Xinjiang Goldwind Science & Technology Co., Ltd.

ENVIRONMENTAL PRODUCT DECLARATION

Product Name:	Goldwind GW155-4.5 wind turbine
Program Operator:	EPDItaly
Publisher:	EPDItaly

Declaration Number:	1
Registration Number:	EPDITALY0134

Issue Date	2020 / 12 / 10
Valid to	2025 / 12 / 10

www.epditaly.it

1. General information

EPD owner	Xinjiang Goldwind Science & Technology Co., Ltd http:// www.goldwind.com.cn
Address of the company	No.8 Bo Xing Yi Road, Beijing Economic & Technological Development Zone Yizhuang, Beijing 100176, P. R. China
Address of Rotor & Nacelle Assembly	No.99 Jianhai Road, Dafeng Economic & Technological Development Zone, Jiangsu Province, China
Company contact	Qiang WANG wangqiang27752@goldwind.com.cn
Name of the product	Goldwind GW155-4.5 wind turbine
Applied standards	ISO 14040-44 – Life cycle assessment ISO 14025 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures
PCR information	ELECTRICITY PRODUCED BY WIND TURBINES EPDItaly 013
Reference EPD system	Regulation of the EPDItaly Programme – rev.5
Program Operator & Publisher	EPDItaly Via G. De Castillia, 10 20124 Milan, Italy www.epditaly.com
LCA was performed by	IVL Swedish Environmental Research Institute www.ivl.se
Independent verifier	ICMQ Via Gaetano De Castillia, 10 - 20124 Milano, Italy https://www.icmq.it/ Accredited by ACCREDIA

2. Introduction

2.1 Company Information

Goldwind Science & Technology Co., Ltd. ("Goldwind") is one of the world's leading energy solutions company, rooted in the development and manufacturing of wind turbines. Today, Goldwind is China's largest wind energy companies with operations in strategic global markets. Goldwind is dedicated to leading clean energy development, energy conservation and environmental protection. As of year-end 2019, Goldwind has more than 60 GW of installed capacity of wind power, with more than 35,000 wind turbines operating worldwide – over 31,000 of which are Goldwind's signature permanent magnet direct-drive machines (PMDD). Goldwind operates businesses on 6 continents and in 27 countries and regions around the world, with close to 9,000 employees globally.

2.2 Scope and Type of EPD

Product name: The GW155-4.5 permanent-magnet direct-drive wind turbine
Product description: GW155-4.5 permanent-magnet direct-drive wind turbine has a design featuring horizontal axis, three blades, and upwind arrangement of rotor, variable-speed variable-pitch regulation, direct drive, and external rotor. This wind turbine has a 155-meter rotor combined with a 4.5 MW generator; the GW 155-4.5 is especially suited to Class II wind sites. The general details of the wind turbine can be seen in the Table 1 below.

Table 1. The general details of the wind turbine GW155-4.5

General details		
Item	**Unit**	**Parameters**
Basic data of wind turbine		GW 155-4.5
Manufacturer/Model		Xinjiang Goldwind Science & Technology Co., Ltd. GW 155-4.5
Rated power	kW	4500
Class of wind zone		IIIB/S
Design service life	year	≥ 20
Altitude of area where wind turbine is installed	m	0-2000 (included)
Blades		
Manufacturer/Model		GW76
Material of blade		Fiber reinforced epoxy resin
Swept area of wind turbine rotor	m2	18869
Generator		

Manufacturer		Xinjiang Goldwind Science & Technology Co., Ltd.
Generator type		Permanent magnet synchronous generator
Rated power	kW	4800
Rated voltage	V	760V±3%
Frequency range of generator	Hz	5.6 – 8.867
Protection class		IP54
Tower		
Type		Steel tower, concrete tower
Anti-corrosion class		According to Q/GW 201175-2019 onshore wind turbine general anti-corrosion specification of tower
Electrical control system		
Type of control unit		PLC
Control type		Distributed control
Main switch cabinet		Beijing Etechwin Electric Co.,Ltd
Converter		
Number of phases	phases	3
Converter type		Full power converter

Geographical scope:

The study reflects production of GW155-4.5 in China. The country grid average "CN: Electricity grid mix 1kV-60kV (China electric power yearbook)" of electricity applied for the manufacturing and assembling activities. The data for the production of electricity applied represent the country average, Chinese grid mix, for the reason that the raw materials are produced in China. The data are based on the Gabi database and the mix of energy sources are presented in Figure 1.

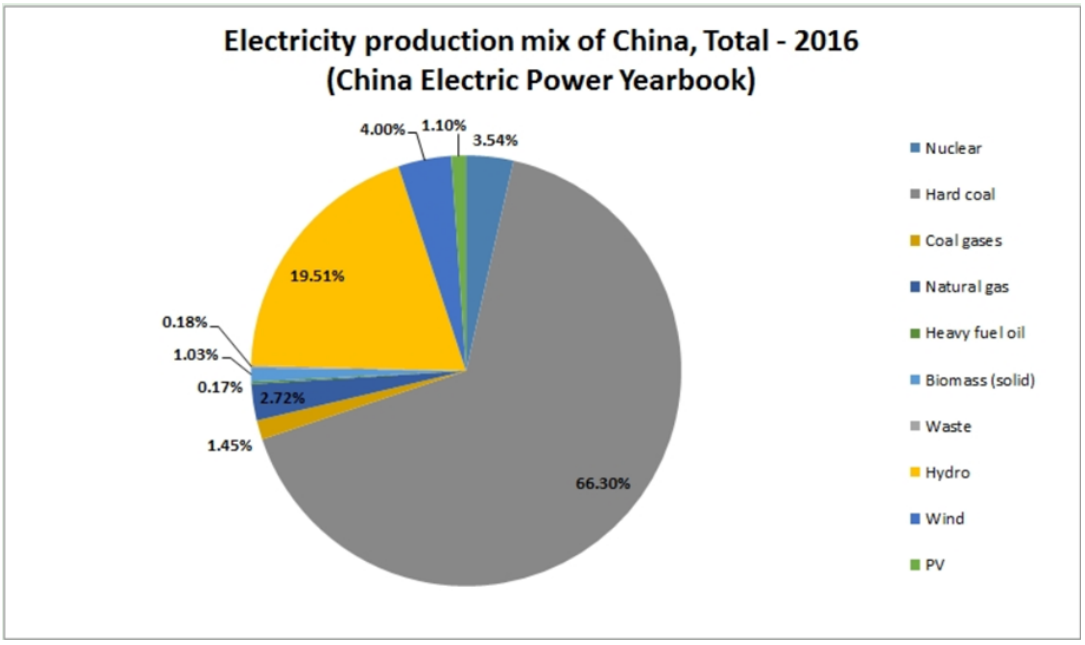

Figure 1 Mix of energy sources for electricity production.

The installation and operation site were chosen based on a wind farm located in an exemplary Canadian wind scenario. The purpose of this EPD is mainly to give an overall picture of the wind power production, which is the core business of Goldwind, rather than focus on any particular wind farm location. For the power output, the details of the report are based on the theoretical calculation of the selected Canadian wind farm.

The Goldwind GW155-4.5 wind turbine has been designed to operate under low to medium wind conditions (IIIB/S). For the purpose of this study, medium wind conditions have been selected as the baseline scenario, as Goldwind predicts medium wind sites to be representative of other major wind regimes globally. The GW155-4.5, designed by Goldwind, is one of the latest in the 4S turbine series and is currently being mass produced and installed by customers. The target markets for this turbine are North America, South America, Europe, Asia, Africa, and Australia. The Canadian wind farm located in the Saskatchewan province is an exemplary scenario, which has been analyzed for mean wind turbine generator (WTG) results and hub heights, which optimizes the produced energy.

Time representativeness: The reference year for this study is from September 2019 to September 2020. The data collected in the production process of each wind turbine components was based on the average data of factory production in the whole year from September 2019 to September 2020.

Database(s) and LCA software used: The LCA-systems are modelled in the Gabi LCA software, Gabi 9.2, SP 40 with Gabi ts data base and professional Ecoinvent database.

Product system description

This study is a cradle-to-grave LCA, assessing the potential environmental impacts associated with electricity generated from a GW155-4.5 wind turbine installed in a 99 MW onshore wind farm. An overview of the life cycle stages included in the LCA study are presented in the flow chart of Figure 2.

Product flow chart

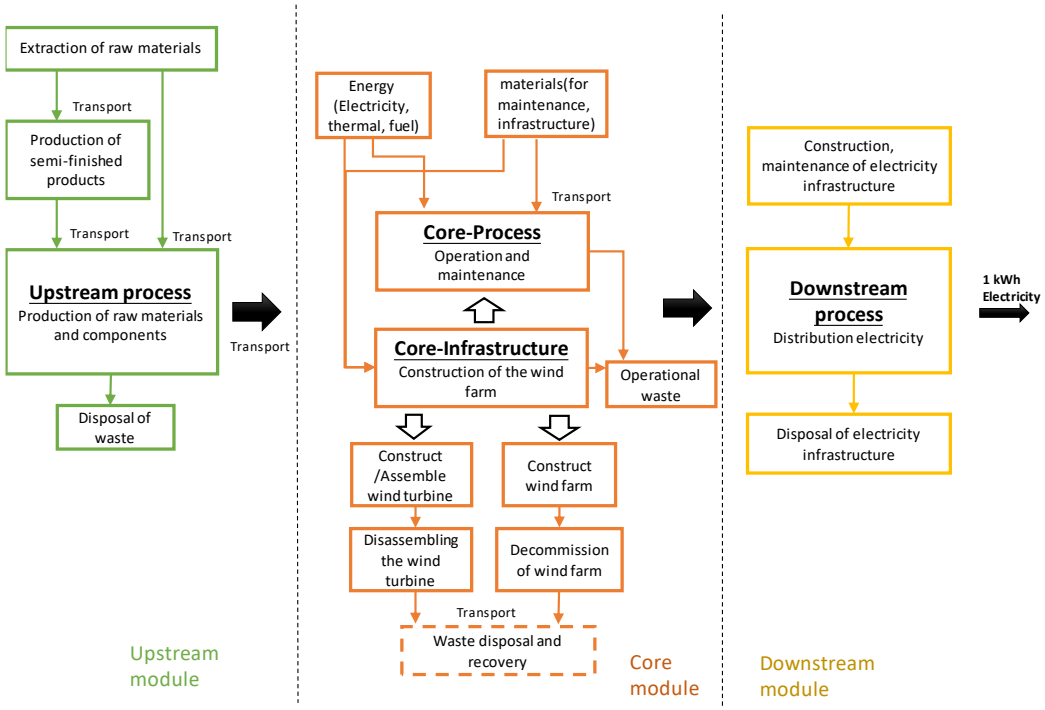

Figure 2. The flow chart of the LCA study

Function Unit:

The functional unit of this LCA study is defined as:

1 kWh of electricity generated through an onshore wind farm utilizing GW155-4.5 wind turbines, located in an exemplary Canadian scenario and operating under medium wind condition (IIIB/S), and thereafter distributed to a 245 kV Canadian electrical grid.

A total reference flow of 405 712 MWh has been used to refer all the inputs and outputs of the system to one single kWh. This reference flow represents the whole net electricity generation from one GW155-4.5 WTG under medium wind (8.5 m/s) during its reference service life (RSL). In order to ensure that the EPDs based on this PCR can be compared, a constant fixed RSL of 20 years was set.

Cut-off rules:

In this study, the cut-off criteria have been controlled of no more than 1 % of materials and energy flows within the system controlled by the EPD holder. It follows the regulation of PCR and EPDItaly system.

3. Environmental performance

In the result table below, it is possible to see the environmental performance of all categories. Each impact category result is presented in Table 2. The results are categorized into “Upstream module”, “Core module-process”, “Core module-infrastructure”, “Downstream module-process”, “Downstream module -infrastructure”.

The column named “Total generated” is the sum of upstream module and core module results. The column named “Total distributed” is the overall results.

Table 2. Results stated the environmental impacts of declared unit (per kWh)[3].

Indicator	Unit per declared unit	Upstream	Core process	Core infrastructure	Total generated [1]	Downstream process	Downstream infrastructure	Total distributed [2]
Climate Change - total	kg CO2 eq	5.10E-03	1.95E-05	1.54E-03	6.66E-03	1.77E-04	4.09E-04	7.25E-03
Climate Change - fossil	kg CO2 eq	5.11E-03	1.95E-05	1.53E-03	6.66E-03	1.77E-04	4.09E-04	7.25E-03
Climate Change - biogenic	kg CO2 eq	-1.65E-05	-5.42E-08	9.39E-06	-7.15E-06	-1.85E-07	-2.74E-07	-7.60E-06
Climate Change - land use and land use change	kg CO2 eq	3.53E-06	2.51E-08	9.30E-07	4.49E-06	1.31E-07	7.27E-07	5.35E-06
Ozone depletion	kg CFC-11 eq	4.30E-11	2.98E-12	8.87E-12	5.49E-11	2.20E-12	3.30E-11	9.01E-11
Acidification	mole H+ eq	1.98E-05	7.12E-07	1.44E-05	3.49E-05	9.43E-07	2.76E-06	3.86E-05
Eutrophication of water	kg P eq	3.47E-07	1.96E-08	2.76E-07	6.43E-07	2.05E-08	1.76E-07	8.39E-07
Photochemical ozone formation	kg NMVOC eq	1.27E-05	2.39E-07	9.71E-06	2.27E-05	6.11E-07	1.77E-06	2.50E-05
Consumption of abiotic resources - minerals and materials	kg Sb eq	2.85E-07	1.19E-08	2.92E-08	3.26E-07	8.93E-09	3.15E-08	3.67E-07
Consumption of abiotic resources - fossil resources	MJ	6.07E-02	4.46E-04	1.66E-02	7.78E-02	2.06E-03	4.71E-03	8.46E-02
Water consumption	m3	1.80E-03	7.10E-06	1.42E-04	1.95E-03	5.26E-05	1.58E-04	2.16E-03
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ	4.28E-03	2.15E-05	6.43E-04	4.95E-03	1.31E-04	3.08E-04	5.39E-03
Use of renewable primary energy resource used as raw material (PERM) [4]	MJ	INA [5]	INA	INA	INA	INA	INA	INA
Total use of renewable primary energy resources (PERT)	MJ	4.28E-03	2.15E-05	6.43E-04	4.95E-03	1.31E-04	3.08E-04	5.39E-03
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ	6.07E-02	4.46E-04	1.66E-02	7.78E-02	2.06E-03	4.71E-03	8.46E-02

Use of non-renewable primary energy resource used as raw material (PENRM) [4]	MJ	INA	INA	INA	INA	INA	INA	INA
Total use of non-renewable primary energy resources (PENRT)	MJ	6.07E-02	4.46E-04	1.66E-02	7.78E-02	2.06E-03	4.71E-03	8.46E-02
Use of secondary raw material (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water (FW)	m3	4.41E-05	1.65E-07	3.61E-06	4.78E-05	1.29E-06	3.67E-06	5.28E-05
Hazardous landfill waste (HWD)	kg	5.52E-09	9.86E-09	5.04E-10	1.59E-08	3.97E-10	0.00E+00	1.63E-08
Non-hazardous waste disposed (NHWD)	kg	8.82E-04	1.65E-08	1.22E-04	1.00E-03	2.51E-05	0.00E+00	1.03E-03
Radioactive waste disposed (RWD)	kg	2.83E-07	1.60E-10	3.34E-08	3.17E-07	7.92E-09	0.00E+00	3.25E-07
Components for reuse (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MFR)	kg	0.00E+00	0.00E+00	1.28E-03	1.28E-03	3.20E-05	0.00E+00	1.31E-03
Material for energy recovery (MER)	kg	INA	INA	INA	INA	INA	INA	INA
Exported electrical energy (EEE)	MJ	INA	INA	INA	INA	INA	INA	INA
Exported thermal energy (ETE)	MJ	INA	INA	INA	INA	INA	INA	INA

(1) "Total generated" represented the environmental impacts generated from "Upstream", "Core process", "Core infrastructure". The impacts from downstream module was not included.

(2) "Total distributed" represented the environmental impacts from the whole life cycle stage of the WTG during the RSL. It was the sum of "Upstream", "Core process", "Core infrastructure", "Downstream process", "Downstream infrastructure".

(3) This table presented the impacts value which have been scaled to 1 kWh as the declared unit.

(4) Input data from databases, trade organizations etc. do NOT distinguish between resources used as material and energy, even though there is a difference in practice.

(5) "INA" represent the indicator has not been evaluated the output.

As data in the above, the upstream has the greatest contribution to the climate change, which is responsible for 70 % of the total CO_2 and other greenhouse gas emissions in terms of global warming potential. On average, the upstream is responsible for 62 % of all the environmental impact categories. The second largest environmental factor is the core infrastructure, which is responsible for 22 % environmental impacts on average. Among all the environmental impacts for downstream infrastructure, the photochemical ozone formation and eutrophication of water have the largest impact, which is 37 % and 21 % respectively. The core process and downstream process has relatively low environmental impact, which is on average 2% and 2% respectively.

4. References

EPDItaly013, PCR Title: ELECTRICITY PRODUCED BY WIND TURBINES;

The EPDItaly system, https://www.epditaly.it

Gabi database. The Gabi database 9.2 (SP40) was used. SP40 relates to the ServicePak level of the Gabi 2020 database.

Gabi LCA software. The Gabi LCA software and corresponding database are provided by thinkstep in Leinfelden-Echterdingen, Germany. Gabi version 9 was used.

LCA database published by the ecoinvent association originally known as the ecoinvent Centre, the Swiss Centre for Life Cycle Inventories. Since June 2013 ecoinvent is a not-for-profit association founded by institutes of the ETH Domain and the Swiss Federal Offices. The version 3.6 from 2019, September was used.

ISO (2006a). ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

ISO (2006b). ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

ISO (2006c). ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines.

Thinkstep. The provider of the Gabi LCA software and database.

World Steel Association (worldsteel) is an industry association, with members in every major steel-producing country, representing steel producers, national and regional steel industry associations, and steel research institutes.

Technical Specification, GW155-4.5 V40R02C100 Wind Turbine Technical Specification Edition: A No.:GW-08CP.0055, Xinjiang Goldwind Science & Technology Co., Ltd.

Specification for complete structure tree of direct drive permanent magnet unit for wind turbine generator sets, Enterprise (tentative) standard of Goldwind Technology Co., LTD, Q/GW200032—2019