As Warming and Drought Increase, A New Case for Ending Big Dams

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By Jacques Leslie • November 4, 2021

Lake Oroville, the reservoir behind the Oroville Dam in California, at a near-record low level on September 1. Because of drought, the dam has not operated since August 5. George Rose / Getty Images

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As the hydroelectric dam industry tries to reposition itself as a climate change solution, more and more evidence shows that climate change actually undermines the case for hydro dams.

Gone are the days when hydropower was considered the predominant engine of the world economy, leading a tenfold increase in global energy production over the twentieth century. Now its advocates portray it as a complement to wind

and solar energy, a necessary source of steady output to balance wind and solar's intermittent generation — and therefore a key component in the battle to limit climate change.

One reason for the industry's shift in strategy is that newly installed global capacity in hydropower lags far behind new wind and solar capacity, and declined each year from 2013 to 2019, with only a slight uptick in 2020. Another reason is that if hydropower is accepted as a tool for combating climate change, hydro developers would have a better chance of qualifying for financial support from governments and international institutions — all possessing funds they need for their pricey projects. With the ongoing United Nations conference on climate change in Glasgow in mind, Eddie Rich, chief executive officer of the International Hydropower Association (IHA), said recently that because of hydropower's purported climate change-fighting attributes, his group seeks "appropriate support in the form of tax relief or concessional loans to ensure projects are bankable, as well as streamlining the approval process."

But the IHA faces an uphill battle in overcoming dams' well-established liabilities — including ravaging the ecosystems of at least two-thirds of the world's major rivers and upending the lives of hundreds of millions of people living both upstream and downstream from dams. Climate change further

weakens the case for hydroelectric dams by intensifying droughts that increasingly hamper electricity production and by boosting evaporation from reservoirs as temperatures rise. In the pre-climate change era, plentiful methane emissions from some reservoirs might have been considered inconsequential, but now they are a major source of concern.

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The just-completed 2021 World Hydropower Congress — whose theme was "Renewables Working Together" — ended with the announcement of the "San José Declaration on Sustainable Hydropower," a document that affirms the industry's commitment to best practices, including careful consultation with communities threatened by dam construction, responsible management of biodiversity impacts, and a long-overdue ban on projects in UNESCO World Heritage Sites. The document has been endorsed by at least 40 governments and such luminaries as Tony Blair, former British prime minister, and Malcolm Turnbull, former Australian prime minister.

But there is ample evidence that the IHA's efforts amount chiefly to greenwashing, portraying the industry as socially

and environmentally sensitive while carrying out business as usual. For all its gaudy rhetoric, the San José Declaration contains vague and untested enforcement mechanisms, and it remains unlikely that IHA member companies would be disciplined for violating its provisions.

A case in point is the Teesta-V hydroelectric dam in the Indian Himalayan state of Sikkim, constructed on a Brahmaputra River tributary and completed in 2008. In September the IHA awarded the project its "Blue Planet" Prize for "excellence in sustainable hydropower development," noting that Teesta-V "met or exceeded international good practice" across 20 performance standards — ranging from cultural heritage to erosion to sedimentation — embraced by the IHA. Yet according to International Rivers, a nonprofit that advocates for people imperiled by dams, there was minimal consultation with local and Indigenous residents during the dam's planning and construction, and blasting and tunneling caused landslides, sinkholes, drying up of residents' water sources, and cracked walls and foundations in local houses that sometimes led to collapses, leaving some residents homeless. Last year, what *India Today* called a "massive" landslide beginning at the dam's abutment left large boulders on top of the dam, damaging it and cutting off electricity generation for nine hours. It's far from reassuring that the IHA chose Teesta-V as the best of dozens of projects

evaluated for the prize.

The Teesta-V hydroelectric dam in Sikkim, India. Diptendu Dutta / AFP / GettyI mages

The hydro industry portrays itself as the perfect antidote for wind and solar's intermittency, but climate change has underlined the industry's own reliability problem, which plays out in years instead of hours. In recent years, drought intensified by climate change has caused reservoirs on all five continents to drop below levels needed to maintain hydroelectric production, and the problem is bound to worsen as climate change deepens. Because of the U.S. West's current megadrought, California's huge State Water Project is generating electricity at just 35 percent of its 10-year average. At Oroville, California, site of the United States' tallest dam,

the power plant stopped working on August 5 and has not operated since. Hydropower capacity at Hoover Dam, which holds back the U.S.'s largest reservoir, Lake Mead, has dropped by 25 percent, and Glen Canyon Dam, site of the nation's second-largest reservoir, Lake Powell, may be unable to generate any electricity as soon as next year, according to the U.S. Bureau of Reclamation. Because of the drought, the U.S. Energy Information Administration estimated in September that national hydropower production would drop by 14 percent from 2020 to 2021.

The international picture is no better. Beginning in 2013, Southern Africa has experienced frequent droughts that caused the world's largest manmade reservoir, at the Kariba Dam on the Zambia-Zimbabwe border, to fall to 11 percent of capacity by 2019, frequently hampering electricity generation. This was a serious blow to the two countries' economies, and millions of people experienced blackouts for extended periods. In South America, the worst drought in a century has caused huge drops in hydropower output, causing electricity shortages, price increases, and economic crises in Brazil, Chile, and Paraguay. Dams customarily deliver two-thirds of Brazil's energy output, but reservoir levels have dropped to 24 percent of capacity. Jair Bolsonaro, Brazil's Trumpian president, is far from a conservationist, but in March he called on Brazilians to "turn off a light at home" a few days before the government increased electricity prices by 7 percent.

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Climate change has made dams unreliable in another way — the hydrological record, already limited by the low number of years it covers, has lost what predictive power it possessed. This has introduced vast uncertainty into flow assumptions that engineers took as their starting point in dam design. Now "thousand-year floods" may happen every decade or more, and permanent rivers may dwindle to trickles. Since climate change will produce more and bigger floods, new reservoirs must be expanded to accommodate them — adding to dams' costs and environmental destruction. But most of the time, that additional capacity will go unused, increasing the dams' inefficiency.

All this casts further doubt on another IHA claim, of hydro dams' "affordability." A study appearing this month in *Global Environmental Change* that assessed 351 proposed Amazon basin hydroelectric dam projects found that, because of climate-change-augmented drought, periods when the dams are incapable of producing electricity would increase, and periods when the plants operate at full capacity would decrease. As a result, many projects would have to more than double their planned electricity rates in order to break even —

as the study put it, “rendering much of future Amazon hydropower less competitive than increasingly lower cost renewable sources such as wind and solar.”

Even disregarding climate change, the case for investing in dams has grown weaker in the last decade. A landmark 2014 Oxford University study in *Energy Policy* that evaluated 245 large dams found that they weren’t cost-effective and that their actual costs were nearly double their budgeted costs. Rich, the IHA chief executive, argued in an interview that the study was misleading because it omitted the bountiful indirect benefits of hydropower, in the form of economic stimulus. But the study also didn’t consider the indirect harm inflicted by dams — fish extinctions, ecosystem destruction, shattered Indigenous societies, the forced resettlement of at least 100 million people displaced by reservoirs, and life-changing disruptions to the lives of another half-billion downstream dwellers. The study asked one question — are dams profitable? — and answered it with a “no.” The indirect costs and benefits are much harder to calculate, but it’s difficult to imagine that their transient benefits would surpass their permanent environmental devastation.

Lake Kariba, the world's largest reservoir, in 2018 (left) and 2019 (right), after drought lowered water levels, stunting hydropower output at the Kariba Dam on the Zambia-Zimbabwe border. NASA

A follow-up Oxford University study published last month identifies a consistent bias in cost-benefit analyses of public investments that leads to overestimates of project benefits and underestimates of costs — and of the eight investment types studied (including railroads, bridges, roads, etc.), dams' cost overruns were by far the highest. In part, this is because large dams take so long to build — more than eight years on average, not counting a few years of studying, planning, and

acquiring permits — which makes the likelihood of unanticipated setbacks and cost increases, so-called "black swans," much higher. Dams' long gestation periods diminish their usefulness in fighting climate change, since the accelerating nature of the climate crisis means that infrastructure operating in the next few years is far more valuable than infrastructure completed a decade from now.

Even the hydro industry's claim that dams generate "clean" energy is only partially true, for a significant fraction of reservoirs emit copious amounts of methane, a particularly potent greenhouse gas that this August's Intergovernmental Panel on Climate Change report singled out as requiring "strong, rapid, and sustained" emission reductions to ward off more catastrophic warming. A 2019 study of 509 existing and proposed Amazon basin dams found that over a 20-year period, emissions from 25 percent of proposed lowland dams would emit more greenhouse gases than fossil fuel power plants. In the interview, Rich countered that other studies show that, over dams' entire lifecycle, their emissions would be no greater than "green" technologies such as wind and solar. But even if true, this assertion overlooks the fact that most methane emissions from reservoirs occur in the first decade after commissioning, at the very time when reductions in methane emissions are considered most urgent.

Climate change is, first of all, a story about water. Since

climate change has upended the planet's hydrology, countering it requires a capacity to deal with massive uncertainty. Technologies that can do that must be nimble, flexible, modular (not one-of-a-kind), quickly and cheaply built, easily moved and replaced — like recently developed mini-hydro units a fourth the size of a railroad car that can be sited along the sides of rivers and canals and generate up to a megawatt of electricity in concert with natural river functions and with negligible damage to fish and environment.

By contrast, big hydroelectric dams menace ecosystems even beyond their own watersheds, and require upfront expenditures into the billions of dollars that don't generate electricity or revenue for years. Their monumentality was once considered a public relations asset, yielding images of massive walls and tumbling water that world leaders loved to brandish in seeming validation of their own grandeur. Now all that cement means that the dams are stolid, inflexible, hard to repair, impossible to relocate, and extremely costly to remove — the opposite of what the new era requires.