



## Hydropower Doesn't Count as Clean Energy

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Opponents of dams have long argued against putting barriers in the natural flow of a river. Dams, they point out, prevent endangered fish from migrating, alter ecosystems, and threaten the livelihoods of local communities.

Native Americans, fishing communities, and environmentalists have made these arguments in their quest to decommission four dams on Klamath River, which runs from southwest Oregon to the coast of California. But with California requiring a 25 percent reduction in the state's carbon dioxide emissions by 2020, clean energy has suddenly entered the Klamath dam debate.

Bill Fehrman, president of PacifiCorp, the hydropower company that owns these Klamath dams, says replacing the power from these dams "could result in adding combustion emissions to the environment."

Meanwhile, across the border in Canada, Hydro-Québec, the world's biggest producer of hydropower, claims that "compared with other generating options, hydropower emits very little greenhouse gas," thus "contributing significantly to the fight against climate change."

Maybe not. Recent reports on methane emissions suggest that dams are anything but carbon-neutral.

According to recently published estimates from Ivan Lima and some of his colleagues at Brazil's National Institute for Space Research, the world's 52,000 largest dams release 104 million metric tons of methane annually. If Lima's calculations are correct, then dams would account for about four percent of the total warming impact of human activities -- and would constitute the largest single source of human-related methane emissions.

As Lima points out, if methane released from reservoir surfaces, spillways, and turbines were taken into account, India's greenhouse emissions could be as much as 40 percent higher than its current official estimates. But though India ranks among the world's top polluters, as a developing nation it is not required to cut emissions -- and has yet to measure methane from its 4,500 dams. And that's a problem, because while methane does not last as long in the atmosphere as carbon dioxide, its heat-trapping potential is 25 times stronger.

### A Swirling Debate

Lima is not alone in questioning whether dams' emissions may be as harmful in terms of climate change as those from fossil fuel plants. In 2004, Philip Fearnside of the National Institute for Research in the Amazon suggested that a massive surge of methane emissions could occur when water is discharged under pressure at hydroelectric dams in a process known in the industry as "degassing."

The problem with dams is that organic matter gets trapped in them when land is first flooded, and more gets flushed in, or grows there, later on. In tropical zones, such as Brazil, this matter quickly decays to form methane and carbon dioxide.

But just how big a problem this creates is controversial. A debate has been raging for years between researchers connected to Hydro-Québec and Brazil's Eletrobras, the world's largest hydropower companies, and several small teams of independent hydrologists.

According to Fearnside, if degassing emissions were factored in at several large hydropower plants in Brazil, then these dams would be larger contributors to global warming than their fossil fuel counterparts. To be precise, Fearnside suggested that during the first decade of its life, each of these dams would emit four times as much carbon as a fossil fuel plant that makes the same amount of electricity.

Fearnside's claims have triggered a firestorm. Luis Pinguelli Rosa, formerly of Eletrobras but now based at the Federal University of Rio de Janeiro, claimed Fearnside had made "scientific errors,"

including a failure to grasp how degassing works, and so had exaggerated the emission levels.

Rosa pointed out that Fearnside had extrapolated his calculations from data taken from the Petit Saut dam in French Guyana in the years immediately following the creation of the reservoir, when organic matter, and thus methane emissions, would likely be their highest. Patrick McCully, executive director of the Berkeley, CA-based International Rivers Network, says that one of the areas of strongest disagreement among reservoir emissions researchers is how to quantify net emissions.

In a recent paper, "Fizzy Science," McCully shows that key factors influencing reservoir greenhouse gas emissions include fluctuations in water level, growth and decay of aquatic plants, decomposition of flooded biomass and soils, the amount of methane bubbling from the surface, and the amount of carbon dioxide diffusing in.

But as McCully points out, "The most comprehensive analyses of net emissions have been done by Fearnside -- while Pinguelli Rosa has only presented data on gross emissions."

With controversy continuing to swirl about methane emissions from dams, including those in boreal regions such as Québec, where the soil is famously peaty, as well as those in China and India, where lots more dams are planned, Stanford University researchers Danny Cullenward and David Victor are calling for more study of the issue. "Whether you are a conservative Brazilian like Rosa, or a more aggressive Brazilian like Fearnside, we are looking at a significant amount of methane that currently is not being factored into global models for atmospheric methane and global [climate] change," says Cullenward, who believes that more data are sorely needed.

Doug Dixon, manager of Hydropower Research at the Electric Power Research Institute in Washington, DC says his group is not doing any research into methane emissions from dams at the present time.

"It's a controversial issue," says Dixon. "There are scientists on both sides of fence as to whether there are significant greenhouse gas emissions from dams."

Noting that methane emissions from dams has not surfaced as a major concern in temperate areas of the US, Dixon adds, "But it's a big issue for the World Bank."

While the World Bank acknowledges the goal of addressing greenhouse gas concerns in its investment portfolio, and though it funds fewer dams than it used to, it still invests tens of millions a year, and it's unclear if it considers methane emissions when deciding on projects.

Former World Bank Director Paul Wolfowitz spoke publicly about the importance of investing in clean energy, but the climate change position of the bank's new director, Robert Zoellick, is less clear. Carbon Credits for Dams?

If methane emissions from dams turn out to be as big as a problem as some scientists now estimate, how will this affect the politics of hydroelectricity?

Cullenwald says he and IRN's McCully have both argued that the Intergovernmental Panel on Climate Change (IPCC) should take up the issue as a Special Project, but that global geopolitics are confounding the effort. At the United Nations Climate Change Conference in Nairobi, Kenya in the fall of 2006, McCully urged IPCC officials to do a study on dams and methane -- but he ran into opposition.

"They said they wouldn't be able to do a Special Report, because that would need a lot of agreements, and Brazil, which is very powerful politically, is dead set against it, as is India," McCully says. "However, the IPCC folks did say that this definitely is an issue that needs to be better understood, and that their next report is going to be on renewables. They made a verbal commitment to deal with the methane emissions issue, but it could take years."

Other climate-related bodies have already been forced to look at methane emissions as they relate to dams. Currently developed nations that fund clean energy projects can get carbon credits to meet their Kyoto Protocol targets through a program called the Clean Development Mechanism (CDM). Under the program, some dams are eligible for credits, while others are not.

"They (CDM) have adopted a policy that says 'no' to very large reservoirs being able to get carbon credits," McCully says. Medium-sized dams are given some allowances, however.

"It means that at least the very worst, dams are not going to get carbon credits," says McCully, noting that 400 dams have applied to receive carbon credits under the CDM, and that half of all these dams are in China.

McCully argues that dams are not the best option in terms of energy efficiency compared to solar, wind, and geothermal options.

"So, in terms of energy efficiency, solar, wind and geothermal options are better, and hydropower is not renewable, because reservoirs fill up with sediment and cost billions to dredge," he says, pointing to dams on the Colorado River, which are seeing the lowest water levels in recorded history.

There is a potential energy upside to the methane emissions equation. Capturing methane in reservoirs and using it to fuel power plants, says Lima, would mean we could "avoid the need to build new dams with their associated human and environmental costs."

McCully agrees that there could be benefits to capturing and burning the methane from reservoirs. "Doing so could significantly reduce the methane emissions. So while it would do away with an argument against the dams-as-clean-energy theory, extracting methane for electricity could help Brazil to not build any more dams. And removing methane reduces the dam's warming impact by 25 times."

### Murky Waters

For now, at least, the science surrounding methane and dams remains so inconclusive that the issue is unlikely to play a decisive role in the immediate debates about dam construction and decommissioning. As the fight continues over the dams on the Klamath and many other rivers, uncertainties about methane emissions will mostly serve to make already complex arguments even thornier. To make the issue even murkier, removing a dam could lead to a short-term burst of emissions.

"No one has measured emissions there [on the Klamath], and they may be high," McCully says. "A couple of the dams have horrendous water quality and a huge algae problem, but there's also the question of how much [greenhouse gases] could be released if these dams are decommissioned, because there could be loads of carbon in the sediments. No one really knows. It's pretty complicated."

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