



This unit process is composed of this document and the data sheet (DS) *DS\_Stage1\_O\_Natural\_Gas\_Well\_Completion\_2011.01.xls*, which provides additional details regarding calculations, data quality, and references as relevant.

### **Goal and Scope**

This unit process accounts for natural gas venting during well completion. This unit process is relevant to all modeled natural gas extraction profiles, including conventional onshore, conventional offshore, associated gas, Barnett Shale, Marcellus Shale, and coal bed methane. The process is based on the reference flow of 1 piece per kg of natural gas well construction and installation, as described below, and as shown in **Figure 1**.

This process is used during LC Stage #1 in conjunction with other unit processes to model the extraction of natural gas. It is assembled by *DF\_Stage1\_O\_Natural\_Gas\_Assembly\_2011.01.doc*. The assembly unit process quantifies the fraction of each piece of equipment and proportion of operations needed under LC Stage #1 to produce 1 kg of natural gas ready for transport (LC Stage #2) to the energy conversion facility (LC Stage #3).

### **Boundary and Description**

This unit process accounts for natural gas venting during well completion. This unit process is relevant to all modeled natural gas extraction profiles, including conventional onshore, conventional offshore, associated gas, Barnett Shale, Marcellus Shale, and coal bed methane. **Figure 1** shows the boundary of this unit process.

The venting rate varies according to well type, with unconventional wells having higher completion venting rates than conventional wells. The completion venting rates for seven types of natural gas wells are shown in **Table 1**. These venting rates are based on the background documents to EPA's national GHG inventory (EPA, 2011). **Table 1** also shows the production rate of each type of natural gas well; production rate is used to apportion completion venting per unit of natural gas produced over the life of the natural gas well. **Table 2** shows values for inputs and outputs on the basis of the reference flow. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS sheet.

Figure 1: Unit Process Scope and Boundary

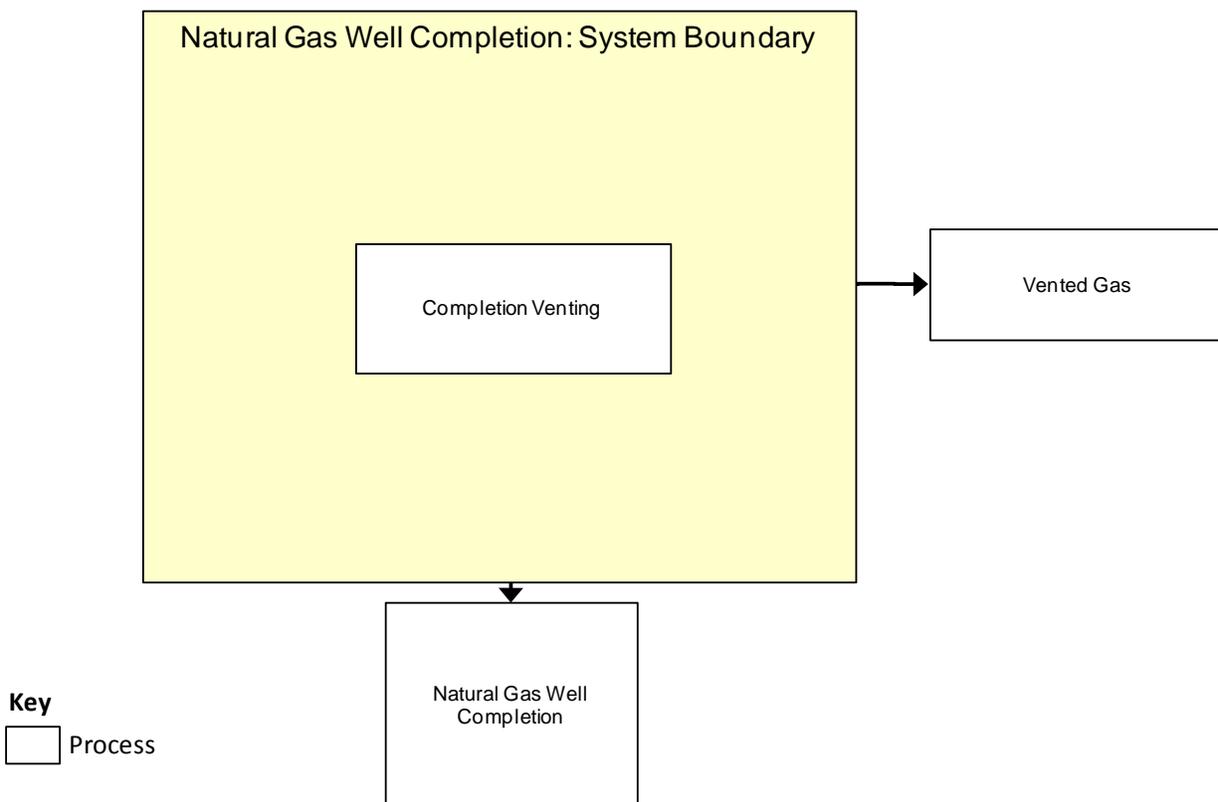


Table 1: Values for Natural Gas Production Rates and Completion Venting

Natural Gas Type	Production Rate		Completion Venting Rate	
	Estimated Ultimate Recovery (Billion Cubic Feet)	Daily Production Rate (kg/day)	(1,000 cubic feet/episode)	(kg/episode)
Onshore Conventional	0.72	1,252	37	705
Associated Gas	1.32	2,295	37	705
Offshore	30.7	53,376	37	705
Tight Gas	1.2	2,086	3,670	70,000
Barnett Shale	3.0	5,216	9,175	175,000
Marcellus Shale	3.25	5,651	9,175	175,000
Coal Bed Methane	1.15	1,999	50	945

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
<b>Inputs</b>		
Natural gas USA [Natural gas (resource)]	5.12E-05	kg
<b>Outputs</b>		
Natural Gas Well Completion [Construction]	1.00	piece/kg NG
Vented gas [intermediate product]	5.12E-05	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**. Values shown reflect default values based on the conventional onshore profile, with adjustable parameters set as shown in **Table 1**. Inputs and outputs for other natural gas profiles can be derived using the associated DS along with the relevant parameter values, as listed in Table 1.

### Embedded Unit Processes

None.

### References

EPA 2011 United States Environmental Protection Agency. 2011. Greenhouse Gas Emissions Reporting from the Petroleum and Natural Gas Industry; Background Technical Support Document. Available at [http://www.epa.gov/climatechange/emissions/downloads10/Su\\_bpart-W\\_TSD.pdf](http://www.epa.gov/climatechange/emissions/downloads10/Su_bpart-W_TSD.pdf) (Accessed April 4, 2011)..

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### Section III: Document Control Information

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**Section IV: Disclaimer**

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