



# NETL Life Cycle Inventory Data

## Process Documentation File

**Process Name:** Coal Cleaning  
**Reference Flow:** 1 kg of Coal  
**Brief Description:** The amount of electricity required to power equipment used for cleaning coal at underground and surface mines as well as accounting for coal loss during production activities.

---

### Section I: Meta Data

---

**Geographical Coverage:** US **Region:** N/A  
**Year Data Best Represents:** 1983-2002  
**Process Type:** Extraction Process (EP)  
**Process Scope:** Gate-to-Gate Process (GG)  
**Allocation Applied:** No  
**Completeness:** Individual 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:**

Electricity *[kWh/kg] Coal cleaning electricity per unit of coal extracted*

Mine\_type *[dimensionless] 0 = Surface mine; 1 = Underground mine*

Surface\_Loss *[kg/kg] Coal losses for surface mines*

UG\_Loss *[kg/kg] Coal losses for underground mines*

**Tracked Input Flows:**

|  |   |
|--|---|
| Electricity [Electric Power]                 | <i>[Technosphere] Amount of electricity required to power equipment used in cleaning coal at underground and surface mines.</i> |
| Coal, handled [Intermediate Product]         | <i>[Technosphere] Coal input to the cleaning process; accounts for all losses during production</i>                             |
| Coal, surface, water [Intermediate flow]     | <i>[Technosphere] Connection with surface coal water use unit process</i>   |
| Coal, underground, water [Intermediate flow] | <i>[Technosphere] Connection with underground coal water use unit process</i>   |

**Tracked Output Flows:**

|                                      |                       |
|--------------------------------------|-----------------------|
| Coal, cleaned [Intermediate Product] | <i>Reference flow</i> |
|--------------------------------------|-----------------------|

---

## Section II: Process Description

---

**Associated Documentation**

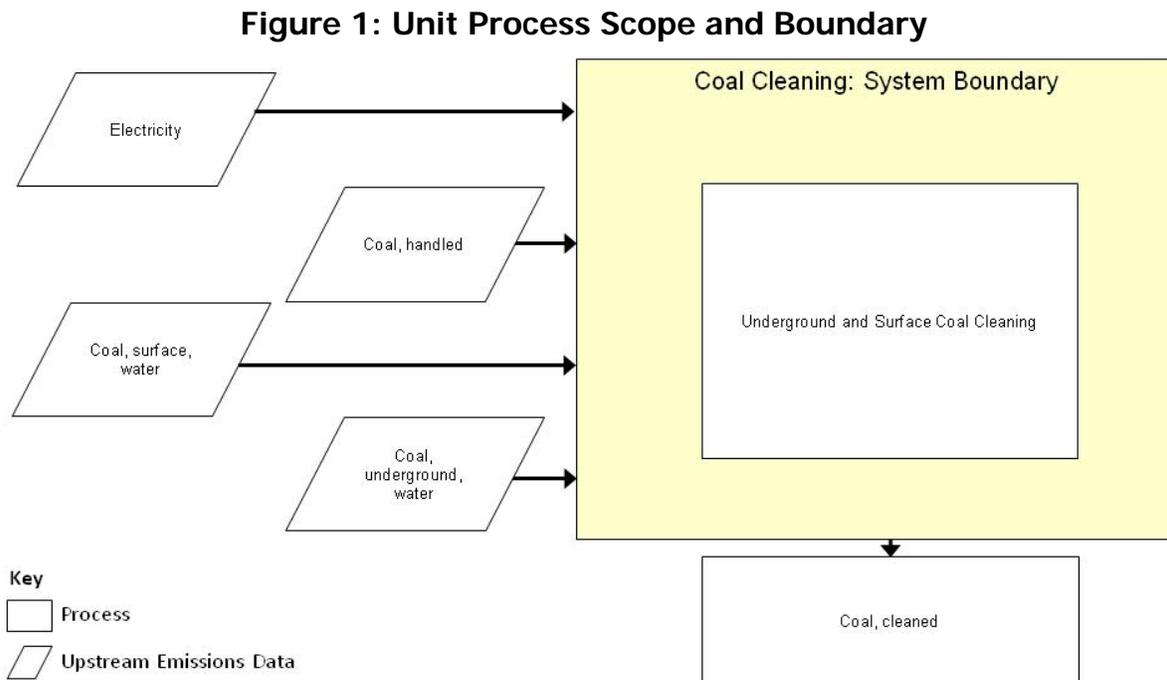
This unit process is composed of this document and the data sheet (DS) *DS\_Stage1\_O\_Coal\_Cleaning\_2013.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

**Goal and Scope**

This unit process provides a summary of relevant input and output flows associated with the amount of electricity required to power equipment used for cleaning coal at underground and surface mines. A centrifuge, flotation machine, screens, and magnetic separator are the pieces of equipment used to clean coal. The process also accounts for the coal losses that are incurred during the production and processing steps to scale upstream activities for one kg of coal at the entrance to the RMT gate. Key inputs are electricity, coal, surface water, and underground water. All of these items are also adjustable parameters to measure uncertainties. Cleaned coal is the key output. The unit process is based on the reference flow of one kg of coal. The relevant flows of this unit process are described below and shown in **Figure 1**.

## Boundary and Description

Figure 1 provides an overview of the boundary of this unit process.



The electricity requirement was calculated using the Energy and Environmental Profile of the U.S. Mining Industry developed by the U.S. Department of Energy's Energy Efficiency and Renewable Energy division and National Mining Association (U.S. Department of Energy and National Mining Association, 2002). Chapter Two of the source focused on coal; description of coal types, overview of coal mining, energy requirements for underground and surface mines, and emissions from coal mining. The data source provides energy data for specific mining activities such as coal handling, extraction, and grinding. BCS, Incorporated (BCS) developed the data by integrating the U.S. Department of Energy's Energy Information Administration's 1997 Coal Industry data into the Western Mining Engineering, Inc.'s SHERPA Mine Cost Software to create 2002 estimates. BCS also used Mine and Mill Equipment Cost, An Estimator's Guide to develop the data. Newer data for specific coal mining processes are not available. This unit process parameterizes key variables, which allow for evaluation of data uncertainty when used in a life cycle model.

A centrifuge, flotation machine, screens, and magnetic separator were the pieces of equipment used to clean coal. It was assumed that all equipment used electricity, and the values in the reference, specific to underground mines, were also valid for surface mines. The reference flow of this unit process is one kg of coal. The electricity

requirement was calculated by dividing the sum of the equipments' energy requirements, in Btu per ton, by the appropriate conversions to obtain the electricity needed in kWh per kg of coal. Electricity was placed as a parameter in the DS file, so the item could be adjusted to measure uncertainties. A document by the World Bank Group referenced data for underground and surface mine coal losses (World Bank Group). To obtain the underground mine coal losses for conventional and longwall underground mines, the sum of the solid loads, in tons per 1,000 tons coal produced, were divided by 1,000 to convert the value to kg of solids per kg of coal. The average coal losses were determined by taking the average value of the conventional and longwall values, calculating the sum of the solid loads, and dividing the solids load sum by 1,000 to obtain the value in kg of solids per kg of coal. The values determined for the conventional and longwall underground mines were the minimum and maximum values, respectively, for coal losses, while the average was the coal losses for underground coal mines. This same method was also used to calculate the surface coal mine losses. It was assumed that the majority of the mass in liquid effluents is water; therefore, it is neglected as loss. Water emissions are accounted for separately in the Water Use Quality (Surface or Underground) unit processes. Another assumption was dust emissions were used to account for the correct amount of coal that must be mined to provide one kg of processed coal for transport. The particulate matter emissions are accounted for separately in the Extraction (Surface or Underground) unit processes. Underground and surface coal losses were placed as a parameter in the DS file, so the item could be adjusted to measure uncertainties. Other parameters included mine type, coal input to cleaning process, water input for surface mining, and water input for underground mining.

**Table 1** shows the input and output flows of this unit process. Additional details regarding input and output flows, including calculation methods, are contained in the associated DS sheet.

**Table 1: Unit Process Input and Output Flows**

| Flow Name                                    | Value    | Units (Per Reference Flow) |
|--|----------|----------------------------|
| <b>Inputs</b>                                |          |                            |
| Electricity [Electric Power]                 | 4.21E-04 | kWh/kg                     |
| Coal, handled [Intermediate Product]         | 1.01     | kg/kg                      |
| Coal, surface, water [Intermediate flow]     | 1.00     | kg/kg                      |
| Coal, underground, water [Intermediate flow] | 0.00E+00 | kg/kg                      |
| <b>Outputs</b>                               |          |                            |
| Coal, cleaned [Intermediate Product]         | 1.00     | kg                         |

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

### Embedded Unit Processes

None.

### References

U.S. Department of Energy and National Mining Association. 2002. *Energy and Environmental Profile of the U.S. Mining Industry : Chapter 2 Coal*. U.S. Department of Energy.

<http://www1.eere.energy.gov/manufacturing/resources/mining/pdfs/coal.pdf>.

World Bank Group. *Pollution Prevention and Abatement Handbook-Coal Mining and Production*. World Bank Group.

[http://www.ifc.org/wps/wcm/connect/79a98080488552b5ac5cfe6a6515bb18/coal\\_PAH.pdf?MOD=AJPERES&CACHEID=79a98080488552b5ac5cfe6a6515bb18](http://www.ifc.org/wps/wcm/connect/79a98080488552b5ac5cfe6a6515bb18/coal_PAH.pdf?MOD=AJPERES&CACHEID=79a98080488552b5ac5cfe6a6515bb18)



**Section III: Document Control Information**

---

**Date Created:** July 31, 2013

**Point of Contact:** Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV

**Revision History:**

Original/no revisions

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

NETL (2013). NETL Life Cycle Inventory Data – Unit Process: Coal Cleaning - Version 01. U.S. Department of Energy, National Energy Technology Laboratory. Retrieved [DATE] from [www.netl.doe.gov/LCA](http://www.netl.doe.gov/LCA)

---

**Section IV: Disclaimer**

---

Neither the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) nor any person acting on behalf of these organizations:

- A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights; or
- B. Assumes any liability with this report as to its use, or damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by NETL. The views and opinions of the authors expressed herein do not necessarily state or reflect those of NETL.