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A case study of sustainable development at the Penonomé wind farms, a CDM registered project in Coclé

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SIT Study Abroad

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Abstract

The Penonomé wind projects fit into a long history of previous internationally financed development projects in Panama, including those from the Clean Development Mechanism. A moderate level of research has been conducted on other Clean Development Mechanism projects, but despite contributing to 5% of Panama's energy needs and constituting the largest wind park in Central America, the Penonomé wind farms remain little researched. Semi-structured interviews were conducted with relevant people associated with the project or with relevant information to gain more information about the case study. Using the information processed from these reviews and information from publicly available resources, the sustainability of the development of the Penonomé wind farms were assessed using the Agence Française de Développement's Sustainable Development Analysis metrics. Notable results included community engagement on the part of the developers, environmental and social impact measures conducted, carbon reductions thanks to displacement of fossil fuel producing plants in the national interconnected system, remote control of the wind farm on the part of the turbine manufacturer from outside the country, and alleged ties between the manufacturer of the wind turbines and modern slavery practices in Xinjiang, China. In all, the wind project contained many minor and major sustainability issues, as well as minor and major contributions to sustainability. The project's effects were deemed to be mostly positive across the 7 dimensions of the Sustainable Development Analysis metrics, with the notable exception of allegedly exacerbating social inequalities in Xinjiang, China, and the remote operation of the wind farm by the turbine's manufacturers.

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Research Question

To what extent have the Penonomé wind farm projects been successful in meeting the Clean Development Mechanism's stated goal of contributing to sustainable development in Panama, according to the Agence Française de Développement's Sustainable Development Analysis metrics?

Research Objective

Analyze to what extent the Penonomé wind farms constitute sustainable development according to the Agence Française de Développement's Sustainable Development Analysis metrics

Introduction

The Clean Development Mechanism in Panama

Emissions of greenhouse gasses produced as a result of human activities threaten to irreversibly warm our planet to a dangerous level, threatening both the preservation of the environment and the natural capital upon which human beings worldwide rely. Most attempts at remediation have proved woefully inadequate in resolving this crisis, which could displace 1.2 billion people by 2100 and result not only in loss of coastal areas, livelihoods, and water sources, but also an increase in inter-state conflict in the form of resource wars (Bellizzi, et al., 2023).

In an attempt to address the warming climate, 154 nations of the world met in Rio De Janeiro in June of 1992 to form an international treaty later known as the United Nations Framework Convention on Climate Change (UNFCCC) (Framework Convention, 1992). In 1997, parties to the UNFCCC met in Kyoto to produce the Kyoto Protocol, a framework through which to reduce carbon emissions. The Kyoto Protocol acknowledged that greenhouse gas emissions were linked to economic development, and that developed nations were more responsible than developing nations for solving climate change, as they had become industrialized following the emission of an enormous amount of greenhouse gasses and possessed more power and financial resources than developing nations with which to alter their carbon footprint (United Nations Framework Convention on Climate Change, 1997).

The Kyoto Protocol outlined carbon emission reductions for 36 industrialized "Annex I countries" (later expanded to 39 "Annex B countries"), or developed nations who both ratified the protocol and agreed to binding targets for carbon emissions. These countries mostly consisted of European nations as well as Australia and Canada, though notably not the United States, who signed the treaty but did not ratify it (U.S. Department of State, 1998). Ratified Annex B countries were set to reduce their carbon emissions by an average of 5% over a 5 year period—2008-2012, or the first commitment period (UNFCCC, 2008).

Naturally, these targets would prove difficult to meet for industrialized countries whose political willingness to bear the brunt of the costs of aiding the climate in the world's largest tragedy of the commons remained understandably weak. This problem necessitated Article 12 of the Kyoto Protocol, which defined a "Clean Development Mechanism," or CDM. The two stated goals of the CDM are (1) emissions reduction and sustainable development in developing

nations, and (2) helping Annex I countries meet their Kyoto Protocol binding targets (Kyoto Protocol, 1997).

Across the world, the CDM was one of the largest and yet least understood market-based mechanisms of the UNFCCC. Essentially, it is a carbon trading mechanism whereby industrialized Annex B countries can buy Carbon Emission Reductions, or CERs, with which to offset their carbon emissions from developing countries sponsoring renewable energy projects, reforestation projects or other types of carbon offset projects. One CER is equal to one tonne of carbon offset. These credits are sold directly by the project developers, approved by both the developing nation and UNFCCC (Participant 4, personal communication, November 29, 2023). CERs from CDM projects can be bought by Annex B countries, the original buyers, and by institutions and corporations, and traded on an exchange market.

Panama has long relied on fossil fuels for its economic development (IEA, 2023). It jumped on the possibility of being able to sell CERs and built much of its modern renewable energy infrastructure with investments from Annex I countries that contributed money in exchange for CERs. CDM projects proved enticing for the Panamanian government because they increased investment in the country and improved its energy infrastructure at the same time. In 2002, a year after the first year CDM projects could be registered, the government considered 25 CDM projects (FUPASA, 2002). By August 2008, the beginning of the first commitment period, 123 were either approved or in the process of consideration. Most of the projects in Panama represented thousands, if not hundreds of thousands, of CERs, totalling 43,383,827 tonnes offset (Climate Change and Desertification Unit, 2008).

The regulatory body in charge of approving CDM projects in Panama, also known as the Designated National Authority, or DNA, was a part of the Ministry of the Environment, or MiAmbiente. This power made it relatively straightforward for the government to approve projects. Other developing nations worldwide realized the potential of CDM projects. High population nations like China and India flooded the market (Participant 4, personal communication, November 29, 2023). With greater supply and a general lack of demand their price crashed (CDM Policy Dialogue, 2012). This resulted in fewer CDM projects being built in the second commitment period, or the second period of binding targets established by the UNFCCC, from 2013 to 2020 (Participant 4, personal communication, November 29, 2023). Panama currently has no CDM projects listed on the United Nations carbon offset platform, though ones have been recently completed in the second commitment period, like the Penonomé wind farms (FMO, n.d.).

A moderate amount of sociopolitical, economic, and environmental research has been conducted on the CDM in Panama, though projects elsewhere have received more attention, as larger nations contribute more CERs to the carbon trade market. Most research on the CDM in Panama revolves around hydroelectric dams, which provide the largest proportion of non-fossil fuel energy sources in Panama (IEA, 2023). However, almost no research has been conducted on the Penonomé wind farms, the largest of the wind farms of Central America. Total capacity of the wind farms reaches 270 megawatts (MW), accounting for a full 5% of Panama's total energy

needs (Bobidilla, 2017) (UNFCCC, 2018). That constitutes multitudes more than the 2 most studied power projects in Panama, the Barro Blanco and Monte Lirio dams, combined.

The Clean Development Mechanism's legacy in Panama is understudied and complex. A dive into its operation through the lens of its largest wind power farm will likely prove important in examining the continuing impact of the CDM in Panama. As Panama continues its transition away from fossil fuels and attempts to sustainably develop, it is worth evaluating to what extent CDM registered projects have been able to supplement its sustainable development.

Evaluating Internationally Financed Development in Panama

Panama has a long history of foreign development finance within its borders. The obvious, and most famous, example is that of the Panama canal, built by the United States following previous attempts by the French for an estimated over-budget cost of $209,905,000,000 2009 US dollars (Maurer & Yu, 2011, p. 106). Though the *Ancon* famously first passed through the canal in 1914, it was not until 1921 that official commercial operations began, meaning the project took approximately 18 years to ultimately complete (Maurer & Yu, 2011, p. 106). This project was not without its faults. Famously, the Panama canal's ownership remained a point of contention between the United States and Panama throughout the 20th century. The United States also siphoned money to its own citizens, avoided the employment of Panamanian workers, did not allow Panamanian businesses to operate in the zone, and used its military leverage to force a low payment for the canal territory (Maurer & Yu, 2006). Clearly, the earliest attempts at internationally financed development left something to be desired.

In the world of internationally financed development, foreign aid seems a possible solution to the many problems of foreign direct investment, like that of the Panama Canal project. What most clearly defines foreign aid is the power politics between the aider and the aided (Hattori, 2001). Pessimists argue the generosity and gratitude found in foreign aid is simply translated material dominance and subordination, making recipients more complicit in the system that makes them vulnerable and weak in the first place (Hattori, 2001). Supporters of foreign aid often laud its abilities to improve material circumstances of poorer nations, strengthen interstate relationships, and contribute to global health, such as the global effort to eradicate smallpox through vaccinations in the Global South during the 1960s and 1970s (Henderson, 1987).

In the post World War II era, the United Nations more clearly recognized the dangers of global warming and human activity on the environment. The 1972 UN conference on the Human Environment is widely viewed as the origin of the sustainable development movement (United Nations, 1972). As more and more information about the potential effects of climate change emerged, highlighted in texts like the 1987 Brundtland Report, progress continued, albeit over the course of many years (World Commission on Environment and Development, 1987). In 1992, the UN Conference on Environment and Development (UNCED) furthered the momentum of the sustainable development movement (United Nations, 1992). Then, in 1997, the Kyoto Protocol paved the way for the first sustainable development mechanism, the previously mentioned Clean Development Mechanism (Kyoto Protocol, 1997).

After the CER's market crash from 2012-2013, critics accused sustainable development systems of being too broad and complex, threatening national prerogatives, and being incompatible with market mechanisms (UNEP-STU Partnership & Gold Standard, 2018). However, proponents claimed these myths applied to old systems, and that new systems could fix previous problems (UNEP-STU Partnership & Gold Standard, 2018). They point to the UN's Global Goals, a new initiative following the 2015 Paris Climate Accords, drafted in the most inclusive process yet for outlining sustainable development (Verles, 2016). It's a far cry from other examples of internationally financed development, like the Panama Canal project a century before. In it, national prerogatives are set by countries themselves, preserving their sovereignty on their own issues, though they are monitored by an international framework to ensure compliance to sustainable development goals (Verles, 2016). Supporters of the sustainable development movement argue market mechanisms can work with sustainable development under contexts different to that of the CDM. For instance, Gold Standard claims that it is a myth that sustainable development cannot be measured (Verles, 2016). They claim the new 17 sustainable development goals developed by the UN, which incorporate everything from poverty to hunger to clean energy and industry, show that sustainable development can be cooperative, measurable, and compatible with market mechanisms (Verles, 2016).

These 17 goals (made up of 169 targets) are:

1. No Poverty: End poverty in all its forms everywhere
2. Zero Hunger: End hunger, achieve food security and improved food nutrition and promote sustainable agriculture
3. Good Health and Well-Being: Ensure healthy lives and promote well-being for all at all ages
4. Quality Education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Gender Equality: Achieve gender equality and empower all women and girls
6. Clean Water and Sustainability: Ensure availability and sustainable management of water and sanitation for all
7. Affordable and Clean Energy: Ensure access to affordable, reliable, sustainable, and modern energy for all
8. Decent Work and Economic Growth: Promote sustained, inclusive and sustainable economic growth, full and productive appointment and decent work for all
9. Industry, Innovation, and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10. Reduced Inequalities: Reduce inequality within and among countries
11. Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient and sustainable

12. Responsible Consumption and Production: Ensure sustainable consumption and production patterns
13. Climate Action: Take urgent action to combat climate change and its impacts
14. Life Below Water: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
15. Life on Land: Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16. Peace, Justice, and Strong Institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Partnerships for the Goals: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (Halkos & Gkampoura, 2021)

When it comes to Panama's national priorities among the 17 goals, the government has focused on inequality, poverty, hunger, education, healthcare, and government institutions (Gabinete Social, 2015). This policy follows a hierarchy of needs approach, wherein the nation wishes to develop its institutions so that all have a decent standard of living before tackling grander issues like climate change and biodiversity conservation. However, this is not to say Panama is not environmentally conscious: the second sphere of its 5 spheres model constructed as part of its National Strategic Plan for 2030 revolves around planetary health as a whole (Gabinete Social, 2015).

Meanwhile, The Agence Française de Développement (AFD), a French public financial institution focused on foreign development, has maintained their own sustainability metric, the Sustainable Development Analysis (SDA) since 2013, with the express interest of analyzing the success of their foreign aid efforts (Agence Française de Développement, 2018). The SDA was updated in 2017 to align with France's Climate and Development Strategy and the 17 sustainable development goals (SDGs) (Agence Française de Développement, 2018). The SDA has been modified since according to shifting national priorities, but its newest blueprint incorporates all 17 of the goals into one of 7 dimensions:

1. Goals 1, 8, 9, 11, and 12: Sustainable and Resilient **Economy** for People and the Planet
2. Goals 1, 2, 3, 4, 6, 8, 10, and 11: **Social** Inequality Reduction and Inclusion
3. Goal 5: **Gender** Equality
4. Goals 2, 6, 14, and 16: **Biodiversity** Conservation, Management of the Environment, and Natural Resources
5. Goals 7, 12, and 13: Transition to a **Low-Carbon** Pathway
6. Goals 1, 2, 11, and 13: Climate Change **Resilience**

7. Goals 16 and 17: Long-Term Project Impact and **Governance** Framework (Agence Française de Développement, 2023)

Altogether, internationally financed development has changed immeasurably since the days of the Panama Canal, and an impact assessment of the Penonomé Wind Farms, one of its best known examples, tells us multitudes about how internally financed development affects the livelihoods, environment, economy, and resilience of Penonomé.

Methods

Interviews

I interviewed people associated with the Penonomé wind farms project, such as members of the companies that built or maintain the site or government employees that reviewed the site, as well as people not directly involved with the site that proved to have important insights on it, such as academics and members of international governmental bodies or NGOs.

I identified potential participants through online searching. If a contact was listed under relevant information in a journal article the contact wrote, if I discovered the contacted person works for one the companies or agencies I am researching, or if I found their name in a relevant UN document, I attempted to contact them. The result was 55 pages of inquiries formatted in single-spaced Times New Roman 12 font, sent to 56 associated people or organizations. I conducted 12 total interviews. The acceptance rate was 12 of 56 inquiries, or ~21.4%. 12 interviews were conducted.

I was originally planning on staying in Panama City to conduct the interviews in person. However, with the large protests surrounding the constitutionality of the Cobre Panamá mine, the SIT administration changed our plans. I had three choices on where I could live during the Independent Study Project, the most convenient of which for my project was El Valle de Antón, Coclé, Panamá. It was the closest to Penonomé, had consistent access to wifi, and possessed a climate which was more conducive to hours of sitting at a computer without air conditioning.

Because I was in El Valle, and many of my contacts were internationally based, the majority of my interviews occurred on the digital platform of the participant's choice. Participants were allowed to choose the time during which they preferred to meet. As the project was my sole focus at the time, participants were exclusively interviewed at the exact time they requested, limiting my impact on their day-to-day life.

Once the call had begun, before I could do anything else, I needed the interviewees to provide informed consent. To provide informed consent, I read the informed consent document I had prepared (see Appendix A). I then read them additional questions pertaining to the interview regarding consent to be quoted and audio-recorded (see Appendix B). If they gave consent to be audio-recorded, I would inform them that I would begin to audio record now. I would then activate the recording software Open Broadcasting Software (OBS) to record the interview, and store the file on my desktop.

I would then ask how much time the interviewees had to spare. Their availability would

affect question prioritization and time management of the interview.

I would usually begin the actual questions with softer, easier, and broader inquiries, such as "what was your role regarding the Penonomé wind project?" or "where is your company based?" regardless as to if I already knew the information. These questions helped ease the interviewee into the structure of the interview, and gave them time to get comfortable before more specific, technical questions were asked.

I followed a semi-structured interview type for all participants, so as to not waste their time, but also to allow for flexibility (Knott et al., 2022). Many of the interviewees were busy people in important positions that gratefully allowed me to ask them questions. As such, I was careful to have all of my notes in order and questions ready well before the interview so that it was as efficient as possible. If an interviewee mentioned something interesting, such as a connection they had that I was not previously aware of, or if I required elaboration, I inquired for more information.

Most interviews lasted just around 30-45 minutes, with a few interviews lasting an hour, and one almost an hour and a half. I was sure to continually check up on the interviewees to make sure they were comfortable with continuing.

At the end of each interview, I asked the interviewee this question:

> Do you know of anyone that would be interested in speaking with me that might have interesting or important knowledge about the CDM, the Penonomé wind farms, or anything else that you believe is relevant to my research, based upon this discussion?

This methodology allowed me to engage in snowball sampling (Goodman, 1961). Snowball sampling meant I more easily reached out to important contacts with the backing of previous contacts, but was also limited by the fact that sampling was not strictly random and the interviewees providing referrals had their own assumptions I could not control when trying to determine who would be most able to help me (Parker et al., 2019).

I only held one meeting per participant, though I did reach out later to some interviewees via email if I required elaboration about something they said. Most meetings were held online, except for one, with participant 8.

Archival and Online Research

Archival and online research proved a large portion of my research. Important information often came in the form of documents given to me by interviewees that were not normally publicly searchable or available.

Sustainable Development Analysis

The AFD's Sustainable Development Analysis consists of the 7 dimensions previously mentioned in the introduction. These 7 dimensions are rated across a 6 point scale, from -2 to +3 (see Appendix D). It is not expected that every sustainable development project contributes to every

dimension of the SDA. Ideally, no negative ratings will be recorded for a given sustainable development project. Statistics from this ratings system are recorded individually. For instance, a 2023 AFD project supporting technical and vocational training inside Cambodia earned +2, +2, +2, +1, 0, +1, and +2 ratings across the 7 dimensions, in the same order as presented in the introduction (SDA investment portfolio). The reason these ratings are not averaged out is to prevent any poor ratings from being disguised by a mean positive (Agence Française de Développement, 2023). If the project presents negative and positive effects across the same dimension (for instance, across different populations, resources, or places, a double rating can be applied (ex., (-2; +3) (see AppendixD). Levels one through three are cumulative; a level +3 rating can only be met by also meeting the requirements for levels 1 and 2 (see Appendix D).

The SDA ratings system is the same method I will be employing in my results.

Ethics

I underwent an IRB/LRB review process designed to independently analyze the ethicality of my research, for which I was approved. This involved crafting informed consent documents in both English and Spanish, completing a human subjects review form, presenting example interview questions, and submitting a research proposal including a literature review, methods, and ethics section. This process was designed to prevent undue stress on interviewees.

To minimize the burden I laid on my interviewees, I let them choose the time and place of the interview, and they always had the option to leave early. I reminded them of this option throughout the interview when I detected that we had continued for longer than one half hour.

In terms of power differentials, all of the people I interviewed were older than me, further advanced in their career, politically powerful, or a combination. At the same time, I could not ignore the fact that I did not want to exert undue pressure on them. I stated upfront and openly that participation was completely voluntary and that there was no penalty for not participating.

To mitigate participant stress, I would start most questions with some brief facts so that the participant felt versed. At the beginning of the interview, I was prepared to explain what the Penonomé wind farm was if the participant was unfamiliar with it to give them some background information. However, all of the participants said they were familiar with the wind farm and its operation.

At the same time, some questions I wanted to ask I elected not to. Upon learning of a possible connection between the wind turbine's manufacturers and modern slavery, I did not choose to ask about the connection to any interviewers, upon consultation with my research advisor. It was suggested that bringing up the topic could shut the interview down prematurely and betray the interviewee's trust in me.

The goal, in the end, was to minimize stress to study participants and to ensure that questions I ask provide a reasonable expectation of decent information for my paper. In order to protect interviewees' identities, I needed to make their responses anonymous and confidential.

Sometimes, information could not be shared with me. I had to accept a limit to participant openness, because I could not push interviewees to give an answer involving information they

considered confidential. I also wanted to avoid interviewees guessing their way toward an answer they did not know.

I did not elect to share any personally identifiable information about the interviewees at any time to anyone, not even to my research advisor.

I did not store participants' data in publicly accessible databases or in shared documents. I only contacted people online, meaning I did not invade their physical space to request participation. As for data collection, I only collected relevant data—nothing else like age, wealth, address, or any other form of irrelevant and unnecessary personal information. Data presented in final reports was anonymized.

I did not interview populations at risk, and no compensation was involved.

Results

Historical Context

Before we can evaluate the wind farms, we have to understand the context in which they were built. Understanding the context is not an especially easy task. In 1998, the energy business was privatized in Panama (Participant 8, personal communication, December 5, 2023). Privatization means following the long and tangled line of companies, contractors, and agencies associated with the Penonomé wind farms constituted a considerable portion of the information tracking necessary for this project. In Panama, corporate secrecy laws do not allow the identity of stakeholders in companies to be known. The quantity of connected information also means that to perform the SDA, necessary context is grand in scope.

Energy projects require a considerable amount of paperwork and permits before construction begins. For wind farms to be built, the developer first needs to apply for a license with ASEP, the Autoridad Nacional de los Servicios Públicos (ASEP) and have it approved (*AN No.4075*, 2010). After acquiring a license, tenders must be signed with the government (Participant 8, personal communication, December 5, 2023). A tender is essentially a contract the government offers to a company for them to build a certain capacity of energy, usually measured in MW (Participant 8, personal communication, December 5, 2023). This capacity is determined by evaluating predictions for increases in electricity generation over the next few years (Participant 8, personal communication, December 5, 2023). Tenders are sold to the lowest bidder in an auction, or the energy company that claims they can produce that capacity of power at the cheapest price (Participant 8, personal communication, December 5, 2023).

The problem during the time slightly before the creation of the Penonomé wind farms was that only 1 or 2 companies would show up to these auctions to bid (Participant 8, personal communication, December 5, 2023). The major energy generators collaborated in a “rigged and corrupt” scheme to force the government to sell them the tenders for a ludicrous sum (Participant 8, personal communication, December 5, 2023). Often the government could not afford to sell tenders for these prices, and the establishment of electricity generation projects suffered as a result (Participant 8, personal communication, December 5, 2023). The previous government that came before the construction of the Penonomé wind farms had only issued two tenders, totalling

800 MW (Participant 8, personal communication, December 5, 2023). These tenders were never built, because the power companies who bought them had always intended to simply resell the rights to build the generation to another company later down the line for a hefty profit (Participant 8, personal communication, December 5, 2023).

According to participant 8, this broken system was never altered for about 20 years because the government managers of ETESA, the energy transmission company that sells the tenders, simply weren't doing their job (personal communication, December 5, 2023). Leadership changed administration to administration under a system of patronage (Participant 8, personal communication, December 5, 2023).

This lack of capacity installation exacerbated an especially poor situation for Panama, because, unlike most countries, Panama's demand for electricity has grown 6-8% each year for the past 20 years (Participant 8, personal communication, December 5, 2023). A 2012 industry trend analysis noted net consumption of energy in Panama jumped from about 2.5 TWhrs in 1990 to almost 6 in 2009 (BMI Research, 2012). These numbers demonstrate enormous growth for its expanding economy, but the situation was incredibly precarious. The same analysis noted that government funding would be unreliable and sporadic, and the private sector had to lead the way (BMI Research, 2012). But, without construction by the private sector, Panama would soon encounter shortages.

Meanwhile, the generators scrambled to predict which direction Panamanian energy would take in the near future. Panama was expected to transition away from dirtier fossil fuels like bunker, a source of energy that it had been excessively reliant on in the past (Participant 7, personal communication, December 5, 2023). Expectations remained that hydropower would remain the dominant source of electricity over the next decade, since there was already so much installed capacity in commercial operation, in part fueled by the CDM (BMI Research, 2014a). Another certainty was the growth of non-hydro renewables and gas, which were predicted to be the fastest growing sectors of the power sector in Latin America (BMI Research, 2014a). Non-hydro renewables like solar and wind were expected to increase by 85% from 2014 to 2023, and gas by 75% (BMI Research, 2014a). Still, it was not totally clear which sector, renewables or gas, would come to make up the majority of the sector. Often, companies with limited resources had to pick a side for their investments. AES, the largest energy generator in the country, ultimately chose natural gas, investing 800 million dollars into plants like Gas Natural Atlántico, a grand LNG terminal with a gas storage capacity of 180,000 m^3 (Secretaría Nacional de Energía, 2016).

In 2013 and 2014, the energy demand anomaly and the lack of generation collided. These were years of energy shortages (Participant 8, personal communication, December 5, 2023). Most of the shortages occurred in April and May, in the dry season (Participant 8, personal communication, December 5, 2023). These shortages required the government to import and ration electricity (Prizma, 2014). Shortages occurred largely due to a lack of power capacity and an overreliance on hydropower for renewables. Hydropower constitutes 60% of Panamanian renewable energy, but only 2 hydropower projects in Panama, Bayano and Fortuna, possess

dammed reservoirs, gravity batteries that can be tapped into when rain levels are low (InterEnergy, 2020). Because most dams relied on constant feed from rivers, during the dry season, with less rain to feed the rivers, they were less able to produce electricity (Participant 8, personal communication, December 5, 2023). So, dirtier thermal plants were required to supplement the lack of electricity, but because of the tender rigging, there was not enough installed capacity (Participant 8, personal communication, December 5, 2023).

The market reflected this shortcoming. In Panama, electricity is sold in one of two ways by generators: through the spot market, or through Power Purchase Agreements (PPAs). PPAs are long-term contracts generators strike with producers in order to guarantee a sale (Participant 8, personal communication, December 5, 2023). PPAs can be physical, meaning generators get to sell what they produce, or financial, where generators earn money regardless of changes in day-to-day electricity demand—meaning distributors pay the same price every day yearly (Participant 12, personal communication, December 7, 2023). The spot market is a variable market, where extra money can be made selling electricity to meet detected shortages (InterEnergy, 2020). If a company cannot fulfill its PPA contracts, it must buy from the spot market (Participant 8, personal communication, December 5, 2023). In 2014, the spot market lay at $200 per MWhr (Participant 8, personal communication, December 5, 2023). For context, in Q2 of 2023, it was just $115.20 per MWhr (UEP Penonomé II S.A. and Technisol Group, 2023). This simple number shows that supply for electricity could not meet demand.

Shortages hurt people. Not only do they prevent average people from living their daily lives, they increase costs for vulnerable people with limited spending power and, in some cases, endanger them. Turning off streetlights, traffic signals, and refrigerators, for instance, risks public safety and public health. Panamanians were furious. At the same time, the blackouts were forcing the government to spend more in an already worsened fiscal position (The World Bank, 2015). The situation was so poor the President of Panama gave the new head of ETESA, the company in charge of energy transmission in Panama, emergency powers to combat the crisis (Participant 8, personal communication, December 5, 2023).

It was into this world that the Penonomé wind farms were constructed. They were the first ever to be built in Panama, and the largest to be built in all of Central America (Participant 7, personal communication, December 5, 2023). Uncertainties remained as to whether or not it would aid the crisis. The first phase came into commercial operation in 2015, and proved a welcome addition (Participant 8, personal communication, December 5, 2023). In Panama, wind farms act as a hedge against hydropower (Participant 8, personal communication, December 5, 2023). When hydropower cannot be produced in the dry season, that is when wind speeds are highest in Panama (Participant 8, personal communication, December 5, 2023). So, wind power was able to fill the dry season gap that had previously remained unfilled. This revelation forced revisions to the previous industry trend analyses in October of 2014 because of the grand scope of the project, in which experts predicted wind energy to compromise 6.2% of total electricity generation in Panama (BMI Research, 2014b). Wind power is not an example of firm capacity generation, meaning the Penonomé wind farms always needed to be topped off by thermal

plants, but it did prove to be useful to curb the energy crisis (Participant 8, personal communication, December 5, 2023).

Project Organization

In this context section, I explain most of the relevant organizations found on my organizations flowchart (see Appendix G). The Penonomé wind farms project was originally started by Rafael Pérez-Pire, a Spanish national from the Unión Eólica Española (UEE) (Participant 6, personal communication, December 1, 2023). UEE was a Spanish wind farm development company that had developed more than 186 MW of power in its home market of Spain (Prizma, 2014). This company is now extinct, restructured into the Unión Eólica Panameña, S.A. (UEP), a Panamanian registered business (Participant 6, personal communication, December 1, 2023). UEP became a Panamanian corporation in order to be able to bid on a Panamanian tender. In Panama, an S.A. company is a *Sociedad Anonima*, or an anonymous society. This designation means that information about investors and the like is not published (Españo, 2009). Still, we know that 92% of ownership remained with former members of UEE, and that 8% lay with some unknown Panamanian investors (Prizma, 2014). The anonymity is not inherently suspicious; it is a common form of corporate governance within Panama.

UEP applied for and secured licenses for 4 wind power plants (Rosa de Los Vientos, Marañón, Portobelo, and Nuevo Chagres) between 2010 and 2012 (*AN No.4075,* 2010) (*AN No.5379*, 2012). In order to receive these licenses, UEP had to comply with various Environmental and Social Impact Assessments (ESIAs) conducted by relevant experts from universities, companies, consultancies, and other organizations (Autoridad Nacional del Ambiente, 2009).

For construction purposes, the 270 MW project was split into 2 Special Purpose Vehicles (SPVs) to make logistics easier, as well as various stages and phases (Participant 5, personal communication, November 30, 2023). The two SPVs were Unión Eólica Panameña I (UEP I) and Unión Eólica Panameña II. Special purpose vehicles are smaller companies that are meant to conduct a certain task (Participant 5, personal communication, November 30, 2023). For UEP I, this task was the construction and maintenance of a 55 MW wind power plant in Penonomé at the Nuevo Chagres stage I site (Participant 5, personal communication, November 30, 2023). For UEP II, the task was the same, except for a 215 MW wind power plant at the Nuevo Chagres stage II, Rosa de los Vientos stages I and II, Portobelo, and Marañón sites (Participant 11, personal communication, December 6, 2023). UEP II's wind power project was renamed Laudato Si, after the second encyclical of Pope Francis urging climate action (Participant 11, personal communication, December 6, 2023).

2.5 MW Turbines for the two companies were supplied by Goldwind Americas, a US-based subsidiary of the Chinese company Goldwind Science and Technology Co. Ltd., formerly Xinjiang Goldwind Science and Technology Co. Ltd. (Participant 11, personal communication, December 6, 2023). Goldwind's holding company, Goldwind International

Holdings (HK) Limited, bought and owned UEP I from 2016-2020 for 71 million dollars (Prizma, 2013). UEP I was then sold to AES Panamá, a subsidiary of the US-based AES Corporation, for $72 million (AES Panama, 2020). The wind farm was then renamed AES Panama S.R.L (AES Panama, 2020). For simplicity's sake, I will mostly continue to use the term UEP I throughout the rest of this paper when referring to what is now AES Panama S.R.L., because most of the paper regards the period when the company was known as UEP I.

UEP II was bought by InterEnergy (Participant 6, personal communication, December 1, 2023). Their corporate structure does not list UEP II as a subsidiary like Goldwind does (InterEnergy, 2018). Instead, Portland Panamá Wind LP, registered in the Cayman Islands, owns 13% of InterEnergy Holdings (IEH) Penonomé Holdings, registered in the Cayman Islands, and InterEnergy Group Ltd. (Guernsey) owns the remaining 87% (Participant 6, personal communication, December 1, 2023). Guernsey and the Cayman Islands are tax havens; the main portion of the holding company is located in Jersey, U.K, rooted through organizational structures in London and Spain (Participant 6, personal communication, December 1, 2023). Most of InterEnergy's work occurs in Latin America and the Caribbean, however. IEH Penonomé owns 95.24% of UEP II, and Greenfield 4.76% (Participant 6, personal communication, December 1, 2023).

How Energy Actually Gets Transported

In Panama, when a person receives their energy bill, they pay three parties: a generator, a transmitter, and a distributor (Participant 8, personal communication, December 5, 2023). UEP I and UEP II are generators, AKA they generate electricity. The same goes for any other producer of electricity, from fossil fuel plants to solar farms and geothermal power. Panama is an energy diverse country, and its generation is entirely privatized (Participant 7, personal communication, December 5, 2023). Energy is collected at a substation prior to transmission. For UEP I and UEP II, the El Coco substation is a shared asset that both SPVs use (InterEnergy, 2020). The substation is operated by an engineer hired by Ingeteam (*AN No. 16623*, 2021).

Transmission in Panama is controlled by one company, ETESA (Participant 8, personal communication, December 5, 2023). Transmission is essentially moving power from substations near generation centers to be used elsewhere (Participant 8, personal communication, December 5, 2023). Often, "elsewhere" consists of substations outside of cities, operated by distributors (Participant 8, personal communication, December 5, 2023). ETESA is a private company owned by the government (Participant 8, personal communication, December 5, 2023). When it was first privatized in 1998, it had much more independence than it does now (Participant 8, personal communication, December 5, 2023). Since then, the Panamanian government has often put their hand in ETESA (Participant 8, personal communication, December 5, 2023). Participant 8 described the company as a "bastard" now, not completely public, and not completely private (personal communication, December 5, 2023). In fact, ITP reviews of the company label its largest problem a lack of corporate governance (Participant 8, personal communication, December 5, 2023).

When ETESA was formed, it received two services: a Panamanian weather service, in order to predict when renewable energy would be most available, and the National Dispatch Centre (CND, after the Spanish spelling) (Participant 8, personal communication, December 5, 2023).

Energy grids worldwide do not possess storage sufficient enough to store electricity produced for later use (Participant 8, personal communication, December 5, 2023). In energy grids, electricity must be produced exactly according to electricity demand, in order to prevent the grid from shorting itself out, or on the other side of the coin, from shortages (Participant 8, personal communication, December 5, 2023). Operators at the CND predict what electricity demand will look like in the near future, based on time of day, holidays, long term pattern changes, and other factors (Participant 8, personal communication, December 5, 2023). In Panama, 60% of electricity is used for air conditioning, and air conditioning is mostly used in the middle of the day, for instance (Participant 8, personal communication, December 5, 2023). The CND sends out preorders one week and preorders one day in advance to all generators (Participant 8, personal communication, December 5, 2023). These preorders tell each generator how much the CND expects them to produce in the next predicted period, assigning values in MWs (Participant 8, personal communication, December 5, 2023). All generators in Panama are expected to only ever produce, at maximum, 95% of their capacity, except for solar and water, who produce 100% (Participant 8, personal communication, December 5, 2023). This requirement is in place in case another plant fails and power has to be made up somewhere within the grid using the last 5% capacity of other generators (Participant 8, personal communication, December 5, 2023). At the peak of the day there is more solar and hydropower water available due to predictable weather patterns (Participant 8, personal communication, December 5, 2023).

Solar and hydropower are prioritized as part of Panama's renewable energy incentives (Participant 8, personal communication, December 5, 2023). Energy from other sources are then layered on top of the initial generators to meet total demand (Participant 8, personal communication, December 5, 2023). Gaps are most often filled with firm capacity generators, who can turn production on and off easily to be made available whenever necessary, like with a reservoir and or gas storage (Participant 8, personal communication, December 5, 2023). These reservoirs and fuel storage locations are the make-do batteries of interconnected energy grids, storing potential energy in the chemical bonds of petroleum molecules or in the gravitational positionality of reservoirs.

Once electricity is ordered on an hour-by-hour basis by the CND, the electricity is generated according to the predicted needs of the country by UEP I and UEP II, and transmitted by ETESA (Participant 8, personal communication, December 5, 2023). Once it reaches a substation on the outskirts of a city, the distributors come into play (Participant 8, personal communication, December 5, 2023). Distribution is handled by one of three companies in Panama: Elektra Noreste, S.A. (ENSA), Empresa de Distribución Eléctrica Chiriquí (EDECHI), and Empresa De Distribución Eléctrica Metro-Oeste (EDEMET) (Arroyo, 2021).

Each of the distributors operates in a different sector of the country: EDECHI in the West, EDEMET in the center, and ENSA in the East (InterEnergy, 2020). Distributors take transmitted electricity from ETESA and convert it to electricity usable to everyday people and businesses, connecting homes, office buildings, and small businesses to the grid (Participant 8, personal communication, December 5, 2023). They then charge for their services, giving a cut of the fee to ETESA and the appropriate generator.

When privatization occurred in 1998, ownership of the three distributors were split in 3 parts: 49% of the stake remained with the government, 49% went to a private controller, and 2% went to the employees of the individual distributors (Participant 8, personal communication, December 5, 2023). For EDECHI and EDEMET, ownership lay with Naturgy Energy group, a Spanish company (Empresa de Distribución Eléctrica Chiriquí, S.A., 2019) (Empresa de Distribución Eléctrica Metro Oeste, S.A., 2019). For ENSA, ownership lay with Empresas Públicas de de Medillín (EPM), a Colombian company (Arroyo, 2021). Later, employees of the distributors mostly sold their shares, leading to the ownership percentages we see today (see Appendix G) (InterEnergy, 2020).

The CDM and the Penonomé Wind Farms

For all CDM projects in Panama, certain criteria have to be met to be eligible for submission.

1. The Environmental Impact Assessment Directorate (DEIA, by its Spanish acronym) analyses and approves projects by conducting assessments of existing environmental management tools, such as the Environmental Management Plan and/or the Environmental Adequacy Plan (Participant 10, personal communication, December 6, 2023).
2. The Verification of necessary compensations and certification of a lack of outstanding debts are carried out by the DEIA (Participant 10, personal communication, December 6, 2023).
3. The Climate Change Directorate (DCC) then confirms compliance with an official letter (Participant 10, personal communication, December 6, 2023).
4. Finally, following a process involving a third-party verifier, the DCC issues the Approval Letter for registration with the Clean Development Mechanism (CDM) (Participant 10, personal communication, December 6, 2023).

Steps 1-2 of the criteria are already checked by the ESIAs required for any major energy infrastructure project. Steps 3-4 are all part of the normal DNA approval and registration request processes required by the UNFCCC, with Executive Board approval afterwards (Participant 1, personal communication, November 26, 2023). In this case, the independent validator was RINA, an Italian environmental consulting group, who approved of the project (RINA Services S.p.A., 2012). These third parties are paid by the project developers themselves, and so,

according to participant 4, they have perverse incentives to approve the project of their commissioners (personal communication, November 29, 2023). It should be noted that RINA misspells "Unión Eólica Panameña" as "Union Eolica Panameña" throughout their validation document, though this fact cannot be extrapolated into conclusions about their criticality (RINA Services S.p.A., 2012).

Participant 4 was incredibly vocal about his disapproval of CDM projects (personal communication, November 29, 2023). Participant 4 called them a way of justifying inaction, citing a lack of institutional integrity and overestimations of emissions reductions (personal communication, November 29, 2023). Because CERs can be resold, participant 4 complained of little transparency about the paths credits take from buyer to seller (personal communication, November 29, 2023).

Another large complaint in the literature was a lack of follow-up on the sustainability aspects defined in the project design document (du Monceau & Brohé, 2011). Indeed, monitoring efforts of energy projects only calculate how much energy is generated, and do not include any other aspects of sustainability like reduction of social equality or mitigation of in-situ environmental damage (UNFCCC, 2010).

The ACD, a Panamanian nonprofit, was particularly critical of CDM projects in Panama, claiming they have generated serious environmental and social conflicts, and even contributed to violation of human rights (Alianza para la Conservación y el Desarrollo, 2017). The Manifesto of Central American and Mexican Civil Society simply called the CDM "extractivist capitalism," complaining that it actively slowed progress, accelerates the intensity of climate change, and sharpens social conflict, poverty, and inequality (Alianza para la Conservación y el Desarrollo, 2017). These claims lay mostly related to especially mismanaged projects like that of the Barro Blanco dam, which involved forced displacement of indigenous land unjustified by compelling and overriding public interests (Center on Migration, Citizenship, and Development, 2016).

The developers of the Penonomé wind farms originally planned to sell CERs as a source of revenue for the project (Participant 6, personal communication, December 1, 2023). They received all approval and authorization forms necessary from both Panama and the United Kingdom, who were involved indirectly as an Annex I Designated National Authority (Participant 4, personal communication, December 1, 2023). However, authorization, approval, and registration were only completed at the end of 2012 (Participant 4, personal communication, December 1, 2023). By 2013, the price of CERs had crashed to almost zero (Participant 4, personal communication, December 1, 2023). With additional fees for registration and fees paid per CER sold, the selling of CERs ultimately proved unprofitable, and the plan to sell CERs was abandoned shortly after all approval stages had been completed (Participant 4, personal communication, December 1, 2023).

However, CER credits are meant to be sold as a source of revenue only to developers that would otherwise never have been able to build their green projects (Participant 4, personal communication, December 1, 2023). The fact that the project was built and approved, yet was financially successful without CER sales, shows that it was likely already to be profitable, and

that CER sales were not ever needed. This financial success contrasts claims of additionality the project validator raises, and falls in line with the historical distribution of CDM projects (Participant 4, personal communication, December 1, 2023). Energy industry projects have made up almost 3/4s of all CDM projects completed, in part because generation of electricity always produces at least some cash, compared to waste management agriculture projects that often just cost money (Naik et al., 2014).

Although CERs were never sold, this project is still tied to the CDM in many important ways. Its attachment indicates that even if the project sold CERs, that these CERs would not have been additional. Given that the sustainability of energy project CERs are only measured through generation in monitoring projects, the project's sustainability as a CDM project can still be considered. I could find no evidence of any energy-industry CDM projects being cancelled after commercial operations had resumed outside of a major scandal, which the Penonomé wind farms have not elicited.

Financing

We have much more information about how UEP II financed their construction than we do for UEP I, though their sale to Goldwind likely provided some capital for that construction project.

InterEnergy's Laudato Si plant incurred construction costs of $430 million (Arroyo, 2021). $130,000,000 in equity was contributed by InterEnergy (Participant 6, personal communication, December 1, 2023). As for the remaining $300 million, Panamanian markets were limited in terms of project financing (Participant 6, personal communication, December 1, 2023). Development banks played a "fundamental" role in securing money for the projects (Participant 6, personal communication, December 1, 2023). They were more conservative, leading them to offer better rates than other private banks (Participant 7, personal communication, December 5, 2023). The International Finance Corporation (IFC) spearheaded the $300 million loan that would pay for the project (Arroyo, 2021). As an intergovernmental development bank part of the World Bank Group, they had certain standards for their loans to ensure they met the Equator Principles, a set of environmental and social corporate governance (ESG) goals to ensure development was sustainable (Participant 5, personal communication, November 30, 2023). The process by which they verified compliance with these standards will be discussed in later sections.

The IFC's debt package was broken up into constituent parts, highlighted here:

> $80 million senior loan from IFC
> $60 million senior loan from IFC's managed co-lending portfolio program
> $144 million in senior loans syndicated to development finance institutions and Panamanian banks
> $16 million subordinated loan from IFC (Arroyo, 2021)

The $144 million senior loan from the IFC's managed co-lending portfolio program came from 6 major banks: Banco Nacional de Panamá from Panama, Oesterreichische Entwicklungsbank AG (OeEB) from Austria, Central American Bank for Economic Integration (CABEI), Banco General, S.A., Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden N.V. (FMO) (Netherlands), and Societe de Promotion et de Participation pour la Coopération Économique (Proparco) (France) (Participant 7, personal communication, December 5, 2023).

In 2020, UEP II's $262.664 million debt was refinanced into 18-year, 6.5% interest rate green bonds, sold to Panamanians and investors worldwide (InterEnergy, 2020).

Sustainable Development Analysis

Before beginning sustainable development analysis, it should be acknowledged that assessments of social and environmental impacts mostly took place in two time periods: during the initial ESIAs conducted pending license approval for UEP, starting in 2009, and the two Prizma LLC evaluations, one from 2013 for UEP I and one from 2014 for UEP II (Participant 5, personal communication, November 30, 2023). The ESIAs from ANAM, documents hundreds and hundreds of pages long, are the only required sustainable development study needed to begin construction in Panama. However, the IFC elected to conduct its own independent review by Prizma, an ESG consultancy group, who was hired by the respective developers (Participant 5, personal communication, November 30, 2023). The IFC evaluated all 8 of its performance standards, listed below:

> PS1 — Assessment and Management of Environmental and Social Risks and Impacts: the environmental and social management system enables us to anticipate environmental and social risks posed to the business activities and avoid, minimize, and compensate for such impacts, if applicable.
>
> PS2 — Labor and Working Conditions: the management of the relationship between workers and managers to provide fair, safe and healthy conditions to everyone, and the identification of risks in the primary supply chain.
>
> PS3 — Resource Efficiency and Pollution Prevention: integration of good practices and technologies to promote energy efficiency, use of resources in a sustainable way and reduction of greenhouse gas emissions.
>
> PS4 — Community Health, Safety and Security: the adoption of responsible practices to reduce risks related to worksite accidents, hazardous materials and spread of diseases including emergency preparedness and response, security force management, and design safety measures.
>
> PS5 — Land Acquisition and Involuntary Resettlement: to minimize the impact of involuntary resettlement or displacement, through mitigation measures such as fair compensation and improvements to and living conditions.
>
> PS6 — Biodiversity Conservation and Sustainable Management of Living

Natural Resources: protection and conserving of biodiversity, maintenance of ecosystem services, and managing living natural resources for a sustainable development.

PS7 — Indigenous Peoples: assurance that our business activities minimize negative impacts fosters respect for human rights, dignity and culture of indigenous populations, and promotion of development benefits in culturally appropriate ways; plus, informed consultation and participation with indigenous people throughout the project process.

PS8 — Cultural Heritage: protection of cultural heritage from adverse impacts of project activities and supporting its preservation, also promoting equitable sharing of benefits from the use of cultural heritage (InterEnergy, 2020).

Based on compliance with these criteria, IFC eventually declared the UEP Penonomé wind farms a Category B project, meaning that it is a business activity with potential limited environmental or social risks that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures (Prizma, 2014). Sustained review occurred throughout the lifespan by ANAM, though information about initial reviews are more easily found (Participant 8, personal communication, December 5, 2023).

It should also be noted that Penonomé was not the first place that was considered for a wind farm (see Figure E1). The Caribbean coast of Panama has higher wind speeds than the center of the country (Giardinella et al., 2011). However, developers cannot just plant turbines where the highest wind speeds are, they have to go to where the best place to build is (Participant 5, personal communication, November 30, 2023). Hence, at least 3 other sites were rejected before Penonomé, for various reasons (see Figure E1).

Costs in order to meet mitigation measures also proved expensive, totalling to $1,314,600 (see Appendix F). It is not clear if operation stage costs are paid continuously or once, though the nature of the cost appears to be continuously paid, most likely yearly (see Appendix F).

Biodiversity

General Biodiversity Measures

The first choice that was taken into account was the site. The wind farms are on a considerably sized chunk of land: 18,500 hectares, though only 40ha have actual wind turbines on them, since a 500m buffer zone exists around the wind farm for noise, visual impact reduction, and safety purposes (Prizma, 2013). Penonomé is built on existing cattle ranches, farms, and plantations, disturbed land consisting mostly of grasslands and bushes (Participant 3, personal communication, November 27, 2023).

The Environmental management plan for the wind farms show costs associated with compensating destruction of natural habitats and preventing the destruction of more habitats through construction and operation of the site (Autoridad Nacional del Ambiente, 2009).

General costs:
Erosion control: $60,000
Prevention and minimization of deterioration of the soil structure: $100,000
Control and prevention of fuel spills, protection of remaining vegetation, minimization, compensation for the loss of vegetal cover: $101,800
Protection and recovery of habitats: $90,000
Prevention and control of the generation of dust, polluting gasses and noise: $18,000

Construction phase
Monitoring air quality: $4,000
Monitoring noise: $5,500
Monitoring water quality: $12,000

Operations stage:
Avoiding contamination of soil and surface water: $150,000
Control of noise generated by wind blades: $50,000
Study and monitoring of possible crash events (birds): $100,000
Air quality of the work environment: $5,000
Noise: $22,800
Water quality: $6,000

Plans
Wildlife rescue and relocation plan: $50,000
Environmental education plan: $25,000

These costs total to about $800,100, though many of these costs may be associated with benefiting humans first and foremost, with the added benefit of monitoring the environment (Autoridad Nacional del Ambiente, 2009).

Impact assessments by the ESIA determined these environmental effects on biodiversity:

Soil - directly negative, low intensity and low extension
Atmosphere - negative, low intensity and low extension
Water - negative with low intensity and low extension
Noise - direct negative, low intensity and high extension
Fauna - direct negative, low intensity and low extension
Vegetation - direct negative, with low intensity and low extension (Autoridad Nacional del Ambiente, 2009)

Each of these environmental effects are addressed with a relevant mitigation method supervised by a relevant supervisor, such as ANAM or the Ministerio de Obras Públicas (MOP) (Autoridad Nacional del Ambiente, 2009). Action plans for each mitigation are listed in the ESIA (Autoridad Nacional del Ambiente, 2009).

Surveys of fauna involved listing every mammal, reptile, amphibian, bird, and fish found in the area (Autoridad Nacional del Ambiente, 2009). No vulnerable or endangered animals were found in these surveys (Autoridad Nacional del Ambiente, 2009). Updated surveys found 2 International Union for the Conservation of Nature (IUCN) vulnerable species: *Boa constrictor* and *Dasyprocta punctata* (Autoridad Nacional del Ambiente, 2009). However, these species have since been listed as species of least concern (Emmons, 2016) (Arzamendia, 2021).

Trees

According to Prizma, for every tree felled, 10 trees of native species must be replanted and maintained for 5 consecutive years (Prizma, 2014). Not many trees had to be removed given the nature of the site (Participant 3, personal communication, November 27, 2023). However, a tree researcher told me that environmental compensation is not a standardized practice (Participant 3, personal communication, November 27, 2023). Most of the time, projects like these do not use native trees in reforestation, even when they say they will (Participant 3, personal communication, November 27, 2023). Mi Ambiente does not have the willpower or budget to check this sort of reforestation, and often companies get away with never reforesting in the first place (Participant 3, personal communication, November 27, 2023).

Cedrella odorata was listed by Prizma as being an IUCN vulnerable species (Prizma, 2014). Participant 3 told me that its wood is very good and in high demand, but that it cannot be harvested from Penonomé because it is too arid for the wood to develop well there, so it is less vulnerable to deforestation there (personal communication, November 27, 2023). Most of the tree species found in the savannah tropical dry forests of the kind found near Penonomé can be found across the Pacific dryland, as well (Participant 3, personal communication, November 27, 2023).

Flying Vertebrates

The site of the wind farm is 13km from the Parita Bay Important Bird Area (Prizma, 2014). A landfill is nearby, attracting approximately 1,000-2,000 vultures to the area (Prizma, 2014). Some birds might also come to feed on the rice fields (Prizma, 2014). In their report, Prizma mentioned migratory birds could occasionally pass through the area (Prizma, 2014). Their report was based on research conducted by two PhD scientists with a US educational background (Participant 5, personal communication, November 30, 2023). Listening devices were used to identify bats and other measures to identify birds. However, bat and bird mortality scans found 2-3 common bat species deaths and 1 dead vulture per month, which they considered not of great concern (Prizma, 2014).

However, the period they studied the bats and birds was during January and June (Prizma, 2014). The fall migration is much larger and more dense (Participant 2, personal communication, November 26, 2023). Participant 2 told me that it is very important that bird surveys are done during

migration months rather than just any months (personal communication, November 26, 2023).

Participant 2 told me that the area is very bat diverse, and the participant worried that birds would have to fight the winds from the blades (Participant 2, personal communication, November 26, 2023). Participant 2 told me that in Panama, flights are stopped in Tocumen due to the migratory birds, so great is the number of birds migrating through Panama (personal communication, November 26, 2023). Monitoring needs to be done every single day, and in the early morning or else other animals could take the carcasses and disappear them (Participant 2, personal communication, November 26, 2023).

According to the ESIAs, day and night excursions to determine impacts on flying animals were carried out (Autoridad Nacional del Ambiente, 2009). Reports were made based on interviews with locals, captures, sightings, and review of works by previous authors, all conducted by specialized biological researchers at the University of Panama (Autoridad Nacional del Ambiente, 2009). The scientists acknowledged that not all those that exist in the environment will be recorded, but they tried to record all those that could be most sensitive for the project (Autoridad Nacional del Ambiente, 2009).

The wind turbines have a height between 80 and 100 meters with blades of up to 50 meters, which would make bats fly up a minimum of 30 meters above the ground to get hurt (Autoridad Nacional del Ambiente, 2009). But, bats normally fly in between trees for food, not in open pastures, and they would not be able to fly that high as the winds would be too strong for them (Autoridad Nacional del Ambiente, 2009).

No birds of prey were recorded by the ESIA studies, which opposes the Prizma studies, which showed them as the most abundant (Autoridad Nacional del Ambiente, 2009).

The scientists in the ESIA conclude that there are no migratory routes for birds in the area (Autoridad Nacional del Ambiente, 2009). The birds that use the central mountain range to migrate generally are the largest, and fly the highest (Autoridad Nacional del Ambiente, 2009). Most birds prefer to migrate near the coast, and birds that migrate tend to travel in the same direction as the wind, so they do so at very high altitudes where the wind is greater (Autoridad Nacional del Ambiente, 2009). For instance, raptors tend to fly between 200 and 1,200 meters, or at least 100 meters above the tallest point of the wind towers, taking advantage of ascending air currents that form only during the day (Autoridad Nacional del Ambiente, 2009). Swallows, swifts, and nightjars also only migrate during the day (Autoridad Nacional del Ambiente, 2009). This diurnal behaviour means the birds are more likely to be able to see the wind turbine blades to avoid a collision.

In some European countries with wind farms, several species of birds have been found to nest within the parks, indicating their adaptation to the presence of wind turbines (Autoridad Nacional del Ambiente, 2009). And, to combat bird flight issues, the UEP designed the park to have at least 300 meters between each turbine to give birds room to maneuver (Autoridad Nacional del Ambiente, 2009). Plus, the rotations are also slow enough to allow birds to pass through without hitting a blade, since they built the wind farm in an area with some of the most

consistent, instead of some of the most fast, wind speeds (Autoridad Nacional del Ambiente, 2009).

According to the literature, as many as 140,000-328,000 birds die each year in the contiguous United States from wind turbine collisions (Loss et al., 2013a). However, 988 million birds also die each year from crashing into buildings in the United States (Scott et al., 2014). One participant even remarked that as he was working in a tall building in Panama City, he heard repeated thumps on the windowpane behind him for hours, just from birds hitting his building (Participant 5, personal communication, November 30, 2023). An additional 4 billion birds a year die from house cats (Loss et al., 2013b). A study of one wind farm in India found an average of 0.26 carcasses a year, citing habitat loss as a much greater concern for bird conservation (Kumara et al., 2022). The established scientific literature tells us that bird deaths from wind farms are not as great as from other more common, less considered sources.

A 2nd interviewee said that bird monitoring at Laudato Si was conducted Monday to Friday, and that they found 80 deaths per year, much less than a similar wind farm in Spain (Participant 9, personal communication, December 5, 2023). He also mentioned a lack of nearby bats, though without data from before construction, assessing impacts of construction on local species is very difficult (Participant 9, personal communication, December 5, 2023). Still, he found that rain affected animal carcass sightings more than did the wind farms (Participant 9, personal communication, December 5, 2023). He considered the project sustainable enough when it came to birds and bats (Participant 9, personal communication, December 5, 2023).

According to a different participant, a company that did the ESIA in the beginning does reporting every 6 months (Participant 8, personal communication, December 5, 2023). The most they record are noise levels and birds and bats killed (Participant 8, personal communication, December 5, 2023). There are no regulations whatsoever on top of that, except for noise and radiation (Participant 8, personal communication, December 5, 2023).

Based on this information, I would score the Penonomé wind farms a +1 on the SDA biodiversity metric. A dialogue has been conducted with the project sponsor on biodiversity conservation and sustainable natural environment issues, as per the AFD's criteria.

Low-Carbon Transition

Before mentioning the Penonomé wind project's impact on the grid, I should mention that one source told me total green energy production is impossible (Participant 12, personal communication, December 7, 2023). Wind, solar, and hydro cannot be produced 100% of the time, and one still needs thermal power to balance out the matrix (Participant 12, personal communication, December 7, 2023).

According to the ESIA, in the period before the Penonomé wind farms were built, hydrocarbon prices were increasing, and yet hydrocarbons were being burned more to meet demand in Panama (Autoridad Nacional del Ambiente, 2009). Nevertheless, Panama's COP26 agreement stated it committed to have 30% of electricity come from solar, wind, or biofuel (Participant 8, personal communication, December 5, 2023). Additionally, Panama's National

Energy Plan commits the country to convert 70% of its generation to be renewable by 2050 (Secretaría Nacional de Energía, 2016). This project has been specifically noted to contribute to Panama's National Energy Plan by creating more renewable energy that will be available through the dry season (Prizma, 2014).

Panama has a plan to become renewable, and it already has incentives in place to incentivize renewable production (Participant 8, personal communication, December 5, 2023). The CND was created to dispatch generation facilities based on the lowest marginal cost offered (InterEnergy, 2020). If we compare Gas Natural Atlántico's LNG terminal price of $113.48/MWhr to Laudato Si's average PPA price of $104.40 or $65.30 depending on the contract, we see that there Laudato Si can offer cheaper prices than purportedly more efficient fossil fuels (Secretaría Nacional de Energía, 2016) (UEP Penonomé II S.A. and Technisol Group, 2023).

At the same time, Panama possesses great incentives for renewable generation now. ETESA is obligated to buy from wind, solar, and hydro plants without a reservoir greater than 8 hours ahead of fossil fuels (Participant 8, personal communication, December 5, 2023). As such, in December 2015, wind energy from Penonomé supplied up to 16.34% of a day's generation and an average of 8.5% per month, which isn't even far into the height of the dry season (Secretaría Nacional de Energía, 2016). Wind energy displaced a large amount of carbon generated power (Participant 6, personal communication, December 1, 2023). By contributing renewable energy to the country's energy matrix, the Penonomé wind farms mitigate the effects of climate change (Participant 11, personal communication, December 9, 2023). It may have even contributed to AES's decision to purchase UEP I, as they competed over the same market for spot prices when their gas plants were operating (Participant 6, personal communication, December 5, 2023).

In terms of the actual statistics of carbon emissions reduced, a press report from Laudato Si claims that over its lifetime, the park will displace the emissions of 450 thousand tons of carbon dioxide, 1,000 tons of nitrogen oxide and 500 tons of sulfur dioxide (Parque Eólico Laudato Si, 2017). Yearly, it purports to reduce the use of 900,000 barrels of oil per year (Parque Eólico Laudato Si, 2017). At the same time, MiAmbiente predicts 1,527.18 tons of carbon saved for each MWhr produced per year, or 274,892 tons of carbon dioxide emissions per year avoided (Autoridad Nacional del Ambiente, 2009). The UNFCCC estimated an offset of 381,000 carbon offset per year (Participant 4, personal communication, November 29, 2023). Carbon displacement numbers do not match across different sources, but all still demonstrate high pollution reduction.

Based on this information, I would score the Penonomé wind farms a +2 on the SDA low-carbon metric. The project mobilizes the private sector and acts as a technical measure for long-term carbon efficiency, as per the AFD's criteria.

Climate Change Resilience

Electricity generated by wind energy is highly dependent on suitable wind conditions. If

conditions are unfavourable, wind energy generation may fall well below expectations. For instance, when the La Niña phenomenon occurs, the rainy season is extended, and the dry season, the period of higher and more consistent winds, is lessened (InterEnergy, 2020). A natural disaster like a hurricane could also damage equipment, which is already defective due to supplier failure on the part of Goldwind (InterEnergy, 2020). Goldwind supplied faulty turbine blades with a predicted lifespan of half that the technical specifications predicted, or 10 years less time (InterEnergy, 2020).

Both the occurrence of extreme weather events and intensification and frequency of La Niña effects are expected with an intensification of climate change (Cai et al., 2015). However, wind power also does not have inputs like fuel that traditional thermal plants do. This lack of variable costs means that Panama is less subject to fuel price changes and global logistics issues than are thermal plants (Participant 5, personal communication, November 30, 2023). At the same time, wind farms are a source of clean energy, contributing to lessen the effects of climate change by reducing emissions. Additionally, all infrastructure projects are at least somewhat vulnerable to natural disasters, especially those near the coast, where sea level rise is most apparent.

Based on this information, I would score the Penonomé wind farms a +1 on the SDA climate change resilience metric. The project takes into account the climate risks involved in the project intervention area in its design and implementation in line with national adaptation issues.

Social Inequality Reduction and Inclusion

Associated Costs

The associated costs with inequality reduction and community inclusion on the part of UEP according to the ESIA reports were as follows:

General costs:
Erosion control: $60,000
Prevention and minimization of deterioration of the soil structure: $100,000
Control and prevention of fuel spills, protection of remaining vegetation, minimization, compensation for the loss of vegetal cover: $101,800
Prevention and control of the generation of dust, polluting gasses and noise: $18,000
Prevention of work accidents: $10,000
Prevention and control of human diseases: $50,000
Rescue and protection of elements of archeological value: $150,000

Construction phase
Monitoring air quality: $4,000
Monitoring noise: $5,500
Monitoring water quality: $12,000

Operations stage:

Avoiding contamination of soil and surface water: $150,000
Control of noise generated by wind blades: $50,000
Community relations: $100,000
Air quality of the work environment: $5,000
Noise: $22,800
Vibrations: $4,500
Water quality: $6,000

Plans
Citizen participation plan: $10,000
Risk prevention plan: $30,000
Environmental education plan: $25,000 (Autoridad Nacional del Ambiente, 2009)

Included in these costs are protections against environmental damage that could indirectly or directly affect humans.

Case studies and Indigeneity

The area where the Penonomé wind farms were built were not located in any indigenous comarca nor near indigenous held lands (Prizma, 2014). One participant claimed the law in Panama is "perfectly good" at preventing land displacement of indigenous people (Participant 6, personal communication, December 1, 2023). They encountered only a small amount of the "fun and games found in Panama," a euphemism for paying indigenous communities to squat and claim lands are theirs, which were cleared and used by farmers well before construction began (Participant 6, personal communication, December 1, 2023).

To preserve cultural heritage, if archeological finds were found during construction, construction had to pause for the artifacts to be properly excavated (Prizma, 2014). No archeological sites were unearthed, however.

Community Communication

Prior to construction, 3 public meetings were held to discuss the Rosa de los Vientos project, just one of the four total projects (Autoridad Nacional del Ambiente, 2009). These meetings consisted of 20 minutes of an opening speech and an hour-long presentation including talks by an engineer about the project and the positive and negative impacts of the projects according to an ESIA report (Autoridad Nacional del Ambiente, 2009). Then there were 40 minutes for questions and answers and refreshments courtesy of UEP afterwards (Autoridad Nacional del Ambiente, 2009). There was little interest in the community in participating (Autoridad Nacional del Ambiente, 2009).

One forum's notes were recorded by BBE & Asociados (Autoridad Nacional del Ambiente, 2009). This particular meeting began at 2:30pm on a Saturday, when most people would be off work (Autoridad Nacional del Ambiente, 2009). BBE noted there was a good

turnout from La Ortiga, but less from El Rosario, Llano Marin, Chorrellita, Aguas Frias, and very little from Coco (Autoridad Nacional del Ambiente, 2009). About 46 people in all attended the forum they monitored (Autoridad Nacional del Ambiente, 2009). Questions to the presenters included about where exactly the turbines would be located and the amount of land it would affect (Autoridad Nacional del Ambiente, 2009). For instance, professor Ramón Ceped from Aguas Frías asked how long the feasibility study had been carried out and if there were other wind parks already operating in Panama (Autoridad Nacional del Ambiente, 2009). Another woman, Maylin Montenegro asked about if the parks would be similar to ones she saw in Spain (Autoridad Nacional del Ambiente, 2009). Participant 8 mentioned other common concerns were if the windmills would suck the water out of the ground like in the Netherlands, push the clouds away, or cause cancer from radiation (personal communication, December 5, 2023).

The meeting stopped at 4:20 when there were no other questions to be asked, and ended early (Autoridad Nacional del Ambiente, 2009). The ESIA report includes handwritten attendance sheets and photos of the meetings to prove they actually occurred (Autoridad Nacional del Ambiente, 2009).

To inform the public about these meetings, an easy-to-read letter was posted around town (Autoridad Nacional del Ambiente, 2009). Door-to-door notifications were also conducted (Autoridad Nacional del Ambiente, 2009). Brochures consisting of information about the pros and cons of wind electricity production were distributed to the public, and ads were taken out in local newspapers about the meeting, as well (Autoridad Nacional del Ambiente, 2009).

The ESIA contains hundreds of signed informed consent documents from nearby residents (Autoridad Nacional del Ambiente, 2009). It also contains pledges UEP made on how exactly to mitigate socioeconomic concerns, supervised by ANAM and the Ministry of Health of the Republic of Panama (MINSA) (Autoridad Nacional del Ambiente, 2009).

Two months of community workshops were conducted as part of a Citizen Participation Plan (Prizma, 2014). Citizens were notified through newsprint media, radio, flyers, door-to-door canvassing, and formal invitations (Prizma, 2014). Prizma interviewed local community members, including large, small, and medium landowners, as well (Prizma, 2014). They confirmed all the necessary ESIA meetings took place (Prizma, 2014). More concerns about the wind farms pushing the clouds away were raised, just like in the original meetings (Participant 5, personal communication, November 30, 2023). Nobody ever objected to the wind projects at the meetings Prizma recorded for UEP I (UEP I Prizma).

The wind farm's visual impact was described as "moderate" since it is not near tourist areas, cultural sites, unique landmarks, or protected areas (Prizma, 2014). Participant 5 noted that in emerging markets like Panama, wind farms are viewed as a positive rather than a negative (personal communication, November 30, 2023). He was also very impressed with the original developers (Participant 5, personal communication, November 30, 2023). According to him, the CEO of UEP gave out his cell phone number to individuals affected so if they had problems they could call him (Participant 5, personal communication, November 30, 2023).

Land Leasing

UEP negotiated deals for land with 21 landowners for all phases of the project (Prizma, 2014). Autoridad Nacional de Administración de Tierras, or ANATI, the state land agency, was one, and the rest were companies, private persons, or co-operatives (Prizma, 2014). The size of land taken from each landowner averaged around 3.5% of their total land (Prizma, 2014). All land was leased for 25 years (Autoridad Nacional del Ambiente, 2009). Property owners could do whatever they want with their land so long as it did not affect the wind farm (Autoridad Nacional del Ambiente, 2009). The contracts include a clause explaining UEP is responsible for disassembling the farm when its lifespan is completed at its expense (Autoridad Nacional del Ambiente, 2009). Every year, 1-2% of wind farm revenue is saved for this purpose (Participant 8, personal communication, December 5, 2023). The expenses to elevate the contract to a public deed were paid entirely by UEP (Autoridad Nacional del Ambiente, 2009). Balboas per year paid depended on the electricity generated by the turbine each year, since generation is variable (Autoridad Nacional del Ambiente, 2009). At minimum property owners earn $6,000 a year, and at maximum $9,000, per wind turbine on their property (Autoridad Nacional del Ambiente, 2009). All private landowners received in total at least $700,000, including a rice cooperative whose land was technically owned by ANATI who offered less than 1% of their land (Prizma, 2014). Even if they could not grow rice anymore, the price they earned from the wind turbines, which only take up 0.65ha each, was considerably more than was possible to earn from rice, with market prices in 2012 leading to total gross sales ranging from $2,160-$2,790 per year (Prizma, 2014).

However, most of the land used for the wind farm came from cattle pastures. Because ranching is still possible with wind turbines on a leaser's land, property owners quickly found themselves with two sources of income, including a newer one that was more financially stable than their previous one (Prizma, 2014). Every participant interviewed by Prizma that leased land to the wind farms asked whether they could have more wind turbines, and many said they now had the money to buy tractors and other farm equipment they could not afford before (Participant 5, personal communication, November 30, 2023). Sometimes the people said they felt like they won the lottery, because the people next door did not get the same benefits if they did not have a wind turbine on their property (Participant 5, personal communication, November 30, 2023). Most complaints came from people that were annoyed they weren't earning as much money as their neighbors (Participant 5, personal communication, November 30, 2023). As participant 5 explained, the developer is not expected to compensate everyone who wants compensation, but those who need to be compensated (Participant 5, personal communication, November 30, 2023).

The wind farm's land leasing was not without its challenges, of course. Prizma identified three lots of land identified as being affected (Prizma, 2014). The developers offered to build the homeowners new windows and plant trees around the lot for noise (Prizma, 2014). One older lady on a farm wanted much more compensation than was being offered. The company wanted to rebuild her house to be better on another part of the property (Participant 5, personal communication, November 30, 2023). She hated that idea (Participant 5, personal communication, November 30, 2023). They went to court (Participant 5, personal communication, November 30, 2023). This

woman claimed if her property were a five star resort, the compensation would be higher (Participant 5, personal communication, November 30, 2023). However, the property was used instead as a weekend home (Participant 5, personal communication, November 30, 2023). The two parties could not come to an agreement for a considerable period, but eventually one was reached (Participant 5, personal communication, November 30, 2023).

On July 8th, 2016, an owner of property 120m from a turbine (well within the 500m buffer zone) did not want his land affected by the wind farm and appealed to ASEP (*AN No. 9530*, 2016). Bartolomé Alberto Jaramillo Laure's lawyer said he was worried about dangers from a wind farm, like electrical contact, fires, collapses, explosions, or more (*AN No. 9530*, 2016). The fall of a wind turbine blade could cause damage in a radius of up to 1,000m, claimed his lawyer (*AN No. 9530*, 2016). UEP Penonomé II requested that his appeal be nullified because he had no houses on his property, and no one was living there (*AN No. 9530*, 2016). Mr. Laure said that he bought the property in 2005, long before the wind farm was planned, intending to build a home when he earned enough money (*AN No. 9530*, 2016). He requested that the forced servitude he had to endure was to be fairly compensated for the limitation of his property rights (*AN No. 9530*, 2016). ASEP mediated and ruled in his favor (*AN No. 9530*, 2016). The compensation was not specified (*AN No. 9530*, 2016). However, on March 1st 2016 a reconsideration appeal was filed by UEP Penonomé II (*AN No. 9530*, 2016). UEP Penonomé had their appeal declared proven (*AN No. 9530*, 2016). The previous ruling was made null and void (*AN No. 9530*, 2016). On April 28th, 2016, the administrative process behind the case was officially terminated (*AN No. 9530*, 2016).

Another affected person was the mayor, whose house lay within the buffer zone. She, however, approved of the project (Prizma, 2014). The population size in the direct area of influence was approximately 3,466 people (Prizma, 2013).

As for other homes within the buffer zone, shadow flicker was limited to 23 hours per year, as opposed to the 30 considered to be acceptable according to Good International Industry Practices (Prizma, 2014). Blade glint also quickly ended as grime built (Prizma, 2014). Noise decibel levels before the project's start were 3 decibels on average (Autoridad Nacional del Ambiente, 2009). Afterwards, noise decibel levels hovered around 52 (Autoridad Nacional del Ambiente, 2009). 52 decibels is 8 decibels below the national threshold (Autoridad Nacional del Ambiente, 2009). The closest towns are at a distance of 300 to 450 m from wind turbines, with expected sound levels being 45db (Autoridad Nacional del Ambiente, 2009).

When it comes to generally accepted human rights practices, displacement must be measured according to whether it is justified by compelling and overriding public interests (Center on Migration, Citizenship, and Development, 2016). Considering only a small number of people's secondary residences were affected and they were compensated for the greater good of the Panamanian grid system, the combined marginal benefit to Panamanians as a whole probably outweigh the individual grievances issued by the angry and dissatisfied landowners.

Construction

Construction included monitoring of air, noise, and water pollution to remain under acceptable levels (Autoridad Nacional del Ambiente, 2009). For the construction, 1,694.68m of new roads, each one 8m across, had to be built to reach the site (Autoridad Nacional del Ambiente, 2009). These roads could be used by the locals afterwards.

Delivering assets to the site proved to be the most difficult problem because the engineers needed to respect local needs. For instance, to move wind turbine blades to the site after importing them from China, they rode along Pan-American highway at night in large convoys to avoid displacing local traffic (Participant 6, personal communication, December 1, 2023). "Every third day was a public holiday," which made transport more "annoying," according to participant 6 (personal communication, December 1, 2023). Then, there was normal maintenance that had to be conducted, including site safety and checking on subcontractors (Participant 6, personal communication, December 1, 2023). The project was delivered with "commendable safety" (Participant 6, personal communication, December 1, 2023). In the end, most issues involved small events like a wind farm hitting a cow, or someone killing a chicken by accident, just like any other large construction project (Participant 5, personal communication, November 30, 2023).

Goldwind

In March 2021, the IFC closed all investments with three Chinese companies engaged in or sourcing from the Uyghur region in China (Murphy et al., 2022). The nonprofit Hong Kong Watch also lists the company of Goldwind as US-sanctioned due to its sourcing (Goodman & Patterson, n.d.).

A good part of the reasoning behind these distancing measures was an investigation by the nonprofit Campaign for Accountability, as a part of their Tech Transparency Project (2021). This investigation found extensive ties with the XPCC, or Xinjiang Production and Construction Corps, a quasi-governmental paramilitary organization that controls extensive areas of Xinjiang and regularly uses forced labor in their production of cotton (Campaign for Accountability, 2021).

At least one factory was poised in advanced stages to transfer forced Uyghur labor from Hotan to its site in 2016 (Campaign for Accountability, 2021). There was no public evidence that human transfers ever happened, since the limited government information that previously revealed this possible labor transfer program has since been deleted (Campaign for Accountability, 2021).

Wu Gang, the founder and chairman of the company, participates in fanghuiju, a surveillance program meant to suppress potential religious or 'extremist' behaviors in the domestic realm, in a form of cultural genocide (Campaign for Accountability, 2021).

These are not the only serious allegations Goldwind has been subject to. A Hong Kong watch report found credible evidence of involvement in construction of internment camps in Xinjiang, as well as forced labor programs (Patterson et al., 2022). Goldwind Australia, a subsidiary of the larger Goldwind Science and Technology Co. Ltd., acknowledged several inherent modern slavery risks within their business in a statement (Goldwind Australia, 2022). These not only involve factories, but also the mines from which raw materials are mined, which

are located in areas with significant human rights issues and low labor rights protections (Goldwind Australia, 2022). They also acknowledge high inherent risks in third party arrangements for labor hire, and in shipping labor (Goldwind Australia, 2022). In July of 2023, Xinjiang Goldwind Science and Technology Co., Ltd changed its name on the Hong Kong stock exchange to simply Goldwind Science and Technology Co., Ltd, most likely to dissociate itself with the globally well-known human rights abuses occurring in Xinjiang (Goldwind Science & Technology Co., Ltd., 2023).

It is not clear if UEP, UEP I, or UEP II were aware of these human rights abuses. The Tech Transparency Project report was only released in June of 2021, after Apple became involved with the company and it received greater attention in the West (Campaign for Accountability, 2021). One participant mentioned "shenanigans" their Chinese partners were up to, but when asked to specify, mentioned differences in business practices between China and the outside world, citing that the project was one of Goldwind's first outside of Panama (Participant 6, personal communication, December 1, 2023).

Based on this information, there is a non-zero chance that the wind turbines currently in operation in Penonomé were constructed under circumstances of modern human slavery by members of oppressed Turkic minorities in Xinjiang. Though outside of the scope of Panama, effects to social inequality worldwide must be considered.

Based on this information, I would score the Penonomé wind farms a (-2; +1) on the SDA social inequality and inclusion metric, taking advantage of the differentiated impacts across territories clause. In Panama, this project improves living conditions through actions on access to essential goods and services, opportunities, and income. It has also been the subject of a dialogue with the counterparty on including disadvantaged populations among the beneficiaries. However, in Xinjiang Autonomous Prefecture, People's Republic of China, the project allegedly exacerbates inequalities and exclusion or discrimination with respect to one or more groups.

Gender Equality

After analysis and dialogue, this project does not have a significant impact on gender equality, leading to a score of 0 on the SDA gender equality resilience metric.

Contribution to a Sustainable and Resilient Economy

Rafael Pérez-Pire took considerable risk spending the time measuring wind and navigating through the permitting process, getting control of the site, and commissioning the social and environmental permitting (Participant 6, personal communication, December 1, 2023). Panama has a reasonably robust permitting process (Participant 6, personal communication, December 1, 2023).

Like any large project, there are obvious risks to any major large infrastructure project. However, these risks are lessened in Panama. Participant 12 noted that financial risks of the project were acceptable according to IFC standards (personal communication, December 7, 2023). This acceptance was in part because of Panama's political stability relative to its Central American

neighbours (Participant 8, personal communication, December 5, 2023). Panama's political stability means that large infrastructure projects like the Penonomé wind farms are more likely to be maintained for longer, since risks are lower. At the same time, the $300 million loan for UEP II construction came from the fiscally conservative IFC, who was less likely to invest in riskier projects, and who offered lower interest rates for loans, meaning the debt agreement was non-predatory (Participant 6, personal communication, December 1, 2023).

The Penonomé wind farms were financially successful for this reason. UEP II alone earned $15,723,000 dollars in revenue in Q2 of 2023 (UEP Penonomé II S.A. and Technisol Group, 2023). These revenues are beneficial to average Panamanians because it means fewer costs need to be socialized at the expense of Panamanian consumers (Participant 6, personal communication, December 1, 2023). Participant 6 noted that the permitting processes behind another Penonomé competitor, AES's LNG terminal, Gas Natural Atlántico, were extremely opaque and required extensive socialization (personal communication, December 1, 2023). The project was representative of an overblown system, according to participant 6 (personal communication, December 1, 2023).

The Penonomé wind farms also produce cheaper electricity, thanks to their lack of variable fuel costs, at an average PPA rate of US$102.75/MWh for UEP II, compared to Gas Natural Atlántico's $113.48/MWhr (InterEnergy, 2020) (Secretaría Nacional de Energía, 2016). According to Laudato Si, cheaper clean energy prices resulted in a saving of 88 million dollars in operating costs of the Panamanian Electrical System per year (Parque Eólico Laudato Si, 2017). ANAM claims Panamanian society as a whole saves $30,000 per hour, constituting 1% savings on energy prices annually (Autoridad Nacional del Ambiente, 2009).

In terms of the local community affected, positive externalities included about 42 jobs per year, representing 223,000 Balboas annually (Autoridad Nacional del Ambiente, 2009). These higher-paying positions led to a 2% average salary increase for the local community (Autoridad Nacional del Ambiente, 2009). 300 temporary construction workers were needed at maximum construction, 85% of which were sourced locally (Prizma, 2013). In their ESIA, ANAM predicted "high benefits" for Panama during the lifetime of the project (Autoridad Nacional del Ambiente, 2009). Additionally, 20% of the money earned from the sale of CERs from this project were planned to go into an annual fund for community support, 10% more than the UNFCCC requirement, according to the IFC, though these CERs were never sold (*Resolución IA-352-10*, 2010).

Notable Operational Issues

In order to determine if the Penonomé wind farms contribute to a sustainable economy, we have to evaluate problems they have encountered with the national grid system. After investigation of all ASEP resolutions regarding the Penonomé wind farms, the following major failure points were noted.

1. Event No. 180: On January 24th, 2015, a partial blackout of 2 hours and 27 minutes occurred in the National Interconnected System (NIS) as a result of a single-phase failure at the Llano Sanchez Substation (*AN No.13362*, 2019) The single phase failure resulted in the division into two subsystems (*AN No.13362*, 2019). Subsystem 1 had no failures. Subsystem 2, or the other half the power grid, which included the el Coco substation, collapsed due to the generation deficit (*AN No.13362*, 2019). The collapse was due to "incorrectly loaded settings in the primary and secondary distance protections" of the El Coco substation. UEP I was fined B./ 200,000 for its failure to meet transmission standards (*AN No.13362*, 2019).
2. International Control: On 9th of February 2018, inspections were carried out at UEP I and UEP II (*AN No.16623*, 2021). At one point, the CND requested the operator at the El Coco Substation to vary the power flow and he proceeded to inform Goldwind USA in Chicago about this order execution (*AN No.16623*, 2021). Rules stipulate that control of power must rest in local hands (Participant 8, personal communication, December 5, 2023). Upon learning about this suspicious activity, inspectors investigated the offices of UEP I and UEP II (*AN No.16623*, 2021). A copy of an ETESA agreement was unearthed (*AN No.16623*, 2021). The ETESA agreement established the operating procedure for the El Coco substation (*AN No.16623*, 2021). The operating procedure said that the operations were to be controlled remotely from Goldwind USA's Chicago headquarters whenever possible (*AN No.16623*, 2021). ETESA was aware of how operations of UEP I were carried out through this contract, but did not care that it violated local control rules (Participant 8, personal communication, December 5, 2023). Its role was transmitting power, not determining where it was controlled from (Participant 8, personal communication, December 5, 2023).

   The operator, who is employed by INGETEAM, receives instructions from the CND and then immediately communicates with the Chicago operator, who actually controls the park, and there maneuvers are made to stop or put the turbines into operation (*AN No.16623*, 2021). Operations cannot actually be maneuvered from the El Coco substation because there "the equipment cannot be guaranteed to function properly" (*AN No.16623*, 2021).

   Another central issue unearthed by the investigation is that only one operator controls the electricity generation for two separate companies with separate licenses (*AN No.16623*, 2021). It also takes time for remote coordination, which affects energy operation. Remote operation puts the National Interconnected system at risk, since it may take time to take advantage of wind resources and increase generation, or time to lower generation which could bring stability problems (*AN No.16623*, 2021).

   The general manager of UEP Penonomé II testified that at one point the CND operator had given instructions to increase park generation to 100MW from 60MW, but that these instructions had not been followed through by the El Coco substation operator (*AN No.16623*, 2021). The general manager asked why and the two operators said that it

was human error since the operator on duty was inexperienced (*AN No.16623*, 2021). This disruption lasted 28 minutes, during which time the wind park lost potential money (*AN No.16623*, 2021). UEP wanted to increase its power faster but could not because of its coordination system (*AN No.16623*, 2021). The contract clauses with Ingeteam and Goldwind USA, however, did not contain compensation clauses, so the SPVs incurred all losses (*AN No.16623*, 2021). UEP I was made to pay 50,000 Balboas and UEP II made to pay 30,000 for failing to deliver energy promptly (*AN No.16623*, 2021).

No more delays have occurred since the day of the event according to UEP II, and UEP I says they still have a compliance rate of 99.17% (*AN No.16623*, 2021).

Based on this information, I would score the Penonomé wind farms a (-1;+1 on the SDA economy metric. The project contributes to improving the social and environmental impact of the economic growth model, integrating the creation of decent jobs. However, its remote operation model is incredibly concerning.

Governance

Monitoring and evaluation systems incorporate the government in the form of continued monitoring and reporting on the part of relevant government agencies every 6 months (Participant 8, personal communication, December 5, 2023). When project modifications required new ESIAs, the modified ESIAs reprinted most of the information from the initial ESIAs instead of conducting new ones (Autoridad Nacional del Ambiente, 2009).

Exit plans also exist, with 1-2% of all revenues generated devoted to covering costs of disassembly, which often can cost as much as construction (Participant 8, personal communication, December 5, 2023). These costs, according to the contracts signed between UEP and the landowners, are entirely paid for by UEP (Autoridad Nacional del Ambiente, 2009). The SPVs later inherited this responsibility (Participant 4, personal communication, November 29, 2023). The only evidence that will be left after operation is over are small slabs of concrete flush with the ground where the turbines were once held in place (Participant 8, personal communication, December 5, 2023).

Since the Penonomé wind farm project was a private sector enterprise, sustainable development effects on governance are understandably limited. Based on this information, I would score the Penonomé wind farms a +1 on the SDA governance metric. The sustainability of the project was taken into account in the project design and affected groups participated in steering groups and monitoring committees, as indicated by the governance dimension metric.

Discussion

In the beginning I expected this paper to more so cover the Clean Development Mechanism, because it was planned to be one of the revenue streams of the project. The project quickly expanded beyond that. I still believe that the Clean Development Mechanism provides an important frame for the project. It, the IFC investment, and the involvement of multinational corporations (MNCs) like

AES, InterEnergy, and Goldwind secure this project as an important example of internationally financed development.

It was also a struggle to determine the basic facts of the wind project. There is no one perfect source for discovering the organizational structure behind the Penonomé wind farms. Determining both the organization and financing of the project each took about as much effort as did determining the sustainability of the project, heavily involving responses from interviewers to piece together often conflicting information found in the business literature.

Panama has a troubled history of internationally financed megaprojects displacing or not destroying the livelihoods of indigenous peoples. The Barro Blanco dams, funded by several European development banks, for example, resulted in failure to respect certain human rights, such as a right to housing and a right to health (Obergassel, 2017). Hydroelectric projects near Naso indigenous lands in Bocas del Toro encountered similar problems with destruction of fish stocks (Paiement, 2007). The fact that indigenous groups were taken into account for this project should be applauded. However, the practice of including and respecting indigenous peoples should also be a norm of Panamanian internationally financed development, not an outlier.

Interviewers frequently compared their experience with the project on previous experiences, exemplifying personal case studies. For example, participant 5 called the community relationships built between the developers and people of Penonomé "unusually good" compared to his previous experiences (personal communication, November 30, 2023). Participant 5 mentioned a wind farm he worked on in Mexico had to be protected with garrisons of security, and had issues with corruption, gang warfare, and displaced indigenous peoples (Participant 5, personal communication, November 30, 2023). It also involved little community decision-making compared to the Penonomé wind farms (International Finance Corporation, 2019). Participant 5 was just happy there were no guards with machine guns like in Mexico (personal communication, November 30, 2023). The security was "just a couple of guys on motorcycles" checking for vandalism in Penonomé (Participant 5, personal communication, November 30, 2023). The operation was altogether more socially inclusive and safe.

Participant 5 also mentioned that social perceptions of the visual impacts of wind farms are much more different in emerging markets like Panama compared to in the US or UK, places he had worked before (personal communication, November 30, 2023). In the UK or US, people are much more likely to pursue "Not in My Backyard" policies (Participant 5, personal communication, November 30, 2023). As such, my US-based opinions of the visual impacts of wind projects could not be translated to Panamanian tolerance for wind turbines.

Participant 6 used to work on coal and diesel plants, but after a change of heart, transitioned to renewables to fight the climate crisis, sitting on multiple sustainability committees in his home country (personal communication, December 1, 2023). Compared to his previous work, he was immensely proud of his work on the Penonomé wind farms (Participant 6, personal communication, December 1, 2023). He was also impressed by Panamanian business practices when it came to developing the wind farm (Participant 6, personal communication, December 1, 2023). In the Dominican Republic, he said, the concept of honoring a contract is a novelty, done by exclusion and

not the norm (Participant 6, personal communication, December 1, 2023).

Participant 8 hoped that in the future, Panama would become a major energy distributor, thanks to its stable financial position (Participant 8, personal communication, December 5, 2023). For example, Argentina has twice as much capacity for wind due to mountains that channel air currents (Participant 8, personal communication, December 5, 2023). But, it is more expensive to pursue wind power there because of the political risk (Participant 8, personal communication, December 5, 2023). Combined with the fact that Panamanian energy generation is entirely privatized, and that Panamanian markets are limited in their ability to raise capital, the Argentinian case study tells us that Panama's continued growth of its power generation will rely extensively on Panama's ability to maintain its status as a politically stable country with a reputation for honoring contracts (Participant 8, personal communication, December 5, 2023). Normally, I would worry that the Supreme Court's ruling that the Cobre Panama mining contract was unconstitutional after its ratification would endanger this special privilege Panama enjoys, but it is less likely that the same environmentally conscious Panamanians will rally to demonstrate against a future wind energy plant. However, Panama's history of protesting hydroelectric dams will likely be noted by future internationally-based investors.

When it came to using the SDA, I found that many of the faults consistent with the wind farm's operations can be attributed to Goldwind. Goldwind remotely operates both wind farms, removing control from Panamanian hands (*AN No.16623*, 2021). I thought the question I would be asking myself throughout the process of determining sustainable development would be "is this project sustainable?" and not "is this project development?" If control over 5% of Panamanian electricity isn't granted to Panamanians, and wind turbines can be turned off remotely from the United States, can that be considered development at all (Arroyo, 2021)? At the same time, Goldwind also supplied defective wind turbine blades, and allegedly contributes to modern slavery in Xinjiang (InterEnergy, 2020) (Campaign for Accountability, 2021). I considered not including this detail in my paper, since the alleged offence takes place outside of Panama, but I found it too important to exclude. Within the press, NGO realm, and business world, researchers have made connections between the Penonomé wind farms and Goldwind, and between Goldwind and modern slavery practices, but I have not found evidence connecting the Penonomé wind farms and modern slavery practices within the established literature so far.

I also found it difficult to narrow the complex web of issues found within most dimensions into a single defined number value. I think the AFD's SDA is still the strongest metric I could have used for the sustainable development analysis I conducted, but measuring a concept as broad as "sustainability" is incredibly daunting. At the same time, if results are presented without a good definition of sustainability, then people are likely to define the sustainability of the project in different ways. I found when questioning the interviewees that each had different definitions for sustainability. Some were tighter than others, some involved net positives, and others a simple mitigation of the negatives. And, of course, different connotations change according to the translation of the term.

In terms of sampling, snowball sampling allowed me to reach many more people than would

be normally possible, but it only exposed me to a small network of contacts. Those outside of said network were usually not available to be reached.

At the same time, many people and organizations did not respond to inquiries to interview. They likely possessed important or interesting information regarding the wind farms, but these insights were not possible for me to learn about. As for the people I did speak with, there are incentives everybody has to reveal or not reveal information that I will never understand.

I still do not possess all the information possible about the project, meaning that my conclusions are based on limited information, albeit a great amount of information. With more time to interview, this lack of information problem could be alleviated, but ultimately much information is not publicly available outside of the companies involved. At the same time, most information available came from during the initial stages of construction, and from UEP II, which was more transparent about its business practices. I did not include much of the missing information regarding the continued upkeep of sustainable practices and UEP I's work.

The sustainable development analysis is ultimately a useful tool, but still an abstract one. My hope for the future is that more comprehensive and quantitative tools will be developed to more objectively quantify development sustainability, though quantifying development sustainability may prove impossible.

Finally, I have a competent but not fluent grasp of Spanish. When pouring through Spanish-language documents and interviewing Spanish speakers in Spanish, I may have misinterpreted or missed information relating to the wind farms.

Conclusion

I think this project handled a lot of the most difficult aspects of developing a major construction project with uncommon care. The leasing of land instead of displacing landowners, the choice of location in pastures, the cooperation with local communities, the economic benefits given to average people paying utility bills, and the environmental quality tests performed to prevent pollution all exemplify sustainable development. And, at the end of the day, the project is renewable energy. It might still be worth asking if the wind farms would be as sustainable without the legal hoops the Panamanian government and the IFC made it pass through, but ultimately sustainable development isn't the responsibility of the developers, only. It's equally the responsibility of the governing body and financiers, hence the ESG consultations.

This project had many minor issues, like some home displacement, grid integration issues, and variations in carbon displacement calculations. However, compared to many of its fossil fuel counterparts, and considering the intensity of issues other major construction projects might have had in similar circumstances, I do not find these minor issues to be of incredible concern, even in combination.

However, Goldwind's alleged use of human slavery in its supply chain cannot be tolerated. The SDA does not adequately demonstrate this alleged evil.

It should also be noted that monitoring information was not as publicly available as were impact assessments conducted before and shortly after construction of the Penonomé wind farms. It

is difficult to make conclusions about a development project's sustainability with few monitoring metrics evaluated.

Ultimately, the ratings for the Penonomé wind farms are as follows:

1. Sustainable and Resilient **Economy** for People and the Planet: (-1;+1)
2. **Social** Inequality Reduction and Inclusion: (-2; +1)
3. **Gender** Equality: 0
4. **Biodiversity** Conservation, Management of the Environment, and Natural Resources: +1
5. Transition to a **Low-Carbon** Pathway: +2
6. Climate Change **Resilience**: +1
7. Long-Term Project Impact and **Governance** Framework: +1

And the most significant lessons learned were:

1. Wind power as a technology has enormous potential to benefit investors, local communities, consumers of electricity, and the National Interconnected System within Panama, when developed, monitored, and operated in a sustainable way.
2. Panama must preserve its political and economic stability to continue to earn international financing to expand its privatized energy grid.
3. Supply chain opaqueness and corporate secrecy makes inherent problems harder to find and address.
4. Panama must decide how much longer it will allow its private sector to collaborate with Goldwind as it expands its wind power capacity.

In the future, I think more economic research into the supply chains that begin with the manufacturing of the materials that make up the wind turbines to their final installation could prove incredibly useful, though following the supply chain could stand monumentally challenging, as it proved for me. It might also be impossible given Chinese limits on information from Xinjiang, and the abundance of S.A. type companies within Panama. Although Panama is obviously doing its best to mitigate its reputation as a tax haven, transparency of information remains a real issue. The information I found was buried across networks of contacts, and often opaque.

I also believe that more research on AES's practices could prove useful, as well. And, of course, given more time to conduct research, one could integrate more perspectives into their arguments, including a possible survey of the opinions of those near the 500 meter buffer zone in Penonomé, almost a decade after initial construction.

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Appendix A

Informed consent

My name is John Matuszewski. I am a student with the SIT Panama Tropical Ecology, Marine Ecosystems, and Biodiversity Conservation program.

I would like to invite you to participate in a study I am conducting (for partial fulfillment of my SIT Study Abroad program in Tropical Ecology, Marine Ecosystems, and Biodiversity Conservation). Your participation is voluntary. Please read the information below, and ask questions about anything you do not understand, before deciding whether to participate.

The purpose of this study is to determine to what extent the Penonomé Wind Farms constitute sustainable development, a stated goal of the Clean Development Mechanism.

There are no foreseeable risks to participating in this study and no penalties should you choose not to participate; participation is voluntary. During the interview you have the right not to answer any questions or to discontinue participation at any time.

There are no foreseeable benefits to participating in this study and no penalties should you choose not to participate; participation is voluntary. However, this study would benefit me in determining the effectiveness of the CDM's work on the Penonomé wind farms in Panamá.

No Compensation is involved.

Data will be stored on my password-protected computer. Nobody will have access to your data other than me, and I will only be recording your name, your job position, and the organization with which you are affiliated, as well as an audio tape of the interview itself, if you allow me. Your name will not be used in the final report or presentation I will be making, and your organization will not be named. Data collected will be stored for a maximum of 5 years and then deleted.

When the results of the research are published or discussed in conferences, no identifiable information will be used.

Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

Would you still like to participate?

Appendix B

Requests for quotations and audio recordings

May I quote from the interview in either the presentation or article resulting from this work?

May I audio-record you for notetaking/translation purposes?

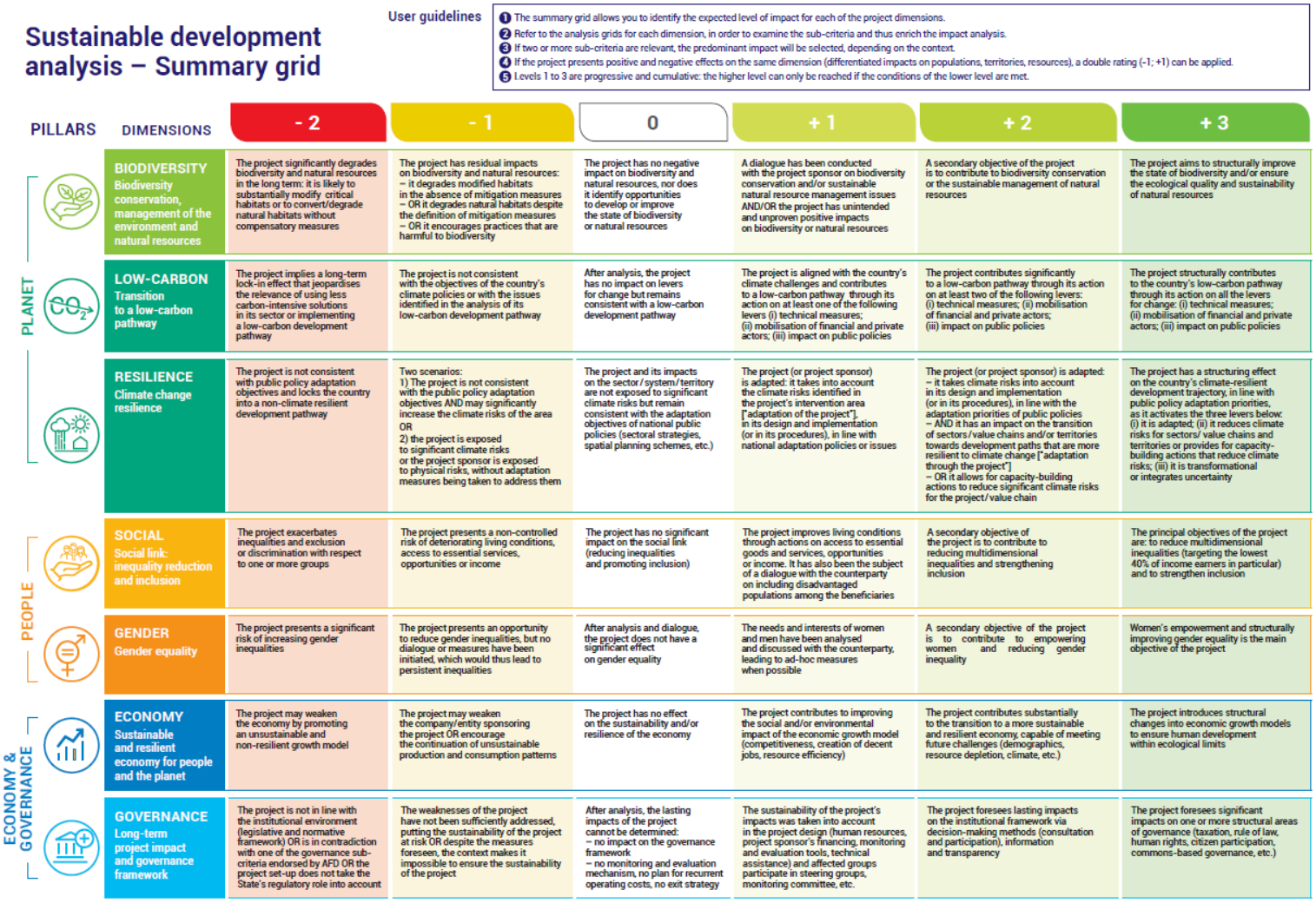
Appendix C

Participant list

1. US Academic, November 26, 2023
2. Panamanian Bird Biologist, November 26, 2023
3. Panamanian Tree Biologist, November 27, 2023
4. Belgian NGO Employee, November 29, 2023
5. US ESG Consultant, November 30, 2023
6. English Energy Company Employee, December 1, 2023
7. Panamanian Lawyer, December 5, 2023
8. Panamanian Former Employee of an Energy Company, December 5, 2023
9. Panamanian Biologist, December 5, 2023
10. Panamanian Government Employee, December 6, 2023
11. Panamanian Engineer, Energy Company Employee, December 6, 2023
12. Panamanian Banker, December 7, 2023

Appendix D

AFD Sustainable development analysis grid



Sustainable development analysis – Summary grid

User guidelines

1. The summary grid allows you to identify the expected level of impact for each of the project dimensions.
2. Refer to the analysis grids for each dimension, in order to examine the sub-criteria and thus enrich the impact analysis.
3. If two or more sub-criteria are relevant, the predominant impact will be selected, depending on the context.
4. If the project presents positive and negative effects on the same dimension (differentiated impacts on populations, territories, resources), a double rating (-1; +1) can be applied.
5. Levels 1 to 3 are progressive and cumulative: the higher level can only be reached if the conditions of the lower level are met.

PILLARS	DIMENSIONS	- 2	- 1	0	+ 1	+ 2	+ 3
PLANET	**BIODIVERSITY** Biodiversity conservation, management of the environment and natural resources	The project significantly degrades biodiversity and natural resources in the long term: it is likely to substantially modify critical habitats or to convert/degrade natural habitats without compensatory measures	The project has residual impacts on biodiversity and natural resources: – it degrades modified habitats in the absence of mitigation measures – OR it degrades natural habitats despite the definition of mitigation measures – OR it encourages practices that are harmful to biodiversity	The project has no negative impact on biodiversity and natural resources, nor does it identify opportunities to develop or improve the state of biodiversity or natural resources	A dialogue has been conducted with the project sponsor on biodiversity conservation and/or sustainable natural resource management issues AND/OR the project has unintended and unproven positive impacts on biodiversity or natural resources	A secondary objective of the project is to contribute to biodiversity conservation or the sustainable management of natural resources	The project aims to structurally improve the state of biodiversity and/or ensure the ecological quality and sustainability of natural resources
	LOW-CARBON Transition to a low-carbon pathway	The project implies a long-term lock-in effect that jeopardises the relevance of using less carbon-intensive solutions in its sector or implementing a low-carbon development pathway	The project is not consistent with the objectives of the country's climate policies or with the issues identified in the analysis of its low-carbon development pathway	After analysis, the project has no impact on levers for change but remains consistent with a low-carbon development pathway	The project is aligned with the country's climate challenges and contributes to a low-carbon pathway through its action on at least one of the following levers (i) technical measures; (ii) mobilisation of financial and private actors; (iii) impact on public policies	The project contributes significantly to a low-carbon pathway through its action on at least two of the following levers: (i) technical measures; (ii) mobilisation of financial and private actors; (iii) impact on public policies	The project structurally contributes to the country's low-carbon pathway through its action on all the levers for change: (i) technical measures; (ii) mobilisation of financial and private actors; (iii) impact on public policies
	RESILIENCE Climate change resilience	The project is not consistent with public policy adaptation objectives and locks the country into a non-climate resilient development pathway	Two scenarios: 1) The project is not consistent with the public policy adaptation objectives AND may significantly increase the climate risks of the area OR 2) the project is exposed to significant climate risks or the project sponsor is exposed to physical risks, without adaptation measures being taken to address them	The project and its impacts on the sector / system / territory are not exposed to significant climate risks but remain consistent with the adaptation objectives of national public policies (sectoral strategies, spatial planning schemes, etc.)	The project (or project sponsor) is adapted: it takes into account the climate risks identified in the project's intervention area ["adaptation of the project"], in its design and implementation (or in its procedures), in line with national adaptation policies or issues	The project (or project sponsor) is adapted: – it takes climate risks into account in its design and implementation (or in its procedures), in line with the adaptation priorities of public policies – AND it has an impact on the transition of sectors / value chains and/or territories towards development paths that are more resilient to climate change ["adaptation through the project"] – OR it allows for capacity-building actions to reduce significant climate risks for the project / value chain	The project has a structuring effect on the country's climate-resilient development trajectory, in line with public policy adaptation priorities, as it activates the three levers below: (i) it is adapted; (ii) it reduces climate risks for sectors / value chains and territories or provides for capacity-building actions that reduce climate risks; (iii) it is transformational or integrates uncertainty
PEOPLE	**SOCIAL** Social link: inequality reduction and inclusion	The project exacerbates inequalities and exclusion or discrimination with respect to one or more groups	The project presents a non-controlled risk of deteriorating living conditions, access to essential services, opportunities or income	The project has no significant impact on the social link (reducing inequalities and promoting inclusion)	The project improves living conditions through actions on access to essential goods and services, opportunities or income. It has also been the subject of a dialogue with the counterparty on including disadvantaged populations among the beneficiaries	A secondary objective of the project is to contribute to reducing multidimensional inequalities and strengthening inclusion	The principal objectives of the project are: to reduce multidimensional inequalities (targeting the lowest 40% of income earners in particular) and to strengthen inclusion
	GENDER Gender equality	The project presents a significant risk of increasing gender inequalities	The project presents an opportunity to reduce gender inequalities, but no dialogue or measures have been initiated, which would thus lead to persistent inequalities	After analysis and dialogue, the project does not have a significant effect on gender equality	The needs and interests of women and men have been analysed and discussed with the counterparty, leading to ad-hoc measures when possible	A secondary objective of the project is to contribute to empowering women and reducing gender inequality	Women's empowerment and structurally improving gender equality is the main objective of the project
ECONOMY & GOVERNANCE	**ECONOMY** Sustainable and resilient economy for people and the planet	The project may weaken the economy by promoting an unsustainable and non-resilient growth model	The project may weaken the company/entity sponsoring the project OR encourage the continuation of unsustainable production and consumption patterns	The project has no effect on the sustainability and/or resilience of the economy	The project contributes to improving the social and/or environmental impact of the economic growth model (competitiveness, creation of decent jobs, resource efficiency)	The project contributes substantially to the transition to a more sustainable and resilient economy, capable of meeting future challenges (demographics, resource depletion, climate, etc.)	The project introduces structural changes into economic growth models to ensure human development within ecological limits
	GOVERNANCE Long-term project impact and governance framework	The project is not in line with the institutional environment (legislative and normative framework) OR is in contradiction with one of the governance sub-criteria endorsed by AFD OR the project set-up does not take the State's regulatory role into account	The weaknesses of the project have not been sufficiently addressed, putting the sustainability of the project at risk OR despite the measures foreseen, the context makes it impossible to ensure the sustainability of the project	After analysis, the lasting impacts of the project cannot be determined: – no impact on the governance framework – no monitoring and evaluation mechanism, no plan for recurrent operating costs, no exit strategy	The sustainability of the project's impacts was taken into account in the project design (human resources, project sponsor's financing, monitoring and evaluation tools, technical assistance) and affected groups participate in steering groups, monitoring committee, etc.	The project foresees lasting impacts on the institutional framework via decision-making methods (consultation and participation), information and transparency	The project foresees significant impacts on one or more structural areas of governance (taxation, rule of law, human rights, citizen participation, commons-based governance, etc.)

Figure D1. AFD Sustainable Development Analysis Summary Grid (Agence Française de Développement, 2023).

Appendix E

Proposed alternative sites

Alternatives	Environmental and Social Aspects	Constructability & Feasibility	Decision
Alternative A: Cerro Azul, eastern Panama	Located in a forested area in the vicinity of a protected area, large property owners not eager to negotiate	Difficult to access, required construct through mountainous terrain	Rejected
Alternative B: Las Tablas, south of Penonomé	Mountainous location with more significant access road construction impacts	No existing access roads, long distance to connect project to national grid, mountainous terrain which creates costly constructability challenges	Rejected
Alternative C: Portobello, area near Colon	Natural area with intact forests	Access would entail significant environmental impacts, long distance to connect project to national grid	Rejected
Alternative D: UEP Penonomé Project	No material environmental & social footprint, supportive community and landowners	Flat area, easy site access, vicinity to national grid	Preferred and selected alternative

Figure E1. Proposed Alternative sites for the wind farm construction drafted by UEP, and organized by Prizma (Prizma, 2014).

Appendix F

Socioeconomic and environmental issue mitigation costs

Etapa de Construcción		
Medio Afectado	**Medida de Mitigación**	**Costo**
Suelo y Agua	Control de Erosión	60.000.00
Suelo	Prevención y minimización del deterioro de la estructura del suelo.	100.000.00
Suelo	Control y prevención de derrames de combustible.	90.000.00
Vegetación	Protección de la vegetación remanente, minimización, indemnización y compensación de la pérdida de cobertura vegetal.	101.800.00
Fauna	Protección y recuperación de los hábitats.	50.000.00
Aire	Prevención y control de la generación de polvo, gases contaminantes y ruido.	18.000.00
Socioeconómico	Prevención de accidentes laborales.	10.000.00
Socioeconómico.	Prevención y control de enfermedades.	50.000.00
Socioeconómico.	Rescatar y proteger posibles hallazgos de piezas o elementos con valor arqueológico.	150.000.00
Monitoreos (etapa de construcción)		
Calidad del Aire		4.000.00
Ruido		5.500.00
Calidad de agua		12.000.00
Etapa de Operación		
Suelo y aguas	Evitar la contaminación de suelo y aguas superficiales.	150.000.00
Socioeconómico, biológico.	Control del ruido generado por las aspas eólicas.	50.000.00
Fauna	Estudio y seguimiento a eventos de posibles choque de aves.	100.000.00
Paisaje, Socioeconómico	Relaciones comunitarias	100.000.00
Monitoreo (etapa de operación)		
Calidad de aire del ambiente laboral		5.000.00
Ruido		22.800.00
Vibraciones		4.500.00
Calidad de agua		6.000.00
Planes		
Plan de participación ciudadana		10.000.00
Plan de prevención de riesgos		30.000.00
Plan de rescate y reubicación de fauna		50.000.00
Plan de educación ambiental		25.000.00
Plan de contingencias		100.000.00
TOTAL		1.314.600.00

Figure F1. Environmental and socioeconomic issue mitigation costs. (Autoridad Nacional del Ambiente, 2009).

English translation:

General costs:
Erosion control: $60,000
Prevention and minimization of deterioration of the soil structure: $100,000
Control and prevention of fuel spills, protection of remaining vegetation, minimization, compensation for the loss of vegetal cover: $101,800
Protection and recovery of habitats: $90,000
Prevention and control of the generation of dust, polluting gasses and noise: $18,000
Prevention of work accidents: $10,000
Prevention and control of human diseases: $50,000
Rescue and protection of elements of archeological value: $150,000

Construction phase
Monitoring air quality: $4,000
Monitoring noise: $5,500
Monitoring water quality: $12,000

Operations stage:
Avoiding contamination of soil and surface water: $150,000
Control of noise generated by wind blades: $50,000
Study and monitoring of possible crash events (birds): $100,000
Community relations: $100,000
Air quality of the work environment: $5,000
Noise: $22,800
Vibrations: $4,500
Water quality: $6,000

Plans
Citizen participation plan: $10,000
Risk prevention plan: $30,000
Wildlife rescue and relocation plan: $50,000
Environmental education plan: $25,000

Appendix G

Organization Diagram

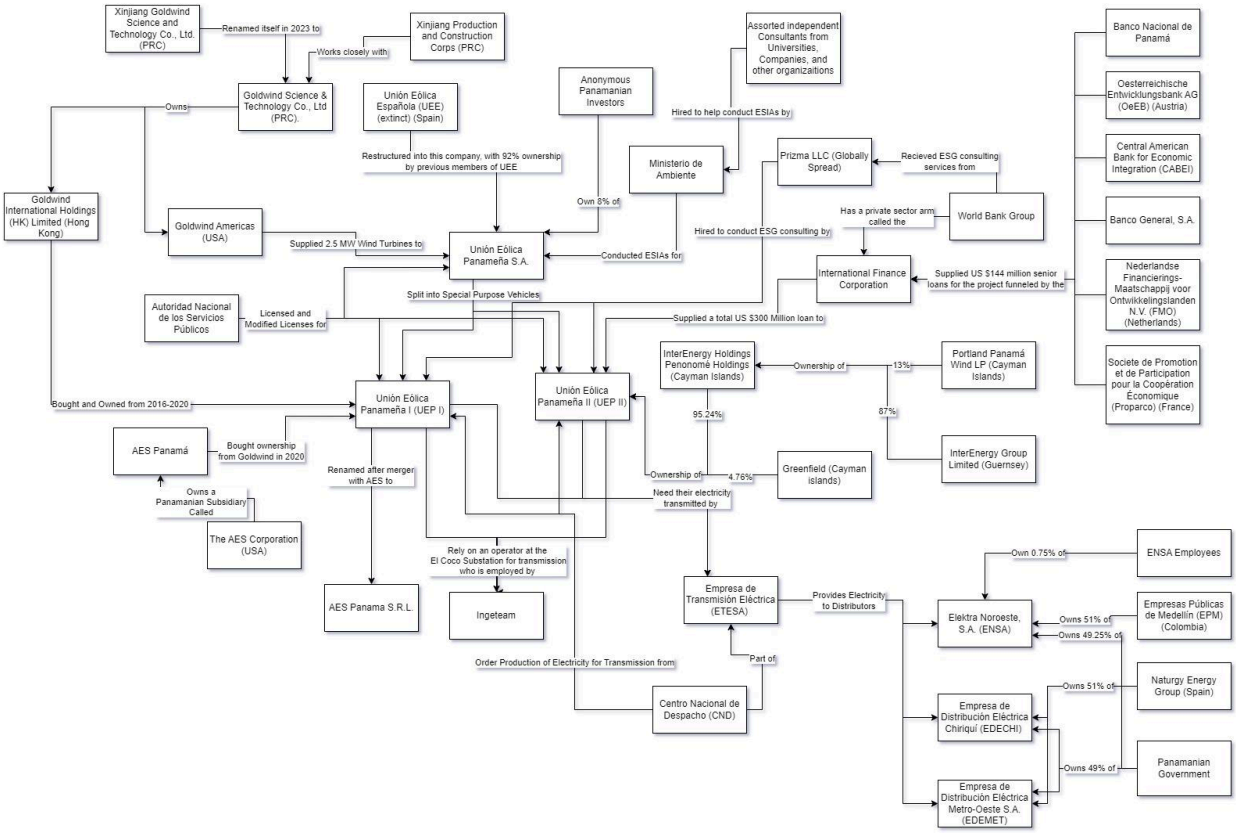


Figure G1. Relationship diagram of major players related to the Penonomé wind farms