NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Commissioning and Decommissioning of Powder River Basin Coal Mine

Reference Flow: 1 kg of Powder River Basin Sub-Bituminous Coal

Brief Description: Calculates fuel consumption and resulting emissions to commission and decommission a surface mine for Powder River Basin sub-bituminous coal in Wyoming. Decommissioning values represented as a percentage of the commissioning values.

Section I: Meta Data

Geographical Coverage: US **Region:** Wyoming

Year Data Best Represents: 2009

Process Type: Installation Process (IP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: Individual 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:

Decommissioning percent	*Percent of needed diesel, and resulting combustion and other air emissions, from commissioning a Powder River Basin subbituminous coal mine, which is assumed to be needed/created during the decommissioning of the mine*

Tracked Input Flows:

Diesel [Crude oil products]	*Diesel (from crude oil) input for commissioning/decommissioning machinery operations*

Tracked Output Flows:

PRB Coal (NETL) [Hard Coal Products]	*Coal mine production flow for surface mined Powder River Basin subbituminous coal (reference flow)*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and data sheet (DS) *DS_Stage1_I_CommissionDecommission_PRB_CoalMine_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers the fuel combustion and emissions created during the construction (commissioning) and the end of life (decommissioning) of a Powder River Basin subbituminous surface coal mine located in Wyoming, for the extraction of raw materials in Life Cycle (LC) Stage #1. The unit process is based on the reference flow of 1 kg of cleaned, crushed (to approximately 3 inches) Powder River Basin coal, as described below and in **Figure 1**. This commissioning and decommissioning unit process includes the consumption of diesel fuel by construction/demolition machinery used to perform mine commissioning and decommissioning activities (including all on-site facilities), as well as combustion emissions associated with diesel fuel consumption. Construction of machinery used at the mine during mine operations, as well as input flows and emissions associated with mine operations, are addressed in separate unit processes.

Boundary and Description

The boundary for this unit process includes initial clearing and construction activities that take land in its natural state and to turn it into a Powder River Basin surface coal mine. These activities include clearing natural vegetation, excavation of soil and rock, grading, and construction of needed facilities. The boundary also includes decommissioning of the mine. That is, after all of the readily available coal has been extracted from the mine, decommissioning will result in the removal of infrastructure, re-contouring of land at the former mine site to the extent warranted, and planting of vegetation to help return the land to its natural state (TEEIC 2010).

The data for the commissioning of the Powder River Basin surface subbituminous coal mine came from a compilation of various sources. Many of the emission factors were

taken from the Red Cliff Mine located in Colorado, which is a proposed underground bituminous coal mine. Additional references provide estimates on the distance of road needed to be built through the surface mine and the associated emission with its construction. More soil removal and grading is expected than for an underground mine, causing additional particulate matter emissions.

Figure 1 provides an overview of the boundary of this unit process. As shown, upstream emissions associated with the production and delivery of diesel fuel are accounted for outside of the boundary of this unit process, via proprietary profiles contained within the GaBi model. However, no machinery production is considered, since it is assumed that machinery would be used for numerous construction or demolition jobs before being replaced.

Since the commissioning and decommissioning process focuses on fuel inputs and their associated combustion, it is important to understand the data sources along with their underlying assumptions and relevance to the study. Fuel consumption was based on the estimated acreage of the mine and the associated length of road which must be built. The combustion emissions were based on the Red Cliff Mine Environmental Impact Statement, completed by the US Bureau of Land Management (BLM) for the proposed coal mine in western Colorado (BLM 2009). The data were provided in tons of emission per year of commissioning. For this information to be useful in the context of this project, the data were converted to kilogram of emission per kilogram of coal that is anticipated to be produced over the lifetime of the coal mine, using the information provided in **Table 1**. Although Red Cliff Mine is producing less than the proposed surface mine, it was assumed that the commissioning emissions would be similar on a per kilogram of coal output value.

Red Cliff Mine documentation did not include mercury or ammonia emissions from fuel combustion. Mercury emissions data were therefore obtained from a separate source (Conway *et al.* 2005) and calculated based on the fuel demand. Ammonia emission factors were obtained from a U.S. Environmental Protection Agency (EPA) publication and used to calculate the commissioning emissions (Roe *et al.* 2004). Reliable data for water use during coal mine commissioning and decommissioning were unable to be located and were, therefore, taken as a minor data limitation.

Data were not readily available to model the decommissioning portion of the mine life cycle. Therefore, it was assumed that decommissioning would result in 10 percent of the total fuel use and emissions that would result from commissioning. An adjustable parameter was also included in the unit process, to enable the user to update this assumption. Should the commissioning and decommissioning of the mine prove to be significant, further analysis on this data point is suggested, which may result in an increase or decrease in the value of this adjustable parameter, in comparison to the default value of 10 percent.

Table 2 provides a summary of modeled input and output flows. Additional details regarding input and output flows, including calculation methods, are contained in the associated DS.

Figure 1: Unit Process Scope and Boundary

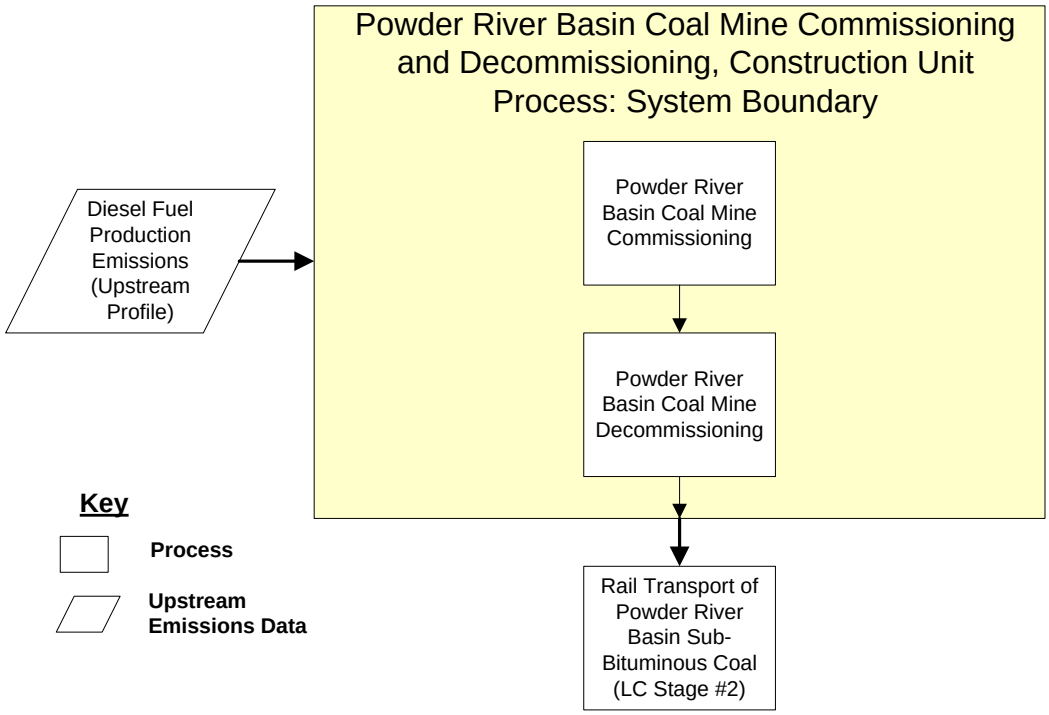

Table 1: Commissioning and Decommissioning Information

Data Point	Value	Unit	Reference
Red Cliff Mine Commissioning Time Period	1.5	years	BLM 2009
Red Cliff Yearly Mine Expected Output	7,257,000 (8,000,000)	tonnes (tons)	BLM 2009
Red Cliff Total Mine Expected Lifetime Output	217,724,000 (240,000,000)	tonnes (tons)	NETL Engineering Calculation
Powder River Basin Yearly Mine Expected Output	60,804,000 (67,025,000)	tonnes (tons)	NETL Engineering Calculation
Powder River Basin Estimated Total Mine Output	1,824,122,000 (2,010,750,000)	tonnes (tons)	NETL Engineering Calculation

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Diesel [Crude oil products]	**3.8574E-08**	**m^3**
Outputs		
PRB Coal (NETL) [Hard Coal Products]	1	kg
Carbon dioxide [Inorganic emissions to air]	1.51E-06	kg
VOC (unspecified) [Organic emissions to air (group VOC)]	5.44E-10	kg
Methane [Organic emissions to air (group VOC)]	4.51E-11	kg
Nitrogen oxides [Inorganic emissions to air]	1.21E-08	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	2.79E-11	kg
Sulphur oxide [Inorganic emissions to air]	9.85E-12	kg
Particulate Matter, unspecified [Other emissions to air]	3.41E-06	kg
Carbon monoxide [Inorganic emissions to air]	3.94E-09	kg
Mercury (+II) [Heavy metals to air]	5.13E-15	kg
Ammonia [Inorganic emissions to air]	8.46E-10	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

BLM 2009 — Bureau of Land Management. 2009. *Red Cliff Mine Draft Environmental Impact Statement, Appendix H: Air Quality Analysis Modeling Report*. U.S. Department of the Interior. http://www.blm.gov/rmp/co/redcliffmine/documents/draft_eis/Volume_II/Appendix_H_Air_Quality_Analysis_Modeling_Report.pdf (Accessed March 19, 2009).

Conaway *et al.* 2005 — Conaway, C.H., *et al*. 2005. "Estimate of mercury emission from gasoline and diesel consumption, San Francisco Bay area, California." *Atmospheric Environment* 39:101-105.

Roe *et al.* 2004 — Roe, S.M., *et al*. 2004. *Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report*. Emission Inventory Improvement Program, U.S. Environmental Protection Agency. April, 2004.

TEEIC 2010 — Tribal Energy and Environmental Information. *Coal Mining: Decommissioning and Site Reclamation Impacts.* Tribal Energy and Environmental Information. http://teeic.anl.gov/er/coal/impact/decom/index.cfm (Accessed January 21, 2010)

Section III: Document Control Information

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