Loja Villonaco:

A Case Study on the Energy, Environmental and Social Impacts of Chinese Investment in Clean Energy in Ecuador

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[1] CELEC EP. (2016, February 10). *El Parque Eólico Villonaco supera el factor de planta estimado.*

Abstract

Chinese investment is extremely important in the Latin American and Caribbean (LAC) region, however, Chinese investment and Chinese-executed development projects in Latin America in general and Ecuador in particular have also been historically controversial in their environmental and social dimensions. That is largely because these investments and projects have consisted of large hydroelectric projects and oil concessions in the Amazon that are endemic to these kinds of problems. In this study, the social and environmental impacts of Chinese clean energy (specifically wind energy) investment in Ecuador were analyzed, through the analysis of a particular case of this investment, the Villonaco Wind Farm in Loja, Ecuador. This study is interesting because it is the first to look at Chinese investment in clean energy that is not hydroelectric energy. This case study investigation involved desk-based research on the political, environmental and social history of development projects and standards in Ecuador (in addition to other relevant topics), as well as field-based research in Ecuador, including a field visit to the Villonaco Wind Farm itself and the execution of interviews with over 30 diverse, relevant actors representing all of the major stakeholder groups of the project. What was broadly found is that, contrary to the literature which details the trends of poor environmental and social performance in Chinese-financed and developed projects in LAC and Ecuador more specifically, while the Villonaco Wind Farm project has not been particularly pleasing to the populations located in the area of influence of the project, it generally passes the test for an environmentally-sound, socially-acceptable project of its scale, and it is a remarkably unique project in its location (2,720m above sea level in the Andes of Ecuador, making it the highest wind farm in the world), and its operational success (a capacity factor of 63%, indicating extremely high efficiency).

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TABLE OF CONTENTS

ABSTRACT ..... **II**

ACKNOWLEDGEMENTS ..... **III**

LIST OF PHOTOS/TABLES/FIGURES ..... **V**

LIST OF ACRONYMS & ABBREVIATIONS ..... **V**

1. INTRODUCTION AND BACKGROUND **1**

2. LITERATURE REVIEW **4**

3. FRAMEWORK AND METHODOLOGY **6**

4. ECUADORIAN/PROJECT BACKGROUND **11**

ECUADORIAN REGULATORY ENVIRONMENT SURROUNDING THE ENVIRONMENT & DEVELOPMENT 11
ECUADOR'S NATIONAL CLIMATE PLAN & INTERNATIONAL CLIMATE AGREEMENTS 13
THE CHINESE-ECUADORIAN RELATIONSHIP 13
WIND POWER AND ECUADOR'S NATIONAL ENERGY & ELECTRICITY MATRIX 14

5. RESULTS **14**

ORIGINS/HISTORY OF THE PROJECT VILLONACO 15
OPERATION, ENERGY PRODUCTION AND PRODUCTIVE PERFORMANCE OF VILLONACO 17
SOCIAL IMPLICATIONS 18
Upstream Inclusion: Socialization/Consultation *18*
Midstream Inclusion: Construction Phase *21*
Downstream Inclusion: Social Benefits (Jobs, improved infrastructure, etc.) *22*
Perception/Acceptance of the Project: *27*
ENVIRONMENTAL IMPLICATIONS 31
Downstream Consideration: The Environmental Management Plan *35*
Actual/Perceived Environmental Impacts: *36*
NATIONAL IMPLICATIONS: 39
INTERNATIONAL IMPLICATIONS: 42

6. SUMMARY & CONCLUSIONS **43**

SUMMARY OF RESULTS 43
CONCLUSIONS 46
Policy Implications *47*
Recommendations for Future Research *49*

REFERENCES **51**

APPENDICES **55**

List of Photos/Tables/Figures

PHOTO 1: INTERVIEW WITH SR. JOSÉ MARCEL CORONEL, PRESIDENT OF THE NEIGHBORHOOD BELÉN 24
PHOTO 2: VISITOR CENTER (CENTRO DE INTERPRETACIÓN) AT THE VILLONACO WIND FARM 27
PHOTO 3: HIGH-TENSION POWER LINES IN THE NEIGHBORHOOD OF OBRAPÍA 28
PHOTO 4: VIEW OF THE VALLEY BELOW THE VILLONACO WIND FARM 32
PHOTO 5: ENTRANCE TO THE VILLONACO WIND FARM 39
PHOTO 6: VIEW OF THE VILLONACO WIND FARM, TAKEN FROM THE UTPL CAMPUS IN THE CITY OF LOJA 46
PHOTO 7: THE 'VILLONACO' SIGN, AND A VIEW OF SEVERAL OF THE WIND FARM'S TURBINES IN THE BACKGROUND 50

TABLE 1: NET BENEFITS FRAMEWORK, ADAPTED FOR ANALYSIS OF THE VILLONACO WIND FARM 7
TABLE 2: STAKEHOLDERS INTERVIEWED AS PART OF FIELD RESEARCH 9
TABLE 3: SUMMARY OF INVESTIGATION RESULTS 15
FIGURE 1: LOCATION OF THE VILLONACO WIND FARM AND ITS ZONE OF INFLUENCE 19

List of Acronyms & Abbreviations

FDI: Foreign Direct Investment
LAC: Latin America and the Caribbean region
COFDI: Chinese Outward Foreign Direct Investment
RoN: Rights of Nature
GHG: Greenhouse gas
EIA: Environmental Impact Assessment (Estudio de Impacto Ambiental)
EP: Public Enterprise (Empresa Pública)
EMP: Environmental Management Plan
CELEC EP/CELEC: The Ecuadorian Electric Corporation (Corporación Eléctrica del Ecuador), a state-owned public enterprise responsible for the generation, transmission, distribution, commercialization, import and export of electric energy in Ecuador
CELEC EP GENSUR/GENSUR: A Business Unit of CELEC, incorporated in June 2011 and engaged in the area of renewables-based electric power generation, specifically in southern Ecuador
NDC: Nationally Determined Contributions
BAU: Business as usual
AFOLU: Agriculture, Forestry and Other Land Use

LULUCF: Land Use, Land Use Change and Forestry
MERNNR: Ministry of Energy and Non-renewable Natural Resources (Ministerio de Energía y Recursos Naturales No Renovables)
MAE: Ministry of the Environment (Ministerio del Ambiente)
NGO: Non-Governmental Organization
ADEPLAN: a company whose mission is to support sustainable development efforts in the southern provinces of Ecuador and in Latin America
FLACSO: Latin American Faculty of Social Sciences (Facultad Latinoamericana de Ciencias Sociales)
UTPL: la Universidad Técnica Particular de Loja
UNL: la Universidad Nacional de Loja
UEER: Executing Unit of Renewable Energies (Unidad Ejecutora de Energías Renovables)
SA: Limited Public Enterprise (Sociedad Anónima)
ENERLOJA SA: Formerly UEER
ENERSUR EP: Formerly ENERLOJA SA
CAF: Development Bank of Latin America (Corporación Andina de Fomento)
SNI: National Interconnected System (Sistema Nacional Interconectado)
CDM: Clean Development Mechanism
UNFCCC: United Nations Framework Convention on Climate Change
PDTC: Territorial Community Development Plan (Plan de Desarrollo Territorial Comunitario)
MEER: Ministry of Electricity and Renewable Energy (Ministerio de Electricidad y Energía Renovable)
CONAIE: The Confederation of Indigenous Nationalities of Ecuador (Confederación de Nacionalidades Indígenas del Ecuador)
VIALSUR EP: Loja-based public enterprise dedicated to construction and maintenance of road systems, and related and complementary works
NACYMEL-COINTEC: Quito-based construction company
PMA: Environmental Management Plan (Plan de Manejo Ambiental)
CDB: China Development Bank

1. Introduction and Background

Chinese investment is fast becoming one of the largest sources of foreign investment for developing countries, and Ecuador is no exception. What is interesting is that whereas the large bulk of Chinese investment in the energy sector is in large coal and hydroelectric power projects that are endemically threatening to the health and livelihoods of local communities, Ecuador is one of just a handful of countries where China has invested in cleaner energy technologies such as solar and wind power. Ecuador has a long history of conflict surrounding development projects in general, especially projects related to energy. The typical narrative is that these projects in Ecuador are going to be controversial, even more so when they have Chinese investment/involvement. This paper will show how the Villonaco wind farm project in Loja, Ecuador has been different and why, serving as a case study of the social (and environmental) impacts of Chinese investment in wind energy in Ecuador.

China's relationship with the Latin American and Caribbean region (LAC) has been most consistently centered around China's need for natural resources to support their economic development, and Latin American nations having rich reserves of natural resources, and needing financial and infrastructural resources. The two specific sectors which are the focus of economic cooperation between China and the region are infrastructure, and resources and energy.[2] Infrastructure and energy projects in sum accounted for 75% of Chinese loans toward LAC from 2005 to 2014.[3] The rising prevalence and importance of infrastructure-based construction projects have resulted from the deterioration, and in many cases, lack of infrastructure in LAC, as well as China's technical/infrastructural capacity and pursuit of economic development.[4] Another key aspect of the LAC-China economic relationship is that China has recently grown into a major export destination for this region, second to the United States, nearly tripling its share of total LAC exports over the last decade. These exports have also increasingly become concentrated in extractive and agricultural products, which has meant that LAC-China exports cause more greenhouse gas (GHG) emissions and use more water per dollar of output than other exports.[5]

These relationship trends between China and LAC in general, in many ways translate over to the relationship between China and Ecuador, which dates back 40 years. Diplomatic relations between Ecuador and China were formally established on January 2, 1980, with Ecuador

2 Teng, C. C. (2017). The Pattern of China's Financial Initiative in Latin America: A Comparative Study. *Issues and Studies*, 53(1), 1–27.

3 Peters, E. D. (2015) *China's Evolving Role in Latin America: Can It Be a Win-Win?* Washington, DC: Atlantic Council's Adrienne Arsht Latin America Center Report.

4 Gransow, B. (2015). Chinese infrastructure investment in Latin America. *Journal of Chinese Political Science*, 20(3), 267-287.

5 Ray R., Gallagher K., López A., & Sanborn C. (2017). China in Latin America: Lessons for South–South Cooperation and Sustainable Development. In Ray R., Gallagher K., López A., & Sanborn C. (Eds.), *China and Sustainable Development in Latin America: The Social and Environmental Dimension* (pp. 3-30). London; New York: Anthem Press.

acknowledging the existence of 'One China'.[6] Ecuador's initial (and continued) interest in China has been as a means to mitigate economic dependence on traditional partners like the U.S. and to diversify exportation. China's interest in Ecuador has laid primarily in its abundance of primary commodities (namely, natural resources like oil), with Chinese loans-for-oil viewed by the Ecuadorian government as a solution to fund the government's energy development and redistributive policies (in the short term).[7]

While much of the relationship between these two countries since 2008 has consisted of this important loans-for-oil dynamic, a significant portion of the recent credits that Ecuador has received from China have been used in energy projects designed to transform Ecuador's energy matrix from one based on finite resources to one based on renewable energy resources.[8] China's financial resources and construction assistance in Ecuador, particularly in recent years, have been poured into key infrastructural projects, particularly those related to power generation and transportation.[9] If one thing has been consistent in Ecuador's energy and development strategy, it is the attraction of Chinese loans. The Ecuadorian national government has signed contracts with Chinese firms and accepted financing from Chinese banks to implement a medley of development projects, including exploration of and extraction of oil, hydropower projects (Coca Codo Sinclair, Sopladora), and mining projects such as the Mirador copper mine. While these projects have been praised by the national government, they have also been shaded by controversy. Though the wind project Villonaco was, like these projects, funded by a Chinese bank and developed (in part) by a Chinese firm, it has not suffered from the same kind of controversy and negative environmental and social impacts as these projects.

The overarching research question and scope of analysis for this investigation is: To what extent is the Chinese-financed wind farm Villonaco a case of inclusive, clean and scalable energy in Ecuador? As part of this broad inquiry, the primary focus was in analyzing the local socio-environmental impact of Villonaco, with secondary interests in analyzing how this project fits into Ecuador's energy/electricity matrix and priorities at the national scale, and how it fits into Ecuador's international agenda, specifically its relationship with China. Similar kinds of analyses have been conducted for many other development projects, including a number of analyses conducted in Latin American countries. This study builds on this previous research by conducting an analysis of a clean energy project financed by China in rural Ecuador.

Though the Villonaco Wind Farm is the first wind project to have been developed with Chinese assistance in Ecuador, its astounding productive success/high efficiency, relative lack of controversy, and relatively responsible social/environmental performance, indicate that Chinese Foreign Direct Investment (FDI) is an increasing dynamic, and has the ability to establish infrastructure and generate capacity and know-how in new and innovative sectors in Ecuador, beyond the continuation of extractive processes and transactions.

6 Herrera-Vinelli, L., & Bonilla, M. (2018). Ecuador-China Relations: the Growing Effect of Chinese Investment on Ecuadorian Domestic Politics, 2007–2016. *Journal of Chinese Political Science, 24,* 623-641.

7 Escribano, G. (2013). Ecuador's Energy Policy Mix: Development versus Conservation and Nationalism with Chinese Loans. *Energy Policy, 57,* 152–159.

8 Herrera-Vinelli, L., & Bonilla, M. (2018).

9 Teng, C. C. (2017).

In a country as resource-rich as Ecuador, the resource of wind is one that has not been much scrutinized in the published literature, and has not been exploited, until the start of this century. Two Ecuadorian wind farms were constructed in the Galapagos in the mid 2000s, and Villonaco, erected in 2013, became the first wind farm in continental Ecuador. Thus, the beginning of wind energy development in Ecuador marks a unique opportunity for Ecuador to make its mark in resources that are not just extractable, namely oil/agricultural goods. The Villonaco project falls in a very unique place, coming at the heels of a long period of Ecuador's rich biodiversity and resources being exploited, at a time when there has been a history of the country having complications and dissension related to development/energy projects. Difficulties with past development/energy projects have included harm to local populations, and environmental unsustainability, in particular at the start of a period of changing priorities in Ecuador to clean energy projects. The initiation of these clean energy projects began most notably with the establishment of Ecuador's first National Development Plan in 2007, under then-president Rafael Correa.

The case of Villonaco is also interesting and important to investigate as it allows us to better understand Ecuador's changing relationship with China, as well as the changing nature of its own energy matrix and energy priorities/national priorities more broadly. These evolving priorities include increased electricity coverage and security, diversification and greening of energy sources, increased energy independence, increased institutional and technical capacity building capability, and development in the broadest sense.

While the term development is often discussed solely in a positive light, not all development is sustainable, and not all sources of energy are sustainable. Thus, no matter how small-scale a project is, it is important to look at the dynamics of development and its impacts on the people and environment in the surrounding area.

As it appeared that literature on the topic of the Villonaco Wind Farm was scarce, it seemed to be a worthwhile endeavor to conduct and provide this case study analysis to fill in a gap of knowledge while at the same time adding onto a growing literature of similar analyses of sustainable development projects. Specific areas of interest in conducting this study included information related to the local social and environmental impacts of the project.

An additional basis for choosing the wind farm Villonaco as the topic of investigation was its uniqueness, as it is both record-setting and record-breaking. As noted above, Villonaco is the first wind farm constructed in continental Ecuador, and is currently the highest wind farm in the world. Other distinctive features of Villonaco are its small size and its record-breaking operational success to date in terms of its measured capacity factor. My analysis thus aims to fill the gap in information, by giving a sense of the true nature/impact of this unique project.

The remainder of this paper is organized as follows: Section 2 provides a review of literature that has conducted investigations similar to mine, focusing on the social and environmental impacts of development projects in general, and Chinese involvement in development in Latin America in particular. Section 3 explains the framework used to structure my investigation, the methodology and fieldwork that was carried out to execute this investigation, and how the framework was put into action. Section 4 provides relevant background for my research and

particular case study, so as to contextualize the investigation, analysis and conclusions of this paper. Section 5 communicates the results of my research, structured as the "filling-out" or completion of my established framework. These results have been categorized/summarized on a scale from positive → neutral/no impact → negative, in accordance with the modified net benefits framework that was utilized (discussed in detail in Section 3). Section 6 presents a final summary/synopsis of the findings of my research, and provides some analysis and conclusions drawn from these results, including policy implications and recommendations for future related research.

2. Literature Review

There is an abundance of literature on the social and environmental impacts of big development projects, as well as a large subset of this literature focused on these impacts in Latin America. *Subterranean Struggles: New Dynamics of Mining, Oil, and Gas in Latin America* by Bebbington and Bury comprises an analytical collection in which a multitude of different experts explore the dynamics of struggle surrounding extractive processes in Latin America from a number of different perspectives in a number of Latin American countries, ultimately arguing that such struggles are endemic to the new extractive economy of the region.[10] In their case study of the Marlin Mine in Guatemala, authors Zarksy and Stanley evaluate whether this mine has been able to promote sustainable development, using an original 'net benefits' framework that combines both 'weak' and 'strong' sustainability principles. Ultimately, they find that the Marlin Mine has not promoted sustainable development, as there is little evidence that the mine meets either weak or strong sustainability criteria.[11]

In *The Co-Benefits of Stakeholder Engagement: Environmental and Social Safeguards, Infrastructure Investment, and Deforestation in the Andean Amazon, 2000-2015,* author Rebecca Ray tests the association between two types of reforms to the environmental and social governance of infrastructure projects, prior consultation and grievance mechanisms, and the environmental impacts resulting from infrastructure projects in the Andean countries Colombia, Ecuador, Peru and Bolivia. This paper finds that the utilization and enforcement of prior consultation regimes have a strong, positive and significant impact on relative tree cover change near project sites, while the establishment of grievance mechanisms by development finance institutions (DFIs) does not relate significantly to tree cover change (though it may be key to avoiding other kinds of risks). Lastly, the paper finds that DFI and country safeguards seem to

10 Bebbington, A., & Bury, J. (2013). *Subterranean Struggles: New Dynamics of Mining, Oil, and Gas in Latin America*. 1st ed. Austin, Tex.: U of Texas.

11 Zarsky, L., & Stanley, L. (2013). Can Extractive Industries Promote Sustainable Development? A Net Benefits Framework and a Case Study of the Marlin Mine in Guatemala. *Journal of Environment and Development*, *22*(2), 131–154.

act as a mutually-enforcing network, in which each acts as a back-up/insurance policy against the failure/disappearance of the other.[12]

There is also a small but growing section of literature that has focused on the environmental and social impacts of Chinese funded and executed development in LAC. In the study *Chinese Mining in Latin America: A Comparative Perspective*, authors Irwin and Gallagher examine the extent to which the Chinese mining firm Shougang Hierro Peru is an outlier in social (labor) and environmental performance in its mining operations, relative to other foreign and Peruvian mining firms, to address the broad concern that Chinese mining companies operating in Latin America have a worse labor and environmental record than other mining companies. They ultimately find that while this Chinese firm does have a very poor record of labor and environmental performance in Peru, there are firms from other countries (one in particular from the US) that perform worse, and some Peruvian firms that are not far behind, suggesting that Chinese firm behavior in Latin America should not be analyzed in isolation, especially in a sector with such endemic labor and environmental problems.[13]

Similarly, the paper *Evading Sustainable Development Standards: Case Studies on Hydroelectric Projects in Ecuador*, conducted by a team of researchers from the university FLACSO Ecuador, compares two recently constructed hydroelectric dams to explore the extent to which social and environmental safeguards have been implemented successfully by Chinese and non-Chinese financed dam projects -- the Coca-Codo Sinclair dam (PHCCS), financed by the Export-Import Bank of China, and the Baba Multipurpose Project (PMB), initially financed by the Inter-American Development Bank but in the end executed with funds from the national Ecuadorian government. The study finds that the safeguards of the China Ex-Im Bank did not lead to better outcomes at the PHCCS than the national Ecuadorian safeguards implemented at the PMB, and that in both cases the effectiveness of safeguards depended more on the mobilization of local civil society than on the existence of these official safeguards.[14]

In the study *A Line in the Equatorial Forests: Chinese Investment and the Environmental and Social Impacts of Extractive Industries in Ecuador*, authors Ray and Chimienti conduct a case study on the social, environmental and economic experiences of two Chinese-owned extractives firms operating in Ecuador, Andes Petroleum and PetroOriental, so as to draw lessons for future Chinese oil investments and concessions in the Ecuadorian Amazon. Ray and Chimienti find that to date, Andes Petroleum and PetroOriental have had relatively positive experiences in Ecuador when compared to other domestic and foreign-owned firms in the extractive sector, though the social and environmental conditions of Andes Petroleum's new concession zones vary greatly from where they are currently located. The authors posit that how Andes Petroleum handles its expansion into these new zones, particularly under the additional Ecuadorian law on prior

12 Ray, R. (2018). *The Co-Benefits of Stakeholder Engagement: Environmental and Social Safeguards, Infrastructure Investment, and Deforestation in the Andean Amazon, 2000-2015.* Boston: BU Global Development Policy Center Working Paper.

13 Irwin, A., & Gallagher, K. P. (2013). Chinese Mining in Latin America: A Comparative Perspective. *Journal of Environment and Development*, *22*(2), 207–234.

14 Vallejo, M. C., Espinosa, B., Venes, F., López, V., & Anda, S. (2019). "Evading Sustainable Development Standards: Case Studies on Hydroelectric Projects in Ecuador." In Ray R., Gallagher K., & Sanborn C. (Eds.), *Development Banks and Sustainability in the Andean Amazon*. London: Routledge.

consultation, will determine whether the Ecuador-China model becomes a model of responsible extraction/oil production, or whether it will showcase a letdown of Ecuador's extensive protective legal framework.[15] While studies of the environmental and social impacts of Chinese funded and contracted development in LAC have been executed by many, with just a few key examples having been elaborated upon here, a study on the impact of Chinese financing and involvement in wind energy projects in Ecuador has yet to be executed, thus making this particularly investigation into the Villonaco Wind Farm unique.

3. Framework and Methodology

Drawing on the above literature, I adapted the framework employed by Stanley and Zarskey to explore my own research question: To what extent is the Chinese financed wind farm Villonaco a case of inclusive, clean and scalable energy in Ecuador? In their paper, Zarsky and Stanley question whether extractive industries can promote sustainable development, using the Marlin Mine in Guatemala as a case study, and a 'Net Benefits Framework' as their framework of analysis. The Net Benefits Framework, developed by Zarksy and Stanley for their own analysis purposes, is the framework I will be adapting for my own analysis of the Villonaco wind farm. As described by Zarsky and Stanley, the net benefits framework integrates both weak and strong sustainability principles. Weak sustainability views increases in human capital and welfare as being substitutable for losses of nonrenewable resources/costs to the environment, while strong sustainability maintains that there are certain services and systems provided by nature which are non-substitutable. Zarsky and Stanley define 'net benefits' as the "joint generation of net gains to human welfare, defined as local acceptance and high economic benefits, and low risks to the resilience of environmental life-support systems, especially water, evidenced by best practice management standards." [16]

The table below aims to lay out the framework within which I will develop my analysis and elaboration of my research question(s), and through which I will examine and present my results. I will not simply check the boxes of this framework to indicate my conclusion of overall impact of each portion of this analysis being 'positive, 'neutral', or 'negative', but will elaborate upon each portion of my analysis, using this nominal range from positive—negative as a way to conceptualize all parts of this analysis post-analysis, in relation to one another and to my main research questions.

15 Ray, R., & Chimienti, A. (2017). A Line in the Equatorial Forests: Chinese Investment and the Environmental and Social Impacts of Extractive Industries in Ecuador. In Ray R., Gallagher K., López A., & Sanborn C. (Eds.), *China and Sustainable Development in Latin America: The Social and Environmental Dimension* (pp. 107-144). London; New York: Anthem Press.

16 Zarsky, L., & Stanley, L. (2013).

Table 1: Net Benefits Framework, Adapted for Analysis of the Villonaco Wind Farm

Social Implications	*Upstream inclusion:* Socialization/consultation process(es)
	Midstream inclusion: Construction phase (jobs, etc.)
	Downstream inclusion: Job creation? New/improved infrastructure? Increased access to electricity? Other benefits?
	Perception/acceptance of the project: Expectations vs. reality (ex. Of linkages), overall reflection on what impact of this project on the local community has been, personal sentiments about the project (are people content? Worried/dissatisfied?)
Environmental Implications	*Upstream consideration:* Review/analysis of the EIA (Environmental Impact Assessment). What is included in the EIA (what are the main environmental concerns/considerations for this project?) How comprehensive/high quality is the EIA?
	Downstream consideration: Review/analysis of the EMP (Environmental Management Plan). What does the EMP include, how well are the plans/programs that are established in the plan/in place managing the environmental impact of the project? How comprehensive/high quality is the EMP?
	Actual/perceived environmental impacts of the project: What have the realized/actual environmental impacts of this project proven to be (as reported by the stakeholders interviewed)? What are the environmental impacts perceived to be? How well have the EMP and related environmental regulation requirements been executed/complied with?
National Implications	What implications has Villonaco had/may it have for the energy matrix and priorities of Ecuador as a whole? Is this project scalable?
International Implications	How does Villonaco fit into Ecuador's relationship with China, what has been the impact of Chinese financing/involvement in this project (on all of the above factors)? What implications has it had for Ecuador's international identity and agenda more broadly?

The method for applying this framework involved a number of steps. To start, throughout the Fall 2019 semester a literature review was conducted and desk research completed to learn as much as possible about the background and context of Villonaco, and about Villonaco itself. The resources consulted included published academic papers written in both English and Spanish, the websites of various Ecuadorian actors involved in the project, including the government entity/enterprise unit of CELEC, CELEC EP GENSUR (hereafter referred to as GENSUR), and government ministries such as the Ministry of Energy and Renewable Energy and the Ministry of the Environment, press articles, and any relevant documents available online through GENSUR or the Ecuadorian government. The aim in doing this research was to find information on/answers to as many of the questions and topic areas included in the research framework as possible, and to make note of information that could not be found. Also, in the Fall 2019

semester, research travel funding was applied for and received, which funded a two-week research trip to Ecuador in January 2020. Because Villonaco is a relatively small project, and because one of the main areas of investigation was the local socio-environmental impact of the project, it was decided from the inception of this thesis project that a trip to Ecuador to conduct field research, if possible, would be extremely advantageous.

Towards the end of the Fall 2019 semester, the process of compiling a list of actors that would be beneficial to interview in order to answer the questions included in the research framework began. In addition, the process of corresponding via email with a number of these actors was initiated in order to begin making plans for the research trip. The research trip itself took place from January 4 – January 18, 2020. The first of these two weeks was spent in Ecuador's capital, Quito, where interviews with a number of government actors, civil society actors, academic professionals and professionals working in related fields/with experience relevant to this research regarding Villonaco were executed. The second week of the research trip was spent in the city and province of Loja, where the wind farm Villonaco is located. During this week, a visit and tour of the Villonaco wind farm and Villonaco substation were completed, and interviews were conducted with a number of relevant actors. In total, interviews were conducted with over 30 individuals representing all major stakeholder groups engaged with the project, though by no means with every single person involved. These major groups included national and municipal-level government officials, individuals from the entity that co-developed and manages the project (GENSUR), the Chinese government (Economic/Commercial Office of the Chinese Embassy), academic and other professionals with familiarity of the project/working in similar fields, and the populations of the project's area of influences (represented by the neighborhood presidents).

Those interviewed in Loja included individuals affiliated with GENSUR (who were/are thus involved in the direct planning and management of Villonaco), officials of the municipal government of Loja, local academic professionals and stakeholders, and the neighborhood presidents of 5/10 of the neighborhoods included in the area of influence defined by GENSUR. Two of the five interviews with neighborhood presidents took place in the local neighborhoods themselves, which provided the opportunity for an additional level of observational analysis. A table of the actors interviewed during the fieldwork conducted in Ecuador is included in Table 2 below.

Table 2: Stakeholders Interviewed as part of Field Research

Type of Actor	Position/Title	Name of Actor
Government Actors (national and municipal)	Director of International Affairs (MERNNR)	Verónica Giler
	Representative of the Planning and Investment Directorate of MERNNR	Briggette Flores
	Vice Minister of Electricity (MERNNR)	Gonzalo Uquillas
	Director of Environmental Management for the Municipality of Loja	Renato Paredes
	Environmental Coordinator in Office of Environmental Management, Municipality of Loja	Diana Ochoa Tapia
	Coordinator of MAE (Ministry of the Environment) Zone 7 (based in Loja)	Benjamin Ludeña
	Director of the Department of Tourism, Municipality of Loja	Silvana Sisalina Dávila
	Technical Coordinator of the Department of Tourism, for the Municipality of Loja	Fernando Picoita Navarro
	Director of Economic and Social Inclusion for the Municipality of Loja	Yelena Bustamante
Chinese diplomatic actors	Attaché of the Office of Economics and Commerce of the Chinese Embassy in Quito	Chen Jiahui
Individuals affiliated directly with GENSUR/Villonaco	Manager of GENSUR	Enith Carrión
	Specialist in Environmental and Social Management for Villonaco	Ricardo Amaya
	Head of Maintenance of the Villonaco Wind Farm	Roberto Fernandez
	Head/Chief/Manager of the Villonaco Wind Farm	Jimmy Valerezo
Neighborhood presidents (representatives of area of influence of Villonaco)	President of the neighborhood of Belén	Digna Robles
	President of the neighborhood of Obrapía	Jose Marcelo Coronel
	President of the neighborhood of Plateado	Ángel Tandazo
	President of the neighborhood of Ciudad Victoria	Wilmer Leiva
	President of the neighborhood of Victor Emilio Valdivieso	Jose Gaona Cruz

Civil society actors	Director of Aves y Conservación (Quito-based NGO)	Tatianna Santander
Professionals in related fields/with related knowledge	Socio-Environmental Investigator	Sofía Jarrín
	Lawyer and consultant in international trade, sustainable development and environment	Mario Amparo
	Planning Manager the Empresa Electrica Quito, former Vice-minister of Energy (2007-2009)	Esteban Casares
	Director of ADEPLAN, former director of ENERSUR EP	Jose Vicente Aguirre
Academic professionals	Professor at FLACSO	Betty Espinosa
	Professor at FLACSO	Maria Cristina
	Professor at FLACSO	Victor Lopez
	Professor at UTPL	Manuel Ayala Chauvin
	Professor at UNL	Jorge Maldonado-Correa

My field work was fruitful not only in the information I was able to obtain directly from the stakeholders I interviewed, but in a number of documents I was able to request and ultimately receive from several of my interviewees, including the Environmental Impact Assessment for the project, a written history of the inception phase of the project from 2002-2012, 2018 data on national electricity generation in Ecuador, and written information on the Villonaco project and the upcoming projects Villonaco II and III.

Following the research trip/field work, my work consisted of following up with several individuals I had interviewed to request further information, clarification and documentation, reviewing the documents I received through my field work, and translating and synthesizing the information learned in my interviews, information from documents, and the information collected during my literature review and desk research. The research conducted prior to my field work was undoubtedly essential to contextualizing my research and to gathering a foundational base of knowledge to answer the questions included in my framework, however my field work allowed me to fully apply my framework, as I was able to visit the wind farm and surrounding/area of influence itself, and was able to interview a medley of stakeholders and tailor my questions from my framework specifically to these actors. I was thus able to gain answers to the majority of my framework questions, often from several different perspectives.

4. Ecuadorian/Project Background

Ecuador is a country that has been challenged by limited private investment, but has made a commitment to clean energy, while also relying on indigenous people and social cohesion as a core component of the coalition for its power structure. In order to put the results of this investigation into context and allow them to be better understood by the reader, an overview of Ecuador's environmental/development regulatory structure, its environmental commitments (domestic and international), its relationship with China, and some background about the project in particular, are provided below.

Ecuadorian Regulatory Environment Surrounding the Environment & Development

There are a number of laws and regulations that make up the regulatory environment surrounding development projects (such as Villonaco) in Ecuador, including the Rights of Nature (as stipulated in the 2008 Constitution), the Ley Orgánica de Participación Ciudadana, the Law on the Environment, Law on Pollution Control, and the Criminal Code. The Ecuadorian Constitution and the International Labour Organization Indigenous and Tribal Peoples Convention 169 (ILO 169), to which Ecuador is a signatory, require prior consultation with local communities, and the Constitution also contemplates the obligation of the state to promote the development of renewable and non-polluting energy, and mandates the state to find ways to reduce GHG emissions. Additionally, activities such as oil extraction, mining and logging within a wildlife-protected area are only allowed in "exceptional circumstances", as requested by the president of the republic to the national assembly. Electrical generation is not included in these activities as it is not considered extractive.[17] The Ley Orgánica de Participación Ciudadana is the Ecuadorian law which spells out the rights of populations to prior consultation (regarding any decision proposed that might affect them). Under this law, communities are granted the right to (and the competent authorities are obliged to carry out) prior, free and informed consultation within a reasonable timeframe. Any decision that may affect the environment should entail 'ample/full-scale and timely' community consultation. Lastly, the prior consultation articles of the law state that if there is a majority opposition from the respective community during consultation, the decision to execute the project or not will be made by resolution by the higher administrative authority. In the case of execution of an opposed project, it is required that parameters that minimize the impact of the decision on communities and ecosystems be established.[18]

In 2008, Ecuador became the first country in the world to guarantee the rights of nature (RoN) in its constitution. The four RoN articles grant nature the inalienable right to exist, persist, regenerate, and be respected, and give Ecuadorian citizens the right to sue for enforcement of

17 Camborda, C. (2016). *Assessing the Divergence: Social and Environmental Safeguard Policy by the Inter-American Development Bank and Export Import Bank of China; Case Study of Coca Codo Sinclair.* [Unpublished undergraduate honors thesis]. Boston University.

18 Ley Orgánica de Participación Ciudadana. (2010). Gobierno Nacional de la República del Ecuador.

these rights.[19] However, the official incorporation of these rights into the constitution has by no means assured the protection of the environment in Ecuador since 2008. The articles comprising the RoN leave much room for interpretation. What comprises 'nature' is purposefully left expansive, and anyone (even non-Ecuadorians) can bring suit to defend the RoN, including representatives of the Ecuadorian government itself. Though in 2015, the Constitutional Court established the standard that economic interests cannot take precedence over the RoN, in practice this has not seemed to hold true (ex. Failure of the Yasuni ITT-initiative; and though it was before 2015, the failed RoN suit regarding the negative environmental impacts of the el Mirador mine).[20]

In addition to the RoN, Ecuador also has established social and environmental safeguards related to development projects, namely the requirement of EIAs (Environmental Impact Assessments), EMPs (Environmental Management Plans), and Community development projects in designated areas of impact of a project, and the requirement of Prior Consultation with affected communities. These safeguards, like the inclusion of the RoN in the constitution, have been only moderately and selectively effective at protecting the environment and the people impacted by development projects. The aforementioned study by Vallejo et al. demonstrates this clearly, in its analysis of the Coca-Codo Sinclair and Baba Multipurpose Project hydroelectric dams. The paper finds that in the case of both projects, the effectiveness of safeguards depended more on the mobilization of local civil society than on the mere existence of de jure safeguards.[21]

Additionally, permits from the Ministry of Environment are required for development projects in Ecuador. Prospective projects fall into 4 categories, with the types of projects expected to have the highest potential environmental impact requiring the most comprehensive application/review process. The permitting process requires the execution and approval of an environmental impact assessment (EIA), a public consultation including presentation of the EIA, an environmental management plan and a contingency plan to local communities, and final approval of the EIA by the Ministry of Environment, which then grants the permit. These permits are required before any project begins construction.[22] Violations of environmental law can result in monetary fines, suspension or cancellation of the environmental license, or even the closing of the industry or business involved. If the violations are criminal (as detailed in the Criminal Code), the punishments can include imprisonment.[23]

19 Whittemore, M. E. (2011). The Problem of Enforcing Nature's Rights Under Ecuador's Constitution: Why the 2008 Environmental Amendments Have No Bite. Pacific Rim Law & Policy Journal, 20(3), 659-691.

20 Kauffman, C. M. & Martin, P. L. (2018). Constructing Rights of Nature Norms in the US, Ecuador and New Zealand. Global Environmental Politics, 18(4), 43-62.

21 Vallejo, M. C. et al. (2019).

22 Camborda, C. (2016).

23 Camborda, C. (2016).

Ecuador's National Climate Plan & International Climate Agreements

On June 22, 2017 the Ecuadorian National Assembly unanimously approved the ratification of the Paris Agreement. Prior to approval by the National Assembly, Ecuador's Constitutional Court had declared the Paris Agreement an instrument compatible with the country's constitution. Though Ecuador is only responsible for 0.15% of total global CO_2 emissions, since 1960 the country has experienced record increases in the country's maximum temperature, increased variation in sea temperature, and an average reduction of 40% of the glaciers of Chimborazo, Cotopaxi, Carihuairazo and Antisana.[24]

Ecuador also has a NDC (Nationally Determined Contributions) Program, a national climate plan which aims to reduce emissions by 37.5-45.8% below business as usual (BAU) levels by 2025 in the energy sector (depending on international support).[25] The country aims to mitigate future emissions in the energy, transport, waste and AFOLU sectors, and to adapt to the effects of climate change in the agriculture, energy, environment, LULUCF (land use, land use change and forestry), and water sectors. Ecuador's NDC focuses on mitigation in the energy sector primarily through energy efficiency measures, and although the adoption of renewables is not mentioned, it seems clear that the development of wind projects/exploitation of Ecuador's wind resources can facilitate the mitigation of emissions from the energy sector.

The Chinese-Ecuadorian Relationship

In Herrera-Vinelli and Bonilla's 2018 paper on the growing effect of Chinese investment on Ecuadorian domestic politics, the authors examine the economic relationship between the two countries over the past 30 years. It is noted that trade between the Latin American region and China has generally increased from 2007-2016, and that Ecuadorian trade with China is associated with a serious trade deficit. Additionally, although China's main focus in the region has been trade and investment, aid and assistance ('cooperation') also have become a noteworthy component of the China- LAC relationship - China uses cooperation as a foreign policy tool to achieve its strategic goals.[26] The paper notes that more recently, China draws Ecuadorian attention because of its incipient interest in investing in real estate and wind power, and that it can be argued that the Ecuadorian state has molded its domestic policies in China's favor by giving preferential and flexible treatment to Chinese companies in order to obtain the benefits of Chinese Outward-FDI (COFDI) and Chinese finance. Citing the productive and economic success of the wind farm Villonaco specifically, the paper observes that Chinese companies are breaking new ground in Ecuador, diversifying away from a sole interest in extracted/non-renewable resources to the financing of a myriad of development projects, including ventures into clean energy.

24 Ministerio de Relaciones Exteriores y Movilidad Humana. (2017, June 22). *Ecuador unanimously approves ratification of the Paris Agreement on Climate Change.*

25 United Nations Development Programme. (n.d.). *Ecuador.* NDC Support Programme.

26 Herrera-Vinelli, L., & Bonilla, M. (2018).

Wind Power and Ecuador's National Energy & Electricity Matrix

Although Villonaco has been so technically successful, it is an example of a relatively nascent industry in Ecuador. Villonaco is only the third wind project to have been developed in Ecuador, and is the first in continental Ecuador (the first two being located on the islands of San Cristóbal and Baltra in the Galapagos). Despite its high capacity factor (high efficiency) relative to its small size, Villonaco meets only a miniscule portion of the total energy demand in Ecuador. Capacity factor ('factor de planta' in Spanish), is a common measure of wind energy production, measuring the amount of electricity a wind turbine produces in a given time period (typically a year) relative to its maximum potential.[27] Ecuador's energy matrix is composed of a mix of sources, including oil (88%), natural gas (5%), and renewables (7%). Hydropower accounts for the vast majority of Ecuador's renewable energy production, with solar and wind accounting for only about 1% of annual energy production.[28] However, Ecuador's wind potential has only begun to be exploited, and the planning stages of two more wind projects, Villonaco II and III, have already begun. Additionally, there exists wind potential elsewhere in Ecuador, beyond the province of Loja (though this region alone is estimated to represent 52% of the country's usable wind potential), particularly in several areas along the coast and in the provinces of Imbabura and Bolivar, as identified in the Atlas Éolico del Ecuador (Wind Atlas of Ecuador) developed by the Ministry of Electricity and Renewable Energy in 2013. A coherent development of a mix of renewables and hydropower is a long-run endeavor that would provide Ecuador with a more balanced energy mix, but which requires substantial investment and technological transfer.[29] Villonaco is the first example of this necessary investment and technological (and capacity/knowledge) transfer occurring in the field of wind energy.

5. Results

This section provides the results of the desk research and field research conducted for this investigation, broken down into a number of sub-sections. First, as shown below, is a table summarizing the overall conclusions in answer to the questions posed in my framework, based on my findings. Following the table are my findings on the origins and history of the wind farm Villonaco, along with the most basic and essential facts of the project and its energy output performance. Following this background information, which is derived from both the desk and field research conducted, the bulk of the results are laid out in detail, with dedicated subsections for findings/results related to the Social, Environmental, National and International Implications of the wind farm. Within the first two of these sections, are subsections dedicated to each component of the respective category, as laid out by the framework described in detail in the Methodology/Framework section above, and replicated again with less detail in the table below. The bulk of these results are derived from the interviews conducted during the field research portion of the investigation, though several documents (procured through interviews/interactions

27 American Wind Energy Association. (n.d.). *Basics of Wind Energy: How wind turbines work*.

28 Asociación Ecuatoriana de Energías Renovables y Eficiencia Energética. (2019, September 17). *What is Ecuador Doing to Diversify its Energy Matrix?*

29 Escribano, G. (2013).

with key actors during the field research period) and sources consulted during period of desk research also provided key information summarized in this section.

Table 3: Summary of Investigation Results

Summary of Results		Positive	Neutral/No harm done	Negative
Social Implications	*Upstream inclusion*		X	
	Midstream inclusion	X		
	Downstream inclusion		X	
	Perception/acceptance of the project		X	
Environmental Implications	*Upstream consideration*	X		
	Downstream consideration	X		
	Actual/perceived environmental impacts of the project		X	
National Implications	Implications for the energy matrix and priorities of Ecuador as a whole	X		
International Implications	Influence on the China-Ecuador relationship, on Ecuador's international identity and agenda more broadly	X		

Origins/History of the Project Villonaco

The history of the Villonaco wind farm project begins in 2002 in Loja, with engineering student Sr. Jose Vicente Aguirre's undergraduate thesis. While developing his thesis about alternative energy at la Universidad Técnica Particular de Loja (UTPL), Sr. Aguirre became interested in investigating whether the winds of Villonaco (a hilly range on the outskirts of the city of Loja) could be harnessed for pumping water/electricity production. Sr. Aguirre brought his research proposition to the local prefecture, and was able to gain the support of the Provincial Council of Loja under the administration of Sr. Raul Auquilla, which proceeded to form the Executing Unit of Renewable Energies (UEER) of the Council, and formed the project "Energy Aerogeneration for the Sustainability of Pumping Systems of The Province of Loja". The purpose of this project was to determine the feasibility of constructing artisanal windmills to extract groundwater in different parts of the province of Loja. This project gained the support of CAF, which provided a

non-reimbursable assistance (grant) to the Provincial Council that allowed the project studies to start.

One of the first barriers that was faced was the lack of local experience regarding the use of wind as a resource. It was quickly realized that places where wind could be used to pump water did not exist, and thus the project was reoriented, with the international technical assistance of the Catalan Energy Institute of Spain through the consultancy Normawind, towards wind measurement campaigns to figure out the best spot for a wind farm.

The Villonaco peak has long been a source of legend and story related to the strong winds of this summit. Thus, in the absence of much statistical wind data in this region, knowledge of old indigenous legends about the winds was relied upon. Locations of particularly strong winds along the Villonaco peak, called Huayrapungos ("Gates of Wind" in the indigenous language Quechua (sometimes spelled Kichwa in the Ecuadorian context)) were investigated, and about 6 of these sites along Villonaco were identified as potential wind farm sites. Even after identifying these sites as having the potential to be successful, the technological barrier of developing a project so high in altitude, where there would be losses in efficiency/energy production due to the lower air density, was realized and needed to be investigated and confronted.

Feasibility and basic engineering studies were concluded by the UEER in 2004, and confirmed that a site and project with one of the best wind average projections in the world (12 m/s annual average, identified by the Ministry of Energy of Ecuador as the largest wind resource in the country) had been identified. This attracted the interest of large manufacturers from all over the world. In this time, UEER became ENERLOJA SA, a company that was the bearer of the construction licenses and permits for the Villonaco project.

From 2004-2009, no further development of the Villonaco project took place, due to difficulties in negotiating the financing of the project and a change in government in the prefecture of Loja, and the licenses and permits of the project were transferred from ENERLOJA SA to a private company, Villonaco Wind Power. In 2009, leadership of the prefecture changed again when Sr. Rubén Bustamante Monteros took over as Prefect, and the project was revived. Licenses and permits for the project were transferred to the Ecuadorian state, and in 2010, then-president Correa made the decision to establish Villonaco as a 'Strategic Project of the Ecuadorian State'. The studies and intellectual property of the project were signed over from the public enterprise ENERSUR EP (previously ENERLOJA SA) to CELEC (la Corporación Eléctrica del Ecuador, Ecuador's state-owned electric power generation company) to enable construction, establishing that 30% of the surpluses of the commercial operation of the project would go to infrastructure works in Loja.[30]

Though financing the project was an initial struggle, Ecuador received a loan from the China Development Bank (CDB) in June 2011 for $2 billion, with $37.5 million of this loan earmarked

30 Aguirre, J. A. (2017). *Loja, capital del Viento y de la energía limpia del Ecuador*. Loja: Unpublished document recounting the origins and history of the Villonaco Wind Farm project.

for Villonaco.[3132] In August 2011, then-CELEC Manager Eduardo Barredo H. awarded the construction of the Villonaco wind project to the Chinese company GOLDWIND, signing a contract between CELEC and Goldwind on August 23rd, 2011 in the EPC (Engineering, Procurement and Construction)[33] modality, the purpose of which was the, "design, supply, installation and commissioning of the Villonaco Wind Farm", which included the supply and installation/construction of wind turbines, sub-transmission lines of 34.5 kV and 69 kV, the Villonaco Substation, and "Auxiliary Installations and Buildings".[34] This contract included a warranty/technical guarantee ('guarantee técnica') of 12 years.[35] Additionally, in 2016 CELEC EP signed a $1.7 million contract with Goldwind for three years of technical support.[36]

Operation, Energy Production and Productive Performance of Villonaco

With an approximate investment of 41.5 million USD,[37] the Villonaco wind farm first began tests of the turbines and generation units on January 2, 2013,[38] began the phase of experimental operation on April 24, 2013, and began commercial operation on July 1, 2013.[39] The wind farm has been operating normally within the requirements of the Ecuadorian Electrical System since. The Loja substation receives the energy produced by Villonaco, and connects this energy to the National Interconnected System (SNI).[40] According to Ecuador's Ministry of Electricity and Non-Renewable Resources, Villonaco has provided the SNI a net energy input of 299.10 GWh since initially entering into operation up through January 2017. Villonaco is a relatively small wind farm, consisting of 11 turbines and a total installed potential of 16.5MW. While the capacity of Villonaco is relatively small, it has been extremely productive/efficient for its size and projected output, having generated 52% more energy than predicted in the project's feasibility studies, exceeding expected electricity generation levels of 59.57 GWh/year to 90.92 GWh/year.[41] The turbines of the wind farm Villonaco have produced the highest capacity factor of all wind turbines installed by Goldwind at the global scale. Due to its extremely high capacity factor of 63.86%, Villonaco has been endorsed as a Clean Development Mechanism (CDM) before the United Nations Framework Convention on Climate Change (UNFCCC), according to the Certificate of Validation of the Emission Factor of Project 10054 "Villonaco Wind Power",

31 Alvaro, M. (2011, 28 June). *China, Ecuador Sign $2 Billion Loan Deal.* Wall Street Journal.

32 Ray, R., Gallagher, K. P., & Sanborn, C. (2019). Managing Risk in Chinese Overseas Development: Lessons for the Andean Amazon. In Peters, E. D. (Ed.), *China's Financing in Latin America and the Carribean* (pp. 129-152). Universidad Nacional Autónoma de México.

33 *What is the difference between an EPC and a Turnkey Project?* (2020, March 2). Construction Placements.

34 Email correspondence with Jimmy Valerezo, 3/30/20.

35 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

36 CELEC EP. (2016). *Soporte Técnico para la Operación y Mantenimiento de las Unidades de Generación de la Central Eólica Villonaco*. Servicio Nacional de Contratación Pública, Compras Públicas.

37 Aguirre, J. A. (2017).

38 MERRNR. (n.d.). *Villonaco.*

39 Interview with Sr. Jimmy Valerezo on 1/13/20; Email correspondence with Sr. Jimmy Valerezo on 3/30/20.

40 Anchundia, J. E. P. (2017). *Diagnóstico y análisis de generación de energías renovables no convencionales en el Sistema Eléctrico del Ecuador.* [Unpublished doctoral dissertation/master's thesis]. Universidad Laica "Eloy Alfaro de Manabí".

41 CELEC EP GENSUR. (n.d.). *Central Eólica Villonaco la de Mayor Producción por Turbina en el Mundo.*

published in the records of CELEC.[42] The Clean Development Mechanism is an agreement signed by the industrialized and developing countries that are part of the Kyoto Protocol which obliges them to adopt this alternative to offset their greenhouse gas emissions causing global warming. In this way the Electric Corporation of Ecuador, through the Villonaco Wind Power Plant, meets one of the main objectives of changing the energy matrix, generating clean and environmentally friendly energy.

SOCIAL IMPLICATIONS

Upstream Inclusion: Socialization/Consultation

While all government and GENSUR officials interviewed confirmed that the required processes of socialization and consultation were carried out, the local presidents interviewed either had no knowledge of these processes having taken place, or very little, and second-hand, knowledge. While it seems probable that the required processes did take place, the lack of significant direct local testimony about these processes makes it difficult to know exactly how free, prior and informed these consultation and socialization activities were, as they have left no strong or positive legacy in the minds of the local presidents interviewed.

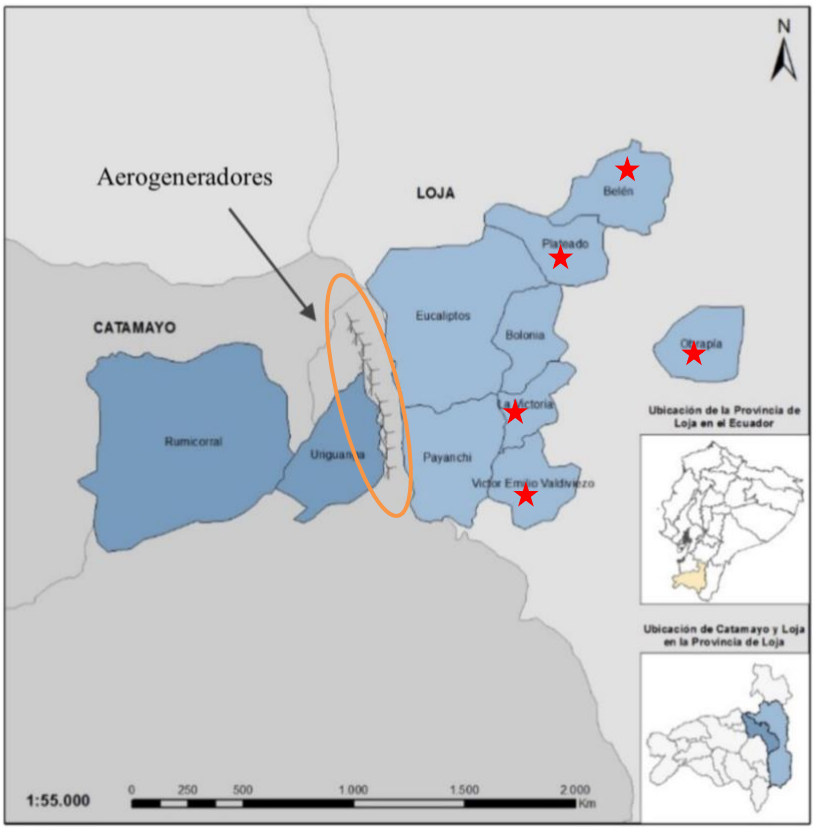
The official area of influence of the project was defined by the public enterprise GENSUR (the entity charged with development and management of the project), and comprises 10 neighborhoods, 8 in the jurisdiction of the city of Loja, and 2 in the jurisdiction of the city of Catamayo. Within this area, GENSUR has designed and currently implements a Territorial Community Development Plan (PDTC), which is (or at least purports to be) an instrument for local development. This plan is the result of the guidelines of MEER (Ministry of Electricity and Renewable Energy), which aims to promote economic and social development in the areas of influence of its new electricity generation projects, from construction through operation.[43] Figure 1 depicts the location of the wind farm in relation to the neighborhoods included in its area of influence.[44] The figure has been edited slightly from its original form to indicate in which neighborhoods interviews with local presidents were conducted with a red star.

42 CELEC EP. (2015). *Central Eólica Villonaco registrada como Mecanismo de Desarrollo Limpio.*

43 Vicuña, D. M., & Pérez, J. E. (2018). Aproximación metodológica al análisis de contenidos a partir del discurso de los actores. Un ensayo de investigación social de procesos de desarrollo local (Loja, Ecuador). *Empiria*, (39), 15–47.

44 Vicuña, D. M., & Pérez, J. E. (2018).

Figure 1: Location of the Villonaco Wind Farm and its Zone of Influence



Neighborhoods in red/denoted by red star in figure: Neighborhoods for which interviews with local presidents were conducted
Area within orange oval: Villonaco Wind Farm (individual wind turbines (aerogeneradores) denoted by three-pronged symbols)
Darker blue areas: Neighborhoods included in zone of influence in the municipality of Catamayo (Rumicorral, Uriguanga)
Lighter blue areas: Neighborhoods included in the zone of influence in the municipality of Loja (Belén, Bolonia, (Ciudad) La Victoria, Eucaliptos, Obrapía, Payanchi, Plateado, Victor Emilio Valdivieso)

All of the government officials interviewed during the period of field research reported that, to their knowledge, GENSUR, the public enterprise in charge of managing the Villonaco project, had complied with the required processes of prior consultation and socialization, and overall has performed well in the sense of being socially (and environmentally) responsible.

Verónica Giler and Briggette Flores of the Ministry of Energy and Non-Renewable Resources stated that CELEC's community relations were and have been excellent, and that CELEC has been involved in/with the communities in the area of influence since the beginning. They stated that an expectation of emblematic projects such as Villonaco is that the local community should

be the first beneficiaries.[45] Vice-minister of Electricity Sr. Gonzalo Uquillas also stated that GENSUR had complied completely and thoroughly with all social requirements of the project.[46]

Enith Carrión and Ricardo Amaya of GENSUR stated that they worked a lot with the people (presumably, those located in the areas of impact), on both the social and environmental sides of the project. They said that socializing the project was really important, particularly at the beginning, because initially people had fear and uncertainty of the project -- worries about noise, the effects on plants and animals, etc. Local authorities were also worried at the start because the technology related to Villonaco was new, there wasn't much existing knowledge related to wind technology. This necessitated a process of capacitation, how to operate, analyze, administrate this project/this kind of project.[47]

Enith Carrión and Ricardo Amaya stated that no indigenous populations live in this area, so this was not something that had to be taken into consideration during the consultation process. CONAIE, the Confederation for Indigenous Nationalities of Ecuador, was contacted for comment on this project, but did not reply.

These officials also confirmed that the land on which Villonaco lies was previously private land, so there was a process of expropriation/purchase of the land from its previous owners at the very beginning stage of the project, and municipality regulations regarding preservation were followed.[48]

A meeting and interview with the Sub-secretary of Environmental Quality (the department of the Ministry of the Environment responsible for reviewing the social participation processes and environmental impact assessments of prospective development projects, and issuing the environmental permits required for all development projects), was unfortunately unable to occur due to a scheduling conflict. The Sub-secretary was contacted via email for a remote interview or written comments, but did not respond.

The president of the neighborhood Ciudad Victoria, Sr. Wilmar Leiva, said that when the Villonaco project began, he was not living in Ciudad Victoria and was not in the role of president, thus he could not directly attest to the specifics of consultation/socialization. However, he had heard that there was socialization of the project, and that people living in the neighborhood hoped that the project would bring about positive change.[49]

President of the neighborhood of Obrapía, Sra. Digna Robles, did not know anything about the process of consultation/whether the neighborhood was consulted before the start of construction of Villonaco. She did say that she believed they were consulted in the late 90s about the possibility of the land being purchased, though this purchase consultation was not clearly linked

45 Interview with Sras. Verónica Giler and Briggette Flores, 1/7/20.

46 Interview with Sr. Gonzalo Uquillas, 1/8/20.

47 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

48 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

49 Interview with Sr. Wilmar Leiva, 1/16/20.

to the Villonaco project. The neighborhood did end up selling the land, and the cables were built.[50]

The president of the neighborhood Plateado, Sr. Ángel Tandazo, was not completely sure about the prior consultation of this project with the local community, whether Villonaco was fully socialized or not. He stated that after the construction of the project, CELEC did distribute some information regarding the wind farm, but that there was not/has not been a process of information transmission to the neighborhood throughout the entire lifecycle of the project.[51]

The president of the neighborhood Víctor Emilio Valdivieso, Sr. José Gaona Cruz, said that consultation/socialization of the project occurred under the neighborhood's previous administration, so he did not have much knowledge of the specifics of these processes. He said that since he has lived in the neighborhood, he saw the construction process take place, but that he and the residents of the neighborhood have never been informed of what was/is taking place at Villonaco, have never been informed of the specifics of the company developing/managing the project, etc.…all those living in Víctor Emilio Valdivieso knew was that turbines were being built, and all they know now is that they have been constructed and operational.

In sum, it does seem that GENSUR (most likely) complied with the minimum requirements of consultation/socialization for the project as stipulated by the Ley Orgánica de Participación Ciudadana, as it did receive the environmental permit needed to begin construction from the Undersecretary of Environmental Quality, a component of approval and permit issuance being review by the department that consultation/a public participation process did take place. The 4/5 interviewed neighborhood presidents that reflected on the topic either had no knowledge or very little specific knowledge of the upstream social inclusion phase of this project – none of them could directly attest to these processes having taken place. In contrast, all government and GENSUR officials consulted corroborated a tale of compliance with consultation requirements and praised GENSUR for its socially-responsible execution of the project.

Midstream Inclusion: Construction Phase

The midstream/construction phase of the Villonaco project does not seem to have had any direct positive employment benefits for the residents of the project's area of influence specifically. That being said, though the bulk of construction was dependent on the Chinese contractor Goldwind, there were also a number of Ecuadorian-based (and Loja-based) companies and institutions involved in this phase of the project.

According to the Ministry of Energy and Nonrenewable Energy (MERNNR) in 2018, the project Villonaco had created 254 direct roles of employment.[52] The Ministry does not elaborate, however, exactly what kind(s) of direct employment, or in what phases of the project these roles of employment were created, or whether this many people are still being directly employed.

50 Interview with Sra. Digna Robles, 1/16/20.

51 Interview with Sr. Ángel Tandazo, 1/16/20.

52 MERRNR. (n.d.). *Villonaco.*

Much more specifically, Sr. Jimmy Valarezo, Head of the Villonaco Wind Farm, reported that 500 people were employed in the civil stage of the project (the opening of access roads and platforms, construction of the foundations of the wind turbines, and construction of buildings)[53], 80 during the construction of the turbines, 40 during the construction of the substation, and 30 people during the building of the transmission lines. The civil works jobs began in July of 2011 with the opening of roads and internal pathways for Villonaco, so as to enable the construction of platforms for the turbines, and these jobs were developed by the Provincial Government of Loja, through the Public enterprise VIALSUR EP.[54]

The teams and components of the Villonaco Wind Farm arrived at the Port Authority of Port Bolivar, in the province of El Oro in Ecuador, on February 14, 2012 (From China). Transportation of these teams and equipment began in May 2012, and included sections of towers, gondolas, generators and blades. These activities were carried out in coordination with the Ministry of Transport and Public Works and the National Police of Ecuador.[55]

During the construction phase, in addition to the contractor Goldwind, the subcontractors were: NACYMEL-COINTEC (a construction company based in Quito) in the construction of the Collector System and the sub-transmission lines, Enerpetrol-COINTEC (an engineering and commercial company based in Quito) in the construction of the Villonaco Substation, Proyeconsul (an engineering services company based in Loja) in the construction of the Information Center and substation buildings, Santa Fé Montejo Villonaco (an exporter and supplier consortium of wind energy generation equipment based in Loja) in the transportation of equipment from Puerto Bolívar to Villonaco, and IMPAWIND (a Loja-based company comprised of local people from Loja that works in the construction, installation and maintenance of wind turbines and solar panels) in the assembly of the turbines.

Downstream Inclusion: Social Benefits (Jobs, improved infrastructure, etc.)

Information and testimony regarding this subset of social implications of the project was varied. All of the government sources/individuals consulted, as well as the individuals from GENSUR, reported that Villonaco has had many (successful) downstream benefits for the local communities, including jobs, infrastructure, and various development projects and services. The local presidents representing half of the area of influence, however, could not attest to receiving any benefits from the Villonaco project, apart from one president who mentioned that principal roads in his neighborhood had been improved. While plenty of benefits to the people of Loja, and of the area of influence specifically, are supposedly happening/have happened, it seems like in actuality they are either not being realized or are at least not perceived by those individuals who should be experiencing the benefits.

53 Email correspondence with Sr. Jimmy Valerezo, 3/30/20.

54 Email correspondence with Srs. Jimmy Valerezo and Israel García, 2/21/20

55 Centro de Interpretación, Central Eólico Villonaco. [Informational panels on the construction of the Villonaco Wind Farm]. Information Center visited/information consulted on 1/13/20.

According to the Ministry of Energy and Nonrenewable Energy (MERNNR) in 2018, the project Villonaco has benefitted more than 200,000 inhabitants of the canton of Loja. Additionally, MERNNR states that in the area of influence of the project, due to the implementation of 'new compensation practices', the following benefits/works have been put into place, all executed by GENSUR:[56]

- the improvement of infrastructure and equipment of Educational Centers
- provision of electricity supply to the parishes of Sucre and San Sebastián
- improvement of roads
- training of inhabitants of the area in phytosanitary control of crops, gardening and maintenance of green areas

The final environmental impact assessment and environmental management plan report for the Villonaco project, within its section on the project's environmental management plan, also discusses the territorial development plan for the project, documenting the name, details, and geographic location of 30 projects to be executed by GENSUR throughout many localities in the area of influence (see **Appendix 1**).[57] Many of these projects are water-related (construction/improvement of sewerage, potable water, and sanitation systems), others are related to construction (broadly) and construction of roads and recreational/sports facilities/fields, electrification and electric power services (this is a bit confusing, as several government and GENSUR officials stated that this project did not result in direct electrification, as all neighborhoods within the area of influence were already incorporated into the grid), and health (provision of equipment and basic sanitary services). Projects related to roads and sewerage are listed as destined for the neighborhood of Belén, projects related electric power service, sewerage and sanitation, and construction are listed as destined for the neighborhood of Ciudad La Victoria, and projects related potable water, sewerage and sanitation are listed as destined for the neighborhood of Victor Emilio Valdivieso. The other two neighborhoods whose presidents were interviewed during the period of field work, Obrapía and Plateado, are not listed as being destined to receive any projects.

Sras. Verónica Giler and Briggette Flores of MERNNR stated that there have been projects developed by CELEC jointly with the local communities, and stated that the wind farm has provided direct benefits to 14 million inhabitants, though they could not give specifics as to what these benefits have been. Additionally, their figure of 14 million direct beneficiaries is a bit unclear, as the total population of Ecuador is just under 17 million people (16,904,867, according to a July 2020 estimate).[58] It seems perhaps that they interpret Villonaco as having directly benefited most of the country's population, perhaps just by its provision of more energy into the SNI? Sra. Giler and Sra. Flores stated that the local communities can be seen as the direct/indirect beneficiaries of this project, it depends how the impacts of the wind farm are viewed.[59]

56 MERRNR. (n.d.). *Villonaco.*

57 Medina, B. P. (2014, July). *Actualización del Estudio de Impacto Ambiental Definitivo del Proyecto Eólico Villonaco: Parque Eólico Villonaco, Subestación Villonaco y Línea de Transmisión 69 KV, Villonaco: Informe Final*. CELEC EP GENSUR.

58 CIA. (n.d.). *SOUTH AMERICA: ECUADOR.* CIA World Factbook.

59 Interview with Sras. Verónica Giler and Briggette Flores, 1/7/20.

Enith Carrión and Ricardo Amaya of GENSUR, in a similarly positive vain, said that the first beneficiaries of this project were the local people, closest to the project. They said that GENSUR has done a great amount of work with local communities to capacitate them, to provide them with the tools, skills, and knowledge so that they can generate their own jobs. They stated that Villonaco has created jobs and led to associated productivity, particularly through the generation of small-scale business nearby the wind farm related to food, cleaning, reforestation, and other areas (for example, people can still walk their animals in the zones to the side of the plant, which can form a component of /provides a form of indirect work). This microbusiness and associated productivity created by the Villonaco have been significant because of the generated economic activity/benefits, and Sra. Carrión and Sr. Amaya stated that they expect these economic benefits to continue into the future.[60]

As regards direct, sustained jobs created by the project, 21 people currently work at Villonaco – 2 in management of the plant, 7 in the operation area, 6 in maintenance, 1 in the area of social and environmental management, 1 in the area of security and occupational health/safety, 2 in the cafeteria, and 2 in general services. Those involved in operations and maintenance work in the wind park itself as well as the substation. Almost all of these 21 individuals are from Loja, apart from two technicians who are from the city of Cuenca.[61] It was not specified how many, if any of these employed individuals, are actually from the area of influence of the project.

None of the 5 neighborhood presidents interviewed could attest to the creation of jobs in their neighborhoods specifically due to this project, and none said they had gained access/increased access to electricity due to the wind farm. Some said that the roads in their neighborhood had been improved slightly due to the project, but others said that the roads have actually deteriorated.

Photo 1: Interview with Sr. José Marcel Coronel, president of the neighborhood Belén

60 Interview with Sr. Jorge Maldonado-Correa, 1/14/20.

61 Email correspondence with Sr. Jimmy Valerezo and Sr. Israel García, 2/21/20.

The president of the neighborhood Belén, Sr. Jose Marcelo Coronel, said that the roads related to Villonaco have been a huge problem. To get to Villonaco, he described, you must travel through Belén, but the roads are not suitable, it is almost as if the roads have been abandoned. The roads are particularly treacherous when it rains. Truly, he said, there is no principal, well-functioning route to be able to travel up to Villonaco from Belén, (though in actuality not many people need to travel up to Villonaco this way).[62]

The president of Obrapía, Sra. Digna Robles, said that she did not know of, and had not been informed of, any environmental/social/development support plan of GENSUR for her neighborhood. However, she mentioned that she was part of a meeting with the Centro de Salúd and CELEC where plans to build a Health Center in the neighborhood of Santa Barbara were discussed. She did not mention when this meeting took place, and didn't know the current status of this project, which she believed was given a budget of ~$7 million.

The neighborhood of Obrapía is unique because it has high-tension power lines running directly through it, which carry electricity from Villonaco. However, this electricity does not go directly to those living in the neighborhood, it is incorporated into the National Interconnected System (SNI) at the Loja Substation. The president of Obrapía stated that she has not received any positive impacts from the project. They have not been the beneficiaries of any improved roads, and are not being consulted/working with CELEC on any current projects to compensate the neighborhood. The president stated that about a year ago, someone from CELEC came to the neighborhood to take some surveys and talk to people living in the area, but that they didn't return afterwards, haven't since, and that nothing came of this visit.

The president of Plateado, Sr. Ángel Tandazo, mentioned that a positive aspect of this project for his neighborhood was the construction of a principal pathway/roads. He also stated that CELEC has a plan to increase access to potable water within Plateado, but that this plan is not in action.

The president of Víctor Emilio Valdivieso, Sr. José Gaona Cruz, said that his neighborhood has not experienced any direct benefits from the project.

Thus, while the works supposedly executed by GENSUR (as reported by MERNNR), may have been executed, the representative authorities for half of the neighborhoods in the area of influence could not attest to the completion of these works, and did not report experiencing any benefits from this project, apart from the one president who mentioned the slight improvement of roads.

To the knowledge of Sra. Yelena Bustamante, Head of the Department of Economic and Social Inclusion for the Municipality of Loja, GENSUR helped to build some chozas (huts) in some of the neighborhoods close to the wind farm, but these actions have not been adequate. She said that people in the neighborhoods are trying to sell coffee, chocolate, empanadas, etc. out of these structures, but that the conditions are not adequate, and they are not well constructed.[63]

62 Interview with Sr. José Marcelo Coronel, 1/16/20.

63 Interview with Sra. Yelena Bustamante, 1/16/20.

In terms of increased access to electricity, locally this really isn't the case, as the neighborhoods in the area of influence were already electrified prior to this project, and the electricity produced by the plant is incorporated into the National Interconnected System.[64] However, it does mean better quality of local energy,[65] as well as increased local energy/electricity security.[66] Within the SNI there is an important connection between the cities of Loja and Cuenca. If something were to happen to this connection, the electricity production of Villonaco helps ensure that there would still be a supply of energy to Loja.[67] More than half of the energy demand of the city of Loja is met by the energy production of Villonaco, making this project a strategic decision/energy infrastructure investment for energy independence of the city, which was previously dependent upon thermoelectric plants powered by oil. Loja has the potential to be energetically autonomous due to Villonaco – it can cover all of the energy needs of Loja -- if there are changes in energy consumption patterns, with people shifting from being passive to active consumers of energy.[68]

Villonaco has also been significant for the city of Loja in its capacity as a tourist attraction. An overall increase in tourism/ecotourism, with many more people visiting the city of Loja, can be attributed to Villonaco.[69] The impact this has had on the communities located in the area of influence is unclear, however. None of the neighborhood presidents interviewed could attest to the increase in tourism having benefited their locality in any way.

The Villonaco Information and Capacitation Center (Interpretation Center), located in the wind park, is in a sense a piece of infrastructure, and thus can be seen as a social benefit not only to the local residents of Loja, but to people who wish to visit the wind farm from all over the world. The center is intended for visitors who wish to learn more about the development of wind energy in Ecuador and the different stages of construction of the Villonaco wind farm. It also serves as a meeting point for the inhabitants of Loja and Ecuador as a whole, where cultural and educational activities can be held. The center consists of a training room, reading room, gallery, cafeteria, exhibition room, and tourist viewpoint/lookout.[70]

64 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

65 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

66 Interview with Sr. Gonzalo Uquillas, 1/8/20; video interview with Sr. Manuel Ayala Chauvin, 1/13/20.

67 Interview with Sr. Jimmy Valerezo, 1/13/20.

68 Video interview with Sr. Manuel Ayala Chauvin, 1/13/20.

69 Interview with Sr. Renato Paredes, 1/15/20.

70 Centro de Interpretación, Central Eólico Villonaco.

Photo 2: Visitor Center (Centro de Interpretación) at the Villonaco Wind Farm

As described in the above section on the history of the Villonaco project, when the project was signed over from ENERSUR EP to CELEC in 2010, it was established that 30% of the surpluses of the commercial operation of the wind farm would go to infrastructure works in Loja. Several interviewed stakeholders, including Sra. Carrión, Sr. Amaya and Sr. José Vicente Aguirre, mentioned their knowledge of this contractual stipulation, but also said that they had seen no evidence of this 30% going towards any kind of investment in Loja.[71]

Perception/Acceptance of the Project:

Generally, all government and GENSUR-affiliated actors (personally) perceived the project as wonderful (in every way, essentially), and also reported that the local communities surrounding the project and people of Loja/Ecuador more broadly, have readily accepted the project and feel very positively towards it. The civil society/more locally-representative stakeholders I spoke to, however, broadly felt indifferent to or approved of the project in its capacity as a wind farm, but were dissatisfied with the project often due to lack of follow-through on promised projects/programs, or due to worries related to the wind farm (particularly in Obrapía). Another common theme across these local actors directly impacted by the wind farm was their lack of any kind of holistic knowledge of the project/wind farm itself. This was the area of social implications in which information and opinion was most varied and dissonant.

President of Belén, Sr. José Marcelo Coronel, said that while he hasn't heard of any complaints/specific problems from residents of his neighborhood, and everything is calm, the roads are the main problem. He said that CELEC did say it would assist Belén as part of its portfolio of Villonaco-related projects, but the company has left the roads destroyed/abandoned, and has not left the neighborhood with anything positive. In his personal opinion, Villonaco is positive in the way it is producing electricity, nothing more. Additionally, as regards expectations, he said that at the beginning of the project, it seemed/was said that the wind farm

71 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20; interview with Sr. José Vicente Aguirre, 1/16/20.

would result in electricity being cheaper. However, in reality, electricity has actually become more expensive. Thus, there is no benefit to the neighborhood from the wind farm.[72]

The president of Ciudad Victoria, Sr. Wilmar Leiva, said that he believes the project is positive in the way it is cleanly generating energy, but that several projects have been promised to his neighborhood that have not been executed. His neighborhood needs an environmental sanitation project to better treat residual/waste water, and strengthen their system of drinking water, as in December 2019 alone, the neighborhood went three days without water. His main complaint is that there have been offers of these projects and programs, from both CELEC and the municipality, but nothing has happened, despite there being written agreements for these projects. He felt that the will and desire of CELEC and municipality to help them does exist, but the technical follow through and resources to execute these projects is lacking. He also expressed that while this project has been novel and is well-known at the national level, there is no diffusion of information about the project to the local population – the community has no knowledge of exactly what the project is, how much energy and economic resources it is generating. He expressed that children in schools and college students are not being invited to the wind farm to know the project better. Additionally, there is no dissemination of the local development plans of CELEC. Overall, the local population is very little informed about the details of this project, though they are the people living closest to it.[73]

Photo 3: High-tension power lines in the neighborhood of Obrapía

In the neighborhood of Obrapía, the high-tension cables that run through the neighborhood, carrying electricity from the Villonaco substation to the Loja substation, are a huge concern/worry. As described by the president of the neighborhood Sra. Digna Robles, there is the impression/widespread belief that these cables are somehow related to the high incidence of

72 Interview with Sr. José Marcelo Coronel, 1/16/20.

73 Interview with Sr. Wilmar Leiva, 1/16/20.

various types of cancer/deaths from cancer in the neighborhood (recently, one person has died from throat cancer, one from stomach cancer, two from lung cancer, and one from prostate cancer). The president said that she doesn't know exactly how, but she believes that the cables somehow create an atmosphere of heightened risk within the neighborhood, that they contaminate the air somehow, that they generate something (she couldn't think of the word). There is also the fear that the cables could fall when there are storms, earthquakes or rain, and could cause damage to peoples' homes or personal property, as the cables run directly through the town, very close to many homes. Sra. Robles said she remembers one instance of a whole section of cables falling, a couple of years ago, which resulted in the death of some chickens, but no other damage.

Sra. Robles said that she, and the residents of the neighborhood in general, do not have any issue with the wind farm itself, she thinks it is good that Villonaco is able to generate clean electricity using the wind. However, the cables of huge concern, and the residents of the neighborhood feel that these cables pose danger to them. Robles said that Obrapía, being a smaller, poorer neighborhood further from the main city of Loja, is not very well known to CELEC, that it does not seem like CELEC is aware of the neighborhood and the negative impacts it is experiencing. A significant realization in interviewing Sra. Robles was that she did not actually know prior to the interview that the cables passing through her neighborhood were carrying electricity generated from the turbines of Villonaco/that they were directly related to Villonaco. She had just assumed that they were electricity cables of some kind, but was not at all aware of their relation to Villonaco.[74]

President of Plateado, Sr. Ángel Tandazo, said that one plan/agreement of GENSUR in relation to Villonaco was to increase access to drinkable water – this plan is not in action, though. Overall, Sr. Tandazo said that the project has been good for the region due to the fact that it doesn't pollute (or at least, doesn't contaminate like fossil fuels), its touristic impact and the nice view that the turbines provide.[75]

The president of Víctor Emilio Valdivieso, Sr. José Gaona Cruz, said that he and the people living in his neighborhood really have no complaints about the wind farm, but also have not received any direct benefit from it. He believes the touristic component of the wind farm is very positive, but his neighborhood does not benefit from the increased tourism in any way. He expressed that he would like GENSUR to be more involved in the neighborhood, specifically implementing a project to create more green spaces. Additionally, he mentioned that they were promised some sports fields and a recreational center by GENSUR, but that these projects have not been executed.[76]

Sr. Ricardo Amaya, the socio-environmental specialist for the Villonaco project, reported that 90% of people (those included in the area of influence) have accepted the project, while ~10% feel that they haven't benefited much/are dissatisfied. 10% of one community has expressed explicit discontent (GENSUR couldn't contract/engage with this community for administrative

74 Interview with Sra. Digna Robles, 1/16/20.

75 Interview with Sr. Ángel Tandazo, 1/16/20.

76 Interview with Sr. José Gaona Cruz, 1/16/20.

and technical reasons). This is apparently tied to the fact that in 2016 there wasn't money for social projects – they (GENSUR) have since been working on financing a project to further invest in this community.[77] Follow-up correspondence with Sr. Amaya and Sra. Carrión was attempted so as to clarify this point, but no response was received.

The turbines do produce some noise, which has reportedly been bothersome to/a complaint of some of the people living closest to the wind farm, according to Enith Carrión and Ricardo Amaya. They stated that there are plans in place to mitigate the noise produced by the turbines by installing acoustic silencers, though this solution is still being tested/is still in the beginning stages of execution.[78]

Sra. Yelena Bustamante, Director of Loja's Department of Economic and Social Inclusion, shared her personal perception that as a clean energy/development project, Villonaco has been excellent, but that it has not been executed with sufficient social development in mind. In other terms, she feels that the vision of GENSUR has not been optimal, that the project has not been executed with a proper vision of social or economic development, and has negatively affected the well-being of the people who live in the area of influence. She said that she knows various people that live close to the wind farm who complain of the noise generated by the turbines, and describe the noise as unbearable and negatively impacting their health. She also knows of people who are selling their lands and homes for this reason, that these areas close to the wind farm are an adequate place to live/have a home.

Though Sra. Bustamante views the project positively in terms of it being a case of clean/renewable electricity generation, and for the positive touristic component of the project, and mentioned that its energy output has to some extent served to lower the local costs of electricity and energy in general, she doesn't feel that the project has had any real positive impact on the local population, and stated that the positive tourism impacts do not make up for the lack of local development. Sra. Bustamante stated that she thinks an adjustment in GENSUR's vision for Villonaco towards one that prioritizes social development is the best thing that could happen to the wind farm.[79]

In contrast to much of the testimony regarding perception and acceptance thus far, Vice-minister of Electricity Sr. Uquillas described the Villonaco project as outstanding overall, saying that the wind farm makes people (the people of Loja, specifically) proud, that they identify with the project and have confidence in it, and that people want to go and visit the wind farm, not just people from Ecuador, but from the US, Peru and Colombia (as well as other countries). Vice-minister Uquillas stated that Villonaco has generated interest in the (local) people, and is a good example of how to complete a socially and environmentally responsible project.[80] Verónica Giler and Briggette Flores of MERNNR similarly expressed their belief that the local population has been very accepting of Villonaco I, and wants the future projects Villonaco II and III.[81]

77 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

78 Discussion/tour of the Villonaco Wind Farm with Sr. Roberto Fernandez, 1/13/20.

79 Interview with Sra. Yelena Bustamante, 1/16/20.

80 Interview with Sr. Gonzalo Uquillas, 1/8/20.

81 Interview with Sras. Verónica Giler and Briggette Flores, 1/7/20.

Professor Manuel Ayala Chauvin also expressed that social acceptance of Villonaco has been a huge success of this project. Professor Jorge Maldonado-Correa said that he believes Villonaco is largely accepted by the local community, though in some suburban neighborhoods of the city of Loja peoples' basic needs are still not being met. Thus, while these people/communities aren't explicitly against the project, there exists discontent and doubt about the priorities of the local government – i.e. why has time/money been used to prioritize this project, but not certain communities' access to clean water?[82]

Thus, there was extreme discrepancy in the reported perception and acceptance of this project by the different actors/stakeholder groups interviewed, and while various government officials and other professionals expressed that the project has been and is accepted and viewed very positively by the community, the representatives of these local communities (the neighborhood presidents), as well as the input of some other individuals made it clear that this is not the case, that there is in fact discontent, worry, and even fear, related to Villonaco, in many cases tied to a mismatch between expectations and reality, namely the lack of follow-through on many of GENSUR's promised projects with communities.

ENVIRONMENTAL IMPLICATIONS

Upstream Consideration: The Environmental Impact Assessment

Copies of the Preliminary Environmental Impact Assessment (EIAp) and the Definitive Study of Environmental Impacts (EIAD) were obtained from Professor Manuel Ayala Chauvin, who was himself involved in the phase of preliminary studies for the Villonaco project. An updated version of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP/PMA) conducted for the Villonaco project in March-June 2013 was provided to me by Sr. Ricardo Amaya, Specialist in Environmental and Social Management for Villonaco, following our interview on January 13, 2020. This is the document that will primarily be considered and referred to in this section, as it is the most updated and comprehensive of the three assessments obtained and reviewed, and builds upon the findings and conclusions of the first two. The updated EIA was executed by a technical team of four environmental consultants, led by lead consultant Sr. Boris Pucha Medina, over the course of 90 days in 2013. In its introduction section, the assessment confirms that this project was granted an environmental permit by the Ministry of the Environment (Undersecretary of Environmental Quality more specifically) on July 26, 2011 following review of the EIAD, an important and most basic first step in executing an environmentally responsible (and fully legal) development project.[83]

The EIA begins by identifying/establishing the environmental baseline, the environmental conditions of the site where the Villonaco Wind Farm is now located before any work on the project began, describing the climate, soil, hydrology, landscape, flora, fauna, human settlements

[82] Video interview with Sr. Manuel Ayala Chauvin, 1/13/16.

[83] Medina, B. P. 5.

and socio-environmental indicators of the area. In qualifying and evaluating the various environmental impacts identified, the assessment looks at the extent, intensity and duration to measure magnitude, and reversibility, location and time to measure the importance of these various impacts.[84]

In addressing the issue of noise often associated with wind farms, the EIA notes that noise produced by the operation of the wind farm is mainly due to the movement of the wind turbine blades. The study states that because these turbines are modern turbines they are "practically silent", and at distances greater than 200m, the whistling sound produced by the blades is completely masked by the noise produced by the wind as it moves through the trees and shrubs of the mountainside. The study identifies two potential sources of noise at the location of the turbines: mechanical noise, produced by the movement of the transmission and generation system; and aerodynamic noise, generated by the flow of the wind over and behind the blades of the turbines. The higher the turning speed of the blades, the greater the sound produced. The study states that due to the perpetually strongly windy climate of the area, the main noise produced will always be the background noise produced by the wind itself.[85] Field monitoring of noise was carried out as part of the assessment to determine the degree of compliance with the Levels of Equivalent Sound Pressure (NPS eq) established as permissible in Ecuadorian legal regulations. The average results of this monitoring were below the 50 dB (decibel) range, within the legally acceptable noise range for a residential area.[86]

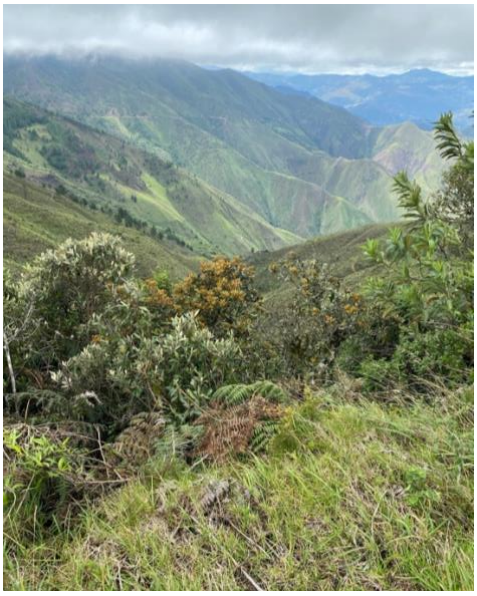


Photo 4: View of the valley below the Villonaco Wind Farm

In its section on the ecosystems and natural environment of the cerro Villonaco, where the wind farm is located, the EIA notes that this area has already experienced high levels of human intervention and conversion of most of its original vegetation cover to other uses. It states that in

84 Medina, B. P. 39-46.
85 Medina, B. P. 69-70.
86 Medina, B. P. 70-72.

this area, the species of large mammals are locally extinct or have been displaced due to human intervention undergone by the site before implementation of the wind project.[87] The study describes in great detail the various specific flora and fauna of the area of the wind farm.

Bird mortality is one common environmental concern and realized impact of wind farms, thus it is appropriate that the EIA for the Villonaco project identifies all of the 29 species of birds registered as living in this area, as well as their state of conservation. All 29 of these bird species fall in the conservation status category of 'least concern', as determined by the "Libro Rojo de las Aves del Ecuador" ("Red Book of the Birds of Ecuador") by Granizo et al. 2002.[88] A comment by many of the actors I spoke to was that not enough research has been done on the impact of Villonaco on birds, and not enough consideration of this impact has been calculated into the design or remedial projects of the wind farm.

The EIA also investigates and summarizes the sociocultural impact of the Villonaco project. It states that the rural parishes of Sucre and San Sebastian are those that experience the most direct influence from the wind farm, and are also the most populated localities included in the area of influence, with respective populations of 69,441 and 55,035. In contrast, the least-populated neighborhood in the area of influence is El Sagrario, with a population of 15,162. [89] It is also noted that an important metric of social wellbeing, poverty due to unsatisfied basic needs (UBN), is 43.59% at the canton level.[90] This metric is not compared to national metrics, but it does seem significant that over 40% of people in the area in which Villonaco is located are impoverished due to not having their basic needs met. This metric also makes more significant the lack of follow-through by GENSUR on many/seemingly most of the development projects promised to neighborhoods in the area of influence of the project. This section of the EIA also discusses the economy, educational and basic services, and social organizations of the area. It does specifically state that all in the area of influence have access to electricity in their homes.[91]

The EIA then identifies the activities related to the operation and maintenance of the wind farm that generate environmental impacts, the environmental factors affected or benefitted from the operation and maintenance of the wind farm, and the (potential) impacts from operation and maintenance of the wind farm.

The EIA states that the activities generating negative impacts resulting from the operation and maintenance of the wind farm (and in order of importance) are:

1. Construction of new civil works (ex. roads, turbine platforms)
2. Noise generation
3. The movement of large amounts of earth/soils (necessary for construction of the turbine platforms)
4. Generation of solid, liquid and hazardous waste
5. Maintenance and cleaning of built works

87 Medina, B. P. 76.

88 Medina, B. P. 84-85.

89 Medina, B. P. 88.

90 Medina, B. P. 91.

91 Medina, B. P. 95.

6. Maintenance of primary works or facilities
7. Transportation of construction/aggregate materials
8. Adaptation and placement of new structures

And, activities generating positive impacts such as:

1. Control and supervision
2. Maintenance and operation of the wind farm, substation and sub-transmission line
3. Slope protection
4. Repair of works[92]

A more detailed description of these activities can be found in **Appendix 2**.

A comprehensive list of the impacts of the wind farm and their relative severity/incidence can be found in **Appendix 3**. The negative environmental impacts that will be generated as a result of the operation and maintenance of the wind farm that have a high degree of affectation/are most serious/damaging include: the increase in noise levels (necessarily inherent to the operation of the wind farm), disadvantages to the health of workers and local people (due to occupational risks or accidents, and the potential for residents to have accidents due to electrical risks to which they may be exposed), and work accidents.

The one positive environmental impact with a high degree of incidence is income generation to the local economy. The EIA states that this is because the operation and maintenance of the wind farm require skilled and unskilled labor, and this thus leads to employment and fixed income for people living in the area.

As regards birds, the impacts section of the EIA states that the impact on birds is estimated to be very small, since the wind farm is located in a place where the density/population of birds is not very high. It also says that the impacts to birds are difficult to measure due to their high mobility, but that there are no records of birds having suffered death or injuries in the period of implementation of the project as of June 2013 (after ~1.5 months of experimental operation).[93] Overall, this results in the impact of 'disturbance of wildlife habitats' being assigned a low degree of incidence.

Overall, the EIA for the Villonaco project is extensive, detailed and thorough. Justification is given for the ranking of certain risks/impacts as more serious than others, and the assessment looks at all of the major components comprising the environment impacted by Villonaco, as well as looking at the impacts/risks during each phase of the project. Ideally, a review of this EIA by a third-party environmental consultant knowledgeable about the region and the project would be the best judgement of whether this assessment is fully comprehensive and unbiased. In the absence of such an educated judgement, my impression of the EIA is that it is in fact comprehensive and high quality.

92 Medina, B. P. 130-132.

93 Medina, B. P. 126.

Downstream Consideration: The Environmental Management Plan

The Environmental Management Plan (EMP/PMA) for the Villonaco project was included in the same final updated report received from Sr. Amaya of GENSUR. The EMP is a legally required tool for development projects in Ecuador that proposes measures and strategies to avoid, counteract, remedy, and compensate for the environmental factors affected by a project, in this case the operation and maintenance of the Villonaco Wind Farm. Execution of the EMP is the total responsibility of GENSUR, and its compliance is audited by the Ministry of the Environment. In the EMP for Villonaco, the following programs are considered:[94]

- Impact Prevention and Mitigation Program[95]
- Signage Program[96]
- Waste Management Program: Solids, Liquids, Hazardous Wastes & Debris[97]
- Environmental Education and Training Program[98]
- Territorial Development Program (discussed in more detail in the *Social Implications: Downstream Inclusion* section of this paper, also see **Appendix 1**)[99]
- Contingency and Risk Program[100]
- Industrial Safety and Occupational Health Program[101]
- Rehabilitation Program of Affected Areas[102]
- Environmental Monitoring and Control Program[103]
- Abandonment and Closure Program[104]

In the EMP for each of these programs, the following parameters are elaborated: Name and type of program, detailed description of the program, objectives of the program, impacts to be managed, the party responsible for execution, the party responsible for verification and compliance of the program, temporality and frequency, implementation schedule, resources required for execution, costs, indicators, means of verification, and designs (if necessary).

The Environmental Monitoring and Control Program laid out in the EMP includes a designated bird monitoring program.[105] While bird impact of the Villonaco Project is projected to be low, this plan states that the affectation of fauna should be monitored on a monthly basis, for three days of the last week of each month, and the effects observed must be registered according to an

94 Medina, B. P. 136.
95 Medina, B. P. 137-145.
96 Medina, B. P. 145-150.
97 Medina, B. P. 150-162.
98 Medina, B. P. 162-167.
99 Medina, B. P. 167-168.
100 Medina, B. P. 168-178.
101 Medina, B. P. 178-182.
102 Medina, B. P. 182-183.
103 Medina, B. P. 183-189.
104 Medina, B. P. 189-191
105 Medina, B. P. 185-187.

official form provided in the plan. The plan provides the following strategies to avoid/solve impacts to flora and fauna in Villonaco:

- Design considerations
- Investigation of bird carcasses/flora and fauna patrols
- Modification of the habitat
- Deterrence techniques
- Removal of flora and fauna

Specifically, the plan recommends a wildlife patrol to search weekly for bird corpses, and to record the number and species of corpses found. The plan states that if the calculated mortality rate exceeds 2 birds/turbine/year or 1 raptor/9 years among the 11 turbines, then measures for habitat modification and/or deviation or deterrence of birds should be considered.

As regards habitation modification/deterrence, the plan recommends removing any accumulation of water in the vicinity of the wind farm, identifying and removing all sources of garbage, and conducting preventative landscaping/maintenance of areas between the turbines to reduce the production of seeds, insects, and rodent populations which may be attractive to birds.

The Environmental Monitoring and Control Program also includes a noise monitoring program which involves regular monitoring of noise levels generated by the wind farm and the Villonaco substation.[106] This plan does not mention; however, what steps are to be taken in the event that noise levels exceeding those safely/legally allowed by the appropriate national laws, are measured.

The EMP is very detailed and seems to be thorough in addressing all of the major/most serious impacts of the Villonaco project. Whether or not these programs have/are actually being executed is another matter, and unfortunately it was not possible to obtain more detailed/updated reports of the status of these projects.

Actual/Perceived Environmental Impacts:

The actual environmental impacts of the Villonaco project thus far seem to have been in line with the information laid out in the 2014 updated EIA. The information in this section is primarily based upon interviews with stakeholders.

Sr. Benjamin Ludeña, coordinator of MAE zone 7 (based in Loja), confirmed that GENSUR has complied well with all required audits and follow-up/monitoring documents of its EMP, specifically in the years 2012, 2015, 2017 and 2018. The MAE is still waiting to receive the environmental reports for the years of 2016 and 2019, though Sr. Ludeña did not express concern that these reports are still pending.[107] This was corroborated by Vice-minister of Electricity Sr.

[106] Medina, B. P. 188-189.

[107] Interview with Sr. Benjamin Ludeña, 1/16/20.

Uquillas, who stated more generally that GENSUR has complied with all technical and environmental requirements in their development and management of Villonaco.[108]

When asked about the environmental impacts of the project, Professor Jorge Maldonado-Correa stated that impacts have not been extensive or serious, but have included some deforestation, noise pollution, and production of oil by the turbines (as long as this oil is managed responsibly, he said, it is not a problem).[109] Sr. Ludeña similarly confirmed (as detailed in the EIA) that the plant also generates oil, batteries, and other wastes.[110]

According to Sra. Carrión and Sr. Amaya, Villonaco's reforestation program (part of the larger Rehabilitation Program of Affected Areas) has been inclusive and successful, with populations from the area of influence directly involved.[111]

Broadly, when asked about the environmental impact of the wind farm, the neighborhood presidents interviewed did not speak to any negative local impacts, but stated that the project was good for the environment because it generates clean energy. President of Obrapía, Sra. Digna Robles, expressed her belief that Villonaco has not affected the ecosystem in which it lies.[112] President of Plateado, Sr. Ángel Tandazo, did say that animals that would normally graze in the areas surrounding the plant are bothered by the noise produced by the moving blades of the turbines, and have had to move.[113] President of Victor Emilio Valdievieso, Sr. José Gaona Cruz, said that when the wind farm began operation, people in his neighborhood thought that the turbines were affecting the climate, bringing stronger winds to the community. He said that he then went up to the wind farm himself when the turbines were not running, and observed that the winds were just as strong, and he was able to tell the community that the turbines were not in fact causing the strong winds.[114] As regards noise, as mentioned in the social implications section, noise has been a complaint of some people living close to Villonaco, though none of the presidents interviewed complained of noise. As previously mentioned, Sra. Enith Carrión stated that GENSUR is in the beginning phases of implementing a project to reduce the sound generated by the turbines.

Though the EIA for the project projected the impact of the Villonaco wind farm on birds to be low/of little concern, as this is still one of the main environmental concerns related to wind farms in general, the issue was explored throughout the period of field research. The Ecuadorian branch of the international NGO Birdlife, Aves y Conservación, was consulted during the period of field research in Quito. While this organization was involved in the beginning phases of the wind project on San Cristobal (specifically in the assessment phase and design phase of the project), the first wind project that was completed in Ecuador, director of the NGO Sra. Tatianna Santander reported no involvement of Aves y Conservación with Villonaco, and specific

108 Interview with Sr. Gonzalo Uquillas, 1/8/20.
109 Interview with Sr. Jorge Maldonado-Correa, 1/14/20.
110 Interview with Sr. Benjamin Ludeña, 1/15/20.
111 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.
112 Interview with Sra. Digna Robles, 1/16/20.
113 Interview with Sr. Ángel Tandazo, 1/16/20.
114 Interview with Sr. José Gaona Cruz, 1/16/20.

knowledge of the Villonaco project. Sra. Santander had no knowledge of the measures that had been taken to protect birds in the area of Villonaco, or of any specific issues of bird mortality related to Villonaco. She did indicate that specific info on birds related to Villonaco should be included in the EIA conducted by GENSUR (which it is).[115]

Sr. Benjamin Ludeña of the MAE commented that there has been a lack of study of the impact of this project on birds. Specifically, he said that there needs to be a focused investigation into how many species of birds (ex. Paloma de Castillo, others), and how many total birds, have died by collision with the turbines of Villonaco. Sr. Ludeña expressed that from his personal perspective, GENSUR/Villonaco lacks a clear/strong environmental plan overall (though it has complied with the minimum plan requirements of the MAE).[116]

Sr. Renato Paredes, Director of Environmental Management for the Municipality of Loja, said that he had heard of some studies of nocturnal birds being conducted at UTPL. He stated that these nocturnal birds have died due to the moving turbines, and that these studies, at least in part, explored the idea of putting lights on the moving blades of the turbines so these birds can see them at night. He had heard about this study/project in its beginning phases, but nothing since. Personally, Sr. Paredes expressed that he feels there haven't been enough studies on the possible negative effects of this project, and that it is important to promote more investigation.[117]

Both Professor Maldonado-Correa and Professor Manuel Ayala Chauvin also mentioned hearing of studies that might have taken place looking at the Villonaco project's impact on birds, but said that they haven't seen any action taken to incorporate bird impact knowledge/impact mitigation plans into the improvement of Villonaco.

Overall, the Villonaco project has had very similar environmental impacts as those laid out in its EMP, with the possible exception of impacts on birds, as discussed below. The issue of noise produced by the project is one of the main realized impacts and concerns, though GENSUR has stated that they are in the process of addressing this issue. One discrepancy between the EIA and the actual/perceived impact is the subject of birds. While the EIA establishes that the impact of the project on birds is low, of the stakeholders interviewed, birds were the main environmental concern associated with Villonaco. Broadly, it seems that the Villonaco project has complied with the environmental requirements and audits of its EMP, though it could not be corroborated via official documentation or testimony from all actors interviewed whether all of the programs of the EMP actually are being executed. While some government officials expressed personal sentiments that more environmental research and remediation needs to be done, most local stakeholders seemed to view the wind farm as having a net positive environmental impact, mainly due to its generation of clean energy.

115 Interview with Sra. Tatianna Santander, 1/6/20.

116 Interview with Sr. Benjamin Ludeña, 1/16/20.

117 Interview with Sr. Renato Paredes, 1/15/20.

Photo 5: Entrance to the Villonaco Wind Farm

NATIONAL IMPLICATIONS:

The national implications of Villonaco have been wholly positive by all accounts, as reported by all stakeholders interviewed. Many of these stakeholders corroborated the same conclusions re: Villonaco's national impact, namely, that its huge 'success' (both in terms of its high energy efficiency/production and socially/environmentally responsible execution and management) has had a decisive motivating influence on the research/feasibility studies into and prioritization of future clean energy (specifically wind) projects in the country, specifically the projects Villonaco II and III, which are currently in the midst of an international bidding process. Other key conclusions included that the project is a key piece in diversifying, strengthening, and expanding the national energy matrix and in transitioning the country into a more sustainable, energy-secure and energy-independent future.

Vice-Minister of Electricity, Sr. Gonzalo Uquillas, expressed that the 'golden rule' is that you should always keep a mix of energy, and wind energy (Villonaco) comprises an important part of this mix. He explained that it is very important to develop alternative energy sources, because many energy sources are fluxes, and cannot be solely relied on. For example, you cannot just depend on hydroelectric generation, as flows of water change with changing weather/climatic conditions (though in 2019, 99% of electricity demand was covered by hydro and renewables). Sr. Uquillas said that while most of the country is electrified, one area that still needs electrification is the Amazon. Connected networks to the Amazon need to be built, and the surplus of clean energy produced in Ecuador, in part by Villonaco, can be moved to the Amazon, to oil fields specifically. Sr. Uquillas also stated that as Villonaco is very close to Peru, it could potentially be incorporated into a regionally integrated electrical system. Lastly, he affirmed that Villonaco's (globally) impressive capacity factor was what motivated his personal and

professional encouragement of the projects Villonaco II and III in 2018.[118] Verónica Giler and Briggette Flores of MERNNR stated similarly that Villonaco exceeding all expectations for productivity was the reason that Villonaco II and III were planned.[119]

Sr. Esteban Casares, former Vice-minister of Electricity (from 2007-2009) and current head of the Electric Company of Quito, stated that within wind power, Villonaco is a unique project -- it has been positive for the country in terms of image, motivating more clean energy projects and building the country's technical and knowledge capacity, and technically positive in terms of its performance/high efficiency of energy production. Sr. Casares said that there have quite recently been studies of other potential wind power sites in Ecuador (including the provinces of Santa Elena, Imbabura, and Bolivar), and that the success of Villonaco I definitely helped the prioritization of Villonaco II and III. Sr. Casares also stated that later this year (2020) there will be a new national regulation regarding distributed energy/energy distribution. This regulation will mean the establishment of more distributed, smaller energy creation centers, with a couple of bigger ones, which will lead to more reliability and security of the electricity grid.[120] The Villonaco Wind Farm is one such example of a small, distributed energy creation center and will thus fit well into this future, more distributed grid, and has already (as described in the Results section) contributed to the reliability and security of local and national energy in Ecuador.

Sr. Benjamin Ludeña, coordinator of MAE Zone 7 (including the province of Loja) characterized Villonaco as an important reference for future clean energy endeavors, and as playing a key role in Loja's national status as a pioneer in clean energy. He mentioned that Loja is also working on other types of clean energy projects, namely solar plants. Sr. Ludeña also explained that while the MAE and GENSUR don't have much relation to one another/do not interact much (apart from MAE acting as supervisor, reviewing the activities of GENSUR), in 2019 the two entities signed an agreement to work together to preserve the Condor-paseo region in Loja. Broadly, he expressed that the intention and wish of the MAE is to develop further plans in conjunction with GENSUR and other organizations to protect the ecosystems of Loja, and to develop institutional strength and relationships in Loja.[121]

Sr. Renato Paredes, Head of Environmental Management for the Municipality of Loja, expressed that Villonaco is very important both for the city of Loja and the country as a whole due to its impact in combating climate change, as well as in motivating more broadly an awareness of the need to transition to cleaner forms of energy.[122]

Enith Carrión, echoing the responses of many others, said that Villonaco has been a good reference for future wind energy endeavors, and that the projects Villonaco II and III have retained the name Villonaco because of the good reputation of the first project. Sra. Carrión also said that 14 places of action for further renewable energy projects have been identified

118 Interview with Sr. Gonzalo Uquillas, 1/8/20.

119 Interview with Sras. Verónica Giler and Briggette Flores, 1/7/20.

120 Interview with Sr. Esteban Casares, 1/10/20.

121 Interview with Sr. Benjamin Ludeña, 1/16/20.

122 Interview with Sr. Renato Paredes, 1/15/20.

throughout Ecuador, and that la Cordillera (where Villonaco is located) is a particularly good region for wind. These 14 places/future projects are key to further diversifying the energy matrix.

Though the production of Villonaco only comprises 0.2% of the national energy matrix, its production is representative of the energy demand of the province of Loja. Villonaco is able to cover 25-30% of the energy demand of the province, the total demand of which is only 1% of national demand.[123] Villonaco's production of energy is also directly tied to a decrease in GHG emissions in the country, cutting national CO_2 emissions by roughly 35 million tons/year, and reducing the annual consumption of fossil fuels by 4.5 million gallons.[124]

According to Sr. Jimmy Valerezo, the wind farm Villonaco II is going to have 24-29 turbines, and Villonaco III will have approximately 31 turbines (compared to the 11 turbines of Villonaco I). These projects are thus expected to exceed not only the size, but the energy output of Villonaco I by a significant amount, and are expected to have similarly impressive capacity factors.[125] These wind farms are also set to be constructed in the same province/region of Loja, la Cordillera. This is evidence that this project (Villonaco I) is in fact scalable.

Professor Manual Ayala Chauvin said that Villonaco is nationally important in the sense that Ecuador is soon going to face a huge energy crisis. He explained that, as the country only has ~30 years of oil left (if the current rate/agenda of extraction and consumption continues), that structural change (shifting towards cleaner/renewable sources of energy, of which Villonaco is an example) and behavioral change (especially changes in consumption, a shift to more "active" consumption) are needed. "Active" consumers are conscious of what they are consuming, and Villonaco can help change peoples' attitudes and actions towards becoming more active consumers.[126] Similarly, Professor Jorge Maldonado-Correa of UNL stated that this project has awoken (Ecuadorian) people's awareness of the need for clean energy, and the importance of moving away from combustibles. Additionally, its production of clean energy (though small relative to total national demand) has reduced reliance on dirtier forms of energy production (ex. Thermo-electric plants that run on diesel).[127]

In sum, Villonaco has had a number of positive national implications, from being a part of the changing perception around and prioritization of clean energy (projects), to bringing pride to the country and region for being such a successful and unique project, to being a unique and important instance of diversifying the national energy matrix. Though the neighborhood presidents interviewed reflected mostly on their local knowledge/perception/experience of the project, most of their positive comments about Villonaco had to do with their appreciation of the fact that the wind farm was generating clean energy (as well as increased tourism).

123 Interview with Sr. Jimmy Valerezo, 1/13/20.

124 Medina, B. P. 5.

125 Interview with Sr. Jimmy Valerezo, 1/13/20.

126 Video interview with Sr. Manuel Ayala Chauvin, 1/13/20.

127 Interview with Sr. Jorge Maldonado-Correa, 1/14/20.

INTERNATIONAL IMPLICATIONS:

Overall, the international implications of Villonaco have been very positive, particularly in the way it has reflected upon/been reflective of Ecuador's increasingly dynamic relationship with China, the capacity it has enabled Ecuador to build in its ability to pursue future wind projects, and the way in which Villonaco has been an international record-breaker and helped Ecuador to meet some of its international climate commitments.

Broadly, according to Sr. Chen Jiahui, (Attaché of the Office of Economics and Commerce of the Chinese Embassy in Quito), Villonaco fits into the Chinese-Ecuadorian relationship in the sense that China and Ecuador have already (recently) developed many clean energy projects together, particularly hydroelectric plants Coca Codo Sinclair and Sopladora, and Villonaco is a neat continuation of this clean development trend. As stated by Sr. Jiahui, China and Ecuador have developed diverse bilateral projects in the areas of energy, oil, infrastructure (including bridges, hospitals, an airport), and the Chinese in particular want to implement more projects like Villonaco. Sr. Jiahui said that he has heard talk that the government of Loja is interested in this possibility of future development projects with China[128].

Sr. Jiahui also explained that Villonaco fits into the historic economic relationship between Ecuador and China, which is based on the fact that China is a large country with many technical resources/highly developed industries and a need for natural resources, and Ecuador is a small country, very rich in natural resources but in need of technical and financial support – the interests of these two countries thus complementing one another. Sr. Jiahui said that renewable energy is a priority/expectation/area of interest for both countries at this time. Both countries want to have a transformation/transition towards clean energy, hence the trend of bilaterally developed clean energy projects, and the expectation that this kind of development will continue.[129]

As regards future Chinese-financed and Chinese-developed projects (and Chinese involvement in general) in Ecuador, Sr. Jiahui said that there are currently more than 90 Chinese companies doing business in Ecuador, as well as other collaborating Chinese entities that have their own plans and interest in implementing their own projects in Ecuador. If these projects are in good faith, said Sr. Jiahui, the Chinese Embassy supports them (their plans and projects).[130]

As concerns the present and future influence of Villonaco on further wind projects, a significant implication/positive impact of the project is that it has led to substantial institutional capacity building within Ecuador and CELEC/GENSUR, allowing the country and its clean development institutions to gain the knowledge/experience of contracting and executing a successful wind project necessary to pursue further wind projects with new international partners. This is illustrated by the projects Villonaco II and III, which are currently in an international bidding process, with 7 prequalifying shortlisted private companies currently undergoing further

128 Interview with Sr. Chen Jiahui, 1/10/20.

129 Interview with Sr. Chen Jiahui, 1/10/20.

130 Interview with Sr. Chen Jiahui, 1/10/20.

evaluation of their bid proposals.[131] These projects will not be developed in tandem with Goldwind (as it is not one of the 7 shortlisted companies), and likely not with any Chinese firm/financing. The contracts will be awarded on a technical and economic basis (the best tender will be chosen).[132]

Related to the technical level of Villonaco, there is a challenge/international stipulation. There are closed blocks (of wind turbine technology) dependent on the manufacturer (Goldwind) that the Villonaco wind farm depends upon. In other words, there are certain parts of the turbines that can't be replaced/supplanted without materials/assistance from Goldwind.[133] A manifestation of this is that in 2019, CELEC signed a contract with Goldwind for the acquisition of various spare parts for the generation units of Villonaco, as well as a contract for the acquisition of ultrasonic sensors for the measurement of wind speeds.[134][135] This means that the operation of Villonaco will always have some dependence on Goldwind.

Beyond Villonaco's implications for Ecuador's relationship with China, the project has also garnered international attention and praise for its incredibly high capacity factor and overall unique nature, positive attention which in turn has reflected well upon Ecuador as a country trying to transition to cleaner forms of energy. In 2015, GENSUR received recognition from the Embassy of the People's Republic of China, along with Goldwind, for Villonaco being the wind farm with the highest capacity factor in the world.[136] Furthermore, Villonaco has helped Ecuador to fulfill some of its international climate commitments, specifically through its endorsement as a Clean Development Mechanism (CDM) before the UNFCCC (discussed in greater detail in the Results section).[137] Lastly, Villonaco is internationally unique in that it is the highest wind farm in the world, at 2,720m above sea level, a fact which is not only novel and interesting, but which makes the feat of its construction and technical success so impressive.[138]

6. Summary & Conclusions

Summary of Results

GENSUR was confirmed to have complied with the upstream inclusion requirements of prior consultation of the communities in the designated area of influence/creation of a plan for

131 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

132 Interview with Sr. Gonzalo Uquillas, 1/8/20.

133 Interview with Sra. Enith Carrión and Sr. Ricardo Amaya, 1/13/20.

134 CELEC EP. (2019). *Adquisición de Repuestos para las Unidades de Generación de la Central Eólica Villonaco.* Servicio Nacional de Contratación Pública, Compras Públicas.

135 CELEC EP. (2019). *Adquisición de Sensores Ultrasónicos para la Medición de Viento dn Aerogeneradores Goldwind GW70/1500 de la Central Eólica Villonaco.* Servicio Nacional de Contratación Pública, Compras Públicas.

136 CELEC EP GENSUR. (n.d.).

137 CELEC EP (2015).

138 Interview with Sr. José Vicente Aguirre, 1/16/20.

community development, and conducted a comprehensive EIA and formulated an EMP that was approved by the MAE. Furthermore, GENSUR has complied with yearly audits of their EMP, as confirmed by local MAE representative Benjamin Ludeña, who is based in Loja.

As regards midstream inclusion, while a number of Ecuadorian companies were involved in the initial construction phase of the project, the majority of individuals involved in this phase were not local to Loja or residents of the designated area of influence. Construction was carried out primarily by workers affiliated with Goldwind, and the Ecuadorian companies involved were mainly larger corporations based out of Quito.

In the downstream (current) phase of the project, most individuals directly working at/for the wind farm are locals of Loja. Additionally, almost all company and government officials interviewed stated that those living close to the wind farm have been the first beneficiaries of the project, and that the creation of various kinds of indirect employment and capacitation has resulted from the Villonaco project, for example people selling coffee and food in the neighborhoods close to Villonaco/included in the area of influence, people from these neighborhoods gaining employment in maintenance of the grounds of the wind farm, related janitorial and cafeteria services. However, none of the 5 neighborhood presidents I spoke to could attest to these kinds of employment opportunities being created in their neighborhood as a result of Villonaco.

Perception and acceptance/reported acceptance of the Villonaco project was mixed. All of the governmental individuals I spoke to spoke only the highest praises of the project, in all capacities, and spoke with confidence about the inclusive, socially-responsible and socially-accepted nature of the project. At the most local level, the five neighborhood presidents I spoke to had varying testaments of the perception and impact of the project on their neighborhoods. Overall, these individuals reported that in general, they, and the people of their neighborhood, had no problem with the project, and that in general they thought it was a good project, as it is generating clean energy. However, they complained of several different negative impacts that the project has had (negative impact of high-tension power lines in Obrapía, deteriorating roads in Belén, no follow-through on clean water programs in Ciudad Victoria). Thus, it seems like the perception of the project in the broadest sense is positive, but the perception of the (effects of the) project within the local context of some neighborhoods was negative.

These neighborhood representatives did not report being the direct and first beneficiaries of the Villonaco project. This being said, any discontent that was expressed to me was relatively latent. There seems to exist no potent discontent, there have been no protests or public demonstrations of discontent, and no outright abuses of human rights or environmental rights seem to have occurred. Thus, it seems that the figure of 90% satisfaction, 10% dissatisfaction reported to me by the socio-environmental specialist of Villonaco, Sr. Ricardo Amaya, is likely a good estimate. However, the theme of lack of follow-through and unkept promises by GENSUR should not be underestimated, as it reflects a gap in many of the supposedly executed/promised benefits of the project to the local communities, and thus hurts Villonaco's ability to have a net positive impact. Moreover, these shortcomings hurt the local communities' likelihood of accepting future projects and their related promises, and cast doubt on other supposed plans of GENSUR, namely the project to address the issue of sound pollution.

As regards upstream environmental consideration, an EIA for the Villonaco project was conducted, and seems to be comprehensive and detailed in its evaluation of the projected environmental impacts of the project. The EMP created for the project seems similarly comprehensive, the only shortcoming being the lack of a plan of action within the Noise Evaluation Plan for a scenario in which the measured noise levels were to exceed the normal allowable level. As regards the actual environmental impacts (and relatedly, performance of the EMP), and perception of environmental impacts of the wind farm, there were no major accounts or claims of environmental degradation related to the project. The most common/serious impact seems to be the noise generated by the turbines, which GENSUR claims to be addressing.

While bird injury and mortality is a major concern/environmental impact typically associated with wind farms, the EIA for the Villonaco project identifies negative impacts on wildlife (birds included) as being of low concern. That being said, many of the stakeholders interviewed expressed concern over the impacts of the wind farm on the area's birds, and expressed that GENSUR has not done enough to investigate and mitigate the impacts to birds.

The environmental implications of the Villonaco project overall seem to have been neutral/slightly positive. GENSUR appears to have complied with the bulk of the required environmental requirements, with the exception of the submission of its 2016 environmental report. All recent audits/reviews of its EMP have been approved by the MAE. Most importantly, the project does not seem to have caused any considerable environmental degradation, and it is positively impacting the environment more broadly by reducing fossil fuel consumption and CO_2 emissions in the country. That being said, it would be beneficial to investigate more into the purported studies being conducted about Villonaco's impact on birds, and into the measures being taken by GENSUR to address noise complaints. In addition, it would be helpful to follow up on the submission of the 2016 environmental report to the MAE, and to review such upon submittal, since it is unusual for such a report to be more than 3 years overdue.

The national implications of Villonaco have been wholly positive by all accounts, as reported by all stakeholders interviewed. Many of these stakeholders corroborated the same conclusions re: Villonaco's national impact, namely, that its huge 'success' (both in terms of its impressively and uniquely high energy efficiency/production and socially/environmentally responsible execution and management) has had a decisive motivating influence on the research/feasibility studies into and prioritization of future clean energy (specifically wind) projects in the country; specifically the projects Villonaco II and III, which are currently in the midst of an international bidding process. Other key national conclusions are that this project is a key component in the diversification, strengthening, and expansion of the Ecuadorian national energy matrix and in transitioning the country into a more sustainable, energy-secure and energy-independent future.

Similarly, the international implications of Villonaco have been very positive, particularly in the way it has been reflective of and has helped to strengthen Ecuador's increasingly dynamic relationship with China, the capacity it has enabled Ecuador to build on its ability to pursue future wind projects, and the way in which Villonaco has been an international record-setting wind farm and has helped the country to meet some of its international climate commitments.

Photo 6: View of the Villonaco Wind Farm, taken from the UTPL campus in the city of Loja

Conclusions

Villonaco seems to, broadly, have been a very successful project, in terms of the high productivity/output in its technical performance, and in terms of its local socio-environmental performance (particularly in comparison to other recent development projects in Ecuador). While some local discontent and shortcomings of the project/of the project's promised benefits to the local population were exposed during the period of field research, GENSUR, as reported by multiple official sources, has adhered to the environmental and social requirements, and the level of discontent is very low, and no action has been taken by local discontented residents. This being said, the existing discontent and reflections on Villonaco as a whole from local presidents interviewed indicate that these local residents of the project's area of influence, and GENSUR, could benefit from a strategy of more frequent and comprehensive communication between locals and the executing entity GENSUR, to address current resident concerns and ensure everyone is on the same page, and relatively more understanding of the Villonaco project. The impacts of this project on the environment appear to have been minimally negative, and realized impacts, specifically some deforestation, are actively being addressed through plans established in Villonaco's PMA.

Villonaco has performed exceptionally well in the technical sense, with one of the highest capacity factors of any wind farm in the world. For the first project of its kind (a wind farm at

such high altitude, the first wind farm on continental Ecuador), it has been an outstanding project in all technical senses. It has increased Ecuadorian capacity to develop further wind projects with more independence in the future, has decreased fossil fuel combustion in the country (albeit by a small degree), has had a positive impact on the perception/acceptance/prioritization of clean energy within the country, and specifically has had a direct impact on the inception and development of plans for two more wind projects in the region of Loja, Villonaco II and III. Thus, though Villonaco's contributions to Ecuador's electricity and overall energy matrix are quantitatively very small, it has undoubtedly had a positive, greening impact on the energy matrix, particularly in how it has inspired and will likely inspire further green energy projects in the country. It is an emblematic national project that serves as an example of Ecuador's untapped renewable energy potential.

Villonaco also serves as a prime example of the transforming relationship of Chinese FDI and infrastructure development-involvement in Ecuador. It is a clear example of how successful (technically/energy production-wise, and also in terms of social/environmental responsibility) Chinese (green) investment can be in Ecuador. This project is a point of pride in the Ecuador-China relationship, as articulated by the many Ecuadorian government officials and the Chinese embassy representative who were consulted during field research, and it will hopefully inspire further green infrastructure funding/development by China in Ecuador. Villonaco serves as an indicator of how diversified Chinese economic involvement in Ecuador has become, and of how this involvement and economic relationship can continue to diversify into different types of investment and development, specifically the potential for green development.

Policy Implications

Most broadly, the case of Villonaco implies that energy/development projects more broadly (developed in Ecuador), and Chinese investment (related to these projects), are not necessarily going to be negative or have negative social and environmental impacts, contrary to what the typical narrative suggests. Villonaco has been able to avoid this narrative of large-scale controversy/conflict for a number of reasons. These include the type of project it is (renewable/clean wind energy), which detaches it from many of the environmental impacts/abuses endemic to other kinds of development and energy projects, namely oil and hydro, and min While the Villonaco project required some manipulation of the environment, it was relatively small scale and in only the initial civil and construction phases of the project, it was not located in an endangered or protected ecosystem, and was (is!) well-managed through its EMP. A second important reason why Villonaco has been able to avoid the negative narrative is the lack of indigenous presence. While historically, much of the conflict and controversy related to development projects has had to do with the siting of projects on indigenous land, insufficient or nonexistent consultation and/or compensation of indigenous peoples impacted by projects, and related human rights abuses, the geographic site elected for Villonaco does not lie on or near indigenous land (and does not appear to be an important indigenous site in any way). Prior to the start of development of the Villonaco Wind Farm, this land in Loja was paramo, uninhabited and unused for agricultural or other productive purposes. Thus, no displacement took place.

A third likely reason why Villonaco has been different, is its relatively small size, in comparison to most disputed projects. Broadly, this project being small meant that the environmental and social footprints of the project were smaller, less impactful, and less (potentially) controversial.

A fourth reason is that Goldwind seems to have been a very responsible contractor, having operated within all environmental and social parameters required by the Ecuadorian state for development projects. Additionally, the nature of the contract between Goldwind and CELEC, which contracted the Chinese firm for the construction of the wind farm and related technical support, meant that post-construction, this project has been managed entirely by GENSUR. Thus, this project featured a successful, though a relatively brief (in comparison to other projects) period of collaboration between Ecuadorian entities and Goldwind, which enabled Ecuadorian wind-related capacity-building to take place, and then put complete control over the project back in the hands of the Ecuadorian state. This is different from many other projects, in which the project is managed exclusively by a Chinese firm, or in which the operation/management structure is more complicated.

That being said, though Villonaco has avoided the worst of the typical development narrative, it has by no means been perfect. While many government officials and officials affiliated with GENSUR spoke highly of the project's social performance, in speaking to several neighborhood presidents, it was clear that there exists worry and discontent related to the project's negative impacts on these communities and lack of realization of various promised projects programs, as well as a lacking knowledge about the wind farm across much of the local population of Loja and the project's area of influence in particular. It is thus recommended that GENSUR engage more actively with the neighborhoods included in Villonaco's area of influence, and make sure it is **a)** on the same page with residents about what is expected and what is actually happening in terms of social projects executed by the public enterprise, and **b)** that residents are fully aware of what exactly the Central Villonaco is, and why their neighborhood is included in the area of influence (ex. In Obrapía, the local president did not know that the power lines running through the neighborhood were carrying electricity generated by Villonaco).

In other words, it is recommended that in the future, GENSUR be 'extra' conscious of its socialization process, and adhere to a comprehensive plan of community engagement throughout the entire lifecycle of its projects, so that it is on the same page as the local population (specifically as regards concerns and expectations). This will help to ensure that discontent or concerns related to their projects do not go unaddressed and manifest into larger issues involving very public discontent/protest.

As mentioned above, the other major policy implications of Villonaco are the positive impact it has had on the perception and success of green energy infrastructure projects in Ecuador. Its success has thus far had a hand in the development of two more wind projects, and may pave the way for other future green policies in Ecuador.

Recommendations for Future Research

Future research related to this topic could look into what the local impacts of the wind farms in Galapagos have been, or could examine the local impact of Villonaco's II and III as they move forward. Further research to make the analysis conducted here about Villonaco more complete would include testimony from the neighborhood presidents of the other 5 neighborhoods included in the area of influence not interviewed, as well as testimony from various residents living in all of these neighborhoods. Additionally, input from the various municipal representatives from the city of Catamayo would be helpful, as two of the neighborhoods in the area of influence were located in Catamayo, not Loja. Unfortunately, field research in Catamayo was not conducted due to limited time and resources, and the majority of the impact of Villonaco being in Loja.

Another recommendation for future research would be to explore the impact of green Chinese financing/infrastructure development across more of Latin America. Specifically, it would be interesting to compare the other wind projects that the firm Goldwind has been completed/been involved with in Latin America. In 2008, prior to the execution of Villonaco I, Goldwind executed a wind farm in Cuba, its first international endeavor. Since developing Villonaco, Goldwind has established wind farms in Bolivia and Chile, and has plans to expand into additional countries in the region, specifically Brazil and Argentina.[139]

Additionally, as the biggest limit of the research I have conducted in this study/about the Villonaco wind farm is that it is case-specific, and thus I cannot talk about its universal application, I would ideally like to conduct a multi-year analysis looking at both a random sample of projects executed by Chinese firms/with Chinese financing in similar sectors under similar conditions, and a random sample of projects executed by non-Chinese firms/without Chinese financing in similar sectors under similar conditions across Latin America. Such an effort would entail survey-based research, with control groups, comparing projects with Chinese involvement vs. without Chinese involvement to see if there's a statistical difference between the two.

139 Goldwind International Holdings (HK) Ltd. (n.d.). *Goldwind South America.*

Photo 7: The ‘Villonaco’ sign, and a view of several of the wind farm’s turbines in the background

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Appendices

Appendix 1: Projects Planned for Implementation as Part of the Territorial Development Plan[140]

#	Project Name	Geographic Location			
		Province	Canton	Parish	Locality
1	Roads and diagonal accesses	Loja	Loja	Sucre	Barrio Los Eucaliptos
2	Health (equipment)	Loja	Loja	Sucre	Barrio Los Eucaliptos
3	Electrification (via Villonaco)	Loja	Loja	Sucre	Barrio Los Eucaliptos
4	Potable Water (Studies and construction)	Loja	Loja	Sucre	Barrio Victor Emilio Valdivieso
5	Sewerage and Sanitation (Studies and construction)	Loja	Loja	Sucre	Barrio Victor Emilio Valdivieso
6	Potable Water (Studies and construction)	Loja	Loja	San Sebastián	Barrio Payanchi
7	Sewerage and Sanitation (Studies and construction)	Loja	Loja	San Sebastián	Barrio Payanchi
8	Sports and Recreation	Loja	Loja	San Sebastián	Barrio Payanchi
9	Electric Energy Service	Loja	Catamayo	El Tambo	Barrio Rumicorral
10	Potable Water (Studies and construction)	Loja	Catamayo	El Tambo	Barrio Rumicorral
11	Electric Energy Service	Loja	Loja	San Sebastián	Barrio Uriguanga
12	Sports and Recreation	Loja	Loja	San Sebastián	Barrio Uriguanga
13	Dwellings/Tenements (Construction of?)	Loja	Loja	San Sebastián	Barrio Uriguanga
14	Electric Energy Service	Loja	Loja	Sucre	Barrio Santa Bárbara
15	Sewerage and Sanitation (Studies and construction)	Loja	Loja	Sucre	Barrio Santa Bárbara

140 Medina, B. P. 168. Translation of unlabeled table.

16	Roads and Accesses	Loja	Loja	Sucre	Barrio Santa Bárbara
17	Electric Energy Service	Loja	Loja	Sucre	Barrio La Victoria
18	Sewerage and Sanitation	Loja	Loja	Sucre	Barrio La Victoria
19	Community construction	Loja	Loja	Sucre	Barrio La Victoria
20	Roads and Accesses	Loja	Loja	Sucre	Barrio Belén
21	Sewerage	Loja	Loja	Sucre	Barrio Belén
22	Potable Water (Studies and construction)	Loja	Catamayo	El Tambo	Ventanas, San Miguel, Chiriaco and Vigones
23	Basic Sanitary Units	Loja	Catamayo	El Tambo	Ventanas
24	Electrification	Loja	Catamayo	El Tambo	Ventanas
25	Electrification	Loja	Loja	Sucre	Menfis (upper, central, lower)
26	Sewerage	Loja	Loja	Sucre	Menfis
27	Electrification	Loja	Loja	Sucre	Sagrado Corazón
28	Potable Water (Studies and construction)	Loja	Loja	Sucre	Sagrado Corazón
29	Sewerage	Loja	Loja	Sucre	Sagrado Corazón
30	Community construction	Loja	Loja	Sucre	Bolonia

Appendix 2: Operation and Maintenance - Related Activities of the Villonaco Wind Farm Responsible for Generation of Socio-Environmental Impacts[141]

ACTIVITY	DESCRIPTION
A. Operation and Maintenance of the Villonaco Generation Plant	
1. Villonaco Wind Farm, Villonaco Substation, Villonaco 69 kV Sub-transmission line, and Complementary Works (Interpretation Center, Accesses, etc.)	
Maintenance and cleaning of constructed works	Maintenance of platforms, accesses, interpretation center, substation, sub-transmission line, etc.
Movement of earths, soils, rubble	Movement of earths/soils for the cleaning of existing works such as accesses, platforms, etc.
Repair of works	Repair of wind turbines, interpretation center, substation, sub-transmission line, etc.
Construction of new civil works	Construction of auxiliary works, retaining walls, concrete, etc.
Slope protection	Slope stabilization, drainage, reforestation
Maintenance of works or primary facilities	Maintenance of civil, painting plastering, floor, ceramics, sweepers, carpets, doors, windows, ceilings, lighting, electrical installations, water, sanitary, etc. works
Transportation of construction materials and debris	Transport of aggregates, construction materials, rubble, for the maintenance and improvement of civil works
Adaptation and placement of new structures	Adequacy of gates, handrails, etc. in civil works
Maintenance and operation of the wind power plant, substation and sub-transmission line	Maintenance and repair of wind turbines, transformers, lines, nets, boards
Generation of noise, shadows	Noise generation by operation of the wind turbines, substation and transformers, as well as a shadow effect due to the movement of the turbine blades
Generation of solid, liquid and hazardous wastes	Generation of solid, liquid and hazardous wastes from the operation of the wind farm, interpretation center, substation, front works for maintenance and/or improvement or new works
Control and supervision	Control and supervision of the built works and the electrical system implemented in the wind project
B. Retirement of the Wind Project	
Retirement of the project	Dismantling of the entire wind project infrastructure
Retirement of inert debris	Transportation and removal of debris and inert materials from the wind project

141 Medina, B. P. 122. Translation of Cuadro No. 30.

Appendix 3: Ranking of the Environmental Impacts of the Operation and Maintenance of the Villonaco Wind Farm[142]

Environmental Component	NEGATIVE IMPACTS	Assessment	Rating
Land/Soils	Impaired soil stability	18	LOW
	Alteration of soil quality	54	MODERATE
	Alteration in land use and occupation	18	LOW
Water	Alteration of water quality	63	MODERATE
Air	Increased noise levels	117	HIGH
	Increased ionizing radiation (electrical and magnetic fields)	18	LOW
Landscape	Alteration of the natural, urban, and rural landscape	54	MODERATE
Flora	Loss of plant species	63	MODERATE
Fauna	Disturbance of wildlife habitats	45	LOW
Socioeconomic & Cultural	Disadvantages in the health of workers	126	HIGH
	Work accidents	126	HIGH
	Restriction on the use of basic services (light, electricity)	36	LOW
	Alteration of the well-being of local people	36	LOW
	POSITIVE IMPACTS		
Land/Soils	Soil stability	18	LOW
Air	Reduction of CO_2 emissions	32	LOW
Flora	Recovery of vegetation and natural spaces	64	MODERATE
Socioeconomic & Cultural	Reduction in the consumption of fossil fuels	55	MODERATE
	Improvement in the provision of basic services (electricity, sanitation, sewer, rainwater & potable water services, roads)	100	MODERATE
	Income generation to the local economy	364	HIGH
	Improving the quality of life	50	LOW

142 Medina, B. P. 130. Translation of Cuadro No. 30.