NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Offshore Natural Gas Rig, Crew Transport

Reference Flow: 1 kg of Natural Gas

Brief Description: This unit process quantifies the energy use and air quality emissions associated with transport of employees/crew members to and from offshore natural gas wells, in support of offshore natural gas extraction.

Section I: Meta Data

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

Year Data Best Represents: 2010

Process Type: Extraction Process (EP)

Process Scope: Cradle-to-Gate Process (CG)

Allocation Applied: No

Completeness: All Relevant Flows Recorded

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:

None.

Tracked Input Flows:

Gasoline – Dom. (NETL) [Crude oil products]	*Gasoline, used as a surrogate for aviation gasoline, combusted in helicopter to transport crew to and from offshore rig*

Tracked Output Flows:

Natural Gas	*Reference flow; 1 kg of natural gas produced to normalized inputs and outputs*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_O_Offshore_Crew_Transport_2011.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers the mass of aviation gasoline fuel and the associated greenhouse gas emissions, including carbon dioxide, methane, and nitrous oxide, that result from the transport of employees and crew members to and from an offshore natural gas platform. Assumptions include that the helicopter can carry 19 passengers at a time and that each crew works a two-week shift before being rotated out for another crew. The process is based on the reference flow of 1 kg of natural gas, as described below and shown in **Figure 1**.

This unit process is used under Life Cycle (LC) Stage #1 to assist in the extraction of natural gas from a variety of natural gas extraction profiles. It is combined with other relevant equipment for LC Stage #1 in a separate operations assembly process, DF_Stage1_O_Assembly_Natural_Gas_2011.01.doc. The assembly process quantifies the relevant flows and emissions associated with each portion of the natural gas extraction profile being modeled, in order to complete extraction and in-field processing of 1 kg of natural gas.

Boundary and Description

Helicopters are used to transport natural gas rig crews and employees to and from shore. The helicopters are powered by the combustion of aviation gasoline, with emission factors of 0.0692 tonnes/MMBtu for carbon dioxide, 8.30E-03 kg/gallon for methane, and 8.70E-04 for nitrous oxide (API 2009). Assuming that each helicopter trip can carry 19 passengers (Sikorsky 2010) and using the fuel heating values and density for CO_2, CH_4, and N_2O results in emissions per passenger-trip of 48 kg, 4.83E-02 kg, and 5.05E-03 kg, respectively. This analysis uses a total crew of 100 people (McGill 2010) and assumes that each crew rotates off the rig every 14 days, resulting in a value of 7.143 passenger-trips per day. The emissions per passenger-trip are multiplied by the passenger-trips per day, resulting in emissions per day of 3.45E02 for CO_2, 3.44E-01 for CH_4, and 3.61E-02 for N_2O.

The fuel density of aviation gas is multiplied by the passenger-trips per day, and converted from MMBtu/day to kg/day, for a total of 1.17E02 kg aviation gasoline/day. A gas production rate of 53,342 kg/day (2,800 Mcf/day) is used for offshore natural gas wells.

Each of the total daily emissions of CO_2, CH_4, and N_2O are divided by the daily natural gas production rate, resulting in greenhouse gas air emissions of 2.52E-04 kg CO_2/kg natural gas, 2.52E-07 kg CH_4/kg natural gas, and 2.64E-08 kg N_2O/kg natural gas. Finally, the amount of fuel used per day (1.17E02 kg) is divided by the natural gas production per day (1.37E06 kg) for a fuel use rate of 8.53E-05 kg/kg natural gas.

Figure 1 provides an overview of the boundary of this unit process. As shown, gasoline (as a surrogate for helicopter aviation gasoline) from an upstream emissions profile is input to the crew transport operations. Greenhouse gas air emissions from transport operations are evaluated to quantify overall carbon dioxide, nitrous oxide, and methane emissions to the atmosphere. This unit process is then combined with other natural gas extraction operations unit processes in a downstream natural gas operations assembly unit process.

Figure 1: Unit Process Scope and Boundary

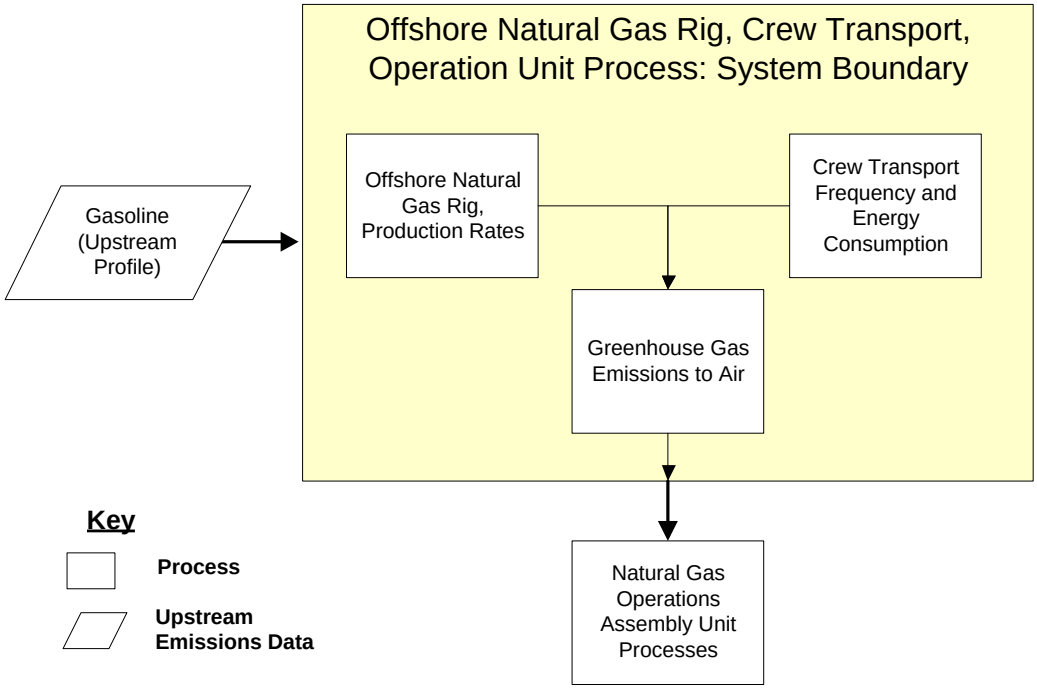

Table 1 summarizes the helicopter crew transport emissions that are relevant within this unit process. **Table 2** provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS.

Table 1: Properties of Crew Transport Process

Air Emission Factors (per kg natural gas produced)			
Flow Name	**Value**	**Units**	**Reference**
CO_2	3.45E02	kg	API 2009; Sikorsky 2010; McGill 2010
CH_4	3.44E-01	kg	API 2009; Sikorsky 2010; McGill 2010
N_2O	3.61E-02	kg	API 2009; Sikorsky 2010; McGill 2010

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Gasoline – Dom. (NETL) [Crude oil products]	**2.19E-03**	**kg**
Outputs		
Natural Gas	**1**	**kg**
Carbon dioxide [Inorganic emissions to air]	6.47E-03	kg
Methane [Organic emissions to air (group VOC)]	6.46E-06	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	6.77E-07	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows. Upstream environmental flows were added during the modeling process using GaBi modeling software, as shown in Figure 1.

Embedded Unit Processes

None.

References

API 2009 — American Petroleum Institute. 2009. *Compendium of Greenhouse Gas Emissions for the Oil and Natural Gas Industry.* 2009. http://www.api.org/ehs/climate/new/upload/2009_GHG_COMPENDIUM.pdf (accessed May 18, 2010).

McGill 2010 — McGill, K. 2010. *11 missing after explosion at oil drilling rig of La. Coast.* Associated Press. April 22, 2010. http://detnews.com/article/20100422/NATION/4220377/11-missing-after-explosion-at-oil-drilling-rig-off-La.-coast (Accessed June 11, 2010)

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Section III: Document Control Information

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Revision History:

Original/no revisions

How to Cite This Document: This document should be cited as:

NETL (2011). *NETL Life Cycle Inventory Data – Unit Process: Offshore Natural Gas Rig, Crew Transport.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: April 2011 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

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