NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Natural Gas Extraction, Other Venting Fugitives

Reference Flow: 1 kg of Natural Gas Extracted

Brief Description: This unit process quantifies the mass of gas emitted as a result of fugitive venting from unidentified natural gas extraction activities.

Section I: Meta Data

Geographical Coverage: United States **Region:** N/A

Year Data Best Represents: 2006

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	☑ Other
Releases to Water:	☐ Inorganic	☐ Organic Emissions	☐ Other
Water Usage:	☐ Water Consumption	☐ Water Demand (throughput)	
Releases to Soil:	☐ Inorganic Releases	☐ Organic Releases	☐ Other

Adjustable Process Parameters:

Vent_rate	*[kg/kg] Adjustable parameter; kg of extracted natural gas that is a fugitive emission per kg of extracted natural gas*
share_CO2	*[dimensionless] fraction of CO_2 in vented gas*
share_CH4	*[dimensionless] fraction of CH_4 in vented gas*

share_NMVOC	*[dimensionless] fraction of NMVOC in vented gas*
share_N2	*[dimensionless] fraction of nitrogen in vented gas*

Tracked Input Flows:

Natural gas USA [Natural gas (resource)]	*Natural gas from nature*

Tracked Output Flows:

Natural Gas Extracted	*Reference flow*
Carbon dioxide [Inorganic emissions to air]	*Emission to air*
Methane [Organic emissions to air (group VOC)]	*Emission to air*
NMVOC (unspecified) [Group NMVOC to air]	*Emission to air*
Nitrogen	*Emission to air*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_O_NG_Extraction_OtherVenting_Fugitives_2011.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process accounts for natural gas that is vented as fugitive emissions by unidentified processes at a natural gas extraction site. Unidentified processes include those that are not modeled explicitly in other unit processes in NETL's LCA model of natural gas. The reference flow of this unit process is 1 kg of extracted natural gas.

Boundary and Description

Routine emissions from natural gas extraction include fugitive emissions from equipment not accounted for elsewhere in the model. These emissions are referred to as "other fugitive emissions", and cannot be captured for flaring.

Data for other fugitive emissions from natural gas extraction are based on EPA data for onshore and offshore natural gas wells (EPA, 2011). EPA's data is based on 2006

production (EPA, 2011) and shows the annual methane emissions for specific extraction activities. EPA's data were converted from an annual basis to a unit-of-production basis by dividing the methane emission rate by the natural gas production rate in 2006. In 2006 the U.S. extracted 19,950,828 MMCF of onshore natural gas and 3,584,190 MMCF of offshore natural gas (EIA, 2011).

Table 1 shows other fugitive emissions from onshore and offshore natural gas extraction and the corresponding emission factors.

Figure 1: Unit Process Scope and Boundary

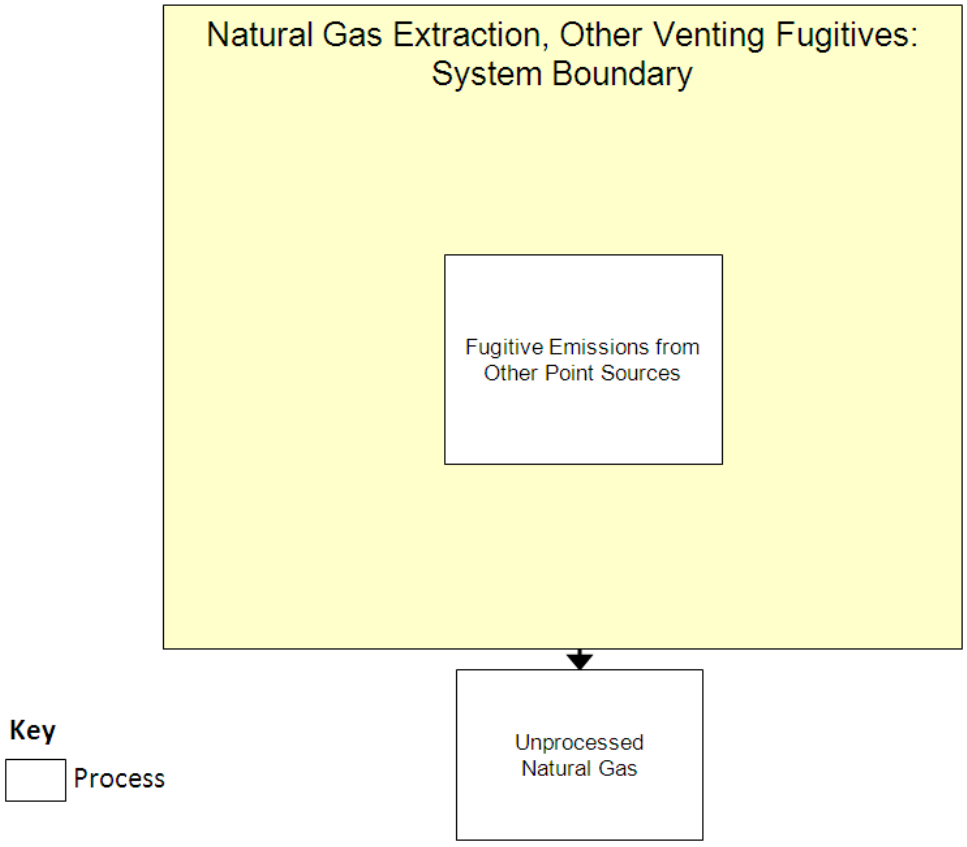

Table 1: Other Fugitive Emissions from Natural Gas Extraction

Onshore Extraction Activity	Value	Units
Separators	4,718	MMCF/yr
Meters/Piping	4,556	MMCF/yr
Pipeline Leaks	8,087	MMCF/yr
Chemical Injection Pumps	2,814	MMCF/yr
Blowdowns, Pipeline	129	MMCF/yr
Pressure Relief Valves	29	MMCF/yr
Mishaps	70	MMCF/yr
Total Emissions	20,403	MMCF/yr
Onshore Natural Gas Extraction Rate	19,950,828	MMCF/yr
Emission Factor	1.02E-03	kg CH_4/kg NG
Offshore Extraction Activity	**Value**	**Units**
Connectors	0.8	MMCF/yr
Flanges	2.38	MMCF/yr
OEL	0.1	MMCF/yr
Other	44	MMCF/yr
Pump Fugitive	0.5	MMCF/yr
Valves	19	MMCF/yr
Loading Operation	0.1	MMCF/yr
Separator	796	MMCF/yr
Pressure Level Controls	2	MMCF/yr
Total Emissions	865	MMCF/yr
Offshore Natural Gas Extraction Rate	3,584,190	MMCF/yr
Emission Factor	2.41E-04	kg CH_4/kg NG

Table 2: Unit Process Input and Output Flows

Flow Name	Onshore Extraction	Offshore Extraction	Units (Per Reference Flow)
Inputs			
Natural gas USA [Natural gas (resource)]	1.02E-03	2.41E-04	kg
Outputs			
Natural Gas Extracted	**1.00**	**1.00**	**kg**
Carbon dioxide [Inorganic emissions to air]	1.55E-05	3.67E-06	kg
Methane [Organic emissions to air (group VOC)]	8.06E-04	1.90E-04	kg
NMVOC (unspecified) [Group NMVOC to air]	1.83E-04	4.32E-05	kg
Nitrogen	1.82E-05	4.30E-06	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Embedded Unit Processes

None.

References

EIA. (2011). Natural Gas Gross Withdrawals and Production. U.S. Energy Information Administration. Retrieved April 5, 2011, from http://www.eia.doe.gov/dnav/ng/ng_prod_sum_a_EPG0_VRN_mmcf_a.htm

EPA. (2011). Background Technical Support Document - Petroleum and Natural Gas Industry.Washington, D.C.

Section III: Document Control Information

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