Carp or Carbon: Hydropower on the Three Rivers

Elliot Firestone, Rose Holdorf, Ainsley Judge, Matt Kazinka

Macalester College – St. Paul, MN

Benefits of Hydropower

- Renewable source of energy
- No carbon emissions or fossil fuel use during regular use
- Little technology needed
- No hazardous byproducts or emissions
- No fuel costs and easy upkeep
- Dams serve flood control functions
- Reservoirs can be valued recreation areas

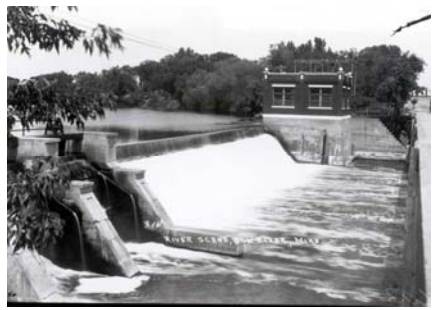
Drawbacks to Hydropower

- High initial environmental and financial cost
- Turbines can be harmful to fish
- Dams prevent free movement
- Peaking designs can seriously impact water flow
- Upriver, habitats and communities are lost to reservoirs
- Downriver, habitats depend on how much water is released
- Dams can be dangerous to boaters
- Dependent on climate
- Limited potential

State of Hydropower on the Three Rivers

River	Plant Name	Capacity	Owner
Mississippi	Blanchard	18 MW	Minnesota
	Lock & Dam #1	14.4 MW	Ford
	St. Anthony	12 MW	NSP/Xcel
	Little Falls	12 MW	Minnesota
	Sartell	9.5 MW	International Paper
	St. Cloud	8.8 MW	St. Cloud
	Lock & Dam #2	4 MW	Hastings
	Bemidji	0.7 MW	Ottertail
Minnesota	Granite Falls	1.2 MW	Granite Falls
St. Croix	St. Croix Falls	25 MW	St. Croix Falls
	Trego	1.4 MW	Trego
	Hayward	0.2 MW	Hayward

Note: Lock & Dam #1 is used by Ford to power its manufacturing and Bemidji and Sartell are used by paper manufacturers.



The Elk River Falls Hydropower Plant (1920)

Recent Activity

Most of the hydropower dams that are in operation on the Three Rivers were built before the 1970s. A survey in 1996 found that there are many opportunities left for hydroelectric expansion left in Minnesota, and there have been many discussions between energy companies and local residents about hydropower, but very few new projects have passed the proposal stage. Minnesota passed a Renewable Energy Standard in 2007 that requires that energy companies such as Xcel provide 30% renewable energy by 2025. Xcel has stated that they are going to meet part of this goal with new hydropower. Hydro Green Energy has installed a 4.4 MW hydrokinetic system at the Lock & Dam #2 on the Mississippi in an agreement with the town of Hastings.

However, Xcel's search for hydroeletric power sources has also brought some controversy. Xcel recently began purchasing hydroelectric power from Manitoba province in Canada, which has had a long and problematic relationship with the indigenous nations who live on the land. A 2004 report done by the St. Paul Army Corps of Engineers set forth requirements that dam operators must regularly release a minimum amount of water to reduce negative impact municipalities downstream during droughts and low-flow events.

Possible Courses of Action

Plan	Benefits	Costs
Wholesale expansion of hydropower	Production of local renewable energy, which helps communities, lessens fossil fuel use, and strengthens grid.	Further environmental damage and impact on riparian habitats due to water level changes.
Remove environmentally harmful dams and optimize hydropower	Production of local renewable energy, but to a lesser degree than all-out hydropower development, would likely have less of an impact on river levels.	New technologies are unproven and potentially costly, dam removal is expensive and dirty, and the impacts of microgeneration and hydrokinetic generation are uncertain.
Status quo	Doesn't need to be heavily researched, doesn't cost any money, doesn't make things worse, continues with current river patterns.	Nothing is improved; environmental damage remains at current level, and we generate no new renewable energy.
Actively reduce dams and hydropower	Restores pristine river habitat and natural processes.	Increases dependence on fossil fuels, causes shifts in water levels and flooding, expense of dam removal, locks cannot be removed.

Utilizing Current Infrastructure

Locks and dams that do not currently generate electricity as well as dams with antiquated turbines and generators can be retrofitted with modern hydroelectricity systems to reduce environmental impact and generate additional renewable energy. Channelized waterways that do not serve as habitats, such as irrigation runoff ditches and sewers, can be fitted with microgeneration turbines to produce power without affecting fish or people. Microgeneration such as the Zotloterer Gravitational Vortex Power Plant could also be used in some small streams with relatively little impact.

Hydrokinetic Generation

Hydrokinetic generation operates in much the same way as wind energy does: individual turbines rotate to generate electricity from the natural flow of the river. No dams are required, and freeflow systems are suitable for both river and tidal areas. Hydrokinetic generation is in its infancy, however, and possible environmental impacts are still unclear.

Current Proposals

The Crown Hydro proposal for Saint Anthony falls is an "invisible" run-of-river generator that will siphon away part of the Mississippi's flow away from the spillway though a turbine, with flow that varies based on river levels and tourist demand for the scenic spillway. Other companies such as SAF Hydroelectric have also submitted proposals for hydropower on the Lower St. Anthony Falls. The historic Pickwick Mill at Trout Creek Falls in Southeast Minnesota recently got a grant from the Southeast Minnesota Clean Energy Resource Teams (CERTS) to do a feasibility study for microgeneration. This $5,000 study will examine if installing a small-scale hydroelectric plant will be an economically viable way for the mill to generate clean energy and revenue.

A Hydro Green Energy Inc. Hydrokinetic Installation

Prototype Zotloterer Gravitational Vortex Power Plant

Our Recommendations

Given the substantial need for renewable energy sources, we recommend the careful and smart expansion of hydroelectric power. Rather than creating new locks and dams, which often harm river environments, we should take advantage of existing locks and dams on the Three Rivers and generate hydroelectric power by installing high-efficiency turbines on them. We can also use small scale, non-intrusive hydrokinetic turbines and and "microhydro" generators to provide electricity for individuals and communities along the rivers. New hydropower systems should be cited away from areas with high biodiversity or keystone species.

We believe that government agencies and programs such as Minnesota's Clean Energy Resource Teams (CERTS) should continue to conduct viability assessments for hydropower generation along the Three Rivers. It should be one of several methods used to generate more clean energy and to meet Minnesota's Renewable Energy Standard.

St. Anthony Falls

Pre-Hydropower

Falls utilized but eroding (1902)

Concrete Spillway (2002)

Saint Anthony Falls on the Mississippi River in the Twin Cities was a major factor in Minneapolis' development as a mill town and the site of the first hydroelectric generation in the Western Hemisphere in 1882. Over the years, the falls eroded up the river until the natural falls were replaced with a concrete spillway in the 1960s. Saint Anthony Falls is now the proposed site of "invisible" run-of-river hydroelectric generation, the Crown Hydro installation.

References

Benson, Lorna. "Should the Mississippi River Gorge Be Restored?" Minnesota Public Radio. 2 July 2004. <news.minnesota.publicradio.org>

"Cranking Up our Hydropower Resources." DNR. Online article. <www.dnr.state.mn.us/waters>.

"Department of Commerce calls for more wind energy, efficiency from Xcel." Minnesota Department of Commerce. 2000. <www.state.mn.us/portal/mn >

"Facts about Hydroelectric Power at St. Anthony Falls." Crown Hydro. 2008. <www.crownhydro.com>

"Hydro." Xcel Energy. 2008. <www.xcelenergy.com/XLWEB>

"Hydro Green Energy." Hydro Green Energy. 2007. <www.hgenergy.com>

"Hydropower." Clean Energy Resource Teams. 2003. <www.cleanenergyresourceteams.org>

"Hydropower Development in Minnesota." DNR. Online article. <www.dnr.state.mn.us/waters>.

"Hydropower sites in Minnesota." DNR. Online article. <www.dnr.state.mn.us/waters>.

Lenhart, Chris. "Dam Removal to Restore Rivers in Minnesota." Sierra Club. <northstar.sierraclub.org/campaigns/water `

"Lower St. Anthony Falls Hydroelectric Project." SAF Hydroelectric LLC. 7 July 2007. <www.xcelenergy.com/docs/SAFreport3-2007.pdf>

O'Regan, Mary. "Hydroelectric power plant planned for neighborhood back on hold." Downtown Journal. 10 Sept 2007. <www.tcdailyplanet.net>

Richardson, William B. "Feasibility Study: Microhydro-power at Trout Creek Falls and Pickwick Mill, Pickwick, Minnesota." Historic Pickwick Mill. March 2008. <http://www.pickwickmill.org>

Scheck, Tom. "Minnesota May Be on Verge of 'Energy Revolution.'" Minnesota Public Radio. 1 Feb 2007. <minnesota.publicradio.org>

"St. Anthony Falls." Wikipedia. 18 April 1008. <en.wikipedia.org/wiki/Saint_Anthony_Falls>

"Xcel Energy - Report." ProxyInformation.com. 2008. <www.proxyinformation.com/xcelreport2002B.htm>

"Zotloterer Gravitational Vortex Power Plant." Pure Energy Systems Wiki. 11 March 2008. <peswiki.com/index.php>