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HYDROELECTRIC DAMS IN AMAZONIA AS CONTRIBUTORS TO GLOBAL WARMING: THE CONTROVERSY HEATS UP

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Hydroelectric dams in Amazonia emit six times more greenhouse gases as gross recurrent (i.e., inventory) emissions than Brazil's official estimates currently admit. This is because the official estimates only count emissions from the reservoir surface, not from the turbines and spillways. Gross recurrent emissions in 1990 (the worldwide baseline year for national emissions inventories under the climate convention) totaled 8 million tons of CO_2-equivalent carbon if calculated using the global warming potential for methane adopted by the Kyoto Protocol. This is approximately equal to the fossil fuel used by the city of São Paulo. The impact is dominated by Tucuruí (75% of the total), followed by Balbina (18%), Samuel (5%) and Curuá-Una (2%). Emissions from the turbines and spillways are especially important at Tucuruí, while surface emissions are more important at Balbina (Table 1).

The impact of hydroelectric dams on global warming includes factors in addition to those falling under this category in the national emissions inventories mandated by the climate convention. Most important is CO_2 emission from aerobic decay of dead trees projecting above the water (especially at Balbina). This is considered a form of deforestation and, because the reservoirs (except Samuel) were filled before 1988, is not counted in inventory's net committed emissions accounting for deforestation in the baseline period (1988-1994 in the case of Brazil). The net impact of dams on global warming includes downward adjustments for pre-dam ecosystem fluxes and for fossil-fuel emissions displaced by the dam's electrical output (Table 1). A full-chain energy analysis (not attempted here) would include additional impact from cement, steel and fossil fuel used in dam construction. Net impact decreases with reservoir age but stabilizes after about 10 years; in 1990 Tucuruí was 6 years old, Balbina 3 years, Samuel 2 years and Curuá-Una 13 years. Analyses of Samuel and Curuá-Una indicate stabilization at emission levels substantially higher than those for fossil-fuel generation. In 1990 the net impact of all four "large" (> 10 MW) dams was at least double the impact of generating the same power from oil, and taken together they emitted four times more than the fossil fuel they displaced.

Table 1 – Hydroelectric dam emissions in Brazilian Amazonia in 1990
(million tons CO_2-C equivalent)

Flux source	Tucurui	Balbina	Samuel	Curuá-Una	Total	Percentage of total recurrent emission
Recurrent (inventory) emissions						
Surface emissions	0.54	0.75	0.08	0.008	1.38	17
Turbine emissions	2.48	0.72	0.24	0.08	3.52	44
Spillway emissions	3.07	0.00	0.04	0.06	3.17	39
Total recurrent emissions	6.09	1.47	0.37	0.14	8.06	100
Additional components of net impact						
Forest biomass aerobic decay	2.58	6.43	1.13	0.01	10.15	
Pre-dam ecosystem fluxes (a)	-0.09	-0.15	-0.02	-0.003	-0.27	
Displaced fossil fuels	-3.86	-0.34	-0.13	-0.04	-4.38	
Net emission	4.71	7.41	1.35	0.11	13.57	
Hydro emission as multiple of thermal	2.3	23.5	11.8	3.9	4.2	

(a) Pre-dam ecosystem fluxes: CH_4 sink in forest soil, N_2O source in forest soil, and CH_4 source from forest termites.