NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Commissioning and Decommissioning of Illinois No. 6 Coal Mine

Reference Flow: 1 kg of Illinois No. 6 Coal

Brief Description: Calculates fuel consumption and resulting emissions to commission and decommission an Illinois No. 6 underground, bituminous coal mine in Illinois. Decommissioning values represented as a percentage of the commissioning values.

Section I: Meta Data

Geographical Coverage: US **Region:** Colorado

Year Data Best Represents: 2004

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 fuels (gasoline and diesel) and resulting combustion emissions from commissioning an Illinois No. 6 bituminous 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*
Gasoline (regular) [Crude oil products]	*Gasoline (from crude oil) input for commissioning/decommissioning machinery operations*

Tracked Output Flows:

Hard Coal (Illinois No. 6) [Hard Coal Products]	*Coal mine production flow for Illinois No. 6 bituminous coal*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and data sheet (DS) DS_Stage1_I_CommissionDecommission_I6_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 for the construction (commissioning) and the end of life (decommissioning) of an Illinois No. 6 bituminous underground coal mine located in Saline County, IL, 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) Illinois No. 6 coal, as described below and in **Figure 1**. The commissioning and decommissioning unit process includes the consumption of diesel fuel and gasoline 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 and gasoline 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 an Illinois No. 6 underground coal mine. These activities include clearing of 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,

recontouring the land around the mine to the extent warranted, and planting of vegetation to help return the land to its natural state (TEEIC 2010).

Much of the information used to model Illinois No. 6 underground bituminous coal mine operations (contained in a separate unit process) was collected from data available for the Galatia Mine, located in Saline County, IL. However, no information was available for the commissioning or decommissioning of the Galatia Mine, or of other nearby mines. As a substitute, information from the Red Cliff Mine, located in Colorado, was used. The Red Cliff Mine is a proposed underground mine that would produce a low-sulphur coal by longwall and pillar mining techniques (BLMC 2009). Information regarding the specific type of coal to be mined at Red Cliff was not available; however, the McClane Canyon Mine is located three miles north of the proposed Red Cliff Mine and produces bituminous coal. Based on the proximity of the two mines, and because Colorado is known to have substantial bituminous coal reserves, it is assumed that bituminous coal will also be produced at the Red Cliff Mine.

Figure 1 provides an overview of the boundary of this unit process. As shown, upstream emissions associated with the production and delivery of gasoline and 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 and emissions data were taken from 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**. As shown, the projected production rate for the Red Cliff Mine is 8.0 million short tons per year, while the average production rate for the Galatia Mine used for this study is approximately 6.6 million short tons per year. Although the Red Cliff Mine would have a somewhat larger production rate as compared to the Galatia Mine, it was assumed that commissioning and decommissioning fuel usage and emissions would be similar for both mines.

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 US 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

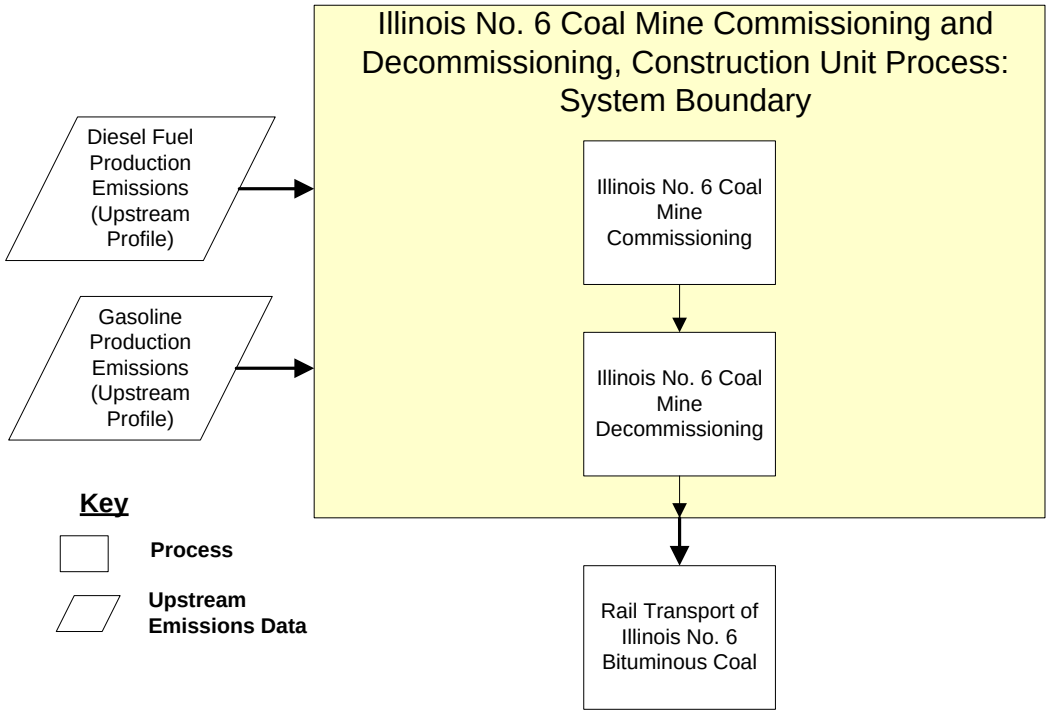

Table 1: Commissioning and Decommissioning Information

Data Point	Value	Unit	Reference
Red Cliff Mine Commissioning Time Period	1.5	years	BLM 2009
Red Cliff Yearly Mine Expected Output	8,000,000	tons	BLM 2009
Red Cliff Total Mine Expected Lifetime Output	240,000,000	tons	NETL Engineering Calculation
Galatia Yearly Mine Expected Output	6,613,000	tons	IDCEO 2008
Galatia Estimated Total Mine Output	198,000,000	tons	NETL Engineering Calculation

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Diesel [Crude oil products]	**2.89E-09**	**m^3**
Gasoline [Crude oil products]	**3.50E-12**	**m^3**
Outputs		
Hard Coal (Illinois No. 6) [Hard Coal Products]	1.00E+00	kg
Carbon dioxide [Inorganic emissions to air]	1.27E-05	kg
VOC (unspecified) [Organic emissions to air (group VOC)]	4.56E-09	kg
Methane [Organic emissions to air (group VOC)]	3.78E-10	kg
Nitrogen oxides [Inorganic emissions to air]	1.01E-07	kg
Nitrous oxide (laughing gas) [Inorganic emissions to air]	2.34E-10	kg
Sulphur oxide [Inorganic emissions to air]	8.25E-11	kg
Particulate Matter, unspecified [Other emissions to air]	3.41E-07	kg
Carbon monoxide [Inorganic emissions to air]	3.30E-08	kg
Mercury (+II) [Heavy metals to air]	3.86E-16	kg
Ammonia [Inorganic emissions to air]	6.35E-17	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).

BLMC 2009 — Bureau of Land Management Colorado. 2009. *Proposed Red Cliff Coal Mine Project Description.* Bureau of Land Management Colorado. http://www.blm.gov/co/st/en/BLM_Programs/land_use_planplan/rmp/red_cliff_mine.html (Accessed January 13, 2010)

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.

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

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