

LOS HIERROS HYDROELECTRIC PLANT - CHILE



Figure 01: General photo of project on the construction phase/ Source: Provided by Besalco.

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1. PROJECT INTRODUCTION

This case study outlines the evaluation of the Los Hierros hydroelectric power station, which is located 130 kilometers southwest of Talca city, next to El Melado River basin in the municipality of Colbún, Linares Province, Maule Region, Chile. Construction of the energy project began in 2013 by Besalco Construcciones S.A., the entity responsible for developing the project, delivering the energy produced to the Central Interconnected System (SIC), and selling the energy on the SPOT market.

The project consists of a power station that will deliver a total installed capacity of 19.85 MW with a total energy generation potential of 110 GWh per year. It includes a 17.3 km, 110 kV electric transmission line. Both the power plant and the transmission line are part of the scope of this evaluation. It is important to mention that Los Hierros II, a second hydropower plant located downstream from the Los Hierros project, is considered an independent project that is outside of the scope of this assessment.

Los Hierros will comprise a total of two Francis turbines designed for a nominal power output of 11,756 kW, an installed capacity of 19.85 MW, and a total energy generation potential of 124,920 MWh per year. The project expects a nominal flow of 20 m³/sec, and a net drop of 104 meters. The estimated total investment in the project will be US \$50 million over a 2-year construction period and a 60 year operational phase. An abandonment phase has not been anticipated as failing equipment will be replaced on a continual basis.

2. PROJECT DESCRIPTION & LOCATION

Today, in the context of increased economic development and energy demand, approximately 70% of Chile's national electrical energy is comprised of hydroelectric power. The remaining 30% is energy derived from fossil fuels, and, to a much lesser extent, wind and biomass. It is important to point out that Chile is currently only exploiting 13% of its hydroelectric potential, primarily due to the great distance between hydroelectric opportunities and the country's capital city, Santiago de Chile, the location of 40% of the nation's electric demand. Despite this, the government is committed to implementing national energy policies that ensure environmental protection and promote energy efficiency that is low cost and socially equitable.

As such, Los Hierros is one of the five hydroelectric power stations that form the Melado-Ancoa Hydroelectric Complex, a comprehensive project that seeks to use the Melado River's water in a non-consumptive manner to generate renewable energy. The complex is anticipated to be fully operational by the end of 2015.

In this context, the main goal of Los Hierros is to use existing infrastructure to develop hydroelectric potential in El Melado's irrigation canal, which will significantly reduce the impacts created by the hydroelectric plant. Particularly, the Los Hierros project does not plan new water extraction points, but leverages the existing ones, and thus it is not necessary to interrupt the area with construction of a raceway. Moreover, this will be a run-of-the-river project, which means that no water storage or reservoir is required, and that no increase in the capacity of the existing reservoir will occur.

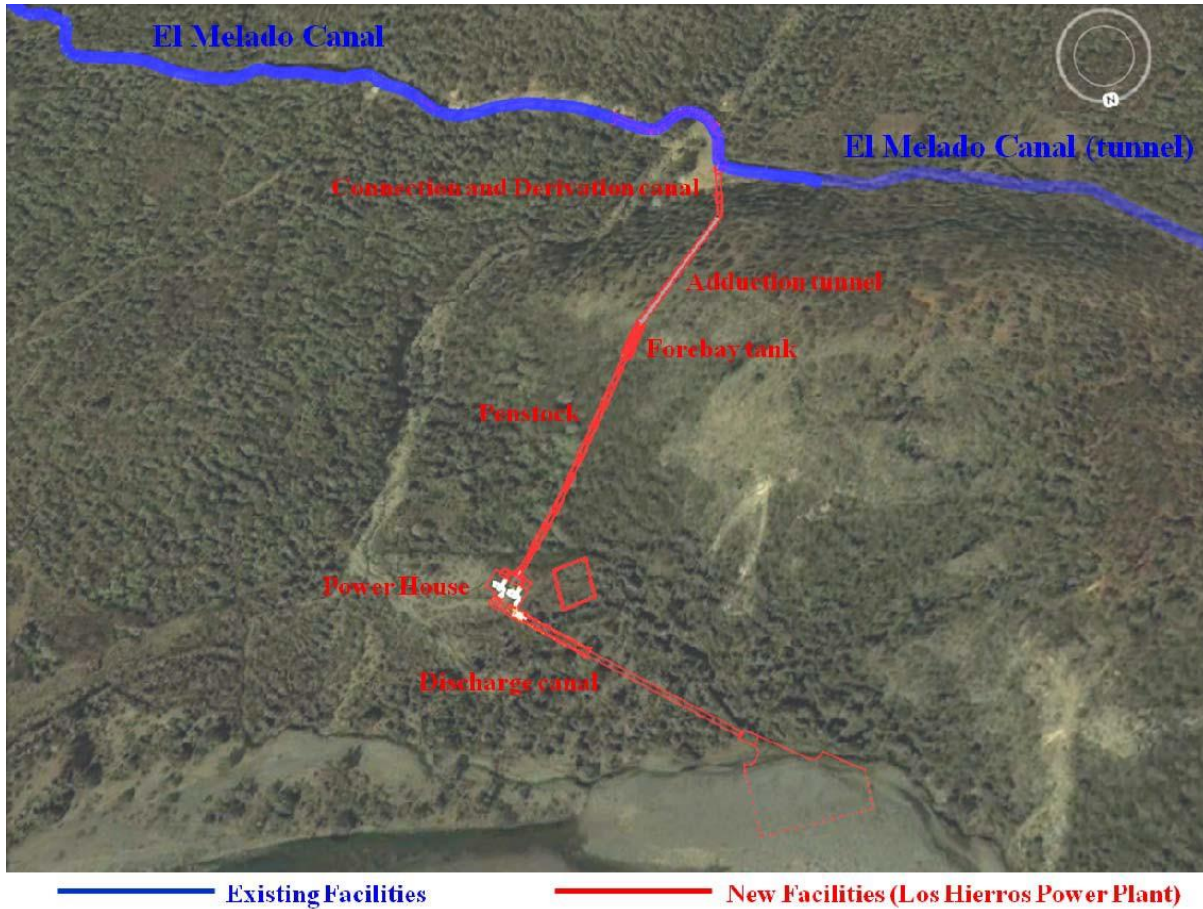


Figure 02: Schematic view of the project. Source: "Formulario de diseño del proyecto", p. 5.

As mentioned within the documentation provided, *"The project's only purpose is to generate electricity by using water force to rotate the turbines which trigger the generator. However, some aspects have to be taken into consideration: the project activity uses water from a canal built for irrigation which is still used for this purpose. The water is property of the irrigators association and permission for water use by the project is granted through a contract. In exchange, Besalco is responsible for improving the civil conditions of the canal and paying a percentage of the electricity generated to the irrigators association. These improvements were observed during the site visit and the contract was reviewed..."*¹.

Los Hierros will deliver a total installed capacity less than 20 MW, and qualifies as a project of Non-Conventional Renewable Energy (ERNC, for its acronym in Spanish), according to the General Electrical Services Law. As a result, the project is also a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol.

¹ "Report on compliance with WDC recommendations. Los Hierros Hydroelectric Power Plant", February 2013, TÜV Nord, page 12 (2013-02-19 WCD Los hierros final)

Los Hierros hydroelectric plant, Chile

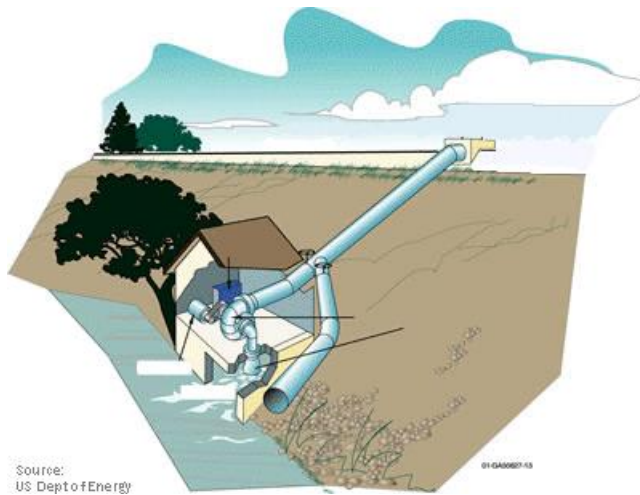


Figure 03: “Central hidroelectrica de pasada”. . Source: Besalco S.A., US department of energy.



Figure 04: Project location, municipality of Colbún, Linares Province, Maule Region, Chile. . Source: Besalco S.A.



Figure 05: “El Melado Canal”, 0.5 km route.
Source: Besalco S.A., US department of energy.



Figure 06: “El Melado Canal”, siphon “El Toro”, 1.2 km route. . Source: Besalco S.A., US department of energy.

3. APPLICATION OF THE ENVISION RATING SYSTEM²

The *Envision* rating system is a set of criteria that assess and evaluate any specific piece of infrastructure. In this case the infrastructure to be assessed is a hydroelectric power plant, designated Los Hierros. The main intent of this rating is to evaluate both the hydroelectric power station Los Hierros and the Transmission Line used to transport the energy produced in the turbines to the Sistema Interconectado Central (SIC).

Envision consists of 60 credits grouped into five categories: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk. Each credit pertains to a specific indicator of sustainability such as reducing energy use, preserving natural habitat, or reducing greenhouse gas emissions. Those credits are rated on a five-point scale referred to as a ‘level of achievement’: improved, enhanced, superior, conserving, and restorative. Evaluation criteria are provided to determine if the qualifications for each level of achievement has been met for a particular credit. In each of the five categories there is a specific credit called “Innovative or exceed credit requirements”. This is an open window to reward exceptional performance or the application of innovative methods.

The criteria for the levels of achievement vary from credit to credit but generally an ‘improved’ level of achievement is awarded for performance that slightly exceeds regulatory requirements. ‘Enhanced’ and ‘superior’ levels indicate gradual improvement, while ‘conserving’ often indicates performance that achieves a net-zero or neutral impact. ‘Restorative’ is the highest level and is typically reserved for projects that produce an overall positive impact for the given credit criteria. The *Envision* system weighs the relative value of each credit and level of achievement by assigning points. Credit criteria are documented in the *Envision Guidance Manual*, which is available to the public on the ISI³ and Zofnass Program⁴ websites.

Appendix C provides a table with the detailed project assessment, specifications for each of the credits, and recommendations for Los Hierros project.

² Anthony Kane, Zofnass program research director, and Salmaan Khan, research assistant, wrote most parts of this section.

³ www.sustainableinfrastructure.org

⁴ www.zofnass.org

EVALUATION CATEGORIES

4.1. QUALITY OF LIFE

The first category of the *Envision* rating system is Quality of Life. The assessment here mainly refers to the impact of the project on the surrounding communities and their well-being. As stated in the *Envision* manual, “Quality of Life particularly focuses on assessing whether infrastructure projects are in line with community goals, incorporated into existing community networks, and will benefit the community long-term.”⁵ It also determines if the project is aligned with the community needs.

This category is divided into 3 subcategories and 12 credits: Purpose (QL 1.1, QL 1.2, QL 1.3, and QL 1.4), Community (QL 2.1, QL 2.2, QL 2.3, QL 2.4, QL 2.5, and QL 2.6) and Well-Being (QL 3.1, QL 3.2, QL 3.3).

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
1	PURPOSE	QL1.1 Improve community quality of life	2	5	10	20	25
2		QL1.2 Stimulate sustainable growth and development	1	2	5	13	16
3		QL1.3 Develop local skills and capabilities	1	2	5	12	15
4	COMMUNITY	QL2.1 Enhance public health and safety	2			16	
5		QL2.2 Minimize noise and vibration	1			8	11
6		QL2.3 Minimize light pollution	1	2	4	8	11
7		QL2.4 Improve community mobility and access	1	4	7	14	
8		QL2.5 Encourage alternative modes of transportation	1	3	6	12	15
9		QL2.6 Improve site accessibility, safety and wayfinding		3	6	12	15
10	WELLBEING	QL3.1 Preserve historic and cultural resources	1		7	13	16
11		QL3.2 Preserve views and local character	1	3	6	11	14
12		QL3.3 Enhance public space	1	3	6	11	13
Maximum points possible:							181

Figure07: Quality of life category, credits distribution.

4.1.1. Purpose

In the **Purpose subcategory**, out of three credits, two were evaluated as Enhanced (QL 1.2 Stimulate Sustainable Growth and Development, and QL 1.3 Develop Local Skills and Capabilities), and one was evaluated as Improved (QL 1.1 Improve Community Quality of Life).

Los Hierros will be constructed in the El Melado watershed, specifically in the town of El Melado, which is mainly concentrated along the main road near the river. The project is expected to have a positive impact on both the environment and the economy. Los Hierros will enhance access to the residential area by improving roads, and will also upgrade water access for residents who consume water from the canal but do not have water during wintertime due to the fact that the canal currently does not carry water between the months of March and November. The project will generate approximately 165 jobs within the community, primarily during the construction phase. After the completion of the project, 5 people will continue working at the hydroelectric power station during the project’s lifespan. Los Hierros long-term job creation (operation phase) represents more than 16% of El Melado's population of 31 people. The population ranges in age between 9 and 65 years, and is aging overall due to the fact that

⁵ *Envision* Guidance Manual, p.30

almost 70% are adults (21 people), and 77% are male.⁶ Despite this, it is important to point out that hiring local and regional residents⁷ will be a priority.

Within the Environmental Impact Study, social and archaeological environments were also assessed. Community participation and involvement in the project were encouraged through community meetings organized by Besalco S.A., during which the characteristics of the project were presented, and issues, potential solutions and mitigation measures were discussed.



Figure 08: Public consultation. Picture provided by Besalco S.A.



Figure 09: Public consultation. Picture provided by Besalco S.A.



Figure 10: "Quebrada de Medina". Wooden house, regular conservation status. Source: Estudio de impacto ambiental.

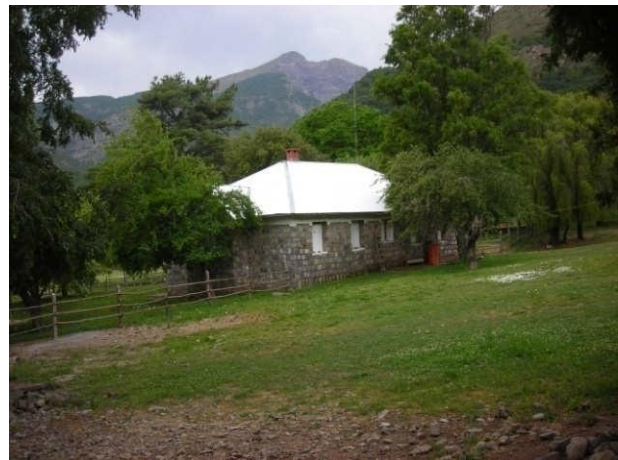


Figure 11: "Quebrada de Medina". Stone dwelling, good condition. Source: Estudio de impacto ambiental.

⁶ "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.5. Medio social y arqueológico", 188-189 (08_Linea Base Medio Humano CH LH)

⁷ "Presentación consulta pública. Central hidroeléctrica Los Hierros", page 18 (08_Presentación Consulta Pública CH LH)

4.1.2. Community:

In the **Community subcategory**, one credit was evaluated as Improved (QL 2.1 Enhance Public Health and Safety), one as Enhanced (QL 2.6 Improve Site Accessibility, Safety & Wayfinding), and one as Conserving (QL 2.2 Minimize Noise and Vibration). Finally, three credits received No Score (QL 2.3 Minimize Light Pollution, QL 2.4 Improve Community Mobility and Access, and QL 2.5 Encourage Alternative Modes of Transportation).

Regarding public health and safety issues, Besalco Construcciones S.A. has an Integrated Management System for Quality, Environment, Safety and Occupational Health (GIS) that includes a Plan for Occupational Safety and Health. This plan aims to implement an effective system of prevention and control of hazards in company activities, and to implement preventive management tools suited to the characteristics of each project, in compliance with all legal requirements. It is important to point out that the plan must be implemented by contractors and subcontractors.

Regarding noise impacts, the project team conducted detailed studies to assess noise levels during the construction and operation phases. In order to solve potential negative effects, Los Hierros will include mitigation measures such as the installation of sound barriers. Due to the fact that the powerhouse is the most important source of noise generated, machinery and turbines will have a soundproof capsule during the operation phase.

According to the information provided by the project team, Los Hierros does not encourage alternative modes of transportation since it will be located in a relatively isolated area. Moreover, the project team has not provided documentation demonstrating that the impacts of the project on community access and mobility have been comprehensively addressed.



Figure 12: Acoustic measurement point #1. Police checkpoint. Source: Estudio de Impacto Acustico, 2010.



Figure 13: Acoustic measurement point #4. Inhabited dwelling (stable). Source: Estudio de Impacto Acustico, 2010.



Figure 14: improvement of canal edge. Picture provided by Besalco S.A.



Figure 15: improvement of canal edge. Picture provided by Besalco S.A.



Figure 16: signage in the works area. Picture provided by Besalco S.A.

4.1.3. Wellbeing:

In the **Wellbeing subcategory**, out of three credits, two were evaluated as Superior (QL 3.1 Preserve Historic and Cultural Resources, and QL 3.2 Preserve Views And Local Character), and one as No Score (QL 3.3 Enhance Public Space).

One of the main goals of Los Hierros is to use existing infrastructure to develop hydroelectric potential in El Melado irrigation canal, which will significantly reduce the impacts generated by the hydroelectric project. Particularly, the Los Hierros project does not plan new water extraction points, but leverages the existing ones, and therefore it will not be necessary to interrupt the area to construct a raceway. In other words, the project's design reflects its context and reduces alteration of the scenic landscape. Due to the necessary vegetation clearing and incorporation of foreign elements discordant with the natural landscape, the project also considers mitigation measures to improve visual quality.

A detailed study assessed the archaeology of the Los Hierros influence area, but no evidence was found of the existence of archaeological remains or sites that require special attention. Due to the characteristics of the terrain, future archeological findings seem to be unlikely. However, prior to the construction phase, an environmental supervisor is responsible for coordinating a multidisciplinary team to relieve the area of biotic and archaeological components. In addition, archaeological monitoring and verification visits will occur every two months, and yearly during the first two years of operation.



Figure 17: characteristic landscape from the visual point PO-1.
Source: Estudio de impacto ambiental, p.112.



Figure 18: characteristic landscape from the visual point PO-1.
Source: Estudio de impacto ambiental, p.112.



Figure 19: characteristic landscape from the visual point PO-2.
Source: Estudio de impacto ambiental, p.113.



Figure 20: characteristic landscape from the visual point PO-2.
Source: Estudio de impacto ambiental, p.113.

4.1.4. Summary of results for the Quality of Life Category.

The table below shows the distribution of credits as well as the level of achievement reached in each credit (figure 21).

LOS HIERROS, CHILE				PT	Performance	% Total	max
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve Community Quality of Life	2	Improved	8.0%	25
2			QL1.2 Stimulate Sustainable Growth & Development	2	Enhanced	12.5%	16
3			QL1.3 Develop Local Skills And Capabilities	2	Enhanced	13.3%	15
4		COMMUNITY	QL2.1 Enhance Public Health And Safety	2	Improved	12.5%	16
5			QL2.2 Minimize Noise And Vibration	8	Conserving	72.7%	11
6			QL2.3 Minimize Light Pollution	0	No Score	0.0%	11
7			QL2.4 Improve Community Mobility And Access	0	No Score	0.0%	14
8			QL2.5 Encourage Alternative Modes of Transportation	0	No Score	0.0%	15
9			QL2.6 Improve Site Accessibility, Safety & Wayfinding	3	Enhanced	20.0%	15
10		WELLBEING	QL3.1 Preserve Historic And Cultural Resources	7	Superior	43.8%	16
11			QL3.2 Preserve Views And Local Character	6	Superior	42.9%	14
12			QL3.3 Enhance Public Space	0	No Score	0.0%	13
QL0.0 Innovate Or Exceed Credit Requirements				0	N/A		
QL				32		17.7%	181

Figure 21: Summary of results in Quality of life category.

The biggest opportunities for improvement in the Quality of Life (QL) category for the project occur in the Community subcategory. Considering all credits and the maximum possible values for each indicator, the percentage of achievement equates to 17.7%, or 32 points out of 181.

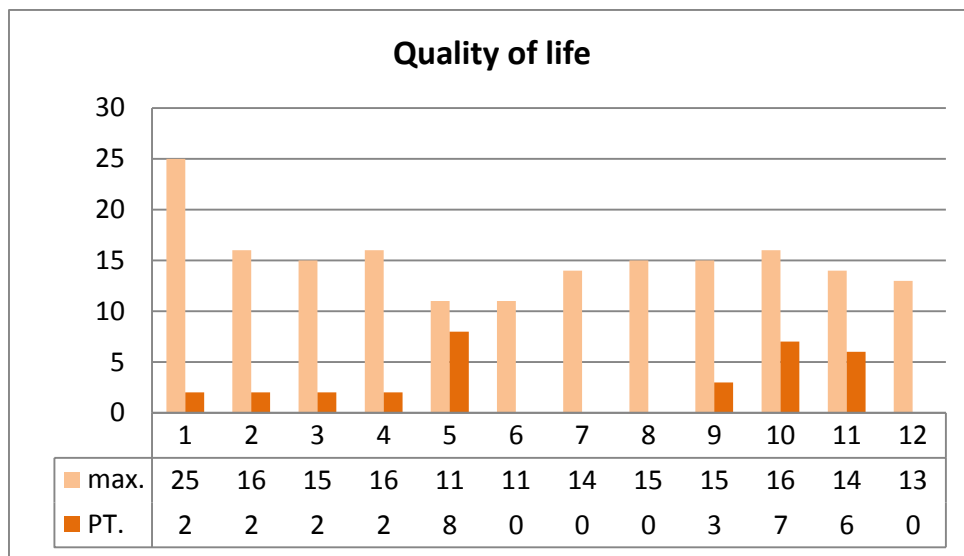


Figure 22: Summary of results in Quality of life category

4.2. LEADERSHIP

*Envision's Leadership category evaluates the collaboration, management and planning of the project's team, as well as its stakeholders. Envision states that "communicate and collaborate early on, involve a wide variety of people in creating ideas for the project, and understand the long-term, holistic view of the project and its life cycle."*⁸

The 12 credits in this category are: Collaboration (LD 1.1, LD 1.2, LD 1.3, LD 1.4), Management (LD 2.1, LD 2.2) and Planning (LD 3.1, LD 3.2, LD 3.3).

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE	
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	2	4	9	17	
14			LD1.2 Establish a sustainability management system	1	4	7	14	
15			LD1.3 Foster collaboration and teamwork	1	4	8	15	
16			LD1.4 Provide for stakeholder involvement	1	5	9	14	
17	LEADERSHIP	MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	3	6	12	15
18			LD2.2 Improve infrastructure integration	1	3	7	13	16
19	LEADERSHIP	PLANNING	LD3.1 Plan for long-term monitoring and maintenance	1	3		10	
20			LD3.2 Address conflicting regulations and policies	1	2	4	8	
21			LD3.3 Extend useful life	1	3	6	12	
							Maximum points possible:	121

Figure 23: Leadership category, credits distribution.

4.2.1. Collaboration

In the **Collaboration subcategory**, one credit was evaluated as Enhanced (LD 1.4 Provide for Stakeholder Involvement), and three as Improved (LD 1.1 Provide Effective Leadership and Commitment, LD 1.2 Establish a Sustainability Management System, and LD 1.3 Foster Collaboration and Teamwork).

According to the information provided by the project team, Besalco S.A. has an Integrated Management System for quality, environment, occupational health and safety that applies to all of the company's construction projects. This system states that contracts should include clauses that oblige contractors to meet standards defined by Besalco S.A. for its programs. The Los Hierros project followed the ISO 14001:2004 guidelines, which require an environmental management system, and the project team has provided documentation⁹ supporting its commitment to the environmental aspects of the project.

The project team anticipates periodic interactions with members of the Canal Melado Association. Besalco S.A. has proven its commitment to promoting communication with the stakeholders through biannual meetings and keeps the community informed by publishing a quarterly newsletter named Open Channel. However, the majority of the communication is primarily one way and promotional. The participation of local residents has primarily occurred within community meetings organized by Besalco

⁸ *Envision Guidance Manual*, p.60

⁹ "Informe Bimestral Gestión Ambiental. Proyecto Línea de Transmisión eléctrica Los Hierros - Canal Melado y subestación Los Hierros y Canal Melado ", Mayo-Junio 2013

S.A. with the aim of presenting the characteristics and associated impacts of the project, and discussing potential solutions and mitigation measures.

4.2.2. Management:

In the **Management subcategory**, one credit was evaluated as No Score (LD 2.1 Pursue By-Product Synergy Opportunities), and one credit was Restorative (LD 2.2 Improve Infrastructure Integration).

As already mentioned, the main goal of Los Hierros is to use existing infrastructure to develop hydroelectric potential in El Melado irrigation canal. The use of existing infrastructure significantly reduces the impacts generated by the hydroelectric project. Particularly, the Los Hierros project does not plan new water extraction points, but leverages the existing ones, and therefore it will not be necessary to interrupt the area to construct a raceway. Additionally, according to the project team, Los Hierros uses or improves infrastructure in two other ways: (1) due to the fact that Los Hierros will operate during wintertime it will not affect irrigation for farming, which occurs mainly between December and February. It also will improve water access for residents who use water from the canal but who do not have water between March and November, and (2) roads will be improved, thus enhancing access to the residential areas.

The concept of by-product synergy opportunities refers to “the identification and cost-effective use of unwanted materials located near the project.”¹⁰ No information has been provided regarding programs to use unwanted materials from nearby facilities; however, it is important to mention that temporary structures required for the construction of Los Hierros will be reused during the construction of Los Hierros II.¹¹ The goal is to prioritize existing infrastructure and minimize disruption to the area.

4.2.3. Planning:

In the **Planning subcategory**, one credit was evaluated as Improved (LD 3.3 Extend Useful Life), and the remaining two were evaluated as No Score (LD 3.1 Plan for Long-Term Monitoring & Maintenance, and LD 3.2 Address Conflicting Regulations & Policies).

The Los Hierros hydroelectric power station will last 60 years and, at the end of its life, reengineering of the project will be contemplated in consideration of technological advances at that time. In addition, reconditioning has been planned after 30 years of operation which is expected to double the hydroelectric power station's lifespan. However, the project team has not provided documentation of considerations for flexibility, durability and resilience. Moreover, no information has been provided regarding a clear plan for long-term monitoring and maintenance of the Los Hierros project.

¹⁰ Envision Guidance Manual, p.70

¹¹ Los Hierros II: A 5.1 MW power station that will be placed strategically to tap the same water resources turbinated by Los Hierros

4.2.4. Summary of results for the Leadership category.

The table below (figure 24) shows the distribution of the credits, as well as the level of performance achieved in each.

LOS HIERROS, CHILE				PT.	Performance	% Total	max
13	LEADERSHIP	COLLABORATION	LD1.1 Provide Effective Leadership And Commitment	2	Improved	11.8%	17
14			LD1.2 Establish A Sustainability Management System	1	Improved	7.1%	14
15			LD1.3 Foster Collaboration And Teamwork	1	Improved	6.7%	15
16			LD1.4 Provide For Stakeholder Involvement	5	Enhanced	35.7%	14
17	MNGMT.	LD2.1 Pursue By-Product Synergy Opportunities	0	No Score	0.0%	15	
18		LD2.2 Improve Infrastructure Integration	16	Restorative	100.0%	16	
19	PLANNING	LD3.1 Plan For Long-Term Monitoring & Maintenance	0	No Score	0.0%	10	
20		LD3.2 Address Conflicting Regulations & Policies	0	No Score	0.0%	8	
21		LD3.3 Extend Useful Life	1	Improved	8.3%	12	
LD0.0 Innovate Or Exceed Credit Requirements				0	N/A		
LD				26		21.5%	121

Figure 24: Summary of results in Leadership category

The biggest opportunities for improvement in the Leadership (LD) category occur in the Planning subcategory. Considering all credits and the maximum possible values for each indicator, the percentage of achievement equates to 21.5%, or 26 points out of 121.

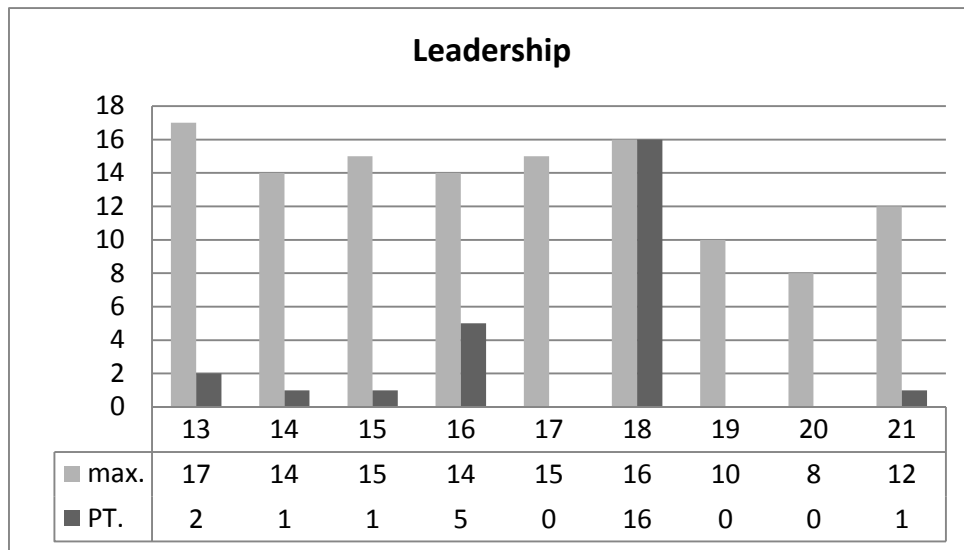


Figure 25: Summary of results in Leadership category

4.3. RESOURCE ALLOCATION

The Resource Allocation (RA) category deals with the quality and source of the materials used in the project during its construction and operation phases. Use and allocation of materials and other resources has a great impact on the overall sustainability of the project. The RA category is divided into 13 credits: Materials (RA 1.1, RA 1.2, RA 1.3, RA 1.4, RA 1.5, RA 1.6, RA 1.7), Energy (RA 2.1, RA 2.2, RA 2.3) and Water (RA 3.1, RA 3.2, RA 3.3).

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE	
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce net embodied energy	2	6	12	18	
23			RA1.2 Support sustainable procurement practices	2	3	6	9	
24			RA1.3 Use recycled materials	2	5	11	14	
25			RA1.4 Use regional materials	3	6	9	10	
26			RA1.5 Divert waste from landfills	3	6	8	11	
27			RA1.6 Reduce excavated materials taken off site	2	4	5	6	
28			RA1.7 Provide for deconstruction and recycling	1	4	8	12	
29	ENERGY	RA2.1 Reduce energy consumption	3	7	12	18		
30		RA2.2 Use renewable energy	4	6	13	16	20	
31		RA2.3 Commission and monitor energy systems		3		11		
32	WATER	RA3.1 Protect fresh water availability	2	4	9	17	21	
33		RA3.2 Reduce potable water consumption	4	9	13	17	21	
34		RA3.3 Monitor water systems	1	3	6	11		
						Maximum points possible:	182	

Figure 26: Resource Allocation category, credits distribution.

4.3.1. Materials:

In the **Materials subcategory**, out of seven credits, one was assessed as Enhanced (RA 1.6 Reduce Excavated Materials Taken Off Site), three were evaluated as Improved (RA 1.3 Used Recycled Materials, RA 1.4 Use Regional Materials, and RA 1.5 Divert Waste From Landfills), and three received No Score (RA 1.1 Reduce Net Embodied Energy, RA 1.2 Support Sustainable Procurement Practices, and RA 1.7 Provide for Deconstruction & Recycling).

Besalco S.A. has a standardized procedure for establishing and maintaining adequate management of waste generated by all of the company’s projects. This procedure will be implemented in Los Hierros with the aim of controlling potential environmental impacts and establishing certain necessary internal controls.

Regarding the recycling and use of regional materials, materials from the excavations will be reused in the construction of road platforms, production of aggregates for concrete, and structural fills during the construction phase. During the course of construction, all excavated material will be deposited in a limited storage area for subsequent selection and reuse later. Despite these efforts, the project team did not provide any data to prove that a life cycle or net embodied energy assessment of materials used was performed in accordance with recognized and accepted methodologies.

Additionally, to transport the major equipment to the Plant - such as the turbine snail, transformers, and generators - the project team will build a temporary road to access the Melado River. They will use the

natural deposits of fluvial sedimentary material to avoid affecting the river's hydraulic shaft and disrupting the flora along the banks and meanders of the river. The filler material will be extracted from deposits of accumulated material. It is important to point out that although the total amount of excavated material is expected to be retained on site, only 66% of it will be reused for a particular purpose.¹² This proportion may be increased by the fact that the excavation material will be stockpiled in a specific area; however, the project team has not provided information to support this idea.



Figure 27: collection of plant material. Picture provided by Besalco S.A.



Figure 28: deposits of accumulated material. Picture provided by Besalco S.A.

4.3.2. Energy:

In the **Energy subcategory**, out of three credits, one was assessed as Restorative (RA 2.2 Use Renewable Energy), one was evaluated as Enhanced (RA2.3 Commission & Monitor Energy Systems), and one received No Score (RA 2.1 Reduce Energy Consumption).

Los Hierros is a hydroelectric power plant and, according to the Environmental Impact Assessment, the energy used for its operation will be renewable and generated by the project on-site (two Francis turbines which will be rotated by water force). However, the project does not consider alternatives to reduce energy consumption during the construction or operation processes.

Los Hierros is expected to generate 110 GWh per year; the energy produced will be delivered to the Central Interconnected System (SIC) and will be sold to the SPOT market. Importantly, the project qualifies as a Non-Conventional Renewable Energy (ERNC, acronym in Spanish) project according to Chile's General Electrical Services Law, and it is a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol.

Regarding the monitoring of energy systems, during the operation phase the project machinery will receive periodic maintenance and evaluations of vibration and pulsation, alternator insulation, and oil analysis. Maintenance will be performed by the project team with support of the contractors. However, the project team has not provided documentation to prove that advanced monitoring systems, such as energy sub-meters, will be used to enable more efficient operations.

¹² "Estudio de Impacto Ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 23 (08_ Descripción del Proyecto CH LH).

4.3.3. Water:

In the **Water subcategory**, all three credits were evaluated as Improved (RA 3.1 Protect Fresh Water Availability, RA 3.2 Reduce Potable Water Consumption, and RA 3.3 Monitor Water Systems).

As specified within the Report on Compliance with World Commission on Dams (WDC) Recommendations "... *Los Hierros activity does not modify the river flow as the water is directly taken from an existing irrigation canal. The only modifications are related to repairs or improvements to sections of the existing canal in bad condition due to their age (over 80 years)*..."¹³ However, the project team has not provided information about features incorporated into the design to minimize the long-term negative net impact on ground and surface water source quality and quantity, or to achieve a net positive impact on water sources.

The Los Hierros project will include a concrete plant with a recirculating water system which, according to the project team, will reduce the use of potable water for the concreting process to zero. In addition, to reduce the possibility of contaminating fresh water in the vicinity of the project, waste from chemical toilets will be channeled to the wastewater treatment plant.

In order to stress their commitment to guaranteeing the water system's performance and to meeting the conditions described in the Environmental Qualification Resolution, Besalco will hire a local Environmental Supervisor who will be in charge of verifying compliance during the construction phase and project implementation. The Environmental Supervisor will verify compliance with the Environmental Qualification Resolution, and regulations of other associated regulatory bodies, and will develop an environmental management system that will foster system efficiency.



Figure 29: construction of concrete plant with a recirculating water system. Picture provided by Besalco S.A.

¹³ "Report on compliance with WDC recommendations. Los Hierros Hydroelectric Power Plant", February 2013, TÜV Nord, pages 6-7 (2013-02-19 WCD Los Hierros final)

4.3.4. Summary of results, Resource Allocation category:

The table below (figure 30) shows the distribution of credits, as well as the level of performance achieved in each credit. The biggest opportunities for improvement are in the Materials subcategory. Considering all credits and the maximum possible values for each indicator, the percentage of achievement equates to 23.1%, or 42 points out of 182.

LOS HIERROS, CHILE			PT	Performance	% Total	max	
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce Net Embodied Energy	0	No Score	0.0%	18
23			RA1.2 Support Sustainable Procurement Practices	0	No Score	0.0%	9
24			RA1.3 Used Recycled Materials	2	Improved	14.3%	14
25			RA1.4 Use Regional Materials	3	Improved	30.0%	10
26			RA1.5 Divert Waste From Landfills	3	Improved	27.3%	11
27			RA1.6 Reduce Excavated Materials Taken Off Site	4	Enhanced	66.7%	6
28			RA1.7 Provide for Deconstruction & Recycling	0	No Score	0.0%	12
29	ENERGY	RA2.1 Reduce Energy Consumption	0	No Score	0.0%	18	
30		RA2.2 Reduce Pesticide and Fertilizer Impacts	20	Restorative	100.0%	20	
31		RA2.3 Commission & Monitor Energy Systems	3	Enhanced	27.3%	11	
32	WATER	RA3.1 Protect Fresh Water Availability	2	Improved	9.5%	21	
33		RA3.2 Reduce Potable Water Consumption	4	Improved	19.0%	21	
34		RA3.3 Monitor Water Systems	1	Improved	9.1%	11	
RA0.0 Innovate Or Exceed Credit Requirements			0	N/A			
RA			42		23.1%	182	

Figure 30: Summary of results in Resource Allocation category

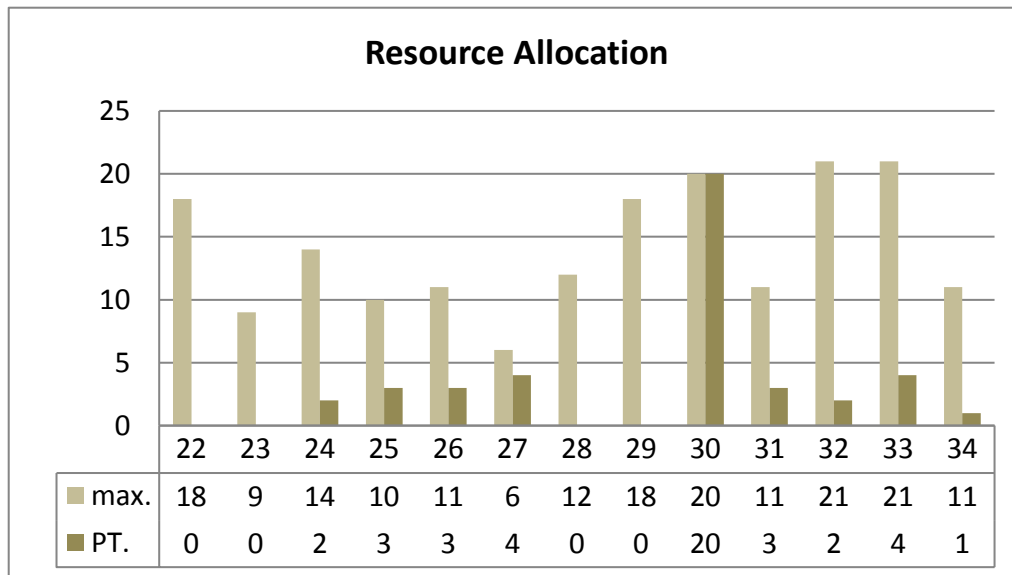


Figure 31: Summary of results in Resource Allocation category

4.4. NATURAL WORLD

The Natural World category addresses “how to understand and minimize negative impacts while considering ways in which the infrastructure can interact with natural systems in a synergistic, positive way.”¹⁴ The NW category is divided into 14 credits related to project siting (NW 1.1, NW 1.2, NW 1.3, NW 1.4, NW 1.5, NW 1.6, and NW 1.7), impacts on land and water (NW 2.1, NW 2.2, NW 2.3), and biodiversity (NW 3.1, NW 3.2, NW 3.3, NW 3.4).

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE	
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat			9	14	18
36			NW1.2 Protect wetlands and surface water	1	4	9	14	18
37			NW1.3 Preserve prime farmland			6	12	15
38			NW1.4 Avoid adverse geology	1	2	3	5	
39			NW1.5 Preserve floodplain functions	2	5	8	14	
40			NW1.6 Avoid unsuitable development on steep slopes	1		4	6	
41			NW1.7 Preserve greenfields	3	6	10	15	23
42	LAND & WATER		NW2.1 Manage stormwater		4	9	17	21
43			NW2.2 Reduce pesticide and fertilizer impacts	1	2	5	9	
44			NW2.3 Prevent surface and groundwater contamination	1	4	9	14	18
45	BIODIVERSITY		NW3.1 Preserve species biodiversity	2			13	16
46			NW3.2 Control invasive species			5	9	11
47			NW3.3 Restore disturbed soils				8	10
48			NW3.4 Maintain wetland and surface water functions	3	6	9	15	19
Maximum points possible:							203	

Figure 32: Natural World credit distribution

4.4.1. Siting:

The **Siting sub-category** presents a wide distribution of results. One credit was evaluated as No Score (NW 1.1 Preserve Prime Habitat), three were assessed as Improved (NW 1.2 Preserve Wetlands and Surface Water, NW 1.6 Avoid Unsuitable Development on Steep Slopes, and NW 1.7 Preserve Greenfields), two were classified as Enhanced (NW 1.4 Avoid Adverse Geology, and NW 1.5 Preserve Floodplain Functions), and one was evaluated as Conserving (NW 1.3 Preserve Prime Farmland).

The Los Hierros project is sited on land identified as having high ecological value, due to the Precordillera geological formation of the area. The project is located in the Maule River Basin, which is part of the central region of a Fluvial-Glacio-Volcanic plain; it is also next to the Melado River basin, in the municipality of Colbún, which is located near Radal Siete Tazas National Park, Los Bellotos de Melado National Reserve, and Los Altos de Lircay. Furthermore, the transmission line is located in an area that is considered prime habitat. According to the Environmental Impact Assessment, the soil types are prime for wildlife conservation and forestry production. The site is not currently farmed.

As with every hydroelectric power station, Los Hierros is dependent upon water infrastructure. However, the project has been designed to mitigate stormwater and flood damage by stabilizing the ground during construction of access roads, and by locating camps and facilities outside flood-prone areas. Similar to the geography of Chile, this site is characterized by a progressive decline in elevation from east to west, and has slopes ranging between 40 and 60 degrees that are susceptible to flows and

¹⁴ Envision Guidance Manual, p.116

landslides. However, the Los Hierros project will follow best practices to minimize the exposure and risk from erosion, landslides, and other natural hazards.



Figure 33: Grassland formation within the study area.
Source: Estudio de impacto ambiental, p.122.



Figure 34: Scrub formation within the study area.
Source: Estudio de impacto ambiental, p.123.



Figure 35: Forest formation within the study area.
Source: Estudio de impacto ambiental, p.124.



Figure 36: Xerophytic vegetation formation within the study area.
Source: Estudio de impacto ambiental, p.124.

4.4.2. Land and Water:

In the **Land and Water subcategory**, out of three credits, one was assessed as Conserving (NW 2.2 Reduce Pesticides and Fertilizer Impacts), one was evaluated as Superior (NW 2.3 Prevent Surface and Groundwater Contamination), and one was considered No Score (NW 2.1 Manage Stormwater).

In order to prevent surface and groundwater contamination, Los Hierros incorporates a Physical Environmental Action Plan that includes a preventative strategy to mitigate surface contamination from hazardous materials in four different scenarios: car accidents, accidental spills due to work fronts, spills of chemicals or contaminants (oils, lubricants and paints) on the ground, and spills of hazardous substances into waterways. To implement the everyday and emergency protocols, staff will be trained to handle these types of substances and react accordingly. During the construction and startup phases,

an Environmental Supervisor will be in charge of verifying compliance with the Environmental Qualification Resolution. Moreover, the project team will utilize the natural deposits of fluvial sedimentary material to avoid impacting the river's hydraulic shaft and riparian vegetation, and the fill material will be selected from stored deposits of accumulated material.

The Los Hierros landscaping was designed to incorporate plant species that require no pesticides, herbicides, fertilizers, or integrated pest management approaches. The construction of both the hydroelectric power station and the transmission line will require a minimal level of soil intervention, where logging and removal of vegetation will be limited to what is strictly necessary. Moreover, the re-vegetation plan only includes plants that are suited to the conditions of the site, and the approved reforestation plan will be achieved once 75% survival is verified and the composition of the original native forest is preserved.

Although Los Hierros considers the construction of rainwater drainage mechanisms aimed to stabilize the ground near construction of new access roads, the project team does not provide information or evidence to support that this project improves the area's stormwater runoff quantity and quality.



Figure 37: residential waste collection. Picture provided by Besalco S.A.



Figure 38: hazardous materials collection. Picture provided by Besalco S.A.

4.4.3. Biodiversity:

In the **Biodiversity subcategory**, the Los Hierros hydroelectric power plant performs well. One credit was evaluated as Improved (NW 3.1 Preserve Species Biodiversity), one credit as Superior (NW 3.2 Control Invasive Species), one credit as Conserving (NW 3.3 Restore Disturbed Soils), and one credit as Enhanced (NW 3.4 Maintain Wetland and Surface Water Functions).

A detailed study was conducted to determine the habitats and species characteristic of the area. Birds were the most common group of animals found (21 different species), followed by mammals (9 species), and then amphibians (only one species was detected, the spiny toad). In order to mitigate adverse impacts of the hydroelectric power plant, the project team has identified different relocation areas and has scheduled monitoring. The project team has also programmed the construction of a fence around the canal with provisions to enable wildlife passage.

In an equally detailed study, a total of 58 different plants were detected. Evidence that the area has had little intervention is the fact that 81% of the species identified were native and only 17% were characterized as allochthonous¹⁵ plants. During the construction phase, a total area of 1.3 hectares of native forest (Roble-Hualo) will be affected during 2013 and restored in 2014. Trees will be removed, but at the end of the construction phase, 100% of the soils disturbed during the work will be restored, with the exception of soil used for permanent construction which will not be recovered.

Regarding the wetland and surface water functions, it is important to point out that Los Hierros activity does not result in new reservoirs or in an increase in capacity of the existing reservoir. Moreover, the operation does not affect the river flow because the water is taken directly from an existing irrigation canal¹⁶.



Figure 39: wildlife passage. Picture provided by Besalco S.A.



Figure 40: hazardous materials collection. Picture provided by Besalco S.A.



Figure 41: fish in the area. *Trichomycterus areolatus*, *oncorhynchus mykiss*, and *cheirodon galusdae*. Estudio de impacto ambiental, p.181.



Figure 42: animals in the area. *Lycalopex culpaeus*, *liolaemus schroederi*, *cyanoliseus patagonus*. Estudio de impacto ambiental, p.160-161.

¹⁵ Refers to those plants that are not original from the studied area.

¹⁶ "Report on compliance with WDC recommendations. Los Hierros Hydroelectric Power Plant", February 2013, TÜV Nord

4.4.4. Summary of results, Natural World category:

The table below (figure 43) shows the distribution of credits, as well as the level of performance achieved in each credit.

LOS HIERROS, CHILE			pt.	performance	% total	max.	
35	NATURAL WORLD	SITING	NW1.1 Preserve Prime Habitat	0	No Score	0.0%	18
36			NW1.2 Preserve Wetlands and Surface Water	1	Improved	5.6%	18
37			NW1.3 Preserve Prime Farmland	12	Conserving	80.0%	15
38			NW1.4 Avoid Adverse Geology	2	Enhanced	40.0%	5
39			NW1.5 Preserve Floodplain Functions	5	Enhanced	35.7%	14
40			NW1.6 Avoid Unsuitable Development on Steep Slopes	1	Improved	16.7%	6
41			NW1.7 Preserve Greenfields	3	Improved	13.0%	23
42	L & W	NW2.1 Manage Stormwater	0	No Score	0.0%	21	
43		NW2.2 Reduce Pesticides and Fertilizer Impacts	9	Conserving	100.0%	9	
44		NW2.3 Prevent Surface and Groundwater Contamination	9	Superior	50.0%	18	
45	BIODIVERSITY	NW3.1 Preserve Species Biodiversity	13	Improved	81.3%	16	
46		NW3.2 Control Invasive Species	5	Superior	45.5%	11	
47		NW3.3 Restore Disturbed Soils	8	Conserving	80.0%	10	
48		NW3.4 Maintain Wetland and Surface Water Functions	6	Enhanced	31.6%	19	
NW0.0 Innovate or Exceed Credit Requirements			0	N/A			
NW			74		36.5%	203	

Figure 43: Summary of results in Natural World category

Opportunities for improvement can be found in all three sub-categories of the Natural World (NW) category, but the biggest opportunity is for the implementation of better stormwater management measures. Considering all credits and the maximum possible values for each indicator, the percentage of achievement equates to 36.5%, or 74 points out of 203.

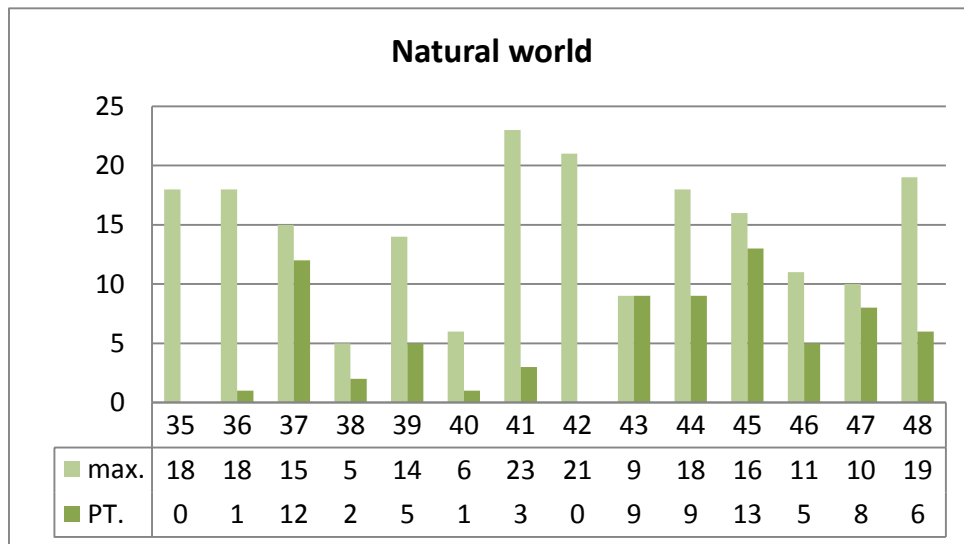


Figure 44: Summary of results in Natural World category

4.5. CLIMATE AND RISK

Envision’s Climate and Risk category is divided into two main sub-categories, emissions and resilience. The main goals of the category are to “minimize emissions that may contribute to increased short and long-term risks” and “to ensure infrastructure projects are resilient to short-term hazards or long-term altered future conditions.”¹⁷ The credits are distributed as: Emissions (CR 1.1, CR 1.2), and Resilience (CR 2.1, CR 2.2, CR 2.3, CR 2.4, CR 2.5).

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE
49	CLIMATE & RISK	EMISSIONS					
50		CR1.1 Reduce greenhouse gas emissions	4	7	13	18	25
51		CR1.2 Reduce air pollutant emissions	2	6		12	15
52	RESILIENCE	CR2.1 Assess climate threat				15	
53		CR2.2 Avoid traps and vulnerabilities	2	6	12	16	20
54		CR2.3 Prepare for long-term adaptability				16	20
55		CR2.4 Prepare for short-term hazards	3		10	17	21
		CR2.5 Manage heat islands effects	1	2	4	6	
Maximum points possible:							116

Figure 45: Climate and Risk credit distribution.

4.5.1. Emissions

The Los Hierros project realized an outstanding performance in the **Emissions subcategory** with 78% achievement (31 points out of 40). Regarding the credits, one was assessed as Restorative (CR 1.1 Reduce Greenhouse Gas Emissions) and one as Enhanced (CR 1.2 Reduce Air Pollutant Emissions).

Los Hierros will lead to a reduction in equivalent carbon emissions and is considered net carbon negative. The project will constitute a positive contribution to Chile’s sustainable development, not only for the aforementioned reduction in greenhouse gas emissions, but because it will contribute to a cleaner energy matrix. It has been estimated that between 2012 and 2019, the hydroelectric power plant will result in an emissions reduction equivalent to 592,608 tons of CO₂.¹⁸ Los Hierros qualifies as a Non-Conventional Renewable Energy (ERNC, acronym in Spanish) project under Chile's General Electrical Services Law, and as a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol. As a CDM, the project provides “...emission reductions that are additional to what would otherwise have occurred, (and) must qualify through a rigorous and public registration and issuance process. Approval is given by the Designated National Authorities...”¹⁹

Energy needed to power the project will be produced on-site. The project operations will not produce emissions of CO₂ or N₂O. Moreover, due to the fact that the project activity will not result in new reservoirs or in an increase in capacity of the existing reservoir, the hydroelectric power station will not produce emissions of CH₄.

¹⁷ Envision Guidance Manual, p.150

¹⁸ "Formulario de diseño del proyecto (MDL DDP) - Versión 03", pages 7 and 30 (08_ PDD Los Hierros).

¹⁹ http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

4.5.2. Resilience

The **Resilience subcategory** offers several opportunities for improvement. Out of five credits, two were assessed as Improved (CR 2.2 Avoid Traps and Vulnerabilities, and CR 2.4 Prepare for Short-Term Hazards), and the remaining three were evaluated as No Score (CR 2.1 Assess Climate Threat, CR 2.3 Prepare for Long-Term Adaptability, and CR 2.5 Manage Heat Island Effects).

The project team has identified three short-term hazards (natural hazards, risks associated with construction works, and risks associated with the operation phase), and has analyzed potential consequences and implemented prevention measures for each one. Moreover, the project team has developed a contingency plan that comprises actions and measures in case of: mudflows and avalanches, landslides, flooding, seismic events, fire, explosions, traffic accidents and spills of hazardous substances. However, there is no evidence that Los Hierros is prepared for long-term adaptability to altered climate conditions, supply shortfalls, or other significant long-term changes in operational or environmental conditions.

The Los Hierros hydroelectric power station complies with minimum local regulations and does not affect or disrupt activities currently developed in the area of direct influence. In order to better understand the potential effects of Los Hierros on the community, the project team has coordinated two community meetings with Colbún residents.

4.5.3. Summary of results Climate and Risk category.

The table below (figure 46) shows the distribution of credits as well as the level of performance achieved in each credit:

LOS HIERROS, CHILE			PT.	Performance	% Total	max.
49	EMISSION	CR1.1 Reduce Greenhouse Gas Emissions	25	Restorative	100.0%	25
50		CR1.2 Reduce Air Pollutant Emissions	6	Enhanced	40.0%	15
51	RESILIENCE	CR2.1 Assess Climate Threat	0	No Score	0.0%	15
52		CR2.2 Avoid Traps And Vulnerabilities	2	Improved	10.0%	20
53		CR2.3 Prepare For Long-Term Adaptability	0	No Score	0.0%	20
54		CR2.4 Prepare For Short-Term Hazards	3	Improved	14.3%	21
55		CR2.5 Manage Heat Island Effects	0	No Score	0.0%	6
CR0.0 Innovate Or Exceed Credit Requirements			0	N/A		
CR			36		29.5%	122

Figure 46: Summary of results in Climate and Risk category

In the Climate and Risk category, the biggest opportunities for improvement are within the Resilience subcategory. Considering all credits and the maximum possible values for each indicator, the percentage of achievement equates to 29.5%, or 36 points out of 122.

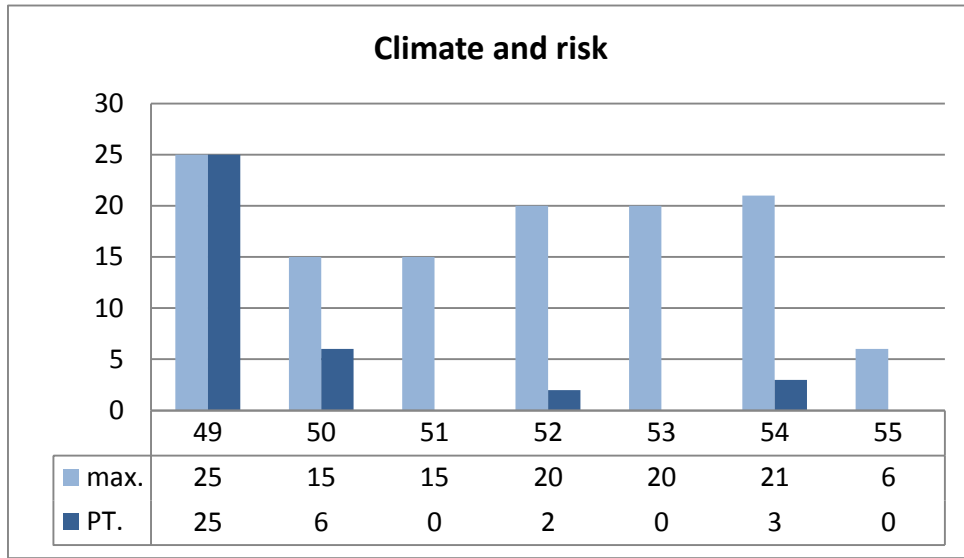


Figure 47: Summary of results in Climate and Risk category

5. RESULTS AND CONCLUSION

This evaluation of the Los Hierros hydroelectric power plant reveals the strengths of the project and its significant contribution to Chile's sustainable development. Furthermore, this evaluation has pointed out which categories of analysis provide great opportunities for improvement.

In the **Quality of Life category**, the project obtained 32 out of 181 points, or 17.7%, which represents the project's worst performance in any of the five categories of the *Envision* rating system. However, there are a number of ways in which the project will improve the quality of life of area residents. The project will generate clean energy, will improve access to water, and will create local jobs, especially during the construction phase. It is also important to note that Los Hierros will consume existing infrastructure to develop hydroelectric potential in El Melado irrigation canal, and will thus minimize interruption to the area.

The existence of archaeological remains or sites that require special attention was carefully evaluated by the project team, but due to the characteristics of the terrain, archeological findings seem to be unlikely. Additionally, the project team plans to hold talks for all staff on site, to disseminate knowledge about the archaeological heritage of the area, the legal bodies that protect this heritage, and procedures regarding unexpected findings.

Regarding Los Hierros' impacts on the health and quality of life of the people close to the project, noise impacts were carefully assessed, and through mitigation measures, noise levels were reduced below maximum levels. However, the project team did not provide documentation proving that Los Hierros was designed to better protect public health and safety. Additionally, constructed works don't allow for walking distance and pedestrian accessible to multi-modal transportation, and there is no evidence that the project team have made decisions considering creating new links to public transport rather than relying on motorized vehicles for providing access. Finally, there is no evidence an overall assessment of lightning needs for the project or its components contributing to reductions in lighting energy requirements. In sum, the engagement of the affected communities in the project design should be improved.

In the **Leadership category**, the project obtained 26 out of 121 points, or 21.5%. This performance ranked fourth among the five categories in the *Envision* rating system. The project exemplifies leadership in sustainability, fulfilling all the requirements of a Clean Development Mechanism under the Kyoto Protocol. An important aspect of Los Hierros is that it will use existing infrastructure to develop hydroelectric potential in El Melado irrigation canal, which will significantly reduce the impacts generated by the hydroelectric power plant.

It is important to mention that Besalco S.A. has made commitments to sustainability that are clearly stated in the Company's Integrated Management System and that apply to all of the company's construction projects. Besalco S.A. is also committed to fostering periodic interaction with stakeholders and members of the Canal Melado Association through biannual meetings and the publication of a quarterly newsletter named Open Channel. However, according to the information provided by the project team, the majority of the communication is and will be primarily one way and promotional.

In the **Resource Allocation category**, the project obtained 42 of 182 points, or 23.1%, which was the project's third best performance out of the five categories of the *Envision* rating system. Los Hierros qualifies as a Non-Conventional Renewable Energy (ERNC, acronym in Spanish) project according to Chile's General Electrical Services Law, and it is a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol.

Several efforts to use recycled materials or re-use materials in situ are being developed. The total amount of excavated material is expected to be retained on site, and 66% of it will be reused for a particular purpose. Regarding waste concerns, Besalco S.A. has a standardized procedure for establishing and maintaining adequate management of waste generated by all of the company's projects. This procedure will be implemented for Los Hierros with the aim of controlling potential environmental impacts and establishing certain necessary internal controls. To ensure compliance with these procedures, the project will put different professionals in charge of specific controls.

During the construction period, water for industrial purposes as well as for drinking will be obtained from El Melado Canal; drinking water will be flocculated using a coloring system. The Los Hierros power plant will have a concrete plant with a recirculating water system which, according to the project team, will reduce the use of potable water for the concreting process to zero, and reduce the possibility of contaminating freshwater in the vicinity of the project. It is important to point out that waste from chemical toilets will also be channeled to the wastewater treatment plant. Besalco will hire a local Environmental Supervisor who will be in charge of verifying compliance with regulations and establishing an environmental management system during the construction and project implementation.

In the **Natural World category**, the project obtained 74 out of 203 points, or 36.5%, which was the project's best performance in any of the five categories of the *Envision* rating system. Los Hierros is located in an area assessed as having high ecological value that is proximate to national parks and reserves. Moreover, the transmission line is located in an area that is considered prime habitat, with soil types that are prime for wildlife conservation and forestry production. Several studies were conducted to achieve a detailed assessment of the area's biodiversity, and different species of flora and fauna have been identified. Species relocation areas were designated, monitoring plans have been scheduled, and a fence will be constructed around the canal that enables wildlife passage between habitats.

Reduction of pesticides and fertilizer impacts is strongly addressed by this project. The landscaping was designed to incorporate plant species that require no pesticides, herbicides, fertilizers, or integrated pest management approaches. Logging and removal of vegetation will be limited to what is strictly necessary; re-vegetation will include only plants that are suited to site conditions.

The project design incorporates a Physical Environmental Action Plan, which was approved by the Maule Regional Environmental Commission and includes a preventative strategy to mitigate surface contamination from hazardous materials. The Plan was developed for four different scenarios and includes protocols that will be carried out by trained staff. Moreover, to prevent surface and groundwater contamination during the project's construction and startup phases, an Environmental Supervisor will be hired, and impacts to the river's hydraulic shaft and riparian vegetation will be minimized when possible. At the end of the construction phase, 100% of the soils disturbed during the work will be restored, with the exception of soil used for permanent construction which will not be

recovered. Despite the fact that Los Hierros is a hydroelectric power plant, floodplain functions are expected to be preserved. The project has been designed to mitigate stormwater and flood damage by stabilizing the ground during construction of access roads, and by locating camps and facilities outside flood-prone areas. Moreover, the project is not expected to modify the river's flow.

In the **Climate and Risk category**, the project obtained 36 out of 122 points. This represents 29.5%, which was the project's second best performance out of the five categories. Los Hierros is expected to result in a reduction of 592,608 tons of CO₂ between 2012 and 2019. Furthermore, Los Hierros qualifies as a Non-Conventional Renewable Energy (ERNC, acronym in Spanish) project under Chile's General Electrical Services Law, and is a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol. However, the project could be improved by providing an assessment of climatic threats and a plan for long-term adaptability.

The graphs below demonstrate the project's performance under the three Infrastructure 360^o Awards. The **People and Leadership Award** (figure 48) represents the QL and LD categories from the Envision™ Rating System. The project received a score of 58 points out of a total of 302 combined points within these categories, which equates to a 19.2 % level of achievement. The **Climate and Environment Award** (figure 49) represents the RA, NW and CR categories within the Envision™ Rating System. The project received a score of 152 points out of a total of 507 combined points within these categories, which equates to a 30.0 % level of achievement. Thus, the overall achievement of Los Hierros hydroelectric plant under the **Infrastructure 360 Award** (figure 50) is 210 out of 809 points, or 26 % of the total score.

This report evaluates the sustainability performance of Los Hierros hydroelectric plant according to the Envision™ Rating System. The report identifies areas in which the project scored highly, as well as low-scoring areas that represent opportunities for which the project team can learn and improve on in future projects, as they strive to achieve sustainable project design and construction methodologies.

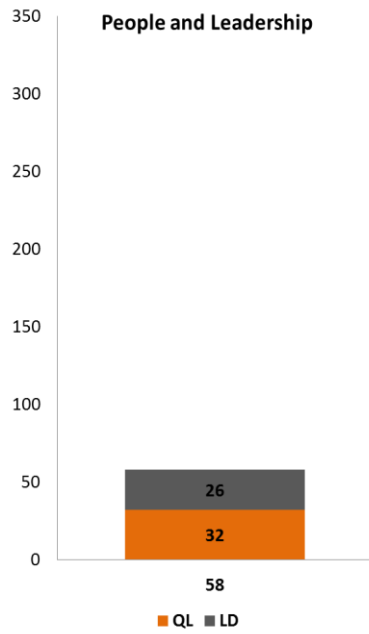


Figure 48: People and Leadership.

Score distribution

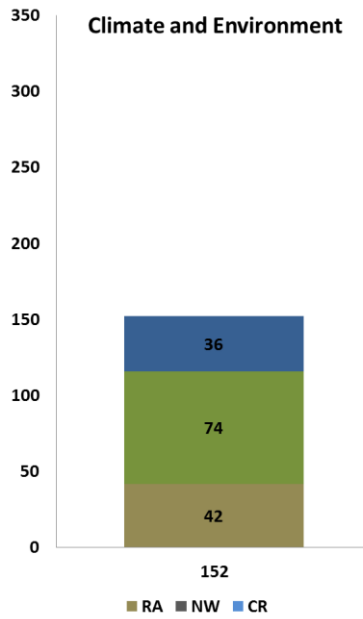


Figure 49: Climate and Environmental.

Score distribution

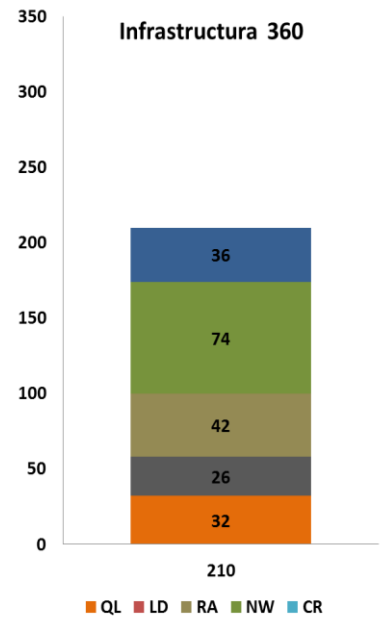


Figure 50: Infraestructura 360.

Score distribution



APPENDIX A: PROJECT PICTURES AND DRAWINGS



Figure 51: "El Melado Canal", 0.5 km route.

Source: Besalco S.A., US department of energy.



Figure 52: "El Melado Canal", siphon "El Toro", 1.2 km route.

Source: Besalco S.A., US department of energy.



Figure 53: signage in the works area. Picture provided by Besalco S.A.



Figure 54 : Grassland formation within the study area.
Source: Estudio de impacto ambiental, p.122.



Figure 55: Scrub formation within the study area.
Source: Estudio de impacto ambiental, p.123.

Los Hierros hydroelectric plant, Chile



Figure 56: characteristic landscape from the visual point PO-2.
Source: Estudio de impacto ambiental, p.113.



Figure 57: characteristic landscape from the visual point PO-2.
Source: Estudio de impacto ambiental, p.113.



Figure 58: residential waste collection. Picture provided by Besalco S.A.



Figure 59: hazardous materials collection. Picture provided by Besalco S.A.



Figure 60: collection of plant material. Picture provided by Besalco S.A.

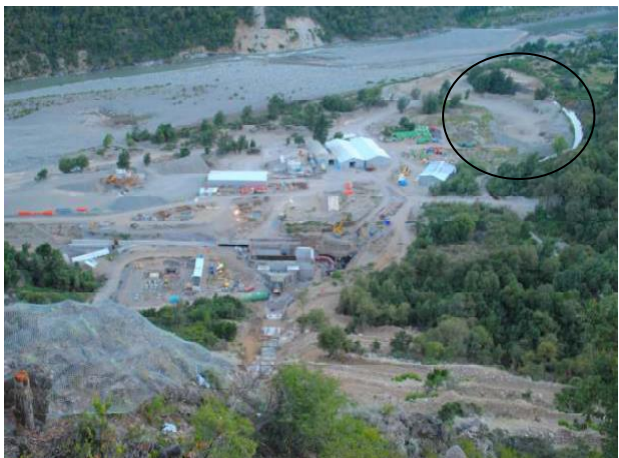


Figure 61: deposits of accumulated material. Picture provided by Besalco S.A.

APPENDIX B: ENVISION POINTS TABLE

CREDIT SCORING

			IMPROVED	ENHANCED	SUPERIOR	CONSERVING	RESTORATIVE	
1	QUALITY OF LIFE	PURPOSE	QL1.1 Improve community quality of life	2	5	10	20	25
2			QL1.2 Stimulate sustainable growth and development	1	2	5	13	16
3			QL1.3 Develop local skills and capabilities	1	2	5	12	15
4		COMMUNITY	QL2.1 Enhance public health and safety	2			16	
5			QL2.2 Minimize noise and vibration	1			8	11
6			QL2.3 Minimize light pollution	1	2	4	8	11
7			QL2.4 Improve community mobility and access	1	4	7	14	
8			QL2.5 Encourage alternative modes of transportation	1	3	6	12	15
9			QL2.6 Improve site accessibility, safety and wayfinding		3	6	12	15
10		WELLBEING	QL3.1 Preserve historic and cultural resources	1		7	13	16
11			QL3.2 Preserve views and local character	1	3	6	11	14
12			QL3.3 Enhance public space	1	3	6	11	13
							Maximum points possible:	181
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	2	4	9	17	
14			LD1.2 Establish a sustainability management system	1	4	7	14	
15			LD1.3 Foster collaboration and teamwork	1	4	8	15	
16			LD1.4 Provide for stakeholder involvement	1	5	9	14	
17		MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	3	6	12	15
18			LD2.2 Improve infrastructure integration	1	3	7	13	16
19		PLANNING	LD3.1 Plan for long-term monitoring and maintenance	1	3		10	
20			LD3.2 Address conflicting regulations and policies	1	2	4	8	
21			LD3.3 Extend useful life	1	3	6	12	
							Maximum points possible:	121
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce net embodied energy	2	6	12	18	
23			RA1.2 Support sustainable procurement practices	2	3	6	9	
24			RA1.3 Use recycled materials	2	5	11	14	
25			RA1.4 Use regional materials	3	6	9	10	
26			RA1.5 Divert waste from landfills	3	6	8	11	
27			RA1.6 Reduce excavated materials taken off site	2	4	5	6	
28			RA1.7 Provide for deconstruction and recycling	1	4	8	12	
29		ENERGY	RA2.1 Reduce energy consumption	3	7	12	18	
30			RA2.2 Use renewable energy	4	6	13	16	20
31			RA2.3 Commission and monitor energy systems		3		11	
32		WATER	RA3.1 Protect fresh water availability	2	4	9	17	21
33			RA3.2 Reduce potable water consumption	4	9	13	17	21
34			RA3.3 Monitor water systems	1	3	6	11	
							Maximum points possible:	182
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat			9	14	18
36			NW1.2 Protect wetlands and surface water	1	4	9	14	18
37			NW1.3 Preserve prime farmland			6	12	15
38			NW1.4 Avoid adverse geology	1	2	3	5	
39			NW1.5 Preserve floodplain functions	2	5	8	14	
40			NW1.6 Avoid unsuitable development on steep slopes	1		4	6	
41			NW1.7 Preserve greenfields	3	6	10	15	23
42		LAND & WATER	NW2.1 Manage stormwater		4	9	17	21
43			NW2.2 Reduce pesticide and fertilizer impacts	1	2	5	9	
44			NW2.3 Prevent surface and groundwater contamination	1	4	9	14	18
45		BIODIVERSITY	NW3.1 Preserve species biodiversity	2			13	16
46			NW3.2 Control invasive species			5	9	11
47			NW3.3 Restore disturbed soils				8	10
48			NW3.4 Maintain wetland and surface water functions	3	6	9	15	19
							Maximum points possible:	203
49	CLIMATE & RISK	EMISSIONS	CR1.1 Reduce greenhouse gas emissions	4	7	13	18	25
50			CR1.2 Reduce air pollutant emissions	2	6		12	15
51		RESILIENCE	CR2.1 Assess climate threat				15	
52			CR2.2 Avoid traps and vulnerabilities	2	6	12	16	20
53			CR2.3 Prepare for long-term adaptability				16	20
54			CR2.4 Prepare for short-term hazards	3		10	17	21
55			CR2.5 Manage heat islands effects	1	2	4	6	
							Maximum points possible:	116

*The five innovation credits are bonus points and not included in total point tallies

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APPENDIX C: CREDIT DETAILS

CATEGORY I, PEOPLE AND LEADERSHIP (PL)		
SUB CATEGORY: QUALITY OF LIFE		
	LOS HIERROS, CHILE	RECOMMENDATIONS
<p>QL1.1 Improve Community Quality of Life</p>	<p>Improved</p> <p>Los Hierros will be constructed in the El Melado watershed, specifically in El Melado town. There are some small communities along El Melado watershed , that totalize approximately 250 people: Las Yeguas, El Salto, El Peillán, El Peumo, Corral de Salas, Quebrada Turbia, El Toro, La Vinilla, El Malli, La Huerta, Saavedra, Carrizales and El Melado. According with the human environment assessment conducted by Macrocap, the urban and demographic characteristics of El Melado are the following:</p> <ul style="list-style-type: none"> - The spatial distribution of the population is dispersed with concentration on the river (on the main road) and around the Retén Fronterizo El Melado. - The total population is 31 people with an age range between 9 and 65 years. The population has undergone an aging process due to the fact that almost 70% are adults (21 people), and 77% are male (LBMH-CH-LH, p 188-189). - The educational level of the population is relatively low, and those residents with superior education are not permanent dwellers. - The town lacks social organization or community leaders. The major social actors are the policemen that dwell the Retén Fronterizo El Melado. - The main economic activities are agricultural livestock, which are temporary and unstable. A 66% of the workers are employees, and the rest of them work independently. - The living conditions are precarious, residents lack water supply, sewerage, electricity and residential waste services. - The town has a very difficult access through a route that reaches only one house, and to access the other houses is through interior roads. - The town has a school but lacks health, sports or commercial facilities. <p>The project team has identified and contacted El Melado residents and the Asociación de Canalistas (canal owners and operators) which are the main stakeholders affected by "Los Hierros", but not on a systematic basis. At the same time, as listed below, it has identified the main positive externalities that the project produces for the community:</p> <ul style="list-style-type: none"> - it will improve water access for residents that use water from the canal and don't have water during winter time due to the fact that "Los Hierros" will operate in winter time. - Jobs will be generated, improving the quantity and quality of jobs available. Additionally, local residents will be hired. - Roads will be improved, enhancing the access to the residential areas. - The amount of oil and coal used will decrease, improving the balance of payment and investment. - People could train to specialize for positions in the plant operation (technology impact). 	<ul style="list-style-type: none"> * align the project vision and goals to the needs and goals of the host and affected communities, * identify and address adverse impacts to nearby communities, * improve affected communities engagement in the project design process (provide evidence showing the extent to which options were identified, and any needed reasonable changes to the project made in accordance to community needs or plans),
	<p>2</p> <p><u>Source</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.5. Medio social y arqueológico", 187-193, and 197-201 (08_Linea Base Medio Humano CH LH) "Minuta consulta pública. Central hidroeléctrica Los Hierros", pages 2 and 4 (08_Minuta Consulta Pública CH Los Hierros)</p>	

<p>QL1.2 Stimulate Sustainable Growth & Development</p>	<p>2</p>	<p>Enhanced</p> <p>Los Hierros contribution to El Melado town economic growth and development consists primarily of jobs creation. During the construction phase, Los Hierros is expected to create a total of 165 new jobs in various stages (during the first months, the total number of employees will be limited to 60 people), and, during the operation phase, the project will require a total of 5 permanent workers. In other words, Los Hierros long term job creation (operation phase) represents more than 16% of El Melado's population. It is important to point out that hiring priority will be for local and regional residents. (PCP-CH-LH, p 18)</p> <p>According to the project team, Los Hierros has other four positive externalities on the community:</p> <ul style="list-style-type: none"> - Due to the fact that "Los Hierros" will operate in winter time, it will improve water access to those residents that use water from the canal and today don't have water during winter time - Roads will be improved, enhancing the access to the residential areas. - The amount of oil and coal used will decrease, improving the balance of payment and investment. - People will have to specialize for positions during plant operation (technology impact). <p><u>Source</u> "Presentación consulta pública. Central hidroeléctrica Los Hierros", page 18 (08_ Presentación Consulta Pública CH LH) "Minuta consulta pública. Central hidroeléctrica Los Hierros", pages 2 and 4 (08_Minuta Consulta Pública CH Los Hierros)</p>	<ul style="list-style-type: none"> * analyze the effects of the delivered work on local productivity and the quality of operating, recreational, and/or cultural capacity, * demonstrate how the project improves community attractiveness for compatible industries and business, and overall business environment, * provide a detailed analysis on how the project will work with local community to improve their prospects for sustainable economic growth and development
<p>QL1.3 Develop Local Skills and Capabilities</p>	<p>2</p>	<p>Enhanced</p> <p>According to the information provided by the project team in December of 2012, a total of 55 local and regional residents were hired for the construction of the transmission line. The project team is committed to develop formal communication channels with the local government in order to improve and guarantee hiring residents from Colbun that meet the requirements. (ICdP, p 1)</p> <p>Regarding training issues, the project team has developed and implemented the four courses listed below:</p> <ul style="list-style-type: none"> - Crews administration, - Quality management for construction material garment works, - Industrial formwork assembly in building works, - Heavy Machinery Maintenance, <p>Moreover, hired workers will have to specialize for positions during plant operation. This fact is defined by the project team as a technology positive impact.</p> <p><u>Source</u> "Informe de contratación de personal para proyecto en Comuna de Colbun.", page 1 (08_ Informe Contratación de Personal) "Programa de Capacitación: II Semestre 2011", page 1 (08_ Programa de Capacitación) "Minuta consulta pública. Central hidroeléctrico Los Hierros", page 4 (08_Minuta Consulta Pública CH Los Hierros)</p>	<ul style="list-style-type: none"> * develop programs to hire local firms as well as workers at expanded skills level, * prove the project's educational programs shift from specific project needs to local capacity development, and community competitiveness * identify community educational and employment needs and shortfalls * provide documentation of the prospect skill mix of local project hires in relation to overall project employment.

<p>QL2.1 Enhance Public Health And Safety</p>	<p>2</p>	<p>Improved</p> <p>Besalco Construcciones S.A. has an Integrated Management System for Quality, Environment, Safety and Occupational Health (GIS) that includes the "Plan for occupational safety and health" which aim is implementing an effective system of prevention and control of hazards in the activities undertaken by the company, and is intended to implement preventive management tools suited to the characteristics of each project, seeking to comply with all legal requirements. It is important to point out that the plan must be implemented by contractors and subcontractors.</p> <p>According to the mentioned plan, the project team has identified a total of 118 sources of risks for the project workers, and has developed a matrix including the risk evaluation and control measures for each one of the incidents that might arise from the identified risk sources. Moreover, this matrix analyzes the likelihood of occurrence and magnitude of all the incidents.</p> <p><u>Source</u> "Plan de gestión para el cero daño. PLA-SIG-GE-01Plan de Seguridad y Salud Ocupacional", pages 3 and 4 (08_Plan de Seguridad y Salud Ocupacional) "Matriz Identificación de Peligros, Evaluación de Riesgos y Determinación de Controles" (08_Matriz Ident. Peligros y Ev. Riesgos)</p>	<p>* provide documentation of where and the degree to which the project team changed the design of the project to better protect public health and safety, * show hoe the changes in the methodologies and protocols are to be passed onto the construction contractor.</p>
<p>QL2.2 Minimize Noise And Vibration</p>	<p>8</p>	<p>Conserving</p> <p>During the construction phase of Los Hierros, noise is produced by blasting, and by transit of vehicles and machinery. Based on sound power levels provided by the respective manufacturers, the project team projected Los Hierros noise levels to exceed authorized noise levels and during the construction phase the increasing sound pressure levels will endanger the population. In this context and in order to solve the mentioned negative effects, the project includes mitigation measures and installation of sound barriers described below:</p> <ul style="list-style-type: none"> - Edge acoustic barriers will be located 3 meters away from the receivers, and will be 4 meters high, and 30 mm thick above the ground level. - Barriers will be installed at the edge of the workspace in the construction of the powerhouse and along its access. These barriers will also be built with the same configuration as the barriers in receptor sites and have a height of 5 m. - There will be a schedule for blasting which will be informed to El Melado community, so people can safeguard. <p>It is important to point out that the project team has conducted studies to predict noise that will be present during the construction phase. Moreover, they provided evidence indicating that once the mitigation measures are implemented, the noise levels will reduce below legal maximum levels.</p> <p>Regarding the operation phase, the powerhouse is the most important source of noise generated. The project team conducted projections considering the fact that the machinery and turbines will have a soundproof capsule, and found out that the noise emissions levels will be below the regulated levels.</p> <p><u>Source</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 7 (08_Descripción del Proyecto CH LH).</p>	<p>* provide studies and assessments showing that resulting noise and vibration levels will be sustainably below previous levels, * create quieter communities</p>

<p>QL2.3 Minimize Light Pollution</p>	<p>0</p>	<p>No Score</p> <p>The project team states that the lightning design is classified as lacking significant negative impact, and points out that during the operation stage the project measures to improve energy efficiency in lighting will be incorporated. However, documentation has not been provided supporting an overall assessment of lightning needs for the project or its components contributing to reductions in lighting energy requirements.</p> <p>During the construction phase, light towers are listed among the used machinery. (DdP-CH-LH, p 7)</p>	<p>* provide documentation of lightning assessment conducted for the project, and of lightning zones levels appropriate for the needs of project,</p> <p>* provide plans, drawings, specification showing the reduction in lightning intensity, use of energy-efficient lightning, removal of unneeded lightning, use of automatic turnoff systems, application of non-lightning alternatives.</p>
		<p><u>Source</u></p> <p>"Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 7 (08_ Descripción del Proyecto CH LH).</p>	
<p>QL2.4 Improve Community Mobility And Access</p>	<p>0</p>	<p>No Score</p> <p>According to the information provided by the project team, "Los Hierros" will have five access roads to the project area, as listed below:</p> <p>i) Permanent roads: routes 115CH and K-593-L that connect Talca with El Melado canal (km 5.5)</p> <p>ii) Improved Central Operation Road: it's the road along El Melado canal that will provide access to the powerhouse, and will be the main access during operations. The Asociación de Canalistas del Canal Melado will be responsible for these improvements.</p> <p>iii) Crossing road access: this road will provide access to the powerhouse by crossing the Quebrada Los Hierros at its lower area.</p> <p>iv) Access roads to the cargo house: this development will be approximately 370 m in length and 4 m in width, considering the gutter rainwater drainage to stabilize the ground.</p> <p>v) Temporary road construction on riverbed: these roads will provide access to major equipment coming for the plant from Route K-593-L. It is important to point out that these access roads will be private and with restricted access. Specifically, limited to authorized personnel during the construction phase, and during the operation stage to technicians responsible for the operation and maintenance of the plant.</p>	<p>* provided documentation to support that the impacts of the project on community nor have access and mobility been comprehensively addressed.</p> <p>* provide evidence to confirm that the project team have made decisions considering creating new links to public transport rather than relying on motorized vehicles for providing access,</p> <p>* provide analysis or data to support the community survey mentioned by the project team.</p>
		<p><u>Source</u></p> <p>"Resolución Exenta N° 190: Calificación ambiental del proyecto Los Hierros", pages 5 and 7 (08_ RCA 190 -2010).</p>	
<p>QL2.5 Encourage Alternative Modes of Transportation</p>	<p>0</p>	<p>No Score</p> <p>According to the information provided by the project team, "Los Hierros" does not encourage alternative modes of transportation since it is not located in an urban area. It's located 130 kilometers southeast of Talca city, in the basin of El Melado river, and administratively in Comuna Colbun from Maule Region. According to the information provided by the project team, constructed works don't allow for walking distance and pedestrian accessible to multi-modal transportation.</p>	<p>* working with the community, develop and encourage alternative modes of transportation,</p> <p>* design bicycle and pedestrian walkways, trails and networks that connect to the site and constructed works.</p>
		<p><u>Source</u></p> <p>"Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 8 (08_ Descripción del Proyecto CH LH)</p>	

<p>QL2.6 Improve Site Accessibility, Safety & Wayfinding</p>	<p>3</p>	<p>Enhanced</p> <p>According to the information provided by the project team, during the construction phase they will employ signaling to prevent damage to persons, vehicles and material losses by traffic accidents. Regarding road improvement works, the project team will implement a safeguard to maintain the development separate from hiking and horseback riding activities. More precisely, the project team will implement signaling indicating that jobs are running on the road, and staff will control traffic in both directions. Both, day and nighttime signaling comply with the regulations of the Direccion de Vialidad. The project team has provided pictures to show its signaling strategy. However, documentation was not provided proving that they have appropriately addressed safety and accessibility in and around the constructed works for emergency personnel, neither that they have extended accessibility and signage to protect nearby sensitive sites. It is important to point out that Besalco S.A. undertakes the responsibility of implementing the Plan "Implementacion de senailetica sendero de Chile del Rio Melado y Los Bellatos" which consists of the implementation of signage with information (signs indicating direction, location and orientation, danger signs, maps and interpretive information, etc.) installed along the stretch of El Melado River and Los Bellotos. This plan will provide the user with information to route along the path safely and enriching.</p> <p><u>Source</u> "Resolución Exenta N° 190: Calificación ambiental del proyecto Los Hierros", pages 13, and 17 (08_ RCA 190 -2010). "Califica ambientalmente el proyecto "Línea de Transmisión Eléctrica (L TE) Los Hierros- Canal Melado; y Subestaciones Los Hierros y Canal Melado", pages 38 (08_RCA 151-2011)</p>	<p>* provide design documents showing plans for access and egress routes for emergency personnel, users and occupants, * provide documents showing plans for accessibility to and protection of nearby sensitive and/or cultural sites, * design documents and plans showing how the project will impact public safety and security, and how it will integrate with the local community and its environmental and cultural resources.</p>
<p>QL3.1 Preserve Historic And Cultural Resources</p>	<p>7</p>	<p>Superior</p> <p>According to the archaeological inspection conducted in "Los Hierros" influence area, there was no evidence found on the existence of archaeological remains nor sites that require special attention. However, based on the information provided by the project team, there was a reduced area where it was not possible to run a thorough inspection due to vegetation density, difficulty in access, its inspection will be required during the construction stage. However, due to the characteristics of the terrain, archeological findings seem to be unlikely. More precisely, during the construction phase of "Los Hierros", an environmental supervisor was expected to be responsible for coordinating a multidisciplinary team to release the area of biotic component, and archeology, before the cleaning of area. The information provided by the project team referred to archaeological monitoring and verification visits every two months, and yearly during the first two years of operation. These visits will be conducted by an archaeologist or a degree in archeologist, who will be responsible for controlling the conditions of preservation of archaeological sites and determining the protection measures. Additionally, the project team plans to hold talks for all staff on site, providing knowledge about the characteristics of the archaeological heritage of the zone, the legal bodies that protect this heritage, and procedures regarding unexpected findings. On July 27, 2012, Besalco S.A. conducted a training session on archaeological topics for its staff and subcontractors. A total of 46 people attended the session.</p>	<p>* provide location and design drawings demonstrating that the site avoids impacting any cultural resource, or of efforts to mitigate impacts, * prove project team efforts to enhance or restore existing historic and cultural resources.</p>

	<p><u>Source</u> "Registro de capacitación, reunión y toma de conocimiento" (08_ Capacitación Arqueología) "Califica ambientalmente el proyecto "Línea de Transmisión Eléctrica (L TE) Los Hierros- Canal Melado; y Subestaciones Los Hierros y Canal Melado", pages 22, 36, and 52 (08_RCA 151-2011)</p>	
<p>QL3.2 Preserve Views And Local Character</p>	<p>6</p> <p>Superior</p> <p>Firstly, it is important to mention that the main goal of Los Hierros is to use existing infrastructure to develop hydroelectric potential in El Melado irrigation canal. The use of existing infrastructure significantly reduces the impacts generated by the hydroelectric project. Particularly, the Los Hierros project does not plan new water extraction points, but leverages the existing ones, and therefore it will not be necessary to interrupt the area to construct a raceway. In other words, the project's design reflects its context by fitting with local character.</p> <p>Secondly, according with the information provided by the project team, a landscape analysis was conducted in the influence area of "Los Hierros". In this area, were identified the following landscapes: forest hillside east / west, quebrada, scrub, high areas with low vegetation, and river box. For each of these three observation points were selected to evaluate their landscape value, quality and fragility. Six vegetation experts were responsible for analyzing and classifying the selected observation points.</p> <p>Based on the results, forest and scrubland are placed directly in the location of the project works and showed high quality and fragility landscape values. The loss of continuity of the landscape, as well as incorporating human elements affecting the natural conditions of the area, will affect the quality of the landscape seen from points near El Melado River. By contrast, in other visual basins and landscaping points, the existence of human elements such as roads and visibility limitations will reduce the magnitude of their impact on visual quality. The documentation provided by the project team also mentions mitigation measures against visual fragility and visual quality problems due to vegetation clearing, and the incorporation of foreign elements discordant with the natural landscape. Among them, they include the two actions listed below:</p> <ul style="list-style-type: none"> - Both electrical conductors and structures will be of opaque materials with low reflectivity to decrease their visibility, - Existing vegetation will be retained as a green curtain and fast growing shrubs will be planted to create a curtain of vegetation in most visually exposed areas. <p>Finally, it is important to mention that the project team has not provided documentation supporting substantial involvement of local officials and decision makers in developing design guidelines, neither aiding local communities in developing more comprehensive policies and regulations regarding views and fit with local context.</p> <p><u>Source</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 7 and 11 (08_ Descripción del Proyecto CH LH). "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4: Paisaje", pages 105, 110, and 116 (08_ Estudio Basal Paisaje) "Califica ambientalmente el proyecto "Línea de Transmisión Eléctrica (L TE) Los Hierros- Canal Melado; y Subestaciones Los Hierros y Canal Melado", page 37 (08_RCA 151-2011)</p>	<p>* provide documentation proving any efforts to aid local communities in developing a more comprehensive policies and regulations regarding views and fit with local character.</p>

QL3.3 Enhance Public Space	0	No Score	* provide documentation and plans proving that the project adds to public space (i.e. parks, plazas, recreational facilities, or accessible space in wildlife refuges) in a way that significantly enhances community livability.
		The project team has not provided documentation to support that they are opening space to community activity, accessible for human recreation and enjoyment.	
		<u>Source</u> N/A	
QL0.0 Innovate Or Exceed Credit Requirements	0	N/A	
	32		

SUB CATEGORY:LEADERSHIP			
	LOS HIERROS, CHILE		RECOMMENDATIONS
LD1.1 Provide Effective Leadership And Commitment	2	Improved	* provide evidence on commitment to sustainability has moved beyond general statements to more specific ones, * prove wide-range examples of past or ongoing activities undertaken (and performance achieved) to improve sustainable performance.
		According to the information provided by the project team, Besalco S.A. has made both a written commitment to and public statements regarding sustainability principles. More specifically, the company has an Integrated Management System for quality, environment, occupational health and safety that applies to all of the company's construction projects. This system states that contracts should include clauses that oblige contractors to meet standards defined by Besalco S.A. for its programs. Regarding its public statements, the company has a policy of principles and values that is available on its website and, among its basic principles of behavior, includes socially responsible actions and environmental care. Moreover, Julio Espinoza Lolas, Besalco's CEO, states that the company's development strategy and economic productivity are based on protecting the interests of their shareholders, customers, employees, collaborating companies, and communities. However, it is important to point out that the project team has neither provided documentation supporting the organization's commitment to sustainability for the specific project, nor moved beyond general statements to more specific ones.	
		<u>Source</u> "Programa de medio ambiente", Mayo 2012, pages 1, 4, and 17 (08_Programa de Medio Ambiente) "Política de principios y valores Besalco", Mayo 2010, page 10 (08_Online politica de principios y valores BESALCO) "Política Integrada de Gestión", Febrero 2012, page 1 (08_Política Sistema Integrado de Gestión)	

<p>LD1.2 Establish A Sustainability Management System</p>	<p>1</p>	<p>Improved</p> <p>Los Hierros was certified as ISO 14001:2004 that provides a criteria for an environmental management system, and the project team has provided documentation supporting its commitment to the environmental aspects of the project (environmental management bimonthly report). However, the project team has not provided documentation proving the incorporation of social performance considerations into the project management system to improve sustainable performance. Moreover, they have not listed the economic and social aspects of the project that relate to sustainability, and they have not described project roles, responsibilities and authorities for addressing these issues.</p>	<p>* improve alignment between sustainable management polity with the scope, scale and complexity of the project (policies should address changing conditions, design variables),</p> <p>* provide a list of project goals, objectives and performance targets prioritized based on their importance and consequences of change,</p> <p>* provide documentation showing business processes and mechanisms to manage project complexities and changing conditions,</p> <p>* provide evidence on project sustainability management system being design to address broadly changes in the design variables.</p>
		<p><u>Source</u></p> <p>"Certificacion ISO 14001: 2004, Besalco Construcciones S.A.", Bureau Veritas, Julio 2012, (08_ Certificación ISO 14001_2004)</p> <p>"Informe Bimestral Gestión Ambiental. Proyecto Línea de Transmisión eléctrica Los Hierros - Canal Melado y subestación Los Hierros y Canal Melado ", Mayo-Junio 2013 (08_ Informe Gestión Ambiental LT)</p>	
<p>LD1.3 Foster Collaboration And Teamwork</p>	<p>1</p>	<p>Improved</p> <p>The project team has provided documentation supporting its periodic interaction with members of Asociación Canal Melado. Besalco S.A. has proven its commitment to promoting communication with them by holding biannual meetings. Additionally, to achieve the goal of keeping the community informed, the project team also publishes a quarterly newsletter named Open Channel. However, the project team has not provided documentation proving their shift from a task view to a system view of project design and delivery, or a systematic approach to improve sustainable performance.</p>	<p>* prove multi-disciplinary project team work to find ways to improve sustainable performance, commensurate with the owner's goals and objectives, technical feasibility, costs and appetite for risk,</p> <p>* provide evidence on the importance of risk sharing recognized, and included as part of the owner's contract with the design team.</p>
		<p><u>Source</u></p> <p>"Trabajo en Equipo y Canales de Comunicación", pages 1, and 2 (08_ Canales de Comunicación)</p>	

LD1.4 Provide For Stakeholder Involvement	5	<p>Enhanced</p> <p>The project team has provided documentation supporting its periodic interaction with members of Asociación Canal Melado. Besalco S.A. has proven its commitment to promoting communication with them by holding biannual meetings and, to achieve the goal of keeping the community informed, they also publish a quarterly newsletter named Open Channel. However, according to the information provided by the project team, the majority of the communication is primarily one way and promotional. The participation of local residents has primarily occurred within community meetings organized by Besalco S.A. with the aim of presenting the characteristics and associated impacts of the project, and discussing potential solutions and mitigation measures.</p> <p>It is important to mention that the project team has conducted a demographic characterization of El Melado, the only town in the area of direct influence of Los Hierros, and has demonstrated its successful response to complaints from residents affected by the project. (CdA) (source: 08_ Carta de Agradecimiento) However, the project team has not provided documentation to prove planned active engagement and dialogue with all of its stakeholders.</p>	<p>* provide evidence on the existence of solid, credible programs and mechanisms for obtaining an incorporating stakeholders and community feedback into the project.</p>
		<p><u>Source</u> "Trabajo en Equipo y Canales de Comunicación", pages 1, and 2 (08_ Canales de Comunicación) "Carta de agradecimiento - Unidad vicinal 35", noviembre 2011, (08_ Carta de Agradecimiento)</p>	
LD2.1 Pursue By-Product Synergy Opportunities	0	<p>No Score</p> <p>The project team does not provide information or evidence to support Los Hierros identification and cost-effective use of unwanted materials located near the project.</p>	<p>* provide documentation of contracts and searches made in nearby facilities, as compared to the total number of potential opportunities, * provide evidence on a detailed assessment of by-product synergy opportunities for use on the project, * provide records of by-product synergy opportunities identified, assesed and pursued.</p>
		<p><u>Source</u> N/A</p>	

<p>LD2.2 Improve Infrastructure Integration</p>	<p>16</p>	<p>Restorative</p> <p>The main goal of Los Hierros is to use existing infrastructure to develop hydroelectric potential in El Melado irrigation canal. The use of existing infrastructure significantly reduces the impacts generated by the hydroelectric project. Particularly, Los Hierros project does not plan new water extraction points, but leverages the existing ones, and therefore it will not be necessary to interrupt the area to construct a raceway. Additionally, according to the project team, Los Hierros uses or improves infrastructure in two additional ways: (1) due to the fact that Los Hierros will operate during winter time, it will improve water access to those residents who use water from the canal and who do not have water during winter time, and (2) roads will be improved, enhancing access to the residential areas. Finally, it is important to mention that Los Hierros temporary works projects, such as infrastructure and activities required to support the construction phase of the project, will be used during the Los Hierros II construction phase as well. The goal of this decision is to prioritize existing infrastructure and minimize the area of intervention.</p> <p><u>Source</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 7 and 11 (08_Descripcion del Proyecto CH LH). "Minuta consulta pública. Central hidroeléctrica Los Hierros", pages 2 and 4 (08_Minuta Consulta Pública CH Los Hierros) "Estudio de Impacto Ambiental Central Hidroeléctrica Los Hierros II. Obras de Generación y Transmisión. Capítulo 1. Descripción de Proyecto", Rivas y Asociados Consultores, pages 12, and 14 (08_Descripción de Proyecto CH LH II)</p>	<p>N/A</p>
<p>LD3.1 Plan For Long-Term Monitoring & Maintenance</p>	<p>0</p>	<p>No Score</p> <p>According to the information provided by the project team, the operation of Los Hierros will last 60 years and at the end of its life, reengineering of the project will be contemplated in consideration of technological advances at that time. However, the project team has not provided information or evidence of a clear plan for long-term monitoring and maintenance of the Los Hierros projects.</p>	<p>* develop a clear and comprehensive plan in place for long-term monitoring and maintenance of the constructed works, * provide evidence of sufficient resources allocated for the monitoring and maintenance of constructed works.</p>

		<u>Source</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 10 and 43 (08_ Descripción del Proyecto CH LH)	
LD3.2 Address Conflicting Regulations & Policies	0	No Score According to the information provided by the project team, Los Hierros meets Chile's legal requirements. However, laws, regulations, policies or standards of practice affecting the project are followed regardless of their intended purpose or compatibility with sustainable goals and objectives. The project team has not provided documentation proving they worked with regulatory bodies to mitigate any potential negative effects of or conflicts between regulations.	* develop an extensive assessment of negative impacts from conflicting regulations an policies.
		<u>Source</u> "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 18-31 (08_ RCA 190 -2010).	
LD3.3 Extend Useful Life	1	Improved According to the information provided by the project team, the operation of Los Hierros will last 60 years and, at the end of its life, reengineering the project will be contemplated in consideration of technological advances at that time. In addition, reconditioning has been planned after 30 years of operation that is expected to double the hydroelectric power station's lifespan. However, the project team has not provided documentation proving the project was designed in a way that adds considerations for flexibility, durability and resilience.	* provide documentation of how the overall design will allow for expansion, reconfiguration, or multiple uses, * develop a feasibility study to identify key areas where increasing investment in extending useful life will offer a reasonable payback.
		<u>Source</u>	
LD0.0 Innovate Or Exceed Credit Requirements	0	N/A	
	26		

CATEGORY II: CLIMATE AND ENVIRONMENT (CE)			
RESOURCE ALLOCATION			
	LOS HIERROS, CHILE		RECOMMENDATIONS
RA1.1 Reduce Net Embodied Energy	0	No Score No data is available to prove that a life cycle energy assessment was performed in accordance with recognized and accepted methodologies.	* develop a life cycle energy assessment to estimate materials' embodied energies, * provide documentation to evidence project team efforts to reduce the net embodied energy of the project.
		<u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 7 (08_ Descripción del Proyecto CH LH).	

<p>RA1.2 Support Sustainable Procurement Practices</p>	<p>0</p>	<p>No Score</p> <p>The information provided by the company is not sufficient to assess this credit. On their answers to each credit, they mention the existence of a file with a list of contractors, but they don't provide this file or information. However, the list of contractors is not enough information to support the analysis of this credit.</p> <p><u>Source:</u> N/A</p>	<ul style="list-style-type: none"> * define a sound and viable sustainable procurement program (policies and criteria for supplier identification and selection), * provide documentation to evidence that the project team procured materials from sustainable sources, * provide evidence of certification of materials and supplies, * provide evidence on efforts to identify any unresolved worked health and safety or environmental violations of the manufacturers or supplier.
<p>RA1.3 Used Recycled Materials</p>	<p>2</p>	<p>Improved</p> <p>Maule's Regional Environmental Commission certificated "Los Hierros" as a project that meets Chile's environmental requirements. This certification includes the fact that materials from the excavations will be reused in the construction of road platforms, production of aggregates for concrete and structural fills during the construction phase. In the course of temporary works, all material from the excavation will be deposited in a limited area for subsequent selection and reuse in new works.</p> <p>Additionally, to transport the major equipment to the plant (turbine snail, transformers, generators), the project team will build a temporary road to access the Melado River. They will use the natural deposits of fluvial sedimentary material to avoid affecting the river's hydraulic shaft and disrupting the flora along the banks and meanders of the river. The filler material will be extracted from deposits of accumulated material.</p> <p><u>Source:</u> "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 5, 6 and 7 (08_ RCA 190 -2010).</p>	<ul style="list-style-type: none"> * provide an inventory of specifications for materials seeking inclusion as containing recycled content, * provide documentation to prove that all materials meet the necessary quality and performance criteria required for the intended application, * estimate the percentage of the total project materials by weight or volume that are reused or recycled.
<p>RA1.4 Use Regional Materials</p>	<p>3</p>	<p>Improved</p> <p>The fact that "Los Hierros" will reuse the materials from excavations for making roads and structural fills during the construction phase (please, see credit "RA1.3 Used Recycled Materials"), is evidence that the project team is making efforts to acquire materials through local sources. More precisely, although local sourcing is considered, materials sourced within the distance requirements are not a high percentage of the total.</p> <p>In the responses to each credit, the project team mentions that the percentage of local materials used in the project is 70%. However, the information they provide does not support this fact. The supporting file is only a list of subcontractors. In order to verify the 70% claim, more information is needed.</p> <p><u>Source:</u> "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 5, 6 & 7 (08_ RCA 190 -2010).</p>	<ul style="list-style-type: none"> * provide an inventory of materials, plants, aggregates and soils for construction sourced near the site, * estimate the percentage of the total project materials by cost that are sourced locally.

<p>RA1.5 Divert Waste From Landfills</p>	<p>3</p>	<p>Improved</p> <p>Besalco S.A. has a standardized procedure for establishing and maintaining adequate management of waste generated in all the company's projects. This procedure will be implemented in the project with the aim of controlling potential environmental impacts and establishing certain necessary internal controls.</p> <p>Besalco S.A.'s recycling protocol includes the following elements: the minimization of waste generation given the technical-economic constraints; the separation of recyclable material for further transport to recycling sites; and the classification and differentiation between domestic, industrial and hazardous waste. Each of these categories has a specific treatment procedure. Specifically, due to the fact that during the construction phase the project will generate industrial and domestic waste, the project team has arranged properly-labeled and classified airtight containers for storage and transport to approved centers for disposal.</p> <p>It is important to mention that to ensure compliance with these procedures the project will have different professionals responsible for control: administrative engineer, chief of the area, supervisors and head of environmental management.</p> <p><u>Source:</u> "Manejo de Residuos", pages 1 & 9 (08_Procedimiento Manejo de Residuos) "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", page 8 (08_ RCA 190 -2010).</p>	<p>* provide waste management plans including the volume of anticipated waste generation, waste type and methods to reduce waste generation, * describe strategies included in the plan to reduce waste generation and to minimize waste reuse and recycling, * estimate total waste reduction measures and percentages of materials diverted to recycling or reuse (weight or volume).</p>
<p>RA1.6 Reduce Excavated Materials Taken Off Site</p>	<p>4</p>	<p>Enhanced</p> <p>According to the Environmental Impact Assessment, the total volume of earthworks will be 117,000 m3 and will be composed as follows: structural fill material with an approximate compacted volume of 17,000 m3 (15%); aggregate material for concrete with a total volume of sand and gravel of 40,000 m3 (34%); and excavation and removal of material that will total a volume of approximately 60,000 m3 (51%). It is important to mention that the materials from the excavations will be reused in the construction of road platforms and production of aggregates for concrete and structural fills, in order to minimize the impacts associated with the generation of rejected material that comprises approximately 20,000 m3 (17%). Until needed, the unused excavation material will be stockpiled in an area designated exclusively for this purpose.</p> <p>Based on the above, although the total amount of excavated material is expected to be retained on site, only 66% of it will be reused for a particular purpose. This proportion may be increased by the fact that the excavation material will be stockpiled in a specific area; however, the project team does not provide information to support this idea</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 23 (08_ Descripción del Proyecto CH LH).</p>	<p>* provide a more detailed description on how the stockpiled excavation material will be used.</p>

RA1.7 Provide for Deconstruction & Recycling	0	<p>No Score</p> <p>The operation of the hydroelectric facility is expected to last for 60 years, at which time reengineering of the site will be contemplated in consideration of new technological advances. Thus, abandonment of the project is not anticipated, but in the case of obsolescence, a modification or replacement of the infrastructure on the same site may be needed. However, the project team has not specified materials that can be easily recycled or reused after the useful life of the project.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 10 and 43 (08_ Descripción del Proyecto CH LH).</p>	<p>* provide an inventory of the materials incorporated into the design that retain some value for future use, and the percentage (by cost or weight) likely to be recycled at end of life, * provide documentation proving efforts to facilitate the future disassembly and recycling of materials.</p>
		<p>No Score</p> <p>The energy for the project operation will be provided by two Francis turbines which will be rotated by water force, and during the construction time by 60 kVA generators with an average consumption of 12 liters per hour. However, the project team has not provided evidence of consideration of alternatives to reduce energy consumption during the construction or operation processes.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 37 (08_ Descripción del Proyecto CH LH).</p>	
RA2.1 Reduce Energy Consumption	0	<p>No Score</p> <p>The energy for the project operation will be provided by two Francis turbines which will be rotated by water force, and during the construction time by 60 kVA generators with an average consumption of 12 liters per hour. However, the project team has not provided evidence of consideration of alternatives to reduce energy consumption during the construction or operation processes.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 37 (08_ Descripción del Proyecto CH LH).</p>	<p>* provide documentation proving efforts to identify and analyze options for reducing energy consumption in the operation and maintenance of the constructed works, * provide an inventory of the energy saving methods and strategies considered and incorporated into the design. * estimate the annual energy consumption over the life of the project, compared to an industry benchmark.</p>
RA2.2 Use Renewable Energy	20	<p>Restorative</p> <p>"Los Hierros" is a hydroelectric project and, according to the Environmental Impact Assessment, the energy used for its operation will be renewable and generated on-site by the project (two Francis turbines which will be rotated by water force). This particular hydroelectric power plant is expected to generate 110 GWh per year; the energy produced will be delivered to the Sistema Interconectado Central (SIC) and will be sold to the SPOT market. Importantly, the project qualifies as a Non-Conventional Renewable Energy (ERNC, acronym in Spanish) project according to Chile's General Electrical Services Law, and it is a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 7 (08_ Descripción del Proyecto CH LH).</p>	N/A
RA 2.3 Commission & Monitor Energy Systems	3	<p>Enhanced</p> <p>During the operation phase the project machinery will receive periodic maintenance that will consist of the evaluation of vibration and pulsation, alternator insulation, and oil analysis among other practices. Maintenance will be performed by the project team with support of the contractors. However, the project team does not provide documentation to prove advanced monitoring systems, such as energy sub-meters, which will enable more efficient operations.</p>	<p>* provide evidence of the incorporation in the design of advanced monitoring systems, such as energy sub-meters, which enable more efficient operations.</p>

<p>RA3.1 Protect Fresh Water Availability</p>	<p>2</p>	<p>Improved</p> <p>"...The Project activity does not modify the river flow as the water is directly taken from an existing irrigation canal. The only modifications are related to some repairs or improvements to the existing canal in those sections where it was in bad conditions due to its age (over 80 years)..." (WDC-LHF, p. 6-7)</p> <p>According to the Environmental Impact Assessment, the project team has identified the sources for industrial water and drinking water. On the one hand, industrial water will be obtained from the Melado Canal throughout the construction period. On the other hand, drinking water will also be obtained from the Melado Canal but will be flocculated using a coloring system. Alternatively, water dispensers will be placed in working areas.</p> <p>Based on the information provided by the project team, there is no evidence of a detailed assessment of the project's water requirements (average peak demands and long term needs, long term availability and replenishment or recharge of freshwater, inventory of opportunities for water reuse or groundwater recharge on site, calculations of volume of fresh water discharged after use, location of discharge and impact of discharge on receiving water quality and quantity). The project team does not provide information about incorporated design features to minimize the long term negative net impact on ground and surface water source quality and quantity or to achieve a net positive impact on water sources.</p> <p><u>Source:</u> "Report on compliance with WDC recommendations. Los Hierros Hydroelectric Power Plant", February 2013, TÜV Nord, pages 6-7 (2013-02-19 WCD Los hierros final) "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 8 and 30 (08_ Descripción del Proyecto CH LH). "Proyecto planta de producción de hormigones premezclados - Melon Hormigones S.A.", pages 9-11 (08_Memoria Explicativa Planta de Hormigon)</p>	<p>* provide documentation proving a sound and comprehensive water availability and requirement assessment, * provide documentation to support that the project achieves a net positive water impact replenishing the quantity and quality of fresh water surface and ground supplies.</p>
<p>RA3.2 Reduce Potable Water Consumption</p>	<p>4</p>	<p>Improved</p> <p>The project will have a concrete plant with a recirculating water system which, according to the project team, will reduce the use of potable water for the concreting process to zero, and reduce the possibility of contaminating fresh water in the vicinity of the project. It is important to point out that waste from chemical toilets will also be channeled to the wastewater treatment plant.</p> <p>Maule's Regional Environmental Commission certified that the project "Los Hierros" meets Chile's environmental requirements. This includes the fact that it meets applicable environmental regulations for water protection.</p> <p>However, the project team did not provide documentation to support a percentage analysis on the project's reduction of potable water use.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 8, 23-25 and 30 (08_ Descripción del Proyecto CH LH). "Proyecto planta de producción de hormigones premezclados - Melon Hormigones S.A.", pages 9-11 (08_Memoria Explicativa Planta de Hormigon)</p>	<p>* develop a feasibility and cost analysis to determine the most effective methods for potable water reduction, and incorporate the into the design, * provide evidence on the project reducing potable water consumption over industry norms (estimate annual water consumption over the life of the project).</p>

RA3.3 Monitor Water Systems	1	Improved	<p>* provide evidence of the installation of easily accessible and clearly labeled water sub-meters capable for monitoring the water flow of, at a minimum, all major project functions, * provide evidence on how the integration of impact monitoring and operational monitoring allow responsive management.</p>
		<p>In order to stress Besalco's commitment to guarantee the water system's performance and conditions described in the Environmental Qualification Resolution, the company will hire a local Environmental Supervisor who will be in charge of verifying compliance during the construction phase and project implementation. The function of the Environmental Supervisor will be to verify compliance with the Environmental Qualification Resolution, and regulations of other associated regulatory bodies, and to develop an environmental management system that will foster system efficiency.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. BSC – CH LH – Adenda 2 – Anexo G, Capítulo 6: Plan de Medidas Ambientales", page 5 (08_Plan de Medidas Ambientales CH LH).</p>	
RA0.0 Innovate Or Exceed Credit Requirements	0	N/A	
	42		

NATURAL WORLD			
	LOS HIERROS, CHILE		RECOMMENDATIONS
NW1.1 Preserve Prime Habitat	0	No Score	<p>* provide documentation demonstrating preservation of "prime habitat" by establishing a minimum area of 300 ft for a natural buffer zone around these areas, * provide documentation demonstrating increase the area of "prime habitat" through the restoration of prime habitat either on the project site of adjacent to it.</p>
		<p>Some of the elements cited below prove that the hydropower plant "Los Hierros" is placed on land that has been identified as of high ecological value. On the one hand, its influence area is located on the specific ecological formation of the Precordillera, which is distributed longitudinally from the Colbun dam to the south of the Perquilauqué River, and is characterized by typical Andean forests of oak, cypress and hualo trees. On the other hand, it is also being constructed next to the basin of the Melado River, in the municipality of Colbún, which is located near Radal Siete Tazas National Park, the Los Bellotos de Melado National Reserve, and the Altos de Lircay. Moreover, the transmission line is located in an area that is considered prime habitat. According to the Environmental Impact Assessment, the soil types are prime for wildlife conservation and forestry production.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.4: Medio Biótico." page 120 and 126 (08_Linea Base Medio Biótico CH LH). "Estudio de Impacto Ambiental - . Capítulo 3.3.5: Suelo y edafología", page 85 (08_Extracto Línea Base Suelo LT LH - CM).</p>	

<p>NW1.2 Preserve Wetlands and Surface Water</p>	<p>1</p>	<p>Improved</p> <p>As the project is a hydroelectric power station, its construction and operation are inconceivable if not utilizing a water body. Specifically, Los Hierros is located in the Melado river basin, in the municipality of Colbún, Linares Province, Maule Region, Chile. However, "...the Project activity does not modify the river flow as the water is directly taken from an existing irrigation canal. The only modifications are related to some repairs or improvements to the existing canal in those sections where it was in bad conditions due to its age (over 80 years)..." (WDC-LHF, p. 6)</p> <p>According to the contract signed between Besalco and the association of the irrigators, only the exceeding water of the canal will be used in the project activity. The total flow of the water used for energy generation is added back to the river Melado which is the river which the canal takes water from. (WDC-LHF, p. 7)</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 8 (08_ Descripción del Proyecto CH LH). "Report on compliance with WDC recommendations. Los Hierros Hydroelectric Power Plant", February 2013, TÜV Nord, pages 6-7 (2013-02-19 WCD Los hierros final)</p>	<p>* develop a restoration plan for waterlands or water bodies including, at a minimum, a site map outlining locations of restoration, and proof that both required action types were taken (stabilization of the stream channel or shoreline, and re-vegetation with native plant communities).</p>
<p>NW1.3 Preserve Prime Farmland</p>	<p>12</p>	<p>Conserving</p> <p>The project is located close to the municipality of Colbun which is governed by the inter-regulatory Colbun Machicura Plan. This document regulates the land use structure of Colbun and Machicura's lake banks, and the towns of Colbun and Panimavida, but the area of the project (Melado) is not within its jurisdiction. The project's influence area is characterized by four types of land use: forest (37.8 hectares), scrub (15.3 hectares), Xerophytic (3.2 hectares), and grassland (19.9 acres) which is far away from the area of intervention and has not been studied in depth. In this context, the project is not placed in a site of prime farmland, unique farmland, or farmland of statewide importance that should be conserved for future generations.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.3.4: Suelos." page 69 (08_Linea Base Medio Biótico CH LH).</p>	<p>* provide evidence of efforts to restore prime farmland to productive state, and conserved for future generations.</p>

<p>NW1.4 Avoid Adverse Geology</p>	<p>2</p>	<p>Enhanced</p> <p>Chile is located on the South American plate which is characterized by subduction earthquakes that tend to occur every ten years. More precisely, three different seismic areas may be identified within the country (western, middle and eastern), and their level of risk decreases from west to east. (EIA, Chapter 3.3.4.6, pages 79-80)</p> <p>The project is located between the eastern and middle areas, where there is the lowest seismic risk. During the last big earthquake in 2010, the area suffered small mass removals and landslides, but no major consequences.</p> <p>Further, to estimate the local seismic risk, an independent assessment evaluated three characteristics of the project's site: fault zones (sources of energy release), lithology (favors the spreading and duration of earthquakes), and slope (the larger the angle of the slope, the greater risk of landslide). The main findings were as follows: only one fault scarp was found in the study area; lithology plays an important role in the development of detachments, where they are transformed into rock avalanches that are channeled into the ravines; and that the study area slopes (between 40 and 60 degrees) are susceptible to the generation of flows and landslides. (EIA Chapter 3.3.4.6., pages 80-82)</p> <p>It is also important to point out that the Maule Regional Environmental Commission certified that the Los Hierros project meets Chile's environmental requirements. This includes the approval of a prevention plan for risks associated with natural phenomena such as seismic events, movements and landslides, and a contingency plan with mitigation measures against seismic events during the period of operation.</p> <p><u>Source:</u> "Estudio de impacto ambiental: Línea de Transmisión Eléctrica Los Hierros–Canal Melado, y Subestaciones Los Hierros y Canal Melado. Capítulo 3.3.4.6. Riesgo Sísmico", pages 79-82 (08_ Línea Base Geología y Geomorfología LT LH -CM). "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 14-15 (08_ RCA 190 -2010).</p>	<p>* establish hazard areas, developed buffers around adverse geologic areas, and create runoff controls and spill prevention and cleanup plans * chose a site that avoids earthquakes and karst-related damage and does not affect underlying aquifers</p>
<p>NW1.5 Preserve Floodplain Functions</p>	<p>5</p>	<p>Enhanced</p> <p>Due to the fact that Los Hierros is a hydroelectric power station, the project is dependent upon water infrastructure. However, the project has been designed to mitigate stormwater and flood damage by stabilizing the ground during construction of access roads, and by locating camps and facilities outside flood-prone areas. Moreover, flood emergency plans have been prepared for the project's construction and operation phases, and Maule's Regional Environmental Commission has already approved them. According to a third-party assessment of Besalco S.A., the riparian and aquatic habitats and in-channel physical and vegetative habitats have been maintained since the project's first construction phase, which included a water discharge site and construction of a temporary road. Moreover, based on the Clean Development Mechanisms (CDM) application form provided by the project team, Los Hierros activity does not result in new reservoirs or in an increase in capacity of the existing reservoir where the power density of the plant is less than 4W/m² (PDD-LH, p 8).</p>	<p>* estimate pre and pre-development floodplain infiltration capacity * enhance aquatic habitat connectivity and sediment transport * modify infrastructure subject to frequent damage by floods being modified or removed</p>

		<p>Source: "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 13-14 (08_ RCA 190 -2010). "Informe N 3: Inspección fauna acuática. Sector: Sitio de descarga de aguas y camino provisorio lecho Rio Melado", pages 16, 17 and 27 (08_ Informe N° 3 Inspección Fauna Acuática). "Estudio de impacto ambiental: Línea de Transmisión Eléctrica Los Hierros–Canal Melado, y Subestaciones Los Hierros y Canal Melado. 3.3.4: Geología, Geomorfología y Áreas de Riesgo" (08_ Línea Base Geología y Geomorfología LT LH -CM). "Formulario de diseño del proyecto (MDL DDP) - Versión 03", page 8 (08_ PDD Los Hierros).</p>	
<p>NW1.6 Avoid Unsuitable Development on Steep Slopes</p>	<p>1</p>	<p>Improved</p> <p>The project will be located in the Maule River Basin which is part of the central region of a Fluvial-Glacio-Volcanic plain. Similar to the geography of the entirety of Chile, this site is characterized by a progressive decline in elevation towards the west, and has slopes ranging between 40 and 60 degrees that are susceptible to flows and landslides.</p> <p>Maule's Regional Environmental Commission certified that the Los Hierros project meets Chile's environmental requirements. This includes the approval of a prevention plan of risks associated with natural phenomena such as seismic events, and movements and landslides. Moreover, the project has a Plan for Stabilization of Slopes and Mass Removal Control to mitigate possible destabilization of slopes and risk of landslides caused by construction works within the project's area of influence. The project follows best practices as much as possible to minimize the exposure and risk from erosion, landslides, and other natural hazards.</p>	<p>* improve the documentation of processes used to identify and choose site that includes meetings with officials and other stakeholders, site options with benefits and shortfalls of each and reasoning used for final site selection * documentation of process used to identify high-risk hillsides or steep slopes and their location relative to final site selection</p>
		<p>Source: "Estudio de impacto ambiental: Línea de Transmisión Eléctrica Los Hierros–Canal Melado, y Subestaciones Los Hierros y Canal Melado. Capítulo 3.3.4.6. Riesgo Sísmico", pages 62 (08_ Línea Base Geología y Geomorfología LT LH -CM). "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 14-15 (08_ RCA 190 -2010) "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. BSC – CH LH – Adenda 2 – Anexo G, Capítulo 6: Plan de Medidas Ambientales", page 11 (08_ Plan de Medidas Ambientales CH LH).</p>	
<p>NW1.7 Preserve Greenfields</p>	<p>3</p>	<p>Improved</p> <p>The main goal of the project is to use existing infrastructure to develop hydroelectric potential in the Melado irrigation canal. The use of existing infrastructure significantly reduces the impacts that would be generated by a hydroelectric project. In particular, the project does not plan new water extraction points, but leverages the existing ones, and therefore it is not necessary to interrupt the construction area of the proposed raceway. Moreover, Los Hierros II, a 5.1 MW power station, will be placed strategically to tap the same water resources turbinated by Los Hierros. It will produce electricity through non-consumptive use of water from the Melado River, leveraging flows arising from the return of the waters of Los Hierros. Due to the reuse of some of the existing infrastructure, it is estimated that at least 25% of the project area is situated on a greyfield site.</p>	<p>* improve documentation showing the percentage of the developed area of the site that was formerly developed and may be classified as a greyfield * provide documentation of greyfield status of site (local state or federal agency) * develop a remediating plan according to the ASTM report</p>

		<p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 7 and 11 (08_ Descripción del Proyecto CH LH)</p>	
<p>NW2.1 Manage Stormwater</p>	<p>0</p>	<p>No Score</p> <p>Although Los Hierros considers the construction of rainwater drainage mechanisms aimed to stabilize the ground near construction of new access roads, the project team does not provide information or evidence to support that this project improves the area's stormwater runoff quantity and quality.</p>	<p>* provide documentation of the initial, final post-development, and water storage, infiltration, evaporation, water harvesting and/or cistern storage capacities using TR-55 CNs or other continuous simulation modeling methods to describe cite conditions. Percentage of improvement in water storage capacity for greenfields, grayfields, and brownfields.</p>
		<p><u>Source:</u> "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 13-14 (08_ RCA 190 -2010).</p>	
<p>NW2.2 Reduce Pesticides and Fertilizer Impacts</p>	<p>9</p>	<p>Conserving</p> <p>The project team designed the landscaping to incorporate plant species that require no pesticides, herbicides, fertilizers, or integrated pest management approaches. The construction of both the hydroelectric power station and the transmission line will require a minimal level of soil intervention, where logging and removal of vegetation will be limited to what is strictly necessary. Moreover, the revegetation plan only includes plants that are suited to the conditions of the site, and the approved reforestation plan will be achieved once 75% survival is verified and the composition of the original native forest is preserved.</p>	<p>N/A</p>
		<p><u>Source:</u> "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 12-13 (08_ RCA 190 -2010). "Califica ambientalmente el proyecto "Línea de Transmisión Eléctrica (LTE) Los Hierros- Canal Melado; y Subestaciones Los Hierros y Canal Melado"." page 26, 28, 37 (08_ RCA 151-2011) "Resolución 3/2013:Plan de manejo de obras civiles bosque nativo" page 1 (08_ Res Plan de Manejo OC CH LH).</p>	

<p>NW2.3 Prevent Surface and Groundwater Contamination</p>	<p>9</p>	<p>Superior</p> <p>The project design incorporates a Physical Environmental Action Plan, which was approved by the Maule Regional Environmental Commission and includes a preventative strategy to mitigate surface contamination from hazardous materials. The Plan was developed for four different scenarios: car accident, accidental spills due to work fronts, spills of chemicals or contaminants (oils, lubricants and paints) on the ground, and spills of hazardous substances into waterways. In order to implement the everyday and emergency protocols, staff will be trained to handle these types of substances and react in to spills.</p> <p>The commitment to protect surface and groundwater contamination is evidenced by the fact that during the project's construction and startup phases Besalco will hire an Environmental Supervisor who will be in charge of verifying compliance with the Environmental Qualification Resolution. Furthermore, the project team expects to reduce some of the project's potential negative effects during the construction phase. For example, in order to transport the major equipment to the plant (turbine snail, transformers, generators), a temporary road to access the Melado River will be built. The project team will also utilize the natural deposits of fluvial sedimentary material to avoid impacting the river's hydraulic shaft and riparian vegetation. Moreover, the fill material will be extracted from deposits of accumulated material.</p> <p><u>Source:</u> "Resolución Exenta N° 190: Calificación ambiental del proyecto Los Hierros", pages 10, 11, 14-15 (08_ RCA 190 -2010). "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. BSC – CH LH – Adenda 2 – Anexo G, Capítulo 6: Plan de Medidas Ambientales", page 5 (08_Plan de Medidas Ambientales CH LH). "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", pages 34-35 (08_ Descripción del Proyecto CH LH).</p>	<p>* develop a plan to reduce or eliminate potentially polluting substances from the construction and operation on the complete works, * develop a plan to reduce future contamination by cleaning up areas of contamination and instituting land use controls to limit the introduction of future contamination resources</p>
<p>NW3.1 Preserve Species Biodiversity</p>	<p>13</p>	<p>Improved</p> <p>Macrocap, a consulting company, has developed a detailed assessment related to the habitat and species that characterize the project's influence area. Birds were the most common group of animals found, with a total of 21 different species. Although most of them are not considered endangered species, the burrowing parrot (loro trichahue) is classified as a vulnerable conservation species, despite being the most prevalent and accounting for 40% of all birds on the site. A second group of animals identified were the amphibians but only the spiny toad was detected. The five species of reptiles observed were categorized as vulnerable conservation. Finally, among the nine species of mammals in the area, two of them were included in a conservation category, and the Puma concolor was categorized as an endangered species. Although the most abundant native species is the long-tailed mouse, the mammal with the highest presence is the rat (which is proof of the high degree of their intervention). The Maule Regional Environmental Commission certified that the project meets Chile's environmental requirements. This included the approval of a Rescue and Relocation Plan that aims to mitigate adverse impacts of the project. According to the tolerance of each species, different relocation areas were identified and monitoring plans have been scheduled. Moreover, regarding the movement of species between habitats, the project team has scheduled the construction of a fence around the canal with provisions to enable wildlife passage.</p>	<p>* Increase available habitat connectivity: no only to protect and upgrade existing habitats, but to restore and create new habitats. * Prove efforts to reinstate appropriate vegetation, improve and expand wildlife corridors, and link existing habitats.</p>

		<p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.4: Medio biótico", pages 151-157 (08_Linea Base Medio Biótico CH LH) "Abovedado y cercado de canal para atravesio de fauna" (08_Abovedado y Cercado de Canal (Fauna)). "Resolución Exenta N° 190: Calificación ambiental del proyecto Los Hierros", pages 15-17 (08_ RCA 190 -2010).</p>	
<p>NW 3.2 Control Invasive Species</p>	<p>5</p>	<p>Superior</p> <p>Macrocap's detailed assessment also lists the 58 different plants detected in the project area. Evidence that this is an area with little intervention is the fact that 81% of the identified species were native, and only 17% of them were characterized as allochthonous plants (non-native species characteristic of sediment or rock). It is important to mention that only 2% of the native species were classified as vulnerable. There is no specific mention of invasive species in the area. Regarding animal species, 78% of the 36 species detected were native, whereas the 22% of species remaining were equally divided between exotic and endemic species.</p> <p>The project design incorporates a Conservation Plan, which was approved by the Maule Regional Environmental Commission and includes measures for the protection of natural species such as prohibitions on the introduction of domestic animals to areas of work, on the killing or capturing of wildlife specimens, on lifting nests or destroying burrows and on taking any action that unnecessarily disturbs wildlife.</p>	<p>* Improve the monitoring and detection mechanisms of invasive species that emerge on-site in the future * Develop a plan to actively eliminate invasive species and ensure that invasive species stay off the site</p>
		<p><u>Source:</u> "Resolución Exenta N° 190: Calificación ambiental del proyecto Los Hierros", 12 (08_ RCA 190 -2010). "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.4: Medio biótico", pages 1126-132, 151-155 (08_Linea Base Medio Biótico CH LH)</p>	
<p>NW3.3 Restore Disturbed Soils</p>	<p>8</p>	<p>Conserving</p> <p>Maule's National Forest Corporation approved Besalco's request to remove trees and reforest the area in order to carry out the work necessary to build the hydroelectric project. At the end of the construction phase, 100% of the soils disturbed during the work will be restored, with the exception of soil used for permanent construction which will not be recovered. The aforementioned plan includes a total area of 1.3 hectares of native forest (Roble-Hualo) that will be affected during 2013 and restored in 2014. The reforestation process will be achieved once a 75% rate of survival of 3.000 trees per hectare is verified, and the original forest composition is preserved.</p>	<p>* Develop an alternative to compensate the fact that the solid used for permanent construction is not being recovered. * Restore the soils disturbed as a result of previous development (soils must be reused for functions comparable to their original function).</p>
		<p><u>Source:</u> "Resolución 3/2013:Plan de manejo de obras civiles bosque nativo" page 1 (08_ Res Plan de Manejo OC CH LH).</p>	

<p>NW3.4 Maintain wetland and surface water functions.</p>	<p>6</p>	<p>Enhanced</p> <p>Based on the Clean Development Mechanisms (CDM) application form provided by the project team, Los Hierros activity does not result in new reservoirs or in an increase in capacity of the existing reservoir where the power density of the plant is less than 4W/m² ("Formulario de diseño del proyecto", page 8). Moreover, according to the information provided Los Hierros maintains the ecosystem functions of waterbodies and their riparian areas at a superior level. An assessment study by Besalco S.A. provides evidence that the quantity and composition of the site's benthonic fauna has not been modified, despite the development of the first stages of the project, which include a water discharge site and a temporary road. Regarding the diversity of native fish, the study does not mention any significant modification; however, it recommends the improvement of hydroelectric connections to guarantee fish free mobility from upstream to downstream. Its aim is to permit free fish passage, allowing them to avoid the intervened areas. According to the British Biological Monitoring Working Party (BMWP), the studied area has good water quality that has been maintained despite the construction of the temporary road in the river bed. Sediment transport has not been analyzed for this project. The company provided a study focused on the characterization of Los Hierros II's sediments, but does not provide information on how Los Hierros affects sediment transportation quality or capacity. Moreover, there is no documentation demonstrating that sediment transport will not be affected.</p> <p><u>Source:</u> "Informe N 3: Inspección fauna acuática. Sector: Sitio de descarga de aguas y camino provisorio lecho Rio Melado", pages 16, 17 and 27 (08_Informe N° 3 Inspección Fauna Acuática). "Anexo 3.4: Estudio Cruce de Quebradas", pages 8, 44 and 51 (08_Estudio Cruce de Quebradas CH LH II). "Formulario de diseño del proyecto (MDL DDP) - Versión 03", pages 7 and 30 (08_PDD Los Hierros).</p>	<p>* Develop a plan to improve the hydroelectric connection to guarantee fish free mobility amount upstream and downstream * Provide documentation demonstrating that sediment transport will not be affected by the construction and operation of Los Hierros.</p>
	<p>0</p>	<p>N/A</p>	<p>c</p>
<p>74</p>			

CLIMATE AND RISK			
	LOS HIERROS, CHILE		RECOMMENDATIONS
CR1.1 Reduce Greenhouse Gas Emissions	25	Restorative <p>According to Macrocap, the company responsible for the project's Environmental Impact Assessment, the project qualifies as Non-Conventional Renewable Energy (ERNC, acronym in Spanish) under Chile's General Electrical Services Law. Moreover, it is a Clean Development Mechanism (CDM) in the context of the Kyoto Protocol. As a CDM, the project provides "...emission reductions that are additional to what would otherwise have occurred, (and) must qualify through a rigorous and public registration and issuance process. Approval is given by the Designated National Authorities...". (Source: http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php).</p> <p>It is important to mention that according to the information provided by the project team, the estimated amount of emission reductions over the selected crediting period from 2012 to 2019 will be 592.608 tons of CO2.</p>	N/A
		<p><u>Source:</u> "Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto", page 7 (08_ Descripción del Proyecto CH LH). "Formulario de diseño del proyecto (MDL DDP) - Versión 03", pages 7 and 30 (08_ PDD Los Hierros).</p>	
CR1.2 Reduce Air Pollutant Emissions	6	Enhanced <p>According to Los Hierro's CDM project design document form, the project baseline emissions include only CO2 emissions associated with electricity generation in fossil fuels that are displaced due to the project activity. In turn, the project operation activity produces no emissions of CO2 or N2O. Moreover, due to the fact that Los Hierros activity does not result in new reservoirs or in an increase in capacity of the existing reservoir, this hydroelectric power station produces no emissions of CH4.</p> <p>Maule's Regional Environmental Commission certificated Los Hierros as a project that meets Chile's environmental requirements. This certification includes the fact that the project complies with local laws and regulations regarding the control of dust. Due to the fact that atmospheric emissions of the project will be dust from earthworks and vehicle traffic, the project team has committed to watering roads and dust emission sites during the summer season, ensuring the technical review of all vehicles used by the project, prohibiting waste incineration (it will be taken to a disposal site), using airtight trucks to transport materials, and requesting corresponding technical reviews of contractors and suppliers.</p>	* provide documentation to prove that the project implements measures to improve air quality to better than pre-development levels.
		<p><u>Source:</u> "Formulario de diseño del proyecto (MDL DDP) - Versión 03", page 8 (08_ PDD Los Hierros). "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", pages 19-22 (08_ RCA 190 -2010).</p>	
CR2.1 Assess Climate Threat	0	No Score <p>The project team does not provide information or evidence to support that Los Hierros has a comprehensive Climate Impact Assessment and Adaptation Plan that identifies climate change risks and possible responses.</p>	* develop a Climate Impact

		<u>Source:</u> N/A	
CR2.2 Avoid Traps And Vulnerabil ities	2	Improved Maule's Regional Environmental Commission certificated Los Hierros as a project that meets Chile's environmental requirements, which means that the project complies with the minimum local regulations and does not affect or disrupt the activities currently developed in the area of direct influence. In order to better understand the potential effects of the project on the community, the project team has coordinated two community meetings with Colbún residents. It is important to point out that the project team has also conducted an analysis to determine flood flows in the area of the project power station, and a seismic risk evaluation for the Melado hydroelectric complex, which is formed by the Los Hierros, Los Hierros II, Túnel Melado, El Malcho, and Chupallar power plants. However, the information provided by the project team does not assess the project's potential traps and vulnerabilities and their associated costs or risks.	Assessment and Adaptation Plan that identifies climate change risks and possible responses.
		<u>Source:</u> "Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros", page 10 (08_ RCA 190 -2010). "Central Los Hierros. Análisis de crecidas en zona de casa de máquinas" (08_ Extracto Línea Base Suelo CH LH) "Central hidroeléctrica Los Hierros II y túnel melado. Ingeniería básica: riesgo sísmico" (08_ Análisis Riesgo Sísmico CH LH II)	
CR2.3 Prepare For Long- Term Adaptabili ty	0	No Score The project team does not provide information or evidence that Los Hierros is a resilient project that can adapt to altered climate conditions, supply shortfalls, or other significant long-term changes in operational or environmental conditions.	* assess potential traps and vulnerabilities and their associated potential costs and risks, * provide evidence on efforts to avoid, alleviate or eliminate significant infrastructure traps such as high and long term operational costs and/or vulnerabilities.
		<u>Source:</u> N/A	
CR2.4 Prepare For Short- Term Hazards	3	Improved The Los Hierros project team identified the following three different groups of risks: 1. Natural Hazards: mud flows and avalanches, landslides, flooding, and seismic events. 2. Risks associated with construction works: fire, explosions, traffic accidents and spill of hazardous substances. 3. Risks associated with the operation phase: fire and traffic accidents. For each one of the listed risks, the project team has analyzed potential consequences and implemented prevention measures. Moreover, it has developed a contingency plan that comprises actions and measures in case of: mudflows and avalanches, landslides, flooding, seismic events, fire, explosions, traffic accidents and spill of hazardous substances. In this context, it is important to mention that Maule's Regional Environmental Commission certified that the project Los Hierros meets Chile's environmental requirements. This includes the approval of the mentioned plans, and a Plan for Stabilization of Slopes and Mass Removal Control to mitigate possible destabilization of slopes and risk of landslides caused by the construction works within the entire Los Hierros area of influence.	* provide documentation to prove that the project restores habitats in a way that reduces the impacts of future short-term disasters (strategies used and how they minimize the risk).

		<u>Source:</u> "Resolución Exenta N° 190: Calificación ambiental del proyecto Los Hierros", pages 12-15 (08_ RCA 190 -2010).	
CR2.5 Manage Heat Island Effects	0	No Score	
		The project team does not provide information or evidence that the project manages or minimizes the incidence of solar radiation, heating of surfaces and surrounding air.	
		<u>Source:</u> N/A	
CR0.0 Innovate Or Exceed Credit Requirements	0	N/A	
	36		

TOTAL:	210	LOS HIERROS, CHILE
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APPENDIX D: SOURCE LIST

DOCUMENTATION PROVIDED
General Information
"Trabajo en Equipo y Canales de Comunicación"
"Registro de capacitación, reunión y toma de conocimiento"
"Carta de agradecimiento - Unidad vicinal 35", noviembre 2011,
"Certificación ISO 14001: 2004, Besalco Construcciones S.A.", Bureau Veritas, Julio 2012,
"Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto"
"Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 1: Descripción del proyecto"
"Central Los Hierros. Análisis de crecidas en zona de casa de máquinas"
"Estudio de Impacto Ambiental - . Capítulo 3.3.5: Suelo y edafología"
"Informe de contratación de personal para proyecto en Comuna de Colbun."
"Informe Bimestral Gestión Ambiental. Proyecto Línea de Transmisión eléctrica Los Hierros - Canal Melado y subestación Los Hierros y Canal Melado ", Mayo-Junio 2013
"Estudio de impacto ambiental: Línea de Transmisión Eléctrica Los Hierros–Canal Melado, y Subestaciones Los Hierros y Canal Melado. Capítulo 3.3.4.6. Riesgo Sísmico"
"Matriz Identificación de Peligros, Evaluación de Riesgos y Determinación de Controles"
"Formulario de diseño del proyecto (MDL DDP) - Versión 03"
"Presentación consulta pública. Central hidroeléctrica Los Hierros"
"Programa de Capacitación: II Semestre 2011"
"Programa de medio ambiente", Mayo 2012
"Resolución Exenta Nº 190: Calificación ambiental del proyecto Los Hierros"
"Resolución 3/2013:Plan de manejo de obras civiles bosque nativo" page 1
"Abovedado y cercado de canal para atravesado de fauna"
"Estudio de Impacto Ambiental Central Hidroeléctrica Los Hierros II. Obras de Generación y Transmisión. Capítulo 1. Descripción de Proyecto", Rivas y Asociados Consultores
"Anexo 3.4: Estudio Cruce de Quebradas"
"Informe N 3: Inspección fauna acuática. Sector: Sitio de descarga de aguas y camino provisorio lecho Rio Melado"
"Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. Capítulo 4.4: Medio biótico"

"Proyecto planta de producción de hormigones premezclados - Melon Hormigones S.A."
"Minuta consulta pública. Central hidroeléctrica Los Hierros"
"Política de principios y valores Besalco", Mayo 2010
"Estudio de impacto ambiental: Central hidroeléctrica Los Hierros. BSC – CH LH – Adenda 2 – Anexo G, Capítulo 6: Plan de Medidas Ambientales"
"Plan de gestión para el cero daño. PLA-SIG-GE-01Plan de Seguridad y Salud Ocupacional"
"Política Integrada de Gestión", Febrero 2012, page 1
"Manejo de Residuos"
"Califica ambientalmente el proyecto "Línea de Transmisión Eléctrica (L TE) Los Hierros- Canal Melado; y Subestaciones Los Hierros y Canal Melado"
"Report on compliance with WDC recommendations. Los Hierros Hydroelectric Power Plant", February 2013, TÜV Nord