



NETL Life Cycle Inventory Data

Process Documentation File

Process Name: Biomass Grinding for Coal-Biomass Cofiring
Reference Flow: 1 kg of Ground Biomass
Brief Description: This unit process quantifies the energy use and select air emissions associated with biomass grinding. Biomass grinding is included prior to biomass combustion, either as a cofiring or standalone component.

Section I: Meta Data

Geographical Coverage: United States **Region:** N/A
Year Data Best Represents: 2010
Process Type: Auxiliary Process (AP)
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 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:

N/A

Tracked Input Flows:

Biomass [Intermediate product] *Biomass generated and transported within the boundary of the study*

Power [Electric power] *Electricity from the grid*

Tracked Output Flows:

Ground Biomass [Intermediate Product] *Reference flow*



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Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage3_O_Biomass_Grinding_2011.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers grinding of biomass, in support of coal-biomass cofiring, as described in greater detail below. Biomass grinding is the process of size reduction for chipped biomass, as it is received from biomass production and transport, in order to make it suitable for combustion and power production within a pulverized coal (PC) boiler. Because biomass is chipped during the harvesting process (within an upstream unit process), no additional size reduction is required for biomass firing within a stoker boiler. Therefore, this unit process is applicable only to cofiring within a PC boiler. This unit process considers energy use (electricity) as well as particulate emissions (wood dust) associated with biomass grinding. The calculations presented for this unit process are based on the reference flow of 1 kg of ground biomass, as described below and shown in **Figure 1**. This unit process is used under Life Cycle (LC) Stage #3 to assist in the conversion of biomass to electricity via coal-biomass cofiring.

Boundary and Description

Biomass arrives at the energy conversion facility under LC Stage #3 as chipped SRWC biomass, chipped forestry residuals, or as standard harvest switchgrass, corn stover, and other herbaceous biomass feedstocks. Biomass grinding is assumed to occur within tub grinders designed for grinding woody biomass. Energy requirements for grinding were derived from Ciolkosz and Wallace (2011), which reports that grinding requires 270 to 450 kJ electricity/kg biomass for grinding. An average value of 360 kJ/kg was used in support of this process. Particulate emissions (PM10) from the grinding process (that is, dust from grinding) were also quantified. Based on BAAQMD (2008), airborne PM10 emissions from the grinding of wood in tub grinders results in 0.0144 lb PM10 per ton of ground biomass.

Figure 1 provides an overview of the boundary of this unit process. As shown, biomass that is produced and transported within upstream unit processes is input to biomass grinding operations. Energy (electricity) consumption is then quantified for the grinding process, and is input to the system using an upstream emissions profile. Other energy use is presumed to be negligible. Air emissions of PM10 from grinding are also evaluated. This unit process then feeds into separate unit processes for biomass torrefaction and coal-biomass to electricity production within an energy conversion facility.

Figure 1: Unit Process Scope and Boundary

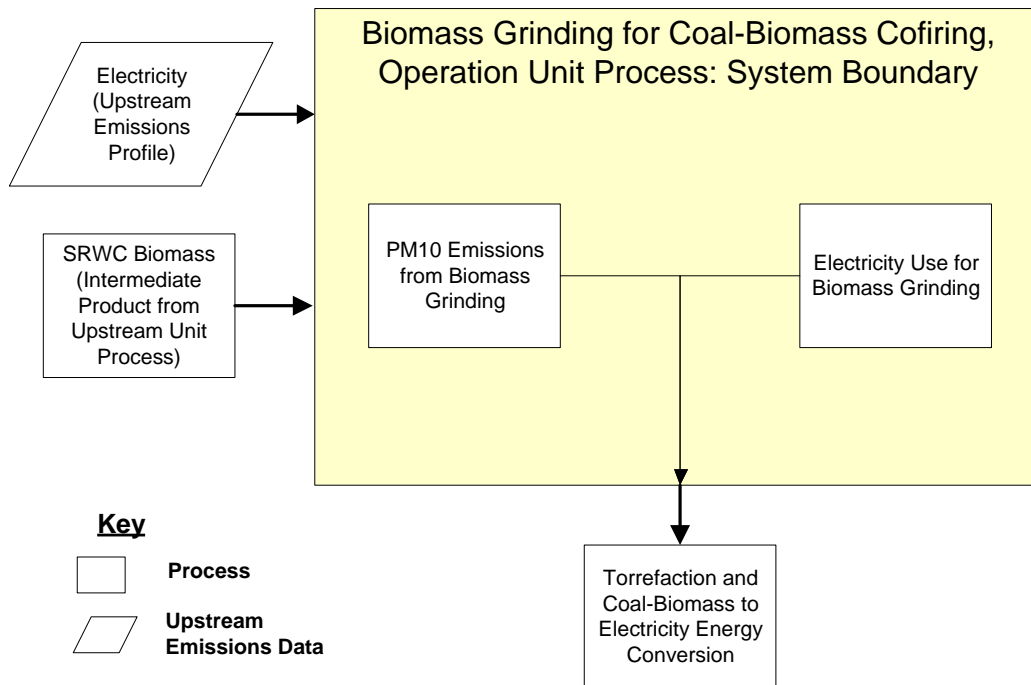


Table 1 summarizes airborne emissions factors and energy inputs and outputs that are applied within this unit process. **Table 2** provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS.

Table 1: Energy Requirements and Emission Factors

Flow Name	Value	Units (Per Reference Flow)
Grinding Energy, low	270	kJ/kg
Grinding Energy, high	450	kJ/kg
Grinding Energy, average	360	kJ/kg
Particulate Matter (PM10)	0.0144	lb/ton biomass

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Biomass [Intermediate Product]	1.000012	kg
Power [Electric power]	0.360	MJ/kg
Outputs		
Ground Biomass [Intermediate product]	1.000E+00	kg
Dust (PM10) [Particles to air]	7.206E-06	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

- BAAQMD 2008 Bay Area Air Quality Management District. 2008. Permit Handbook, Bay Area Air Quality Management District, 11.13, Tub Grinders. Available at: http://hank.baaqmd.gov/pmt/handbook/rev02/PH_00_05_11_13.pdf (Accessed on April 27, 2011).
- Ciolkosz and Wallace 2011 Ciolkosz and Wallace. 2011. A review of torrefaction for bioenergy feedstock production. Biofuels, Bioproducts, and Biorefining 10.1002/bbb.275. Available at: <http://onlinelibrary.wiley.com/doi/10.1002/bbb.275/full> (Accessed on April 27, 2011).

Section III: Document Control Information

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