

March 20, 2012  
Updated June 2, 2012

## **THE SANTO ANTÔNIO DAM'S CDM PROPOSAL: COMMENTS ON THE PROJECT DESIGN DOCUMENT**

Philip M. Fearnside  
National Institute for Research in Amazonia (INPA)  
Manaus, Amazonas, Brazil  
[pmfearn@inpa.gov.br](mailto:pmfearn@inpa.gov.br)

### **THE SANTO ANTÔNIO DAM**

Granting the Santo Antônio Dam Certified Emissions Reductions (CERs) under Clean Development Mechanism (CDM) would allow purchasers of these certificates to release 51 million tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) into the atmosphere elsewhere in the world. As will be explained here, none of the supposed reduction in CO<sub>2</sub>e from the dam project is real, and approving the project therefore represents a setback for global efforts to contain climate change.

The Project Design Document (PDD) for the Santo Antônio Dam's proposal for carbon credit under the Kyoto Protocol's is indeed revealing, both of the flaws in the current CDM system and of the inconsistencies between Brazilian government's stated concern for climate change and its engaging in maximum exploitation of loopholes in CDM regulations. The PDD (Santo Antônio Energia S.A., 2012) refers to various Brazilian government documents that support promotion of hydroelectric dam as a means of mitigating greenhouse-gas emissions. Unfortunately, the fact that Amazonian dams produce large amounts of greenhouse gases, especially during their first ten years of operation (the time horizon for the current CDM project), has been shown in many peer-reviewed studies in the scientific literature (e.g., Abril et al., 2005; Delmas et al., 2004; Fearnside, 2002, 2004, 2005a, 2006a, 2008, 2009a, 2011; Kemenes et al., 2007, 2007, 2011). Although emissions from Santo Antônio will be significantly lower than those in existing Amazonian dams, they will not be zero as claimed by the project.

Despite the document's using zero as the emission for the project in its calculation of climate benefits, a table is included (p. 10, Table 4) where the admission is made that the dam would produce methane (although no quantities are mentioned). The same table also states that emissions of CO<sub>2</sub> and N<sub>2</sub>O are zero, each of these being only a "minor emission source". Unfortunately, both of these gases are also produced. Creating the reservoir will kill forest trees in the flooded area, and these generally remain projecting out of the water, where the wood decays in the presence of oxygen, thus producing CO<sub>2</sub>. The greatest emissions occur in the first decade, as in the ten-year time horizon of the current CDM project. See calculations for existing Amazonian reservoirs in Fearnside (1995). Nitrous oxide (N<sub>2</sub>O) is also emitted (Guérin et al., 2008).

The project proponents take advantage of a CDM regulation that allows zero emissions to be claimed if the power density is over 10 W/m<sup>2</sup> (p. 28). Unfortunately, having a high power density does not, in fact, result in zero emissions. A high power density means that the area of the reservoir is small relative to the installed capacity, which, in turn, reflects the amount of water available in the river. The small area means

that emissions through the reservoir surface (from bubbling and diffusion) will be smaller than in a large reservoir, but not zero.

With the exception of bays and tributaries along the reservoir edges, the water in the reservoir moves fast enough to prevent stratification. However, in these edge areas where water velocities are much lower than the average for the reservoir as a whole, anoxic water is expected at the bottom of the reservoir, with resulting methane formation in the sediments (Forsberg & Kemenes, 2006). Some of the methane produced would be released through bubbling, but the dissolved methane that does not reach the surface will be prevented from reaching the turbines because the methane would be oxidized when the water from these bays mixes with oxygenated water in the main channel. Methane emissions will therefore be much lower than in typical Amazonian dams where the main body of the reservoir stratifies.

The document calculates reservoir area for the purpose of computing the power density, which is the installed capacity in Watts divided by the area in square meters. The area of the reservoir used is calculated as area at the normal maximum water level of 70.5 m (354.40 km<sup>2</sup>), minus 164.00 km<sup>2</sup> described as "the river course," making the increased flooded area 190.40 km<sup>2</sup> (p. 6). The PDD points out that a clarification approved by the CDM Executive Board (EB15) allows this lowering of the reservoir area used in the calculation of power density (W/m<sup>2</sup>) for purposes of taking advantage of a CDM criterion allowing zero emission to be claimed if the power density is less than 10 W/m<sup>2</sup>. If the full area of the reservoir at the normal maximum water level were used (354.40 km<sup>2</sup>), the power density would be 8.9 W/m<sup>2</sup>, or less than the 10 W/m<sup>2</sup> cutoff for making use of the loophole to claim zero emissions. The assumption is that the water over the "river course" is not emitting methane. Unfortunately, this water also emits methane, as shown by numerous studies that have measured reservoir surface fluxes at a variety of monitoring points in Amazonian reservoirs (see publications cited above). Unfortunately, there is no scientific basis either for allowing a claim of zero emissions if the power density is less than the 10 W/m<sup>2</sup> or for the broadening of the loophole by the Executive Board's "clarification."

In the case of the Santo Antônio Dam, the major contribution to global warming is the granting of credit for a mitigation project that is not additional to what would have happened without the project. The Project Design Document calculates a benefit of 51,464,028 CO<sub>2</sub>e over 10.5 years (June 2012 – Dec. 2022) (p. 35). This claim represents 14 million tons of carbon. Much, or possibly even all, of this represents "hot air" that will contribute to further climate change. Brazil, as one of the countries expected to suffer most from projected climate changes, cannot afford to contribute to such a scheme. "Hot air" is carbon credit without a real climate benefit. This project creates hot air in two ways. First, it is based on the fiction that the hydroelectric dam will have zero emissions. Second, the project is not "additional", as required by Article 12 of the Kyoto Protocol in creating the Clean Development Mechanism. Projects are supposed to gain credit only if the claimed emissions reductions would not have taken place without the CDM funding. In this case, the dam is planned and financed by Brazilian companies with the full expectation of making a profit without any additional help from the CDM. None of the 51 million tons of CO<sub>2</sub>-equivalent claimed is additional. The definitive proof of this is that the project is financed and construction is almost complete while the CDM proposal is still under review, meaning that the investors were confident of an attractive return without the CDM. The presentation of an unattractive internal rate of

return (IRR) in the Project Design Document is inconsistent with the IRR values used by the investors, reflecting the considerable lengths to which the project proponents went in order to claim that the dam would not be built without help from the CDM (see: International Rivers, 2012). The justification for claiming that the project would be financially unattractive rests on showing that a calculated IRR (adjusted downward for “country risk” and other factors) is lower than a “benchmark” IRR value chosen by the project, in this case 10.35%. Surely few investment opportunities would return 10.35% per year after taxes and in real terms, meaning after discounting inflation. While calculations of the IRR can easily be manipulated to produce a value to support a bogus claim of additionality, the behavior of the investors offers an unambiguous demonstration of the non-additionality of the project that all people can understand, whether or not they have the knowledge or patience to follow the IRR calculations. Apparently the Executive Board of the CDM believes that building a dam before CDM support is obtained is not proof of non-additionality. This, at the very least, has the appearance of revealing a gross bias in favor of approving projects regardless of their true additionality. I would suggest that the Executive Board take note of the damage that this practice does to their credibility and to that of the CDM.

## **ENVIRONMENTAL LICENSING**

The PDD says of the environmental licensing that “This process consisted of 64 public meetings with the participation of 2000 people from the local communities that inhabit the area of direct influence of the hydroelectric plant” (pp. 46-47). It neglected to say anything about the content of those meetings, namely that virtually 100% of what was said was highly critical of the dam.

The PDD form asks for “conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party” (p. 47). The PDD answers this by stating that “The project has all required environmental licenses issued by IBAMA” and listing the licenses. Not mentioned are the multiple irregularities in the licensing process. The gravest was the replacement of the head of the licensing sector of IBAMA just before the preliminary license was approved (the previous head of the sector had supported his technical staff in declining to approve the license). The new head of the licensing department was then promoted to head IBAMA, and approved the installation license in that capacity. This inaugurated a new period in licensing, in which any project can be approved no matter how severe its impacts (see discussion of the Belo Monte Dam in Fearnside, 2012).

## **ENVIRONMENTAL AND SOCIAL IMPACTS**

Readers of the section of the PDD on environmental and social impacts (pp. 42-47) will have little idea of the severity of the impacts of the Santo Antônio Dam. The PDD even goes so far as to claim that “the Project will have an overall positive impact on the local and global environments” (p. 47). Unfortunately, the dam will have multiple impacts, including blockage of the migration of the giant catfish of the Madeira (*Brachyplatystoma rouxeauxii* and *Brachyplatystoma platynemum*), which have, until now, been a vital economic resource not only in Brazil’s state of Rondônia but also in Peru and Bolivia. The dam will also affect floodplain (*várzea*) lakes that are important fish-breeding sites downstream of the dam (not included in the environmental impact

study, or EIA), release methylated mercury and destroy the livelihoods of the human population that has traditionally depended on the Madeira River. I suggest consulting the book entitled *Muddy Waters* (Switkes, 2008), some of the chapters in the Public Ministry's review of the EIA (e.g., Fearnside, 2006b; Forsberg & Kemenes, 2006) and other sources on the impacts of these dams (e.g., Fearnside, 2009b; Ortiz, 2007; Vera-Diaz et al., 2007).

The Madeira River dams, including Santo Antônio, are surely among the most controversial hydroelectric projects in the world today because of their impacts and because of the history of their licensing. The CDM, as part of the Framework Convention on Climate Change (FCCC) and the United Nations, should think very carefully about whether it wants to associate its name with a set of scandals such as this. The effect would be to contribute to eroding the public image of the Climate Convention, with damaging consequences for present and future efforts to mitigate global climate change.

### LITERATURE CITED

- Abril, G., F. Guérin, S. Richard, R. Delmas, C. Galy-Lacaux, P. Gosse, A. Tremblay, L. Varfalvy, M.A. dos Santos & B. Matvienko. 2005. Carbon dioxide and methane emissions and the carbon budget of a 10-years old tropical reservoir (Petit-Saut, French Guiana). *Global Biogeochemical Cycles* 19: GB 4007, doi: 10.1029/2005GB002457
- Delmas, R., S. Richard, F. Guérin, G. Abril, C. Galy-Lacaux, C. Delon & A. Grégoire. 2004. Long term greenhouse gas emissions from the hydroelectric reservoir of Petit Saut (French Guiana) and potential impacts. pp. 293-312. In: A. Tremblay, L. Varfalvy, C. Roehm & M. Garneau (eds.) *Greenhouse Gas Emissions: Fluxes and Processes. Hydroelectric Reservoirs and Natural Environments*. Springer-Verlag, New York, NY, USA, 732 pp.
- Fearnside, P.M. 1995. Hydroelectric dams in the Brazilian Amazon as sources of 'greenhouse' gases. *Environmental Conservation* 22(1): 7-19. doi:10.1017/S0376892900034020
- Fearnside, P.M. 2002. Greenhouse gas emissions from a hydroelectric reservoir (Brazil's Tucuruí Dam) and the energy policy implications. *Water, Air and Soil Pollution* 133(1-4): 69-96.
- Fearnside, P.M. 2004. Greenhouse gas emissions from hydroelectric dams: Controversies provide a springboard for rethinking a supposedly "clean" energy source. *Climatic Change* 66(2-1): 1-8.
- Fearnside, P.M. 2005a. Brazil's Samuel Dam: Lessons for hydroelectric development policy and the environment in Amazonia. *Environmental Management* 35(1): 1-19.
- Fearnside, P.M. 2005b. Do hydroelectric dams mitigate global warming? The case of Brazil's Curuá-Una Dam. *Mitigation and Adaptation Strategies for Global Change* 10(4): 675-691.

- Fearnside, P.M. 2006a. Greenhouse gas emissions from hydroelectric dams: Reply to Rosa et al. *Climatic Change* 75(1-2): 103-109.
- Fearnside, P.M. 2006b. Pareceres dos consultores sobre o Estudo de Impacto Ambiental do Projeto para aproveitamento hidrelétrica de Santo Antônio e Jirau, Rio Madeira-RO. Parecer Técnico sobre ecossistemas. Parte B, Volume 1, Parecer 8, pp. 1-15 In: *Pareceres Técnicos dos Especialistas Setoriais—Aspectos Físicos/Bióticos. Relatório de Análise do Conteúdo dos Estudos de Impacto Ambiental (EIA) e do Relatório de Impacto Ambiental (RIMA) dos Aproveitamentos Hidrelétricos de Santo Antônio e Jirau no, Rio Madeira, Estado de Rondônia*. Ministério Público do Estado de Rondônia, Porto Velho, Rondônia. 2 Vols. Available at: <http://www.mp.ro.gov.br/web/guest/Interesse-Publico/Hidreletrica-Madeira>
- Fearnside, P.M. 2008. Hidrelétricas como "fábricas de metano": O papel dos reservatórios em áreas de floresta tropical na emissão de gases de efeito estufa. *Oecologia Brasiliensis* 12(1): 100-115. [English translation available.](#)
- Fearnside, P.M. 2009a. As hidrelétricas de Belo Monte e Altamira (Babaquara) como fontes de gases de efeito estufa. *Novos Cadernos NAEA* 12(2): 5-56. [English translation available.](#)
- Fearnside, P.M. 2009b. Impactos de presas hidroeléctricas en la Amazonía. In: *Memoria "Evaluación de Impactos Ambientales de grandes hidroeléctricas en regiones tropicales: El caso del río Madera" 19 y 20 de Maio de 2009*, WWF-Bolivia, La Paz, Bolívia (CD-ROM). Available at: [http://philip.inpa.gov.br/publ\\_livres/2009/Hidroelectricas%20Rio%20Madera-Philip-Fearnside.pdf](http://philip.inpa.gov.br/publ_livres/2009/Hidroelectricas%20Rio%20Madera-Philip-Fearnside.pdf)
- Fearnside, P.M. 2011. Gases de efeito estufa no EIA-RIMA da hidrelétrica de Belo Monte. *Novos Cadernos NAEA* 14(1): 5-19.
- Fearnside, P.M. 2012. Belo Monte: A Spearhead for Brazil's Dam-Building Attack on Amazonia? *Global Water Forum* 19/03/12. <http://www.globalwaterforum.org/2012/03/19/belo-monte-dam-a-spearhead-for-brazils-dam-building-attack-on-amazonia/>
- Forsberg, B.R. & A. Kemenes 2006. Pareceres dos consultores sobre o Estudo de Impacto Ambiental do Projeto para aproveitamento hidrelétrica de Santo Antônio e Jirau, Rio Madeira-RO. Parecer Técnico sobre Estudos Hidrobiogeoquímicos, com atenção específica à dinâmica do Mercúrio (Hg). Parte B, Volume 1, Parecer 2, pp. 1-32 In: *Pareceres Técnicos dos Especialistas Setoriais—Aspectos Físicos/Bióticos. Relatório de Análise do Conteúdo dos Estudos de Impacto Ambiental (EIA) e do Relatório de Impacto Ambiental (RIMA) dos Aproveitamentos Hidrelétricos de Santo Antônio e Jirau no, Rio Madeira, Estado de Rondônia*. Ministério Público do Estado de Rondônia, Porto Velho, Rondônia. 2 Vols. Available at: <http://www.mp.ro.gov.br/web/guest/Interesse-Publico/Hidreletrica-Madeira>

- Galy-Lacaux, C., R. Delmas, C. Jambert, J.-F. Dumestre, L. Labroue, S. Richard & P. Gosse. 1997. Gaseous emissions and oxygen consumption in hydroelectric dams: A case study in French Guyana. *Global Biogeochemical Cycles* 11(4): 471-483.
- Galy-Lacaux, C., R. Delmas, J. Kouadio, S. Richard & P. Gosse. 1999. Long-term greenhouse gas emissions from hydroelectric reservoirs in tropical forest regions. *Global Biogeochemical Cycles* 13(2): 503-517.
- Guérin, F., G. Abril, S. Richard, B. Burban, C. Reynouard, P. Seyler & R. Delmas. 2006. Methane and carbon dioxide emissions from tropical reservoirs: Significance of downstream rivers. *Geophysical Research Letters* 33: L21407, doi: 10.1029/2006GL027929.
- Guérin, F., G. Abril, A. Tremblay & R. Delmas. 2008. Nitrous oxide emissions from tropical hydroelectric reservoirs. *Geophysical Research Letters* 35: L06404, doi: 10.1029/2007GL033057.
- Gunkel, G. 2009. Hydropower - A green energy? Tropical reservoirs and greenhouse gas emissions. *CLEAN - Soil, Air, Water* 37(9): 726-734.
- International Rivers. 2012. Comments on the Santo Antônio Hydropower Project Submitted to the Perry Johnson Registrars Carbon Emissions Services. International Rivers, Berkeley, California, U.S.A. 12 pp.
- Kemenes, A., B.R. Forsberg & J.M. Melack. 2007. Methane release below a tropical hydroelectric dam. *Geophysical Research Letters* 34: L12809. doi: 10.1029/2007GL029479. 55.
- Kemenes, A., B.R. Forsberg & J.M. Melack. 2008. As hidrelétricas e o aquecimento global. *Ciência Hoje* 41(145): 20-25.
- Kemenes, A., B.R. Forsberg & J.M. Melack. 2011. CO<sub>2</sub> emissions from a tropical hydroelectric reservoir (Balbina, Brazil). *Journal of Geophysical Research* 116, G03004, doi: 10.1029/2010JG001465
- Ortiz, L. 2007. *The Amazon River's Largest Tributary Is under Threat*. Friends of the Earth Brazil, Porto Alegre, RS, Brazil. 17 pp. Available at: <http://www.internationalrivers.org/files/Livreto.pdf>
- Pueyo, S. & P.M. Fearnside. 2011. Emissões de gases de efeito estufa dos reservatórios de hidrelétricas: Implicações de uma lei de potência. *Oecologia Australis* 15(2): 114-127. doi: 10.4257/oeco.2011.1502.02 [English translation available](#).
- Santo Antônio Energia S.A. 2012. Santo Antonio Hydropower Project. PDD version: 01.1 (27/10/2011) Clean Development Mechanism Project Design Document Form (CDM-PDD) Version 03. 53 pp. Available at: <http://cdm.unfccc.int/Projects/Validation/DB/S253ZCTBJU9LJ3VF72CS1J8SHY02PP/view.html>

- Switkes, G. (ed.). 2008. *Águas Turvas: Alertas sobre as Conseqüências de Barrar o Maior Afluente do Amazonas*. International Rivers, São Paulo, SP, Brazil. 237 pp. Available at: <http://www.internationalrivers.org/am%C3%A9rica-latina/rios-da-amaz%C3%B4nia/rio-madeira/%C3%A1guas-turvas-alertas-sobre-conseq%C3%BC%C3%AAs-de-barrar-o-> Partial English translation available at: <http://www.internationalrivers.org/en/latin-america/amazon-basin/madeira-river/introduction-and-article-the-madeira-hydroelectric-and-hid>
- Vera-Diaz, M.C., J. Reid, B. Soares-Filho, R. Kaufmann & L. Fleck. 2007. *Effects of Energy and Transportation Projects on Soybean Expansion in the Madeira River Basin*. CSF Series number 7. Conservation Strategy Fund, Lagoa Santa, Minas Gerais, Brazil. 26 pp. Available at: [http://conservation-strategy.org/sites/default/files/field-file/Madeira\\_soy\\_final\\_draft2.pdf](http://conservation-strategy.org/sites/default/files/field-file/Madeira_soy_final_draft2.pdf)