Brookfield Renewable Power's $35 million project on Lower St. Anthony Lock and Dam near downtown Minneapolis involved installing 16 turbines in an auxiliary lock next to the shipping channel. Power from the project can provide electricity for as many as 7,500 homes.

A new look at hydropower

Thanks to new technology and recent tax incentives, new energy proposals are coming to district rivers

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Call it a return to renewable roots.

Hydropower has been around long before the words "renewable energy" became a political lightning rod in the energy industry. But over the years, proponents of hydropower have watched it become a stepchild to sun-absorbing solar panels and spinning windmills.

But thanks to new technology and new applications of old ideas—and tax incentives for both—hydropower is again being talked about, as proponents argue that thousands of dams could be retrofitted to produce small-batch electricity.

The Mississippi River, for example, has never been much of a hydropower producer, especially compared with the Colorado, Missouri and Columbia rivers. But spurred by aggressive renewable energy tax credits and new hydropower technology, a handful of companies have filed plans to transform the lock-and-dam system on the Upper Mississippi from Minneapolis to Rock Island, Ill., into a small powerhouse of hydro. There are similar plans for several other lock-and-dam rivers throughout the country, including the Fox in eastern Wisconsin.

Though traditional dam-and-turbine hydropower has become somewhat passé over the years because of environmental protests, its relative efficiency—especially compared with other forms of renewable energy—is also creating renewed interest in this old-form power source. Montana, for example, has 12 proposed and active projects involving dam-and-turbine hydropower on rivers.

The Ol' Miss

The main player on the Upper Mississippi, Boston-based Free Flow Power, has several projects at various stages of the approval process with the Federal Energy Regulatory Commission (FERC) to develop hydropower at lock-and-dam systems in the U.S. Army Corps of Engineers St. Paul District. The company has several approaches, but the fundamental idea attaches turbines to existing dam infrastructure to capture water energy at five locks and dams (numbers 3, 4, 6, 7 and 9) between Red Wing, Minn., and Lynxville, Wis., that will generate more than 51 megawatts (MW).

And that's not all that's happening on the river. Free Flow has proposed projects using the same technology for dams at Coon Rapids, Minn. (8MW) and at Genoa, Wis. (10 MW). Hydro Green Energy is working on a similar plan at a Red Wing, Minn., lock and dam (4MW). And in downtown Minneapolis, Crown Hydro has proposed to divert part of the river to an underground tunnel to create 1.7 MW of renewable power, but has run into a storm of opposition.

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The full-scale potential of such projects is modest; the Upper Mississippi proposals alone could add close to 100 MW, give or take, to the energy grid, or a tenth of the power of Xcel's Prairie Island nuclear plant, and enough to power about 75,000 homes for a year. Despite all the FERC filings and grand designs, the only project to reach fruition is Brookfield Renewable Power's 10 MW project near downtown Minneapolis at the Lower St. Anthony Falls Lock and Dam, which recently began producing power.

But the new proposals have other advantages. Dams have been heavily criticized for producing environmental debacles, but there seems to be no great opposition to the lock-and-dam proposals at this time. Rupak Thapaliya, national coordinator for the Hydropower Reform Coalition in Washington, D.C., said the proposals he's seen are "relatively benign" since they build off existing infrastructure that has no chance of being removed as long as shipping remains viable on a river. And as energy companies and the public alike seek more renewable energy, the Mississippi and other rivers in the Ninth District not yet tapped for much hydro are likely to see more attention.

"We're seeing hydropower included more and more in both state and federal incentives, whether that be for state renewable energy standards or federal tax incentives like the production tax credit," said Jeff Leahey, the National Hydropower Association (NHA) director of government affairs. "Those are providing incentives for people to look at new developments."

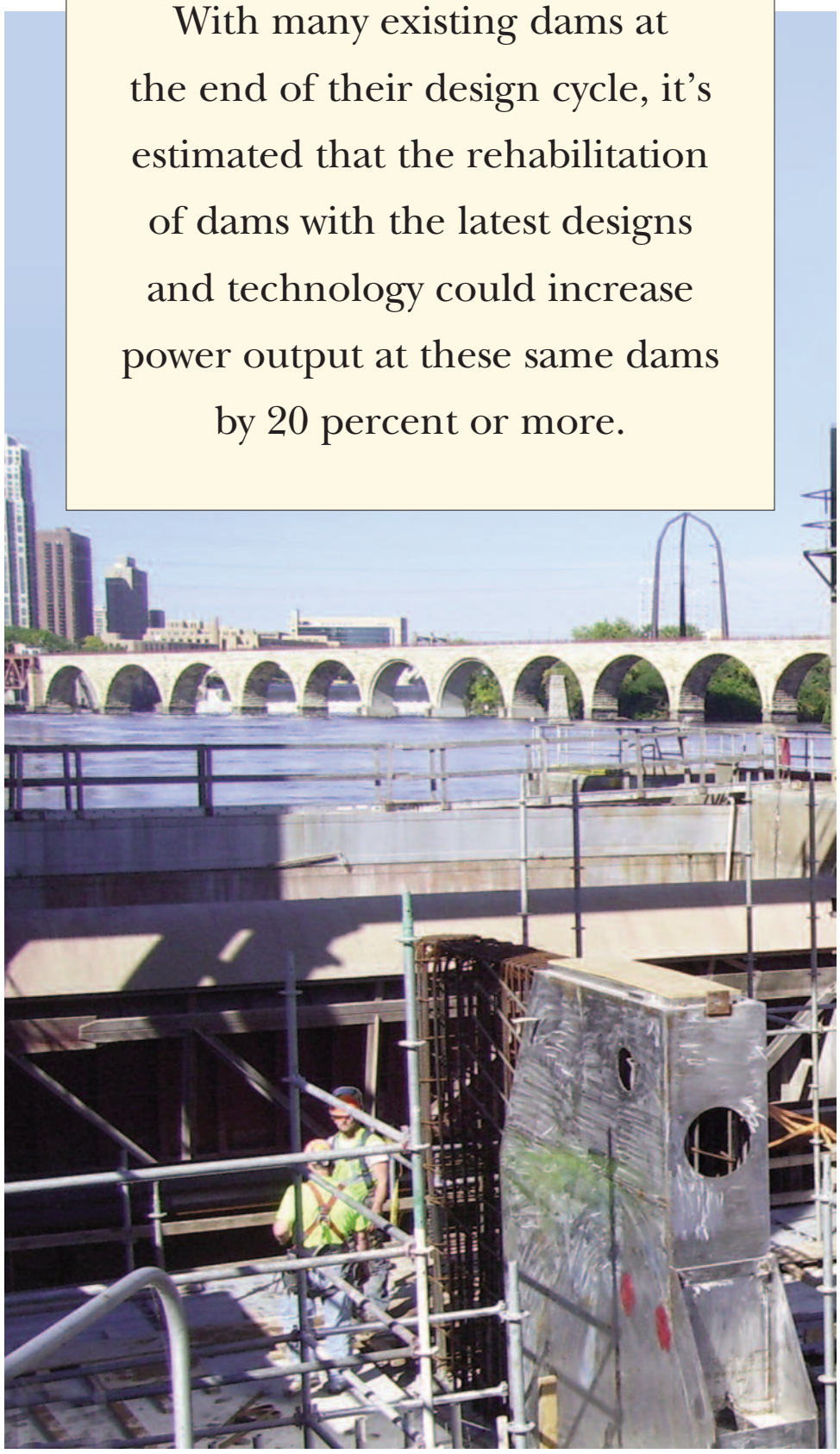
Hydropower supplies 7 percent of total annual electricity generation, but two-thirds of the nation's renewable electricity, the result of its efficiency in generating electricity compared with other renewables. Jon Guidroz, Free Flow's director of project development, said water is 800 times more dense and carries 26 times the force of air.

In fact, some hydro plants generate electricity more efficiently than even coal, evident in the average cost per kilowatt for each. Reports from the Wisconsin Valley Improvement Co., which helps operate 25 hydro plants on the Wisconsin River for 10 utilities, show that hydropower there is produced for less than one cent per kilowatt hour, half the cost of nuclear and one-third the cost of fossil fuel. Other reports show similar results.

New spin on an old idea

Despite that efficiency advantage, environmental concerns and protests have halted any new large-scale dam projects for decades. Still, many believe there is potential for significantly more hydropower production. A recent NHA study, corroborated by earlier studies by the U.S. Department of Energy, concluded that by 2025, there could be 60,000 MW of additional capacity across the country, enough to power tens of millions of homes. The added capacity comes from a variety of sources, including in-stream hydrokinetics, which features turbines underwater capturing wave energy, according to Leahey.

With many existing dams at the end of their design cycle, it's estimated that the rehabilitation of dams with the latest designs and technology could increase power output at these same dams by 20 percent or more.



The majority of the additional generation, however, comes from doing more with the infrastructure in place. With many existing dams at the end of their design cycle, it's estimated that the rehabilitation of dams with the latest designs and technology could increase power output at these same dams by 20 percent or more. PPL Montana is spending $230 million to upgrade Rainbow Dam at Great Falls, which will increase its current 36 MW of production by 70 percent.

But as much as a third to one-half of that potential new capacity comes simply from adding turbines to dams that currently generate no power, and that's also where new technology comes into play. Most dams in place today do not generate power, and that's because they suffer from "low head"—when the height of a river above and below a dam or lock is less than about 30 feet; the lower the drop, the less energy that can be produced.

The Garrison Dam over the Missouri River—the fifth-largest earthen dam in the world—generates 580 MW of electricity, but is the only source of hydropower in North Dakota. Other rivers in that state simply don't have the flow to produce much energy or do not have a lock-and-dam system that could add hydro, according to Mike Diller, director of economic regulation at the North Dakota Public Service Commission.

South Dakota has four major dams on the Missouri River, one reason that hydro generates almost half of the state's electricity. But the state otherwise has few untapped hydro assets. "The flows on our rivers vary dramatically—in spring you have good flows; in summer not much is happening," said Chris Nelson, vice chair of the Public Utilities Commission.

Follow the money

Relatively new federal incentives might change the equation a bit. In 2005 and 2008, production tax credits were extended to hydropower developers to encourage them to improve existing facilities, add hydro to nonpowered dams and build hydrokinetic power in rivers and oceans that takes advantage of constantly moving water to spin submerged turbines.

Through the energy investment tax credit, hydro and other energy developers write off 30 percent of the cost of a project. And since developers may want that in the form of cash, rather than a write-off, a Treasury Department program allows them to get a direct grant from the federal government, said the NHA's Leahey.

That's not all. FERC has been encouraging "small hydro"—defined as less than 5 MW—by streamlining the permitting process and dedicating staff to answer inquiries about it. In a speech last year before the U.S. House of Representatives, FERC's director of energy projects, Jeff Wright, said that "small hydropower is an important part of the nation's energy mix, and offers the potential to add a substantial renewable, flexible capacity."

Mark Stover, Hydro Green's vice president of corporate affairs and the architect of many of the tax credits as the former lobbyist for the NHA, said one of the primary challenges for hydro in rivers like the Mississippi is attempting to capture energy in low-head settings. Advocates of evolving low-head technology say the approach allows for energy capture without having to create lakes and change the basic contours of rivers.

The energy created is modest, but could be widely applied; only about 3 percent of the nation's 82,000 dams currently produce any power, and about half of those nonproducing dams are at least 25 feet in height, according to the National Inventory of Dams, compiled by the U.S. Army Corps of Engineers.

One of those is Clark Canyon Dam on the Beaverhead River in western

Montana, where Riverbank Power is installing 4.7 MW of new generation. Turnbull Hydro recently put a 13 MW plant online in an irrigation canal—a glorified, manmade ditch—in Fairfield, Mont., with the support of a local energy supplier. Hydrodynamics, another small energy provider, has proposed nine small projects on existing dams in that state, the majority under 3 MW, but none have been built yet, according to Tom Kaiserski, who manages the energy promotion division of the Montana Department of Commerce.

Free Flow's Guidroz agrees that low-head technology has come of age. "You've got dams out there with 10, 15, 20 feet of head, with an enormous potential onsite to realize power," he said. "You have to dust off the lenses of hydropower and come at it with a new perspective."

Hydro Green used the nation's first hydrokinetic energy pilot project at the lock and dam in Hastings, Minn., to develop a new low-head turbine for in-stream applications. But Stover said the Hastings experiment proved to Hydro Green that the best market for its turbines was in conventional hydropower, and not hydrokinetic, and is now applying that wisdom to lock-and-dam systems. Using the knowledge gained from two years of field tests, the company has created a low-head hydropower turbine "we are confident will work in these [lock-and-dam] settings," he said.

Potential challenges

Still, the reality of widely retrofitting dams, or of new hydrokinetic applications, is a bit more sobering. A 2009 NHA study revealed that the Midwest—from the Dakotas to Michigan and Ohio—have the least hydro potential of any region in the nation.

And for all the potential running through these many small-scale projects, there are many roadblocks, including the expense of retrofitting a lock and dam on the Mississippi, and finding the money could pose a problem. Brookfield, which built the only finished project, is a deep-pocketed player in energy. Free Flow and Hydro Green, in contrast, are relatively small companies with aggressive business goals.

Hydro Green has a total of 34 low-head dam projects in the pipeline nationwide, totaling 1,000 MW and has raised $5.5 million in corporate financing. The company just moved its corporate offices from Houston to Chicago to be closer to the sites of its proposals. Free Flow brought in $5.7 million this year from investors and claims a staff of more than 30 employees, with offices in Boston and New Orleans.

Still, neither company would release even the rough details of the cost of adding hydro to a lock and dam. Brookfield Power's project on the Lower St. Anthony represented a $35 million investment, according to the company's website.

More than a few proposals have come and gone. Nanette Bischoff, FERC coordinator with the U.S. Army Corps of Engineers St. Paul District, said market conditions have doomed proposals over the years. "It comes down to an economic decision, and if energy companies won't pay enough for the power, the energy developer figures it will be a waste of time and money," she said.

And if the first few projects on conventional dams or locks and dams have negative environmental consequences, the energy developers on the river may have a harder time moving forward, according to Bob Larson of Nelson Energy, a two-person firm in suburban Minneapolis that develops hydro concepts, including the Brookfield Power operation on Lower St. Anthony Falls.

FERC's permitting process requires energy developers to notify all parties impacted by new dam proposals, including environmental groups. Though the Hydropower Reform Coalition and others have not expressed opposition to the lock-and-dam proposals, Larson recalled something he has heard many times. "Hydro is easy to go after for opponents because, compared to other renewals, it has been around the longest and the opponents are so well-educated on the topic." f

Hydro in the Ninth District

Since 1999, the hydropower share of electricity production has generally declined in the district—by as much as a third in some states.

That is partly due to two reasons. First, hydropower has seen little expansion over the years, while energy production and consumption have risen significantly since 1999. Second, hydropower depends on river flows, and the years of drought in the Dakotas and Montana have had an impact on its production. That influence can be seen in 2010 figures, which increased dramatically in the Dakotas, taking advantage of a high-water year in the Missouri River basin.

Hydropower's share of a state's electricity production is also a bit misleading because some states are major power exporters. South Dakota produces about three times the hydropower as its northern sibling, but hydropower's share of state electricity production is more than 10 times higher (54 percent versus 4 percent, respectively). That's because North Dakota's vast coal reserves have made it a major producer (and exporter) of power.

The federal government defines energy in "megawatt hours," or MWh. One MWh is 1 million watt hours.

Montana
Production
2009: 9,505,940 MWh
2010: 9,230,000 MWh
Percent of total electricity production from hydro (2009): 35.6 percent

North Dakota
Production
2009: 1,475,251 MWh
2010: 2,042,000 MWh
Percent of total electricity production from hydro (2009): 4.3 percent

South Dakota
Production
2009: 4,432,451 MWh
2010: 5,765,000 MWh
Percent of total electricity production from hydro (2009): 54.1 percent

Minnesota
Production
2009: 809,000 MWh
2010: 752,000 MWh
Percent of total electricity production from hydro (2009): 1.5 percent

Wisconsin
Production
2009: 1,393,988 MWh
2010: 1,392,000 MWh
Percent of total electricity production from hydro (2009): 2.3 percent





Sources: U.S. Energy Information Administration