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Editorial

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Dam It, More Power Scotty!

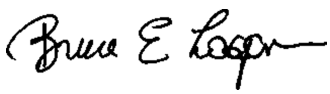
There are ∼80,000 existing dams in the United States, but only ∼3% generate electricity. According to an article in *Civil Engineering*,[1] the 100 most promising sites of the many nonpowered dams could generate an estimated 8 gigawatts (GW) of clean, renewable, carbon-neutral electricity. Other estimates are less optimistic, indicating only 6.2 GW is available, but approximately half of this could still be economically harvested. River water flow is an environmentally friendly source of power that we cannot afford to lose. Capturing this blue energy does not necessarily require building new dams that would disrupt existing environmental systems. In many cases, the dams we need are already there, serving their main functions of river level, navigation, and flood control. These existing sites could be modified to produce power from the flow of the water, in addition to serving their current functions. Of the top 100 sites, 81 are owned by the U.S. Army Corps of Engineers and serve as navigation locks primarily on the Ohio, Mississippi, Alabama, and Arkansas rivers and their main tributaries. This governmental ownership should theoretically make it easier to quickly harvest this clean energy source, but of course, there are regulatory obstacles that can prevent this.

The dams at the Corps sites were built for very specific purposes such as flood control, and by law these functions take precedence over any other roles such as hydropower generation. Therefore, there is a huge existing bureaucratic barrier, even for governmentally owned sites, to modify the dams for any other function. The permitting process itself is a sizable obstacle to allowing these sites to be used for energy generation as it can take 5−10 years for hydropower production to be authorized at a site, and cost as much as $50 million. In comparison, a fossil fuel plant such as a natural gas combined cycle plant can be permitted in as few as 1.5−2 years, for far less money. There is some hope for expediting the hydropower dam permitting process. A bill that could facilitate the permitting process, called the Energy Policy Modernization Act of 2015, has been approved by the Senate, but it is stalled because of concerns that it would undermine environmental safeguards at these sites.

Improvements in dam infrastructure and operation could increase power production at sites where power is already generated. The turbines used at many sites are outdated, with some 50 years old and therefore at the end of their useful life. Replacing them with new and more efficient turbines could generate more power. For example, at one site on the Colorado River, upgrading the existing 10 turbines could increase power by 50%, from 0.8 GW to nearly 1.2 GW. At another site near Allentown, Pennsylvania, upgrading the powerhouse (built in 1910) doubled the power of the existing 108 MW site, by adding an additional 120 MW. The methods used for dam operation and flow control are outdated, affecting our ability to maximize power generation at a site and to maintain or improve flood control. Some of the water manuals that are used by operators are as many as 60 years old and fail to adequately utilize our existing weather infrastructure for predicting storms and flows over time. Another bill being considered by Congress, called FORECAST (Fixing Operations of Reservoirs to Encompass Climatic and Atmospheric Science Trends Act; 2014), could update these manuals to better use modern weather forecasting methods and to incorporate advances in atmospheric science.

Not all dams are useful, and not all dams can become effective power plants. Several dams on the Kalmath River in the western United States, for example, are slated for removal by the end of 2020 to allow for recovery of fisheries and to sustain farming and ranching in the region. These dams currently do not have facilities to allow fish to pass through the dams, and it is estimated that they would be too costly to retrofit with that capability. However, it is not clear how including power generation into their design and planning might have modified the economics and, therefore, the decision making process.

The capture of energy from water could be a boon to local economies and small businesses. There are many towns and businesses along rivers that could benefit from a source of local, clean energy. The design and retrofitting of dams could create new sources of energy and revenue for local economies. There are also many small companies trying to build their business plan around capturing this blue energy source, but their success has been limited by the maze of regulatory permits and the long timeline needed for dam approvals. The laws need to be streamlined to allow both new and existing dams to serve multiple functions, and the whole process of water management and control must be better integrated with power generation, especially given changes in water flows resulting from climate change. As *Star Trek*'s Captain Kirk used to say, "Scotty, we need more power". While that reference was made for power in a spaceship, Earth's inhabitants are also going to need to find ways to produce more, and cleaner, power in the future. Harnessing this carbon-neutral river water power could provide clean and sustainable energy by something as simple as modifying the infrastructure that we already use to control how water flows downhill.



Bruce Logan, Editor, ES&T Letters

AUTHOR INFORMATION

Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

REFERENCES

(1) Reid, R. L. Blue power. *Civ. Eng.* **2016**, *86*, 58−67.

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