# NETL Life Cycle Inventory Data
# Process Documentation File

**Process Name:** Carbon Dioxide Dehydration

**Reference Flow:** 1 kg of Carbon dioxide, Dehydrated

**Brief Description:** Energy use for the dehydration of carbon dioxide extracted from a salt dome well.

## Section I: Meta Data

**Geographical Coverage:** United States **Region:** United States

**Year Data Best Represents:** 2012

**Process Type:** Auxillary Process (AP)

**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:**

| | |
|---|---|
| Life_well | *[yr] Life of primary production phase of well. Uncertainty is +/- 20% range based on professional judgment.* |
| Product_rate | *[kg/d] Daily production rate of carbon dioxide. See "Field Profiles" sheet for production rate calculations. Uncertainty* |

| | |
|---|---|
| | *range of +/-30% is based on professional judgment.* |
| Well_success | *Fraction of wells drilled that produce $CO_2$ at an economically viable level. Source lists historical level of 65%, but indicates that current success rate should be higher.* |
| CO2_loss | *[kg] $CO_2$ emissions from absorption by the glycol.* |
| Dehyd_power | *[kWh] Energy requirements for pumping and heating glycol in the dehydration process.* |

**Tracked Input Flows:**

| | |
|---|---|
| Salt Dome CO2 Well Construction | *[Technosphere] Wells at a salt dome producing $CO_2$* |
| Electricity | *[Technosphere] Electricity for dehydration system* |

**Tracked Output Flows:**

| | |
|---|---|
| Carbon dioxide, dehydrated [Insert] | *Reference flow* |

## Section II: Process Description

### Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_O_CO2_Dehydration_2012.xls*, 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 with the dehydration of water that has been extracted from a natural salt dome. The process includes the energy for dehydration, $CO_2$ emissions expected to take place during the process, and the fraction of a salt dome well needed for the extraction. The reference flow of this unit process is: 1 kg of Carbon Dioxide, Dehydrated.

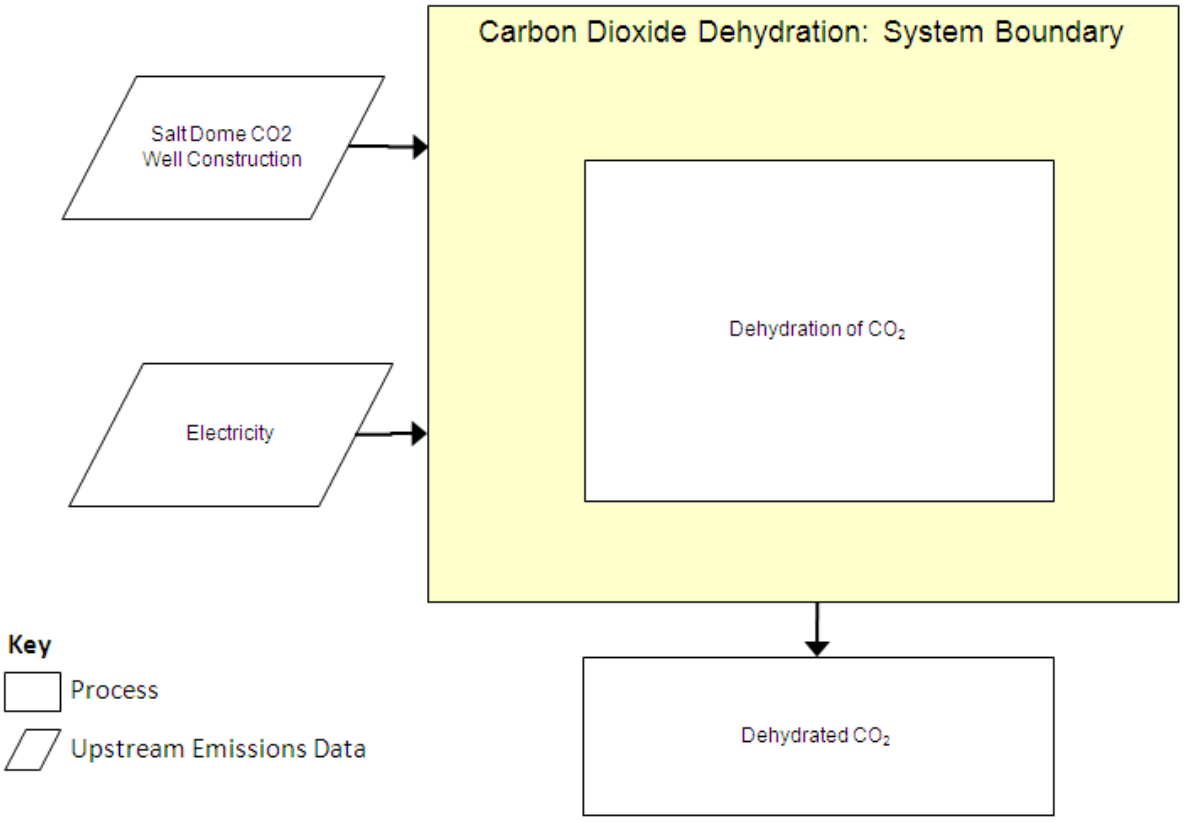
### Boundary and Description

This dehydration unit process receives raw carbon dioxide from a pressurized well and prepares it for compression and pipeline transportation. While other gases may be extracted with the $CO_2$, their release is not tracked. Instead, this unit process only quantifies the fraction of well construction needed to produce one kg of $CO_2$ and the electricity needed to treat it.

The fraction of a single well needed to produce one kg is calculated using a weighted average production rate for wells in Colorado and New Mexico, and an assumed lifetime for each well (DiPietro et al., 2012; Kinder Morgan, 2002, 2008; Rabinowitz et al., 2005). Additionally, a fraction of wells drilled end up not producing $CO_2$ (Rabinowitz, et al., 2005).

Dehydration is modeled using a glycol process, which absorbs the water from raw gas. Because the circulation and heating processes only use electricity there are no emissions other than a small about of $CO_2$ that is absorbed by the glycol (Rabinowitz, et al., 2005). The energy requirement for each of these processes is driven by the amount of water removed from the gas stream. Three gallons of glycol are needed to absorb one pound of water. This means that more water in the gas stream will require a system with more glycol, which increases the reboiler energy and the required pump size (EPA, 2006a, 2006b). The carbon dioxide is assumed to exit the well saturated with water vapor. According to (Spycher et al., 2003), this is about 50.5 pounds of water per million cubic feet of $CO_2$. The dehydrated water content for $CO_2$ is assumed to be the same as for natural gas (Blaylock, 2010).

**Figure 1: Unit Process Scope and Boundary**



## Table 1: Default Parameters and Other Variables for $CO_2$ Dehydration

| Parameter | Value | Unit |
|---|---|---|
| Well lifetime | 25 | yr |
| Production per well | 8.09+05 | kg/day |
| Well success rate | 0.7 | dimensionless |
| $CO_2$ loss per kg | 1.15E-04 | kg |
| Dehydration power | 1.93E-04 | kWh |

**Table 2: Unit Process Input and Output Flows**

| Flow Name | Value | Units (Per Reference Flow) |
|---|---|---|
| Inputs | | |
| Salt Dome CO2 Well [Valuable substance] | 1.94E-10 | pcs |
| Electricity [Electric power] | 1.93E-04 | kWh |
| Outputs | | |
| Carbon dioxide, dehydrated [Intermediate product] | 1.00 | kg |
| Carbon dioxide [Inorganic emissions to air] | 1.15E-04 | kg |

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

## Embedded Unit Processes

None.

## References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EPA. (2006a). *Replacing Gas-Assisted Glycol Pumps with Electric Pumps*. Retrieved November 28, 2012, from http://www.epa.gov/gasstar/documents/ll_glycol_pumps3.pdf

EPA. (2006b). Replacing Glycol Dehydrators with Desiccant Dehydrators. *U.S. Environmental Protection Agency*. Retrieved from http://www.epa.gov/gasstar/documents/ll_desde.pdf

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Rabinowitz, D., & Janowiak, M. (2005). *Reasonable, Foreseeable Development: Oil, Natural Gas, and Carbon Dioxide in Canyons of the Ancients National Monument*. Bureau of Land Management Retrieved November 19, 2012, from http://www.blm.gov/pgdata/etc/medialib/blm/wo/Planning_and_Renewable_Resources/NEPS.Par.99344.File.dat/(6.8.1.2)%20Example%20of%20Reasonably%20Foreseeable%20Development%20Scenario%202.pdf

Spycher, N., Pruess, K., & Ennis-King, J. (2003). $CO_2$-$H_2O$ mixtures in the geological sequestration of $CO_2$. I. Assessment and calculation of mutual solubilities from 12 to 100$^0$C and up to 600 bar. *Ceochimica et Cosmochimica Acta, 67*(16), 3015-3031.

## 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 (2012). NETL Life Cycle Inventory Data – Unit Process: Carbon Dioxide Dehydration. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: November 2012 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

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