Goldwind Science & Technology Co., Ltd.

ENVIRONMENTAL PRODUCT DECLARATION

In compliance with ISO 14025

Product Name: Goldwind GWH170-7.2&GWH175-7.8&GWH182-8.0 Wind Turbine

Sites Plant: Dafeng & Funing, Jiangsu Province, China

Program Operator:	EPDItaly
Publisher:	EPDItaly

Declaration Number	6
Registration Number	EPDITALY 0852

Issue Date	10/02/2025
Valid to	10/02/2030

www.epditaly.it

1. General information

EPD OWNER	
Name of the company	Goldwind Science & Technology Co., Ltd.
Registered office	NO.8 Boxing 1st Road, Economic & Technological Development Zone,Beijing, P. R. China
Contacts for information on the EPD	Yang Liwen yangliwen@goldwind.com

PROGRAM OPERATOR	
EPDItaly	Via Gaetano De Castillian° 10 - 20124 Milano, Italy

INFORMATION ON THE EPD	
Product name (s)	Goldwind GWH170-7.2 & GWH175-7.8 & GWH182-8.0 wind turbine
Site (s)	No.5, Xiang Feng Road, Dafeng Economic & Technology Development Zone, Yanchen, Jiangsu Province, P. R. China No.23, Xiexin Road, Funing Economic & Technology Development Zone, Yanchen, Jiangsu Province, P. R. China
Short description and technical information of the product (s)	wind turbine
Field of application of the product (s)	Wind power generation
Product (s) reference standards (if any)	IEC 61400-1 Wind energy generation systems - Part 1: Design requirements
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	171 "Electrical energy"

VERIFICATION INFORMATION	
PCR (title, version, date of publication or update)	ELECTRICITY PRODUCED BY WIND TURBINES EPDItaly 013 – rev. 1, issue date: 16-03-2020; validity: 15-03-2025;
EPDItaly Regulation (version, date of publication or update)	Regulation of the EPDItaly Programme – rev. 6, issue date: 30-10-2023
Project Report LCA	
Independent Verification Statement	The PCR review was performed by **Ing. Daniele Pace, Arch. Michele Paleari,**

	Ing. Sara Toniolo - info@epditaly.it. Independent verification of the declaration and data, carried out according to ISO 14025: 2010. Internal ☑ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability Statement	Environmental statements published within the same product category, but from different programs, may not be comparable.
Liability Statement	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for life cycle assessment.

OTHER INFORMATION	

2. Introduction

2.1 Company Information

Goldwind Science Technology company is the pioneer and witness in the growth and development of wind power industry in China. Today, with operations in strategic global markets, Goldwind is dedicated to leading clean energy development, energy conservation and environmental protection. As of Jun. 2024, Goldwind has more than 123 GW of installed capacity of wind power, with more than 52 000 wind turbines operating worldwide. Goldwind Technology has been operating business in 6 continents and 43 countries and regions in the world, with above 10 000 employees globally.

2.2 Scope and Type of EPD

Product name: GWH170-7.2&GWH175-7.8&GWH182-8.0 medium-speed permanent-magnet wind turbine

Product description: Goldwind GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine features horizontal axis, three blades, upwind rotor, variable-speed variable-pitch regulation, medium speed drive train, and full-power converter. Goldwind GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine is the third generation of the product route of medium speed and permanent magnet and features excellent power generation performance, high reliability, grid friendliness, and high adaptability. The wind turbine is also highly deliverable based on its modular design and the mature global supply chain of wind turbine components. The general details of the wind turbine can be seen in the Table 1 below.

Table 1. The general details of the wind turbine GWH170-7.2&GWH175-7.8&GWH182-8.0

General details		
Item	**Unit**	**Parameters**
Basic data of wind turbine		GWH170-7.2&GWH175-7.8&GWH182-8.0
Manufacturer/Model		Goldwind Science & Technology Co., Ltd GWH170-7.2&GWH175-7.8&GWH182-8.0
Rated power	kW	7,200 (GWH 170-7.2) 7,800 (GWH 175-7.8) 8,000 (GWH 182-8.0)
Class of wind zone		S
Design service life	year	≥ 20, rated 25
Altitude of area where wind turbine is installed	m	0-2,000 (included)
Blades		
Manufacturer/Model		GW83.3,GW86, Sinoma90.2
Material of blade		Glass fibre reinforced resin
Swept area of wind turbine rotor	m^2	22698, 24053, 26016
Generator		
Manufacturer		Goldwind Science & Technology Co. Ltd
Generator type		Permanent magnet
Rated power	kW	7,500 (GWH 170-7.2) 8,100 (GWH 175-7.8) 8,300 (GWH 182-8.0)
Rated voltage	V	1380V
Frequency range of generator	Hz	55~102 (GWH 170-7.2) 55~104 (GWH 175-7.8) 55~106 (GWH 182-8.0)
Protection class		IP54

Tower		
Type		Tapered steel tower (equipped with ladders and fall protection inside).
Anti-corrosion class		Internal: C3; external: C4
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 liquid-cooled converter
Main materials for the wind turbine production		
Fiberglass, Resin (polyester), Resin (Voltacast 3200), Balsa wood		
Stainless steel, Cast iron, Aluminium alloy, Alloy steel (42CrMo4), Q235-A steel, S355/S325 low alloyed steel, Copper, 65WH600 silicon steel sheet, Galvanized steel sheet.		

Geographical scope:

The study reflects production of GWH170-7.2&GWH175-7.8&GWH182-8.0 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. The data are based on the Gabi database and the mix of energy sources are presented in Figure 1.

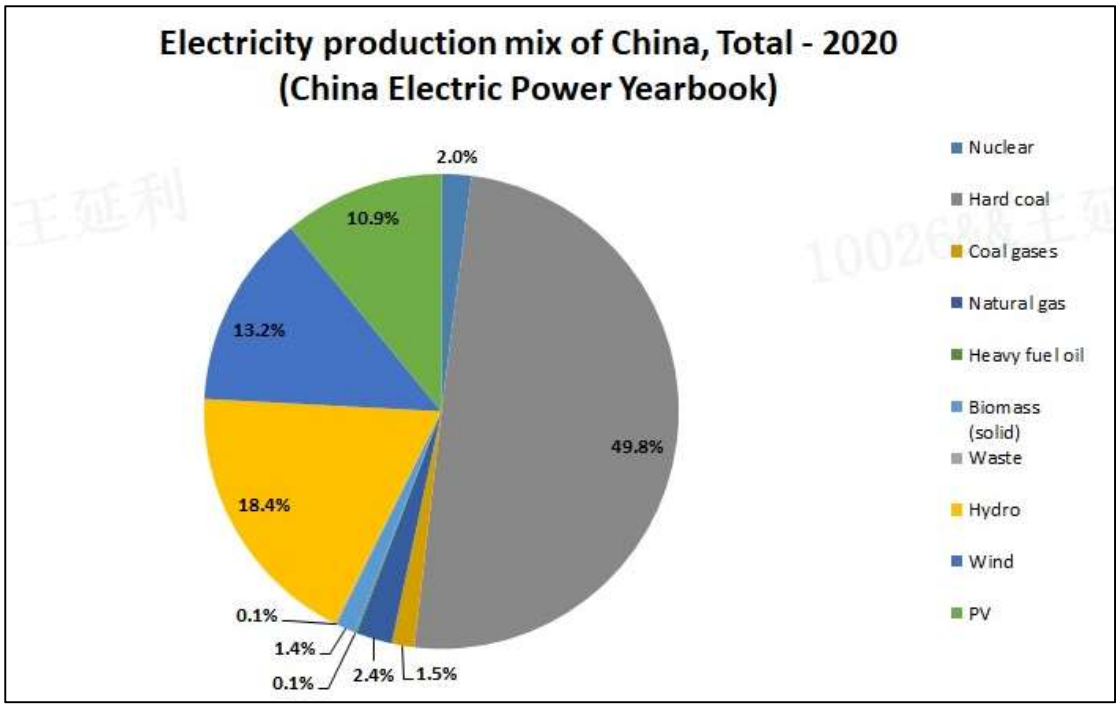

Figure 1. Mix of energy sources for electricity production.

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

The Goldwind GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine has been designed to operate under special design conditions（IEC S）. The GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine's target markets meet North America, South America, Europe, Asia, Africa, and Australia. The Tanzania wind farm is an exemplary scenario, which has been analyzed for mean WTG results and hub heights, which optimizes the produced energy.

Time representativeness: The reference years for this study are from Jan. 2023 to Dec. 2024. The data collected in the production process of each wind turbine components was based on the data of factory production in the two years from Jan. 2023 to Dec. 2024.

Database(s) and LCA software used: The LCA-systems are modelled in the Gabi LCA software, with Gabi TS database and professional Ecoinvent 3.9.1 database.

Product system description

This study is a cradle-to-grave LCA, assessing the potential environmental impacts associated with electricity generated from GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine and fed to the grid. An overview of the life cycle stages included in the LCA study are presented by the figure below.

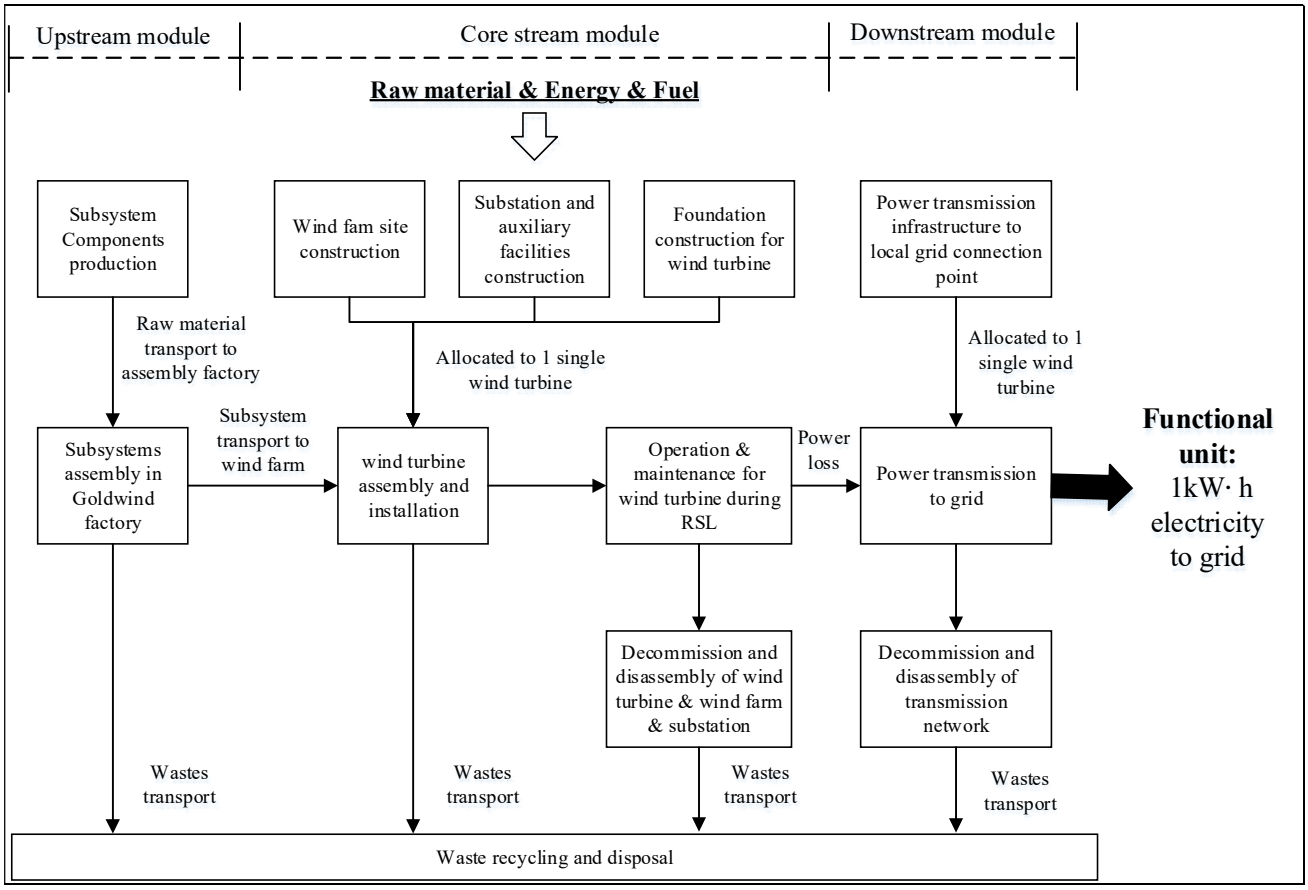

Figure 2. GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine product system for LCA

Function Unit:

The functional unit of this LCA study is defined as:

1 kWh of electricity delivered to the grid by a 100MW wind farm of GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbines located in Miombo, Tanzania.

According to the PCR EPDItaly013 that a constant fixed reference service life of 20 years is assumed, in order to ensure that EPDs based on the PCR can be compared, so we calculated the electricity data for a reference service life of 20 years based on the rated power of this series of wind turbines during its 25 years rated lifecycle. When the RSL equals 20years, total reference flow is 774216.96 MWh for GWH170-7.2MW, 820705.92 MWh for GWH175-7.8MW and 820874.88 MWh for GWH182-8.0MW. They have been used to refer all the inputs and outputs of the system to 1 single kWh. This reference flow represents the whole net electricity generated from one GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine and fed to gird under medium wind (10.90 m/s) during its reference service life (RSL) of 20 years.

Total reference flow is 967771.20 MWh for GWH170-7.2MW, 1025882.40 MWh for GWH175-7.8MW and 1026093.60 MWh for GWH182-8.0MW. They have been used to refer all the inputs and outputs of the system to 1 single kWh. This reference flow represents the whole net electricity generated from one GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine and fed to gird under medium wind (10.90 m/s) during its reference service life (RSL) of 25 years.

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 with RSL=20 years

According to the PCR EPDItaly013 that a constant fixed reference service life of 20 years is assumed, in order to ensure that EPDs based on the PCR can be compared, so we calculated the environmental impact data for a reference service life of 20 years based on the environmental impact of this type of wind turbine during its 25 years rated lifespan. The environmental impact indicators determined by EN 15804:2012+A2:2019 are applied for the LCIA study. The total 20years life-cycle environmental impact results of GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbines are shown in Table 2.

Table 2. The total environmental impact results of GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine(1)~(4)

GWH170-7.2MW						
Impact indicator	**Unit per declared unit**	**Upstream stage**	**Core-process**	**Core-infrastructure**	**Downstream stage**	**Total environmental impact**
Global Warming Potential total (GWP-total)	**kg CO_2 eq**	3.18E-03	2.03E-05	1.41E-03	1.03E-04	4.71E-03
Global Warming Potential total (GWP-fossil)	**kg CO_2 eq**	3.19E-03	2.02E-05	1.40E-03	1.03E-04	4.71E-03
Global Warming Potential total (GWP-biogenic)	**kg CO_2 eq**	-3.21E-06	3.10E-08	8.39E-06	8.05E-08	5.29E-06
Global Warming Potential total (GWP-luluc)	**kg CO_2 eq**	8.91E-07	1.01E-08	6.77E-07	1.87E-07	1.77E-06
Depletion potential of the stratospheric ozone layer (ODP)	**kg CFC-11 eq**	9.45E-14	8.53E-14	4.13E-12	1.52E-12	5.83E-12
Acidification potential, Accumulated Exceedance (AP)	**Mole of H+ eq**	9.96E-06	1.04E-07	6.27E-06	1.08E-06	1.74E-05
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	**kg P eq**	3.46E-08	2.84E-09	9.12E-08	5.87E-08	1.87E-07
Eutrophication, marine	**kg N eq.**	2.27E-06	1.43E-08	1.78E-06	2.21E-07	4.28E-06
Eutrophication, terrestrial	**Mole of N eq.**	2.33E-05	1.56E-07	1.93E-05	2.42E-06	4.51E-05
Formation potential of tropospheric ozone (POCP)	**kg NMVOC eq**	7.01E-06	6.47E-08	5.03E-06	7.92E-07	1.29E-05
Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	**kg Sb eq**	2.67E-08	7.56E-11	2.06E-08	5.96E-09	5.33E-08

Abiotic Depletion for non-fossil resources potential (ADP-fossil)	**MJ**	4.36E-02	6.26E-04	1.46E-02	1.40E-03	6.02E-02
Water deprivation potential, deprivation-weighted water consumption (WDP)	**m³**	8.35E-04	6.01E-06	2.42E-04	3.76E-05	1.12E-03
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	**MJ**	1.13E-02	9.25E-06	7.39E-04	9.60E-05	1.21E-02
Use of renewable primary energy resources used as raw material (PERM)	**MJ**	0	0	0	0	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	**MJ**	1.13E-02	9.25E-06	7.39E-04	9.60E-05	1.21E-02
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	**MJ**	4.36E-02	6.26E-04	1.46E-02	1.40E-03	6.02E-02
Use of non-renewable primary energy resource used as raw material (PENRM)	**MJ**	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	**MJ**	4.36E-02	6.26E-04	1.46E-02	1.40E-03	6.02E-02
Use of secondary raw materials (SM)	**Kg**	0	0	0	0	0
Use of renewable secondary fuels (RSF)	**MJ**	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	**MJ**	0	0	0	0	0
Net use of fresh water (FW)	**m³**	8.39E-05	1.40E-07	6.37E-06	8.75E-07	9.13E-05
Hazardous landfill waste (HWD)	**kg**	2.67E-11	1.01E-16	8.51E-13	1.14E-20	2.76E-11
Non-hazardous waste disposed (NHWD)	**kg**	1.23E-04	3.76E-09	7.35E-05	6.09E-13	1.96E-04
Radioactive waste disposed (RWD)	**kg**	5.19E-07	1.25E-10	1.91E-08	4.84E-15	5.38E-07
Components for reuse (CRU)	**kg**	0	0	0	0	0
Materials for recycling (MFR)	**kg**	6.83E-04	0	2.01E-04	1.16E-06	8.85E-04
Material for energy recovery (MER)	**kg**	0	0	0	0	0
Exported electrical energy (EEE)	**kg**	0	0	0	0	0
Exported thermal energy (EET)	**kg**	0	0	0	0	0

GWH175-7.8MW						
Impact indicator	**Unit per declared unit**	**Upstream stage**	**Core-process**	**Core-infrastructure**	**Downstream stage**	**Total environmental impact**

Global Warming Potential total (GWP-total)	**kg CO_2 eq**	3.04E-03	1.91E-05	1.40E-03	9.73E-05	4.55E-03
Global Warming Potential total (GWP-fossil)	**kg CO_2 eq**	3.04E-03	1.91E-05	1.39E-03	9.70E-05	4.55E-03
Global Warming Potential total (GWP-biogenic)	**kg CO_2 eq**	-2.36E-06	2.92E-08	7.45E-06	7.59E-08	5.20E-06
Global Warming Potential total (GWP-luluc)	**kg CO_2 eq**	8.41E-07	9.55E-09	6.68E-07	1.76E-07	1.69E-06
Depletion potential of the stratospheric ozone layer (ODP)	**kg CFC-11 eq**	1.56E-12	8.04E-14	4.14E-12	1.43E-12	7.21E-12
Acidification potential, Accumulated Exceedance (AP)	**Mole of H+ eq**	9.48E-06	9.83E-08	6.50E-06	1.02E-06	1.71E-05
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	**kg P eq**	3.01E-08	2.68E-09	9.14E-08	5.54E-08	1.80E-07
Eutrophication, marine	**kg N eq.**	2.17E-06	1.35E-08	1.87E-06	2.09E-07	4.26E-06
Eutrophication, terrestrial	**Mole of N eq.**	2.23E-05	1.47E-07	2.03E-05	2.28E-06	4.50E-05
Formation potential of tropospheric ozone (POCP)	**kg NMVOC eq**	6.67E-06	6.10E-08	5.34E-06	7.47E-07	1.28E-05
Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	**kg Sb eq**	2.48E-08	7.13E-11	2.10E-08	5.62E-09	5.15E-08
Abiotic Depletion for non-fossil resources potential (ADP-fossil)	**MJ**	4.17E-02	5.90E-04	1.45E-02	1.32E-03	5.82E-02
Water deprivation potential, deprivation-weighted water consumption (WDP)	**m^3**	8.09E-04	5.67E-06	2.41E-04	3.54E-05	1.09E-03
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	**MJ**	1.09E-02	8.73E-06	7.29E-04	9.05E-05	1.17E-02
Use of renewable primary energy resources used as raw material (PERM)	**MJ**	0	0	0	0	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	**MJ**	1.09E-02	8.73E-06	7.29E-04	9.05E-05	1.17E-02
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	**MJ**	4.17E-02	5.90E-04	1.45E-02	1.32E-03	5.82E-02
Use of non-renewable primary energy resource used as raw material (PENRM)	**MJ**	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy	**MJ**	4.17E-02	5.90E-04	1.45E-02	1.32E-03	5.82E-02

resources used as raw materials) (PENRT)						
Use of secondary raw materials (SM)	Kg	0	0	0	0	0
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	MJ	0	0	0	0	0
Net use of fresh water (FW)	m^3	7.98E-05	1.32E-07	6.32E-06	8.25E-07	8.71E-05
Hazardous landfill waste (HWD)	kg	2.52E-11	9.49E-17	8.27E-13	1.08E-20	2.60E-11
Non-hazardous waste disposed (NHWD)	kg	1.16E-04	3.54E-09	7.26E-05	5.74E-13	1.88E-04
Radioactive waste disposed (RWD)	kg	4.97E-07	1.18E-10	1.91E-08	4.57E-15	5.17E-07
Components for reuse (CRU)	kg	0	0	0	0	0
Materials for recycling (MFR)	kg	6.44E-04	0	1.91E-04	1.10E-06	8.36E-04
Material for energy recovery (MER)	kg	0	0	0	0	0
Exported electrical energy (EEE)	kg	0	0	0	0	0
Exported thermal energy (EET)	kg	0	0	0	0	0

GWH182-8.0MW

Impact indicator	Unit per declared unit	Upstream stage	Core-process	Core-infrastructure	Downstream stage	Total environmental impact
Global Warming Potential total (GWP-total)	kg CO_2 eq	2.94E-03	1.91E-05	1.35E-03	9.73E-05	4.40E-03
Global Warming Potential total (GWP-fossil)	kg CO_2 eq	2.94E-03	1.91E-05	1.34E-03	9.70E-05	4.39E-03
Global Warming Potential total (GWP-biogenic)	kg CO_2 eq	-2.20E-06	2.92E-08	7.96E-06	7.59E-08	5.88E-06
Global Warming Potential total (GWP-luluc)	kg CO_2 eq	8.27E-07	9.55E-09	6.57E-07	1.76E-07	1.67E-06
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq	7.62E-13	8.04E-14	4.05E-12	1.43E-12	6.33E-12
Acidification potential, Accumulated Exceedance (AP)	Mole of H+ eq	9.27E-06	9.83E-08	5.99E-06	1.02E-06	1.64E-05
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg P eq	2.90E-08	2.68E-09	8.97E-08	5.54E-08	1.77E-07
Eutrophication, marine	kg N eq.	2.08E-06	1.35E-08	1.69E-06	2.09E-07	4.00E-06
Eutrophication, terrestrial	Mole of N eq.	2.13E-05	1.47E-07	1.83E-05	2.28E-06	4.21E-05
Formation potential of tropospheric ozone (POCP)	kg NMVOC eq	6.44E-06	6.10E-08	4.79E-06	7.47E-07	1.20E-05
Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	kg Sb eq	2.46E-08	7.13E-11	2.10E-08	5.62E-09	5.13E-08
Abiotic Depletion for non-fossil resources potential (ADP-fossil)	MJ	3.94E-02	5.90E-04	1.40E-02	1.32E-03	5.53E-02
Water deprivation potential, deprivation-	m^3	7.60E-04	5.67E-06	2.32E-04	3.54E-05	1.03E-03

weighted water consumption (WDP)						
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	**MJ**	1.01E-02	8.73E-06	7.17E-04	9.05E-05	1.09E-02
Use of renewable primary energy resources used as raw material (PERM)	**MJ**	0	0	0	0	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	**MJ**	1.01E-02	8.73E-06	7.17E-04	9.05E-05	1.09E-02
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	**MJ**	3.94E-02	5.90E-04	1.40E-02	1.32E-03	5.53E-02
Use of non-renewable primary energy resource used as raw material (PENRM)	**MJ**	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	**MJ**	3.94E-02	5.90E-04	1.40E-02	1.32E-03	5.53E-02
Use of secondary raw materials (SM)	**kg**	0	0	0	0	0
Use of renewable secondary fuels (RSF)	**MJ**	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	**MJ**	0	0	0	0	0
Net use of fresh water (FW)	**m^3**	7.81E-05	1.32E-07	6.11E-06	8.25E-07	8.52E-05
Hazardous landfill waste (HWD)	**kg**	2.50E-11	9.49E-17	8.18E-13	1.08E-20	2.59E-11
Non-hazardous waste disposed (NHWD)	**kg**	1.15E-04	3.54E-09	7.07E-05	5.74E-13	1.86E-04
Radioactive waste disposed (RWD)	**kg**	4.63E-07	1.18E-10	1.90E-08	4.57E-15	4.82E-07
Components for reuse (CRU)	**kg**	0	0	0	0	0
Materials for recycling (MFR)	**kg**	6.44E-04	0	1.91E-04	1.10E-06	8.36E-04
Material for energy recovery (MER)	**kg**	0	0	0	0	0
Exported electrical energy (EEE)	**kg**	0	0	0	0	0
Exported thermal energy (EET)	**kg**	0	0	0	0	0

(1) This table presented the impact value with scaled to 1 kWh as the declared unit.

(2) The impact category provides a zero result since components reuse has not been applied in Goldwind due to the barriers of recovery value, suitability, and technical possibility.

(3) According to PCR that the recovery process which take place outside the boundaries of the product system, only impacts related to the transportation of the waste to the treatment platform should be taken into account. Thus the exported thermal energy and electricity energy provides a zero result .

(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.

4. Environmental performance with Rated 25years life

The environmental impact indicators determined by EN 15804:2012+A2:2019 are applied for the LCIA study. The total rated life-cycle environmental impact results of GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbines are shown in Table 3.

Table 3. The total environmental impact results of GWH170-7.2&GWH175-7.8&GWH182-8.0 wind turbine(1)~(4)

GWH170-7.2MW						
Impact indicator	**Unit per declared unit**	**Upstream stage**	**Core-process**	**Core-infrastructure**	**Downstream stage**	**Total environmental impact**
Global Warming Potential total (GWP-total)	**kg CO_2 eq**	2.55E-03	1.62E-05	1.13E-03	8.25E-05	3.77E-03
Global Warming Potential total (GWP-fossil)	**kg CO_2 eq**	2.55E-03	1.62E-05	1.12E-03	8.23E-05	3.77E-03
Global Warming Potential total (GWP-biogenic)	**kg CO_2 eq**	-2.56E-06	2.48E-08	6.71E-06	6.44E-08	4.23E-06
Global Warming Potential total (GWP-luluc)	**kg CO_2 eq**	7.13E-07	8.10E-09	5.42E-07	1.50E-07	1.41E-06
Depletion potential of the stratospheric ozone layer (ODP)	**kg CFC-11 eq**	7.56E-14	6.82E-14	3.31E-12	1.22E-12	4.67E-12
Acidification potential, Accumulated Exceedance (AP)	**Mole of H+ eq**	7.97E-06	8.34E-08	5.01E-06	8.63E-07	1.39E-05
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	**kg P eq**	2.76E-08	2.27E-09	7.29E-08	4.70E-08	1.50E-07
Eutrophication, marine	**kg N eq.**	1.82E-06	1.15E-08	1.42E-06	1.77E-07	3.43E-06
Eutrophication, terrestrial	**Mole of N eq.**	1.86E-05	1.24E-07	1.54E-05	1.93E-06	3.61E-05
Formation potential of tropospheric ozone (POCP)	**kg NMVOC eq**	5.61E-06	5.17E-08	4.02E-06	6.34E-07	1.03E-05
Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	**kg Sb eq**	2.13E-08	6.04E-11	1.65E-08	4.77E-09	4.27E-08
Abiotic Depletion for non-fossil resources potential (ADP-fossil)	**MJ**	3.49E-02	5.01E-04	1.17E-02	1.12E-03	4.82E-02
Water deprivation potential, deprivation-weighted water consumption (WDP)	**m^3**	6.68E-04	4.81E-06	1.93E-04	3.01E-05	8.96E-04
Use of renewable primary energy excluding renewable primary energy	**MJ**	9.01E-03	7.40E-06	5.91E-04	7.68E-05	9.68E-03

resources used as raw material (PERE)						
Use of renewable primary energy resources used as raw material (PERM)	MJ	0	0	0	0	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ	9.01E-03	7.40E-06	5.91E-04	7.68E-05	9.68E-03
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ	3.49E-02	5.01E-04	1.17E-02	1.12E-03	4.82E-02
Use of non-renewable primary energy resource used as raw material (PENRM)	MJ	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ	3.49E-02	5.01E-04	1.17E-02	1.12E-03	4.82E-02
Use of secondary raw materials (SM)	Kg	0	0	0	0	0
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	MJ	0	0	0	0	0
Net use of fresh water (FW)	m^3	6.71E-05	1.12E-07	5.10E-06	7.00E-07	7.30E-05
Hazardous landfill waste (HWD)	kg	2.14E-11	8.05E-17	6.81E-13	9.15E-21	2.20E-11
Non-hazardous waste disposed (NHWD)	kg	9.82E-05	3.01E-09	5.88E-05	4.87E-13	1.57E-04
Radioactive waste disposed (RWD)	kg	4.15E-07	9.98E-11	1.53E-08	3.87E-15	4.31E-07
Components for reuse (CRU)	kg	0	0	0	0	0
Materials for recycling (MFR)	kg	5.46E-04	0	1.61E-04	9.30E-07	7.08E-04
Material for energy recovery (MER)	kg	0	0	0	0	0
Exported electrical energy (EEE)	kg	0	0	0	0	0
Exported thermal energy (EET)	kg	0	0	0	0	0

GWH175-7.8MW

Impact indicator	Unit per declared unit	Upstream stage	Core-process	Core-infrastructure	Downstream stage	Total environmental impact
Global Warming Potential total (GWP-total)	kg CO_2 eq	2.43E-03	1.53E-05	1.12E-03	7.78E-05	3.64E-03
Global Warming Potential total (GWP-fossil)	kg CO_2 eq	2.43E-03	1.53E-05	1.11E-03	7.76E-05	3.64E-03
Global Warming Potential total (GWP-biogenic)	kg CO_2 eq	-1.89E-06	2.34E-08	5.96E-06	6.07E-08	4.16E-06
Global Warming Potential total (GWP-luluc)	kg CO_2 eq	6.72E-07	7.64E-09	5.34E-07	1.41E-07	1.36E-06

Depletion potential of the stratospheric ozone layer (ODP)	**kg CFC-11 eq**	1.25E-12	6.43E-14	3.31E-12	1.15E-12	5.77E-12
Acidification potential, Accumulated Exceedance (AP)	**Mole of H+ eq**	7.59E-06	7.87E-08	5.20E-06	8.14E-07	1.37E-05
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	**kg P eq**	2.41E-08	2.14E-09	7.31E-08	4.43E-08	1.44E-07
Eutrophication, marine	**kg N eq.**	1.74E-06	1.08E-08	1.50E-06	1.67E-07	3.41E-06
Eutrophication, terrestrial	**Mole of N eq.**	1.78E-05	1.17E-07	1.62E-05	1.82E-06	3.60E-05
Formation potential of tropospheric ozone (POCP)	**kg NMVOC eq**	5.34E-06	4.88E-08	4.27E-06	5.98E-07	1.03E-05
Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	**kg Sb eq**	1.98E-08	5.70E-11	1.68E-08	4.50E-09	4.12E-08
Abiotic Depletion for non-fossil resources potential (ADP-fossil)	**MJ**	3.34E-02	4.72E-04	1.16E-02	1.05E-03	4.65E-02
Water deprivation potential, deprivation-weighted water consumption (WDP)	**m³**	6.47E-04	4.53E-06	1.92E-04	2.84E-05	8.73E-04
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	**MJ**	8.71E-03	6.98E-06	5.84E-04	7.24E-05	9.37E-03
Use of renewable primary energy resources used as raw material (PERM)	**MJ**	0	0	0	0	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	**MJ**	8.71E-03	6.98E-06	5.84E-04	7.24E-05	9.37E-03
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	**MJ**	3.34E-02	4.72E-04	1.16E-02	1.05E-03	4.65E-02
Use of non-renewable primary energy resource used as raw material (PENRM)	**MJ**	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	**MJ**	3.34E-02	4.72E-04	1.16E-02	1.05E-03	4.65E-02
Use of secondary raw materials (SM)	**Kg**	0	0	0	0	0
Use of renewable secondary fuels (RSF)	**MJ**	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	**MJ**	0	0	0	0	0
Net use of fresh water (FW)	**m³**	6.39E-05	1.06E-07	5.05E-06	6.60E-07	6.97E-05
Hazardous landfill waste (HWD)	**kg**	2.01E-11	7.59E-17	6.61E-13	8.63E-21	2.08E-11

Non-hazardous waste disposed (NHWD)	**kg**	9.26E-05	2.84E-09	5.81E-05	4.59E-13	1.51E-04
Radioactive waste disposed (RWD)	**kg**	3.98E-07	9.41E-11	1.53E-08	3.65E-15	4.13E-07
Components for reuse (CRU)	**kg**	0	0	0	0	0
Materials for recycling (MFR)	**kg**	5.15E-04	0	1.53E-04	8.77E-07	6.69E-04
Material for energy recovery (MER)	**kg**	0	0	0	0	0
Exported electrical energy (EEE)	**kg**	0	0	0	0	0
Exported thermal energy (EET)	**kg**	0	0	0	0	0

GWH182-8.0MW

Impact indicator	Unit per declared unit	Upstream stage	Core-process	Core-infrastructure	Downstream stage	Total environmental impact
Global Warming Potential total (GWP-total)	**kg CO_2 eq**	2.35E-03	1.53E-05	1.08E-03	7.78E-05	3.52E-03
Global Warming Potential total (GWP-fossil)	**kg CO_2 eq**	2.35E-03	1.53E-05	1.07E-03	7.76E-05	3.52E-03
Global Warming Potential total (GWP-biogenic)	**kg CO_2 eq**	-1.76E-06	2.34E-08	6.37E-06	6.07E-08	4.70E-06
Global Warming Potential total (GWP-luluc)	**kg CO_2 eq**	6.62E-07	7.64E-09	5.25E-07	1.41E-07	1.34E-06
Depletion potential of the stratospheric ozone layer (ODP)	**kg CFC-11 eq**	6.10E-13	6.43E-14	3.24E-12	1.15E-12	5.06E-12
Acidification potential, Accumulated Exceedance (AP)	**Mole of H+ eq**	7.41E-06	7.87E-08	4.80E-06	8.14E-07	1.31E-05
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	**kg P eq**	2.32E-08	2.14E-09	7.18E-08	4.43E-08	1.41E-07
Eutrophication, marine	**kg N eq.**	1.67E-06	1.08E-08	1.35E-06	1.67E-07	3.20E-06
Eutrophication, terrestrial	**Mole of N eq.**	1.71E-05	1.17E-07	1.47E-05	1.82E-06	3.37E-05
Formation potential of tropospheric ozone (POCP)	**kg NMVOC eq**	5.15E-06	4.88E-08	3.83E-06	5.98E-07	9.63E-06
Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	**kg Sb eq**	1.97E-08	5.70E-11	1.68E-08	4.50E-09	4.10E-08
Abiotic Depletion for non-fossil resources potential (ADP-fossil)	**MJ**	3.15E-02	4.72E-04	1.12E-02	1.05E-03	4.43E-02
Water deprivation potential, deprivation-weighted water consumption (WDP)	**m^3**	6.08E-04	4.53E-06	1.86E-04	2.84E-05	8.26E-04
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	**MJ**	8.05E-03	6.98E-06	5.74E-04	7.24E-05	8.70E-03
Use of renewable primary energy resources used as raw material (PERM)	**MJ**	0	0	0	0	0

Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	**MJ**	8.05E-03	6.98E-06	5.74E-04	7.24E-05	8.70E-03
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	**MJ**	3.15E-02	4.72E-04	1.12E-02	1.05E-03	4.43E-02
Use of non-renewable primary energy resource used as raw material (PENRM)	**MJ**	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	**MJ**	3.15E-02	4.72E-04	1.12E-02	1.05E-03	4.43E-02
Use of secondary raw materials (SM)	**kg**	0	0	0	0	0
Use of renewable secondary fuels (RSF)	**MJ**	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	**MJ**	0	0	0	0	0
Net use of fresh water (FW)	**m^3**	6.25E-05	1.06E-07	4.89E-06	6.60E-07	6.81E-05
Hazardous landfill waste (HWD)	**kg**	2.00E-11	7.59E-17	6.54E-13	8.63E-21	2.07E-11
Non-hazardous waste disposed (NHWD)	**kg**	9.23E-05	2.83E-09	5.66E-05	4.59E-13	1.49E-04
Radioactive waste disposed (RWD)	**kg**	3.71E-07	9.41E-11	1.52E-08	3.65E-15	3.86E-07
Components for reuse (CRU)	**kg**	0	0	0	0	0
Materials for recycling (MFR)	**kg**	5.15E-04	0	1.53E-04	8.77E-07	6.69E-04
Material for energy recovery (MER)	**kg**	0	0	0	0	0
Exported electrical energy (EEE)	**kg**	0	0	0	0	0
Exported thermal energy (EET)	**kg**	0	0	0	0	0

(1) This table presented the impact value with scaled to 1 kWh as the declared unit.

(2) The impact category provides a zero result since components reuse has not been applied in Goldwind due to the barriers of recovery value, suitability, and technical possibility.

(3) According to PCR that the recovery process which take place outside the boundaries of the product system, only impacts related to the transportation of the waste to the treatment platform should be taken into account. Thus, the exported thermal energy and electricity energy provides a zero result.

(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.

Based on the LCIA study of GWH170-7.2&GWH175-7.8&GWH182-8.0 in 25 and 20 years, the most significant contribute processes for each environmental impact categories are identified and summarized in Table 4.

Table 4 Significant contribute processes for environmental impact categories

Impact indicator	Top 3 contributors
Global Warming potential-total	Tower manufacture, blade manufacture, foundation construction & wind turbine installation
Depletion potential of the stratospheric ozone layer (ODP)	Blade manufacture, foundation construction & wind turbine installation, electricity transmission network construction
Acidification potential, Accumulated Exceedance (AP)	Tower manufacture, Blade manufacture, foundation construction & wind turbine installation
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	Electricity transmission network construction, foundation construction & wind turbine installation, electrical control components production
Formation potential of tropospheric ozone (POCP)	Tower manufacture, Blade manufacture, foundation construction & wind turbine installation
Consumption of abiotic resources - minerals and materials	Production of Electrical control system components, production of drivetrain components, substation construction
Consumption of abiotic resources - fossil resources	Blade manufacture, tower manufacture, foundation construction & wind turbine installation
Water deprivation potential, deprivation-weighted water consumption (WDP)	Blade manufacture, tower manufacture, foundation construction & wind turbine installation

5. References

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World Steel Association (World steel) 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.

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