NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Horizontal Wind Turbine Nacelle Cover, 1.5-6 MW

Reference Flow: 1 piece (pcs) of Horizontal Wind Turbine Nacelle Cover, 1.5-6 MW

Brief Description: This unit process tracks the materials and energy needed to manufacture a nacelle cover for a horizontal axis wind turbine, having capacities ranging from 1.5 to 6 MW. Nacelle cover is assumed to be comprised primarily of resin and fiberglass.

Section I: Meta Data

Geographical Coverage: US **Region:** Average

Year Data Best Represents: 2010

Process Type: Manufacturing Process (MP)

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

Allocation Applied: No

Completeness: All 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:

MNU_WSTE	*Percentage of manufacturing waste (scraps) in this process*
MJ_KG	*Required energy (electricity) to manufacture one piece of nacelle cover of the turbine.*
HT_CPTY	*Power production capacity of the wind turbine*
GRP_AMT	*Percentage of input Fiberglass material*

Tracked Input Flows:

Glass fibers [Minerals]	*Glass fibers for nacelle cover manufacture*
Resin glue [Operating materials]	*Resin glue used for nacelle cover manufacture*
Power [Electric power]	*Electricity used for nacelle cover manufacture*

Tracked Output Flows:

Nacelle cover [Manufacturing]	*Manufacturing of a single piece of nacelle cover supporting multi-megawatt capacity horizontal wind turbines*
Unspecified scrap waste [Consumer waste]	*Mass of manufacturing waste that is landfilled*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage3_M_HTurbine_Nacelle_Cover_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process encompasses the material and energy inputs for the manufacture a single nacelle cover for horizontal wind turbines with capacities ranging from 1.5 MW to 6.0 MW. The unit process is based on the reference flow of 1 pcs of nacelle cover. The relevant flows of this unit process are described below and shown in **Figure 1.**

This unit process is combined with other wind turbine component unit processes in an assembly unit process for a single horizontal wind turbine: *DF_Stage3_M_Assembly_Turbine_2010.01.doc*. The assembly unit process quantifies the number of each wind turbine component required to assemble a single horizontal wind turbine.

Boundary and Description

The mass relationships between turbine capacity and turbine components are based on equations developed using a wind turbine scaling model (NREL 2006). The conventional components are representative of 2002 technologies, while the advanced components represent pending designs. The equations for estimating conventional and advanced nacelle cover mass are shown in **Table 1**.

The types of materials used for nacelle cover manufacture are based on estimated material profiles for wind turbine components (NREL 2006). Glass reinforced plastic (GRP) is assumed to be 80 percent of the nacelle cover mass for both conventional and

advanced turbines (NREL 2006), with resin glue making up the remaining mass. The percentages for estimating the material compositions of conventional and advanced nacelle cover pieces are shown in **Table 1**.

This unit process assumes that scrap material is generated by the manufacturing process at a rate of one percent of the weight of the finished main shaft and bearings piece. Of this manufacturing scrap, 100 percent is landfilled (Nalukowe *et al* 2006).

Figure 1 provides an overview of the boundary of this unit process. The cradle-to-gate emissions for the production of materials used for nacelle cover manufacture (e.g., glass fibers, resin glue) are calculated outside the boundary of this unit process and are based on profiles available within the life cycle inventory (LCI) databases.

Figure 1: Unit Process Scope and Boundary

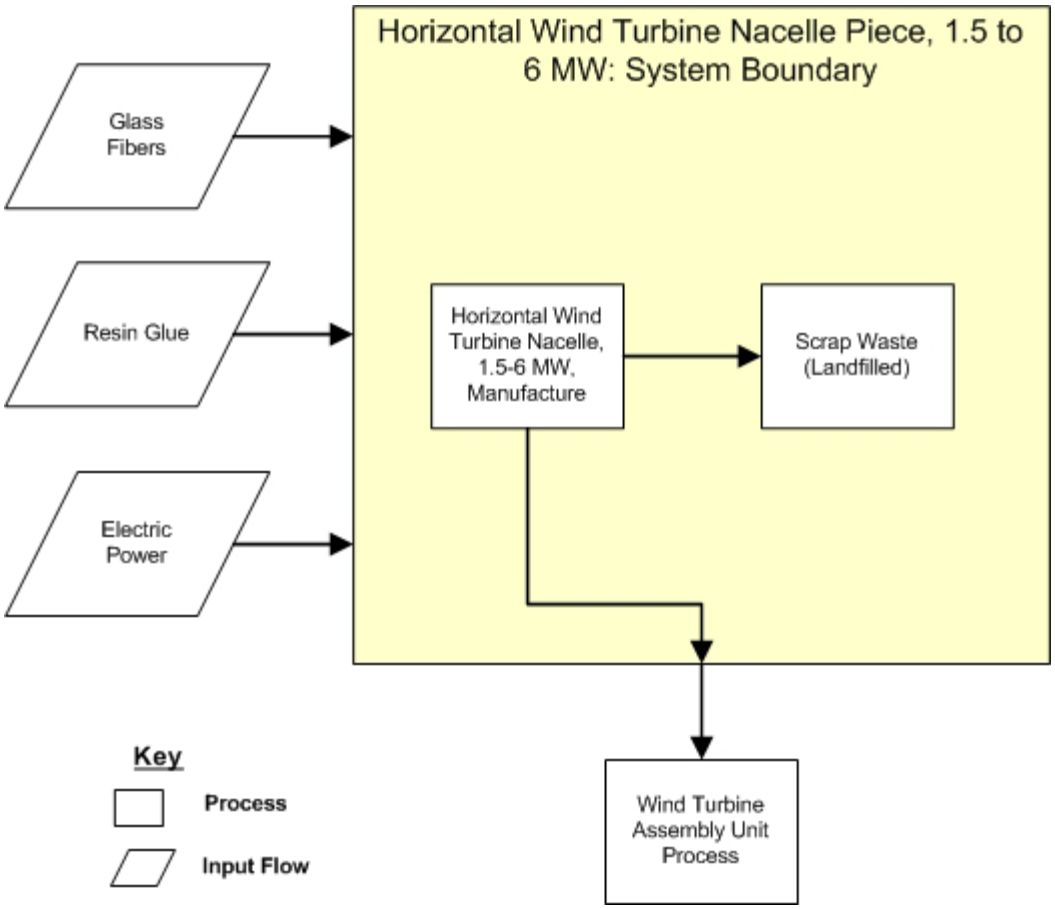

Table 1: Mass Scaling Equations for a Nacelle Cover Piece

Component	Conventional Turbine	Advanced Turbine	Notes	Source
Mass scaling equation	(11.57 x turbine rating + 3849.70) / 10	(11.57 x turbine rating + 3849.70) / 10	turbine rating is in *kw*	NREL 2006
Glass fibers	80%	80%	none	NREL 2006
Resin glue	20%	20%	none	NREL 2006

Table 2: Unit Process Input and Output Flows

Flow Name*	Conventional Turbine	Advanced Turbine	Units (Per Reference Flow)
Inputs			
Glass fibers [Minerals]	2153	2153	kg
Resin glue [Operating materials]	538.5	538.5	kg
Power [Electric power]	30046	30046	MJ
Outputs			
Nacelle cover [Manufacturing]	1.00	1.00	pcs
Unspecified scrap waste [Consumer waste]	2719	2719	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 2.

Embedded Unit Processes

None.

References

NREL 2006	Fingersh, L. Hand, M. Laxson, A. 2006. *Wind Turbine Design Cost and Scaling Model.* National Renewable Energy Laboratory. NREL/TP-500-40566. Golden, Colorado. December 2006. (Accessed June 15, 2010).
Nalukowe *et al*. 2006	Nalukowe, B.B. Liu, J. Damien, W. Lukawski, T. 2006. *Life Cycle Assessment of a Wind Turbine*. May 22, 2006.

Section III: Document Control Information

Date Created: October 25, 2010

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

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