



NETL Life Cycle Inventory Data

Process Documentation File

Resin glue [Operating materials] *Resin glue used for spinner manufacture*

Power [Electric power] *Electricity used for spinner manufacture*

Tracked Output Flows:

Horizontal turbine spinner [Manufacturing] *Manufacturing of a single piece of spinner 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_Spinner_1.5-6MW_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 spinner 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 spinner. 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 spinner mass are shown in **Table 1**.

The types of materials used for spinner manufacture are based on estimated material profiles for wind turbine components (NREL 2006). Glass reinforced plastic (GRP) is assumed to be 40 percent of the spinner mass for both conventional and advanced turbines (DOE 2008), with resin glue making up the remainder. The percentages for

estimating the material compositions of conventional and advanced spinner 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 spinner 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 spinner 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

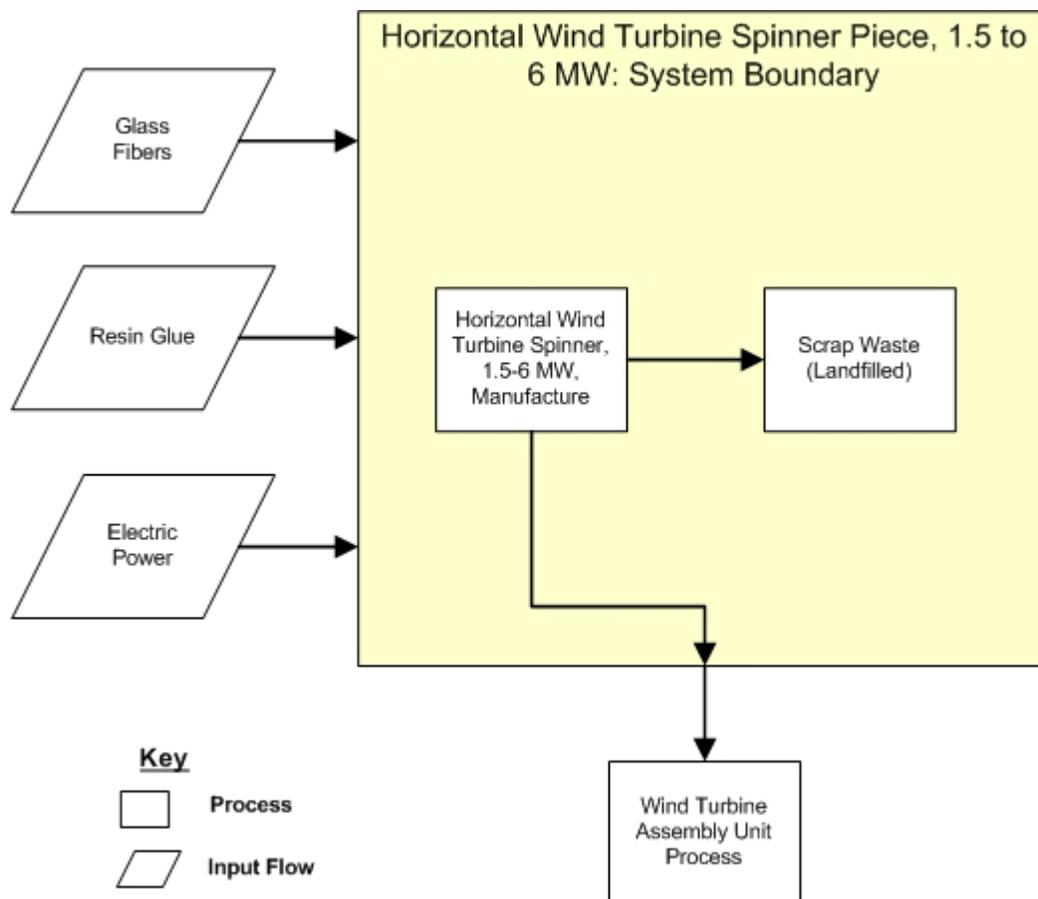


Table 1: Mass Scaling Equations for a Spinner Piece

Component	Conventional Turbine	Advanced Turbine	Notes	Source
Mass scaling equation	$18.5 \times d - 520.50$	$18.5 \times d - 520.50$	d = rotor diameter in <i>m</i>	NREL 2006
Glass fibers	40%	40%	none	DOE 2008
Resin glue	60%	60%	none	DOE 2008

Table 2: Unit Process Input and Output Flows

Flow Name*	Conventional Turbine	Advanced Turbine	Units (Per Reference Flow)
Inputs			
Glass fibers [Metals]	309.8	309.8	kg
Resin glue [Operating materials]	464.7	464.7	kg
Power [Electric power]	8542	8542	MJ
Outputs			
Horizontal turbine spinner [Manufacturing]	1.00	1.00	pcs
Unspecified scrap waste [Consumer waste]	782.3	782.3	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).
- DOE 2008 Department of Energy. 2008. *20% Wind Scenario: Wind Energy Provides 20% of U.S. Electricity Needs by 2030*. DOE/GO-102008-2578.
- 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

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