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Dams in the Amazon: Belo Monte and Brazil's Hydroelectric Development of the Xingu River Basin

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ABSTRACT / Hydroelectric dams represent major investments and major sources of environmental and social impacts. Powerful forces surround the decision-making process on public investments in the various options for the generation and conservation of electricity. Brazil's proposed Belo Monte Dam (formerly Kararaô) and its upstream counterpart, the Altamira Dam (better known by its former name of Babaquara) are at the center of controversies on the decision-making process for major infrastructure projects in Amazonia. The Belo Monte Dam by itself would have a small reservoir area (440 km^2) and large installed capacity (11, 181.3 MW), but the Altamira/Babaquara Dam that would regulate the flow of the Xingu River (thereby increasing power generation at Belo Monte) would flood a vast area (6140 km^2). The great impact of dams provides a powerful reason for Brazil to reassess its current policies that allocate large amounts of energy in the country's national grid to subsidized aluminum smelting for export. The case of Belo Monte and the five additional dams planned upstream (including the Altamira/Babaquara Dam) indicate the need for Brazil to reform its environmental assessment and licensing system to include the impacts of multiple interdependent projects.

The proposed Belo Monte Dam, on Brazil's Xingu River (a north-flowing tributary to the Amazon in the State of Pará; see Figure 1) is the focus of intense controversy due to the magnitude and nature of its impacts. The Belo Monte Dam has become notorious for the threat it poses to indigenous peoples through facilitating a series of planned upstream dams in indigenous areas (e.g., Santos and de Andrade 1990; Sevá Filho 2005). The upstream dams would add substantially to Belo Monte's electrical output by regulating the flow of the highly seasonal Xingu River. The Belo Monte reservoir itself is small relative to the capacity of its two powerhouses, but the five upstream reservoirs are vast, even by Amazonian standards. The largest of these is the Babaquara Dam, which has been re-named the Altamira Dam in an apparent effort to escape the onus of the criticism that the plans for Altamira/Babaquara have attracted over the past three decades since the initial survey, or *inventário*, began in October 1975 (e.g., Chernela 1988; Fisher 1994; Goodland and others 1993; Sevá 1990). The plans for the Xingu River represent a major development with profound environmental and social impacts. They also illustrate problems affecting decision-making for major development projects elsewhere in Amazonia and throughout the world. This article examines the rapidly evolving plans for these dams and the lessons that can be drawn from them.

KEY WORDS: Amazonia; Altamira Dam; Babaquara; Belo Monte; Brazil; Dams; EIA; Environmental impact; Hydroelectric dams; Hydropower; Reservoirs; Xingu River

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The Xingu River has an extraordinary diversity of indigenous cultures. As often pointed out by the late anthropologist Darrell Posey, the planned dams there not only threaten indigenous peoples, but they also threaten groups from four different linguistic trunks with languages as different as English and Chinese. Among the groups threatened is the Kaiapó (also spelled Caiapó), which has an extraverted and highly assertive manner of interacting with Brazilian society at large. This gives events in the Xingu much greater visibility than would be the case if meeker tribes were involved. In February 1989, the Kaiapó were instrumental in organizing the multitribe Altamira Gathering to protest the planned dams. The climax of the event was when Tuíra (Tu-Ira), a Kaiapó woman, placed her machete against the face of the ELETRONORTE representative, José Antônio Muniz Lopes, to emphasize the gathering's demand that the dams not be built. The series of dams would affect an estimated 37 ethnicities (Pontes Júnior and Beltrão 2004). One of the planned dams (the Jarina Dam) would flood part of the Xingu Indigenous Park (Figure 2) and would, therefore, undoubtedly be the most controversial and least likely to gain approval (it would also have the smallest generating capacity of the six dams). However, the most powerful of the upstream dams (Altamira/Babaquara) is currently moving forward through the planning process despite its heavy

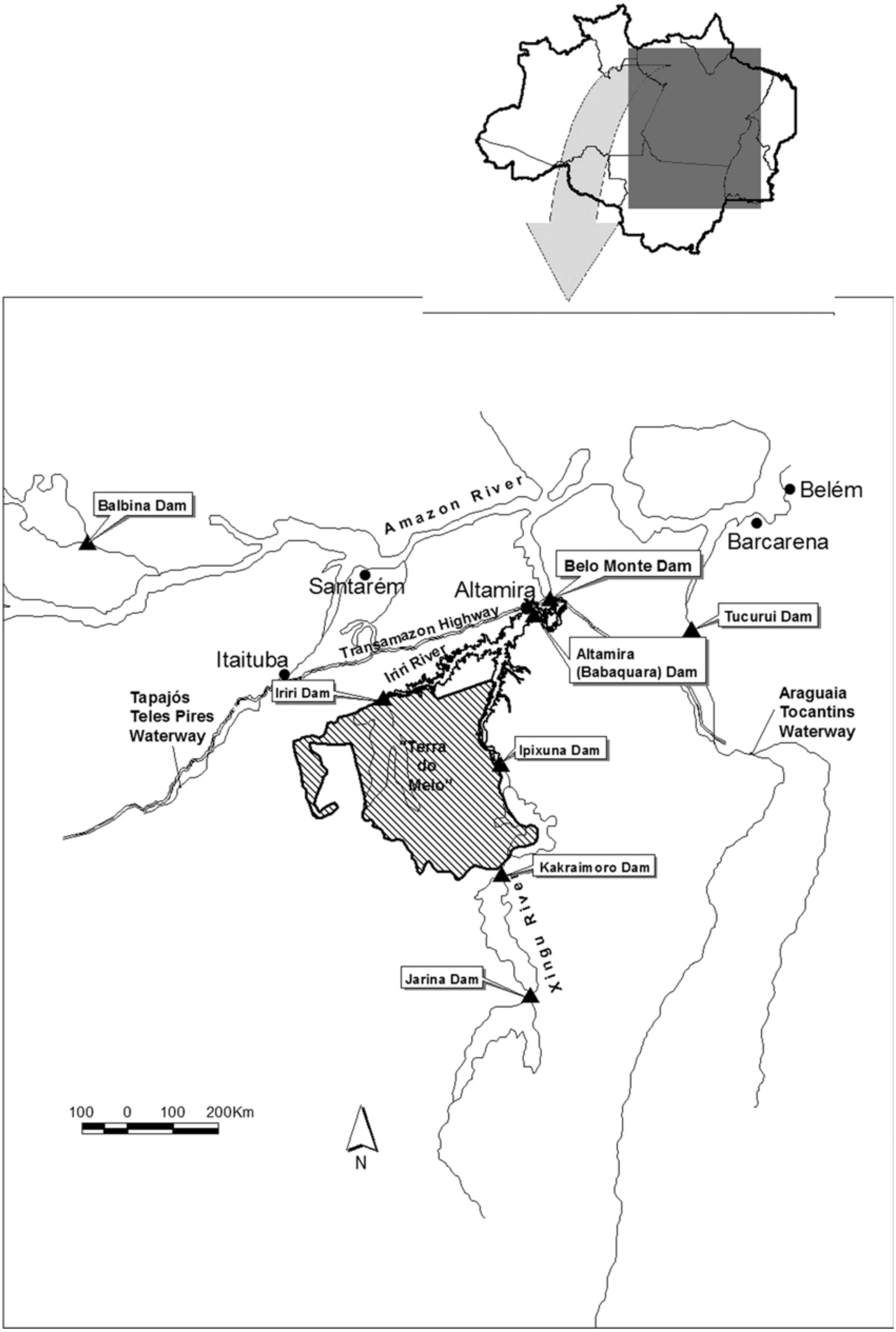

Figure 1. The Belo Monte Dam and locations mentioned in the text.

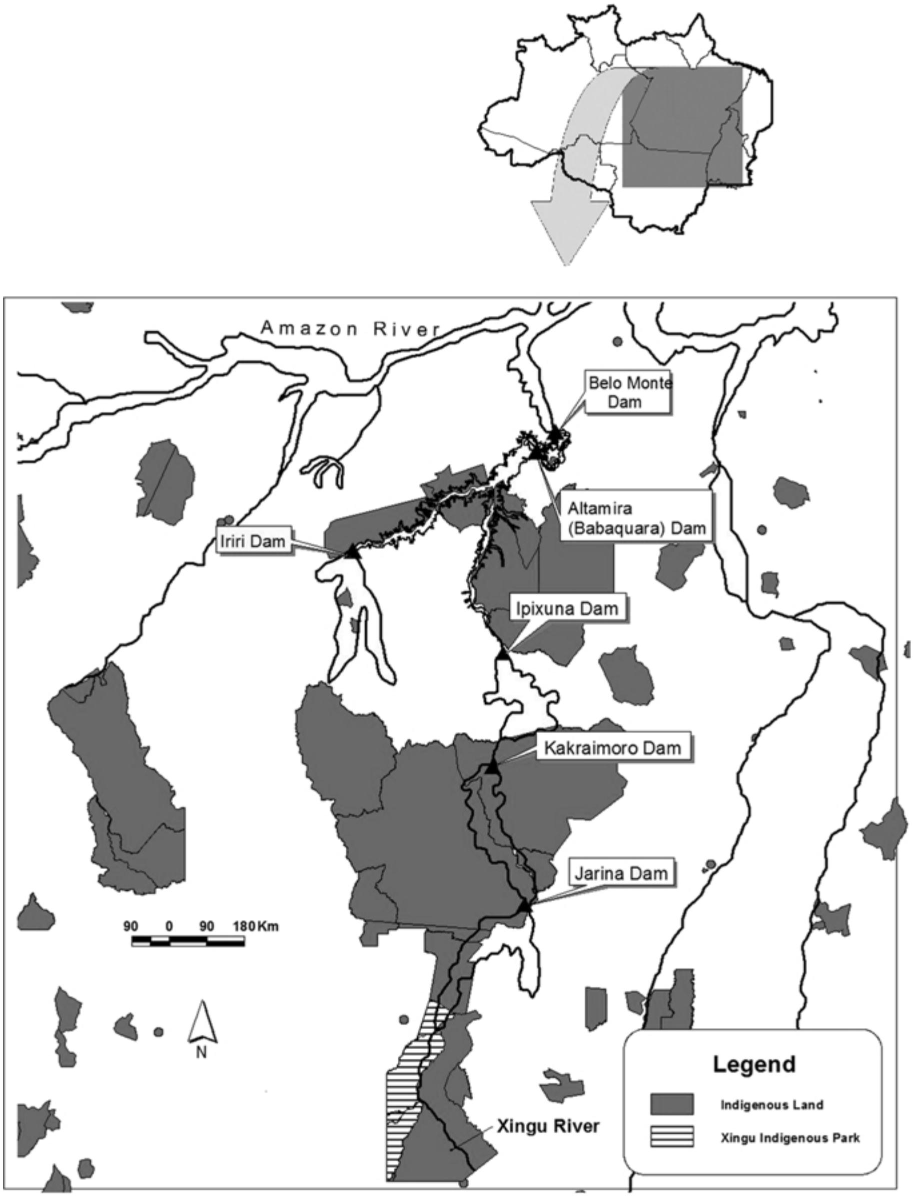

Figure 2. Indigenous areas affected by dams in the Xingu River Basin.

impact on indigenous land, whereas the other upstream dams remain as options that would probably not be openly discussed until after Altamira/Babaquara is approved and under construction.

The question of whether and over what time frame the upstream dams might be built is a major item of uncertainty. Very little information on the upstream dams has ever been made public. The fact that the Belo Monte Dam has been postponed for nearly two decades is seen by some as evidence that the struggles of indigenous peoples and of nongovermental organizations (NGOs) against the more damaging upstream dams would result in their being delayed by at least as long and that they might never be built. Unfortunately, this point of comparison is misleading, as the delay so far has partly been the result of a lack of funds—something that could change overnight. Protection is seen as being guaranteed by Article 231, Paragraph 3 of Brazil's 1988 Constitution, which requires a vote of Brazil's National Congress to approve dams that affect indigenous peoples. Such a vote is traditionally thought to imply both a significant delay and the likelihood that public discussion of the dams' impacts and implications would become much broader—not necessarily with an outcome favorable to the hydroelectric development of the Xingu. A rude awakening from this complacency was delivered on 13 July 2005, when the National Congress suddenly approved Belo Monte's construction with virtually no debate. In other words, depending on timing and the skill of the sponsoring political representatives, even highly controversial measures can be rushed through the congressional approval process. Proposed hydroelectric dams can lie in wait for years for such an opportunity to arise, and approval needs to be obtained only once for a project to go forward.

Actors and Coalitions in the Struggle over Belo Monte

The question of Belo Monte and its associated upstream dams has been and continues to be the subject of an intense struggle between those for and against the project. The two sides are composed of a variety of actors and coalitions. Pressing for construction are the *Barrageiros*, or dam builders, who represent a distinct subculture in Brazilian society (see Fearnside 1989c). The Belo Monte Dam has a special place in *barrageiro* culture—a sort of Holy Grail, the quest for which includes an emotional element that goes beyond the logic of cost/benefit calculations. One of the engineers involved in planning the dam expressed it this way: ''God only makes a place like Belo Monte once in a while. This place was made for a dam.'' Belo Monte takes advantage of a unique location that allows a comparatively low dam to be built relative to the amount of electricity that can be generated. Rather than a traditional design with the powerhouse located at the foot of the dam [as was the plan in the original 1989 design for Kararaô (Belo Monte)], the current (2002) plan for Belo Monte would divert the bulk of the water laterally through a series of canals and flooded streambeds (the Canals Reservoir) to a main powerhouse at a lower elevation, downstream of the great bend of the Xingu River, thus gaining the benefit of the fall in elevation at the great bend and only requiring construction of a smaller dam (at Sitio Pimentel).

Overlapping with the *barrageiro* group are the staffs of the Ministry of Mines and Energy (MME), ELETROBRÁS (Brazilian Electrical Centers—the agency under MME responsible for Brazil's energy development), and ELETRONORTE (Electrical Centers of the North of Brazil—the government company responsible for electrical power in Brazil's northern region). Also included are the construction firms, especially Camargo Correia (which is positioned to win the contracts for the Xingu dams) and the various consulting firms that have been hired by the project proponents to do viability and environmental studies. Academic support is contributed by researchers at COPPE (Coordination for Research and Post-Graduate Study in Engineering, at the Federal University of Rio de Janeiro).

International contributors to the push for the dams include the industries for aluminum and alumina (aluminum oxide, an intermediary product from which metallic aluminum is obtained). Especially important for future developments is the recent entry of China in alumina processing plants to be powered by the dams. China is critically lacking in electrical power and has large volumes of money for investment abroad; this fits well with Brazil's plans to seek foreign capital for Belo Monte and, presumably, for Altamira/Babaquara and any of the other Xingu dams that might be built. Aside from the ore itself, electricity is the main ingredient in processing aluminum: The ingots essentially represent electricity in a form that can be loaded on a ship and exported around the world.

Lined up against construction are the indigenous peoples and the various NGOs that support them, such as Comissão Pró-Índio de São Paulo, Cultural Survival, and the Missionary Indigenous Council (CIMI). These are joined by groups that primarily represent the non-indigenous affected population, such as the Movement of Dam-Affected People (MAB) and the Movement for the Development of the Transamazon Highway and the Xingu (MPDTX). Various environmental NGOs have been active participants, including the International Rivers Network (IRN), the Living Rivers Coalition (CRV), the Socio-Environmental Institute (ISA), Friends of the Earth–Brazilian Amazonia, Environmental Defense (EDF), Greenpeace, and Conservation International. The Ministry of the Environment (MMA) and Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) have repeatedly questioned the dams and their impacts. Academic support has come from researchers at a broad range of institutions, including the Nucleus for High-Level Studies of Amazonia (NAEA) at the Federal University of Pará, the State University of Campinas (UNICAMP), the University of São Paulo (USP), the Emílio Goeldi Museum of Pará (MPEG), and the National Institute for Research in the Amazon (INPA).

The groups on either side of the issue reflect who wins and who loses from the proposed dams. The main winners would be the construction and consulting firms and the aluminum industry; the losers would be the Indians, other dam-affected residents, Brazil's environmental licensing system, and the environment itself.

Hydroelectric Plans for the Xingu River

In 1987, a massive plan was produced by ELETROBRÁS. The plan, known as the ''2010 Plan,'' provided information on dams that were then expected to be built throughout the country by 2010 and listed other planned dams irrespective of the expected date of completion (Brazil, ELETROBRÁS 1987). The 2010 Plan leaked to the public and was subsequently released officially in December 1987. The plan lists 297 dams in all of Brazil, of which 79 are in Amazonia, independent of the intended date of construction. In Amazonia, 10 million hectares would be flooded (Brazil, ELETROBRÁS 1987, p. 153), which represents 2% of the Legal Amazon region or 3% of the originally forested area. Maps of the planned dams (CIMI and others 1986; Fearnside, 1995) make evident the tremendous overall impact of the plan. All major tributaries to the Amazon would be dammed, with the exception of the Acre, Purus, and Javarí rivers, which are in the flat areas of the far-western portion of the region. Following the 2010 Plan's negative reception, electrical authorities never again released lists or other information on the overall extent of dam-building plans. Instead, public documents contain only short lists of dams for construction over limited time periods, such as the 2015 Plan and the various ELETROBRÁS Decennial Plans (Brazil, ELETROBRÁS 1993, 1998).

The 2010 Plan listed Kararaô (Belo Monte) for construction by 2000 and Babaquara (Altamira) for construction by 2005 (Brazil, ELETROBRÁS 1987, pp. 153–154). Such a speedy timetable was probably unrealistic even at the time, when electrical authorities assumed a continuous growth of Brazil's economy and consequent ability to pay for dams, a construction process essentially unfettered by environmental licensing requirements, and easy availability of loans from multilateral development banks with virtually no questions asked on environmental matters. Creation of the World Bank's environment department was only announced in March 1987 and was still incipient in December 1987 when the 2010 Plan was completed. Brazil's own requirements for environmental studies, although enacted as law on 31 August 1981 (Law 6938), had only taken effect with its ''regulamentation'' on 23 January 1986 (CONAMA Resolution 001). Beginning with that resolution, an environmental impact study (EIA), plus a briefer document for public distribution called the ''Report on Environmental Impact'' (RIMA), have been required for major infrastructure projects such as hydroelectric dams. Brazil's incipient environmental licensing system was still being tested by attempts to build major projects with no studies at all, including the Carajás pig-iron smelters and the North–South Railway, both under construction at the time without EIA and RIMA reports, in flagrant violation of the law (Fearnside 1989a, 1989b). The assumption of many was that high-priority projects would, in practice, be built without complying with environmental requirements. Although, to a certain extent, this situation still applies today (including the ease of Belo Monte), it was much more evident during the first few years of environmental licensing in Brazil.

The history of the environmental studies for the Xingu dams reveals many problems that are common to EIA and licensing procedures throughout Brazilian Amazonia. A first set of studies on Kararaô and Babaquara was prepared by CNEC (National Consortium of Consulting Engineers), a consulting firm headquartered in São Paulo (CNEC 1980). Collection of data on many of the specific topics was subcontracted to research institutions, including INPA (National Institute for Research in the Amazon). Editorial control over the reports and their conclusions remained with the consulting firm. In addition to preparing the reports, CNEC presented the case for Belo Monte at a public hearing *(audiência pública)* in Altamira. The hearing was held in the small local cinema, with a significant number of the seats occupied by local authorities and their guests, with the result that many of those who questioned the dam were excluded for lack of space. As is often the case at such hearings, the effectiveness of the local population's participation was hindered by lack of information on the project plans and by lack of people with the appropriate technical skills (see Eve and others 2000; Fearnside and Barbosa 1996a, 1996b).

While the environmental studies were underway, the CNEC consulting firm was purchased by Camargo Corrêa, the construction company expected to win the contracts for building the dams. In practice, the various Amazon tributaries are divided as spheres of influence of specific construction firms (see Fearnside 1999; Pinto 1991). In addition, the Camargo Corrêa group owned a metallurgical silica plant in Breu Branco, Pará, that benefited from subsidized energy prices from Tucuruí (Brazil, ELETRONORTE 1989, p. 11) (also built by Camargo Corrêa) and the network that would be fed by power from the Xingu dams. The various forms of conflict of interest did not lead ELETRONORTE to change consulting firms for the Xingu studies.

The Evolving Plans for Belo Monte

Important design changes were made in the plans for Belo Monte Dam between the first (1989) and second (2002) proposed configurations. The reservoir was reduced from 1225 to 440 km^2 by placing the main dam above the confluence of the Bacajá River. The main rationale for this was to avoid flooding part of the Bacajá Indigenous Area, an important consideration to avoid the need for approval by the National Congress. Rapid approval of Belo Monte by the National Congress in 2005 later showed this precaution to be unnecessary from the point of view of gaining congressional authorization.

The delay in building Belo Monte and the revision of the plans had the beneficial effect of substantially improving the technical advantages of the dam's design. In addition, the delay allowed discovery of important technical errors in the topographic mapping of the area, which increased considerably the estimates of the amount (and cost) of excavation needed for the adduction canal and for the various smaller transposition canals within the Canals Reservoir. The estimates of the amount of excavation that would be in solid rock also increased (Brazil, ELETRONORTE 2002, vol. I, p. 8–22).

An additional revision of the plan was initiated in 2003 with a view to providing justification for overturning the judicial embargo that prevented ELETRONORTE from proceeding with the dam. The alternative plan would reduce the installed capacity, at least in an initial phase. Configurations are being considered with 5500, 5900, and 7500 MW (Pinto 2003). It should be remembered that continually evolving plans represent a common tactic in Amazonian development, allowing project proponents to deflect any criticism by claiming that the critics are uninformed about the current plans, which then move forward to produce projects with essentially the same impacts as those that have been questioned all along. Almost no information has been released on the ''third version'' of Belo Monte that is now under preparation. The sudden approval of Belo Monte by the National Congress now raises the possibility that the revised designs will be abandoned in favor of keeping the 11,181.3-MW configuration in the 2002 design.

The Bureaucratic Steamroller for Belo Monte

The 1989 Altamira Gathering was a turning point in the evolution of plans for the Xingu dams. As a concession to the indigenous peoples, ELETRONORTE changed the name of the first dam from Kararaô to Belo Monte (kararaô is a Kaiapó word with religious significance, which the tribe did not want to have appropriated by ELETRONORTE for promoting a dam that would stimulate creating a string of upstream reservoirs in the tribal territory).

At the same juncture, ELETRONORTE announced that it would remove the dams upstream of Belo Monte from the 2010 plan and undertake a ''resurvey of the fall'' on the Xingu River. This was often presented in ways that implied that the upstream dams, especially the largest (Altamira/Babaquara), would not be built. Several indigenous leaders had this erroneous interpretation of ELETRONORTE's intentions as late as 1994 (personal observation). In point of fact, however, ELETRONORTE had never promised not to build these dams or similar ones, perhaps at slightly different locations and with different names. A ''resurvey of the fall'' refers to remeasuring the topography along the river, possibly altering the location, height, and other engineering characteristics of each dam, but in no way implying that the same areas of forest and indigenous land would not be flooded.

Following the 1989 Altamira Gathering, mention of the five dams planned upstream of Belo Monte abruptly vanished from ELETRONORTE's public discourse. In 1998, Babaquara would suddenly reappear, with a new name (the Altamira Dam), when it was listed in the ELETROBRÁS 1999–2008 decennial plan in a table of key future dams, indicating that it would be completed in 2013 (Brazil, ELETROBRÁS 1998, p. 145). Since then, the 6588-MW Altamira/Babaquara Dam has quietly crept into official presentations of plans (e.g., Brazil, MME-CCPESE 2002; Santos 2004). Inclusion of funds in the 2005 federal budget for an improved viability study of the Altamira/Babaquara Dam confirms its priority in current plans for hydroelectric development on the Xingu River. The remaining four dams [Ipixuna (1900 MW), Kakraimoro (1490 MW), Iriri (770 MW), and Jarina (620 MW)] are absent from public discussion, although the continued activity of ELETRONORTE engineers in the locations in question is an indication that this lack of visibility does not mean that the plans have been abandoned. Rather, it indicates the increasing sophistication of the electrical sector in guiding public discussion in ways that minimize questioning of the plans.

A second study for Belo Monte was completed in 2002 as a ''preliminary version'' by the Foundation for the Support and Development of Research (FADESP), a public-interest organization (OCIP) associated with the Federal University of Pará (UFPa) (Brazil, ELETRONORTE nd [2002]). The choice of FADESP was made in September 2000 without the normal bidding (*licitação*). The explanation given was that UFPa was widely known for its technical excellence. Unfortunately, despite the strong academic reputation of the university as a whole, the credibility of the OCIP that the university had created to obtain consulting contracts such as this has been repeatedly questioned (Pinto 2002a, 2002b). The R$3.8-million (approximately US$2 million) EIA for Belo Monte was rejected by federal courts in May 2001. A restraining order from another court allowed work on the study to continue and for a version of the reports (Brazil, ELETRONORTE nd [2002]) to be completed before the restraining order was overturned in 2002.

When FADESP was chosen to do the environmental studies for Belo Monte, it had just produced an EIA and RIMA for the Tocantins/Araguaia waterway that had been rejected by IBAMA as deficient (Carvalho 1999), and construction of the waterway was under judicial embargo because of ''fraud'' in the study (Switkes 2002). The ''fraud'' refers to the section of the report on the waterway's probable impacts on the indigenous peoples who inhabit the Bananal Island—the passages concluding that the impacts would be severe had been edited out at the request of the project proponents, leading the anthropologists who had drafted the section to initiate a lawsuit to have the passages restored. Multiple failings in the environmental impact study (FADESP 1996) led to a court order in June 1997 suspending work on this waterway (Switkes 1999). FADESP had also produced an EIA and RIMA for the Tapajós–Teles Pires waterway, where passage through an indigenous reserve is a major concern, only to have the reports rejected for ''complete inconsistency'' (Pinto 2001). None of this bodes well for FADESP's environmental studies for Belo Monte, where indigenous issues are a key part of the controversies surrounding the dam.

The EIA/RIMA process for hydroelectric dams suffered a setback in 2001, when the non-Amazonian portions of Brazil were subjected to electricity rationing and repeated blackouts (the *Apagão*) due to lack of water in reservoirs in Brazil's central–south region (Fearnside 2004). The *Apagão* was also due to a series of poor decisions on electricity planning and management (Rosa 2003). It is also worth noting that Brazil has a highly inefficient use of energy (e.g., Goldemberg and others 1985) and many untapped opportunities for low-impact energy supply (Bermann 2002). On 18 May 2001, then-president Fernando Henrique Cardoso issued a provisional measure establishing a maximum time of 6 months for granting environmental approval for energy projects (Gazeta Mercantil 2001). Belo Monte was the most prominent target of this measure, which made maximum use of the public reaction to rationing in Brazil's major population centers such as São Paulo and Rio de Janeiro. However, the environmental studies were not able to meet the impossible deadline of 6 months, and by then the crisis had eased with the arrival of the rainy season to refill the hydroelectric reservoirs in south–central Brazil. The provisional measure expired without succeeding in forcing an abbreviated approval of Belo Monte.

A significant event was the 25 August 2001 assassination of Ademir Alfeu Federicci, known as ''Dema,'' a leader of resistance to the dam plans. Dema was head of the Movement for the Development of the Transamazon Highway and the Xingu (MPDTX). He is regarded in the area as a martyr who was killed for his outspoken criticism of the dams (ISA 2001). However, as is often the case in assassinations carried out by hired gunmen, sufficient evidence could not be gathered to bring the case to trial.

The recent surge in industrial deals with China, following a presidential visit to that country in 2004, includes a new Chinese–Brazilian alumina plant in Barcarena, Pará, which is expected to be the largest in the world when completed (Pinto 2004). The Chinese–Brazilian plant (ABC Refinaria) is expected to produce 10 million tons of alumina annually by 2010; this will be in addition to a 7-million ton annual production by the Japanese–Brazilian firm (Alunorte) at the same site—a tremendous increase compared to Alunorte's present annual production of 2.4 million tons (Pinto 2005). In addition, the US firm Alcoa plans to use power transmitted from Belo Monte to produce 800 thousand tons of alumina annually in a new plant to be built at Jurutí (on the Amazon River opposite the mouth of the Trombetas River). The annual production of aluminum by the Japanese–Brazilian smelter (Albrás) will increase from 432 to 700 thousand tons (Pinto 2005). Expansions are also planned of the smelters at the Alcoa/Billiton Alumar plant in Maranhão and at the CAN (Companhia Nacional de Alumínio) plant in the state of Sao Paulo. When deals are made that imply the need for vast amounts of additional electricity, the environmental impact studies and the licensing process for the various planned dams tend to become mere window dressing for a predetermined development.

Pressure for a speedy approval of Belo Monte has continued since 2003 under the presidential administration of Luis Inácio Lula of Silva: In March 2004, President Lula called his ministers together to demand that they find ways to circumvent environmental and other impediments to completing stalled infrastructure projects throughout the country, including 18 hydroelectric dams (Amazonas em Tempo 2004). On 13 July 2005, a legislative decree (no. 788) by the National Congress authorized construction of Belo Monte, pending only approval of viability and environmental studies by the ''competent agencies'' (of the executive branch). Both the house and the senate approved the measure in record time; approval by the senate came only 3 working days after the measure passed the house. Soon afterward several NGOs submitted a brief to the Attorney General's office contesting the decision, and the Federal Prosecutor's office in the State of Pará submitted a request for a Direct Suit of Unconstitutionality against the legislative decree, which had been passed without consulting the affected populations, among other failings. The suit was forwarded to the Federal Supreme Court (TSF) but was rejected on procedural grounds on 1 December 2005.

The Scant Benefits of Belo Monte

The social benefits obtained in exchange for the dams' impacts are much less than official statements imply because much of the energy would go to subsidizing the profits of multinational aluminum companies that employ a miniscule workforce in Brazil. For example, the Albrás smelter at Barcarena, Pará, employs only 1200 people, but it uses more electricity than the city of Belém with a population of 1.2 million (Fearnside 1999; see also Brazil, ELETRONORTE 1987a, p. Amazonas-32 and Pará-12). The aluminum sector in Brazil employs only 2.7 people per gigawatt-hour (GWh) of electricity consumed, second only to iron-alloy smelters (1.1 job/GWh), which also consume large amounts of energy for an export commodity (Bermann and Martins 2000, p. 90).

The debate on energy supply and fossil-fuel substitution needs to go beyond simple calculations of oil burned per kilowatt-hour generated. In the case of large Amazonian dams, it is not necessarily the case that foregoing the construction of a dam means that the equivalent amount of fossil fuel would be burned instead. This is because much of the energy is not used for purposes that are in large part irreducible, such as residential consumption and industry to supply products to the domestic market. Instead, a significant and growing percentage of the energy in Brazil's national grid is used for ''energy-intensive'' industries such as aluminum smelting (e.g., Bermann and Martins 2000; Gitlitz 1993; Pinto 1998). Brazil exports (especially to Japan) large quantities of inexpensive aluminum that is made using energy furnished at highly subsidized rates. The aluminum is smelted using electricity from hydroelectric dams built with money from Brazilian taxpayers and residential consumers.

Belo Monte and the Impacts of Upstream Dams

Belo Monte is just the tip of the iceberg of impact from the project. The main impact comes from the chain of upstream dams, assuming that the political juggernaut set in motion by Belo Monte is successful in overwhelming Brazil's still-fragile environmental licensing system. The Altamira/Babaquara Reservoir, with twice the flooded area of Brazil's Balbina Dam, would be the first of the upstream dams to be built. Electrical authorities have gone to great lengths to separate the Belo Monte project *per se* from its principal impact, which is the impetus it gives to the planned dams upstream.

With an 87.5-m drop in elevation and an average streamflow of 7851 m^3/s (1931–2000 average), the Belo Monte site is hard to beat. Despite the high seasonal variation in water flow, which diminishes somewhat the power benefit that the site (by itself) can provide, the main issue raised by the Belo Monte Dam is more profound than the direct impacts at the reservoir site; It is the system in which dam-building decisions take place. In an ideal Brazil, Belo Monte could meet, if not all, at least much of the promise its promoters portray. However, in the real Brazil of today, it would lead to disastrous social and environmental impacts in exchange for little improvement for the Brazilian people. It would justify upstream dams that flood vast areas of indigenous land, virtually all of which is under tropical rainforest. Annual flooding of a drawdown area of 3580 km^2 in the Altamira/Babaquara Reservoir would provide a permanent carbon source for emission of methane, thus contributing to global warming (see Fearnside 2002, 2005).

Although the initial studies for Belo Monte, completed in 1989, included the benefits of the flow regulation by upstream dams, the difficulty of obtaining a speedy approval soon became apparent to electrical authorities. A new study was therefore drafted for Belo Monte without the presumption of flow regulation by upstream dams. The revised (current) study states:

> The energy study in question considers only the existence of the Belo Monte Hydroelectric Complex on the Xingu River, which means that this dam does not gain any benefit from upstream regulation [of streamflow]. Although the studies of the hydroelectric inventory of the Xingu River carried out at the end of the 1970s had identified five hydroelectric dam sites above Belo Monte, the choice was made not to consider them in the evaluations developed here because of the need to re-evaluate the inventory from a new economic and socio-environmental perspective. We emphasize, however, that the implantation of any hydroelectric development with a regulating reservoir upstream of Belo Monte would increase the energy capacity of this [Belo Monte's] powerplant. (Brazil, ELETRONORTE nd [2002], p. 6–82).

In other words, although a political decision has been made to restrict the official analysis to Belo Monte alone as a needed expediency for getting the project approved, the technical advantages of also building dams upstream (especially Altamira/Babaquara) remain unaffected. In fact, neither ELETRONORTE nor any other government authority has promised not to build these dams–only to postpone a decision on them until a later time. This, of course, is the crux of the problem.

Everyone has heard the adage of the ‘‘camel in the tent’’; A Bedouin camped in the desert might be tempted to let his camel put its head in the tent at night to get away from a sandstorm, but when the man wakes up the next morning he will find the whole camel inside the tent. This is exactly the situation with Belo Monte–once Belo Monte is begun, we are likely to wake up and find Babaquara.

The camel-in-the-tent scenario has occurred with ELETRONORTE projects on at least two parallel occasions. First is the filling of the Balbina Reservoir. In September 1987, less than a month before the reservoir began to fill, ELETRONORTE issued a ‘‘public clarification’’ stating that the reservoir would be filled to only 46 m above mean sea level (below the 50-m level originally planned); a series of environmental studies would be done over several years to monitor water quality before making a separate decision on filling the reservoir all the way to 50 m (Brazil, ELETRONORTE 1987b). However, when the water level reached 46 m, the filling process did not stop for a single second for the intended environmental studies; instead, the filling continued directly to the 50-m level and even beyond (see Fearnside 1989c). In fact, the plan followed by ELETRONORTE engineers at the dam site during the filling process indicated going directly to the 50-m level (Brazil, ELETRONORTE 1987c).

The second example is the expansion of the installed capacity at Tucuruí (i.e., Tucuruí-II). An environmental impact study was in progress for the Tucuruí-II project, but this was truncated when ELETRONORTE began building the project without an environmental study in 1998 (see Fearnside 2001). The rationale was that there would be no environmental impact because the maximum normal operating level of the reservoir would remain unaltered at 72 m above mean sea level (Indriunas 1998). However, once the construction was underway, the policy was quietly changed to raising the water level to 74 m, as had been the original plan. The reservoir has been operating at the 74-m level since 2002.

The plans for Belo Monte *per se* even include an important element of this strategy. The viability study admits unapologetically that

> ...the infrastructure services (access roads, construction site, transmission system, residential town and lodging facilities) will begin as soon as their installation license is approved, which should occur separately from the license for the main civil works, in the course of the so-called ‘‘zero’’ year of the construction project. (Brazil, ELETRONORTE 2002, Vol. II, p. 8–155).

Simply put, this means that the environmental study and licensing process for the Belo Monte Dam are viewed as mere bureaucratic rubber stamps to legalize a decision that has already been made. Were the environmental licensing viewed as an essential input to the decision itself as to whether or not the project should go forward, then there would be no rationale for beginning work on the large package of complementary infrastructure, including the transmission system, while the main project (the dam) remains under consideration.

These examples bode poorly for the future of the Xingu. They suggest that, regardless of what authorities might say now about only approving one dam (Belo Monte), when the time comes in the course of events to begin work on the second dam (Altamira/Babaquara), this is likely to go forward just the same. This means that the impacts of the upstream dams must be considered, and if they are judged unacceptable, then any decision to build Belo Monte must be linked to a credible mechanism for preventing the upstream dams from being built.

If Belo Monte is really economically viable without Altamira/Babaquara, as ELETRONORTE claims, this would in no way diminish the danger of history unfolding to produce the environmental and social disasters implied by the Altamira/Babaquara scheme. This is because, after the completion of Belo Monte, the decision-making process on building Altamira/Babaquara would be dominated by arguments that Altamira/Babaquara would be highly profitable as a means of further increasing the output of Belo Monte.

However, Belo Monte could lead to a different outcome. First, it should be remembered that the Belo Monte site will be there for as long as hydroelectric dams are being built: If no dam is built on this site in the next few decades, the option of building a dam there will still remain open. Before a decision is reached on the construction of Belo Monte, the decision-making system for hydroelectric dams must be radically changed. Basic questions must be faced about what is done with the energy as well as the related question of how much energy is really needed. Not only should the Brazilian government cease encouraging the trend to energy-intensive industry, but these industries, especially aluminum smelting, should be strongly penalized by charging them for the environmental damage their energy use implies. In addition, the Brazilian government needs to develop a credible institutional framework by means of which a commitment can be made *not* to build any of the planned dams upstream of Belo Monte. Given the string of precedents in Brazil's recent dam-building history where the opposite outcome has occurred, such an institutional structure would require some real tests before it could claim adequate credibility to handle a case like Belo Monte, where the temptations to renege on any such promise are extraordinarily powerful. The weak decision-making process concerning large dams was identified as a worldwide phenomenon by the World Commission on Dams, which argued strongly for fundamental reforms (WCD 2000). Belo Monte is a case where immediate action is needed.

Reforms are also needed to restrain the role of construction firms in molding development priorities to favor the large infrastructure projects these firms build. Because Belo Monte has such a strong attraction for the *barrageiro* community, it could potentially serve as a carrot to induce all of these needed reforms. However, the dangers are multiple, and the risk of winding up with Altamira/Babaquara hangs like a dangling sword over all discussions of Belo Monte.

Reforms must go deeper than strengthening the licensing process. After discussing the long list of impacts from dams, one is frequently confronted with the reaction that ''Yes, but we need electricity for progress.'' Although having no electricity would obviously be a barrier to progress, it does not follow that one always needs more—especially if much of it is used to supply aluminum to the world. A national discussion of energy policy is sorely missing. Were fewer dams built in Amazonia, the result would likely be that less of this financial and environmental subsidy would be given to the world at large, rather than supplying the aluminum export industry with additional power generated from fossil fuels. Aluminum smelting companies supplying the international market (as distinct from Brazilian domestic consumption) would either have to move elsewhere or, ultimately, produce less aluminum and switch to lower-impact materials for many uses. The price of aluminum would rise to reflect the true environmental cost of this very wasteful industry, and global consumption would decline to a lower level. Adding one more hydroelectric project to the grid only postpones insignificantly the day when Brazil and the world make this fundamental transformation. One day these environmental costs will be accounted for and considered before decisions are made, such as deals to expand Brazil's electro-intensive industries.

Conclusions

Brazil's dam-building plans in Amazonia imply substantial environmental and social impacts and pose a challenge to the country's environmental licensing system. The proposed Belo Monte Dam is particularly controversial because five planned dams upstream of Belo Monte, including the 6140-km^2 Altamira/Babaquara Dam, would have especially grave impacts, including flooding indigenous land, destroying tropical rainforest, and emitting greenhouse gases. The existence of Belo Monte would greatly increase the financial attractiveness of the upstream dams.

The case of Belo Monte and the other Xingu dams illustrates the absolute necessity of considering the interconnections among different infrastructure projects and the inclusion of these considerations as a precondition for constructing or licensing any of the projects. Postponing analysis of the more controversial projects is not a solution.

An institutional framework needs to be created by means of which commitments can be made not to build specific infrastructure projects that are identified as damaging, a criterion that is likely to include Altamira/Babaquara and the other dams planned in the Xingu River Basin upstream of Belo Monte.

The high environmental and social cost of hydroelectric dams indicates the need for Brazil to reassess its allocation of electricity to energy-intensive export industries, such as aluminum smelting.

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