NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Illinois No. 6 Underground Coal Mine Assembly, Construction

Reference Flow: 1 kg of Illinois No. 6 Bituminous Coal

Brief Description: Calculates the number of each piece of equipment included in an underground, Illinois No. 6 bituminous coal mine. Includes life expectancy and replacement rates for the longwall mining system, continuous miner, conveyor system, and shuttle car.

Section I: Meta Data

Geographical Coverage: US **Region:** N/A

Year Data Best Represents: 2006

Process Type: Basic Process (BP)

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:

longwall_req	*[pc/yr] Pieces of longwall mining systems needed per year of mining*
continuous_req	*[pc/yr] Pieces of continuous miner needed per year of mining*

conveyor_req	*[pc/yr] Pieces of conveyor systems needed per year of mining*
shuttle_req	*[pc/yr] Pieces of shuttle cars needed per year of mining*
mine_life	*[yr/mine] Years of operation per mine (Assumed life of energy conversion facility - See Assumption #1)*
coal_prod_year	*[kg/yr] Kilograms of coal produced in the Galatia mine in 2006*
coal_prod_tot	*[kg/mine] Kilograms of coal produced by mine*
longwall_tot	*[pc/kg] Pieces of longwall systems constructed per kilogram of coal produced*
continuous_tot	*[pc/kg] Pieces of continuous miners constructed per kilgram of coal produced*
conveyor_tot	*[pc/kg] Pieces of conveyor systems constructed per kilogram of coal produced*
shuttle_tot	*[pc/kg] Pieces of shuttle cars constructed per kilogram of coal produced*
site_tot	*[pc/kg] Pieces of site paving constructed per kilogram of coal produced OR number of mines constructed per kilogram of coal produced (mine/kg)*

Tracked Input Flows:

Longwall Miner [Construction]	*[Technosphere] Fraction of a single longwall mining system needed over the lifetime of the mine, including replacements, to produce 1 kg of Illinois No. 6 bituminous coal*
Continuous Miner [Construction]	*[Technosphere] Fraction of a single continuous miner needed over the lifetime of the mine, including replacements, to produce 1 kg of Illinois*

	No. 6 bituminous coal. See Assumption #2
Conveyor System [Construction]	*[Technosphere] Fraction of a single conveyor system needed over the lifetime of the mine, including replacements, to produce 1 kg of Illinois No. 6 bituminous coal. See Assumption #3*
Shuttle Car [Construction]	*[Technosphere] Fraction of a single shuttle car needed over the lifetime of the mine, including replacements, to produce 1 kg of Illinois No. 6 bituminous coal. See Assumptions #3*
Site Paving [Construction]	*[Technosphere] Fraction of site paving needed over the lifetime of the mine, including replacements, to produce 1 kg of Illinois No. 6 bituminous coal. See Assumptions #3*

Tracked Output Flows:

Underground coal mine [Construction]	*Reference Flow*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_C_Assembly_I6_Coal_Underground_Mine_2010.02.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process calculates the fraction of each piece (pc) of equipment that is needed to mine one kilogram (kg) of Illinois No. 6 bituminous coal at an underground longwall mine. Pieces per kilogram (pc/kg) is based on the number of each piece of equipment found at the mine at any given time, how many years each piece of equipment lasts, the lifetime of the mine, and the yearly production of the mine. The construction data for individual pieces of equipment, including an individual longwall mining system, continuous miner, conveyor

system, and shuttle car, are evaluated in separate unit processes. This sheet provides only assembly data for a single Illinois No.6 underground bituminous coal mine. The reference flow of this unit process is: 1 kg of Illinois No. 6 Bituminous Coal.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Specifications for the number of longwall mining systems and continuous miners at the underground coal mine were taken from the Illinois Department of Natural Resources' 2006 Annual Statistical Report (Illinois DNR 2006). These values are from the Galatia mine in southern Illinois, a representative underground mine extracting Illinois No. 6 bituminous coal. This source indicated a total of three longwall mining units and nine continuous miners in use at this mine, and these values were used for this unit process. In an e-mail communication, the expected lifetime of longwall system components was given as 10–15 years (Bruniany 2008). The average of these values (12.5 years) was assumed for the life expectancy of both the longwall mining system and the continuous miner. The lifetime of the plant (30 years) was divided by the life expectancy of the longwall system and continuous miner for a replacement rate of 2.4 for both the longwall system and continuous miner over the lifetime of the plant.

It was assumed that the conveyor system construction unit process was modeled so that a single conveyor system would be adequate to carry as much coal to the surface as required. The conveyor belt has an expected lifetime of 20 years (Goodyear 2008), and it was assumed that the same lifetime would apply to the conveyor system as a whole. Dividing the plant lifetime by the conveyor lifetime resulted in a replacement rate of 1.5 conveyor systems over the study period.

To determine the number of shuttle cars required in the underground coal mine, it was assumed that there was a 2-to-1 ratio between the continuous miners and the shuttle cars, so that there would be 18 shuttle cars. Each shuttle car has an expected lifetime of 12 years (Australian Tax Office 2008). This lifetime results in a replacement rate of 2.5 shuttle cars over the 30-year lifetime of the plant.

Relevant properties of a single underground coal mine used for the calculation of input and output flows for this unit process are shown in **Table 1**. **Table 2** provides a summary of modeled input and output flows. Additional details showing calculation methods for input and output flows, and other relevant information, are contained in the associated DS.

Figure 1: Unit Process Scope and Boundary

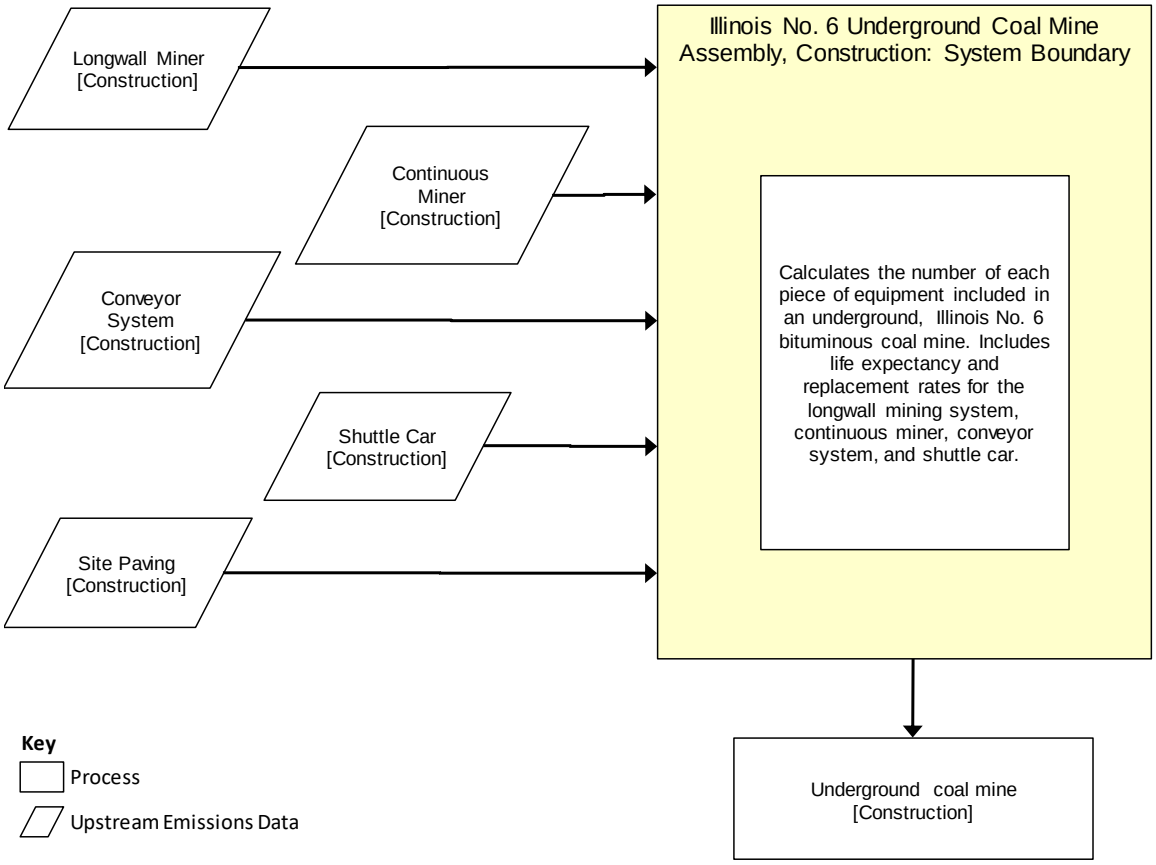

Table 1: Properties of a Single Illinois No. 6 Underground Coal Mine: Construction and Replacement Properties

Property	Value	Units
Longwall Miners in Operation	3	pc
Longwall Miner Lifetime	12.5	yr/pc
Continuous Miners in Operation	9	pc
Continuous Miner Lifetime	12.5	yr/pc
Conveyor Systems in Operation	1	pc
Conveyor System Lifetime	20	yr/pc
Shuttle Cars in Operation	18	pc
Shuttle Car Lifetime	12	yr/pc
2006 Galatia Mine Coal Production	6,546,285,907	kg/yr
Mine Lifetime	30	yr

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Longwall Miner [Construction]	**3.67E-11**	**pc**
Continuous Miner [Construction]	**1.10E-10**	**pc**
Conveyor System [Construction]	**7.64E-12**	**pc**
Shuttle Car [Construction]	**2.29E-10**	**pc**
Site Paving [Construction]	**5.09E-12**	**pc**
Outputs		
Underground coal mine [Construction]	**1.00**	**pc**

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

Embedded Unit Processes

None.

References

Australian Tax Office 2008 — Australian Tax Office. 2008. *Taxation Ruling: TR 2008/4*. Commonwealth of Australia. http://law.ato.gov.au/atolaw/view.htm?docid=TXR/TR20084/NAT/ATO/00001&PiT=20080625000001#PB (Accessed December 14, 2009).

Bruniany 2008 — Bruniany, C. 2008. *E-mail Interview*. August 18, 2008.

Goodyear 2008 — Goodyear Engineered Products. 2008. *Flexsteel Conveyor Belt*. Veyance Technologies, Inc. http://www.goodyearep.com/uploadedFiles/Product_Categories/Conveyor_Belt_-_Heavyweight/Products/HW%20-%20Flexsteel®.pdf (Accessed December 14, 2009).

Illinois DNR 2006 — Illinois DNR. 2006. *Annual Statistical Report, 2006*. Illinois Department of Natural Resources. http://dnr.state.il.us/mines/public/asr2006.pdf (Accessed December 14, 2009).

Section III: Document Control Information

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