

WARMING THE EARTH

HYDROPOWER THREATENS EFFORTS TO CURB CLIMATE CHANGE



The Petit Saut reservoir floods a French Guyana forest, emitting greenhouse gases. Caption: Jacky Brunetaud

The hydropower industry is eager to promote dams as “climate-friendly” alternatives to fossil fuel plants, hoping to benefit from subsidies intended to curb global warming. But, growing evidence suggests that dams and reservoirs are globally significant sources of the greenhouse gases carbon dioxide and, in particular, methane.

Scientists have studied more than 30 reservoirs, and found emissions at all of them. In tropical countries, several of the hydropower plants studied appear to have a much greater impact on global warming than natural gas plants generating equivalent amounts of electricity. While the global warming impact of hydropower outside the tropics does appear to be significantly lower than that of fossil fuel-generated electricity, it is not negligible as has commonly been assumed.

HOW EMISSIONS ARE PRODUCED

Reservoirs emit greenhouse gases because of the rotting of organic matter – the vegetation and soils flooded when the reservoir is created, the plants that grow in the reservoir, and the detritus that flows into the reservoir from upstream. The gases are emitted continuously from the surface of the reservoir, in sudden pulses when gases bubble up from the reservoir bottom and when water is discharged through turbines and spillways.

Canadian scientists have made a preliminary estimate that reservoirs worldwide release up to 70 million tons of methane and around a billion tons of CO₂ each year. This is equivalent to four percent of CO₂ emissions from other sources linked to human activities and about one-fifth of total human-related methane emissions.

The science of quantifying reservoir emissions is still young, however, and filled with uncertainties which are the subject of a heated scientific – and political – debate. The controversies include determining the best methods for measuring emissions from reservoir surfaces, how to account for sources and sinks of gases in the watershed before a dam was built, the magnitude of emissions generated when water is discharged from the dam, and how to compare hydropower emissions with those from fossil fuels.

Gross reservoir emissions are those measured directly at the reservoir surface and dam. But the actual impact of a dam on the global climate depends on *net* emissions. These are calculated by factoring in pre-existing sources and sinks of greenhouse gases in the watershed and how the dam has altered these.

At the Petit Saut Dam in French Guyana, researchers were surprised to find massive methane emissions from water released from the dam – much as a can of fizzy drink suddenly froths up when it is opened and depressurized. These turbine and spillway emissions were much greater than the total volume of methane released from the surface of the Petit Saut reservoir. Few other attempts have been made to measure turbine and spillway emissions. If the Petit Saut data is representative of other dams, researchers may have substantially underestimated actual emissions.

GLOBAL WARMING IMPACT OF VARIOUS ELECTRICITY OPTIONS

Power plant type	Emissions (g CO ₂ -eq/kWh)
Hydro (tropical)	200-3,000*
Hydro (temperate/boreal)	10-200*
Coal (modern plant)	790-1,200
Heavy oil	690-730
Diesel	555-880
Combined cycle natural gas	460-760
Natural gas cogeneration	300

*Represents gross emissions and does not include emissions produced when water is released from the reservoir.

Canadian researchers have estimated average figures for the *gross* emissions from hydropower, without considering turbine and spillway releases. They calculate that average hydro emissions in Canada are 10-200 grams of CO₂-equivalent per kilowatt-hour generated; in the tropics, reservoir emissions are between 200 and 3,000 g CO₂-eq/kWh. By comparison a modern coal plant releases around 1,000 g CO₂-eq/kWh (see table). CO₂-equivalent combines the warming impact of both CO₂ and methane.

BANKING ON CARBON CREDITS

The dam industry has been working hard to ensure that large hydro projects gain from the emergent trade in “carbon credits” being established under the United Nations’ Kyoto Protocol. The Protocol’s Clean Development Mechanism (CDM) is a carbon-trading scheme that allows developed countries to purchase “carbon credits” that subsidize “climate friendly” projects in developing countries. This is supposed to create a win-win situation by helping developed countries meet their emissions quotas under the Protocol and by helping developing countries finance projects that have low greenhouse gas emissions.

Research by IRN and the Indonesia-based NGO CDM Watch reveals that the large-hydro industry could be one of the biggest winners from the CDM. Efforts to reduce climate pollution will suffer as a result. Big hydro threatens to undermine the Kyoto Protocol by taking carbon credits for projects that do not actually reduce emissions, both because of dam and reservoir emissions and because many of the dams proposed for credits would be built even without the credits. Approving carbon credits for big hydro will also divert credits that might

otherwise have gone to promoting new renewables like solar or wind power.

Of the 30 projects proposed for credits as of November 2002, seven are large hydropower schemes. These large hydropower projects make up 38 percent of the potential emission reduction credits. New renewable projects, by comparison, make up only 27 percent of the claimed credits.

The main result of Northern countries buying these carbon credits would not be to support climate-friendly projects. It would instead be to subsidize hydropower developers – which for these projects are mainly subsidiaries of large US energy corporations.

Based on growing evidence that reservoirs are globally significant sources of greenhouse gases, policymakers are urged to adopt the following recommendations.

- Dams and reservoirs (including non-hydropower dams) should be incorporated into global and national inventories of sources of greenhouse gases.
- Regulatory agencies and funders should require an estimate of the global warming impact of any proposed dam project as part of the project approval process, as recommended by the World Commission on Dams.
- The only hydropower projects eligible for Clean Development Mechanism credits should be small projects (10 MW) which comply with the recommendations of the World Commission on Dams.

RESOURCES

“Damming the CDM: How Big Hydro is Ruining the Clean Development Mechanism,” by International Rivers Network and CDM Watch.

“Flooding the Land, Warming the Earth,” published by International Rivers Network.

Both reports can be downloaded at www.irn.org/programs/greenhouse/.

CDM Watch
www.cdmwatch.org

IRN supports local communities working to protect their rivers and watersheds. We work to halt destructive river development projects and to encourage equitable and sustainable methods of meeting needs for water, energy and flood management. Published in 2003.