Environmental product declaration
according to ISO 14025

Electricity generated in photovoltaic power plant

El Romero Solar 196 MW

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UN CPC 171 - Electrical energy
PCR 2007:08 UN CPC 171 & 173 - Version 3.0 - Electricity, steam and hot/cold water generation and distribution

EPD®

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Contents

1. Introduction

1.1 Product and EDP System environmental declarations

This document contains a declaration of the environmental impact (EPD) of the power generated in the El Romero photovoltaic power plant in Chile, based on a Life Cycle Assessment (LCA). It also contains additional environmental information not based on the LCA according to the requirements of the relevant product category rules (PCR), including impacts on the biodiversity in the area, the use of land on the site, the main environmental risks, the electromagnetic fields generated, noise and visual impact.

An Environmental Product Declaration is defined in the ISO 14025:2010 standard as the quantifying of the environmental data of a product according to the categories and parameters specified in the ISO 14040 family of standards, including additional environmental information when relevant.

The main objective of the International EPD® System is its ambition to help and support organisations to communicate the environmental behaviour of their products (goods and services) credibly and understandably.

The system thus offers a complete programme aimed at any organisation interested in developing and communicating EPDs according to ISO 14025:2010 as well as supporting other EPD programmes (e.g., national, sectorial, etc), seeking their cooperation and harmonisation and helping the various organisations to encourage the use of environmental assertions in the international market.

Environmental Product Declarations add a new dimension to the market, offering public information on the environmental behaviour of the products and services. The use of EPDs brings a great number of benefits both for the organisations that develop them on their products and for those who use the information in them.

This EPD was prepared according to the rules of the International EPD Consortium. The International EPD® System is a system for the international use of Type III Environmental Declarations, in accordance with ISO 14025:2010. Both the system and its applications are described in the General Programme Instructions (GPI).

The documents on which this EPD is based are, in hierarchical 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 Programme Instructions for Environmental Product Declarations, Ver. 2.5.
- ISO 14025:2010 - Type III environmental declarations.
- ISO 14040:2006 and ISO 14044:2006 on Life Cycle Assessment (LCA)

1.2

ACCIONA Energía

Acciona Energía is a global renewable energies operator, the largest one in the world dedicated exclusively to clean energies not connected to the conventional electrical companies.

It produces clean, emissions-free power for more than six million homes throughout the planet, thus contributing to progress towards a more sustainable energy system that favours development without putting the environment at risk.

The company carries out this task increasingly competitively thanks to a permanent commitment to innovation, aimed at increasing the efficiency of our technological solutions in areas such as the remote operation and maintenance of facilities, energy storage and grid integration, among others.

With more than 20 years' experience in the sector, Acciona Energía is present in the main renewable technologies, covering activities involving the entire value chain – development, engineering and construction, operation and maintenance and the sale of energy.

All of this is joined by a global vocation with implementation in more than 20 countries on all continents, especially aimed today at the emerging markets with needs for sustainable solutions to drive their development.

Solvency, reliability, experience and a global dimension are essential aspects in our corporate profile that make us a leading renewables player as promoter, partner or supplier of services world wide.

In Acciona we are convinced that renewables are the technologies with the greatest growth expectations in the 21st century given that only these offer a sustainable economical, social and environmental solution to the energy required by the world to drive its development.

The Acciona Energía business management system is certified according to the following international standards:

- **ISO 9001:2015**
  Quality management systems.
- **ISO 14001:2015**
  Environmental management systems.
- **OHSAS 18001:2007**
  Occupation health and safety management systems.

1.3

Unit declared

This document represents the certified Environmental Product Declaration for the energy generated in the El Romero photovoltaic power plant.

In this context, the declared unit is the reference that exactly defines the element being analysed and assessed from the environmental point of view in the declaration. All the information in this document is referenced to the declared unit, which in this case is:

"1 kWh of energy generated in the El Romero photovoltaic power plant that is then uploaded to a high voltage grid (220 kV) in Chile"

The amount of energy used as a reference flow was 12,074,411.763 MWh. This reference flow represents the total net energy that the power station can generate over its 25 years' planned operation. This reference flow is the value that allows the later referencing of all the inputs and outputs to the functional unit defined in the previous paragraph.

1.4

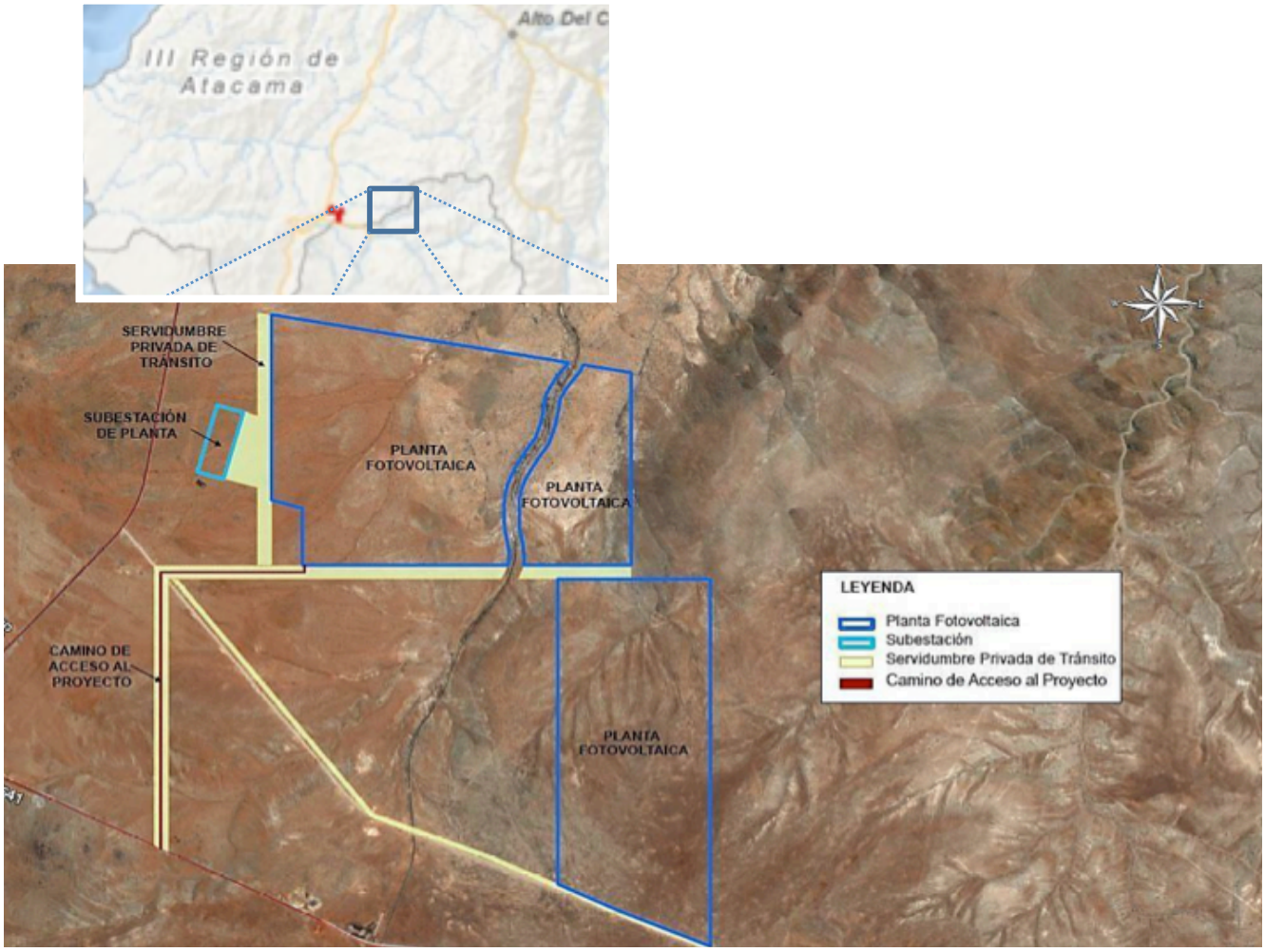
Description of the product system analysed

The product system analysed is the El Romero solar photovoltaic power plant located in the Atacama desert in Chile. The project's area is in the Commune of Vallenar (province of Huasco) in Region III of Atacama (Chile), next to Route 5 and approximately 8 kilometres to the south of the hamlet of Cachiyuyo.

Its geographical location is latitude 29°6'35"S, longitude 70°54'31", also near the locality of Domeyko.

The plant has a real area of 2,800,000 m2 occupied by the panels and planned installation as well as a total of 601.18 hectares of leased area.

El Romero has a peak installed power of 246 MWp and a nominal power of 196 MW using polycrystalline silicon photovoltaic panels. Construction on the site lasted from March 2016 to April 2017, with the milepost of connection to the grid and the start of the test phase occurring in mid-November 2016. The sale of energy began at this time although the official date for the start of operation was March 2017.

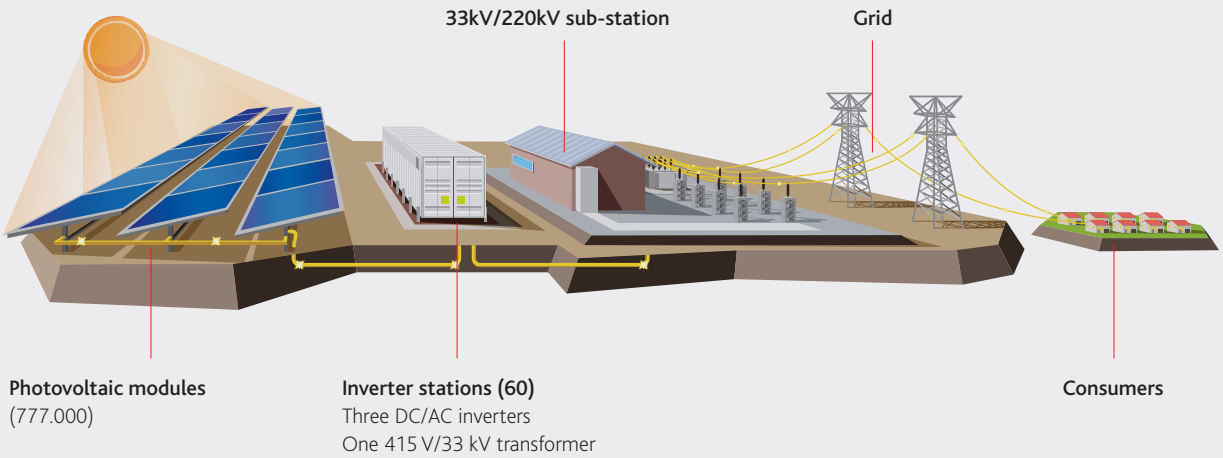


The basic functioning of the power station can be divided into four areas, as shown in Figure 2. There is a first area with the photovoltaic panels where low voltage DC electricity is generated, a second area with the power stations in which the power is inverted to AC and stepped up to 33 kV, a third area containing the power station's output to the grid where the voltage is stepped up again to 220 kV and, finally, the energy sale point near the Don Héctor sub-station some 2.5 km away.

To achieve the suitable functioning of the site, it was necessary to install a set of equipment forming the photovoltaic power plant. The following describes in detail the main equipment in the El Romero solar power station.

Figure 1

El Romero Solar. Plant functioning schematic



Sunlight is converted into DC electricity by the plant's **solar panels**

The DC power is transformed into AC power by the **inverters**.

The **transformers** raise the low voltage (415 V) to medium voltage (33 kV).

In the **sub-station**, the medium voltage is raised to high voltage (220 kV) for injection into the **grid**.

The power grid carries the power to the **consumers**.

PHOTOVOLTAIC PANELS

The photovoltaic panels or modules are the heart of any solar power station since they generate the energy in the system. Their task is to convert the sunlight falling on the panel into electrical current. The panels are formed of photoelectric cells connected together that can absorb the light photons and emit electrons, creating a continuous current.

This element is of great environmental relevance in the system due to the large number of panels installed in a power station with the power of El Romero and to the importance of their efficiency on the final environmental behaviour of the power station. Three types of photovoltaic panels were installed on the site. Their main properties are summarised in the following table.

Table 1

Photovoltaic Panels: Main characteristics

Panel	Technology	Unit power	Units installed	Ef [%]	Supplier	Origin
JAP6-72 315 4BB	Polycrystalline silicon	315 Wp	342.840	16,25	**JA Solar**	China
JAP6-72 320 4BB	Polycrystalline silicon	320 Wp	343.070	16,51	**JA Solar**	China
4BB_HR+315P	Polycrystalline silicon	315 Wp	90.320	16,27	**Hareon Solar**	China

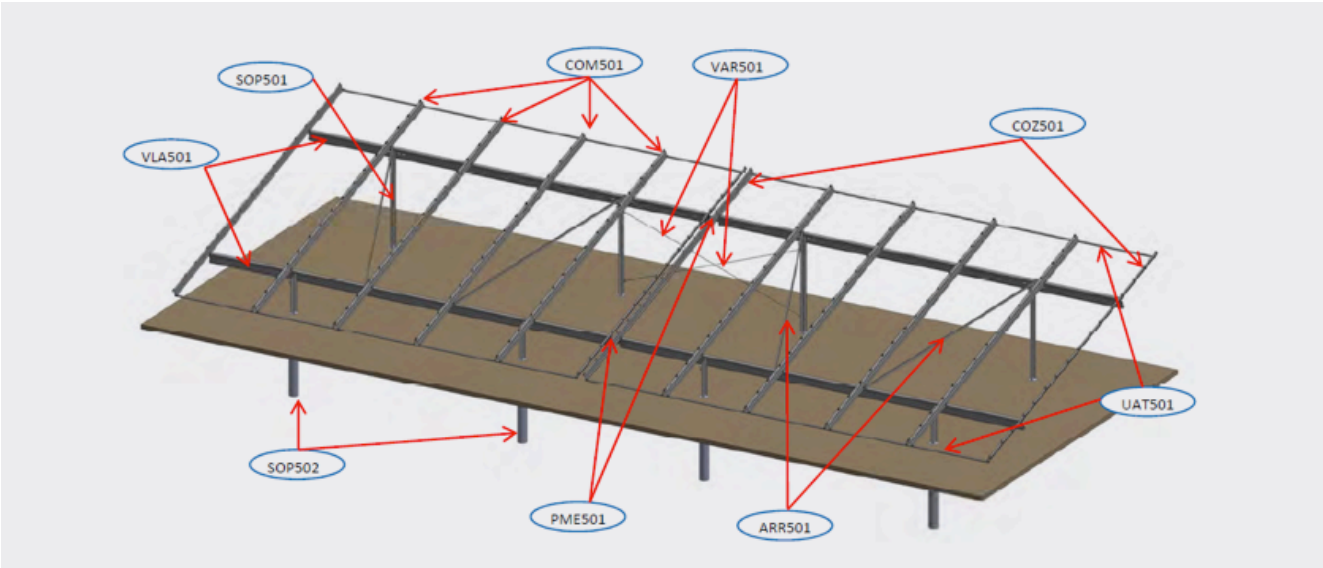
SUPPORT STRUCTURES

The structures that support the photovoltaic panels and protect them from the ground are of the fixed type in this site. As with the modules, the supports were provided by two companies, STI Norland and Krinner. Both structures are made mainly of galvanised steel.

Table 2

Support Structrures: Main characteristics

Support	Units installed	Angle	Capacity	Foundation	Supplier	Origin
ST-F5	9.691	17°	40 modules	Mixed	**STi Norland**	Spain
FLEX-V	4.362	20°	Varying between 30 and 90 modules	Steel studs	**KRINNER**	Germany



INVERTER STATIONS

Once the sunlight has been converted into low voltage DC electricity in the panels, it is carried by cabling to the inverter stations, of which there are 60 dispersed over the site. These inverter stations contain a set of electrical equipment to convert continuous electricity to alternating and then raise the voltage to reduce cabling losses as far as possible. The main items of equipment in the inverter stations are detailed in the following table.

Table 3

Inverter Stations: Main characteristics

Equipment	Total Units	Function	Supplier	Origin
PVS800 1200 kW INVERTER	180	Element that converts DC power generated by the modules to an AC signal.	**ABB**	Spain
TRANSFORMER VACUUM CAST COIL DRY TYPE 3600 KVA	60	Steps up the low voltage electricity to medium voltage.	**ABB**	Spain
MEDIUM VOLTAGE SWITCHGEAR SAFE PLUS SWITCHGEAR 36KV	60	Undertakes operating, metering, protection and/or control of the electricity.	**ABB**	Norway
UPS SYSTEM	60	Provides power for a limited time and during a power cut to the devices connected to it.	**ABB**	China

EL ROMERO ELECTRICAL SUB-STATION

After passing through the inverter stations, the electricity generated is carried by medium voltage underground cabling to an electrical sub-station built specifically in El Romero to deliver the energy generated to the general electrical transport grid.

Before leaving the photovoltaic power plant, the energy's voltage is stepped up again to 220 kV (HV) by the power transformer in the sub-station itself. The main equipment installed in the El Romero sub-station and that was also included in the system to be studied was the following.

Table 4
Electric Substation: Main characteristics

Equipment	Unit installed	Supplier	Origin
Power transformer	1	**SPECO**	China
HV isolator	2	**COELME**	Italy
Medium voltage switchgear	17	**MESA**	Spain
HV switch	1	**SIEMENS**	Germany
Protection, control and metering boards	1	**INGETEAM**	Spain
Lightning conductor	13	**CHINT**	China
MV isolator	1	**CHINT**	China
Auxilliary services reactance and transformer	1	**SCHAFFNER**	Chile
Current and voltage transformers	6	**ARTECHE**	Spain
Telecommunications equipment	6	**COLWAY**	Spain
Generator	1	**CUMMINS**	India
Batteries and chargers	184	**ZIGOR**	Spain
Auxilliary services boards	2	**TECMEL**	Chile
Generation switchgear	1	**SEIS**	Chile
Wave traps	3	**SIEMENS**	Brazil

Despite being outdoors, the sub-station also has its own control building housing the switchgear. The construction of this building was included in the scope of the project.

CONNECTION LINE TO THE GENERAL ELECTRICITY GRID

After reaching the El Romero electrical sub-station and converted to high voltage, the energy must be carried to the point of connection with the Chilean electricity grid, which in this case is relatively near the power station, in the Don Héctor sub-station, 2.5 km away.

An overhead high voltage power line was built for this purpose, consisting of the following elements.

Tabla 5
Connection Line: Main characteristics

Element	Units Installed	Supplier	Origin
Steel pylons	12	**BBOSCH**	Chile
AAAC Flint overhead aluminium cable	8.000 m	**Comercial Aragón**	Chile
OPGW 24 overhead cable	4.000 m	**Comercial Aragón**	Chile
E.H.S 3/8" overhead steel cable	520 m	**Comercial Aragón**	Chile
Optical fibre cable	345 m	**Comercial Aragón**	Chile
220KV underground cable	1.530 m	**NEXANS**	Spain

ADDITIONAL ELEMENTS

As well as all the elements in the photovoltaic system described in the above sections, there is a series of common elements that must also be considered when preparing an LCA for a plant of this type. This refers to all the cabling elements, grouping boxes, connectors, auxiliary control and storage buildings, communication masts and perimeter fence. All these additional elements form part of the life cycle of the El Romero power station and have been considered for preparing the study.

Tabla 6

Additional elements

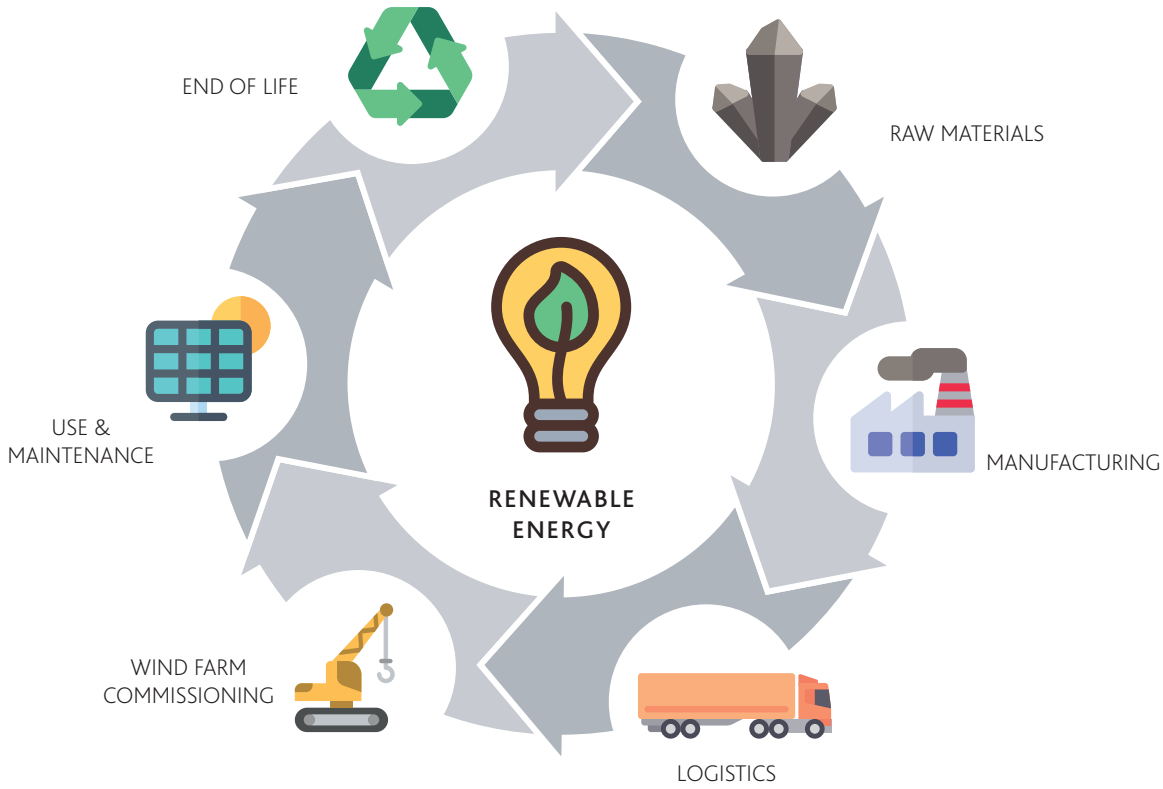
Equipment	Quantity installed	Unit	Supplier	Origin
DC connectors (LV)	13,484	units	**AMPHENOL**	Tunisia
DC cabling (LV)	702,903	m	**POLYCAB**	India
AC Cabling (MV)	119,524	m	**HENGTONG**	China
Optical fibre	40,390	m	**OPTRAL**	Spain
Earthing system	52,490.4	m	**NEXANS**	Chile
Drilling connectors	13,705	units	**NILED**	Spain
Grouping boxes	1,568	units	**CHEMIK**	Spain
Trays	2,001	units	**BASOR**	Spain
Perimeter fence	19,099	m	**HEC**	Chile
Communications mast	1	units	**RAYTECH**	Chile
Auxiliary buildings	4	units	**QUANTA/SARPEL**	Chile

2. Environmental information based on LCA

2.1 Limits of the system assessed

This EPD is based on an exhaustive analysis of the life cycle of the energy generated in El Romero, which is distributed to a high voltage Chilean grid. Because of this, the environmental impacts declared include the entire life cycle of the photovoltaic energy from cradle to grave.

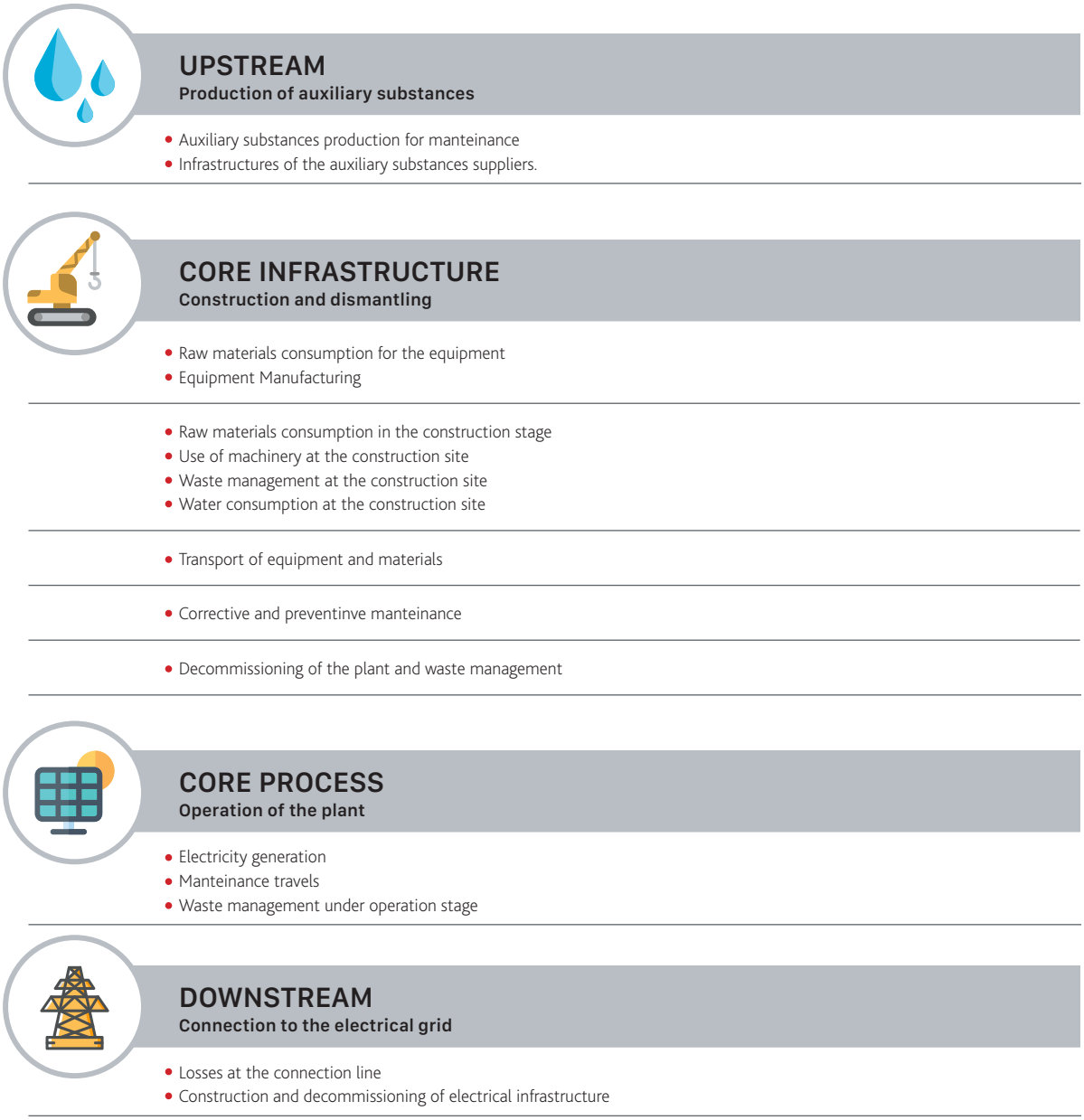
Figure 2
The life cycle of the energy generated in El Romero



As required in the reference PCR, the complete life cycle has been divided into three large blocks to be able to clearly define the limits of the system assessed. These blocks are called upstream, core and downstream. In addition, the core and downstream blocks have in turn been split into the "process" and "infrastructure" sub-divisions.

The following figure shows the limits of the system assessed.

Figure 3



The data used to create the LCA model in the Simapro 8 software were obtained directly by Acciona Energía or by its suppliers. It is this information that ensures that the declared results match the reality of the equipment installed in El Romero. The data used to create the LCA model are fully traceable and were reviewed during the external audit process to verify the EPD.

Acciona Energía's objective was to include all the available information in the Life Cycle Assessment. At the end of the study, environmental information on 99.98% of the total mass flows of the photovoltaic power station was included.

Table 7
El Romero photovoltaic power plant

Group	Theoretical total [kg]	Total analysed [kg]	% Compiled
Photovoltaic system	32.677.193,69	32.677.103,69	100,00%
Common elements	8.765.474,57	8.761.907,79	99,96%
Electrical sub-station	296.147,28	292.433,89	98,75%
Grid connection line	103.573,43	103.573,43	100,00%
TOTAL	**41.842.388,97**	**41.835.018,80**	**99,98%**

Starting with these primary origin data, the Ecoinvent 3.2 database was used to prepare the LCA model. Ecoinvent is the life cycle inventories database most widely-used world wide and contains consistent and transparent information. This database contains industrial level life cycle inventories on energy sources, resources extraction, provision of materials, chemicals, metals, agriculture, wastes handing services and transport services, among others.

Likewise, in the verification audit it was found that less than 10% of the environmental impact came from values with a low quality level, also called "proxy."

The following sections detail the elements included in each block in the study, giving greater emphasis on the data sources and on their geographical and time validity.

2.1.1 UPSTREAM

The "upstream" module considers all the environmental impacts relating to the manufacture of auxiliary substances needed for the correct operation of El Romero throughout its 25 years of operation.

Given that solar photovoltaic energy requires no fuel for its functioning, this module includes consideration of only the main needs for substances that must be consumed during the preventive maintenance stage and their transport to the power station's location.

The Acciona Energía Operation and Maintenance Department has defined a series of operational instructions that describe the main actions to be undertaken during this stage in the power station. These maintenance instructions are the main source used for the requirement for consumables. In this case, the needs for water for periodically cleaning the panels, the need for cleaning the meteorological stations and the maintenance of the substation generator have been considered.

2.1.2 CORE – INFRASTRUCTURE

The "core-infrastructure" module strongly represents the greatest part of the life cycle of the energy generated in El Romero, including all the stages relating to the construction and decommissioning of the El Romero photovoltaic power plant. All the impacts relating to the obtaining of raw materials, the manufacture of the equipment installed, its transport to Chile, the work of constructing the site and its final decommissioning form part of this "core-infrastructure" module.

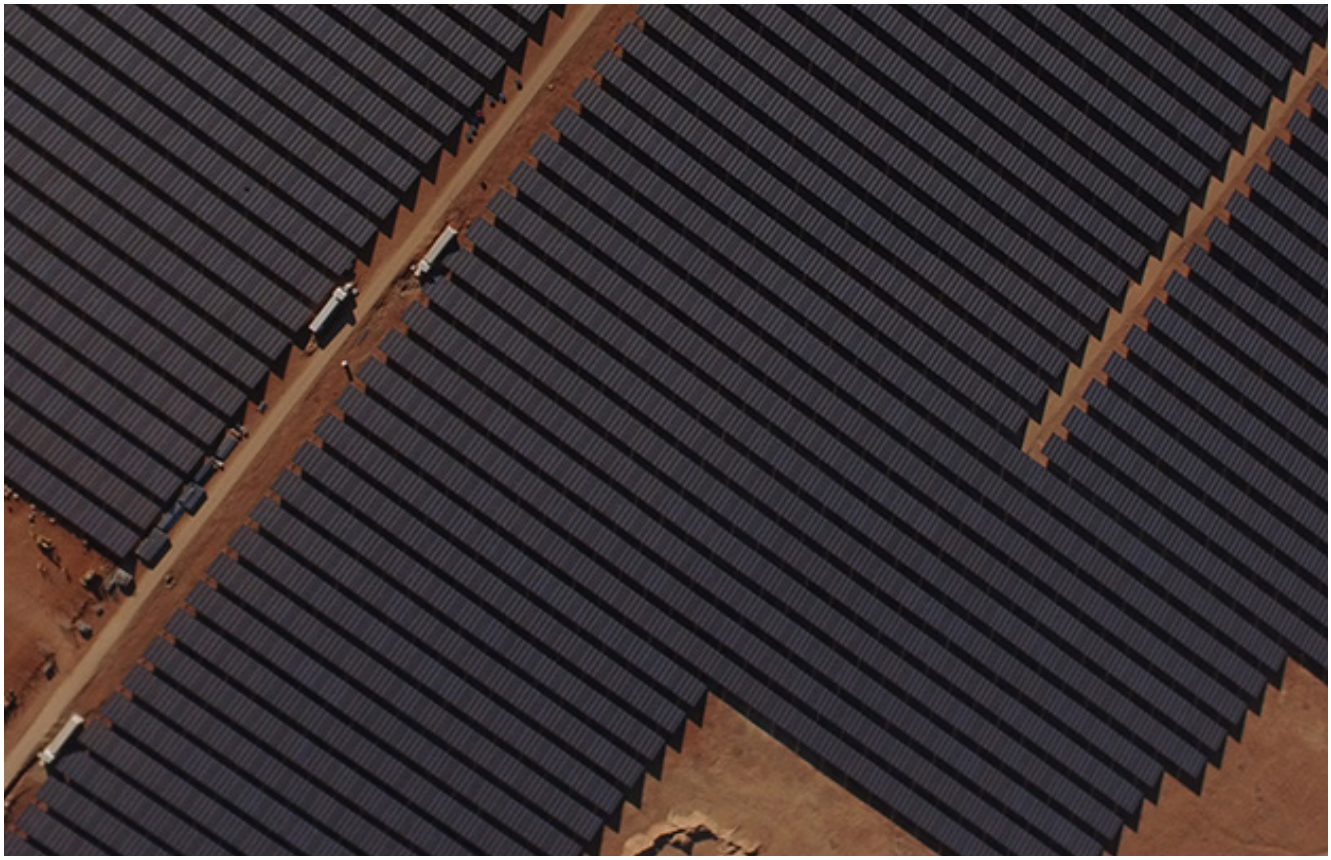
After the decommissioning of the power station, a series of items of equipment and materials appears that will have to be handled appropriately as wastes. The transport of these wastes to their final destination and the environmental impact of their handling also form part of the "core-infrastructure" module.

This module also includes the expected needs for corrective maintenance in the plant, including the re-investment in faulty equipment according to its estimated failure rates.

All the data used for the El Romero LCA were compiled in the period February 2016 – May 2017, simultaneously with the construction of the site and are today considered fully representative of the reality of the photovoltaic power plant throughout its 25 years of operation. A check will be made in the periodic reviews of the LCA that the representativeness over time of the critical data in the study continues to remain at a suitable level.

MANUFACTURE OF EQUIPMENT INSTALLED AND TRANSPORT TO EL ROMERO

During the life cycle inventory preparation stage, in which the necessary information on the equipment installed in El Romero was compiled, the relevant information was requested from all the suppliers involved. These equipment suppliers provided Acciona Energía with all the necessary information for preparing the power station's LCA model, including data on inventories of materials, breakdown of weights, specific Life Cycle Assessments of their products, detailed drawings, technical specifications, safety records and information on consumptions during the manufacturing process.



This included the suppliers of the photovoltaic panels, the support structures, the cabling and connection elements and the equipment in the inverter stations and the sub-station.

The information compiled for these items of equipment faithfully represents the technology installed in El Romero so that the results must be considered representative of their life cycle as long as the equipment installed is not substantially modified.

For the logistics stage, the distances really travelled by each item of equipment from its supplier to El Romero were analysed, also taking into account the transport means used. This information was obtained from the delivery note for each item of equipment provided by the Acciona Energía Purchases Department and from the embarkation record in the same department.

CONSTRUCTION WORK AND INSTALLATION OF THE SITE

Information on the environmental aspects in the site construction phase such as materials consumption, fuel consumption, water consumption and the handling of the wastes generated was collected on site by the Acciona Energía Chile team and the sub-contractors involved in the work during the period of the construction of El Romero. Thanks to this effort, the results of the environmental impact are a faithful representation of the technological systems used for this stage in El Romero.

DECOMMISSIONING AND WASTES HANDLING

The stage of the decommissioning and end of life of El Romero is planned for 2042. It is evident that, despite the planning by Acciona Energía for undertaking this task, the possible modification in the wastes treatment systems of legislation in the matter in Chile requires us to pose a theoretical destination for the wastes that will be generated in this stage.

To estimate the end of life of all the materials and equipment that will be converted into waste after the decommissioning of El Romero, the "Description of the abandonment state" chapter in the EIS (Environmental Impact Statement) prepared by Acciona Energía before beginning the installation work was used as the starting point. In addition, to include the specific regional aspects on the problem of wastes handling in Chile in theory, the "First report on the handling of solid wastes in Chile." published in 2010 by the National Environment Commission of the Government of Chile, was consulted. Likewise, to calculate the environmental impact of transporting all these wastes to each authorised handler, the current distance between El Romero and the main wastes handling options in the area today have been estimated.

For the project abandonment stage, all the current legal and environmental requirements will be met. The mechanical and other unused elements will be removed and transferred for re-use, recycling or deposited in the place authorised for it according to the current regulations. After dismantling the equipment in the El Romero solar power station, the previously occupied areas will be restored.

A destination for each of the elements in the power station has been considered. For more information, the following table contains the theoretical end of life for the main elements in El Romero.

Table 8

Theoretical end of life for the main elements in El Romero

System	End of life theory
Photovoltaic panels	The panels will be disconnected and dismantled manually. The modules in operating conditions will be re-used while the rest of the components will be recycled.
Support structures	The supports are all steel so that after their dismantling and storage they will be transported to a recycling centre. Half of the STI supports have a concrete micro pile which will be demolished and transported to a tip as inert material.
Inverters	The steel parts of the inverters will be recycled completely. The electronic components will be sent to a WEEE handler for their appropriate dismantling and handling. The rest of the materials will be handled via a tip.
Cells	The metal components (mainly copper and steel), the SF6 and the oil will be recovered and recycled safely. The rest of the materials will be handled via a tip.
Transformers	The metal parts of the transformers can be separated and recycled. The resins, plastics and other materials will be handled via a tip.
UPS	To be sent to a waste electrical and electronic equipment (WEEE) handler.
Inverter stations containers	The containers are all steel and therefore will be recycled.
Inverter stations foundations stations	It is assumed that the concrete blocks in the inverter stations will be demolished and removed to an authorised inert wastes tip.
Sub-station power transformer	The metal parts of the transformers can be separated and recycled. The transformer oil will be recovered and recycled as a hazardous waste. The rest of the materials such as the porcelain, insulation paper and plastics will be handled via a tip. It is assumed that the concrete blocks of the sub-station equipment foundations will be demolished and removed to an authorised inert wastes tip.
Internal cabling	After dismantling, the cabling elements will be sent for specific cables treatment, which includes the separation of the conductors from the insulation layers. The metal conductors will then be recycled while the plastic insulation materials will be incinerated.
Auxiliary buildings	After the buildings are dismantled, the steel parts will be stored and then recycled. It is assumed that the buildings' foundation will be dismantled for taking to a tip. The rest of the materials such as ceramics, plastics, concrete blocks, etc, will be handled via an authorised tip.
Connecting line to grid	The power line pylons are entirely steel so that they will be sent for recycling after dismantling. After dismantling, the cabling elements will be sent for specific cables treatment, which includes the separation of the conductors from the insulation layers. The metal conductors will then be recycled while the plastic insulation materials will be incinerated.

2.1.3 CORE – PROCESS

The "core-process" module represents the operation stage of El Romero. As well as including the equipment's technical functioning properties such as output, efficiency and the amount of energy they can obtain from the Sun, it also includes the maintenance journeys to be made by the workers undertaking it during the service life of the power station as well as the appropriate handling of the wastes generated during its 25 years of operation.

One of the critical factors of the analysis of El Romero is the energy that the power station will be able to generate throughout its operational period. It is estimated that the service life of the site will be 25 years, which is the time for which its operation licence lasts, but really its functioning period is slightly longer, 25 years and 5 months.

The power station started to export power in the test phase in mid November 2016. However, commissioning in the operation phase did not occur until March 2017. Therefore, the life cycle of El Romero Solar runs from November 2016 to the end of March 2042 (25 years and 5 months), which is when the operation licence expires.

To calculate the amount of energy generated during these years of operation, this period has been divided into sections depending on the source from which the data have been obtained.

Table 9

Data sources for energy generation

Period	Time	Data source
November 2016 – May 2017	7 months	Real data for the energy generated
June 2017 – December 2017	7 months	Estimate with Chilean electricity grid restrictions
January 2018 – March 2042	24 years and 3 months	Estimate without Chilean electricity grid restrictions

The data that refer to the output of the installation and the energy generated have been provided by the Acciona Energía Photovoltaic Resource Department and is the best information available on the energy that El Romero can generate in the future 25 years for which its operation is planned. In total, it is anticipated that the power station will be able to generate 12,074,411.763 MWh of power throughout its service life, of which 12,062,337.351 MWh will reach the Chilean electricity grid after deducting the losses in the power transport grid.

To represent the reality of the environmental behaviour of El Romero more reliably, it is planned to revise the LCA every three years to include the plant's real generation in this period once this is a known value.

The information used to simulate the workers' maintenance journeys includes the journeys in 4x4 vehicles from La Serena and from Vallenar to El Romero, and an estimate of the internal movements of the vehicles in the plant. The fuel consumed has been calculated with an estimate from Acciona Energía based on the proposed preventive maintenance.

2.1.4 DOWNSTREAM

Finally, the "downstream" stage covers all the impacts that occur from the moment at which the energy leaves the El Romero sub-station transformer until it arrives at the connection point with Chilean electricity grid at 220 kV, located in the neighbouring Don Héctor sub-station.

This downstream module represents two separate impacts. The first is the environmental impact relating to the inevitable power losses that occur in the line connecting El Romero with Don Héctor, caused by the voltage step-up and the Joule effect. This first impact is called specifically "downstream – process" in the context of the EPD.

The second environmental impact is associated with the construction and dismantling of the power line connecting the El Romero sub-station to the Don Héctor sub-station. This second impact is called "downstream – infrastructure."

The high voltage overhead power line that had to be built has a total length of 2.5 km and allows the power generated in the power station to be delivered to the Chilean electricity grid. It should be noted that a simulation was made of the system really built, including the cabling and pylons, with information provided by the suppliers. The power losses in this line were considered by the Acciona Energía Solar Resource Department to be 0.1% of the total energy generated in El Romero.

2.2 Environmental profile

The following tables contain the environmental behaviour of the energy generated in the El Romero photovoltaic power plant from a complete life cycle perspective. The results have been calculated underthe methodology CML-IA v 4.8 – August 2016, and they have been divided into columns according to the stages described in the previous sections. The EPD verifier had detailed access to Life Cycle Assessment information that supports this declaration.

It is important to remember that the unit declared and to which all the values in the tables refer, is:

> *"1 Kwh of energy generated in the El Romero photovoltaic power plant which is them delivered to a high voltage grid (220 KV) in Chile"*

Table 10

Environmental profile of the photovoltaic plant El Romero

Environmental profile	Unit	El Romero 196 MW photovoltaic power plant						
Potential environmental impact		1 kWh of electricity generated and distributed to a consumer at 220 kV						
		Upstream	Core process	Core Infrastructure	TOTAL GENERATED	Downstream process	Downstream Infrastructure	TOTAL DISTRIBUTED
POTENTIAL ENVIRONMENTAL IMPACT								
Global warming potential (100 years)	g CO_2 eq	1,083E-02	4,919E-01	1,962E+01	**2,012E+01**	2,012E-02	2,689E-02	**2,017E+01**
Formation of ground level ozone	g C_2H_4 eq	3,346E-06	9,957E-05	7,575E-03	**7,678E-03**	7,678E-06	1,472E-05	**7,701E-03**
Acidification potential	g SO_2 eq	1,129E-04	4,755E-03	1,445E-01	**1,494E-01**	1,494E-04	3,217E-04	**1,499E-01**
Eutrophication potential	g PO_4^{-3} eq	2,356E-05	8,600E-04	5,859E-02	**5,948E-02**	5,948E-05	1,452E-04	**5,968E-02**
AIR EMISSIONS WITH THE GREATEST CONTRIBUTION TO THE ENVIRONMENTAL IMPACT CATEGORIES								
Carbon dioxide, fossil	g	1,020E-02	4,770E-01	1,684E+01	**1,733E+01**	1,733E-02	2,377E-02	**1,737E+01**
Methane, fossil	g	1,527E-05	3,661E-04	7,621E-02	**7,659E-02**	7,659E-05	9,158E-05	**7,676E-02**
Methane, biogenic	g	3,162E-07	2,055E-06	4,932E-03	**4,934E-03**	4,934E-06	1,682E-06	**4,941E-03**
Ethane, 1-1-difluo-ro-, HFC-152a	g	4,429E-10	6,438E-10	1,441E-03	**1,441E-03**	1,441E-06	1,953E-10	**1,442E-03**
Dinitrogen monoxide	g	6,179E-07	1,659E-05	5,703E-04	**5,875E-04**	5,875E-07	8,126E-07	**5,889E-04**
Sulphur dioxide	g	2,503E-05	7,145E-04	8,678E-02	**8,752E-02**	8,752E-05	1,602E-04	**8,777E-02**
Carbon monoxide, fossil	g	6,471E-05	1,755E-03	4,462E-02	**4,644E-02**	4,644E-05	2,066E-04	**4,670E-02**
Carbon monoxide, biogenic	g	3,975E-07	2,284E-06	3,095E-03	**3,098E-03**	3,098E-06	3,312E-06	**3,104E-03**
Methyl ethyl ketone	g	4,147E-09	4,310E-09	1,913E-03	**1,913E-03**	1,913E-06	1,640E-09	**1,915E-03**
Ethyl acetate	g	4,147E-09	4,310E-09	1,913E-03	**1,913E-03**	1,913E-06	1,640E-09	**1,915E-03**
Benzene	g	7,662E-08	3,134E-06	3,472E-04	**3,504E-04**	3,504E-07	1,403E-06	**3,522E-04**
Ethene	g	1,276E-08	5,089E-07	7,485E-05	**7,537E-05**	7,537E-08	8,300E-08	**7,553E-05**
Pentane	g	1,921E-07	1,114E-05	1,650E-04	**1,763E-04**	1,763E-07	1,766E-07	**1,767E-04**
Acetone	g	4,006E-09	8,719E-08	4,906E-04	**4,907E-04**	4,907E-07	5,507E-08	**4,913E-04**
Ethane	g	1,029E-07	3,941E-06	3,688E-04	**3,729E-04**	3,729E-07	7,936E-07	**3,741E-04**
Nitrogen oxides	g	1,244E-04	5,752E-03	5,890E-02	**6,478E-02**	6,478E-05	7,145E-05	**6,492E-02**
Ammonia	g	1,210E-07	4,547E-06	5,821E-03	**5,826E-03**	5,826E-06	4,728E-05	**5,879E-03**
Hydrogen fluoride	g	1,045E-07	5,096E-07	6,681E-04	**6,687E-04**	6,687E-07	1,258E-06	**6,707E-04**
Hydrogen chloride	g	4,757E-07	4,531E-06	4,852E-03	**4,857E-03**	4,857E-06	2,314E-05	**4,885E-03**

Table 10

Environmental profile of the photovoltaic plant El Romero

Environmental profile	Unit	El Romero 196 MW photovoltaic power plant						
Potential environmental impact		1 kWh of electricity generated and distributed to a consumer at 220 kV						
		Upstream	Core process	Core Infrastructure	TOTAL GENERATED	Downstream process	Downstream Infrastructure	TOTAL DISTRIBUTED
EMISSIONS TO WATER WITH THE GREATEST CONTRIBUTION TO THE ENVIRONMENTAL IMPACT CATEGORIES								
Phosphate	g	6,352E-06	6,799E-05	4,652E-02	**4,660E-02**	4,660E-05	1,148E-04	**4,676E-02**
Nitrate	g	2,040E-06	1,789E-05	1,001E-02	**1,003E-02**	1,003E-05	2,813E-05	**1,007E-02**
COD, Chemical oxygen demand	g	2,677E-05	1,596E-03	4,616E-02	**4,779E-02**	4,779E-05	6,339E-05	**4,790E-02**
EMISSION OF RADIOACTIVE ISOTOPES								
C-14	Bq	6,672E-05	3,138E-03	5,122E-02	**5,442E-02**	5,442E-05	7,612E-05	**5,455E-02**
Rn-222	Bq	3,087E-01	2,442E+00	5,395E+02	**5,422E+02**	5,422E-01	8,779E-01	**5,436E+02**
Kr-85	Bq	4,148E-06	3,220E-05	5,686E-03	**5,723E-03**	5,723E-06	1,363E-05	**5,742E-03**
EMISSION OF CARBON DIOXIDE OF BIOGENIC ORIGIN								
Carbon dioxide, biogenic	g	5,779E-04	9,353E-04	3,869E-01	**3,885E-01**	3,885E-04	5,207E-04	**3,894E-01**
EMISSION OF TOXIC SUBSTANCES								
Particulates, <2,5um al aire	g	1,957E-05	5,651E-04	1,769E-02	**1,827E-02**	1,827E-05	3,515E-05	**1,833E-02**
Particulates, >10um al aire	g	4,959E-06	1,074E-04	3,172E-02	**3,183E-02**	3,183E-05	4,868E-05	**3,191E-02**
Particulates, >2,5um and <10um to air	g	1,731E-06	5,904E-05	1,064E-02	**1,070E-02**	1,070E-05	3,511E-05	**1,074E-02**
PAH, polycyclic aromatic hydrocarbons to air	g	1,337E-09	4,314E-07	8,252E-06	**8,685E-06**	8,685E-09	2,419E-08	**8,718E-06**
PAH, polycyclic aromatic hydrocarbons to water	g	7,402E-10	4,682E-08	8,832E-07	**9,308E-07**	9,308E-10	4,236E-09	**9,359E-07**
Arsenic to air	g	1,012E-09	9,520E-09	1,946E-05	**1,947E-05**	1,947E-08	9,928E-08	**1,958E-05**
Cadmium to air	g	3,804E-10	8,110E-09	6,158E-06	**6,167E-06**	6,167E-09	3,249E-08	**6,206E-06**
Dioxins to air	g	5,897E-15	7,485E-14	1,174E-11	**1,182E-11**	1,182E-14	6,339E-14	**1,189E-11**
EMISSIONS OF OIL TO WATER AND SOIL								
Oils, unspecified to water	g	7,777E-06	4,816E-04	3,177E-03	**3,666E-03**	3,666E-06	4,745E-06	**3,674E-03**
Oils, unspecified to soil	g	8,394E-06	5,222E-04	3,384E-03	**3,915E-03**	3,915E-06	4,391E-06	**3,923E-03**

Table 11

Use of resources of the photovoltaic plant El Romero

Environmental profile	Unit	El Romero 196 MW photovoltaic power plant						
Use of resources		1 kWh of electricity generated and distributed to a consumer at 220 kV						
		Upstream	Core process	Core infrastructure	TOTAL GENERATED	Downstream process	Downstream Infrastucture	TOTAL DISTRIBUTED
NON-RENEWABLE MATERIALS RESOURCES								
Gravel	Kg	5,430E-07	7,941E-06	7,951E-03	**7,959E-03**	7,959E-06	5,243E-06	**7,972E-03**
Calcite	Kg	1,477E-07	3,328E-06	1,236E-03	**1,240E-03**	1,240E-06	2,334E-06	**1,243E-03**
Gangue, bauxite	Kg	2,342E-07	1,844E-07	1,147E-03	**1,147E-03**	1,147E-06	3,401E-06	**1,152E-03**
Iron	Kg	1,631E-07	7,928E-06	7,266E-04	**7,347E-04**	7,347E-07	4,999E-06	**7,405E-04**
Sodium chloride	Kg	5,407E-07	8,087E-08	2,664E-04	**2,670E-04**	2,670E-07	2,278E-07	**2,675E-04**
Clay, unspecified	Kg	4,391E-08	4,689E-07	2,236E-04	**2,241E-04**	2,241E-07	2,763E-07	**2,246E-04**
Fluorspar	Kg	4,265E-10	9,849E-09	1,144E-04	**1,144E-04**	1,144E-07	3,029E-09	**1,145E-04**
Aluminium	Kg	2,205E-08	1,737E-08	1,080E-04	**1,080E-04**	1,080E-07	3,202E-07	**1,085E-04**
Dolomite	Kg	3,011E-10	2,580E-08	6,524E-05	**6,526E-05**	6,526E-08	1,658E-08	**6,534E-05**
Nickel	Kg	3,873E-09	2,471E-07	4,395E-05	**4,420E-05**	4,420E-08	3,068E-07	**4,456E-05**
Zinc	Kg	7,161E-10	2,874E-09	3,236E-05	**3,237E-05**	3,237E-08	2,176E-07	**3,262E-05**
Phosphorus	Kg	5,736E-10	2,076E-09	1,907E-05	**1,907E-05**	1,907E-08	1,173E-09	**1,909E-05**
Chromium	Kg	1,586E-09	8,011E-08	1,807E-05	**1,815E-05**	1,815E-08	1,189E-07	**1,829E-05**
Lead	Kg	3,977E-10	1,596E-09	1,798E-05	**1,798E-05**	1,798E-08	1,209E-07	**1,812E-05**
Other non-re-newable resources	Kg	2,602E-08	9,486E-07	1,534E-04	**1,544E-04**	1,544E-07	5,280E-07	**1,551E-04**
RENEWABLE MATERIALS RESOURCES								
Wood	Kg	6,454E-08	5,848E-07	3,081E-04	**3,088E-04**	3,088E-07	4,269E-07	**3,095E-04**
NON-RENEWABLE ENERGY RESOURCES								
Hard coal	MJ	1,928E-05	2,180E-04	1,041E-01	**1,043E-01**	1,043E-04	1,356E-04	**1,045E-01**
Brown coal	MJ	5,134E-06	3,455E-05	8,809E-03	**8,849E-03**	8,849E-06	1,651E-05	**8,875E-03**
Crude oil	MJ	1,124E-04	6,940E-03	5,057E-02	**5,762E-02**	5,762E-05	8,389E-05	**5,776E-02**
Natural gas	MJ	1,436E-05	3,849E-04	4,736E-02	**4,776E-02**	4,776E-05	8,845E-05	**4,789E-02**
Nuclear	MJ	8,917E-06	6,979E-05	1,621E-02	**1,629E-02**	1,629E-05	2,800E-05	**1,634E-02**
RENEWABLE ENERGY RESOURCES								
Energy from hydropower	MJ	3,111E-06	2,471E-05	1,276E-02	**1,278E-02**	1,278E-05	2,065E-05	**1,282E-02**
Energy from biomass	MJ	1,193E-06	1,095E-05	5,668E-03	**5,680E-03**	5,680E-06	8,454E-06	**5,694E-03**
Wind energy	MJ	5,397E-07	3,845E-06	1,593E-03	**1,597E-03**	1,597E-06	1,469E-06	**1,601E-03**
Solar energy	MJ	2,688E-09	4,512E-08	3,045E-05	**3,050E-05**	3,050E-08	4,049E-09	**3,053E-05**
Electricity use in El Romero	KWh	-	3,887E-06	-	**3,887E-06**	3,887E-09	-	**3,891E-06**

Table 11

Use of resources of the photovoltaic plant El Romero

Environmental profile	Unit	El Romero 196 MW photovoltaic power plant						
Use of resources		1 kWh of electricity generated and distributed to a consumer at 220 kV						
		Upstream	Core process	Core infrastructure	TOTAL GENERATED	Downstream process	Downstream Infrastucture	TOTAL DISTRIBUTED
RESOURCES OF RECYCLED ORIGIN								
Steel	Kg	-	-	3,328E-04	**3,328E-04**	3,328E-07	2,803E-06	**3,359E-04**
Aluminium	Kg	-	-	2,910E-04	**2,910E-04**	2,910E-07	9,737E-07	**2,923E-04**
Copper	Kg	-	-	5,810E-06	**5,810E-06**	5,810E-09	7,123E-08	**5,887E-06**
USE OF WATER								
Total amount of water used	m^3	2,751E-06	7,684E-07	1,179E-04	**1,214E-04**	1,214E-07	2,131E-07	**1,217E-04**
Direct amount of water used in operation	m^3	2,078E-06	-	-	**2,078E-06**	2,078E-09	-	**2,080E-06**

Table 12

Wastes handgling and recycled material of the photovoltaic plant El Romero

Environmental profile	Unit	El Romero 196 MW photovoltaic power plant						
Wastes handgling and recycled material		1 kWh of electricity generated and distributed to a consumer at 220 kV						
		Upstream	Core process	Core Infrastructure	TOTAL GENERATED	Downstream process	Downstream Infrastructure	TOTAL DISTRIBUTED
HAZARDOUS WASTES – NON-RADIOACTIVE								
Hazardous waste - To landfill	g	-	-	6,617E-04	**6,617E-04**	6,617E-07	-	**6,624E-04**
Hazardous waste - To recycling	g	-	1,142E-05	1,730E+00	**1,730E+00**	1,730E-03	-	**1,732E+00**
HAZARDOUS WASTES – RADIOACTIVE								
Volume for deposit of low-active radioactive waste	m^3	3,588E-13	2,015E-11	1,929E-10	**2,134E-10**	2,134E-13	2,862E-13	**2,139E-10**
Volume for deposit of radioactive waste	m^3	6,512E-15	4,911E-14	1,153E-11	**1,159E-11**	1,159E-14	1,765E-14	**1,162E-11**
OTHER WASTES								
Non-hazardous waste - To landfill	g	-	-	8,198E-01	**8,198E-01**	8,198E-04	-	**8,206E-01**
Non-hazardous waste - To recycling	g	-	-	9,064E-01	**9,064E-01**	9,064E-04	8,578E-03	**9,159E-01**

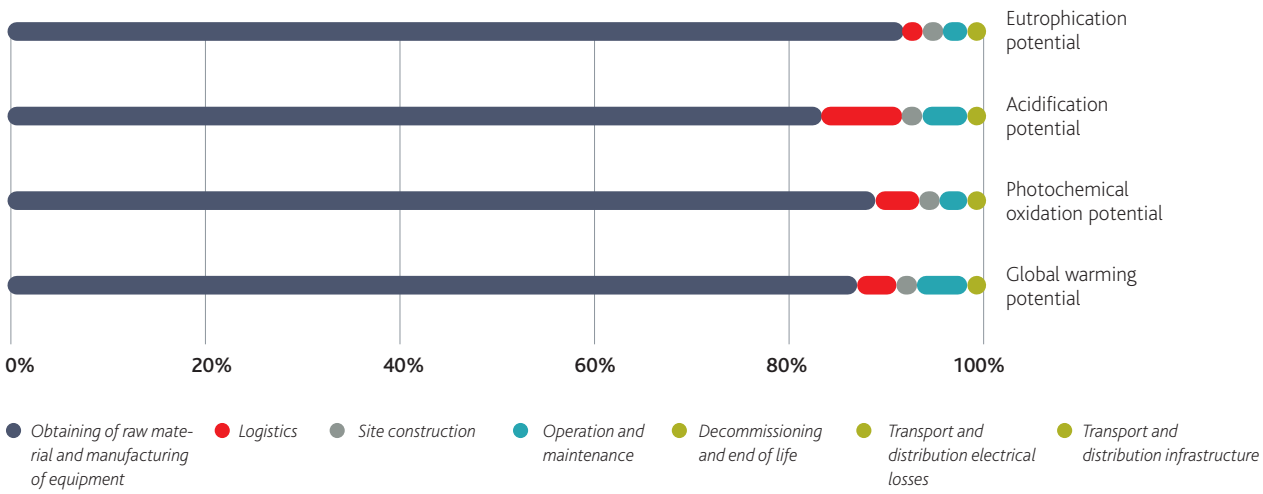
2.3

Interpretation of the results and conclusions

To be able to identify the aspects causing the environmental impacts declared in the previous section, a view is needed of each of the stages in the complete life cycle of the energy generated in El Romero from an integral perspective.

Figure 4

Distributed energy in El Romero Solar



As can be seen in the above figure, the environmental profile is clearly dominated by the stage of obtaining raw materials and manufacturing the equipment. This stage accounts for between 84.3% and 92.2% (according to the category analysed) of the total environmental impact of each kWh generated in El Romero.

The photovoltaic panels stand out as the main environmental aspect in this stage, with an impact much higher than that caused by the support structures, which form the second most important aspect. This is a logical result, given that the panels are the main asset by volume installed in El Romero.

The rest of the environmental impact not caused by the stage of obtaining raw materials and manufacturing the equipment is shared mainly between three stages, logistics, operation and maintenance and, finally, by the construction of the site.

The logistics stage represents between 2.3% and 8.2% of the total environmental impact (according to the category analysed). This impact is caused by the transport of the equipment to the plant, while the project materials transport stage has a much lower repercussion, almost negligible.

The next most important stage is that of operation and maintenance with between 2.57% and 4.41% of the impact according to the category analysed. There are two elements in this stage that stand out mainly, the consumption of fuel associated with the maintenance journeys during the 25 years of operation and the corrective maintenance of the plant. The environmental impact of the corrective maintenance is in turn dominated by the need to change deteriorated photovoltaic panels throughout the service life of El Romero.

The site construction stage has an environmental impact that varies between 1.6% and 2.5% of the total. This result can be considered relatively low considering that a normal trend in the analysis of renewable energy power stations is that their construction has a notable impact. This stage is mainly dominated by the emission of air pollutants associated with the consumption of Diesel fuel by the machinery.

The three remaining stages are decommissioning and end of life, power losses in the transport and distribution line and transport and distribution infrastructure. Each of these three stages has an environmental impact of less than 1% of the total for the four environmental impact categories.

3. Additional environmental information

3.1 Biodiversity protection

The implementation of solar energy as an alternative to other traditional power generation options has evident benefits for the environment. However, the installation of a site of this type in a natural enclave such as the Atacama desert must be undertaken with great care to protect the biodiversity in the area.

With this idea in mind, before starting the El Romero Solar project, Acciona Energía undertook a series of studies aimed at protecting the natural species in the chosen location, thus ensuring that the effect of the work was minimised.

GUANACO CONSERVATION PLAN

The Acciona Energía El Romero solar photovoltaic project is located in the Commune of Vallenar, Region of Atacama. The main wildlife species that inhabit the area can be divided into mammals and reptiles.

The presence of six taxons of mammals was detected, of which the guanaco is the sole wild species.

Acciona Energía acquired the environmental commitment to implement actions that contribute to the conservation of these populations in the area in which the project is located through a Guanaco Conservation Plan.

The monitoring implemented in the area will help to generate information on the current state of the populations and, together with other conservation actions, to reduce the threats to the camelidae and other wildlife in the area.

REPTILES RESCUE AND RELOCATION PLAN

Regarding the population of reptiles in the area, a reptiles rescue and relocation plan was been undertaken to avoid any impact to the land vertebrate wildlife component, safeguarding the genetic profile and the biodiversity of the reptiles and amphibians in the sector.

Generally, the rescue plan is aimed at those reptile species detected in the Project Baseline, Liolaemus atacamensis (Atacama tree iguana), Liolaemus platei (braided tree iguana) and Callopistes maculatus (spotted false monitor).

The examples collected were deposited in gender bags with a maximum of three individuals in each bag or recipient. The permeability of the bags allowed air to enter, reducing the risk of the death of specimens. The routine handling aspects included the frequent checking of the health of the captured individuals.

Aspects such as weight, size, gender and specific identification were recorded. After recording these, the examples were relocated in the relocation area. A total of 486 individuals was rescued and relocated - 373 of L. atacamensis, 106 of C. maculatus and seven of L. platei. All of these examples were freed in good conditions in the project relocation area.

Land wildlife rescues are an important and practical scientific challenge for Chile. The background and assessments of these procedures are very scarce nationally.

BIOLOGICAL MANAGEMENT PLAN

As required during the environmental assessment process for the project, a Biological Management Plan was presented, the environmental commitments of which can be grouped into two blocks.

One comprises an action plan that includes the set of environmental actions and measures to be carried out during the project construction and operation phases and the other, environmental management measures to be implemented to compensate for the effect on plant species in the conservation category in the project area and the restoration of the plant life once the project reaches the end of its service life.

The bushy shrubs in the project area lie mainly in areas with little gradients, poor soil consisting mainly of gravel and very stony. The plant life is dominated by bushy shrubs (low woody content) with an average height that does not exceed one metre and a coverage ranging from 5% (very scarce) to sectors with 10% (scarce). The most common and frequent species in this type of unit are Bulnesia chilensis, Adesmia argentea, Krameria cistoidea, Cordia decandra, Cumulopuntia sphaerica, Encelia canescens and Haplopappus rigidus.

The action plan considers two fronts for protecting the plant life in the area in which the project is inserted.

The following table contains the measures taken for both the fronts differentiated previously to achieve a suitable protection of the plant life in the project area.

Table 13

Medidas de prevención y manejo biológico.

PREVENTION MEASURES
Induction talks for workers, contractors and sub-contractors.
Definition of restricted areas in the project.
Layout of works
BIOLOGICAL MANAGEMENT MEASURES
Definition of target species in the Biological Management Plan.
Construction of an exclusion area with perimeter fence.
Procedure for rescuing and re-locating cacti.
Procedure for rescuing germplasm, nursery techniques and planting of bush species.
Procedure for rescuing and re-locating bulbs.
Restitution procedure for the project abandonment stage.

3.2

Use of land

The area on which El Romero Solar lies is a desert area that could be described as an arid plain. The total area delimited by the project is 601.18 hectares of which 236.4 will remain unaffected after the construction of the site.

Table 14

Corine Land Cover Classes

Corine land cover classes	Area of land occupied (m2)	
	Before the proyect	After construction
Artificial areas	Not applicable	**3,647,800**
Agricultural areas	Not applicable	Not applicable
Wooded and semi-natural areas	**6,011,800**	**2,364,000**
Wetlands	Not applicable	Not applicable
Masses of water	Not applicable	Not applicable

The areas in which construction has modified their initial classification are now occupied by the following elements:

- Photovoltaic panels.
- Steel containers for the inverter stations.
- Electrical transformer sub-station.
- Control and storage buildings.
- Tracks and roads.
- Power line pylons.

It should be noted that after the project decommissioning stage, planned for 2042, it is intended to restore all the affected areas of land to their original state.

3.3

Environmental risks

Acciona Energía undertakes an analysis at the corporate level of the possible environmental risks that may occur accidentally in its projects to be able to classify their potential seriousness.

It is thus possible to act before the occurrence of an unexpected event to minimise both the frequency of the possible risks and their possible effect on the natural environment.

A multi-disciplinary human team was formed to prepare the list of possible accidental environmental scenarios that considered the following aspects.

- Area of the installation affected.
- Source of the danger.
- Initiating event.
- Environmental vector affected.
- Product involved and quantity.
- Measures available to reduce the risk.

Both the corporate standard and the internal procedure used indicate that the risk must be assessed by multiplying two factors, probability (forecast frequency of the accident scenario) and consequences (in environmental terms).

Of the 10 accident scenarios assessed, nine have a "Low" risk level according to the risks matrix. Only one of them has a "Moderate" risk level, mainly due to its probability of occurrence, this being scenario 7 (Spillage of Diesel fuel from the panel washing tractors, polluting the ground).

With this analysis, it can be concluded that El Romero is an installation with a low environmental risk.

3.4 Electromagnetic fields

Regarding electromagnetism, the values of the electrical and magnetic fields associated with the high voltage power lines built for the project have been estimated. The noise and interference levels generated by these transmission lines were also estimated, for both AM radio and TV transmissions. All of this sought to set a baseline for electromagnetic fields in the area in which the Acciona Energía project is located.

Once these values had been estimated, they were compared with the maximum values recommended in the international reference standards to determine the possible effect of the existing lines on both human health and radio communications.

As a result of comparing the values obtained for the project with the recommended levels, it can be concluded that both the electromagnetic field and the radio and TV interferences that will be generated by the operation of the connection line will not exceed the recommended limits, even considering the effects with the existing lines together.

Taking the above into account, it can be stated that there are no risks to the population's health from the electrical and magnetic fields that will be generated by the project in its operation stage and neither will there be important alterations in the quality of radio and TV communications.

3.5 Noise

Supreme Decree 38 of 2011 of the Chilean Ministry of the Environment sets the maximum permitted levels for equivalent continuous sound pressure and the technical criteria for assessing and classifying the emission of annoying noise generated for the community by fixed sources.

The level of the noise generated in El Romero is at all times below these legally set limits. The following describes the main sources of noise throughout the project's life cycle.

CONSTRUCTION STAGE

The construction work increased the sound pressure levels around the project site, mainly due to the use of site machinery. This increase was due to the work itself (earthmoving, materials transport, machinery movement). In any case, because of the absence of nearby receivers, the emissions of this type were not considered relevant for this stage. It should be noted that the nearest populated centre is Cachiyuyo, located approximately 8 km from the project.

OPERATION STAGE

No noise emissions will be generated in the operation stage due to the nature of the project. There will be only noise from small vehicles for maintenance and surveillance activities.

DECOMMISSIONING STAGE

During the El Romero decommissioning phase, the main sources of sound pressure will be the use of machinery during disassembly and earthmoving and the movement of trucks on the access tracks. Since the operations are similar to those in the construction stage, the noise emissions for this stage are not considered a relevant aspect.

3.6

Visual impact

The project area is located in a relatively flat desert area but with low visibility and without special or outstanding elements. Its features and structure are those of the landscapes in the area. The permanent observers are drivers on Route 5 and Route C-541leading to the La Silla observatory.

Before the start of the work, a complete analysis was made of the site to identify, classify and assess the landscape reality of the spaces that would be affected in the project area. This classification was based on three concepts:

- Landscape quality.
- Landscape fragility
- Visibility or visual basin

Based on the quantitative values obtained after this classification, it is possible to classify the project areas according to the method proposed by Ramos (1980).

According to the results observed in the prior assessment, it is possible to determine that the landscape unit affected by the project can be defined as "arid plain" with low visual quality and average visual fragility, being classified as a class 4 landscape.

At the same time, after repeating the assessment including the project elements, the new visibility class obtained was identical to that obtained before the work started (class 4).

Finally, so that the end users can appreciate at first hand the visual effect caused in the area by the El Romero power station in the area, Acciona Energía has created a visual bird's-eye visit of the plant, available at the following link.

www.acciona.cl/proyectos/energia/photovoltaic/planta-photovoltaic-el-romero-solar/

4. Information on the verification and contact

4.1 Information on the verification

Table 15

EPD Programme	EPD International AB Box 210 60, SE-100 31 Stockholm, Sweden www.environdec.com
Registration number	S-P-01081
Publication date	2017-12-12
Validity	2020-10-25
Geographical validity of the declaration	This declaration is valid for the El Romero photovoltaic power plant in Chile
Scope of the declaration	From cradle to grave
Independent verification of the data and declaration, as per ISO 14025:2006	⊗ EPD external verification ◯ EPD process certification
External verifying organisation	Tecnalia R&I Certificación, S.L. Auditor: Elisabet Amat eli.amat@tecnaliacertificacion.com
Verifying organisation accredited or approved by	ENAC. Acreditation number 125/C-PR283
LCA study undertaken by	IK Ingenieria
Reference product category rules (PCR)	PCR 2007:08 UN CPC 171 & 173 Version 3.0 Electricity, steam and hot/cold water generation and distribution
PCR review prepared by	Technical Commitee of the International EPD® System Full list of members of the TC www.environdec.com/TC
PCR prepared by	Technical Commitee of the International EPD® System PCR moderator: Mikael Ekhagen - VATTENFALL Mikael.ekhagen@vattenfall.com
Name of the company and contact	Av. Ciudad de la Innovación, 5 - 31621 Sarriguren, Navarra (España) Phone number: +34 948 00 60 00 e-mail: maria.montero.tineo@acciona.com www.acciona-energia.com

4.2 Additional clarifications

- Neither the verifier nor the program operator is responsible for the legality of the product.
- Environmental Product Declarations of the same product category but different programmes may not be mutually compatible.
- In accordance with the reference PCR, the stage of the use of the electricity has been omitted, given that it may have various functions in different contexts
- The Links and references section contains sources to obtain additional material on the methods used.

5. Links and references

Acciona Energía Spain
www.acciona-energia.com/es

Acciona Energía Chile
www.acciona.cl/l%C3%ADneas-de-negocio/energ%C3%ADa/

"El Romero" photovoltaic power plant
www.acciona-energia.com/es/areas-de-actividad/fotovoltaica/instalaciones-destacadas/planta-fotovoltaica-el-romero-solar/

International Organization for Standardization
www.iso.org

Ecoinvent centre
www.ecoinvent.org

Institute of environmental science / Leiden University
www.cml.leiden.edu

International EPD system
www.environdec.com

I mpact methods and classification factors used
http://www.environdec.com/en/The-International-EPD-System/General-Programme-Instructions/Characterisation-factors-for-default-impact-assessment-categories/

Environmental product declaration
according to ISO 14025

Electricity generated in photovoltaic power plant
El Romero Solar 196 MW

Version: 1.0
Publication date: 2017-12-12
Validity: 2020-10-25
Registration number: S-P-01081

UN CPC 171 - Electrical energy
PCR 2007:08 UN CPC 171 & 173 - Version 3.0 - Electricity, steam and hot/cold water generation and distribution

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