IBERDROLA

ENVIRONMENTAL PRODUCT DECLARATION

Electricity from “Alto de la Degollada” 50 MW on-shore wind farm

EPD®

UNCPC Code 17, Group 171-Electricity generation and distribution

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CONTENTS

ACRONYMS AND ABBREVIATIONS

AEP	Annual Energy Production
B2B	Business to Business
CoE	Cost of Energy
EIS	Environmental Impact Study
EPD	Environmental Product Declaration
GPI	General Programme Instructions
IEC	International Electro technical Commission
ISO	International Organization for Standardization
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
MW	Megawatt
PCR	Product Category Rules
WTG	Wind Turbine Generator
PCC	Point of common coupling

1. INTRODUCTION

1.1 DECLARED PRODUCT

This document represents the certified Environmental Product Declaration (EPD), of the electricity generated in “Alto de la Degollada” 50 MW on-shore wind farm operating under low wind conditions (IEC IIIA) and thereafter distributed to a consumer in the Spanish electrical market.

The complex “Alto de la Degollada” is located between the municipalities of Castrojeriz and Los Balbases, (Burgos - Spain). This wind farm is composed of 25 Gamesa G90 2.0MW wind turbines with a total installed power of 50 MW.

The focus on the development of clean energy and respect for the environment are some of the pillars of Iberdrola’s company model and the factors that distinguish the Group as one of the world’s leading energy companies in the 21st century. Therefore, the company is fully aware of the entire life cycle of their products and how their performance is related to the environment.

The functional unit, to which all outcomes are referred to is:

"1 Kwh of electricity generated in the “Alto de la Degollada” on-shore wind farm, and thereafter distributed to the Spanish 132 KV transmission grid."

Wind energy is the most reliable and effective renewable energy to meet the growing energy demand, with the foreseeable depletion of the non-renewable traditional energy resources. Furthermore, it is a guarantee of competitiveness, because in most countries is responsible for the lowering price of the energy pool.

Although having common features with other renewable energy sources - Avoids CO2 emissions, it’s an inexhaustible resource and reduces the energy vulnerability of countries – its industrial character and maturity, with a developed technological learning curve, allows achieving very competitive market prices.

Wind energy will be the leading technology in transforming the global energy supply structure towards a truly sustainable energy future based on indigenous, non-polluting and competitive renewable technologies.

1.2 ENVIRONMENTAL DECLARATION AND THE EPD SYSTEM

An environmental product declaration is defined in ISO 14025 as the quantification of environmental data for a product with categories and parameters specified in the ISO 14040 standard series, but not excluding additional environmental information.

The international EPD® system has as main goal, the ambition to help and support organizations to communicate the environmental performance of their products (goods and services) in a credible and understandable manner.

Therefore, it offers a complete program for any organization interested in developing and communicating EPDs according to ISO 14025, also supporting other EPD programs (i.e. national, sectorial, etc.) in seeking cooperation and harmonization and helping organizations to broaden the use of environmental claims on the international market.

Environmental Product Declarations add a new dimension to the market, offering information on the environmental performance of products and services. The use of EPDs, leads to a number of benefits for organizations that develop declarations of their own products as well as for those who make use of the information contained in these Environmental Product Declarations.

This EPD has been made in accordance with the standards of the International EPD Consortium. EPD is a system for international use of type III Environmental Declarations, according to ISO 14025. The international EPD® system and its applications are described in the General Program Instructions (GPI).

The documents on which this EPD is based are, in order of relevance:

- Product Category Rules, PCR 2007:08 version 3.0 CPC 171 & 173: Electricity, Steam, and Hot and Cold Water Generation and Distribution.
- General Program Instructions for Environmental Product Declarations, V. 2.01
- ISO 14025 - Type III environmental declarations.
- ISO 14040 and ISO 14044 on Life Cycle Assessment (LCA).

This EPD contains a LCA-based environmental behavior statement. It also contains additional environmental information, in accordance with the corresponding PCR:

- Information about the impact on biodiversity
- Information about land use classification based on CORINE land uses
- Information about environmental hazards
- Information about the electromagnetic fields generated
- Information about the noise generated by the wind turbine generators
- Information about the visual impact of the wind farm

1.3 IBERDROLA LCA AND EPD

Iberdrola as a designer of renewable energy commodities considers that is essential to know the main environmental impacts of its products, which are lower than those generated by traditional energy sources. Despite this, we are aware that there is still environmental improvement potential in our products and that those environmental impacts can be further minimized through an optimized design. The additional development through the EPD® enhances the ability to inform objectively about the complex environmental issues associated with generation of electricity and heat.

The tool used for reducing these impacts is the detailed analysis of the product life cycle. Using the Life Cycle Assessment methodology (LCA) we identify the environmental impacts of our products from the extraction of raw materials until the end of life of the wind turbine. Iberdrola analyzes each phase in a project with the goal of eliminating or minimizing the environmental impacts, assuring that these impacts are not transferred between different life cycle stages.

From this starting point, a further step is the certification by an Environmental Product Declaration of the energy generated and distributed by a Iberdrola’ s wind farm, ensuring the reliability of the data entered into the LCA as well as the transparency about the environmental performance of our products.

2. THE COMPANY AND THE PRODUCT

2.1 IBERDROLA CORPORATION

Iberdrola has undergone a wide-ranging transformation over the last ten years which has enabled it to advance through the ranks to become the number one Spanish energy group, one of the Spanish main companies on the Ibex 35 by market capitalization, the world leader in wind energy, and one of the world's top power companies.

Besides consolidate in Spain, our work has led us to an international reference position, becoming one of the leading operators in the UK, one of the largest producers of wind energy in the USA, the main private generator of Mexico and has consolidated its position as supplier of electricity increased number of customers in Brazil.

We have achieved this position by means of a long-term industrial project which is sound, profitable and creates value, rooted in a strategy of sustainable growth, and by working every day to offer more respectful energy sources. After more than 150 years moving forward, the Company has now laid the firm foundations for its future growth.

At IBERDROLA we are proud of ourselves and of the future we are building. We have done a good job. And we will continue to do a great job to meet the new challenges facing us.

2014 KEY FIGURES

- ✓ Net output: 138.892 GWh.
- ✓ Installed capacity: 45,089 MW.
- ✓ Renewable install capacity: 14.652 MW
- ✓ Electrical power distributed: 214.613 GWh.
- ✓ 32.6 million customers (of electricity and gas).

The annual equivalent of its 45.089 MW installed accounts to more than 12 million tons of petroleum equivalents (TEP) per year and prevents the emission into the atmosphere of more than 30 million tons of CO2 per year. Iberdrola is within the main international sustainability indexes: FTSE4Good and DJSI.

The Company is certified to the following management systems:

- ISO 14001:2004 - Environmental management systems (EMS)
- ISO 14064:2006 - Greenhouse gases
- ISO 9001:2008 - Quality management systems
- OHSAS 18001:2007 - Occupational health and safety management systems

In addition, Iberdrola is founding member of the Basque Ecodesign Center, which mission is to foster the development of ideas and business activities through ecodesign, improving competitiveness and preventing damage to the environment in the Basque Country.

2.2 PRODUCT SYSTEM DESCRIPTION

2.2.1 “Alto de la Degollada” wind farm

The baseline system under study is the on-shore wind farm called “Alto de la Degollada”, located between the municipalities of Castrojeriz and Los Balbases in the province of Burgos (Spain). This place is an inland zone, 50 km away from the city of Burgos. The complex was installed in the year 2010. The wind farm is composed of 25 WTGs model G90 produced by the Spanish wind turbine manufacturer Gamesa. The unitary power capacity of each WTG is 2.0 MW, resulting in 50 MW of total installed power. All the 25 nacelles, rest upon 78m high steel towers.

Fig.1 “Alto de la Degollada” Wind Farm

The average annual electricity generation in the selected wind farm is 105,487 Mwh. This value has been calculated taking into account the measured actual generation on the wind farm and an expected lifetime of 25 years.

Before the construction of the wind farm, the land was characterized as arable and farming areas. Moreover, the results of the environmental impact study conducted before starting the groundwork showed that the whole zone was a low environmental sensibility area.

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The main infrastructures built in “Alto de la Degollada” are gathered in the following list:

- 25 WTGs model Gamesa G90 2.0 MW, with 78m high towers. The wind turbines are binded to the ground using reinforced concrete foundations.
- Underground medium voltage network (20KV) used to interconnect the WTGs. In addition, this network also reaches the transformer substation which is used to evacuate the generated power from the park.
- A transformer substation, located in the center of the complex. This outdoor substation, has a transformation ratio of 20/132 KV, using a power transformer of 53MVA. It also includes a control building.
- Simple circuit overhead power line (132 KV) with a length of 6.868 meters connecting the wind farm’s transformer substation with the substation “Cuatro Picones”

Figure2. Wind Farm Layout

All the internal wiring of the wind farm, the transformer substation and the electrical infrastructure needed to reach the connection point of the electrical network are inside the system boundaries. The infrastructure needed for the electrical transmission and distribution until Iberdrola’s customer of the generated electricity is also included in the present declaration, as well as the inevitable losses that will occur in this electrical transportation stage.

2.2.2 GAMESA G90-2.0 Mw Wind Turbine Generator

Figure3. – G90-2.0 MW Wind Turbine Generator

The multi-megawatt wind turbine Gamesa G90-2.0MW bases its technology on the variable pitch control incorporating the latest technologies to extract the maximum power from the wind with the greatest efficiency. The G90 is a two-megawatt power turbine, has a three-blade rotor of 90 m diameter and a swept area of 6,362 m^2.

The WTG has both aerodynamic braking system and hydraulic lightning protection in accordance with IEC 61024-1, pitch angle control for each of its blades and it is supported by a tapered tower of 78 meters height consisting in four steel sections.

Availability of the machine = 0.98%

Lifetime = 25 years

The G90-2.0MW wind turbine has been designed to optimize the cost of energy and performance in low and medium wind sites. The expected service life of the product is stated in 25 years, without reconsidering Gamesa's life extension program which can significantly enhance this period of time.

Some general advantages of the G90-2.0MW WTG:

- Maximum production at any location.
- Pitch system and variable speed to maximize energy production
- New optimized blade profiles for maximum output and low noise
- Composites reinforced with fiberglass and carbon to achieve lighter blades while maintaining the rigidity and strength
- Technological solutions to ensure compliance with the main requirements of international transmission grid connection.
- Active yaw system to ensure optimal adaptation to complex terrain
- Aerodynamic design and GAMESA NRS ® control to minimize noise emissions
- GAMESA WindNet ®: control and monitoring system with remote web access
- GAMESA SMP own predictive maintenance system

The Gamesa G90-2.0MW is part of the 2.0-2.5MW platform. The key characteristics of this platform are its robustness, stellar reliability and suitability for all kinds of sites and wind conditions, from the most challenging locations to low and medium wind speed sites.

Thanks to this performance, the platform's installed capacity stands at over 15,000 MW worldwide, while average fleet availability is running at over 98%. These turbines enable competitive CoE ratios per MW installed, thanks to the versatile combination of rotors, nominal power and tower height, to achieve peak performance in all kinds of locations and wind conditions.

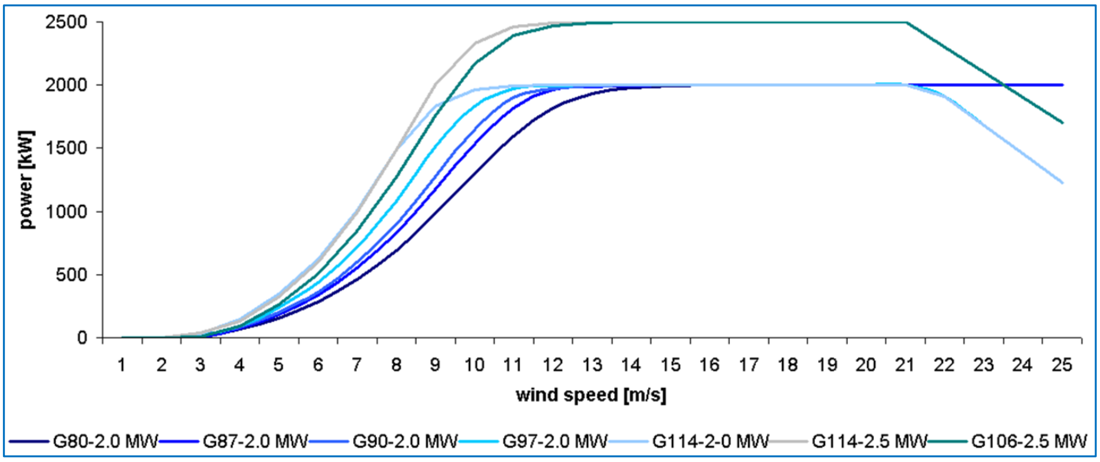

Fig.4.- Gamesa 2.0/2.5 MW platform power curves

2.2.3 Electricity Transmission and distribution infrastructure

Once the wind is converted into electricity by the wind turbine generators, the energy is delivered to each consumer through the electrical transmission and distribution network. This electrical transport stage also entails some environmental impacts that cannot be left out.

Firstly, we must consider the environmental impacts associated with the construction and dismantling of the infrastructure needed to transport all the electricity generated by the WTGs.

The materials used to build these airlines, depend on the voltage level of the electricity being transported in each step, from the power generation until the later consumption.

Furthermore, the electrical losses which occur as a result of the inevitable heating of the electric wires during transport and in the successive voltage transformations that occur until the consumption point cannot be avoided. All these impacts have also been taken into account in the system under study.

The WTG generates low voltage electricity (690V). This voltage is increased in the transformer located inside the nacelle, reaching medium voltage level (20KV) to minimize electricity losses within the wind farm. At the exit of the complex, there is another transformer station allowing the delivery of high voltage electricity to the general network. In the case of "Alto de la Degollada", this high voltage electricity level is set to 132 KV. The concepts in this paragraph are considered as internal wind farm electrical losses.

Then, from the exit of the wind farm the electricity goes through a 6,868 meters long overhead power line (132 KV) which connects the wind farm's transformer substation with the substation "Cuatro Picones", where the electricity is finally sold. The functional unit assessed, covers all the cycle from the generation of electricity until its final delivery to the consumer connected to this 132 KV grid.

The electrical losses until the consumer connected to 132 kV, are considered in the sub-module "downstream process". The measured average value of 2.02% has been considered for the electrical losses in the "downstream process". This means that 2.02% of every delivered Kwh at the grid is lost in the transmission and distribution network before arriving to an average Spanish customer connected to 132 kV.

2.2.4 Win Energy Life Cycle

The following figure encompasses the full cradle-to-grave life cycle of the energy generated by a wind farm.

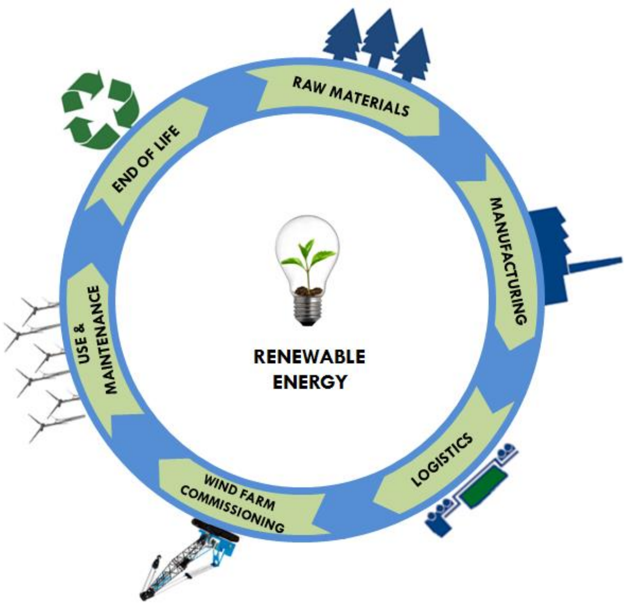

Figure 5.- Wind Energy Life Cycle

The main environmental impacts of the generated energy are related to the manufacturing of the different components of the wind turbine and the construction of the wind farm. All the steps in this diagram have been taken into account for the assessment. As shown in the mentioned figure, the life cycle of energy is a complex system in which it is necessary to clearly establish the boundaries between phases to avoid mistakes. Following the recommendations of the PCR, the energy life cycle has been divided into three main modules, core module, up-stream module and down-stream module. The concepts included in each of these modules are summarized in the following paragraphs.

2.2.4.1 Core module

The core phase encompasses all the steps related to the construction, operation and decommissioning of the wind farm from the cradle to the grave. This comprehends all the stages from the extraction of the raw materials needed to build the WTG and the wind farm, until the dismantling of the wind farm, including the proper management of the generated waste and the recycled components as well as their corresponding end of life treatments.

This module also refers to the manufacturing processes of the WTG performed by Gamesa and its suppliers. Besides, the required maintenance of the machinery during its service life is included, both preventive and corrective actions (estimated component replacements and repairs, maintenance travels, operating waste management, etc.). All the environmental impacts arising from the logistics related to the previously mentioned concepts are part of the core module too.

Finally, the core also contains a vital part of the wind turbine life cycle, which is the G90 machine's technical performance. Factors such as the annual energy production, the availability of the machine, the electrical losses during operation or the energy self-consumption of the turbine for its auxiliary systems, have a decisive influence on the environmental impact of the declared unit.

2.2.4.2 Up-stream module

The upstream module considered in the study, includes the environmental impacts related to the production of all necessary ancillary substances for the proper operation of the wind farm "Alto de la Degollada" during the 20 years of service life. Since this kind of electricity generation system doesn't require any fuel, this module mainly includes the required quantities of hydraulic oil, lubricating oils and greases, as well as the emissions arising from the transport of these substances from the suppliers to the wind farm.

2.2.4.3 Down-stream module

The downstream stage comprises all the impacts that happen from the moment when the energy is delivered to the electricity network (leaving this way the wind farm), until the moment when it reaches the final consumer, that in this case is assumed to be connected at a 132 KV network. Thus, for this stage it is necessary to consider not only the construction and dismantling of the electrical network required for the energy transportation, but also the inherent losses during the electrical transport and voltage transformation.

3. ENVIRONMENTAL PERFORMANCE BASED ON LCA

3.1 LIFE CYCLE ASSESSMENT METHODOLOGY

As stated in ISO 14025:2010 (Environmental labels and declarations - Type III environmental declarations - Principles and procedures), the environmental impact data outlined in a Environmental Impact Declaration EPD, are part of the results obtained from an analysis following the Life Cycle Assessment methodology.

The LCA methodology, which has been followed when conducting this study is a procedure based on the international standards ISO 14040, ISO 14044 and the Product Category Rules for CPC 171.

With the use of the LCA method we are able to obtain a complete breakdown of the elementary inputs and outputs which compose our product system along its whole life cycle. These inputs and outputs are given in the form of raw material consumptions or as different kind of emissions, and are the indicators showing the real interaction of the analyzed product with nature.

Besides, the LCA methodology also allows us to obtain global results associated to different environmental impact categories such as global warming potential, acidification potential, eutrophication potential or photochemical ozone creation potential, if we apply different characterization methods.

The LCA only quantifies information on environmental impacts, leaving apart social and economic indicators. In the same way, some environmental impacts associated with the product life cycle as land use, impacts on biodiversity, electromagnetic fields, noise, visual impact or accidental risks cannot be identified from the LCA perspective. For this reason, these environmental impacts will be individually analyzed in section 4 of this EPD ("Additional environmental information").

3.2 SYSTEM BOUNDARIES AND DATA SOURCES

This Environmental Product Declaration reflects the life cycle impact of the electricity generated at the "Alto de la Degollada" on-shore 50 MW wind farm operated by Iberdrola, and thereafter distributed to a Spanish consumer connected to a 132 KV electrical grid.

The following figure provides a simplified representation of the boundaries of the studied system, decomposing the life cycle on different modules, as required by the PCR.

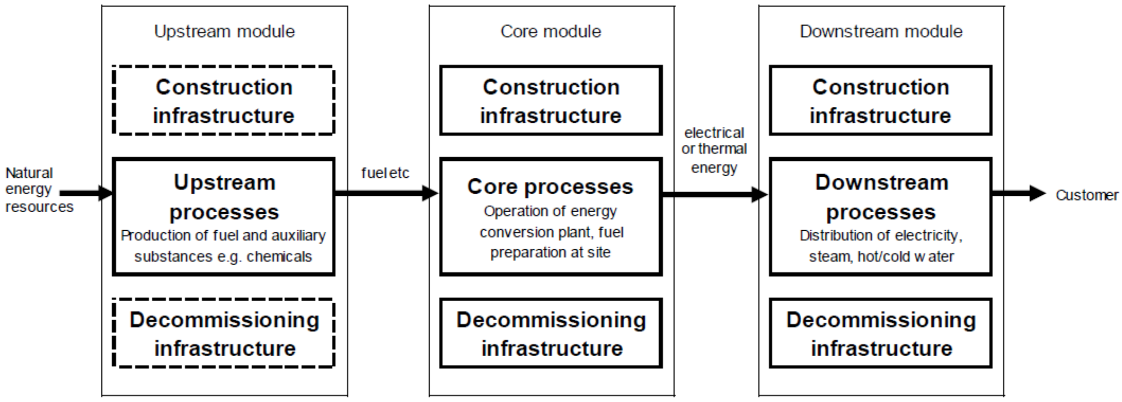

Figure 6.- System boundaries

The blocks in the graph above whose boundary is a dashed line, have not been taken into account in the LCA, as permitted by the associated PCR. The data used to create the models of the life cycle phases described in the above diagram, have been obtained directly from Iberdrola or from its suppliers. These data are fully traceable and are the basis for ensuring that the results of the LCA correspond to the reality of the delivered electricity.

All the data for which Iberdrola has direct access to, have been included in the analysis seeking the best data completeness. However, given the complexity of the system and the multitude of information needed and in order to ease the assessment, the following cut-off criteria have been followed when making the life cycle inventory:

- The sum of all material flows that have not been included in the analysis should be less than 1% of the total weight of all material flows.
- The sum of all energy flows that have not been included in the analysis should be less than 1% of the total energy flows.
- The replacement of components that have a lower failure rate than 0.009 failures per WTG during the entire service life, have not been included in the analysis.

By the time the study ended, the 99,89% of the total material flows of the system had been successfully included (99,51% of the total materials of the wind turbine, as well as the 100% of the materials used to build the wind farm). In addition, all the energy flows incurred in Gamesa’s manufacturing plants have also been included in the analysis.

From these primary data, when creating the life cycle model of the analyzed system, the Ecoinvent 2.2 life cycle inventories database has been used. Ecoinvent is the most recognized LCA database worldwide used by around 4,500 users in more than 40 countries. This database contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services. Ecoinvent is the world's leading supplier of consistent and transparent life cycle inventory (LCI) data of known quality.

All the data used to create the life cycle model of the electricity generated by the wind farm under study, reflect the technology currently used by Iberdrola in “Alto de la Degollada” and are considered fully representative for the period of validity of this EPD.

3.2.1 Core - Infrastructure

Data on the materials needed for the construction and subsequent decommissioning of each WTG, represent the actual technology installed in “Alto de la Degollada” wind farm. The LCA that Gamesa “Corporación Tecnológica” conducted for their WTG G90 2.0MW has been the main source of data used when creating the LCA model.

Data on the materials needed and the machinery use for the construction of the wind farm, the transformer substation and the internal wiring of the wind farm, were obtained from real data gathered by Iberdrola during the construction of the power plant.

Given the fact that the data used for both the manufacturing of the WTG and the construction of the wind farm represent the machinery actually installed in “Alto de la Degollada” wind farm, the results shown in this EPD are considered to be representative during the whole lifespan of the wind farm, and are verified during the period of validity shown in the cover page. The EPD verifier had access to more comprehensive information on the data used for this modelization.

Data on WTG production processes have been obtained from measurements and records during the year 2012, obtained in the manufacturing plants owned by Gamesa. These data are considered representative of the manufacturing processes of the WTGs installed in "Alto de la Degollada". The Spanish electricity mix of the corresponding year has been used to model the power consumption of these production centres, using data from REE "Red Eléctrica Española" as source.

In the case of an on-shore G90 2.0MW WTG delivered to any European location, the factories involved in the manufacturing of the machine are the ones collected in the following table. All these manufacturing plants have been individually assessed for the purpose of the study:

MANUFACTURING PLANT	LOCATION	ACTIVITY
Gamesa Ágreda	Ágreda (Soria – Spain)	Nacelle assembly
MADE	Medina del Campo (Valladolid – Spain)	Rotor assembly
Gamesa Cantarey	Reinosa (Cantabria – Spain)	Generator manufacture
Componentes eólicos	Albacete (Albacete – Spain)	Blade manufacture
Componentes eólicos Cuenca	Cuenca (Cuenca – Spain)	Blade root manufacture
GET ECHESA Asteasu	Asteasu (Guipuzcoa – Spain)	Gearbox parts machining
GET TRELSA Lerma	Lerma (Burgos – Spain)	Gearbox assembly
FNN Burgos	Burgos (Burgos – Spain)	Metal casting
Valencia Power Converters	Benissanó (Valencia – Spain)	Production and assembly of cabinets and converters
Apoyos y estructuras metálicas Olazagutia[1]	Olazagutia (Navarra – Spain)	Tower manufacturing

Table 1.- Manufacturing plants

In addition to this processes, in the table below the main suppliers that were considered for the LCA are also listed:

COMPONENT	SUPPLIER
Cabinet envelopes	HERCOR
Rear frame and crane system	ARAÍN
Nacelle cover / Rotor cover	IMPRE
Low speed shaft	LUCCHINI
Low speed coupling	STÜWE
High speed coupling	ZERO MAX
Transformer	ABB
Yaw bearing	REDUCEL
Hydraulic group and pitch system	HINE
Blade bearings	ROLLIX
Paint	HEMPEL
Oil	SHELL
Resins	MANKIEWICZ
Pre-preg	GURIT

Table 2.- Main suppliers

[1] Plant owned by the enterprise "Grupo Daniel Alonso".

The manufacturing processes carried out by Iberdrola’s suppliers, have been analyzed through the combination of data on manufacturing processes from ecoinvent 2.2 database and data provided by the suppliers themselves.

All the G90 wind turbine components are designed to have a service life equal to or greater than the turbine itself. However, sometimes the WTG is exposed to situations that differ from the normal design operation, that can reduce the expected lifetime of a component or even disable it.

Seeking to have a good overview of the environmental impact caused by these unexpected failures and the need for reinvestment of components, the impact of performing corrective maintenance actions on the WTGs has been modeled in the LCA which supports this EPD. Data on failure rate statistics have been taken directly from internal studies made by the WTG manufacturer. In combination with these data, the repair activities carried out by Gamesa in its manufacturing plants has also been assessed, with the objective of knowing the recovery rate capacity arisen from Gamesa’s efforts to fix critical modules as generators, gearboxes, blades or transformers for example. This effect is considered in the core infrastructure module.

Finally, the materials that appear after the decommissioning of the wind farm and their end-of-life management have been estimated according to the following sources:

- Wind turbine generators recycling manual. Source: AMBIO
- Decommissioning project of the Igea-Cornago sur wind farm. Source: GER
- Decommissioning, restoration and landscaping project of the Sierra de Porta wind farm. Source: TAXUS
- Analysis of end of life options for wind turbine blades. Source: GAIKER

After the 25 years of operation, the land is restored to its previous condition, before the initial construction of the wind farm took place. In order to achieve this land restoration, reached the decommissioning moment Iberdrola follows the following steps:

1. Removal of the structure of the wind turbine
2. Demolition of foundation and underground wire network
3. Demolition of substation, road access and platforms
4. Vegetal cover surface treatment
5. Seeding and planting, landscape recovery
6. Recycling of wind turbine components
7. Waste treatment and disposal

For the LCA, the following hypotheses have been assumed. All the metals (either ferrous or not) are sent to recycling processes. All the electronic components are correctly managed and sent to a WEEE treatment process. The 26,3% of the plastics are recovered to be sent to recycling processes while the other 73,7% are sent to landfill and incineration processes[2]. The building materials used for the foundation of the WTGs are left in the wind farm and the blades are sent to landfill. All the lubricants and hydraulic oils used along the 25 years of operation of the wind farm are properly managed in order to allow subsequent reuses or energetic valorization.

[2] Source: "Plastics, the facts 2013" - Plastics Europe

3.2.2 Core-Process

All the environmental impacts associated with the operation of the wind farm, given its 25 years of life, have been taken into account in this module. One of the main advantages of the wind energy over other non-renewable sources of energy is its independence on fossil fuels. This environmental benefit is reflected at this stage when we look at the results.

In the core-process module the following concepts have been considered:

- Preventive maintenance required during the lifespan of the wind farm, including the maintenance staff trips to the wind farm.
- Data on the need for consumables allowing the correct operation of the WTG.
- The proper waste management of the consumables needed during operation and maintenance of the wind farm, including transportation stage to the authorized entity for later treatment.

The data used in the LCA on the technical performance of the system during its operational phase, have been obtained from internal documents of Iberdrola and Gamesa. This includes aspects such as annual energy generation, machine availability, energy losses in the wind farm, maintenance protocols, etc. These data reflect the technologies currently used in "Alto de la Degollada" and are considered representative as long as no substantial technical changes are introduced in the behavior of the machine during the operation and maintenance phase.

3.2.3 Upstream

Since wind power requires no fuel for equipment operation, the upstream module includes the production of auxiliary substances that are necessary for the operation of the energy conversion plant. Therefore, in this section the following concepts have been taken into account:

- Production of the necessary quantities of hydraulic oil, lubricating oils and fat by Iberdrola's suppliers.
- All the transport associated with the need to carry these maintenance supplies from the suppliers till the "Alto de la Degollada" wind farm.

The replacements of lubricating oil, hydraulic oil and fat due to preventive maintenance were obtained from the lubrication charts and from the maintenance manual of the WTG. These documents specify the maintenance needs of this equipment and are considered representative, provided that no substantial variations related to the maintenance of the wind turbine occur.

The infrastructure and the equipment of the suppliers of the auxiliary substances necessary for the operation of the wind farm have been excluded from the analysis, as allowed by the PCR.

3.2.4 Downstream

The downstream module represents mainly two different environmental impacts. The first one is the impact related to the construction and decommissioning of the electrical grid, which is considered within the sub-module "downstream infrastructure". The second impact is related to the electrical losses inherent to the voltage transformations and to the Joule effect when transporting the generated electricity, which are considered in the sub-module "downstream process". Note that these losses depend on the connection voltage of the final consumer.

The average value of 2.2% has been considered for the electrical losses in the "downstream process". This means that 2.2% of every injected kWh at PCC is lost in the transmission and distribution network before arriving to an average European customer connected to 132 kV.

With regard to the electrical transmission and distribution system infrastructure, the existing infrastructure on Spain was analyzed. After combining the available infrastructure in Spain with the specific energy demand, the number of km of electrical grid needed to include in the LCA were calculated.

The data used for the modelization of the electrical networks have been obtained from the ecoinvent 2.2 database.

3.3 ECO – PROFILE

In the following tables, it is shown the environmental behavior of the energy generated in "Alto de la Degollada" wind farm from a life cycle perspective. The results have been disaggregated in the phases that were described above. The EPD verifier had access to more comprehensive information on the LCA which supports this declaration.

The functional unit, to which all outcomes are referred to is:

"1 Kwh of electricity generated in the "Alto de la Degollada" on-shore wind farm, and thereafter distributed to the Spanish 132 KV transmission grid."

Figure 6.- "Alto de la Degollada" wind farm

3.3.1 "Alto de la Degollada" 50 Mw On- shore Wind Farm.

ECO-PROFILE	UNIT	Alto de la Degollada 50 MW on-shore wind farm						
USE OF RESOURCES		1 KWh electricity generated and distributed to a 132 KV customer						
		Upstream	Core Process	Core Infrastructure	TOTAL GENERATED	Downstream Process	Downstream Infrastructure	TOTAL DISTRIBUTED
Non-renewable material resources								
Gravel	g	7,076E-03	7,323E-03	3,006E+01	3,007E+01	6,075E-01	1,771E-02	3,070E+01
Iron	g	7,547E-04	5,227E-04	2,484E+00	2,486E+00	5,021E-02	2,469E-02	2,561E+00
Calcite	g	9,520E-04	7,505E-04	1,678E+00	1,680E+00	3,394E-02	9,877E-03	1,724E+00
Clay	g	9,644E-04	2,108E-04	5,486E-01	5,497E-01	1,110E-02	5,810E-03	5,666E-01
Nickel	g	4,501E-05	9,833E-06	2,491E-01	2,491E-01	5,033E-03	2,738E-04	2,544E-01
Sodium chloride	g	7,948E-05	3,980E-04	1,279E-01	1,284E-01	2,593E-03	9,591E-04	1,319E-01
Chromium	g	1,724E-05	3,561E-06	1,024E-01	1,024E-01	2,069E-03	2,439E-05	1,045E-01
Magnesite	g	1,020E-05	6,867E-06	4,552E-02	4,554E-02	9,198E-04	1,527E-05	4,647E-02
Colemanite	g	1,352E-07	6,693E-09	4,403E-02	4,403E-02	8,893E-04	1,575E-07	4,492E-02
Other non-renewable resources[3]	g	4,163E-04	5,861E-05	9,425E-02	9,473E-02	1,913E-03	7,644E-03	1,043E-01
Non-renewable energy resources								
Nuclear	MJ	1,141E-04	3,843E-05	1,963E-02	1,978E-02	3,995E-04	2,351E-04	2,041E-02
Crude oil	MJ	2,931E-03	2,196E-04	4,146E-02	4,461E-02	9,012E-04	4,084E-04	4,592E-02
Lignite	MJ	4,915E-05	6,676E-06	6,476E-03	6,532E-03	1,320E-04	8,647E-05	6,751E-03
Hard coal	MJ	6,494E-05	1,647E-05	5,073E-02	5,081E-02	1,026E-03	5,934E-04	5,243E-02
Natural gas	MJ	2,662E-04	3,674E-05	3,472E-02	3,502E-02	7,075E-04	2,041E-04	3,593E-02
Renewable material resources								
Wood	m3	3,602E-04	5,116E-05	5,838E-02	5,879E-02	1,188E-03	1,336E-03	6,132E-02
Water Use								
Total amount of water use	m3	1,142E-06	3,975E-07	2,239E-04	2,254E-04	4,553E-06	2,474E-06	2,324E-04
Direct amount of water in the core process	m3	-	1,991E-08	-	1,991E-08	4,021E-10	-	2,031E-08
Renewable energy resources								
Energy from hydro power	MJ	1,475E-05	6,976E-06	7,126E-03	7,148E-03	1,444E-04	2,030E-04	7,495E-03
Energy from biomass	MJ	6,016E-06	9,241E-07	1,137E-03	1,144E-03	2,311E-05	2,219E-05	1,189E-03
Wind electricity	MJ	2,031E-06	2,704E-07	7,267E-04	7,290E-04	1,473E-05	1,347E-06	7,451E-04
Solar electricity	MJ	2,961E-08	7,411E-09	7,620E-05	7,623E-05	1,540E-06	1,962E-08	7,779E-05
Electricity use in the wind farm[4]	Kwh	-	5,360E-02	-	5,360E-02	1,083E-03	-	5,468E-02
Secondary resources								
Aluminium	g	-	-	6,123E-03	6,123E-03	1,237E-04	-	6,247E-03
Copper	g	-	-	6,688E-03	6,688E-03	1,351E-04	-	6,823E-03
Steel	g	-	-	1,246E+00	1,246E+00	2,518E-02	-	1,272E+00
Recovered energy flows	MJ	-	-	-	-	-	-	-

Non-renewable material resources reported, are a list of the material flows representing more than a 0,1% in mass, of the total raw material input flows. The rest of the non-renewable material flows are reported together as a sum of 83 substances, representing the 0,29% in mass of the total input material flow.

3 Sum of 83 substances

4 The electricity used in the wind farm is generated by the wind turbines itself. The environmental impact in conjunction with this electricity consumption has been included in the results.

ECO-PROFILE	UNIT	Alto de la Degollada 50 MW on-shore wind farm						
POLLUTANT EMISSIONS		1 KWh electricity generated and distributed to a 132 KV customer						
		Upstream	Core Process	Core Infrastructure	TOTAL GENERATED	Downstream Process	Downstream Infrastructure	TOTAL DISTRIBUTED
Potential environmental impacts								
Acidifying gases	g SO_2 eq	3,884E-04	7,749E-05	4,314E-02	4,361E-02	8,809E-04	5,714E-04	4,506E-02
Eutrophying substances	g PO_4 eq	9,135E-05	5,444E-05	2,327E-02	2,342E-02	4,730E-04	3,430E-04	2,423E-02
Global warming potential (100yrs)[5]	g CO_2 eq	4,755E-02	1,394E-01	9,743E+00	9,930E+00	2,006E-01	1,138E-01	1,024E+01
Ozone depleting potential (20yrs)	g CFC-11 eq	2,534E-08	2,461E-09	1,544E-06	1,572E-06	3,175E-08	5,616E-09	1,609E-06
Formation of ground level ozone	g C_2H_4 eq	2,263E-05	3,003E-06	3,578E-03	3,604E-03	7,279E-05	5,543E-05	3,732E-03
Emissions to air which contribute most to the environmental impact categories								
Carbon dioxide, fossil	g	4,355E-02	1,385E-01	8,825E+00	9,007E+00	1,819E-01	9,368E-02	9,282E+00
Methane, fossil	g	1,404E-04	2,455E-05	2,414E-02	2,431E-02	4,910E-04	2,170E-04	2,501E-02
Dinitrogen monoxide	g	9,750E-07	5,936E-07	3,482E-04	3,498E-04	7,065E-06	2,077E-06	3,589E-04
Carbon monoxide, fossil	g	5,978E-05	3,157E-05	7,547E-02	7,556E-02	1,526E-03	1,223E-03	7,831E-02
Methane, chlorodifluoro-, HCFC-22	g	8,799E-10	1,127E-10	4,912E-06	4,913E-06	9,924E-08	8,190E-10	5,013E-06
Methane, bromotrifluoro-, Halon 1301	g	2,207E-09	2,026E-10	3,299E-08	3,540E-08	7,150E-10	3,251E-10	3,644E-08
Methane, bromochlorodifluoro-, Halon 1211	g	2,211E-10	2,901E-11	3,452E-08	3,477E-08	7,023E-10	2,190E-10	3,569E-08
Methane, tetrachloro-, CFC-10	g	4,455E-11	4,680E-11	1,622E-07	1,623E-07	3,279E-09	9,523E-11	1,657E-07
Sulfur dioxide	g	2,840E-04	2,549E-05	2,359E-02	2,390E-02	4,828E-04	3,939E-04	2,478E-02
Nitrogen oxides	g	1,442E-04	7,055E-05	2,544E-02	2,566E-02	5,182E-04	2,184E-04	2,639E-02
Ammonia	g	9,466E-07	1,079E-06	4,816E-04	4,836E-04	9,769E-06	6,767E-06	5,001E-04
Hydrogen chloride	g	1,201E-06	2,202E-07	5,868E-04	5,882E-04	1,188E-05	4,062E-06	6,042E-04
Ethane	g	2,003E-06	1,915E-07	1,680E-04	1,702E-04	3,437E-06	1,272E-06	1,749E-04
Ethene	g	1,932E-07	2,738E-08	6,846E-05	6,868E-05	1,387E-06	5,553E-07	7,062E-05
Pentane	g	4,805E-06	3,726E-07	9,454E-05	9,972E-05	2,014E-06	9,045E-07	1,026E-04
Butane	g	3,881E-06	2,960E-07	6,906E-05	7,324E-05	1,479E-06	6,884E-07	7,541E-05
Propene	g	1,769E-07	1,495E-08	2,473E-05	2,493E-05	5,035E-07	7,018E-08	2,550E-05
Emissions to water which contribute most to the environmental impact categories								
Phosphate	g	5,012E-05	3,142E-05	1,757E-02	1,765E-02	3,566E-04	2,999E-04	1,831E-02
COD, Chemical Oxygen Demand	g	9,048E-04	5,877E-04	6,650E-02	6,799E-02	1,373E-03	2,898E-04	6,966E-02
Nitrate	g	1,376E-05	2,341E-06	4,175E-03	4,191E-03	8,466E-05	4,969E-05	4,325E-03
Emissions of radioactive isotopes								
C-14	KBq	3,646E-07	1,281E-07	5,953E-05	6,002E-05	1,212E-06	7,050E-07	6,194E-05
Rn-222	KBq	6,610E-03	2,198E-03	1,080E+00	1,089E+00	2,200E-02	1,340E-02	1,124E+00
Kr-85	KBq	1,436E-07	2,171E-08	1,848E-05	1,865E-05	3,766E-07	9,377E-08	1,912E-05
Emissions of biogenic carbon dioxide								
Carbon dioxide, biogenic	g	5,795E-04	9,244E-05	1,311E-01	1,318E-01	2,662E-03	1,601E-03	1,361E-01

[5] The biogenic carbon dioxide emissions are included in the global warming potential.

ECO-PROFILE POLLUTANT EMISSIONS	UNIT	Alto de la Degollada 50 MW on-shore wind farm — 1 KWh electricity generated and distributed to a 132 KV customer						
		Upstream	Core Process	Core Infrastructure	TOTAL GENERATED	Downstream Process	Downstream Infrastructure	TOTAL DISTRIBUTED
Emissions of toxic substances								
Particulates, <2,5 um to air	g	1,419E-05	7,391E-06	7,573E-03	7,595E-03	1,534E-04	6,027E-05	7,809E-03
Particulates, >10 um to air	g	1,586E-05	5,388E-06	1,548E-02	1,550E-02	3,130E-04	1,952E-04	1,601E-02
Particulates, >2,5 um, and <10 um to air	g	5,623E-06	3,179E-06	1,090E-02	1,091E-02	2,204E-04	1,241E-04	1,126E-02
PAH, polycyclic aromatic hydrocarbons to air	g	5,698E-09	2,282E-09	3,342E-06	3,350E-06	6,766E-08	5,163E-07	3,934E-06
PAH, polycyclic aromatic hydrocarbons to water	g	2,386E-08	1,494E-09	1,593E-06	1,619E-06	3,270E-08	3,584E-09	1,655E-06
Arsenic to air	g	9,218E-09	1,771E-09	9,012E-06	9,023E-06	1,823E-07	1,688E-07	9,374E-06
Cadmium to air	g	4,725E-09	6,608E-10	2,393E-06	2,398E-06	4,845E-08	5,671E-08	2,504E-06
Dioxins to air	g	1,032E-14	1,336E-13	2,488E-11	2,503E-11	5,056E-13	1,769E-13	2,571E-11
Emissions of oil to water and ground								
Oils, unspecified to water	g	2,771E-04	1,336E-05	2,518E-03	2,808E-03	5,673E-05	3,274E-05	2,898E-03
Oils, unspecified to soil	g	2,926E-04	1,346E-05	2,407E-03	2,713E-03	5,480E-05	3,389E-05	2,802E-03

ECO-PROFILE WASTE & MATERIAL SUBJECT TO RECYCLING	UNIT	Alto de la Degollada 50 MW on-shore wind farm — 1 KWh electricity generated and distributed to a 132 KV customer						
		Upstream	Core Process	Core Infrastructure	TOTAL GENERATED	Downstream Process	Downstream Infrastructure	TOTAL DISTRIBUTED
Hazardous waste - Non-radioactive								
Hazardous waste - To recycling	g	-	-	3,646E-02	3,646E-02	7,365E-04	0,000E+00	3,720E-02
Hazardous waste - To incineration	g	-	4,262E-02	4,472E-03	4,709E-02	9,512E-04	1,742E-04	4,821E-02
Hazardous waste - Radioactive								
Volume for deposit of low-active radioactive waste	m3	4,195E-13	1,392E-13	6,828E-11	6,884E-11	1,391E-12	8,345E-13	7,107E-11
Volume for deposit of radioactive waste	m3	1,056E-13	3,161E-14	1,699E-11	1,712E-11	3,459E-13	2,121E-13	1,768E-11
Other waste								
Non-hazardous waste - To landfill	g	-	-	9,120E+00	9,120E+00	1,842E-01	0,000E+00	9,304E+00
Non-hazardous waste - To incineration	g	-	-	3,362E-03	3,362E-03	6,792E-05	3,484E-04	3,779E-03
Non-hazardous waste - To recycling	g	-	-	2,743E+00	2,743E+00	5,541E-02	2,995E-02	2,828E+00
Inert waste (Rock, sand etc) – To inert landfill	g	-	-	2,113E+01	2,113E+01	4,268E-01	-	2,156E+01

The emissions declared under the heading "emissions which contribute most to the environmental impact categories", are the ones contributing more than the 0,5% of the total environmental impact in any of the 5 impact categories assessed.

3.4 HOT SPOT ANALYSIS AND CONCLUSIONS

In order to find the aspects which are mainly causing these environmental impacts, is needed to look into every phase of the whole life cycle from an integral perspective.

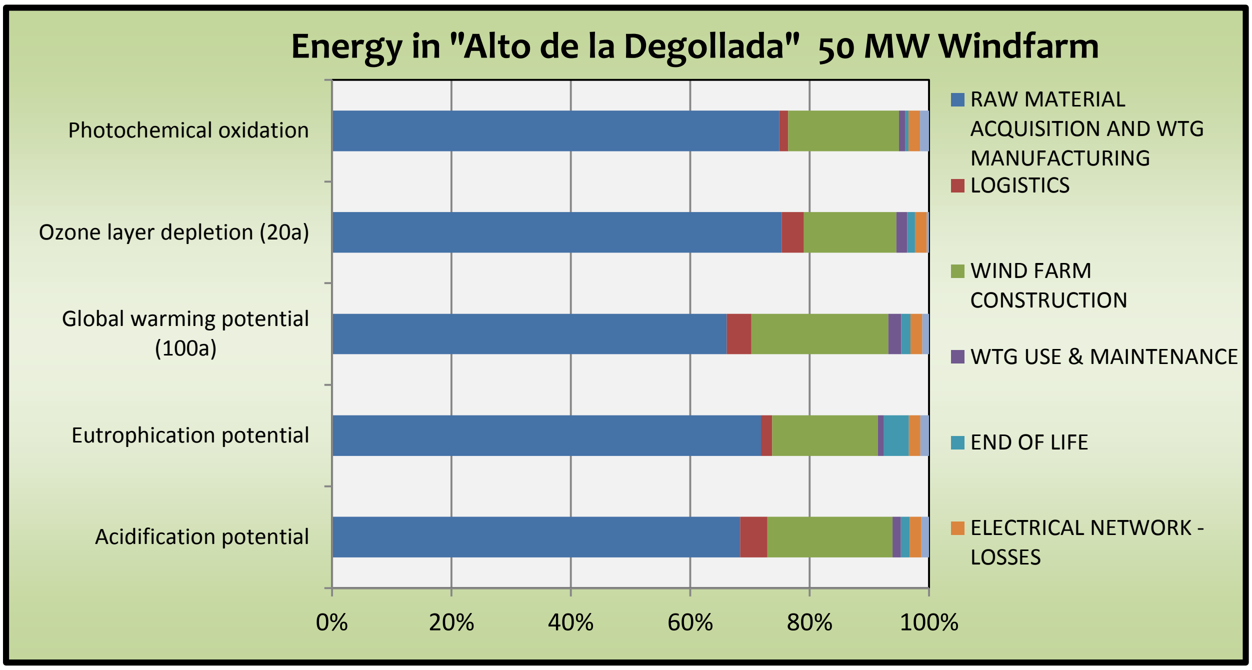

Figure 6.-Environmental hot spots

As shown in the figures above, there are two main phases within the life cycle of the electricity produced responsible of approximately the 90% of all the environmental impacts in average.

These are raw material acquisition and WTG manufacturing, and wind farm construction. For example, the raw material acquisition and WTG manufacturing goes from a 66% of the life cycle impacts in the category "Global warming potential" to a maximum of 75% in the category "Ozone layer depletion". In the other hand, the phase wind farm construction goes from a 15% in the category "Ozone layer depletion" to a 23% in "Global warming potential".

For these reasons these stages are the most relevant phases within the life cycle of the energy generated in "Alto de la Degollada" from an environmental point of view and should be carefully designed in future projects.

These are logical results, since a wind turbine does not consume any fossil fuel during its operation as the conventional energy sources do, so the main environmental aspect of this technology is related to the manufacturing of its infrastructure. This is mostly caused by the raw materials needed to manufacture all the steel parts of the WTG and the subsequent machining phases. The most critical component in this phase is the tower by far. The blades, the gearbox, the main shaft and the rest of the parts that shape the rotor, have also a significant environmental impact..

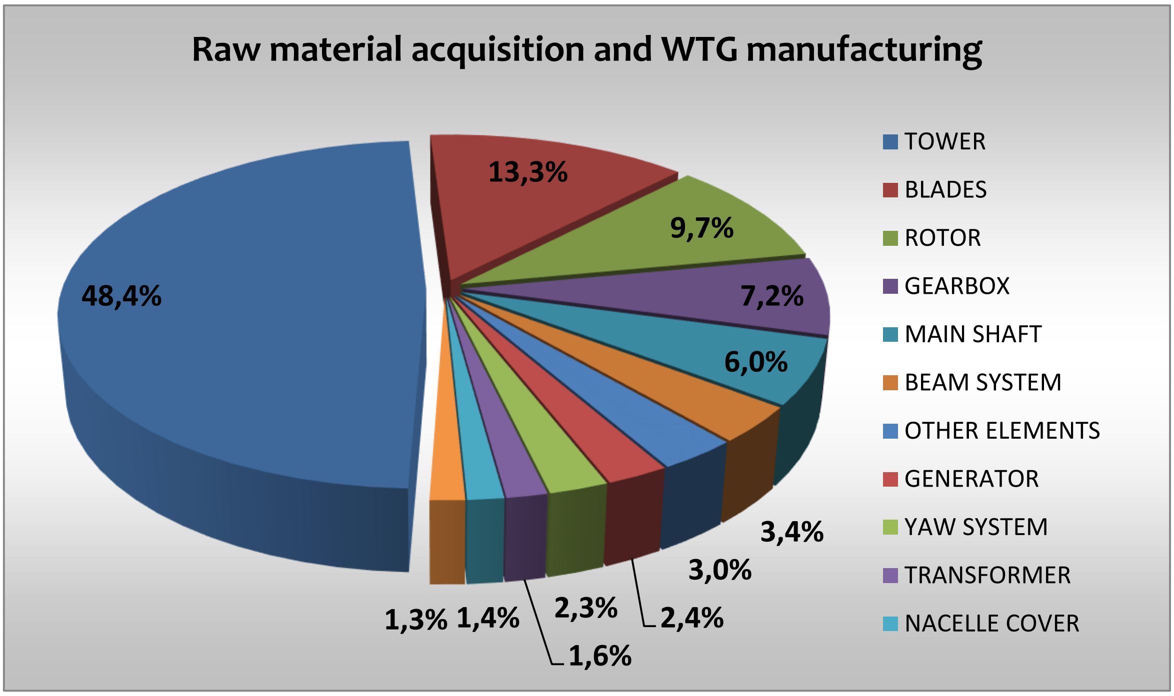

Figure 7.Global warming potential share for the raw material acquisition and WTG manufacturing phase

When we look at the wind farm construction, the most relevant environmental aspects are the materials which compose the foundation (mainly concrete and steel), followed by the fuel burned in the construction machinery.

Regarding the electricity grid infrastructure, the impacts are mostly related to the raw materials used for the high voltage wires (copper, aluminum, steel and polymers), as well as for the transport associated to bring these materials to the European countries where the wires are manufactured.

The rest of the modules as for example use and maintenance, end of life, electrical losses in the network and logistics, have a minor contribution to the life cycle environmental impacts of the generated and distributed energy in "Alto de la Degollada".

Finally, is important to point out that since the functional unit is 1 Kwh generated and distributed, the main environmental aspect in this system is the amount of electricity generated. The best potential environmental improvements will be indubitably associated to an effective increase in the amount of energy generated and distributed to the final consumer.

4. ADDITIONAL ENVIRONMENTAL INFORMATION

4.1 IMPACT ON BIODIVERSITY

Iberdrola conducts an Environmental Impact Assessment prior to every wind farm project. These kinds of studies are usually a prerequisite demanded by the local public administration. Nevertheless, when such a study is not a legal requirement, Iberdrola applies internal controls in order to ensure compliance with legal and internal environmental requirements.

The strategy of the company considers a combination of elements related to prevention, management and remediation of damage to natural habitats which might result from the operation of the wind farm. To ensure the existing natural integrity, aiming at the stability of the environmental resources, is critical the impact avoidance to local communities and the insurance of the minimum impact to the existing biodiversity.

Specifically for the complex of “Alto de la Degollada”, the Environmental Impact Assessment set down some actions to be done in order to protect the existing biodiversity.

4.1.1 Flora

The vegetation may be affected by the need of land preparation for the wind farm installation and could be degraded because of the building works, accesses, roads, foundations and other elements of the site. Therefore and to minimize these effects, Iberdrola took the following actions in “Alto de la Degollada”.

- The topsoil extracted from the excavation of the service roads and from the foundation of the wind turbine generators was kept to be used in the restoration of the degraded areas when finishing the groundwork. The new road accesses created did not affect the existing vegetation. If needed, the layout was re though, in order to avoid the negative affection.
- The extracted soil and waste material which appeared during the execution of the excavations for the underground power lines and in the embodiment of concrete footings, was reused for the conditioning and landscape restoration works.
- Protection of the areas designated for using or handling of substances which may cause accidental spills, with pollution potential to soil and water, either surface water or groundwater.
- Replacement of woodland and scrub in the affected areas, on the cases that repercussion to adjacent forest land can’t be avoided.
- All the oils and machinery wastes should be correctly handled. For that purpose, these kinds of waste were sent to an authorized waste manager.
- A 1.500m long vegetable wall was erected on the place known as “Prado Carnicero”, to reduce the visual impact from the surroundings of the wind farm. This wall is composed of the vegetal species “Quercus faginea” and “Populus nigra”.
- Control the possibility of having prioritary species present in the area, such as Poo-bulbosae astragalion or Lino differentis-Lepidietum sububali.
- Restoration of vegetation affected by the work, in order to assure that the area does not remain occupied by road or infrastructures. Repopulate the area with bushes and scrubs of the same type of the ones in the surroundings.
- Staking of all areas affected by the project prior to the start the construction, to avoid a physical repercussion higher than the strictly necessary.

- Removal of all temporary facilities and all waste, debris and equipment used or generated during the execution of the works.

4.1.2 Fauna

Furthermore, the alteration of the natural environment has consequences on the fauna of the area, which also requires taking certain measures to reduce this way of impact. The wind farm is located on a place populated by many species. Iberdrola compensates the reduction of useful surface for the local wildlife with the following measures.

- Given the fact that the south side of the wind farm is an area of usual concentration of steppe birds such as pin-tailed sandgrouses (Pterocles alchata), montagu's harriers (Circus pygargus), hen harriers (Circus cyaneus) and peregrine falcons (Falco Peregrinus), no wind turbine generators were installed within that area.
- Plantation of shrubs with fruit such as Crataegus monogyna, Prunus spinosa, Rubus spinosa and Sorbus spinosa around the existing and new roads, with a density of one shrub every 2 meters. This is made to offset the reduction in the useful area and also to enhance the refuge for several species.
- Plantation of one 20 meter diameter thicket of the previous species, for each of the 25 wind turbines.
- The stone heaps were kept in their place, taking into account that these act as coverage for the autochthonous species.
- Installation of one 50 liter trough and one 10 liter feeder for each WTG installed.
- All the power lines should be underground, restoring and correctly signaling the trenches on the surface. During the execution of the works for laying underground power lines, the intention is to close the trenches as soon as possible, avoiding falling animals.
- Installing all the internal wiring of the wind farm in the underground, thereby avoiding electrocution of birds by contact with electrical power conductors.
- The water resources of the area, either surface or underground, should be protected ensuring that they won't be affected by accidental spills or leakages.
- The overhead power networks were constructed minimizing the affection to birds, installing bird guards in the lines when needed.
- The location of the wind turbines was selected to be in non-forested areas where the presence of animals is reduced.
- Monitor bird collisions with the goal of establishing corrective measures.

Regarding the impact on wildlife, especially on birds, it is determined that because of these preventive measures taken, the impact is small because the wind farms are placed in situations studied to affect as little as possible to their behavior. Besides, the risk of collision of birds on the blades is reduced since they quickly become accustomed to the turbines.

4.2 LAND USE

4.2.1 Description of land use in "Alto de la Degollada"

The complex "Alto de la Degollada" is located between the municipalities of Castrojeriz and Los Balbases, (Burgos). The wind farm has 25 wind turbines with a total installed power of 50 Mw, arranged in three rows of NW-SE direction. The nearest population is also near, standing 2.7 km away from the nearest wind generator. The wind farm is located at a distance of approximately 2.5 km of a site of community interest called "Riberas de la subcuenca del río Pisuerga."

Iberdrola conducts an analysis of the soil condition before and after the wind farm is installed. Below, the land use description of the selected wind farm is shown. This information has been extracted from the Environmental Impact Study (EIS) conducted before the construction of the wind farm.

Before the construction of the wind farm, the land was characterized as arable and farming areas. Moreover, the results of the environmental impact study conducted before starting the groundwork showed that the whole zone was a low environmental sensibility area.

The reference wind site mentioned is mainly composed of the following infrastructures:

- Towers
- Foundations y tower bases
- Roads

The wind farm was installed in the year 2010, so that by the time this environmental product declaration was written, “Alto de la Degollada” had 5 years of ongoing operation. The expected lifetime of the WTGs is considered as 20 years.

4.2.2 Land use – Corine Land Cover classification

A land use classification based on the Corine Land Cover methodology (CLC) has been made. Iberdrola conducts environmental impact studies (EIS) for every construction site, which are used as the source of the information. In the table below, are presented the land uses in the vicinities of the “Alto de la Degollada” wind farm. The data extracted from the projects are "real ground uses", not administrative uses. They are taken from the work units thereof which are roads, foundations, platforms, trenches for internal wiring and connections and the control building.

The occupied areas are shown in m2, and represent the land use before and after the construction of the wind farm.

LAND USE	BEFORE INSTALLATIO N	AFTER INSTALLATION
Artificial areas	0	151.400
Farming areas	151.400	0
Forest and semi-natural areas	0	0
Wetlands	0	0
Water	0	0
TOTAL	**151.400**	**151.400**

Table 3.- Land use

4.3 ENVIRONMENTAL RISK

Iberdrola performs environmental risk analysis at different stages of projects, according to the criteria of the Standard ISO15008 - Analysis and environmental risk assessment. Although in general the probability and severity of undesirable events is generally very low and happens less frequent than once in three years, there were included those most representative events.

Radiology remains very low because of the lack of radioactive elements through the life cycle of the product, and the controls maintained during manufacturing processes. This section includes all those undesirable events that can occur by chance but will produce relevant environmental impact.

Fire:

A fire emits a large amount of contaminating substances to the atmosphere and also produces waste when components are destroyed by the fire.

Oil spill:

Spills of oil, fuel and lubricants can cause local impacts on water and environmentally sensitive areas. At preventive maintenance operation, substances could be spilled accidentally. The impact of the spills would affect to environmentally sensitive areas.

Concrete spill:

The potential risks of concrete spill during transport of concrete may occur but probability is very low.

In the following table are quantized such impacts, where, by way of comparison, in the right column represent the emissions or other consequences under normal conditions.

POTENTIAL RISKS	Effect	Substances emitted to the air	Substances emitted to the land
Spills of hazardous substances and chemicals	Affection to flora and wildlife	-	Oil
Fires at Nacelle Components	Emissions to the atmosphere	CO2 and others	Waste
Concrete spills	Affection to flora	-	Concrete

Table 4.- Environmental risks

In conclusion, it is seen that the impact produced by the potential risks is considerably lower than those produced in normal conditions.

4.4 ELECTROMAGNETIC FIELDS

The international Commission on Non-Ionising Radiation Protection (ICNIRP), an independent body consisting of international experts, has published recommendations regarding acute health problems. The recommendations are based on knowledge about acute health problems due to changing magnetic fields and propose a limit of 500µT for working environment and for the general public a limit of 100 µT.

Additionally and coming from the EMC Directive (2004/108/EC) (Electromagnetic Compatibility Directive), it is worth noting that EN 62311 and EN 62479 (included in the harmonised standards list for the LV Directive) cover human exposure restrictions for electromagnetic fields, and are relevant to WTG design; these two standards were taken into account when writing the specifications of the machine whose design is validated against these requirements, so we can say that although electromagnetic fields are generated, they will not cause harm to the health of people, being lower than those issued by the ICNIRP recommendations.

The requirements of IEC 62305-4 for the design of surge protection and lightning protection are a critical issue when designing WTGs.

4.5 NOISE

The noise produced by a wind turbine is twofold, mechanical and because of the aerodynamics. The first one is arisen from the machine components operation, and can easily be reduced by conventional techniques. Aerodynamic noise produced by the air flowing on the blades, tends to increase with the speed rotation of the blades. Moreover, with wind flow turbulent conditions, noise may increase. Although inside the nacelle mechanical noises exist, these are considered as low noises compared to aerodynamic ones. At ground level, the only relevant noise is the aerodynamic one.

The emitted noise values in "Alto de la Degollada" are within the normal values within the wind industry. Also noteworthy is that wind farms are located in uninhabited areas and within distances greater than 300 m, the noise level is greatly reduced and is considered negligible to be lower than the ambient noise threshold in nature, wind, etc.

4.2.3 Noise Calculation

There are two international standards that establish noise measurement procedure and noise levels declaration:

- IEC 61400-11 (Ed. 3 2012): Wind turbine generator systems - Acoustic noise measurement techniques. Definition of how to perform noise measurements of a wind turbine.
- IEC 61400-14 (Ed. 2005): Wind turbines - Declaration of apparent sound power level. Definition of how to declare the noise generated by an WTG.
- G90 noise levels have been measured by authorized testing companies based on these standards, and reports are available for whoever is interested.

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4.6 VISUAL IMPACT

The landscape impact caused by the presence of wind turbines and power lines is a subjective aspect, which affects differently, depending on the location of the wind farm. The location of wind farms is also determined by analyzing the different points from which they are visible to, thereby causing minimal visual impact. Each wind farm prior to the decision to its location has had an environmental impact assessment that has been approved by the relevant environmental authority.

The substation and the control building were properly constructed following the local architecture, avoiding the clash with the environment.

In addition, a vegetable wall was erected on the place known as “Prado Carnicero”, to reduce the visual impact from the surroundings of the wind farm. This wall is 1.500 meters long and is composed of the vegetal species “Quercus faginea” and “Populus nigra”.

5. CERTIFICATION BODY AND MANDATORYU STATEMENTS

5.1 INFORMATION FROM THE CERTIFICATION BODY

The verification process of this environmental product declaration has been carried on by Rubén Carnerero Acosta, independent approved verifier by the international EPD® System, which verifies that the attached Environmental Product Declaration complies with the applicable reference documents and also certifies that the data presented by the manufacturer are complete and traceable in order to provide supporting evidence of the environmental impacts declared in this EPD document, according to the EPD-System General Programme Instructions.

The EPD has been made in accordance with the General Programme Instructions for an Environmental Product Declaration, EPD, published by the International EPD Consortium and PCR version 3.0 2007:08 CPC 171 & 173: Electricity, Steam, and Hot and Cold Water Generation and Distribution. The verifier Rubén Carnerero Acosta has been accredited by the International EPD® System to certify Environmental Product Declarations, EPD. This certification is valid until the date XX-XX-2018.

5.2 MANDATORY STATEMENTS

5.2.1 General

Note that EPDs within the same product category but from different programs may not be comparable.

5.2.2 Life cycle stages omitted

According to the reference PCR, the phase of electricity use has been omitted, since the use of electricity fulfils various functions in different contexts.

5.2.3 Means of obtaining explanatory materials

The ISO 14025 standard requires that the explanatory material should be available if the EPD will be communicated to end users. This EPD is industrial consumer oriented (B2B) and communication is not intended for B2C (Business-to-consumer).

5.2.4 Information on verification

EPD PROGRAMME AND PROGRAMME OPERATOR	
The International EPD® System Programme operator: EPD International AB Valhallavägen 81 SE-114 27 Stockholm - Sweden	
INDEPENDENT VERIFICATION OF THE DECLARATION AND DATA	
☐ **Internal** ✓**External**	Rubén Carnerero Acosta Ecoingenium S.L. r.carnerero@ecoingenium.es
PRODUCT CATEGORY RULES	
PCR 2007:08, Version 3.0, CPC 171 & 173: Electricity, Steam, and Hot and Cold Water Generation and Distribution, Date 2015-02-15 / Valid until 2019-02-05	
PCR REVIEW	
Product Category Rules (PCR) review was conducted by "The Technical Committee of the International EPD® System". Full list of TC members available on www.environdec.com/TC	
VALID UNTIL	**REGISTER NUMBER**
29 September 2018	**S-P-00768**
IBERDROLA CORPORATION	

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6. LINKS AND REFERENCES

Additional information about Iberdrola:

www.iberdrola.com

Additional information about the International EPD® System:

www.environdec.com

- Introduction, usage and key elements of the programme:

  http://www.environdec.com/documents/pdf/EPD_introduction_080229.pdf

- General instructions of the programme:

  http://www.environdec.com/documents/pdf/EPD_instructions_080229.pdf

- Annexes:

  http://www.environdec.com/documents/pdf/EPD_annexes_080229.pdf

The International EPD® System is based on a hierarchical approach using the following international standards:

- ISO 9001, Quality management systems
- ISO 14001, Environmental management systems
- ISO 14040, LCA - Principles and procedures
- ISO 14044, LCA - Requirements and guidelines
- ISO 14025, Type III environmental declarations

Database used for the LCA:

- EcoInvent 2.2 Database, published by the Swiss Centre for Life Cycle Inventories

http://www.ecoinvent.org

Other references:

- ✓ Gamesa Corporación Tecnológica – www.gamesacorp.com
- ✓ Red eléctrica española – www.ree.es
- ✓ Comisión Nacional de la Energía – www.cne.es
- ✓ Eurelectric – www.eurelectric.org
- ✓ Réseau de transport d’électricité – www.rte-france.com
- ✓ Électricité Réseau Distribution France – www.erdfdistribution.fr
- ✓ Terna Group - www.terna.it
- ✓ PSE Operator – www.pse-operator.pl
- ✓ Council of European Energy Regulators (CEER) – www.energy-regulators.eu
- ✓ Abb – www.abb.com
- ✓ Worldsteel Association – www.worldsteel.com
- ✓ Copper Development Association – www.copper.org
- ✓ International Aluminum Institute - www.world-aluminium.org
- ✓ European Steel Association - www.eurofer.org
- ✓ Censa – www.censa.es
- ✓ General cable – www.generalcable.es
- ✓ Asociación empresarial eólica – www.aeeolica.org
- ✓ European Wind Energy Association – www.ewea.org
- ✓ German Wind Energy Institute – www.dewi.de
- ✓ IEC 61400-1 Wind Turbine generator system