Complexo Madeira: Environmental Licensing for Large-Scale Hydropower in Brazil

by Daniel Sherwood Sotelino

Daniel Sherwood Sotelino is a legal consultant at Enhesa, an international environmental, health, and safety compliance assistance consulting group.

Summary

Hydropower is often considered a climate-friendly solution to energy needs. Brazil has elected to construct a major hydroelectric project in the Amazon region: *Complexo Madeira*. A case study of *Complexo Madeira* illuminates the Brazilian licensing process for this project and reveals the challenges and benefits of such a process, including the resulting policy changes and political rifts. Brazil's licensing process is relatively demanding, and the environmental impact studies for Brazilian projects are lengthy. The *Complexo Madeira* environmental impact studies considered only nuclear and thermoelectric alternatives to this major hydropower project, and failed to consider energy efficiency or distributed generation as legitimate alternatives—a critical oversight that should be avoided in future hydropower project licensing.

Global climate change is an inherently international problem, so it is critical to examine energy sectors and environmental law all over the world. This is especially true for rapidly developing nations, which tend to increase their energy consumption at a faster rate than the United States and Europe.[1]

This Article explores the environmental licensing process for large-scale hydroelectric generation in Brazil using *Complexo Madeira* as a case study. Brazil produces approximately 400 billion kilowatt-hours (Bkwh) of hydroelectricity per year, and is one of the leading hydroelectric producers in the world.[2] Rightly or not, hydroelectric power is typically considered a renewable source of energy. Yet, the solar energy used by the trees and organisms that are flooded over, and the interruption of migratory fish patterns, for example, compromise the potential for renewal once a major hydroelectric dam is put into place.

Hydropower generates about 85% of the electricity consumed in the country,[3] and Brazil's demand for energy is on the rise.[4] Chances of rationing and blackouts were reportedly expected to rise "above tolerable levels" (5%) by 2010, and reach 14% by 2011.[5] *Complexo Madeira* potentially represents a "renewable," reliable, and known solution, but Brazil should expand its efficiency programs moving forward.

According to the Energy Information Agency, Brazil is the ninth largest consumer of energy in the world.[6] Within its borders, Brazil also contains most of what is left of the Amazon rainforest.[7] This Article uses the licensing process for *Complexo Madeira* to illustrate how Brazil is applying its regulatory scheme to navigate its energy *trilemma*[8]—the tension between the need for additional renewable and reliable energy capacity in the form of major hydroelectric dams, the risk to the Amazon, and the financial cost and opportunities of major infrastructure developments.

1. *See* Energy Information Administration, Brazil: Country Analysis Brief, http://www.eia.gov/countries/country-data.cfm?fips=BR&trk=c and United States: Country Analysis Brief, http://www.eia.gov/countries/country-data.cfm?fips=US&trk=m (last visited Oct. 17, 2012).
2. Energy Information Administration, Brazil: Background, http://www.eia.gov/countries/cab.cfm?fips=BR (last visited Oct. 17, 2012) [hereinafter Brazil: Background].
3. *Id.*
4. *Transmissão do Madeira ainda está no papel*, Folha de S. Paulo, July 11, 2007, at B4.
5. Humberto Medina & Janaina Lage, *Especialistas não descartam racionamento*, Folha de S. Paulo, July 11, 2007, at B4.
6. Brazil: Background, *supra* note 2.
7. *See Map of the Amazon*, Mongabay.com, http://rainforests.mongabay.com/amazon/amazon_map.html (last visited Oct. 17, 2012).
8. Prof. Michael Dworkin, class entitled *Energy Policy in a Carbon-Constrained World* (Sept. 2007). The energy trilemma is the tension between economic growth, energy security, and environmental protection. Every nation faces its own energy trilemma.

The first section of this Article provides an overview of Brazil's energy sector and the federal environmental regulatory scheme governing large-scale hydroelectric power in Brazil. The legal framework for environmental protection in Brazil is fairly convoluted, as over the years, the bureaucracies and agencies have changed names, merged, and splintered.[9] This section will provide information about the relevant agencies and some of the procedural requirements for applicants seeking permits for major hydroelectric infrastructure projects.

The second section introduces the reader to *Complexo Madeira*, a controversial project that involves the construction of two major hydroelectric dams. This section describes the site of the proposed project and highlights some of its environmental peculiarities and sensitivities. It discusses the proposed engineering project itself in terms of cost, potential power generation, and transmission challenges. Finally, it provides an up-to-date summary of where in the licensing process the project currently stands. This section should give readers a basic understanding of the proposed hydro project itself and its current legal status.

The third section serves three purposes. First, it discusses the current status of *Complexo Madeira* up to the current date. Second, it seeks to predict where, if at all, the project may encounter a legal or regulatory requirement with which it cannot comply. Finally, the third section examines what alternatives Brazil may have besides expanding electric generation capacity. The third section concludes that the Brazilian government enforced relatively progressive environmental laws during the *Complexo Madeira* licensing process, and that these dams are likely to be built. It also suggests that there may be economically and environmentally desirable alternatives, such as expanding efficiency programs.

With the threat of global climate change, hydropower often seems a benign enough proposition, as greenhouse gas (GHG) emissions due to a hydroelectric generator are virtually nonexistent once the facility is up and running.[10] But Brazil can do more from a regulatory and investment standpoint to push for more efficiency, not more large-scale hydropower. Efficiency should find support not only from environmentalists who wish to protect sensitive ecosystems like the Amazon rainforest, but also from economists who seek long-term energy solutions and stable economic growth.

I. Brazil and Environmental Licensing

A. An Overview of Brazil and Its Energy Sector

When I was growing up in immense São Paulo, Brazil, in the 1980s and 1990s, power outages were not uncommon, even though my family lived in a house equipped with many "first world' conveniences. As a child, the outages were fun times. We'd light candles, strum guitars, tell ghost stories, or turn on the battery-operated radio to listen to the rest of a *futebol* match. We could still cook because we had a natural gas stove. I did not question these moments of grid failure. Power outages were simply a fact of life. I did not understand that there had to be the electrical capacity and actual generation, transmission, and distribution operating at that exact instant in time for the entire system to function, and for the light in my bedroom to turn on at the flick of the switch.

In retrospect, the power outages could have been caused for any number of reasons. Surely sometimes, the power went out because a distribution line fell due to a storm. Other times, there were droughts, and Brazil's largely hydroelectric-powered grid could not fulfill its capacity, and therefore could not meet the demand. Short-term solutions to these problems were sometimes scheduled brownouts and sometimes unscheduled blackouts. In 2001, there were major droughts and the country went through an energy crisis, with federally enforced rationing.[11] Energy consumption has grown quickly in Brazil, more than tripling in the last 25 years, and the 2001 crisis prompted the country to embark on a mission for increased generation capacity. For decades, Brazil's default long-term solution to electrical capacity needs has been to build more hydroelectric generation.[12]

Brazil is the fifth largest country in the world in terms of both area and population.[13] The country is 8,514,877 square kilometers in size, slightly smaller than the United States and slightly larger than Australia.[14] With over 190,000,000 inhabitants, according to the *Instituto Brasileiro de Geografia e Estatística* or Brazilian Institute of Geography and Statistics (IBGE), Brazil's population ranks between those of Indonesia and Pakistan.[15] In 2011, Brazil had the sixth largest national gross domestic product (GDP)[16]; it was the eighth largest in 2008.[17] It has one of the worst distributions of wealth in the world. Accord-

9. *See* Janelle Kellman, *The Brazilian Legal Tradition of Environmental Protection: Friend or Foe*, 25 Hastings Int'l & Comp. L. Rev. 145, 151 (2002).
10. Of course, there are GHG emissions during construction, and in many cases, carbon sinks such as forested areas are eliminated due to flooding and the construction of transmission corridors.
11. Reinier Lock, *The New Electricity Model in Brazil: An Institutional Framework in Transition*, Electricity J., 2005.
12. Alan Poole et al., Brazil Core Group, *Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China, and India: Brazil Country Report Executive Summary* (2006), http://www.abesco.com.br/datarobot/_arqs/downloads/Executive%20Summary%20Brazil%203CEE.doc (last visited Oct. 17, 2012).
13. Central Intelligence Agency (CIA), The World Factbook: Brazil, https://www.cia.gov/library/publications/the-world-factbook/geos/br.html (last visited Oct. 17, 2012).
14. *Id.*
15. Instituto Brasileiro de Geografia e Estatística, http://www.ibge.gov.br/home/disseminacao/online/popclock/popclock.php (last visited Oct. 17, 2012). The CIA estimates Brazil's population at nearly 200,000,000, https://www.cia.gov/library/publications/the-world-factbook/rankorder/2119rank.html (last visited Oct. 17, 2012).
16. World Bank, Gross Domestic Product 2011, http://data.worldbank.org/data-catalog/GDP-ranking-table (last visited Oct. 17, 2012).
17. World Bank, Gross Domestic Product 2008, http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf (last visited Nov. 4, 2012).

ing to the Energy Information Agency, Brazil is also the ninth largest consumer of energy in the world.[18]

Brazil is a world leader in both the generation and consumption of renewable energy. Approximately 40% of Brazil's energy consumption derives from oil sources,[19] with a ratio of 8:1[20] crude oil to ethanol.[21] The other 60% comes from non-oil sources: 29% hydropower; 7% natural gas; 3% coal; 1% nuclear; and 21% other renewables.[22] Brazil produced approximately 401 Bkwh of hydroelectricity in 2010.[23] Hydropower generates about 85% of the electricity consumed in the country.[24] In 2009, ranking 118th in the world,[25] Brazilians consumed a modest 2,340 kWh per capita per year.[26]

B. Brazil's Basic Environmental Law Framework

Brazil is a democratic nation with a predominantly civil law system. The legal framework for environmental protection in Brazil is complex, with federal agencies having what often appears to be (and sometimes may actually be) overlapping jurisdiction and duties. To further add to the confusion, federal bureaucracies and agencies have changed names, merged, and splintered over the years.[27] This section will provide an overview of the current federal legal framework for major hydroelectric environmental licensing.

1. The Constitution

The *Constituição da República Federativa do Brasil* (Constitution) is Brazil's current and eighth Constitution.[28] Congress approved this Constitution in 1988.[29]

According to Édis Milaré, a leading environmental lawyer and scholar, the Constitution is the source of "the fundamentals of environmental protection" in Brazil.[30] The Constitution has a preamble and nine Titles.[31] Each Title covers a broad topic, and may contain various Chapters.[32] Chapters contain Articles.[33] Articles may contain Sections and subsections.[34]

Title II spells out Brazil's "fundamental rights and guarantees."[35] These fundamental rights and guarantees cover a wide range of topics, from broad and somewhat ambiguous concepts, such as privacy,[36] to very specific mandates, such as the right to not be required to work more than six consecutive hours without rest.[37] There are at least 100 fundamental rights listed in the Brazilian Constitution.[38]

Environmental protection is a recurring theme throughout various Titles of the Constitution.[39] Under Title II, the environment is mentioned once, granting Brazilians the fundamental right to bring legal action on behalf of the public against any activity that harms the environment, administrative morality, or public, historic, or cultural patrimony of the nation.[40]

More extensively addressing environmental protection is Title VIII, Chapter VI, Article 225.[41] Title VIII governs the Social Order, and Chapter VI of Title VIII governs the Social Order of the Environment.[42] Milaré makes six salient points about Article 225.[43]

First, Article 225 creates a *fundamental* right to an ecologically balanced environment.[44] Second, the environment is essentially within the public trust; it cannot be owned by individuals. Third, the environment is considered to be essential to a healthy quality of life. Fourth, along with being entrusted to the public, the government has a duty to preserve and protect the environment. Fifth,

18. Brazil: Background, *supra* note 2.
19. *Id.*
20. *Id.*
21. As early as 2009, the authors of The Coming Global Oil Crisis, http://www.oilcrisis.com/BR/, point out that despite all the publicity on Brazilian ethanol since the turn of the century, the fact remains that ethanol provides only 4% of the energy consumed in Brazil today.
22. Brazil: Background, *supra* note 2.
23. *Id.*
24. *Id.*
25. Globalis, http://globalis.gvu.unu.edu/indicator_detail.cfm?IndicatorID=146&Country=BR (last visited Oct. 14, 2012).
26. Human Development Reports, http://hdr.undp.org/external/flash/climate_maps/electricitypop.html (last visited Oct. 18, 2012).
27. One good source outlining the development of environmental law and agencies in Brazil is Kellman, *supra* note 9, at 151.
28. *See* Édis Milaré, Direito do Ambiente 303-04 (Editora Revista dos Tribunais, 3d ed. rev. 2004).
29. Constituição da República Federativa do Brasil, http://www.senado.gov.br/legislacao/const/con1988/CON1988_29.03.2012/CON1988.shtm (last visited Oct. 17, 2012) [hereinafter Brazil Constitution].
30. Milaré, *supra* note 28.
31. Brazil Constitution, *supra* note 29.
32. *Id.*
33. *Id.*
34. *Id.*
35. *Id.* tit. II.
36. *Id.*
37. Examples of *fundamental* rights listed in Title II also include the following: all citizens, both men and women, are equal in the eyes of the law; intellectual, artistic, scientific, and communicative expression are free from censure or licensing; the right to property is guaranteed; freedom to associate and convene peacefully for legal purposes will not be interfered with; Brazilians over the age of 18 are required to vote; voting is optional for illiterate citizens, for citizens over 16, but under 18 years of age, and for citizens over the age of 70. Constitution tit. II, art. V.
38. This Article will not compare and contrast how fundamental rights are applied similarly or differently in the United States and Brazil. Suffice it to mention that Brazil's fundamental rights are not diluted in terms of legal significance simply because they are so numerous. However, enforcement of fundamental rights is often seen as diluted for various reasons, including (but not limited to) deficient access to social science education and inadequate salaries leading to corruption in various private and public-sector initiatives and organizations.
39. Brazil Constitution, *supra* note 29.
40. *Id.*
41. *Id.*
42. *Id.*
43. Milaré, *supra* note 28, at 307-08.
44. This Article will not discuss whether the fundamental right to an ecologically balanced environment under Article 225 is on equal footing with other fundamental rights conveyed in the Constitution, such as those under Title II. However, I would like to point out that, firstly, the language describing environmental rights as "fundamental" in Article 225 is express and not implied. Second, despite coming under a separate title, there is no reason to believe that fundamental rights in Title II are of greater legal significance than those under Title VIII. Title II describes rights conveyed to each individual citizen (or the entire class of citizens), while Title VIII describes the social order or shared rights. It seems reasonable that the environment appears as a topic under both Title II and Title VIII, but that environmental rights are more fully explained under Title VIII describing the social order.

individual citizens have that same duty—to preserve and protect the environment. Finally, the environment is within the public trust not only for current citizens, but also for future generations.[45]

In addition to these fundamental concepts Milaré distilled from Article 225, §4 of Article 225 specifically highlights the Amazon rainforest (among four other distinct ecoregions) as a national treasure.[46] Article 225 §4 states that the Amazon and its natural resources can only be used in ways that ensure its environmental preservation.[47]

One final observation on the Constitution is that it requires an *Estudo de Impacto Ambiental* or environmental impact study (EIA) "prior to any activity that may cause harm to the environment."[48] This requirement is modeled after the environmental impact statement under the U.S. National Environmental Policy Act (NEPA).[49] The EIA is one of the most important requirements for any applicant seeking legal authorization to build a major infrastructure project.[50]

Each of these concepts is worthy of further analysis, but for the purposes of this Article, they serve simply to lay the groundwork for the discussion about major hydroelectric infrastructure projects in the Amazon in particular. With these constitutional principles in mind, let us turn now to the role of the federal agencies.

2. The Agencies

This section will briefly describe six governmental bureaucracies relevant to *Complexo Madeira*. Four are responsible for environmental protection and two cover energy.[51]

First is the *Ministério do Meio Ambiente* or Ministry of the Environment (MMA). The MMA is the federal government's overarching branch for environmental management and protection.

Within the MMA are several environmental agencies. The two most important agencies within the MMA to understand with regard to hydroelectric licensing purposes are CONAMA and IBAMA. CONAMA is the *Conselho Nacional do Meio Ambiente* or National Council on the Environment. IBAMA is the *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* or Brazilian Environmental and Renewable Natural Resource Institute.

CONAMA is the executive branch's council within the MMA.[52] CONAMA is responsible for creating environmental standards and hearing appeals of administrative decisions.[53]

IBAMA is the enforcement agency of the MMA. IBAMA implements CONAMA's regulations and decisions. IBAMA is responsible for issuing licenses and permits.[54]

Finally, on the environmental side, is the *Sistema Nacional do Meio Ambiente* or National Environmental System (SISNAMA). SISNAMA is not an agency, but rather a system of communication between local and federal bureaucracies.[55] One of its main objectives is the "decentralization of environmental policy and administration."[56] For *Complexo Madeira*, this "decentralization" has found its form in numerous public hearings at the local level, which are reported to the federal government.[57] The government, in turn, has a duty to take these hearings into account when making decisions.[58]

The MMA coordinates communication, policy, and decisionmaking between IBAMA and CONAMA.[59] SISNAMA coordinates environmental policy and protection between federal and local bodies. For purposes of this Article, the focus will be on IBAMA, which is the federal agency responsible for granting environmental licenses under the regulatory scheme.[60]

For energy, there are two important governmental agencies.

The first is the *Agência Nacional de Energia Elétrica* or National Electrical Energy Agency (ANEEL). ANEEL is responsible for regulating Brazil's energy sector. It is analogous to the Federal Energy Regulatory Commission (FERC) in the United States, although the regulatory scheme is substantially different. ANEEL is responsible for conducting auctions for increased capacity in the energy sector, among other duties.

The second is the *Ministério de Minas e Energia* or Ministry of Mining and Energy (MME). MME is a governmental ministry, which also manages government-controlled energy companies, such as Petrobras (the national oil, gasoline, and ethanol company), Furnas, and Eletrobras (electricity companies). It is difficult to analogize the MME with any organization or agency in the United States, though perhaps the U.S. Department of Energy (DOE) comes closest. The MME combines responsibilities for development and implementation of public policy

45. *Id.*
46. The word used is "*patrimônio*," which is translated literally as "patrimony," and for the purposes of this Article will be referred to as "national treasure."
47. Brazil Constitution, *supra* note 29.
48. Abby Rubinson, *Regional Projects Require Regional Planning: Human Rights Impacts Arising From Infrastructure Projects*, 28 Mich. J. Int'l L. 175, 186 (2006).
49. 42 U.S.C. §§4321-4370(f), ELR Stat. NEPA §§2-209. Milaré, *supra* note 28.
50. *Id.*
51. There are other related agencies, such as the *Agência Nacional de Águas* or National Waters Agency (ANA), *Serviço Florestal Brasileiro* or Brazilian Forest Service, and *Instituto Chico Mendes de Conservação da Biodiversidade* or the Chico Mendes Institute for Conservation of Biodiversity (ICMBIO), that will not be discussed here, but do play an important role in the environmental law and water law realms, but this Article will not go into great detail on water resources management or biodiversity.
52. Kellman, *supra* note 9, at 154-55.
53. *Id.*
54. *Id.*
55. Milaré, *supra* note 28, at 396-97.
56. Lesley K. McAllister, Making Law Matter 23 (Stanford Law Books, 2008).
57. *See* Milaré, *supra* note 28.
58. *Id.*
59. *Id.*
60. International law, and state and local regulations and ordinances, are beyond the scope of this Article.

in the areas of energy and natural resources with oversight and appointments of senior management to several energy companies with federal government majority ownership. It is essentially a governmental branch that operates state-owned mega-utility/energy/mining companies.

This Article focuses on IBAMA, because IBAMA has the authority to grant environmental licenses for major projects, such as *Complexo Madeira*, but the other entities mentioned will appear as well.

3. The Licensing Process

On its website, IBAMA provides application forms for a wide range of infrastructure projects, such as railroads, hydroelectric generators, wind farms, mining, transmission lines, ports, highways, bridges, and nuclear facilities.[61]

One of the most critical aspects of any major infrastructure project is the EIA. The Brazilian EIA is analogous to the U.S. environmental impact statement,[62] and is modeled after NEPA's requirements, according to Milaré.[63] Brazil's EIAs are technical and comprehensive documents.[64] Similar to the United States, Brazil uses an *Avaliação de Impacto Ambiental*, or environmental impact assessment (AIA) to determine whether the more comprehensive EIA is needed.[65] The applicant must submit an EIA to IBAMA for approval at the Preliminary License phase, explained below.

CONAMA created a three-step licensing process for regulating "large public works projects," and electricity-generating projects in particular.[66] Each phase requires EIAs. The first step is a *Licença Prévia* or Preliminary License (LP), which requires a showing of economic and engineering viability, EIA reports, and public hearings.[67] The second is a *Licença de Instalação* or Installation License (LI), which authorizes "project implementation."[68] The final step is the *Licença Operacional* or Operating License (LO), which requires a confirmation that any additional required studies provide the necessary data, and allows for the operation of the project.[69] In the event of a violation of legal conditions or environmental standards, or falsification or omission of data, or serious risk to health or the environment, CONAMA retains the authority to suspend the environmental license, even after IBAMA grants a license.[70]

As the licensing body, IBAMA added a fourth step to the process for "large infrastructure projects with multi-state impacts." IBAMA uses the three-step process as established by CONAMA, but with an added first step before the LP, namely *Instauração do Processo* or (IP). IP is literally translated as the "establishment of process," and involves taking "inventory" to establish "project feasibility."[71] IBAMA requires separate studies at each stage of the application.[72]

The LP requires an EIA and a summary of the EIA, known as the RIMA (*Relatório de Impactos no Meio Ambiente)*.[73] The applicant/developer must submit the EIA and RIMA to IBAMA.[74] The EIA must contain a description of the location to be affected in biological, socioeconomic, and geographic terms.[75] It must include an environmental study as well as alternatives to the proposed project.[76] If the project has negative environmental impacts, mitigation must be defined and a mitigation plan must be established.[77] In addition, the EIA must initiate monitoring programs.[78] The RIMA must summarize all of the conclusions of the highly technical EIA and must be made available to the public in understandable terms.[79]

Once the RIMA has been made available to the public, IBAMA holds *audiências públicas* (public hearings) to consult with affected communities.[80] Public hearings can also be held earlier in the process, if IBAMA deems them necessary.[81] IBAMA officially notifies local newspapers of the topic, date, time, and location of the public hearings to be held.[82] Several other governmental agencies, such as SISNAMA, ANEEL, and FUNAI (the National Foundation for Indigenous Peoples), and nongovernmental organizations (NGOs), are usually in communication with IBAMA throughout the licensing application process.[83] After the public hearings, IBAMA may grant or deny the LP.[84]

The LI stage requires submission and approval of a *Plano Básico Ambiental* or Basic Environmental Plan (PBA).[85] If the project requires deforestation, the applicant must also submit a Forest Inventory in order to obtain *Autorização de Supressão de Vegetação* or Authorization for Suppression of Vegetation (ASV).[86]

61. Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis, http://www.ibama.gov.br/licenciamento/, click "Procedimentos" link, scroll down to list of .pdf documents (last visited Oct. 17, 2012).
62. I am specifically avoiding using acronyms for the American environmental impact statement and environmental impact assessment so as not to confuse the issue. In this Article, EIA always refers to Brazil's environmental impact study, which is analogous to the American environmental impact statement, *not* the environmental impact assessment.
63. Milaré, *supra* note 28, at 307
64. *Id.*
65. *Id*. at 316, n.47.
66. Rubinson, *supra* note 48.
67. *Id.*
68. *Id.*
69. *Id.*
70. *Id.*
71. *Id*. *See also* Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis, http://www.ibama.gov.br/licenciamento/index.php (last visited Oct. 17, 2012).
72. Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis, *supra* note 61.
73. *Id.*
74. *Id.*
75. *Id.*
76. *Id.*
77. *Id.*
78. *Id.*
79. *Id.*
80. *Id.*
81. *Id.*
82. *Id.*
83. *Id.*
84. *Id.*
85. *Id.*
86. *Id.*

At the LO stage, the applicant must submit reports on the implementation of the environmental and social mitigation programs described in the PBA and EIA.[87]

Between 2000 and April 2009,[88] IBAMA granted eight LPs and denied five; IBAMA granted 12 LIs and denied 20; IBAMA granted five LOs and denied 50. In that same time period, IBAMA granted 42 ASVs and denied 41.

Interestingly, IBAMA granted three LPs for *Complexo Madeira*, because there is one for each dam, plus one for the complex that includes both dams. This was to avoid the problem of segmentation.[89] Segmentation is where applicants seek licenses for only one small portion of their project at a time, seeking to understate the environmental impact of the total project. The only licenses for which there have been significantly fewer denials than approvals proportionally is the LP, but this may be due more to political pressures than legal requirements. IBAMA only granted all three *Complexo Madeira* LPs after IBAMA had rejected them the first time around under former Minister of the Environment Marina Silva.

When reviewing any license, IBAMA may require several mitigation conditions or alterations in order for approval to be granted.

In one controversial project in southern Brazil, the applicant submitted false statements in its EIA for its hydroelectric LP at *Barra Grande*.[90] According to Abby Rubinson, this prompted an additional procedural requirement that NGOs, government agencies, and regulated entities develop and comply with Terms of Agreement.[91] Presumably, Rubinson found that federal Judge Osni Cardoso Filho required the *Termos de Compromisso* (Terms of Agreement) before the application for an LP is submitted along with the EIA.[92] It is not clear whether the Terms of Agreement step is required in all cases for parties seeking an LP or whether there is any binding authority to Judge Cardoso Filho's decision. Nonetheless, it is relevant to this Article because Odebrecht, the original applicant for *Complexo Madeira*, did attempt to comply with this step and signed the Terms of Agreement in 2006, although no NGOs were party to the agreement.

II. *Complexo Madeira:* Characteristics and Risks

The Amazon rainforest is simultaneously a symbol for environmental hope and degradation. The importance of the Amazon region has been the subject of numerous studies and accounts. Former Brazilian presidential candidate, senator, and Minister of the Environment Silva stated that deforestation is responsible for approximately one-half of Brazil's GHG emissions, even after a 75% reduction in deforestation rates in the last decade.[93] In preparation for the 2009 Copenhagen United Nations Climate Change Conference, the Brazilian government announced that it would aim to reduce projected carbon dioxide emissions by 36.1%-38.9%,[94] enacting this as an aspirational goal under Law 12.187 of December 29, 2009, Establishing the National Climate Change Policy.[95] This "reduction," as compared to projected rates, is largely possible through continued deforestation control; the official number is 50% deforestation control.[96] The value of the Amazon in terms of biodiversity, climate change mitigation, and cultural heritage to Brazilians, South Americans, and the world is immeasurable.

A. *The* Ecótono Cerrado-Amazônia

In 2003, IBAMA concluded its mapping of Brazil's ecoregions under the direction of biologist Moacir Bueno de Arruda, IBAMA's ecosystem coordinator.[97] IBAMA identified seven broad biomes, and a total of 78 ecoregions within those biomes.[98] Arruda's study emphasized the importance of Brazil's three *ecótonos*, the zones of transition between biomes.[99]

The Madeira River is in the remote northwest of Brazil in the state of *Rondônia* in the heart of the Amazon rainforest, close to Bolivia.[100] It is itself one of the largest rivers in the world, and is the main tributary to the Amazon River. During the rainy season, the river and its tributaries flood extensive areas beyond the dry season margins.[101] During the dry season, people and nature use the sediment-rich floodplains as a source of nutrition.[102]

According to Dr. Horácio Schneider, a biologist at the Federal University of the Brazilian Amazonian state of

87. *Id.*
88. While updating the information in this Article, I tried to conduct the same search, but was unable to, as IBAMA has modified their website removing certain features.
89. This is discussed in more detail in Part III.A.1. of this Article.
90. Rubinson, *supra* note 48.
91. *Id.*
92. *Termo de Compromisso Ambiental*, June 26, 2006, *available at* http://www.mp.ro.gov.br/c/document_library/get_file?p_l_id=11116&folderId=27993&name=DLFE-1105.pdf. *See also* João de Deus Medeiros, *Ação Civil Pública Barra Grande deferida por justiça federal*, Rede de ONGS da Mata Atlântica, Oct. 28, 2004, *available at* http://www.rma.org.br/v3/action/news/detail.php?id=933&style=news (last visited Oct. 14, 2012).
93. Marina Silva, address at the Woodrow Wilson Institute, *The Road to Copenhagen: Perspectives on Brazil, China, and India* (Oct. 26, 2009).
94. Marina Lang, *Brasil establece meta de redução de gases entre 36,1% e 38,9%*, Folha de S. Paulo, Nov. 13, 2009, http://www1.folha.uol.com.br/folha/ambiente/ult10007u652157.shtml (last visited Nov. 15, 2012).
95. Presidência da República, Casa Civil, LEI No. 12.187, DE 29 DE DEZEMBRO DE 2009, http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l12187.htm (last visited Oct. 17, 2012).
96. *See* Lang, *supra* note 95. Developed nations, on the other hand, must achieve reductions through major energy infrastructure and behavior changes.
97. Ana Marcia, *Ibama conclui mapeamento das ecorregiões brasileiras*, Ibama/Ascom (2003), http://br.groups.yahoo.com/group/listageografia/message/14174 (last visited Oct. 17, 2012).
98. *Id.*
99. *Id.*
100. Leme, Odebrecht & Furnas, Relatório de Impacto Ambiental (RIMA) das Usinas Hidrelétricas de Santo Antônio e Jirau 8 (May 2005), *available at* http://www.santoantonioenergia.com.br/upload/portal_mesa/pt/usina_santo_antonio/licenciamento/RIMA%20-%20Relatório%20de%20Impacto%20Ambiental.pdf.
101. *Id.*
102. Larry Rohter, *Both Sides Say Project Is Pivotal Issue for Brazil*, N.Y. Times, June 11, 2007, http://www.nytimes.com/2007/06/11/world/americas/11amazon.html?_r=1&ref=science&pagewanted=all (last visited Oct. 17, 2012).

Pará, the site of *Complexo Madeira* is in the transitional area between two distinct biomes—the Amazon rainforest and Brazil's tropical savanna—in the *Ecótono Cerrado-Amazônia*.[103] It is a region that contains endemic species, as well as species that are found only in adjacent ecoregions and biomes.[104] Schneider and Arruda recognize the *Ecótono Cerrado-Amazônia* is one of the most genetically diverse and threatened areas of the Amazon.[105]

The *Ecótono Cerrado-Amazônia* covers nearly 5% of Brazil's land.[106] Arruda's mapping study showed that over 60% of the *ecótono* has been deforested.[107] Schneider finds that the *ecótono* must be a "priority protection area."[108] Priority protection areas are legally recognized by *Decreto* No. 5.092.[109] Yet, less than 0.01% of the region is legally protected, making it the most vulnerable *ecótono* or biome in all of Brazil.[110]

B. Complexo Madeira *and Flooding*

The site of *Complexo Madeira* is in the sensitive *Ecótono Cerrado-Amazônia* region.[111] *Complexo Madeira* involves the construction of two massive hydroelectric plants on the Madeira River.[112] The dams are called the *Santo Antonio* and the *Jirau*.[113] The press often uses *Complexo Madeira* and *Projeto Madeira* interchangeably. *Projeto Madeira*, however, is a larger development strategy that includes building canals connecting various river systems. Those projects are beyond the scope of this Article. For purposes of this Article, *Complexo Madeira* refers to the dams, the transmission lines, and the infrastructure necessary to support the lines and generators, but does not include the canals connecting river systems. *Complexo Madeira* is the largest construction project ever planned for the Amazon region and one of the largest in Brazilian history.[114]

By law, the federal government's agencies must take into account social concerns like community displacement, ecologically sensitive areas, and at-risk species when considering whether or not to grant any license for large infrastructure projects.[115] These factors are difficult to evaluate, so the ratio of kW generated to flooded hectare for proposed projects is often given substantial weight in the EIAs and during the licensing process.[116] However, this statistic does not take the aforementioned social concerns into consideration. Many of the social and environmental concerns are arguably addressed with the EIA, the Terms of Agreement, and during the public hearings.

Hydroelectric plants in Brazil range from nearly 600kW/hectare down to 1 kW/hectare, with the average being 21.7 kW/hectare.[117] Brazil's state-owned electric company, *Eletrobras*, expects the two dams to flood an area of approximately 250 square kilometers beyond the high watermark in the rainy season.[118] Total capacity is estimated at 6,450 MW.[119] This translates to 258 kW/hectare for both *Complexo Madeira* dams. On its face, the project seems comparatively efficient, comfortably exceeding the national average on the kW/hectare analysis. Yet, many concerns have been raised at public hearings: among them the possibility of flooding, erosion, and species degradation being beyond what is predicted.[120]

C. Lost in Transmission?

One particularly troubling problem is the transmission of electricity. The *Complexo Madeira* hydroelectric generators are sited in the remote northwest region of Brazil, but most electricity in the nation is consumed in the populated urban centers in central and southeastern Brazil.[121] *Complexo Madeira* is being built to satisfy the demands of these central and southeastern regions.[122]

To get *Complexo Madeira*'s power to the southeast, 1,500 miles of new transmission lines and the infrastructure to support them must be built.[123] Roads are needed. Gas stations, restaurants, and convenience stores would follow. It is true that these would generate jobs and possibly even some wealth for people in a country where unemployment and poverty are serious problems. However, the environmental impact of the transmission lines and all that goes with them was not included in the EIAs for *Complexo Madeira*.[124] Neither is information available regarding how much power is actually lost in transmission.

103. Memorandum from Amigos da Terra Amazônia Brasileira and the International Rivers Network, *Estudos Não Confiáveis: 30 Falhas no EIA-RIMA do Rio Madeira* (Nov. 2006), at 14.
104. *Id.*
105. *Id. See also* Ana Marcia, *Ibama conclui mapeamento das ecorregiões brasileiras*, Ibama/Ascom (2003); *see also* Revista Época, *Ibama conclui mapeamento das ecorregiões brasileiras*, Jan. 21, 2003, http://revistaepoca.globo.com/Revista/Epoca/0,,EDG55147-6010,00-IBAMA+CONCLUI+MAPEAMENTO+DE+ECORREGIOES+BRASILEIRAS.html (last visited Sept. 17, 2012).
106. Marcia, *supra* note 106; *see also* Época, *supra* note 105.
107. *Id.*
108. Memorandum from Amigos da Terra Amazônia Brasileira and the International Rivers Network, *supra* note 103.
109. *Decretos* are similar to executive orders.
110. The other two *ecótonos* are the *Caatinga-Amazônia* and the *Cerrado-Caatinga*, which are 3.33% legally protected area and 0.05% legally protected area, respectfully.
111. Memorandum from Amigos da Terra Amazônia Brasileira and the International Rivers Network, *Estudos Não Confiáveis: 30 Falhas no EIA-RIMA do Rio Madeira* (Nov. 2006), at 14; *see also* Ana Marcia, *Ibama conclui mapeamento das ecorregiões brasileiras*, Ibama/Ascom (2003), http://br.groups.yahoo.com/group/listageografia/message/14174 (last visited Oct. 17, 2012); *see also* Época, *supra* note 105.
112. Leme, Odebrecht & Furnas, *supra* note 100.
113. *Id.*
114. *Projeto Madeira é apresentada a autoridades da Amazônia*, Linha Direta n. 303, Dec. 2003, at 6-7, *available at* http://www.furnas.com.br/arqtrab/ddppg/revistaonline/linhadireta/LD303_madeir.pdf.
115. José Goldemberg, Energy, Environment, and Development 58 (Earth scan, 1996).
116. *Id.*
117. *Id.* at 58-59.
118. International Rivers, *available at* http://www.irn.org/pdf/iirsa/ElectroMadeira_po.pdf.
119. Leme, Odebrecht & Furnas, *supra* note 100.
120. Memorandum from Amigos da Terra Amazônia Brasileira and the International Rivers Network, *supra* note 111.
121. *Id.*
122. Leme, Odebrecht & Furnas, *supra* note 100; *see also Transmissão do Madeira ainda está no papel*, *supra* note 4.
123. *Transmissão do Madeira ainda está no papel*, *supra* note 4.
124. Leme, Odebrecht & Furnas, *supra* note 100.

The potential for serious environmental harm flowing from *Complexo Madeira* is very high, but the project is moving forward. The next section describes how the project has obtained its licensing so far and what alternatives Brazil might consider instead of additional major hydroelectric projects in the heart of the Amazon in the future.

III. *Complexo Madeira*: Compliance and Alternatives

This section discusses the licensing process to date for *Complexo Madeira* in subsections III.A. and alternatives to major hydropower in subsection III.B.

A. Current Licensing Status

Complexo Madeira is part of a major development program called "*Programa de Aceleração de Crescimento*" or "Accelerated Growth Program" (PAC).[125] ANEEL quickly approved the inventory for the regional project because of the concern that there would be a capacity shortage in Brazil at some point between 2010 and 2011.[126] Many (if not most) Brazilians support the project with the 2001 and 2002 energy crisis fresh in their memories.[127]

1. The Process Begins: The EIA and the Terms of Agreement

Odebrecht, along with Furnas, began the AIA and IP process in 2001.[128] In May 2004, IBAMA held public hearings on *Complexo Madeira*.[129] At that time, the main issue to be decided was whether to require each dam to be considered separately or to have one comprehensive EIA for both dams.[130]

IBAMA determined that the EIA should not be segmented and should instead include both dams.[131] However, IBAMA did not require an EIA for the transmission lines along with the comprehensive EIA. Instead, IBAMA requested a less-detailed "study" of the transmission lines and the necessary 10-kilometer-wide corridor to support the lines.[132] This is particularly interesting because in the past, IBAMA has both granted and denied LPs, LIs, LOs, and ASVs for transmission lines.[133] Furthermore, CONAMA specifically requires EIAs and RIMAs for transmission lines above 230 kilovolts (Kv).[134] As recently as September 2006, *Ate III*, a transmission company, submitted an EIA/RIMA to IBAMA to obtain an LP.[135] How exactly Odebrecht and Furnas managed to avoid the requirement for an EIA with regards to the transmission lines remains a mystery. *Complexo Madeira* requires a 2,450 km transmission line and is almost 10 times longer than the 291 km transmission line *Ate III* applied for in 2006.[136] The *Complexo Madeira* EIA specifically discusses no need for an EIA of transmission lines,[137] even though the transmission lines would occupy over 24,500 square kilometers of land.[138] In any event, IBAMA issued a preliminary license for a *Complexo Madeira* transmission line to the city of Rio Branco in June 2011.[139] Again, it is worth noting that this is an LP for just one segment of the required transmission.

The EIA is divided into five lengthy parts called Tomos.[140] Tomo C discusses how to mitigate the adverse impacts of the project. The 321-page Tomo C document mentions transmission lines three times. It does not discuss environmental impacts of transmission lines, but rather the mitigation of impacts upon already existing infrastructure.[141]

The state of *Rondônia* approved the Terms of Agreement for *Complexo Madeira* on June 26, 2006.[142] The Public Ministry of *Rondônia* State, a prosecutor for the city of *Porto Velho*, the State Environmental Agency, and Odebrecht, the developer/applicant, were parties to the agreement.[143]

125. Lorenna Rodrigues, *Suez vai alterar local de construção da usina de Jirau para reduzir custos*, Folha Online, May 19, 2008, http://www1.folha.uol.com.br/folha/dinheiro/ult91u403410.shtml (last visited Oct. 17, 2012).
126. Humberto Medina & Janaina Lage, *Especialistas não descartam o racionamento*, Folha de S. Paulo, July 11, 2007, http://www1.folha.uol.com.br/fsp/dinheiro/fi1107200714.htm (last visited Oct. 17, 2012).
127. *See* Isabel Clemente & David Friedlander, Época, *Estão pedindo outro apagão*, http://revistaepoca.globo.com/Revista/Epoca/0,,EDR79213-6009,00.html (last visited Oct. 17, 2012).
128. Press Release, Odebrecht, generously provided by Odebrecht counsel, Adriano Sá de Seixas Maia via e-mail communication on Apr. 13, 2009.
129. Leme, Odebrecht & Furnas, Complexo do Rio Madeira—UHE Santo Antonio e UHE Jirau EIA—Vol. 1.
130. *Id.*
131. *Id.*
132. *Id.* at II-17.
133. *See* Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, *supra* note 61.
134. CONAMA Resolution 001, Jan. 23, 1986, *cited by* Milaré, *supra* note 28, at 441.
135. Ate III Transmissora de Energia and Biodinâmica Rio, *Linha de Transmissão 500kV Itacaiúnas-Colinas RIMA*, Sept. 2006.
136. *Id. Transmissão do Madeira ainda está no papel*, *supra* note 4.
137. Leme, Odebrecht & Furnas, *supra* note 129.
138. *Id. Transmissão do Madeira ainda está no papel*, *supra* note 4.
139. IBAMA, *Ibama emite Licença Prévia para linha de transmissão do Madeira até Rio Branco*, http://www.ibama.gov.br/publicadas/ibama-emite-licenca-previa-para-linha-de-transmissao-do-madeira-ate-rio-branco (last visited Oct. 17, 2012).
140. The complete EIA is available on IBAMA's website in 23 electronic .pdf files. Each file contains hundreds of pages. All told, the EIA probably exceeds 3,000 pages. Tomo A discusses the methodologies used in the EIAs, some legal issues, and provides a broad picture of *Complexo Madeira*. Tomo B discusses environmental impacts and shows the geography of the area. Tomo D includes the technical illustrations. Tomo E was submitted after IBAMA requested more information. Finally, there is an 800-page analysis of the EIA by the *Ministerio de Publico* (Public Ministry) of *Rondonia* submitted in December 2006 available as well.
141. Tomo C also includes a definition section where "transmission lines" are mentioned for a fourth time, under the definition of RIMA, stating that EIAs and RIMAs are required for projects that alter the environment, including transmission lines.
142. *Termo de Compromisso Ambiental*, June 26, 2006, *available at* http://www.mp.ro.gov.br/c/document_library/get_file?p_l_id=11116&folderId=27993&name=DLFE-1105.pdf.
143. *Id.*

2. The LP

IBAMA originally rejected the preliminary license applications for *Complexo Madeira* in March 2007.[144]

Illustrating the lack of consensus on the project, then-Minister of the Environment Silva publicly stated that the licenses should only be granted if the parties could prove that there would be no environmental harm. In spite of Minister Silva's opposition, on July 9, 2007, IBAMA reversed its initial rejection and granted the LP for the *Complexo Madeira* dams, largely due to Minister Dilma Rousseff's and President Luiz Inácio Lula da Silva's insistence.[145] IBAMA granted the license as a joint venture between private construction companies and investors, including Odebrecht and Furnas (the state-owned construction company).[146]

The LP was conditional, including clauses allowing IBAMA to modify, suspend, or cancel the license in cases of (i) "violation or non-compliance of any of the conditions or legal norms," (ii) "omission or false statements of relevant information submitted for purposes of licensing," or (iii) "grave environmental and or health risks."[147]

In addition, the LP articulated 33 specific conditions.[148] Examples follow: maximize output of larvae, juvenile fish, and fish eggs[149]; construct two "semi-natural" channels designed to allow target native species to continue their migratory patterns, but making it difficult for invasive species, i.e., species from other parts of the river system, to make their way up the channels[150]; monitor the populations and health of various species; control rates of disease, such as rabies, in bats[151]; detail fauna rescue programs, including methods on capture, care, and release, where release must be into a habitat suitable for survival[152]; and plant native river bank flora along the newly formed reservoir edges.[153] Minister Silva considered the imposed conditions a "victory" for Brazilian society, who "want energy, but also want environmental protection."[154]

On their face, these requirements seem fairly specific, but there are two central problems with the LP's conditions.

First, it is not clear what the standard is to determine that the licensed entity is in noncompliance. For example, how many native species need to be able to make it up the "semi-natural" channels? How many invasive species going up those channels are too many? Do the fauna rescue programs actually have to be implemented? If so, which species are included, and how many specimens of each species must be captured and re-released successfully? How does one determine which habitat is suitable for these reintroduced species? Once native flora have been planted along the new reservoir banks, do they have to be maintained?

Second, it is not clear what exactly is the remedy for noncompliance. If IBAMA finds that one of the entities is in noncompliance, what type of enforcement is available? IBAMA can issue fines[155] and prosecutors can bring cases on behalf of the public to assert constitutional rights.[156] But it is unclear whether injunctions are available for "minor" violations of LP conditions.

The set of facts underlying the *Complexo Madeira* LP is unique, due to the location (a constitutionally recognized national treasure), the extensive set of conditions imposed, the scope of the project, and the looming need for additional capacity in Brazil. While unique to date, it is possible that these questions will arise in other contexts if Brazil continues to expand what is left for potential hydroelectric sites.

If and when the aforementioned questions are presented to the federal judicial system, it is critical that judges and agencies be able to answer them. The government will have to resolve these issues in a way that is consistent with Brazil's Constitution, and the fundamental environmental rights therein conferred. It will also need to establish language and standards that provide guidance to developers and affected communities such that a predictable system for determining compliance and noncompliance is in place.

3. The Auction and Installation License

Even after IBAMA grants the LP, the applicant does not automatically get the right to move forward to the LI phase, but instead, ANEEL holds an auction for those rights. The auction winner must reimburse whoever bore the administrative costs (including the EIA) for their expenses.[157]

144. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, www.ibama.gov.br/licenciamento/modulos/documentos.php?COD_DOCUMENTO=11073 (last visited Nov. 29, 2012).
145. Marta Salomon, *Ministra Marina Silva entrega pedido de demissão a Lula*, Folha de S. Paulo, May 13, 2008, http://www1.folha.uol.com.br/folha/brasil/ult96u401427.shtml (last visited Oct. 15, 2012); Lorenna Rodrigues, *Ibama concede licença para usinas do Madeira; 1º edital sai em agosto,* Folha Online, July 9, 2007, http://www1.folha.uol.com.br/folha/dinheiro/ult91u310596.shtml (last visited Oct. 17, 2012).
146. Lorenna Rodrigues, *Ibama concede licença para usinas do Madeira; 1º edital sai em agosto*, Folha Online, July 9, 2007 *available at* http://www1.folha.uol.com.br/folha/dinheiro/ult91u310596.shtml (visited Sept. 17, 2012).
147. Bazileu Alves Margarido Neto, Interim IBAMA President, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, *Licenca Prévia No. 251/2007*, July 9, 2007, *available at* http://www.aneel.gov.br/arquivos/PDF/Licença%20Prévia.pdf; Eduardo Scolese, *Condicionalidades são "vitória," diz Marina*, Folha de S. Paulo, July 11, 2007, at B5. Translation by Sotelino.
148. *Licença prevê que Ibama pode mudar exigência*, Folha de S. Paulo, July 11, 2007, at B5.
149. Margarido Neto, *supra* note 147.
150. *Id.* at 2-3.
151. *Id.* at 3.
152. *Id.* at 4.
153. *Id*. at 4.
154. Eduardo Scolese, *Condicionalidades são "vitória," diz Marina*, Folha de S. Paulo, July 11, 2007, at B5.
155. Sofia Pinheiro, *Consórcio de usina do rio Madeira é multado em R$ 7,7 milhões*, Folha de S. Paulo, Dec. 24, 2008, http://www1.folha.uol.com.br/folha/dinheiro/ult91u482904.shtml (last visited Oct. 17, 2012).
156. *See generally* McAllister, *supra* note 56.
157. Isabel Clemente & David Friedlander, Época, *Estão pedindo outro apagão*, http://revistaepoca.globo.com/Revista/Epoca/0,,EDR79213-6009,00.html (last visited Oct. 17, 2012).

Odebrecht has to date invested over US$75 million in administrative costs.[158]

In December 2007, a partnership called *Madeira Energia S.A.* (MESA) won the ANEEL auction granting them rights to build one of the dams, the *Santo Antônio* dam.[159] MESA is a public-private partnership that includes Odebrecht, Furnas, and their partners.[160]

On May 19, 2008, *Energia Sustentável do Brasil* or Sustainable Energy of Brasil (Enersus) outbid the Odebrecht/Furnas group and won ANEEL's auction to pursue the rights to the LI and build the *Jirau* dam.[161] Enersus is also a public-private partnership, including the private Suez Group and the public Eletrosul.[162] Upon winning the auction, Suez sought to move the site of one of the two dams 12.5 kilometers from the original site.[163]

Odebrecht threatened to sue Suez, challenging the validity of its auction-winning bid.[164] Odebrecht's official press release made serious accusations.[165] First, Odebrecht argued that Suez's bid did not comply with the rules and conditions of ANEEL's auction.[166] Second, Odebrecht cited a concern with legal uncertainties for future licensing that would arise out of moving the construction of the dam 12.5 kilometers in relation to where it was sited in the EIA.[167] Odebrecht claimed that Suez's bid compromised the isonomy of auction bidders.[168] It further claimed that Suez's construction would be without the necessary technical studies (the EIA) and without the LP.[169] Finally, Odebrecht claimed that Suez's plan would increase flooding and would invade the *Santo Antônio* reservoir.[170]

Ultimately, Odebrecht decided not to take Suez to court, however.[171] Odebrecht reasoned that it supported the government's decision and is committed to contributing to the study of and development of new energy sources.[172]

IBAMA has made specific mitigation demands of Enersus. IBAMA is requiring that Enersus invest 36 million *reais* (about US$18 million[173]) in housing and sewage treatment for low-income families of the nearby city of *Porto Velho*.[174] In addition, IBAMA is requiring Enersus to "adopt" (assume the costs for maintenance of) a natural reserve in the area, as well as a variety of endangered species, including the *Myrmecophhaga jubata* (the great anteater), the *Priodontes giganteus* (giant armadillo), the *Felis onca* (jaguar), and the *Inia geoffrensis* (Amazon porpoise).[175] An interesting development in this requirement was that Carlos Minc, the Minister of the Environment, announced that in the future, *all* licensing will require the applicant to adopt at least one endangered species.[176]

Still, the notion of mitigating the net loss of habitat is problematic. Presumably, currently living populations presently occupy the existing natural habitat. While IBAMA requires Enersus to "adopt" a reserve, this habitat already exists. No new habitat is created to replace the thousands of hectares that are destroyed by flooding and transmission lines.[177]

4. The LO

The only missing link for the full operation of the Complexo Madeira dams is the LO. According to IBAMA's public consultation site, the LO has been issued for the Santo Antonio dam, but not yet for the Jirau dam. Since IBAMA granted the LI and one LO, it is likely IBAMA will grant the LO once the whole project is completed, as long as the entities comply with the conditions set forth for the LP, LI, and any additional conditions that may arise. Legal standards and enforcement measures remain unclear, as discussed in III.B.2. above.

In addition to the substantial environmental risks involved in this project, some scholars raise concerns about the lack of enforcement and accountability in the Brazilian licensing process.[178] Conservation groups such as Instituto Madeira Vivo, Amigos da Terra Amazônia Brasileira, and the International Rivers Network oppose Projeto Madeira.[179] This opposition is often met with begrudging resistance and sometimes outright hostility from southeastern urbanites, the government, mainstream media, and the construction companies.[180] IBAMA does have a safety valve in the environmental license that allows for cancellation of the project at any time if there is "grave" risk.[181] However,

158. *Id.*
159. Lorenna Rodrigues, *Consórcio Odebrecht/Furnas vence leilão do rio Madeira*, Folha Online, Dec. 10, 2007, http://www1.folha.uol.com.br/folha/dinheiro/ult91u353436.shtml (last visited Oct. 17, 2012).
160. *Id.*
161. *Licença prevê que Ibama pode mudar exigência*, Folha de S. Paulo, July 11, 2007, at B5.
162. *Id.*
163. Odebrecht Press Release, generously provided by Odebrecht counsel, Adriano Sá de Seixas Maia via e-mail communication on Apr. 13, 2009.
164. Lorenna Rodrigues, *Suez descarta novas parcerias se Odebrecht recorrer contra Jirau*, Folha Online, July 22, 2008, http://www1.folha.uol.com.br/folha/dinheiro/ult91u424977.shtml (last visited Oct. 17, 2012).
165. Odebrecht Press Release, *supra* note 163.
166. *Id.*
167. *Id.*
168. *Id.*
169. *Id.*
170. *Id.*
171. *Id.*
172. *Id.*
173. The exchange rate range from 2000 to the present has fluctuated, and both currencies have faced periods of inflation, deflation, and devaluation over the years. The Brazilian real has been relatively stable since the Plano Real was implemented in 1994. On September 12, 2012, the Federal Reserve Bank reported the rate of US $1=R$ 2.0274 Brazilian reais (http://www.federalreserve.gov/releases/h10/hist/dat00_bz.htm). For simplicity's sake and for purposes of this Article, 2 reais = 1 U.S. dollar.
174. Lorenna Rodrigues, *Ibama aprova mudança de local da usina de Jirau*, Folha Online, Nov. 13, 2008, http://www1.folha.uol.com.br/folha/dinheiro/ult91u467467.shtml (last visited Oct. 17, 2012).
175. Sabrina Craide, *Licença de Jirau sai ainda hoje e vai exigir medidas compensatórias*, Agência Brasil, Nov. 12, 2008.
176. *Id.*
177. I have my colleague, Ben Pittenger, to thank for making these observations.
178. Kellman, *supra* note 9, at 151; Rubinson, *supra* note 48; McAllister, *supra* note 56.
179. *See* Memorandum from Amigos da Terra Amazônia Brasileira and the International Rivers Network, *supra* note 111; Water *Ad Hoc* Tribunal, Istanbul Turkey, Public Hearing (Mar. 10, 2009).
180. Isabel Clemente & David Friedlander, Época, *Estão pedindo outro apagão*, http://revistaepoca.globo.com/Revista/Epoca/0,,EDR79213-6009,00.html (last visited Oct. 17, 2012).
181. Kellman, *supra* note 9; Rubinson, *supra* note 48.

the project continues to move forward, and IBAMA will probably continue to grant relevant licenses, including the LO to Enersus and MESA, while seeking to craft palatable mitigation requirements.

5. Fines

To further complicate matters, the dams have already been subjected to numerous fines. For example, IBAMA fined MESA nearly $4 million on December 23, 2008, for the deaths of 11 tons of fish in the Madeira River.[182] MESA was expected to challenge the fine, arguing that the fish died due to existing conditions, such as decomposing materials in the water and a sudden natural change in temperature, not due to their construction.[183] The current status of the fine is unknown.

More recently, construction workers at the site have gone on strike (once for a period of 25 days), human rights groups have alleged human rights violations, and environmentalists have sought injunctions to stop construction.[184, 185] According to one report, there have been over 300 occupational and employment violations at the construction sites, such as not granting sufficient rest hours.[186] Most alarming are reports of torture of employees.[187] Employees have also faced arson, vandalism, and theft accusations.[188] Nonetheless, the project continues to move forward; Jirau is expected to go online on January 1, 2013.[189]

B. Alternatives to Major Hydroelectric Projects in Brazil?

The Complexo Madeira EIA and RIMA discuss alternatives, as is required by law.[190] The EIA discusses two forms of alternatives: (i) technological; and (ii) geographic.[191] For technological alternatives, the EIA considers two options: hydroelectric; and thermoelectric.[192] Even if the reasons given for choosing hydroelectric power instead of thermoelectric power are sound, and the reasons given for the location are reasonable, the EIA and RIMA do not discuss other alternatives such as distributed generation[193] and energy efficiency.

One often-used device for considering alternatives is cost-benefit analysis. Though cost-benefit analysis does not take every relevant factor into consideration, and often overlooks or cannot adequately account for environmental damage,[194] it can be helpful in certain contexts, if one acknowledges its limitations.[195]

In 1998, ANEEL implemented a mandatory 1% "wire charge," through Resolution No. 942.[196] Through the wire charge, ANEEL captured 1% of annual utility net revenues.[197] ANEEL then disbursed these wire charges to support energy-efficiency projects.[198] Much of the revenue went to Energy Service Companies (ESCOs), such as PROCEL. PROCEL is a subsidiary of Brazil's largest state-owned electric utility, Eletrobras. ESCOs, like PROCEL, then implement energy efficiency. See Table 1, for an illustration of the performance of these programs.

182. Sofia Pinheiro, *Consórcio de usina do rio Madeira é multado em R$ 7,7 milhões*, Folha de S. Paulo, Dec. 24, 2008, http://www1.folha.uol.com.br/folha/dinheiro/ult91u482904.shtml (last visited Nov. 17, 2012).
183. *Id.*
184. Felipe Luchete, *Ministério do Trabalho aplica 198 autos de infração em Jirau*, Folha de S. Paulo, July 13, 2012, http://www1.folha.uol.com.br/mercado/1120040-ministerio-do-trabalho-aplica-198-autos-de-infracao-em-jirau.shtml (last visited Nov. 17, 2012).
185. The urgently important discussion of human and workers' rights issues related to major hydroelectric projects is beyond the scope of this Article, which seeks to examine the environmental licensing process.
186. Felipe Luchete, *Ministério do Trabalho aplica 198 autos de infração em Jirau*, Folha de S. Paulo, July 13, 2012, http://www1.folha.uol.com.br/mercado/1120040-ministerio-do-trabalho-aplica-198-autos-de-infracao-em-jirau.shtml (last visited Nov. 17, 2012).
187. *Id.*
188. Felipe Luchete, *Ministério Público denuncia 24 operários pro vandalismo*, Folha de S. Paulo, May 11, 2012, http://www1.folha.uol.com.br/mercado/1089164-ministerio-publico-denuncia-24-operarios-de-jirau-por-vandalismo.shtml (last visited Nov. 17, 2012).
189. *ANEEL aprova antecipação do funcionamento de Jirau para 1 de janeiro de 2013*, Folha de S. Paulo, Apr. 24, 2012, http://www1.folha.uol.com.br/mercado/1080795-aneel-aprova-antecipacao-do-funcionamento-de-jirau-para-1-de-janeiro.shtml (last visited Nov. 17 2012).
190. Milaré, *supra* note 28, 458-60.
191. Leme, Odebrecht & Furnas, *supra* note 129, Tomo I, V-3 to V-17.
192. *Id.*
193. With Brazil's vast water resources, perhaps microhydroelectric generation is a more environmentally and economically sound pursuit. *See, e.g.*, Amy Yee, *Microhydro Drives Change in Rural Nepal*, N.Y. Times, June 20, 2012, http://www.nytimes.com/2012/06/21/business/global/microhydro-drives-change-in-rural-nepal.html?src=recg&pagewanted=all (last visited Nov. 4, 2012).
194. Frank Ackermann & Lisa Heinzerling, Priceless (2004).
195. Cass Sunstein, The Cost-Benefit State: The Future of Regulatory Protection (ABA, Chicago, IL, 2002).
196. Robert Taylor et al., *Financing Energy Efficiency: Lessons From Brazil, China, India, and Beyond*, The World Bank 235 (2008).
197. *Id.*
198. *Id.* at 235-36.

Table 1: Investments in Efficiency and Results

Results	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Investments (US$ millions)	3.3	10.3	17.2	42.1	17.2	13.8	9.0	12.9	20.0	19.5	45.0	47.0
Saved electricity (GWh/yr)	344	572	1970	1758	1909	1862	2300	2500	1270	1817	2373	2158
Avoided demand (MW)	70	103	293	976	532	418	640	600	309	453	622	585
Avoided investment (US$ millions)	120	202	693	592	672	655	808	880	450	639	834	760

Source: Table from World Bank Sustainable Development Department, Brazil Country Management Unit, Latin America and the Caribbean Regional Office, *Implementation Completion and Results Report (Loan/Credit No 047309) on a Grant in the Amount of SDR 11.9 Million (US$15 Million Equivalent) to the Centrais Eletricas Brasileiras S.A. (Eletrobras) for an Energy Efficiency Project*, Jan. 25, 2007, at 7, *available at* http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/02/15/000020953_20070215112152/Rendered/PDF/ICR0000184.pdf.

In the aftermath of 2001-2002, ANEEL reduced its wire charge to 0.5%.[199] At that time, Brazil focused on expanded capacity.[200]

Complexo Madeira will cost approximately US$14 billion, including the dams and transmission lines.[201] It will increase capacity by 6,450 MW.[202] It would not be ready until January 1, 2013, at the earliest by most predictions.[203] Information about the cost of the necessary infrastructure to support the dams and transmission lines, such as distribution lines, highways, sewage treatment facilities, environmental monitoring, and maintenance, is unavailable. Odebrecht (the original applicant) spent over US$75 million on administrative costs (including legal fees, public hearings, and EIAs) alone.[204] MESA is likely to pay a $4 million fine,[205] and may accrue additional fines in the future. The ANEEL auctions themselves cost about U.S.$700,000 due to complex bidding systems that require high-end computer programs.[206]

According to Table 1, the World Bank data show that Brazil avoided 5,601 MW of increased capacity in 11 years, with comparably modest resources, US$257.3 million. In other words, Complexo Madeira costs over US$2.17 million per MW, and efficiency costs approximately US$46,000 per MW. Complexo Madeira is 47 times more expensive than efficiency! That does not even take into account the incalculable environmental risk posed by Complexo Madeira.

One oft-cited reason to invest in a major infrastructure project instead of efficiency is the creation of a primary and secondary job market. The Complexo Madeira EIA states that it will require between 26,000 and 40,000 employees.[207] A secondary job market could reach hundreds of thousands of people. But efficiency companies such as PROCEL require employees as well; the same is true of distributed generation. Different from major infrastructure projects, which employ a handful of technical experts, but predominantly low-skill manual laborers, efficiency jobs have the potential to train employees for long-term positions.

There are a variety of financially viable alternatives to encourage efficiency over expanded capacity. One example is "decoupling." Decoupling involves separating utility revenues from total electricity sales.[208] If, for example, a utility knows that it is going to get a fixed rate based on last year's total revenue instead of the total amount of kWh it sells this year, then it will be encouraged to reduce high marginal cost generation. When utilities profit more from implementing efficiency measures, they lose the motivation to generate more revenue from additional sales.

IBAMA should require serious consideration of distributed generation, and especially energy-efficiency alternatives in applicants' EIAs for energy projects. In order for efficiency to be a viable alternative, ANEEL should decouple utility revenues from electricity sales to encourage more efficiency. ANEEL should also increase its wire charge. That would allow utilities to expand efficiency companies like PROCEL.

IV. Conclusion

Brazil is a major player in the search for renewable energy and climate change mitigation. This Article sought to provide an introduction to Brazil's environmental licensing regulatory framework using the *Complexo Madeira* project as a case study. *Complexo Madeira* is illustrative of a "trilemma" because of the tension between the need for reliable renewable capacity, major financial costs, and sensitive ecosystems. Despite the relatively progressive environmental protection laws, protests, and fines, *Complexo Madeira* is being built. This Article suggests that alternatives such as efficiency should be carefully examined

199. *Id.* at 236.
200. Alan Poole et al., Brazil Core Group, Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China, and India: Brazil Country Report Executive Summary (2006), *available at* http://www.abesco.com.br/datarobot/_arqs/downloads/Executive%20Summary%20Brazil%203CEE.doc.
201. Isabel Clemente & David Friedlander, Época, *Estão pedindo outro apagão*, http://revistaepoca.globo.com/Revista/Epoca/0,,EDR79213-6009,00.html (last visited Oct. 17, 2012).
202. Leme, Odebrecht & Furnas, *supra* note 100, at 8.
203. *Transmissão do Madeira ainda está no papel*, *supra* note 4.
204. Clemente & Friedlander, *supra* note 201.
205. Sofia Pinheiro, *Consórcio de usina do rio Madeira é multado em R$ 7,7 milhões*, Folha de S. Paulo, Dec. 24, 2008, http://www1.folha.uol.com.br/folha/dinheiro/ult91u482904.shtml (last visited Oct. 17, 2012).
206. Lorenna Rodrigues, *Realização de leilão de usina do Madeira custará R$ 1,4 milhão*, Folha Online, July 12, 2007, http://www1.folha.uol.com.br/folha/dinheiro/ult91u352813.shtml (last visited Oct. 17, 2012).
207. Leme, Odebrecht & Furnas, *supra* note 100.
208. California's Decoupling Policy, *available at* http://www.fypower.org/pdf/Decoupling.pdf.

before continuing to expand capacity with large generators, hydroelectric or otherwise.

Complexo Madeira is one example of how environmental laws come into tension with renewable energy licensing. The expensive *Complexo Madeira* would have the capacity to generate over 6,000 MW, with relatively low flood acreage for a project of such magnitude. The site for the project is along the edge of where deforested areas meet virtually untouched areas of the Amazon rainforest. The potential for significant environmental devastation is high. The site is also in the remote northwest of Brazil, so much of the generated power and its reliability will be lost in transmission to the densely populated southeast. Despite these complications, the Brazilian government is sanctioning the project.

Brazil may have better alternatives than to build yet another major hydroelectric project. The current environmental and energy regulations are relatively progressive, but do not adequately encourage efficiency or distributed generation over increased major infrastructure energy capacity-building. Given the current status of the licensing, it is unlikely that *Complexo Madeira* will run into any regulatory hurdle with which it cannot comply. Nevertheless, this work seeks to encourage further investment in efficiency and distributed generation before sanctioning projects like *Complexo Madeira* in the future. Specifically, EIAs should be required to seriously consider efficiency and distributed generation as an alternative to increased large-scale capacity.

The *Complexo Madeira* case study is an illustrative example of some of the issues surrounding Brazil's energy trilemma. Brazil has relatively progressive environmental laws. It is one of the leading producers of renewable energy in the world. Major hydroelectric projects like *Complexo Madeira* are familiar to Brazilians and, at first glance, may appear environmentally sound in the climate change context. Yet, Brazil and the world would benefit if lawmakers, investors, teachers, and engineers shift their focus toward energy efficiency and distributed generation, instead of major infrastructure projects to grow capacity in an increasingly volatile environmental reality. This is not to say that Brazil will never need to expand major energy-capacity infrastructure—in some cases, it may—but Brazil would benefit from a policy requiring energy efficiency and distributed generation to be considered in the alternatives section alongside different kinds of major capacity projects in proposed electric-generation EIAs.