting volume

Tracked Input Flows:

Natural Gas [Intermediate flow]

Natural gas product input, including what ends up as marketed product and what is emitted from AGR at gathering and boosting facilities

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_GandB_AGR_2018.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

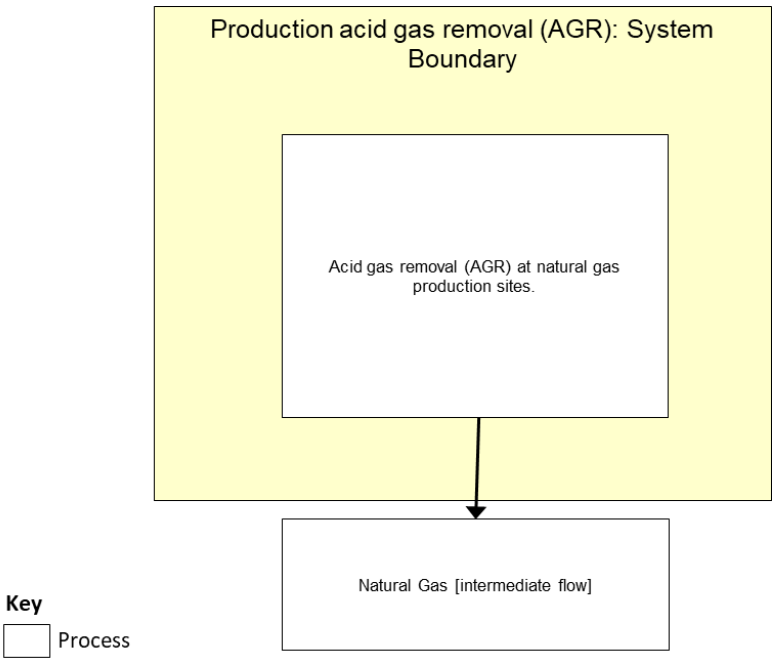
Goal and Scope

This unit process provides a summary of relevant input and output flows associated emissions from acid gas removal at natural gas gathering and boosting facilities. Emissions comprise methane (CH_4) and carbon dioxide (CO_2) vented by acid gas removal (AGR) units. The reference flow of this unit process is 1 kg of gathered and boosted 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 gathering and boosting facilities. Emissions comprise methane (CH_4) and carbon dioxide (CO_2) vented by acid gas removal (AGR) units. The reference flow of this unit process is 1 kg of gathered and boosted 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 natural gas production volume. 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). NETL stratified the GHGRP data to account for onshore production in 14 key production regions. Further, these data were stratified by extraction technology using well identification codes in DI Desktop (Drilling Info, 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** shows parameters for the Appalachian Shale basin; the DS file holds data for Appalachian Shale basin as well as 26 other combinations of basins and extraction technologies. The full scenario list is as follows:

- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Appalachia - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Gulf - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Gulf - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Gulf - Tight
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Arkla - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Arkla - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Arkla - Tight
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in East Texas - Conventional

- Acid gas removal (AGR) at natural gas gathering and boosting facilities in East Texas - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in East Texas - Tight
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Arkoma - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Arkoma - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in South Oklahoma - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Anadarko - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Anadarko - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Anadarko - Tight
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Strawn - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Fort Worth - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Permian - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Permian - Shale
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Green River - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Green River - Tight
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Uinta - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Uinta - Tight
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in San Juan - CBM
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in San Juan - Conventional
- Acid gas removal (AGR) at natural gas gathering and boosting facilities in Piceance - Tight

Table 2 shows the inputs and output for natural gas resource and emission flows. The DS File can compute the output for all 27 onshore scenarios, where each scenario is a combination of a basin and production technology. The tracked input of natural gas (an intermediate flow) 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). Emissions comprise CO_2 and CH_4 emissions to air; 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 gathered and boosted natural gas.

Table 1: Input Parameters

Parameter	Expected Value	Low	High	Units	Description
Combustion activity for compression					
2_AGR_CO2	1.02E+02	0.00E+00	2.41E+02	[tonnes CO_2/yr]	Annual CO_2 emissions from acid gas removal units at natural gas gathering and boosting facilities.
2_AGR_CH4ef	3.73E-05	3.73E-05	3.73E-05	[kg CH_4/kg NG]	Methane emission factor from acid gas removal at gathering and boosting facilities
Natural gas production rates					
2_NG_sent	9.13E+08	6.27E+08	1.23E+09	Mcf	Annual gathering and boosting volume

Table 2: Unit Process Input and Output Flows

Flow Name	Expected	Low	High	Units (Per Reference Flow)
Inputs				
Natural gas [Intermediate flow]]	1.000043E+00	1.000037E+00	1.000048E+00	kg NG
Outputs				
Natural Gas [intermediate flow]	1.00	1.00	1.00	kg NG
Carbon dioxide [Inorganic emissions to air]	1.02E+02	0.00E+00	2.41E+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.

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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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